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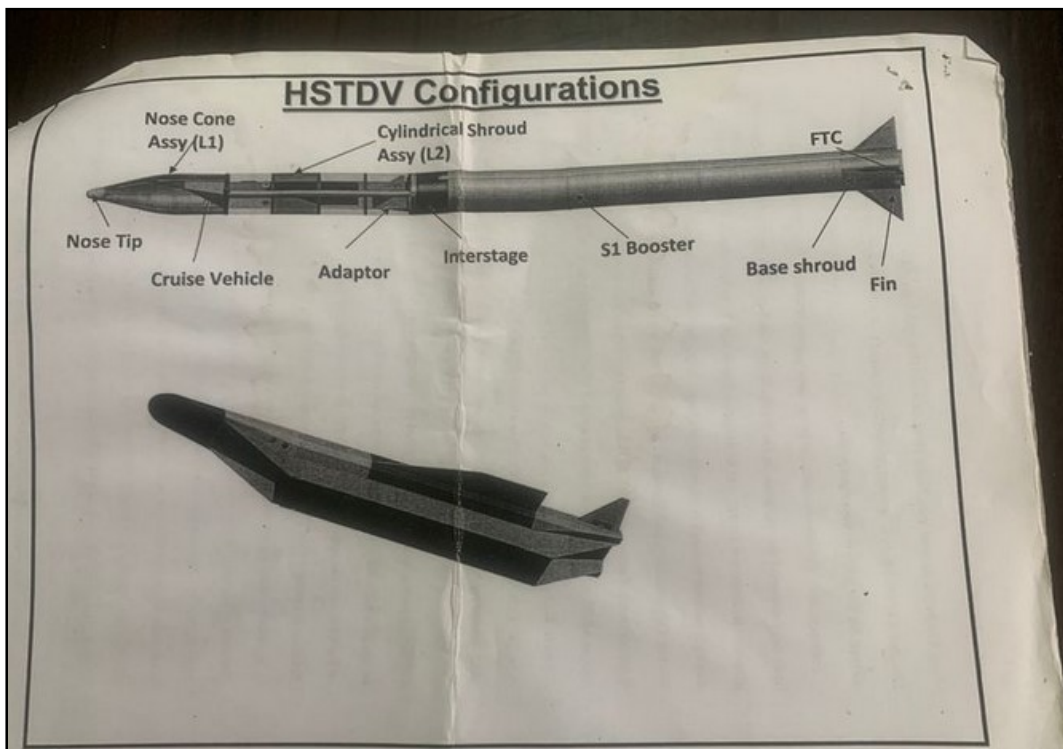
Fri, 18 Sept 2020

India's development of the hypersonic speed vehicle

The successful launch of the HSTDV caps about 14 years of sustained efforts and perseverance of DRDO personnel, making India only the fourth country in the world to successfully develop and launch hypersonic technology demonstrator vehicles

By T.S. Subramanian

It was a convincing camouflage. In the midst of a scrub jungle were two sheds, shaded by the trees around them. The place looked sequestered. Near the sheds was a tall wall which had developed cracks caused by a tree growing on it. In a clearing nearby, there was a banyan tree. In one of the sheds, a high-technology project was in progress. There was a maze of wires, box-like structures and pipes, both made of metal. It was obviously an aero engine that was being built. It was January 2013.



The sketch shows the HSTDV or the cruise vehicle that was flight tested on September 7, 2020 for 20 seconds at a hypersonic speed of more than Mach six. FTC stands for Fin Tip Control. Cylindrical Shroud Assembly is the heat shield covering the cruise vehicle. Credit: By Special Arrangement.

Three young men, A. Raju, P. Satya Prasad and A. Rolex Ranjit were bustling about in the shed, and they were a picture of calm confidence. It was the premises of the Defence Research and Development Laboratory (DRDL), on the outskirts of Hyderabad. The project under way then in

the shed was the Hypersonic Technology Demonstrator Vehicle (HSTDV), spearheaded by the DRDL. What was being developed there was a powerful animal called the air-breathing Supersonic Combustion Ramjet or Scramjet engine. It was an ambitious project of the DRDL, which comes under the Defence Research and Development Organisation (DRDO). The Project Director of the HSTDV at that time was Dr. R.K. Sharma.

More than seven and a half years later, on September 7, 2020, the dream of DRDO's missile technologists, including that of DRDO Chairman, Dr.G. Satheesh Reddy, Dr. Sharma, the HSTDV's current Project Director, Dr. B.V.N. Charyulu, and the three young men came to pass.

At 11.03 a.m. on that day, a launch vehicle which was derived from DRDO's Agni 1 missile rose from a launch complex on the A.P.J. Abdul Kalam Island, off the Dhamra coast, Odisha. On top of the launch vehicle stood the HSTDV. The launch vehicle is also the parent vehicle or the Agni booster rocket. The lift-off weight of the launch vehicle plus the HSTDV mated on top was about 14 tonnes.

At the heart of the HSTDV was the indigenous air-breathing, scramjet engine, developed at the DRDL. The scramjet engine formed the HSTDV's propulsion system. The HSTDV was called the cruise vehicle or the cruiser.

The mission sequence was as follows. There were no glitches in the countdown prior to the lift-off. The launch vehicle vaulted off the launch pad at the appointed time of 11.03 a.m. and sliced steadily through the atmosphere at a speed of Mach 5.6, that is, at 5.6 times the speed of sound. The launch vehicle was rugged enough to withstand the loads imposed on it when it raced through the atmosphere at that velocity.

Once the launch vehicle carried the HSTDV/ cruise vehicle to a height of 30 km, the nose cone and the circular panels (the heat shield), which encapsulated the cruise vehicle and protected it from severe heating and atmospheric turbulence, separated and fell away. Then, the cruise vehicle, which was totally exposed to the atmosphere, was pushed out of the parent/launch vehicle. The launch vehicle fell into the Bay of Bengal. The cruiser took a little longer to stabilise.

Then the real action began. As the intake ducts in the HSTDV opened, air from the atmosphere rushed at a supersonic speed of more than Mach two into the combustion chamber of the scramjet engine and ignited the ethylene fuel. The scramjet engine ignition took place in an autonomous mode. For the next 20 seconds, the HSTDV cruised smoothly at a speed of Mach six and fell 40 km away in the Bay of Bengal. The duration set for this technology demonstrator's flight was twenty seconds. The mission was a huge success. It signalled that DRDO had mastered the highly complex Supersonic Combustion Ramjet or Scramjet engine technology. There was joy in the Mission Control Centre on the tiny island.

When the speed of a body exceeds that of the sound of 343 metres a second, it achieves a speed of Mach one. It is called supersonic when it exceeds Mach one. It is hypersonic when the speed achieved is Mach 5 and above.

In an air-breathing scramjet engine, air from the atmosphere is rammed into the engine's combustion chamber at a supersonic speed. In the chamber, the air mixes with the fuel to ignite a supersonic combustion but the flight will be in a hypersonic regime. So it is called Supersonic Combustion Ramjet or Scramjet.

Soon after the mission's success, DRDO Chairman Dr. G. Satheesh Reddy told this writer over the phone, "This is a great technological achievement of the country. The scramjet engine has been successfully flight-tested at hypersonic speeds within the atmosphere. It paves the way for the development of many more critical technologies, materials and particularly hypersonic vehicles."

Dr. Avinash Chander, former DRDO Director General, put his finger on where the mission's success lay. He said, "We have been able to demonstrate the ignition and sustain the ignition for the flight duration of 20 seconds. It is a major milestone because not many countries were able to do it at the first instance." In other words, the engine should be ignited when the air from the atmosphere is rammed into its combustion chamber at a supersonic speed. It had to be done in

milliseconds. The flame should be held when the cruise vehicle is flying in the atmosphere at a hypersonic speed of Mach six to seven.

What was important was "the control of the total vehicle with minimum drag and maximum thrust", Dr. Avinash Chander said. There should be maximum generation of energy from the scramjet engine and a minimum drag.

Dr. Sharma offered a comparison. He said that igniting the engine when the air was being rammed into the combustion chamber at a supersonic speed was akin to "lighting a match-stick in a hurricane." He added, "Our job was to prove the scramjet engine. We did it."

A hypersonic vehicle has huge potential in both "military and civil applications", said Dr. Avinash Chander, who was a key architect of India's Agni 3, Agni 4 and Agni 5 missiles. "Tomorrow, it can be upscaled and used as a hypersonic missile. With its hypersonic speed, it will pose a big challenge for interception." The scramjet engine could be used in civilian passenger air transportation. It could cut down the time of air travel from India to the US by one-sixth. Hypersonic vehicles can put satellites into orbit at a low cost.

Besides, as a DRDL engineer said, a hypersonic missile "will give you a global reach in targeting places and striking them because of its speed."

Dr. Sharma told this writer in 2013 that the critical technologies needed to be developed for the mission included the scramjet engine and hydrocarbon fuel, the engine's ignition and sustaining it, aero-propulsion integrated configuration, and the development of materials to take care of high temperatures that occurred due to air friction on the leading edges of the cruise vehicle's wings, tail surface and nose tip. The temperature in these areas could exceed 1,000 degrees Celsius. "The internal propulsion system will be very hot. So you need heat-sink materials, which can absorb the temperature," he said. The separation of the HSTDV from the launch vehicle was also a critical technology. They were all developed for the September 7, 2020 flight.

A DRDO top brass called the HSTDV success "one of the greatest technological achievements of India in the past 40 years because it paves the way forward for building missiles that can fly at a hypersonic speed of Mach six to seven." What was important was that it was not an experimental vehicle that was involved in the HSTDV mission. It was almost a prototype vehicle. "The vehicle's design is close to building bigger systems involving the fundamentals. This is the message from the mission", he said.

On May 23, 2016, the Indian Space Research Organisation's (ISRO) Reusable Launch Vehicle - Technology Demonstrator (RLV-TD) flew at a hypersonic speed and its winged space plane made a hypersonic re-entry into the earth's atmosphere. The winged space plane splashed down in the Bay of Bengal. ISRO had earlier tested the air-breathing scramjet engine technology on its Advanced Technology Vehicle (ATV) on August 28, 2016, holding the flame for five seconds at a supersonic (repeat supersonic) speed.

However, DRDO's HSTDV mission on September 7, 2020 was of a much higher magnitude. The cruise vehicle flew at a hypersonic velocity of Mach six for over 20 seconds. While ISRO's ATV was a small one, the HSTDV had a practical configuration which would aid in designing a hypersonic missile later.

Dr. A. Sivathanu Pillai, founder and former Chief Executive Officer of the BrahMos Aerospace Private Limited, called the HSTDV success "a significant milestone" in DRDO's journey for "developing a long range hypersonic missile." The flight was to prove the scramjet engine which forms "the crux of the hypersonic technology." Dr. Sivathanu Pillai, a key architect in developing the supersonic BrahMos cruise missile, noted, "This was not a missile [which was involved in the flight on September 7, 2020]. It was a technology demonstrator...But it puts us on the approach to developing hypersonic missiles."

In an interview in 2013, Dr. Avinash Chander, then DRDO Director-General, said, "The HSTDV is a very strong thrust area of our future. But it is also a very high technology area. It has a lot of challenges in the areas of dynamics, hypersonic regimes etc... The internal scramjet

combustion is a totally new area. We have tremendous heat generation there, the sustenance of combustion, the air intake - they are all very critical..." (Frontline, January 24, 2014).

India's HSTDV flight involved developing cutting-edge technologies in designing the vehicle, conducting the tests on the ground, preparing the vehicles to adapt to required conditions, taking the launch vehicle to a height of 30 km, separating the HSTDV from the parent vehicle and so on. A DRDO missile technologist said, "All these went off systematically on September 7. This was the first time we did a full-scale flight of the HSTDV. Developing the scramjet engine technology is really tough."

The fuel used in the mission was ethylene, and air from the atmosphere was the oxidiser. Air was injected into the fuel at a particular, very high temperature. If that temperature was not achieved, ethylene would not burn, he said.

What was touching was that the technologists involved in the HSTDV mission recalled the pioneering role played by its first Project Director, the late Dr. S. Panneerselvam.

Dr. V.K. Saraswat, former DRDO Director-General and Member, NITI Aayog now, told a group discussion on a television channel, that it was Air Commodore R. Gopalaswami's "idea that led to the commencement of work on hypersonic cruise technologies."

The missile complex at Hyderabad, comprising three facilities, played important roles in developing the HSTDV. The three facilities were DRDL, the Research Centre, Imarat (RCI) and the Advanced Systems Laboratory (ASL).

