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India plans test firing of three more strategic missiles this month

Defence sources said three missiles have been lined up for trials in next one week

By Hemant Kumar Rout

Bhubaneswar: High on a series of successful trials of indigenous weapon systems, India is all set to test fire a few more strategic missiles – home grown and joint venture project before wrapping up the year.

Defence sources said three missiles have been lined up for trials in next one week. While a user trial of short-range ballistic missile Prithvi-II by the armed forces has been scheduled on Wednesday, the Strategic Forces Command of the army will flight test long range ballistic missile Agni-IV on December 18.

A developmental trial of Medium-Range Surface-to-Air Missile (MRSAM) has been planned next week. “Prithvi-II trial will be conducted during night subjected to favourable weather condition. Thursday has also been kept reserve for the test firing. If everything goes as per plan, the MRSAM will be tested on December 22,” the source told TNIE.

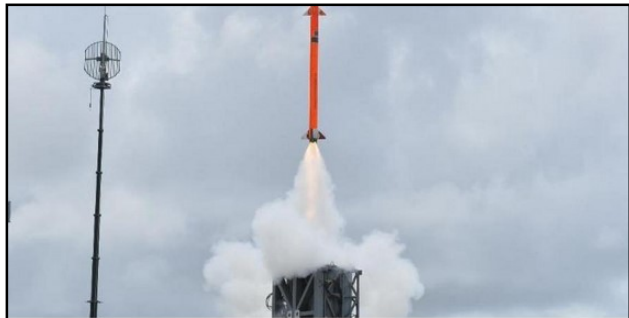
Since Prithvi-II and Agni-IV are two proven missiles, the focus in on the successful trial of the MRSAM, jointly developed by Defence Research and Development Organization (DRDO) in collaboration with Israel Aerospace Industries (IAI).

Powered by a dual-pulse solid propulsion system developed by DRDO, MRSAM has been designed to strike down enemy aircraft, unmanned aerial vehicles, missiles and rockets. Along with the advanced rotating phased array radar, it is equipped with an advanced active radar radio frequency seeker that helps detect moving targets in all weather conditions.

The 4.5-metre long nuclear capable missile weighs around 2.7 tonnes and can carry a payload of 60 kg. The missile launching platform includes a Multi-Functional Surveillance and Threat Alert Radar (MFSTAR) for detection, tracking and guidance of the missile, which can destroy targets 70 km away. The DRDO is planning to extend the range of the missile upto 150 km with indigenous components.

“So far three trials of the missile have been conducted. The missile has maximum speed of Mach 2 and it possesses high degrees of manoeuvrability at target interception range. A team of defence scientists from Israel is camping here for the scheduled test firing,” the source added.

This will be third night trial of Prithvi-II this year. The missile having a strike range of 350 km has already been inducted in the armed forces. Similarly, the 20-metre long two-stage nuclear



Medium-Range Surface-to-Air Missile being launched.
(File photo)

capable Agni-IV missile with a range of over 4,000 km can strike targets anywhere in South East Asia.

<https://www.newindianexpress.com/nation/2020/dec/16/india-plans-test-firing-of-three-more-strategic-missiles-this-month-2236730.html>

ThePrint

Wed, 16 Dec 2020

India working on next 'Astra' missile with 160 km range as Mk1 is integrated in IAF & Navy

The DRDO expects to complete the extension of range by May 2022.

Astra is an indigenous beyond-visual-range air-to-air missile

By Snehash Alex Philip

New Delhi: India is working on an extended range of the indigenous beyond-visual-range (BVR) air-to-air missile 'Astra' (Sanskrit/Hindi for a launched weapon), which will enable it to strike enemy targets 160 km away, without getting out of its own airspace, ThePrint has learnt.

The development comes even as work is on to integrate the current 110 km version of the Astra Mk 1 on board the Indian Air Force's MiG-29 and Light Combat Aircraft 'Tejas' Mk 1, and the Indian Navy's MiG-29K aircraft. The Astra Mark 1 is already integrated with the IAF's Su-30 MKI fighters, and the production process — by state-owned Bharat Dynamics Limited — has begun.

Once the overall integration plans are completed, the Astra will be the standard long-range air-to-air missile across India's entire fighter fleet, except the French-origin Rafale and Mirage.

In July this year, the defence ministry formally sanctioned the purchase of 248 Astra missiles, including 48 for the Navy, after a successful September 2019 trial in which it hit a target 90 km away.

Sources said Astra has export potential too, and will be considered for sale to friendly countries.

Mk 2 by May 2022

As of now, with a range of over 110 km and a maximum speed of Mach 4.5 (over 5,500 kmph), the Astra Mk 1 is seen as a game-changer, which can bring back India's air-to-air combat superiority over Pakistan.