Despite being hobbled by the coronavirus pandemic, the HSTDV project team worked energetically to carry forward the mission activities. The Project Director, Dr. B.V. N. Charyulu, Director, DRDL, Dr. Dashrath Ram, Director, RCI, Dr. B.H.V.S. Narayana Murthy, Director, ASL, Dr. M.R.M. Babu and Director-General (Missiles and Strategic Systems), DRDO, Dr. M.S.R. Prasad led the launch operations.

A lot of credit should go to the nodal facility, the DRDL, for designing, developing and building the HSTDV and its scramjet engine. Testing the scramjet engine on the ground required advanced expertise.

The RCI came up with mission-critical avionics systems, including the navigation, control and guidance systems. It developed the software for these. The RCI made key contributions in actuation (repeat actuation) and telemetry systems.

The ASL delivered the total launch vehicle, which was derived from the Agni 1 missile. But the Agni 1 underwent certain modifications which were required for the mission. Its control systems were fine-tuned to meet the mission requirements. When the launch vehicle climbed vertically at a speed of Mach 5.6 through the atmosphere, with the HSTDV sitting on top of it, there were huge demands on its control systems. Besides, the booster performance had its bounce. So its control systems were ruggedised. Simulation tests were done on the ground to test the ruggedness of the control systems and the margins available in the systems.

While the earlier flight-trial of the HSTDV in June 2019 had control problems, there were no glitches this time. The launch vehicle put the HSTDV in the correct trajectory and its scramjet engine worked well.

As Dr. Sivathanu Pillai said, the mission's success "is a breakthrough in technology and we have to go forward in a big way in the programme for realising the hypersonic missile."

The mission's success has given the DRDO a good understanding of the advanced technologies involved in its success. While the success is a boost for the DRDO, it has to go a long way in working on the next-generation HSTDVs. So far, only the US, Russia and China have tested hypersonic technology demonstrator vehicles. India is the fourth country to do so now.

The success caps about 14 years of sustained efforts and perseverance of DRDO personnel.

<https://www.asiavillanews.com/article/indias-development-of-the-hypersonic-speed-vehicle-58850>



Fri, 18 Sept 2020

How is AKASH MDS in comparison to other missile defence systems?

The Akash (sky) is a mid-range indigenous supersonic short-range surface-to-air missile (SAM) system. It is one of the five missile projects of Integrated Guided Missile Development Programme (IGMDP) of the DRDO. The objective of the project Akash was to develop critical and sophisticated technologies for a ground system and a missile system and integrate these technologies into a state-of-the-art SAM air defence system capable of destroying multiple aerial targets simultaneously.

India initiated a project to develop a Surface to air missile in the early 1990's, as a Result of the Program the Akash project was born, and DRDO successfully test fired the First Akash missile in early 1990. The Akash missile was developed by jointly with the effort of BDL and OFB with the supports from DRDO, as each contributed by integration, development and manufacturing. Akash missile system has the capability to "neutralise aerial targets like fighter jets, cruise missiles and air-to-surface missiles" as well as ballistic missiles.



There was two projects in Akash, one is mark 1 another is mark 2 but both are same, However Mark two has increased range by adding active seeker in the missile. The Akash Mk 1 need continuous radar guidance to hit the target, a bit older technique. That means someone need guides the missile to hit the target.

While Akash Mk 2 missile with an active seeker uses command guidance for the initial phase of interception and then switches to a miniaturized radar fitted in its nose cone for terminal phase (end game) interception. (The current Akash missile uses command guidance for the entire interception phase which limits its effective range.)

Akash missiles are designed to be launched from static or mobile platforms, including battle tanks and wheeled trucks, providing flexible deployment. It can handle multiple targets and destroy manoeuvring targets, such as unmanned aerial vehicles, fighter aircraft, cruise missiles and missiles launched from helicopters.

The missile is capable of destroying aircraft within the range from 30km to 35km and at altitudes up to 18,000m. It renders multidirectional and multitarget area defence. It can carry conventional and nuclear warheads weighing up to 60kg. The integration of nuclear warhead allows the missile to destroy aircraft and warheads released from ballistic missiles. It can operate in all weather conditions.

It can operate autonomously, and engage and neutralise different aerial targets simultaneously. The kill probability of the Akash is 88% for the first and 99% for the second missile on a target. The Akash SAM is claimed to be more economical and accurate than the MIM-104 Patriot, operated by several nations including the US, due to its solid-fuel technology. The Akash can intercept from a range of 30km and provide air defence missile coverage of 2,000km².

The Akash system is fully mobile and capable of protecting a moving convoy of vehicles. The launch platform has been integrated with both wheeled and tracked vehicles. While the Akash system has primarily been designed as an air defence SAM, it also has been tested in a missile defense role. The system provides air defence missile coverage for an area of 2,000 km². The missile has a 60 kg (130 lb) high-explosive, pre-fragmented warhead with a proximity fuse.

A digital proximity fuse is coupled with a 55 kg pre-fragmented warhead, while the safety arming and detonation mechanism enables a controlled detonation sequence. A self-destruct device is also integrated. It is propelled by an Integrated Ramjet Rocket Engine.

<https://www.defenceaviationpost.com/2020/09/how-is-akash-mds-in-comparison-to-other-missile-defence-systems/>



Fri, 18 Sept 2020

India deploys amphibious armoured vehicles in Eastern Ladakh to counter Chinese build-up?

As tensions continue to escalate between India and China over the de-facto Line of Actual Control, the moment has been used to the fullest by both the armies to test new mountain warfare equipment and other weaponry

Today, Indian Defence Minister Rajnath Singh asserted that no force in the world can stop Indian army soldiers from patrolling the country's border in Ladakh region.

“I want to make it clear, skirmishes and face-off are because of this (issue of patrolling),” he said, adding the patrolling pattern is traditional and well defined. “No force in the world can stop Indian soldiers from patrolling. Our soldiers have sacrificed their lives only for this,” the minister said.

Earlier, the Chinese PLA was seen deploying load-bearing hexacopter drones to carry supplies to the inhospitable border region, the Indian forces have been keen to conduct high-altitude trials of its latest military hardware.

Recently, images revealed by Indian Twitterati have disclosed the presence of two new Armoured Personnel Carriers (APCs) in Ladakh undergoing cold weather trials.

These two vehicles are the TATA-DRDO WhAP (also known as Kestrel), and the Kalyani M4 light strike vehicle.

The TATA-DRDO WhAP (aka Kestrel)

Developed jointly by India's state-owned DRDO and private industrial giant TATA, the Kestrel is an 8-wheeled Amphibious Armoured Personnel Carrier, capable of attaining speeds of 100 km/hr on road and 10 km/hr in water.

Being an amphibious vehicle, the Kestrel gives a significant advantage to the troops – not halting for bridges to be laid down by engineers when encountered with a small river or similar hydrological formations. The new APC shall replace the BMP-1s and BMP-2/2Ks in Indian service, which, too, are amphibious.

The Kestrel can be configured to various modifications and has been seen with the Protector Remotely Controlled Weapon Station, Elbit UT30MK2 30mm turret, and a BMP-2 30mm turret as its main armament, while secondary armament includes a coaxial 7.62mm general-purpose machine gun.

However, with the new BMP-2 upgrades being sought after by the Indian Army to fill in the vacuum until Kestrel is deemed fit for service, the critical gap between the Soviet-era BMPs and the modern APCs remains. The ongoing brawl at Ladakh and subsequent testing might see hastening of the development and acquisition process.



The Kalyani M-4

Although primarily manufactured by a South Korean company named Paramount Group, the Mbombe-4 (M-4) is a 4-wheeled Light Armoured vehicle- bridging the gap of an APC and an armored car.

According to experts, partnered with the Tata Kestrel, the Kalyani M4 makes an interesting combination of armor and speed. While the Kestrel provides the armored punch that spearheads an assault, the M4 will back it up with its speed, maneuverability, and ease of maintenance.

According to the company specifications, the Kalyani M4 can go up to the speeds of 140 km/h while carrying 6 crew members including the driver.

The Indian Forces are also testing the HAL-built Light Combat Helicopter (LCH), Rudra attack helicopter and has just reached a milestone by completing high-altitude trials of the HAL's light utility helicopter (LUH).

<https://eurasiantimes.com/india-deploys-amphibious-armoured-vehicles-in-eastern-ladakh-to-counter-chinese-build-up/>

#SWARAJYA

Fri, 18 Sept 2020

DRDO-designed Made-in-India eight wheeled armoured personal carriers undergo trials in Ladakh

By Tarkesh Jha

In the last few weeks, the Indian Army has been operating on full throttle to deploy its most proficient equipment at Ladakh to prepare for any encounter against the Chinese People Liberation Army.

India Today has reported that eight wheeled armoured personnel carrier for infantry troops that are designed and made in India are undergoing trials at Leh.

The vehicles will undergo high-altitude winter trials and could be efficient at transporting the troops and aiding them to occupy strategic heights too. Moreover, the carriers will also undergo tests at Depsang to assess the engine and functioning systems of the artillery.

The report mentions that a successful examination of these newly stationed carriers could cause a tremendous advancement in India's infantry combat vehicles operation.

These are wheeled equipment that tend to be much quicker, swifter, amphibious, and can be airlifted in numbers at several vital points across the Line of Actual Control (LAC).

It was mentioned that these vehicles could be posted at the Pangong Tso lake, Chumar and Daulat Beg Oldi to strengthen the armed forces. Furthermore, it is designed by the DRDO, stressing on the steps being taken by the government to become self-reliant in the defence sector.

<https://swarajyamag.com/insta/drdo-designed-made-in-india-eight-wheeled-armoured-personal-carriers-undergo-trials-in-ladakh>



DRDO designed Eight Wheeled Armoured Personnel Carrier (Army Recognition)

DRDO investigating Howitzer accident, says incident not a setback

Agency is developing the Advanced Towed Artillery Gun Systems with Tata and Bharat Forge and an accident involving the gun took place in Pokharan in Jaisalmer on Saturday

New Delhi: Defence Research and Development Organisation (DRDO) has ordered a detailed investigation into the accident involving its under-development Howitzer that took place in Rajasthan's Pokharan last week during the trial.

The agency is developing the Advanced Towed Artillery Gun Systems (ATAGS) with private sector firms Tata and Bharat Forge. An accident involving the gun took place in Pokharan in Jaisalmer on Saturday.

"We are investigating to find the exact cause behind the accident. It is not a setback to the project in any way and it will help us and the industry to further strengthen the system (howitzer)," DRDO chairman Dr G Sathesh Reddy told ANI when asked about the incident involving the gun.

The ATAGS gun has shown the capability to fire shells at distances beyond 50 kilometres and once inducted, would be one of the most advanced and capable guns of its kind in the world.

The accident, involving the indigenous Howitzer being developed by DRDO and to be produced by Tata and Bharat Forge Limited, took place at a time when India has banned imports of Howitzers from abroad from December this year.

The ATAGS would be one of the major systems developed by DRDO with the private sector defence industry.

<https://telanganatoday.com/drdo-investigating-howitzer-accident-says-incident-not-a-setback>



Fri, 18 Sept 2020

Yediyurappa requests Rajnath Singh to set up DRDO lab in Shivamogga

Chief Minister says State government will provide land for it

Bengaluru: Chief Minister B.S. Yediyurappa called on Defence Minister Rajnath Singh on Thursday and urged for an independent laboratory of the Defence Research Development Organisation (DRDO) in Shivamogga.

The Ministry of Defence has considered the State government's proposal for establishing a research cell of the DRDO at Kuvempu University. But the State is expecting a full-fledged independent DRDO laboratory in Shivamogga with ample number of scientists and technocrats, the Chief Minister said.

Further, the Chief Minister said that the laboratory can explore natural remedial measures for the military use from the Western Ghats region, said a press release.

The land required for the construction of the laboratory as well as the official quarters for the personnel will be provided by the State government, Mr. Yediyurappa told Mr. Rajnath Singh.

<https://www.thehindu.com/news/national/karnataka/yediyurappa-requests-rajnath-singh-to-set-up-drdo-lab-in-shivamogga/article32634146.ece>



Chief Minister B.S. Yediyurappa with Defence Minister Rajnath Singh in New Delhi on Thursday. | Photo Credit: PTI



Wed, 16 Sept 2020

Master Stroke From Leh: DRDO's research institute grows vegetables for Indian army

Watch the ground report from the forward post of Defence Institute Of High Altitude Research, where fresh vegetables are cultivated for the Indian army posted in the region.

As the border remains tense in eastern Ladakh, the Indian Army has stocked up on special clothing, diet and shelter for the long haul to battle the harsh winter at heights exceeding 12,000 feet and temperature as extreme as minus 50 degrees Celsius.

Have a look at the special edition of Master Stroke with Rubika Liyaquat from Leh.

<https://news.abplive.com/tv-show/master-stroke/master-stroke-from-leh-drdo-research-institute-grows-vegetables-for-indian-army-1341154>

Defence News

Defence Strategic: National/International

 **Hindustan Times**

Fri, 18 Sept 2020

No power can stop Indian forces from patrolling Ladakh areas, asserts Rajnath Singh

In tensions that began in early May, Indian and Chinese troops have come face-to-face at multiple points along the de-factor border, known as the LAC. In some of these areas, particularly the Finger Area and Depsang in Ladakh, Indian forces have been cut off from reaching areas they could previously patrol

By Rahul Singh

No force in the world can stop the Indian Army from patrolling borders, defence minister Rajnath Singh told lawmakers in Parliament on Thursday, signalling a resolve to regain access to several areas that are now difficult to reach due to actions by the Chinese army along the Line of Actual Control (LAC).

In tensions that began in early May, Indian and Chinese troops have come face-to-face at multiple points along the de-factor border, known as the LAC. In some of these areas, particularly the Finger Area and Depsang in Ladakh, Indian forces have been cut off from reaching areas they could previously patrol.



Singh's remark came in response to comments by former defence minister AK Antony, who was reacting to the statement by the incumbent made earlier in Rajya Sabha. "The former defence minister has said that China is stopping us from patrolling. I want to make it clear that is the reason for our fight with China. These were patrolling points that were traditional and are well-defined," he said.

Singh added: "...No force in the world can stop Indian jawans from patrolling. If our soldiers have made sacrifices, it is for this reason that they have laid down their lives."

Antony also said that the ongoing talks with China should result in India being able to restore how things were till mid-April in the eastern Ladakh theatre and the outcome should allow that forces are able to patrol right up to India's perception of its border.

In the statement earlier, Singh gave a detailed assessment of the Ladakh situation. "It is easy to start wars but there is no control over how they end," the minister said, underscoring the important of restraint.

While the rest of the statement was similar to that delivered in the Lok Sabha on Tuesday, the defence minister took some questions from members in the Upper House. He is also due to separately hold a closed-door meeting with opposition leaders on the sensitive issue.

"It is reassuring to hear the defence minister say that the army will patrol to its traditional areas in eastern Ladakh. However, this will only happen if there is an agreement on disengagement and return to previous protocols," said former Northern Army commander Lieutenant General DS Hooda (retd).

The Chinese People's Liberation Army's (PLA) aggressive forward deployments in the eastern Ladakh theatre have hindered the Indian Army's patrolling patterns in Depsang, Finger Area on the northern bank of Pangong Tso, Gogra and Kongka La, officials familiar with the developments said on Thursday, speaking on the condition of anonymity.

While Depsang was not among the friction points on the LAC that Singh mentioned in his statement, the officials said the PLA's deployments in forward areas in Depsang have hindered access of Indian soldiers to routes including the ones leading to Patrolling Points (PP) 10, 11, 11-A, 12 and 13.

The Depsang plains lie south of Daulat Beg Oldie in a strategic area that the military calls Sub-Sector North (SSN).

Before the current standoff began, the Indian Army patrolled right up to India's perception of the LAC marked either by geographical features or so-called PPs (in the absence of natural features) dotting the LAC.

In his statement, Singh said China has mobilised a large number of troops and weapons systems along the LAC and the eastern Ladakh theatre, and "there are several friction areas, including Gogra, Kongka La and north and south banks of the Pangong Lake."

The Indian Army took control of key heights overlooking the PLA's deployments on the Finger 4 ridgeline in the first week of September, shortly after it moved and occupied strategic heights on the southern bank to prevent the PLA from grabbing Indian territory, in a stealthy midnight move on August 29.

Before the PLA grabbed positions on Finger 4, the army would patrol right up to Finger 8 that New Delhi considers within Indian territory. Fingers 4 and 8 are eight kilometre apart. The Indian claim line in this sector extends to Finger 8, while the Chinese claim is up to Finger 4.

In the Rajya Sabha, Antony flagged concerns about the PLA's forward deployments restricting the scope of Indian patrolling activity in the Finger Area, a set of eight cliffs jutting out of the Sirijap range overlooking the Pangong lake.

"The other areas where patrolling activity has been affected include Kongka La and Gogra. These areas have traditionally not been disputed as both sides had a somewhat common perception of the LAC. But Depsang and Finger Area are the main worry," the officials said.

In 2013, the PLA set up positions 19km into the Indian side of the LAC in the Depsang sector and triggered a face-off that took three weeks to resolve.

Prepared for the long haul in the Ladakh theatre, India has made arrangements to provide logistics support to its soldiers deployed in forward areas — more than 50,000 Indian troops are likely to remain stationed in the theatre through the winter months to deal with any provocation by the Chinese forces.

Separately on Thursday, the ministry of external affairs said China should sincerely work towards resolving issues. “The Chinese side should sincerely work with the Indian side for complete disengagement at the earliest from all friction areas, including Pangong Lake, as well as de-escalation in border areas in accordance with the bilateral agreements and protocols on maintenance of peace and tranquility in border areas,” said spokesperson Anurag Srivastava.

<https://www.hindustantimes.com/india-news/no-power-can-stop-indian-forces-from-patrolling-ladakh-areas-asserts-rajnath-singh/story-zfr9TqXzW9nOzsK3SmmqAL.html>



Fri, 18 Sept 2020

Amidst standoff with China, India to sign ARLS with Russia; Talks on with the UK, Vietnam for LSA

“Warships usually need to replenish their fuel every few days; the lack of access to ports therefore can be a serious operational limitation,” say experts

By Huima Siddiqui

Amidst the tensions with India and China growing along the Line of Actual Control (LAC), India is ready to ink Logistics Support agreement with Russia next month, and is in talks with the UK and Vietnam for similar agreements. “Warships usually need to replenish their fuel every few days; the lack of access to ports therefore can be a serious operational limitation,” say experts.

“Such Logistics Agreement allows ships operating in company with other navies either during exercises or in an operational deployment to replenish from the logistic support ships of accompanying navies thus obviating the necessity of each navy deploying its own underway replenishment for its own ships,” Commodore Anil Jai Singh, Indian Navy Veteran & Vice President Indian Maritime Foundation tells Financial Express Online.

India-Russia

The draft of the Reciprocal Logistics Support (ARLS) was shared with Russia and is now in its final stages. At a recent virtual interaction with the media, Roman Babushkin, Deputy Chief of Mission, Russian Embassy in India, had said “In mid-October when Prime Minister Narendra Modi and President Vladimir Putin meet for the annual summit the ARLS is expected to be inked.”

Why is this important?

With new shipping routes opening up, and more resources becoming available, with ARLS in place India will get access to the Russian facilities based in the Artic Region.



“Warships usually need to replenish their fuel every few days; the lack of access to ports therefore can be a serious operational limitation,” say experts. (Photo source: IE)

India-Russia Military Cooperation

India and Russia already have a draft ready on the military Logistic Sharing agreement. During the recent meetings between the two countries efforts are on to firm it up for it to be inked during the forthcoming India-Russia Annual Summit which is expected to take place in India.

India-UK Maritime Cooperation

Next year, HMS QUEEN ELIZABETH and the Carrier Strike Group, on her maiden operational deployment, will operate in the Indian Ocean region. And, according to a senior British officer, “Both sides will be undertaking the most complex and sophisticated Ex-KONKAN.” The cornerstone of India’s maritime cooperation is Ex-Konkan. This is designed to test the ability of the two Commonwealth navies to operate side-by-side during the war and other operations.

The UK has been a preferred port of call whenever Indian Navy operates in the northern Atlantic. Therefore, having a Logistics Agreement with the UK, will help the Indian Navy.

The two countries have a common perspective on maritime challenges and have agreed to develop a cooperative framework to face all challenges.

Their intentions for the future is reflected in ambitious shipbuilding and maritime innovation programmes.

The UK has also pitched to jointly work in the areas of aircraft carriers and development of 6th generation fighter aircraft technologies.

The two sides are having a dialogue on electric propulsion for the aircraft carrier and are exploring opportunities to support Make in India initiative.

The UK had last year agreed to place a liaison officer at the Indian Navy’s Information Fusion Centre (IFC) for the Indian Ocean Region (IOR) headquartered in Gurugram. “The process has got delayed due to the global pandemic COVID-19 lockdown,” said a senior officer.

As has been reportedly earlier by Financial Express Online earlier, India has inked a number of white shipping agreements, Logistics Support Agreements (LSA) and maritime cooperation agreements with several countries. It has LSA with countries including Japan, the US, Singapore, France, Oman, Australia.

What is the importance of Logistic Support Agreements?

“From a purely naval and maritime security perspective, the recently signed logistic agreement with Japan will provide the Indian Naval ships operating in the South China Sea and the Western Pacific access to port facilities including logistics and maintenance support from the JMSDF. India has also concluded similar arrangements with some other countries in the region. Such access in friendly foreign countries greatly enhances the endurance of ships to remain at sea for extended periods in distant waters thus providing both, the operational reach and the flexibility to deliver the desired effect,” Commodore Singh, former submariner opines.

“In the last few years, the Indian Navy has adopted a multi-mission deployment with 12-15 IN warships operating independently across the Indo-Pacific to monitor the critical chokepoints bordering the Indian ocean, ensure the safe passage of trade, enhance maritime domain awareness, provide humanitarian assistance and disaster relief, combat non- traditional and sub-conventional security threats and a host of other functions. It is not possible for each ship to be accompanied by a logistic support ship – the availability of logistic and maintenance support in friendly ports is therefore essential for the success of such deployments,” Commodore Singh opines.

In conclusion Commodore Singh says “Equally important is the reciprocal arrangement such an agreement provides. In the emerging maritime security scenario in the Indo-Pacific, like-minded navies will have to work closely together to combat the multitude of traditional and non-traditional security challenges in the region. The navies of India’s Pacific partners with whom India has such arrangements will also be able to therefore operate extensively in the Indian Ocean with access available to Indian ports and naval logistic facilities. This will build capacity in the Indian Ocean and support Indian initiatives as the net security provider in the region.”

According to the former spokesperson of the Indian Navy Capt DK Sharma, “In today’s scenario, the Navies of the world are operating far and wide on various missions, whether be it under NATO mandate or as coalition forces for World Food Programme or for Anti-Piracy in the Gulf of Aden or for that matter HADR missions or flag showing missions in friendly foreign countries (diplomatic duties),” Capt Sharma says.

“The Naval ships whilst operating far and wide and away from their home ports do have the requirement to replenish themselves with fuel and other lubricants etc which are necessary for the machinery. Also the fresh stocks of food in all the ships are also limited for a certain number of days and need to be replenished.

The need to rectify the defects on the complicated machinery, sensors and weapons of the ships are also a reality and have to be attended to on priority should anything go wrong,” the former spokesperson explains.

According to him, “With these types of arrangements in place between friendly and like minded nations, the logistics for maintaining the fleets get simplified and the need for the ships to get back to home ports is obviated. By using a friendly port and the services of that nation reduces the “downtime” of the ships tremendously as also gives them the confidence to the ships that help would not be far even if you’re thousands of miles away from your own country.”

“These agreements do increase the reach of the Navies who don’t have to bother about logistics as they are ensured that the partner country would meet all the requirements promptly,” he adds.

<https://www.financialexpress.com/defence/amidst-standoff-with-china-india-to-sign-arms-with-russia-talks-on-with-the-uk-vietnam-for-isa/2085400/>



DEFENCE AVIATION POST
Your Connect To The World Of Defence And Aviation

Fri, 18 Sept 2020

Rafale ready to “Touch the sky with glory” but what’s next?

The Indian Air force formally inducted Rafael in its golden arrow squadron at an event in Ambala Air Base which was attended by Defense ministers of India and Minister of French armed forces, CDS General Bipin Rawat, Air chief Marshall RKS Bhaduria, CEO of Dassault Aviation, and many more important figures.

The Indian Air Force currently operates 30 fighter squadrons however the IAF needs at least 42 fighter squadrons, further few fighter jets like MIG- 21 also known as “flying coffins” and SPECTAT JAGUARS have to be retired from service in the next few years, to counter this problem and to maintain its legacy The Indian Air Force is making some furious changes in its existing aircraft to make them even more lethal also the IAF is focusing on its own 5th Generation fighter jets.



Below is the detailed list of some of the major upgrades in The Indian Air Force and the current status of India’s own 5th Generation fighter jet.

The Super Sukhoi Programme

The Sukhoi 30 MKI is the frontline fighter jet of the Indian Air Force; it has been around sixteen years since the first Su 30 MKI entered into the service with IAF. The Su-30MKI is a Russian build twin-engine heavy- long-range -multirole fighter jet which is built in India under license by HAL it also comes in the list of the world’s one of the most maneuverable aircraft however in the

past sixteen years a lot of new technologies have been introduced by both countries which are India and Russia and that's why to make these fighters equipped with modern-day technologies, India drafted out a plan to make these machines more lethal and the name of the program was **Super Sukhoi**. The EX Air Chief Marshal of IAF BS Dhanoa said that India needs to upgrade its Sukhoi fleet with an interview with a Russian newspaper; he also added that Russia has helped India to upgrade MIG-21, MIG- 27, and MIG-29. The Super Sukhoi will derive its capabilities mainly from its successors the Su-35 and Su-57. The list of major upgrades in Su-30MKI which will turn it in Super Sukhoi

Radar– The current Su 30 MKI have a radar capable of searching objects till a range of 400 km and tracking them in 200 km of the range that's why many peoples even call it as a mini AWAC(Airborne Warning And Control System) however the current radar is not AESA (Active Electronically Scanned Array) Radar so it can be jammed but Super Sukhoi will have a modern AESA radar and top contender for that is X-BAND N036 BYELKA AESA radar it is the same radar used in Russia's only 5th generation fighter jet which is Su-57

Engine-Another interesting thing to see in the Super Sukhoi program will be its engines the Su-30MKI currently have Saturn AL-31 Turbofan engines which generate a maximum thrust of 123Kn afterburner however new engines of Super Sukhoi are expected to be much more powerful to carry more avionics, weapons, fuel, and thousand other things, the best option are the **Izdeliye 30** engines which are present in Su-57 which generate a thrust of 176 kN with this much thrust the Super Sukhoi can do wonders or other option is the engine of the Su-35 which is **AL-41F1S** these engines can create a thrust of 142.2 kN but still the engines of Su-57 weight 30% less than that of Su-35.

Armament– The major change in the Weapon pattern of Super Sukhoi will be that it would be able to carry three BrahMos- A missiles which have a range of 300-350 KM also the new AESA radar will be able to control long-range missile like in the BVR category so the Super Sukhoi can be equipped with Astra BVR missiles which are much better than current R-77 missiles on Su-30MKI while on the other hand in short-range missile category the ASRAAM (The Advanced Short Range Air-to-Air Missile) are the best options to consider for the Super Sukhoi.

Avionics – The current Sukhoi have analog avionics that with the subsystems of Israel, Russia, and France which will be replaced by Russian modern digital avionics.

There are many other significant upgrades which will be there in Sukhoi 30MKI to make it Super Sukhoi like for reduction of RCS (Radar Cross Section) and even the changes in the structure of Su-30MKI could be done

Conclusion

Super Sukhoi will be the most advanced fighter jet in the family of the 4.5 generation fighters and it would be no wrong to call it as a Non-stealth 5th generation fighter as it would be very advance and powerful however even though it will not be a completely 5th generation fighter it will be still better than fake Chinese 5th generations fighter which is the need of the decades for IAF.

AMCA (Advanced Medium Combat Aircraft)

The Super Sukhoi will be a lethal and best fighter of its 4.5 generation family but still, India lacks having a 5th generation fighter so to overcome that the Hindustan Aeronautics Limited (HAL)

<https://www.defenceaviationpost.com/2020/09/rafale-ready-to-touch-the-sky-with-glory-but-whats-next/>

The trouble with torpedoing India's plan for a third aircraft carrier

Shelving plans for IAC-2 would affect India's blue-water navy capabilities

By Commodore Udai Rao (Retd)

India it appears is all set to torpedo its plans for an second indigenous aircraft carrier, just as China prepares to surge in to the Indian Ocean Region (IOR) with her aircraft carrier group. This, even as India's first indigenous aircraft carrier (IAC-1) *Vikrant*—under construction at Kochi Shipyard Ltd—is reportedly ready to commence her basin trials in September 2020 and is expected to be fully operational by 2022.

Barely a month after taking over as India's first Chief of Defence Staff (CDS), General Bipin Rawat, when speaking to journalists in February 2020, indicated that the Indian Navy may not get approval for a third aircraft carrier (the second indigenous aircraft carrier IAC-2) anytime soon. The reason, he said, was that since aircraft carriers are expensive to build, the priority instead should be to bolster the Navy's submarine fleet.

Many in the defence and strategic community were alarmed at the cursory manner in which the General's comments were made.

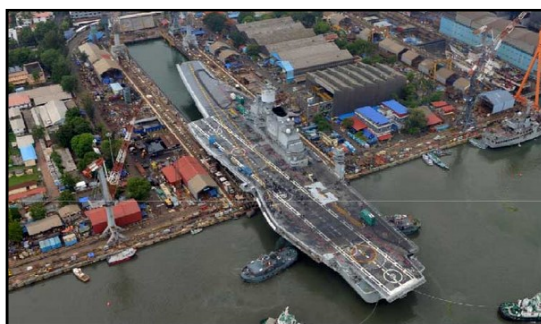
India currently has only one aircraft carrier—the 45,000-ton *INS Vikramaditya*, acquired from Russia in 2013. This is the third carrier to be operated by the Indian Navy since independence. India acquired its first aircraft carrier, *INS Vikrant*, from the United Kingdom in 1961, being the first Asian country to do so. *INS Viraat*, the second carrier and also from the UK, came in 1987. Both have since been decommissioned.

Exorbitant costs involved in operation and maintenance of a carrier and vulnerability to anti-ship missiles besides submarines are touted as reasons against the carrier. While the cost factor is true, carriers take over a decade or so to build and so the expenditure gets spread over that period. Further, an aircraft carrier has a life span of about 40-50 years, which is value for money.

Warships including carriers are meant to go in harm's way and therefore a certain amount of vulnerability will always remain in battle. However, the primary weapons of a carrier are its 'integral aircraft' which have a long reach, far ahead of the carrier group. The aircraft carrier and ships of the fleet/formation afford mutual defence and protection. On the other hand 'shore based aircraft' are limited by operational radius and even with aerial refueling; their effectiveness at extended ranges would be determined by human endurance of the pilots sitting in cramped cockpits.

The argument against a carrier therefore is mainly about the inter-se priority of the shrinking defence budget. The decision to cancel a strategic asset such as the IAC -2, if at all, must be debated at the highest level of the national security leadership and only then announced at an appropriate forum and not during journalistic interaction.

Further, the investment already incurred on carrier production facilities at Kochi Shipyard Ltd would become redundant, if the programme is closed and trained and skilled manpower would dissipate. For instance, when India closed the HDW submarine programme in 1994 for various reasons, it had difficulty in finding trained manpower when subsequently the Scorpene submarine project was approved in 2005.



INS Vikramaditya at the Cochin Shipyard, which is tasked with building IAC-I and was planned to be the yard that would construct IAC-II | Cochin Shipyard

Interestingly, China recently commissioned its first indigenous aircraft carrier, the *Shandong*, in December 2019. Earlier, China acquired the decommissioned Soviet carrier *Varyag* from Ukraine which was towed to China in 2002 under the pretext of turning it in to a theme park—and then later converted to a training aircraft carrier named *Liaoning*.

Simultaneously China spent a lot of time and effort in tailing American carriers and learning the nuances of aircraft carrier operation. China is now working on its third and fourth aircraft carriers of the Type 002 class at the Jiangnan shipyard in Shanghai. The Chinese Navy aims to have at least 10 aircraft carriers by 2050.

China does not require these carriers for the South China Sea (SCS) as she has reclaimed and militarized several islands in the Paracel and Spratly group complete with airstrips, fighter aircraft and air defence systems. These are obviously meant for the IOR to protect the critical import of crude oil from West Asia and West Africa, to fuel China's burgeoning economy. In fact China's first overseas base at Djibouti now has a pier capable of berthing an aircraft carrier.

The Indian Navy is expected to push for a grant of 'Acceptance of Necessity' (AoN) for the third carrier, the IAC- 2 soon. Admiral Karambir Singh, Chief of Naval Staff (CNS) has consistently maintained that the need for a new 65,000-tonne aircraft carrier (IAC-2) remains non-negotiable, since one carrier would need to be deployed on the western and eastern seaboard respectively, while the third undergoes refit and repair. To balance the cost of the third carrier, the IN has reportedly trimmed the number of fighter jets to 36 (two squadrons) from the original 57 planned to be inducted in to the force.

Former PM Atal Behari Vajpayee had said in 2005 "India's maritime area of interest extends from the Straits of Hormuz in the west to Malacca Straits in the east. PM Modi's maritime vision saw the 'Look East' policy re-designated to the 'Act East' policy, enunciated to an 'Indo-Pacific' policy and is intent on reinvigorating the Quadrilateral Security Dialogue or QUAD for short.

All of these have the maritime medium as its backbone—with the Indian Navy being the premier maritime force. The Navy may not be able to meet the political and strategic ambitions of the country without adequate number of carriers.

Several strategic analysts post the Galwan incident have opined that scrapping of the proposed mountain strike corps in 2017 was a strategic mistake; the IAC-2 should not be allowed to go the same way. A 'Blue Water navy' such as the Indian Navy requires both the carriers and submarines in its arsenal and, given the political will, funds can always be made available for the same.

(The author is a former Principal Director Naval Intelligence and has served as a Director in the Cabinet Secretariat.)

<https://www.theweek.in/news/india/2020/09/17/opinion-the-trouble-with-torpedoing-indias-third-aircraft-carrier-programme.html>

What is TROPEX, India's naval exercise preparations for which have begun?

The events at the LAC have left India's military planners with little doubt about the challenges ahead in keeping the Chinese dragon at bay, and the Indian Navy will have to play a key role in these efforts

Key Highlights

- **The Indian Navy has reportedly started preparing for TROPEX, its major exercise that is set to take place in January-February.**
- **Besides the Navy, units from the Army, IAF and Coast Guard take part in the exercise to bolster interoperability**
- **Earlier this month, the Pentagon in its report revealed that the Chinese's PLA Navy is now the largest in the world, even overtaking the US's own navy**

Considering India and China share a 3,500-km long border, the escalation in tensions along the Line of Actual Control (LAC) in eastern Ladakh has, not surprisingly, put the focus on the deployment of Indian Army troops and weapons at the border and, to a lesser extent, the preparedness of the Indian Air Force (IAF). Both the Army and IAF are ready to meet any eventuality should China decide to escalate the tensions further.

But if a localised conflict with China turns into something worse, maritime military operations may also come into play. While China has a much larger navy than India's, the Indian Navy is willing and able to defend the homeland and fight back the adversary should such a situation arise.

But even if there is no danger of an immediate conflict with China, the Indian Navy has to prepare for the future, as the Chinese threat is going to be a reality in the months and years ahead – the events in Ladakh have left India's military planners with no doubt about the challenges ahead in keeping the dragon at bay, and the Indian Navy will play a critical role in these efforts.

Given this backdrop, the Navy has reportedly started preparing for TROPEX, its major exercise that is set to take place in January-February.

The Print quoted defence sources as saying that preparations for TROPEX were in full swing, with additional ships continuing to remain at sea.

While the Navy is already on alert because of the developments at the LAC, TROPEX will be specially planned with an eye on China this time.

TROPEX – and its larger context

TROPEX, a month-long exercise, stands for Theatre-Level Readiness and Operational Exercise, and is carried out by the Indian Navy every two years.

In the intervening period, the Western Naval Command and the Eastern Naval Command hold their individual exercises.

TROPEX assesses the operational preparedness of the Navy. The last TROPEX was carried out in the first two months of 2019, involving around 60 Naval ships along with 12 Coast Guard vessels and 60 planes.

Besides the Navy, units from the Army, IAF and Coast Guard take part in the exercise to bolster interoperability.



Photo courtesy Indian Navy | Photo Credit: Twitter

TROPEX typically includes three phases – the independent workup phase, the joint workup phase, and the tactical phase. In the last one, an actual war-like situation is simulated. All the capabilities of the Navy are tested to see if they meet the objectives as laid down before the exercise commences.

TROPEX gives the Indian Navy accurate insights that help fine-tune combat deployments, operational logistics and force structuring requirements along with material and training imperatives.

Earlier this month, the Pentagon in its report revealed that the Chinese's PLA Navy is now the largest in the world, even overtaking the US's own navy. Though the US remains, by far, a much more powerful naval power than China, the latter is investing more and more in its maritime strength with every passing year. Meanwhile, the gap between the Indian and Chinese navies is growing.

In such a scenario, the Indian Navy will have to maximise its potential and be in a position to inflict unacceptable pain on China in case a war is forced upon India, even as India ramps up its own long-term investment in the Navy and evolves its maritime strategy in the Indo-Pacific in greater coordination with Japan, the US and Australia.

The forthcoming TROPEX will be keeping these realities and potential trajectories in mind.

<https://www.timesnownews.com/india/article/what-is-tropex-india-s-naval-exercise-preparations-for-which-have-begun/654209>

Science & Technology News

THEWEEK

Fri, 18 Sept 2020

Spaced out

While other space agencies have busy schedules, ISRO's launches slip into 2021

By Rekha Dixit

Mission Gaganyaan will not take off this year. However, Indian Space Research Organisation (ISRO) is still hopeful that the last of the three flights in the mission, the one with Indian astronauts, should make it to the 2022 deadline, to coincide with the 75th anniversary of independence.

The first of the three flights of Gaganyaan was to have taken off this December, followed by another unmanned flight next year. The delay has been conveyed to the Space Commission.

Gaganyaan, India's human space flight mission, is a three-flight programme, with only the third actually carrying the astronauts into a lower earth orbit. Given that India is not sending any animals to space before launching the astronauts, the first two flights are important for testing the organisation's capabilities, including the life-support systems.

Instead of astronauts, the first two flights will have on board Vyommitra, a "half humanoid" (as she does not have legs) to help check the systems in the crew module in situ, including temperature, pressure levels and oxygen availability. She will have some level of autonomy to communicate with the ground station.



On the backfoot: File photo of Sriharikota. There has been no launch from here this year | PTI

ISRO's launch calendar has been heavily impacted by the pandemic, and there has been no launch from its spaceport, Sriharikota, this year. In fact, the only ISRO launch this year was G-SAT 30, but it was carried by a French rocket, Ariane, which took off from French Guiana on January 17. Although officials confirm that there may be around three to four launches before the year is over, they admit that the deadlines of several launches planned for the latter half of this year may slip into the next calendar year. This could have a cascading effect on the next year's plans, too.

"We are hopeful that the final manned mission will take off as per the planned schedule, since we still have some time cushion for it," said Vikas Singh, spokesperson, ISRO. At the time the project was announced in 2018, chairperson K. Sivan had said that it was possible to do the mission even earlier, given that the organisation had already done enough R&D on it, and developed prototypes. However, that confidence had not taken into consideration the Covid-19 pandemic, which brought work to a complete halt initially, and even now, it is not business as usual.

Apart from Gaganyaan, ISRO was scheduled to launch Aditya, its first probe to study the sun's corona, too, this year. Chandrayaan-3 is listed for next year. This apart, there are several routine satellite launches, too.

S. Somnath, director, Vikram Sarabhai Space Centre, Thiruvananthapuram, said that two rockets were already at the space port in Sriharikota, waiting to take off since March, but with lockdowns and restricted movement, it has been impossible to do anything. One of these is the first Geo-imaging satellite (GISAT 1), which was to be launched upon a GSLV rocket. The other is a PSLV.

The GISAT is the first of the earth observation geostationary satellites. So far, India has only had polar satellites for earth observation. It is meant for continuous, real time observations, and has applications for weather forecasts, disaster management, as well as military uses. The launch, scheduled for March 5, was called off mysteriously a day before, with ISRO citing technical reasons, and not specifying anything else. The secrecy over the cancellation led to a number of conspiracy theories.

"The technical issues are resolved," Singh said. "We are just waiting for travel to become easier." Almost all of ISRO's centres are involved in a launch, and it takes a minimum of a month's work at the spaceport to "integrate" a rocket for take off—stacking the satellite, evaluating, testing and then when the countdown starts, fuelling. The components come from various places—rockets come from Thiruvananthapuram or Mahendragiri. The satellites are manufactured in Bengaluru, while the payloads may come from various other centres. "This requires the travel of officials to Sriharikota in various batches, across weeks, from different states. Sometimes, we also need international travel to our ground stations in Brunei and Indonesia," explained Somnath. For weeks, the rocket manufacturing centre at Thiruvananthapuram itself was under triple and critical lockdowns.

While ISRO managed to shift a lot of its research to the work-from-home schedule, there are certain things that simply cannot be done from home. Launching a rocket is one of those. Interstate restrictions was one hurdle, the fact that many of the organisation's own staff is affected by the infection, or in quarantine, creates further problems.

Somnath said that the rocket for Gaganyaan's first flight is almost ready. However, other technologies are not in the same phase of readiness, yet, say sources. A lot of the hardware manufacturing contracted to the private sector, too, has been affected by the pandemic. In fact, even the four test pilots of the Air Force, who were sent to Russia, for astronaut training in January, had to twiddle their thumbs for weeks with Russia itself under lockdown. The training has, since, resumed.

Meanwhile, from other spaceports across the earth, some very interesting launches have happened. China has so far had 22 missions since January and reports say it is aiming for a record 40 launches by December. Its best year was 2018, with 39 launches, the highest in the world.

China's most prestigious mission, this year, was the July 22 launch of its Martian probe, Tianwen 1. This probe includes an orbiter, lander and rover.

The United Arab Emirates, too, sent a probe to Mars, the Hope Orbiter, from Japan in July. NASA launched its Mars 2020 mission, which included the Perseverance rover and the Ingenuity helicopter, the first to attempt rotor blade flying in an alien atmosphere. All three spacecrafts are expected to reach Mars next February. They took advantage of a short window that happens every 26 months, when the two planets are closest to each other.

Earlier in June, NASA and private player SpaceX did the first human space flight from the US since 2011, sending astronauts to the International Space Station (ISS). NASA has just announced that the next SpaceX flight to the ISS will take off in late October, taking seven astronauts to the 20-year-old orbital laboratory. In October itself, NASA plans to send a probe to the asteroid Benu, to return to the earth with a sample.

The Russian space agency Roscosmos, too, launched a Proton rocket with two satellites from its Baikonur spaceport in July and is planning, among other things, a flight to the ISS in September.

Experts say that unlike other countries, where facilities are in one place, India's space centres are spread across several states, and the lockdown restrictions have made it impossible for such heavy interstate transport of components and humans. The European Space Agency (ESA) has not been able to do any launches, officials point out, since its spaceports are far away from the headquarters in Paris and their launches will require international travel, even more difficult in these times.

Singh added that a lot of work has resumed in various centres as the country has begun unlocking in phases, and unless there is no other unforeseen event, ISRO should manage three to four launches by the year end. However, he said it was not possible to say which these launches would be, since they are all being readied simultaneously. It would depend on which gets ready, and also on the scheduling.

<https://www.theweek.in/theweek/current/2020/09/17/spaced-out.html>



Fri, 18 Sept 2020

Gaganyaan mission: Astronauts to undergo ISRO module next year

While in Russia, their training is helping them get accustomed to conditions in space — the US, Russia and China are the only three countries to have conducted human spaceflights — the four astronauts will undergo mission-specific training back home

By Anonna Dutt

New Delhi: Four astronauts selected for the country's first human spaceflight will return from Russia in March and undergo training modules designed by the Indian Space Research Organisation (ISRO) for the mission slated for December 2021.

While in Russia, their training is helping them get accustomed to conditions in space — the US, Russia and China are the only three countries to have conducted human spaceflights — the four astronauts will undergo mission-specific training back home.

“The four astronauts, who had been selected from a pool of Indian Air Force pilots, are currently undergoing basic training in GCTC (Yuri Gagarin



ISRO has also shortlisted six experiments that will be carried out in space aboard the first unmanned flight under the Gaganyaan mission. (PTI file photo. Representative image)

Cosmonaut Training Centre) in Russia. They will be back by March next year. They will then receive specific training in India, for which the simulators have been defined. These are the areas where the industry will be contributing in a rich way to realise the simulators,” Dr Unnikrishnan Nair, director, Human Spaceflight Centre of Isro, said.

There will be three main parts to the training in India: a module on the overall project, a module for crew members, and a module on the flight hardware and software.

“Each one is more and more complex (than the previous one),” he said at the International Space Conference and Exhibition organised by Confederation of Indian Industry in association with Isro and its other arms.

India’s first human spaceflight mission, Gaganyaan, has been designed to carry three Indian astronauts to the low earth orbit — an orbit of 2,000km or less — for a period of five to seven days.

But Isro chairperson Dr K Sivan told HT earlier this year that two unmanned flights prior to the final mission will determine whether just one or two crew members will be taken to space and whether the crew will be there for the entire duration, or for just one day, or just over two hours.

Isro has planned the first unmanned flight in December 2020, the second in July 2021, and the first human spaceflight mission in December 2021 — much ahead of the August 15, 2022, deadline set by Prime Minister Narendra Modi. However, the timeline could be affected due to the Covid-19 pandemic, according to officials.

Before the first unmanned flight, Isro needs to complete at least three major tests — an air drop test for the parachute system that will demonstrate the ability to successfully recover an orbiting space capsule; a flight of the test vehicle; and an abort test to demonstrate the escape of the crew in case of an emergency at the launch pad.

Isro has also shortlisted six experiments that will be carried out in space aboard the first unmanned flight under the Gaganyaan mission. This includes four biological experiments – a study on changes in kidney stone formation in drosophila melanogaster (the common fruit fly), the study of SIRT1 gene in it, microbial contamination, and co-crystallisation under microgravity conditions.

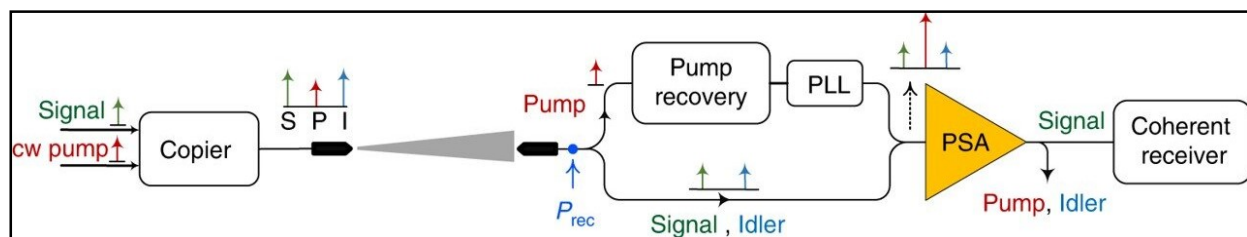
Nair said Gaganyaan will be the first of Isro’s human spaceflight mission, which will be expanded to the exploration of other planets and also the moon in the future. For this, Isro will partner with the industry and academia to develop technologies such as construction in space, tele-robotics and artificial intelligence.

<https://www.hindustantimes.com/india-news/gaganyaan-mission-astronauts-to-undergo-isro-module-next-year/story-t4FP10e2b7sLMgqyJ6QoyH.html>

Space communication: developing a one photon-per-bit receiver using near-noiseless phase-sensitive amplification

By Thamarasee Jeewandara

During space-communication researchers require high-space intersatellite data transfer connectivity for deep-space missions while monitoring Earth. The technology is fundamentally influenced by available transmission power and the aperture size of receiver sensitivity. The transition from radio-frequency links to optical links is now under consideration due to its ability to significantly reduce the channel loss caused by diffraction during communication. In a widely used approach, researchers can develop power-efficient formats along with nanowire-based photon-counting receivers cooled to a few Kelvins to function at speeds below 1-Gigabytes per second (Gb/s). In order to achieve data transfer at data rates of multi-GB/s (as expected for future space applications) the systems will have to rely on pre-amplified receivers together with advanced signal generation and processing techniques, including fibre communications.



Conceptual diagram of a free-space communication link with a PSA pre-amplified coherent receiver. S signal; P pump, I Idler, PLL phase-locked-loop, PSA phase-sensitive amplifier. Credit: Light Science & Applications, doi: 10.1038/s41377-020-00389-2

The sensitivity of such systems can be determined by the noise figure (NF—that measures the degradation of noise-to-signal ratio) of the pre-amplifier. Phase-sensitive optical amplifiers (PSA) promise to provide the best possible sensitivity for long-haul free-space links. In a new report now on *Nature Light: Science & Applications*, Ravikiran Kakarla and a team of scientists in photonics, microtechnology and nanoscience at the Chalmers University of Technology in Sweden developed a new approach using a phase-sensitive optical amplifier (PSA)-based receiver in a free-space transmission experiment. The team achieved an unprecedented bit-error free, black-box sensitivity of one photon per information bit (PPB) at an information rate of 10.5 Gb/s. While they only transmitted the signals across one meter during the study, they believe the outcomes will validate scaled-up communication across space.

Space exploration and satellite-borne sensors

Space exploration conducted by agencies such as NASA, ESA and JAXA, and their data output of satellite-borne sensors impose significant demands on communication systems to operate at higher data rates and reach further into space. The receiver sensitivity should be improved as an important step to enhance data throughput with as few photons received as possible. A better receiver sensitivity will allow longer reach, higher data throughput and the potential to use more compact optics. Common approaches currently in development to improve sensitivity suffer from a low spectral efficiency (SE) and can only achieve modest net data rates due to the trade-off between sensitivity and bandwidth.

For example, scientists widely consider pulse position modulation (PPM) during space communications since it can reach an excellent sensitivity at low signal-to-noise ratios (SNRs), however, the method can result in an ineffective spectral efficiency. As a result, they can employ photon counting receivers to receive pulse position modulation symbols and establish sensitivities of a few photons per bit. However, the resulting superconducting nanowire-based receivers need to be cooled to 2-4 Kelvin to function effectively. Future space communication systems will therefore need to exceed current speeds of function, which require major improvements beyond the existing receiver technology relative to the data rate and sensitivity. In this work, Kakarla et al. expanded on preceding work by including a theoretical analysis to achieve sensitivities with PSAs (phase-sensitive optical amplifiers). The work highlights the benefits of replacing current radiofrequency technologies with the more efficient optical systems to meet future demands of space communication with higher data rates to communicate across greater distances.

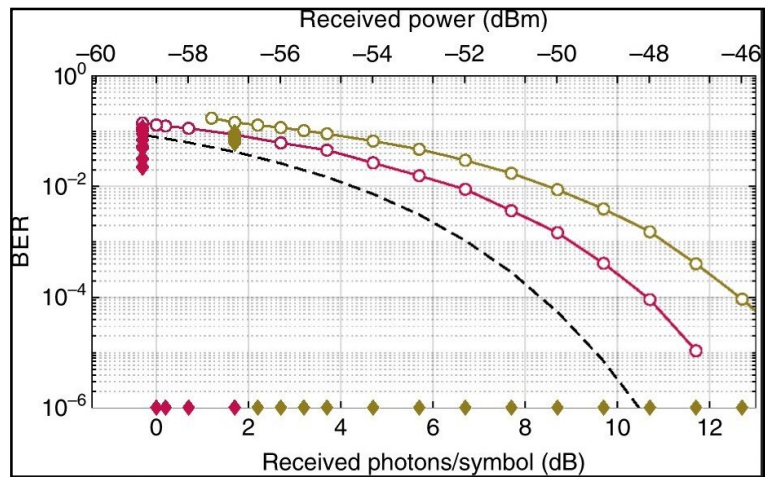
Experimental setup

The scientists used a free-space optical transmission link with a pre-amplified receiver. Since evolving space communication research has adopted technology from the optical fibre communication field, including techniques of advanced forward error correction (FEC), the scientists used a FEC-encoded binary data stream at the transmitter. They modulated the data onto the signal with quadrature-phase-shift keying (QPSK) for a resulting net information rate of 10.52 Gb/s. The team combined the signal with a continuous-wave pump to generate a conjugate idler wave containing the same information as the signal using four-wave mixing (FWM) in a nonlinear optical fibre.

The team amplified the signal, idler and pump waves to the desired output power and launched them into the free-space channel. They used the free-space link to confirm that no additional penalty occurred during the launch of waves into free space. The pump power used in the study was significantly lower than the combined signal and idler power, resulting in a nearly negligible power budget penalty.

Recovering a stable high-power

The team separated the pump waves at the receiver from the signal and idler waves using a wavelength division multiplexer, which they then recovered using optical injection locking – an optical and phase synchronization technique. After phase-sensitive amplification of the recovered wave, they filtered and detected the signal using a standard coherent receiver and a real-time oscilloscope for digital signal processing. The scientists measured a Bit Error Rate of the received signal to understand the performance of the PSA (phase-sensitive optical amplifier) based pre-amplified receiver. They compared the results with an erbium-doped fibre amplifier (EDFA) and the PSA performed better than the EDFA-based receiver. Using the experimental system, Kakarla et al. showed how error-free transmission could be achieved with a received power of 1-photon per information bit (PPB) to provide the best black-box receiver sensitivity reported to date.



Experimental results with 10.52-Gbaud QPSK data, showing BER versus received power (also expressed in photons per symbol) before and after FEC decoding for: EDFA pre-FEC (the brown line with open circles as the measured points); EDFA post-FEC (the brown solid diamond markers); PSA pre-FEC (the red line with open circles as the measured points); PSA post-FEC (the red diamond markers). Credit: Light Science & Applications, doi: 10.1038/s41377-020-00389-2

Outcomes of the study for space communication

The described method is compatible with additional methods that use a different nonlinear platform to obtain improved sensitivity. The PSA approach represented a trade-off between spectral efficiency and sensitivity for receivers used in free-space communication, alongside experimental sensitivity records of using these techniques. While the demonstration focused on applications in deep-space links, they can also be used in atmospheric links to improve sensitivity. Such investigations will need to consider the effect of atmospheric turbulence on the PSA pre-amplified receiver.

In this way, Ravikiran Kakarla and colleagues presented a record black-box sensitivity of one photon per information bit at 10.5 Gb/s using a simple spectrally efficient format. They enabled the method using a phase-sensitive optical amplifier (PSA) approach and ultra-low power injection locking mechanism to achieve the observed sensitivity in the presence of a new noise-free, phase-sensitive pre-amplifier. The outcomes expect to increase the rate of information transmission, while reducing the size of the optics involved. These results can significantly contribute to space communication and in light detection and ranging (LIDAR) applications to monitor Earth.

More information: Ravikiran Kakarla et al. One photon-per-bit receiver using near-noiseless phase-sensitive amplification, *Light: Science & Applications* (2020). [DOI: 10.1038/s41377-020-00389-2](https://doi.org/10.1038/s41377-020-00389-2)

Bryan S. Robinson et al. 781 Mbit/s photon-counting optical communications using a superconducting nanowire detector, *Optics Letters* (2006). [DOI: 10.1364/OL.31.000444](https://doi.org/10.1364/OL.31.000444)

Z. Tong et al. Towards ultrasensitive optical links enabled by low-noise phase-sensitive amplifiers, *Nature Photonics* (2011). [DOI: 10.1038/nphoton.2011.79](https://doi.org/10.1038/nphoton.2011.79)

Journal information: [Light: Science & Applications](#), [Optics Letters](#), [Nature Photonics](#)
<https://phys.org/news/2020-09-space-photon-per-bit-near-noiseless-phase-sensitive-amplification.html>

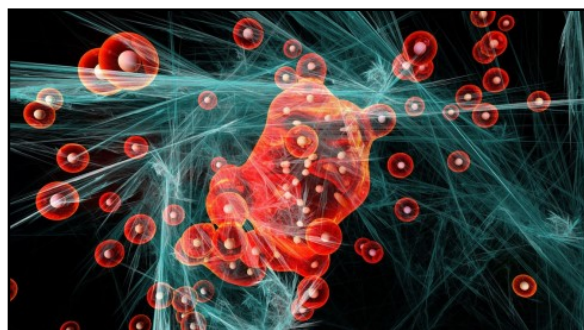


Fri, 18 Sept 2020

Novel ultrafast nuclear magnetic resonance method for investigating molecular exchange

The exchange of molecules between different physical or chemical environments due to diffusion or chemical transformations has a crucial role in a plethora of fundamental processes such as breathing, protein folding, chemical reactions and catalysis.

The NMR Research Unit at the University of Oulu developed an NMR method to speed up to 10000-fold detection of molecular exchange. The method is exploited in the climate change research to understand the composition of atmospheric aerosols in collaboration with the Nano and Molecular Systems (NANOMO) Research Unit at the University of Oulu.



Credit: Pixabay/CC0 Public Domain

Nuclear Magnetic Resonance (NMR) spectroscopy is one of the most versatile spectroscopic methods. NMR spectra are kind of fingerprints of molecules. The method provides also detailed information on the motion and positions of molecules. The most well-known application of NMR phenomenon is the Magnetic Resonance Imaging (MRI) method used in hospitals.

Molecular exchange phenomena can be studied by so-called Diffusion EXchange SpectroscopY (DEXSY). The method is based on the fact that, when the environment of a molecule changes, its diffusion coefficient, which represents the amount of thermal motion, changes as well. However,

the conventional DEXSY method is slow, as each point of multidimensional data has to be collected in separate measurements. Based on spatial encoding of multidimensional data, the NMR Research Unit developed an ultrafast DEXSY experiment, by which the data could be collected in a single scan.

The method was exploited in the investigation of surfactants present in atmospheric aerosols. The study revealed that the surfactants form nanovesicles, which encapsulate water molecules. The method was used to determine how quickly water molecules moved from inside vesicles to outside of them. Structures formed by surfactants can have a significant impact on the surface tension of cloud droplets and, therefore, on climate models.

More information: Otto Mankinen et al. Ultrafast diffusion exchange nuclear magnetic resonance, *Nature Communications* (2020). DOI: [10.1038/s41467-020-17079-7](https://doi.org/10.1038/s41467-020-17079-7)

Journal information: *Nature Communications*
<https://phys.org/news/2020-09-ultrafast-nuclear-magnetic-resonance-method.html>



Fri, 18 Sept 2020

Self-imaging of a molecule by its own electrons

One of the long-standing goals of research on the light-induced dynamics of molecules is to observe time-dependent changes in the structure of molecules, which result from the absorption of light, as directly and unambiguously as possible. To this end, researchers have developed and applied a plethora of approaches. Of particular promise among these approaches are several methods developed in the last years that rely on diffraction (of light or electrons) as means of encoding the internuclear spacings between the atoms that together form the molecule.

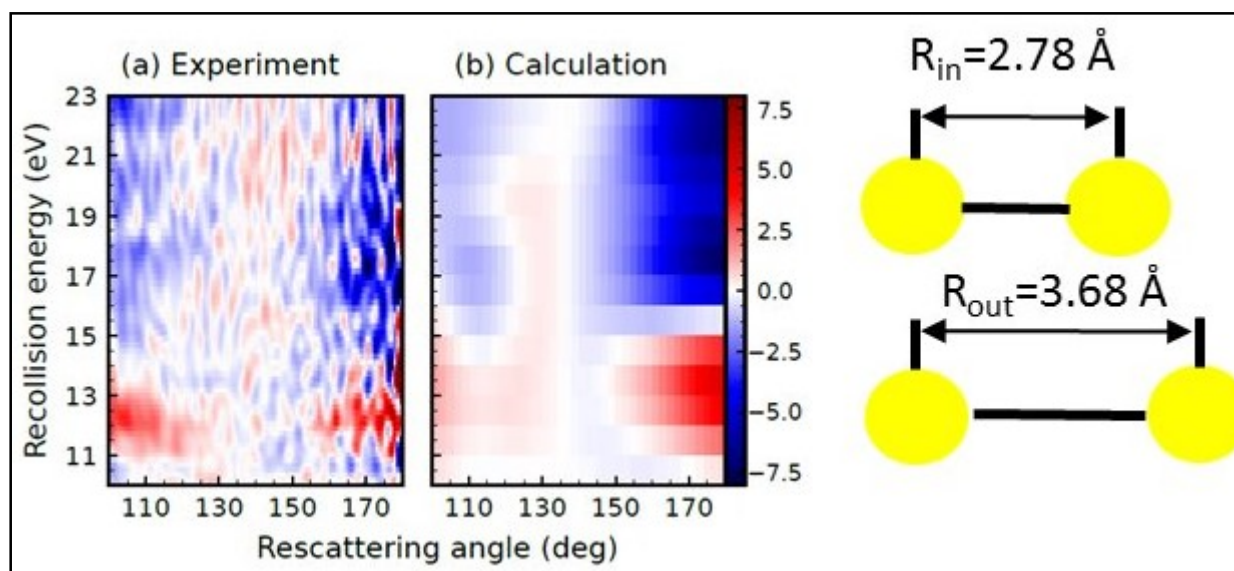


Figure 1: Difference between the electron scattering cross-section measured (a) and calculated (b) at $R = 3.68 \text{ \AA}$ (corresponding to the outer turning point of the vibrational motion) and $R = 2.78 \text{ \AA}$ (corresponding to the inner turning point of the vibrational motion) for the case of an I2 vibrational wave packet created by photo-excitation of the B-state using a visible laser with a wavelength of 555 nm. The difference in the scattering cross-sections is shown as a function of the kinetic energy of the returning electron and the angle into which the electron is scattered. Particularly near a rescattering angle of 180 degrees (i.e. for back-scattered electrons) a major difference is seen between the scattering cross-section at the geometry corresponding to the inner and outer turning point of the vibration. In other words, the time-dependent changes in the internuclear distance are recognizable in time-dependent changes of the measured electron scattering cross-sections. Credit: Forschungsverbund Berlin e.V. (FVB)

In a recent paper (*Phys. Rev. Lett.* 125, 123001, 2020), researchers at the MBI led by Dr. Arnaud Rouzée have shown that high-resolution movies of molecular dynamics can be recorded using

electrons ejected from the molecule by an intense laser field. Following strong field ionization, the electrons that are set free are generally accelerated away from the molecule under the influence of the laser electric field. However, due to the oscillating nature of this field, a fraction of the electrons are driven back to their parent molecular ion. This sets the stage for a so-called re-collision process, in which the electron can be reabsorbed in the molecule (and where the absorbed energy is released in the form of high energy photons) or scatters off the molecular ion. Depending on the kinetic energy of the electron, it can be transiently trapped inside a centrifugal potential barrier. This is a well-known process in electron scattering and in single photon ionization experiments, and is referred to as a shape resonance. The smoking gun for the occurrence of a shape resonance is a large increase of the scattering cross-section. As its name implies, the kinetic energy for which the shape resonance occurs is highly sensitive to the shape of the molecular potential, and consequently to the molecular structure. Therefore, shape resonances can be used to make a movie of a molecule that is undergoing ultrafast nuclear rearrangement.

To demonstrate this effect, the team at MBI recorded a movie of the ultrafast vibrational dynamics of photo-excited I₂ molecules. A first laser pulse, with a wavelength in the visible part of the wavelength spectrum, was used to prepare a vibrational wavepacket in the electronic B-state of the molecule. This laser pulse was followed by a second, very intense, time-delayed laser pulse, with a wavelength in the infrared part of the wavelength spectrum. Electron momentum distributions following strong field ionization by the second laser pulse were recorded at various time delays between the two pulses, corresponding to different bond distances between the two iodine atoms. A strong variation of the laser-driven electron rescattering cross-section was observed with delay, which could unambiguously be assigned to a change of the shape resonance energy position (see Fig. 1) induced by the vibrational wavepacket motion. As such, this work introduces new opportunities for investigating photo-induced molecular dynamics with both high temporal and spatial resolution.

More information: Felix Brausse et al. Evolution of a Molecular Shape Resonance Along a Stretching Chemical Bond, *Physical Review Letters* (2020). DOI: [10.1103/PhysRevLett.125.123001](https://doi.org/10.1103/PhysRevLett.125.123001)

Journal information: [Physical Review Letters](https://phys.org/news/2020-09-self-imaging-molecule-electrons.html)
<https://phys.org/news/2020-09-self-imaging-molecule-electrons.html>



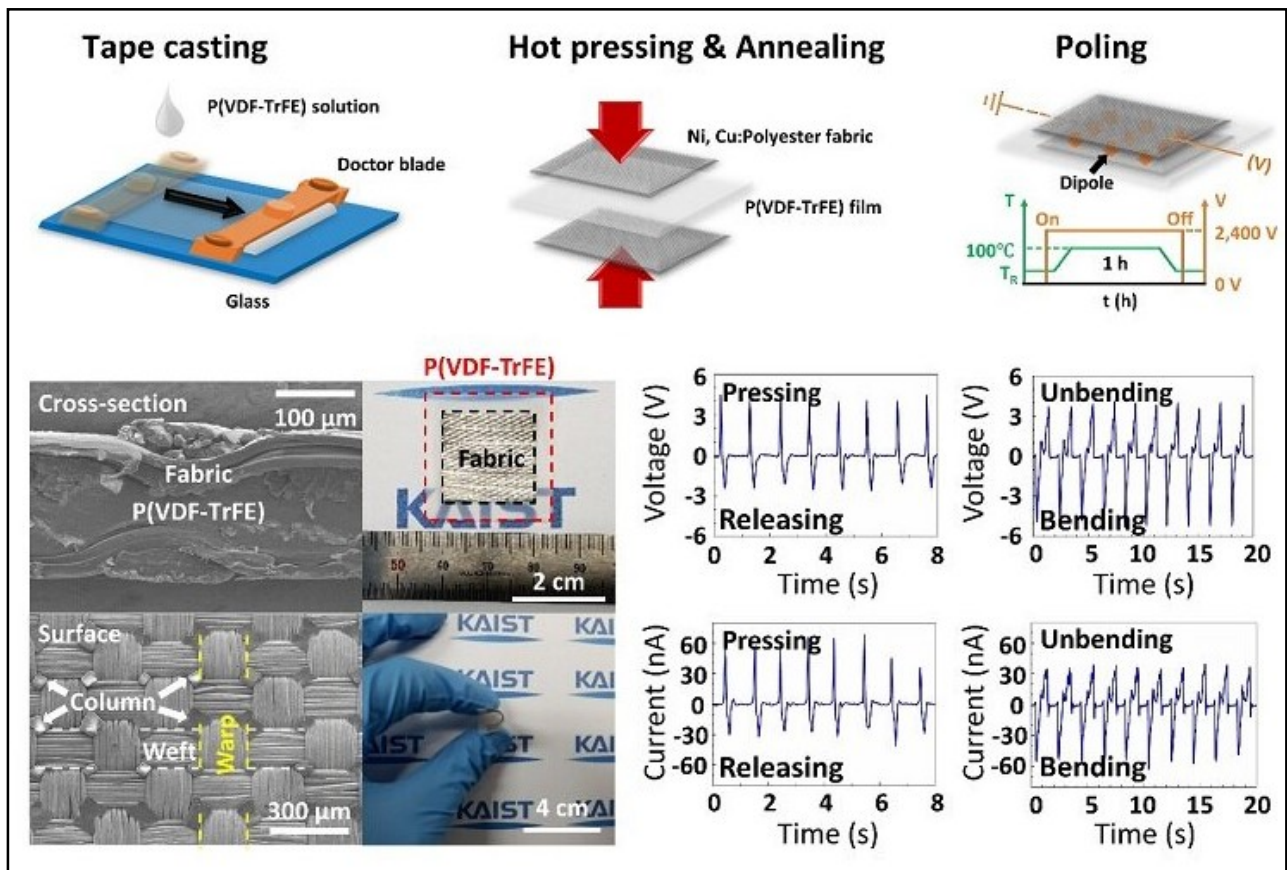
Fri, 18 Sept 2020

Sturdy fabric-based piezoelectric energy harvester takes us one step closer to wearable electronics

KAIST researchers presented a highly flexible but sturdy wearable piezoelectric harvester using the simple and easy fabrication process of hot pressing and tape casting. This energy harvester, which has record high interfacial adhesion strength, will take us one step closer to being able to manufacture embedded wearable electronics. A research team led by Professor Seungbum Hong said that the novelty of this result lies in its simplicity, applicability, durability, and its new characterization of wearable electronic devices.

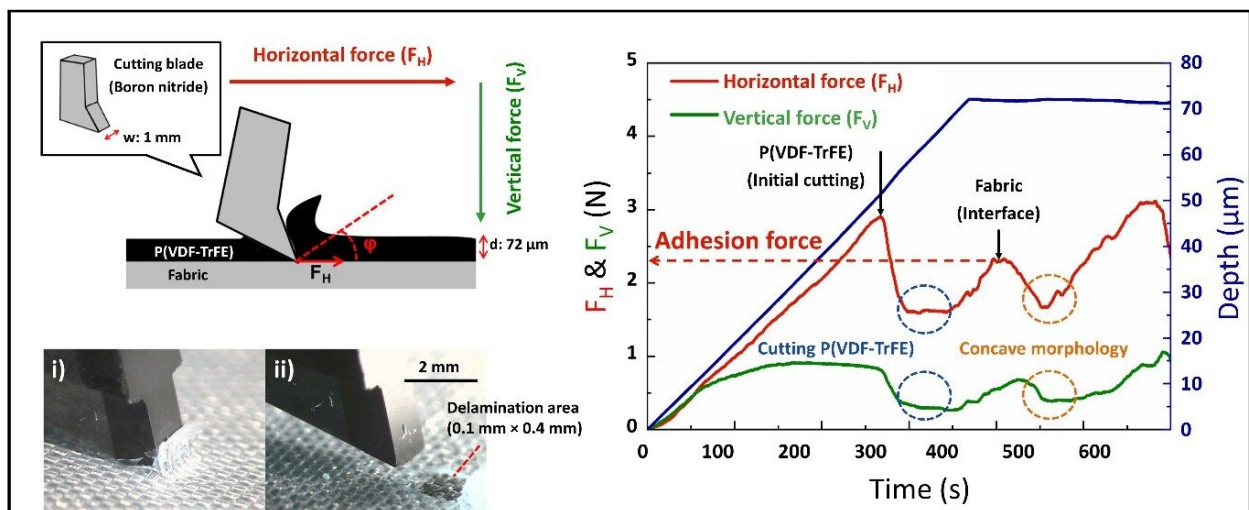
Wearable devices are increasingly being used in a wide array of applications from small electronics to embedded devices such as sensors, actuators, displays, and energy harvesters.

Despite their many advantages, high costs and complex fabrication processes remained challenges for reaching commercialization. In addition, their durability was frequently questioned. To address these issues, Professor Hong's team developed a new fabrication process and analysis technology for testing the mechanical properties of affordable wearable devices.



Fabrication process, structures, and output signals of a fabric-based wearable energy harvester. Credit: The Korea Advanced Institute of Science and Technology (KAIST)

For this process, the research team used a hot pressing and tape casting procedure to connect the fabric structures of polyester and a polymer film. Hot pressing has usually been used when making batteries and fuel cells due to its high adhesiveness. Above all, the process takes only two to three minutes.



Measurement of an interfacial adhesion strength using SAICAS. Credit: KAIST

The newly developed fabrication process will enable the direct application of a device into general garments using hot pressing just as graphic patches can be attached to garments using a heat press.

In particular, when the polymer film is hot pressed onto a fabric below its crystallization temperature, it transforms into an amorphous state. In this state, it compactly attaches to the concave surface of the fabric and infiltrates the gaps between the transverse wefts and longitudinal

warps. These features result in high interfacial adhesion strength. For this reason, hot pressing has the potential to reduce the cost of fabrication through the direct application of fabric-based wearable devices to common garments.

In addition to the conventional durability test of bending cycles, the newly introduced surface and interfacial cutting analysis system proved the high mechanical durability of the fabric-based wearable device by measuring the high interfacial adhesion strength between the fabric and the polymer film. Professor Hong said the study lays a new foundation for the manufacturing process and analysis of wearable devices using fabrics and polymers.

He added that his team first used the surface and interfacial cutting analysis system (SAICAS) in the field of wearable electronics to test the mechanical properties of polymer-based wearable devices. Their surface and interfacial cutting analysis system is more precise than conventional methods (peel test, tape test, and microstretch test) because it qualitatively and quantitatively measures the adhesion strength.

Professor Hong explained, "This study could enable the commercialization of highly durable wearable devices based on the analysis of their interfacial adhesion strength. Our study lays a new foundation for the manufacturing process and analysis of other devices using fabrics and polymers. We look forward to fabric-based wearable electronics hitting the market very soon."

The results of this study were registered as a domestic patent in Korea last year, and published in *Nano Energy* this month. This study has been conducted through collaboration with Professor Yong Min Lee in the Department of Energy Science and Engineering at DGIST, Professor Kwangsoo No in the Department of Materials Science and Engineering at KAIST, and Professor Seunghwa Ryu in the Department of Mechanical Engineering at KAIST.

More information: Jaegy Kim et al, Cost-effective and strongly integrated fabric-based wearable piezoelectric energy harvester, *Nano Energy* (2020). DOI: [10.1016/j.nanoen.2020.104992](https://doi.org/10.1016/j.nanoen.2020.104992)

Journal information: *Nano Energy*
<https://phys.org/news/2020-09-sturdy-fabric-based-piezoelectric-energy-harvester.html>

COVID-19 Research News



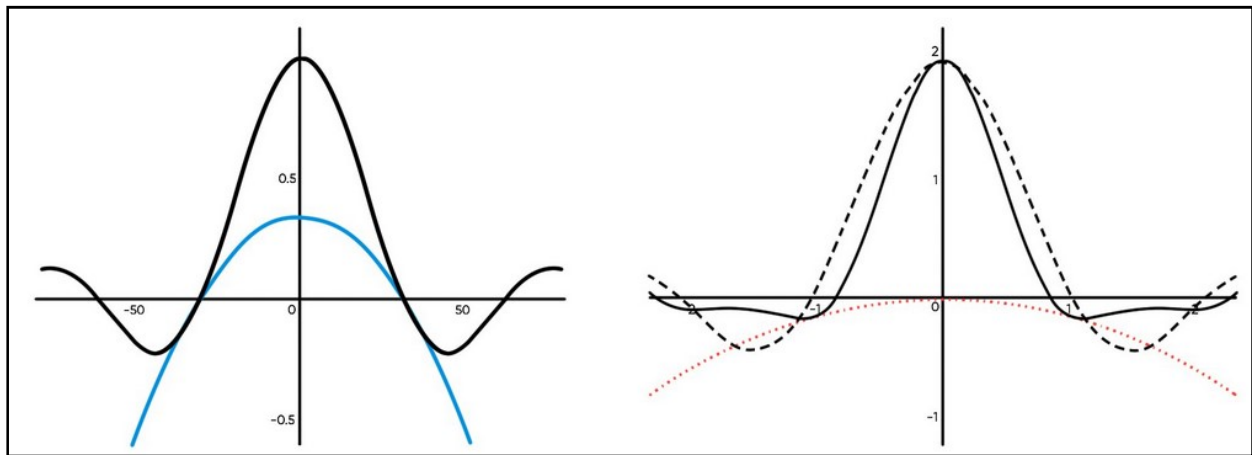
Fri, 18 Sept 2020

Mathematician proposes model describing virus mutations

A team of specialists in mathematical modeling from the RUDN University suggested a qualitative model of virus evolution and of the occurrence of new strains. The results of the study can make predicting virus behavior more efficient and help in the development of new antiviral medications. The article was published in the journal *Mathematics*.

The interaction between a virus and a human body is a very complex phenomenon that can be reduced to two processes: a virus multiplies in host cells, and the organism resists the infection by means of the immune response. A closer look at a virus infection shows that viruses compete for host cells, change under the influence of antiviral drugs, and mutate during its replication. They can evolve at a very high speed by means of modifying old or acquiring new RNA or DNA sequences. Because of these and many other factors, it is difficult for biologists to predict the dynamics of virus evolution, foresee the occurrence of new strains, and assess their potential resistance levels.

The team of Vitaly Volpert, a mathematician from RUDN University, suggested a mathematical model describing the evolution and diversification of virus quasispecies. The model shows a dynamic interaction between the replication, mutation, and elimination of a virus. The results of the work may be further used to predict the occurrence of virus strains capable of avoiding immune recognition and resisting antiviral medications.



Credit: RUDN University

"To keep it simple, the model shows us that existing strains evolve in order to reduce competition between viruses, to weaken virus elimination by the immune response, and to become less sensitive to medication. This tendency leads to the occurrence of drug-resistant strains," says Vitaly Volpert.

Working together with his colleagues, the scientist described a virus strain as a localized solution concentrated around a given genotype. The emergence of new strains corresponds to a periodic wave propagating in the space of genotypes. The occurrence of new distribution peaks in the process of wave propagation coincides with the occurrence of new virus strains. The team described the conditions of occurrence of periodic traveling waves and their dynamics analyzing the stability of spatially homogeneous stationary solutions.

The model is represented by a nonlocal reaction-diffusion equation for the virus density. The equation has two integral terms that correspond to the nonlocal effects of virus interaction with host cells and immune cells.

The new model is qualitative and applicable to different viral infections. However, to better describe the dynamics of virus quasispecies, one needs to know their individual features, such as the nature of their mutations, interaction with the immune system, and response to antiviral medication.

"Using our model, one can develop various methods to prevent the spread of viral infections across body tissues and the occurrence of new strains, i.e. the propagation in the space of genotypes. However, for these approaches to have a practical implementation, they should be combined with experimental and clinical data," adds Vitaly Volpert.

The model has a number of limitations because it is based on several simplifications. Namely, it does not take into account the existence of the variety of immune cells and cytokines (small informative peptide molecules) that take part in the immune response, or complex processes of intracellular regulation and virus replication. However, these limitations help the scientists to determine some common evolutionary features of virus quasispecies that would be difficult to identify in a more complex model. The work of the team can be used as a basis for further investigations.

More information: Nikolai Bessonov et al. Nonlocal Reaction–Diffusion Model of Viral Evolution: Emergence of Virus Strains, *Mathematics* (2020). DOI: [10.3390/math8010117](https://doi.org/10.3390/math8010117)
<https://phys.org/news/2020-09-mathematician-virus-mutations.html>

Coronavirus: Study hints antibody drug may cut Covid-19 hospitalizations

A drug company says that partial results from a study testing an antibody drug give hints that it may help keep mild to moderately ill COVID-19 patients from needing to be hospitalized, a goal no current coronavirus medicine has been able to meet

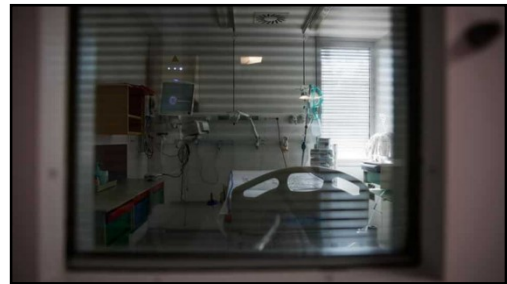
A drug company says that partial results from a study testing an antibody drug give hints that it may help keep mild to moderately ill COVID-19 patients from needing to be hospitalized, a goal no current coronavirus medicine has been able to meet. Eli Lilly announced the results Wednesday in a press release, but they have not been published or reviewed by independent scientists. The drug missed the study's main goal of reducing the amount of virus patients had after 11 days, except at the middle of three doses being tested. However, most study participants, even those given a placebo treatment, had cleared the virus by then, so that time point now seems too late to judge that potential benefit, the company said. Other tests suggest the drug was reducing virus sooner, and the results are an encouraging "proof of principle" as this and other studies continue, Lilly said.

The company said it would talk with regulators about possible next steps but that it was too soon to speculate on whether these interim results might lead to any action to allow early use. "I'm strongly encouraged" by the results, said Dr. Myron Cohen, a University of North Carolina virologist. He had no role in the Lilly study but helps direct antibody studies for a public-private research group the federal government formed to speed testing of these drugs. "This seems to demonstrate what we thought" — that such drugs would give a benefit, he said.

Antibodies are proteins the body makes when an infection occurs; they attach to a virus and help it be eliminated. The blood of survivors is being tested as a treatment for COVID-19 patients because it contains such antibodies, but the strength and types of antibodies varies depending on each donor, and doing this on a large scale is impractical. The drugs that Lilly and other companies are testing are concentrated versions of specific antibodies that worked best against the coronavirus in lab and animal tests, and can be made in large, standardized doses.

They are being tested to treat newly diagnosed COVID-19 patients in hope of preventing serious disease or death, and to try to prevent infection in people at high risk of that such as nursing home residents and health workers. Wednesday's results come from 450 people in a mid-stage study testing an antibody jointly developed by Indianapolis-based Lilly and the Canadian company AbCellera in people with COVID-19 symptoms not severe enough to warrant hospitalization. The drug is given once through an IV and was tested at three doses. Neither the patients nor their doctors knew which patients received the drug or placebo infusions.

Hospitalization or ER visits occurred in 1.7%, or 5 of 302 patients given the drug and 6% or 9 of 150 of those given placebo. The company did not disclose whether those results met scientific tests to rule out that they could have occurred by chance alone. The company felt that giving the actual numbers "told the story in the most balanced way," said Lilly's chief scientific officer, Dr. Daniel Skovronsky.



An empty hospital bed is seen in a room in the Intensive Care Unit (ICU) at the Robert Ballanger hospital in Aulnay-sous-Bois near Paris as the outbreak of the coronavirus disease (COVID-19) continues in France, September 15, 2020. (Representational)(REU)

The difference seems large enough to suggest a true benefit and the result is “promising” even though the study missed its main goal, said Dr. Peter Bach, a health policy expert at Memorial Sloan Kettering Cancer Center in New York with no role in the study. The study will continue to test the antibody drug in combination with another from a Chinese company, Junshi Biosciences. Three late-stage studies of it also are underway, including two sponsored by the U.S. National Institutes of Health. Lilly has already started manufacturing its antibody drug, hoping to have hundreds of thousands of doses ready by fall if studies give positive results. Another company that developed an antibody drug cocktail against Ebola — Regeneron Pharmaceuticals Inc. — now is testing a two-antibody drug for coronavirus.

(This story has been published from a wire agency feed without modifications to the text. Only the headline has been changed.)

<https://www.hindustantimes.com/health/coronavirus-study-hints-antibody-drug-may-cut-covid-19-hospitalizations/story-cOAcUFHd8bnOZuRcpnjpL.html>



Fri, 18 Sept 2020

Dr Reddy’s-Sputnik V deal, explained: Could India get a Covid-19 vaccine this year?

India Coronavirus (Covid-19) vaccine: Ultimately, how well this vaccine does will depend on the protocol that DRL follows, the results from the Indian phase 3 trials, and data generated from post-registration trials in Russia and late-stage trials in other countries

By Prabha Raghavan

New Delhi: Drugmaker Dr Reddy’s Laboratories (DRL) announced on Wednesday (September 16) that it will distribute 100 million (10 crore) doses of Russia’s Sputnik V Covid-19 vaccine in India after conducting final-stage human trials and receiving regulatory clearances here.

Should India’s top drug regulatory body sign off on phase 3 trials in the country, Sputnik V will replace Serum Institute of India’s (SII’s) ‘Covishield’ as the frontrunner in the race to produce a Covid-19 vaccine for India.

What is the Sputnik V vaccine?

This is a vaccine that uses what is known as ‘human adenoviral vector’ technology. Adenoviruses cause a wide range of illnesses ranging from fevers, coughs, and sore throats to pink eye, diarrhoea, and bladder infections. The adenovirus is modified and weakened so that it cannot replicate in the human body. Instead, it will act like a Trojan Horse, carrying instructions for the cells in the human body to produce the spiky outer layer (spike protein) of SARS-CoV-2, the virus that causes Covid-19.

This is expected to help the body recognise the spike protein as a foreign substance and build an immune response against it so that it can tackle the real virus when it tries to infect.

Sputnik V uses two different genetically modified adenoviruses to carry the spike protein. The vaccine containing the second adenovirus is given 21 days after the first one, and is expected to “boost” the body’s immune response and build “long-lasting immunity”.

Developed by Moscow-based Gamaleya Research Institute of Epidemiology and Microbiology, the Sputnik V vaccine was approved for public use in Russia on August 11.



A new vaccine is on display at the Nikolai Gamaleya National Center of Epidemiology and Microbiology in Moscow, Russia. (AP)

What does DRL’s agreement mean for India? How soon will it be available to the public in this country?

While India has been in discussions with Russia to explore the possibility of using Sputnik V here for around a month now, the DRL deal is the first concrete development that shows the vaccine will come to India.

DRL on Wednesday announced its agreement with the Russian Direct Investment Fund (RDIF) – Russia’s sovereign wealth fund that has been closely involved in these discussions – to carry out phase 3 human clinical trials of the vaccine in India, following which it would distribute the vaccine here for public use.

If the timeline given by RDIF is to be believed, about 100 million (10 crore) Indians can expect to start getting a Covid-19 vaccine by the end of this year. Each dose of the vaccine includes two vials containing separate adenoviral vectors, according to an RDIF spokesperson.

Going by the government’s vaccination priorities, healthcare, and frontline workers, as well as those who work in occupations that would make them vulnerable to Covid-19 exposure, might be the first to get this (or indeed, any other) vaccine. Following this, the older population and those with co-morbidities may get the shot.

Of course, this will depend on how long it takes for the phase 3 trials to conclude in India, and whether India’s regulatory authorities are convinced by the safety and efficacy data generated in these trials.

The development of any vaccine is a long, complex process. What are the things to look out for in the Russian candidate going forward?

This vaccine was approved in Russia even before phase 3 trials were conducted. Even the phase 1 and 2 human trials were conducted on a very small group of fewer than 100 people. While findings from the early studies showed that the vaccine was safe, the relatively small number of volunteers in the trials, and the skipping of phase 3 trials before approvals, has drawn global criticism.

The only way to truly ascertain the safety and effectiveness of this vaccine is to look at long-term information from those vaccinated in the earlier trials, as well as to conduct larger phase 3 trials over a longer period of time.

These phase 3 trials often enroll thousands of volunteers representing a more diverse population, and checks for whether the vaccine is able to generate the required immune response effectively and without any serious adverse reactions.

To this end, post-registration trials involving 40,000 volunteers are now underway, according to RDIF. Brazil is also expected to approve the vaccine for local use only after phase 3 trials.

How well this vaccine does in India will now depend on the protocol that DRL follows, the results from phase 3 trials here and data generated from post-registration trials in Russia and late-stage trials in other countries. DRL is expected to approach the Indian regulator with its request to conduct the phase 3 trial here “shortly”, according to RDIF.

<https://indianexpress.com/article/explained/covid-19-vaccine-india-russia-sputnik-dr-reddy-6599780/>