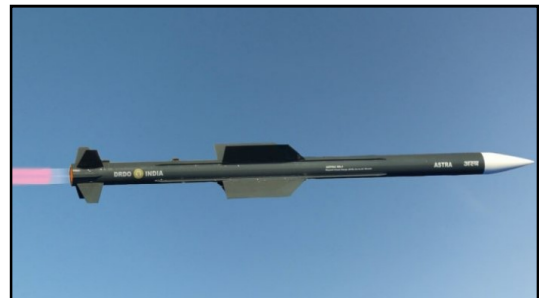
While India now also has European developer MBDA's Meteor missiles with the Rafale's induction, they are much more costly (Rs 25 crore each) compared to the Astra (Rs 7-8 crore).

For the second version of the Astra missile, called Mark 2, the Defence Research and Development Organisation (DRDO) is working on dual-pulse rocket motor to extend the range up to 160 km by May 2022, sources in the defence and security establishment told ThePrint.

Work is also going on to replace the Russian radio frequency (RF) seekers' on the missile with indigenous ones, a source said.

"Three air launch and captive flight tests have been completed with indigenous RF seekers. The indigenous seeker will be proven by June 2021. Subsequently, Astra Mk-1 & Mk-2 missile will be using the indigenous seeker in production," the source said.

At present, all subsystems, except the RF seeker and the inertial measurement unit (IMU), are indigenous. The seekers are being indigenised by Bharat Electronics Limited, Bengaluru, and will be inducted by June 2021, sources said, adding that efforts are on for the development of the indigenous IMUs too.



The 'Astra' beyond-visual-range air-to-air missile developed by DRDO | Photo: Commons

Project Astra was initiated in 2001

In 2001, the DRDO had initiated discussions with various stakeholders on the design and development of an indigenous air-to-air missile system, which could take on adversary targets beyond the visual range, thus providing a strategic advantage.

Subsequently, Hyderabad's Defence Research and Development Laboratory (DRDL) was identified as the nodal lab, and a task force was formed to undertake preliminary studies.

Sources said although financial sanctions were not available then, activities were initiated with the internal funds of the DRDO.

"The major challenges were the development of RF Seeker, miniaturised and robust missile hardware, and integration on IAF frontline aircraft without the support of the foreign Original Equipment Manufacturer (OEM)," a source said, adding that DRDO's management wanted DRDL to demonstrate the basic capability even before the project sanction.

Simultaneously, the IAF was requested to generate the programme standard and quality requirement (PSQR).

Testing Phase

The initial effort was to prove the Astra's performance in ballistic launch from the ground launcher. A source explained that this was done to demonstrate its safe release from the ground, before testing it on manned aircraft.

In May 2003, three ballistic missile tests were conducted from the Integrated Test Range, Balasore, using the ground launcher.

The propulsion system was proven and the safe release from ground was demonstrated. Subsequently, the PSQR was released, and the project named Astra was sanctioned on 1 April 2004 for a duration of 101 months.

During this period, Astra was to be developed and integrated on the Su-30 MKI with the feasibility for integration on MiG-29, Mirage 2000 and LCA platforms as well.

"One of the specifications in the PSQR was the requirement of a smokeless propellant system. However, the propulsion system used in the 2003 ground flight trials was with a certain level of smoke. This called for a re-development of a new smokeless propellant for Astra," a source said.

The team then started working on the system, even as in parallel, a team was formed within DRDO laboratories for the development of the avionics system, meeting Astra's space constraints.

In 2007, the control and guidance flight trials were initiated. In the first trial, it was found that the missile was experiencing wing-induced oscillations, which had serious implications for the performance.

"One of the most critical technologies required for Astra was the RF seeker technology which was not available in the country then. Therefore, a decision was taken to develop the seeker to meet Astra specifications through AGAT, Russia, an established seeker manufacturer," the last source cited above said.

In 2011, the final missile configuration was frozen and hardware developed to conduct the guided trials, which were conducted successfully in December 2012.

Meanwhile, SDI Bangalore was identified to modify the software of Su-30 MKI aircraft — mission computer, radar computer and display computer — to integrate the Astra missile.

A launcher was designed and developed to integrate Astra missiles on aircraft. The design of the launcher was such that it should let the missile be integrated on any aircraft with minimum changes, sources said.

In May 2014, Astra was air-launched for the first time with all systems performing meeting mission requirements.

"In order to prove in various scenarios and envelope of the aircraft, 35 air launches and 150 captive flight sorties were conducted to meet the requirements of the IAF. With the successful launches in September 2019, the Astra weapon was finally accepted by the users," another source said.

Export Potential of Astra

Sources said the present Astra missile has export potential and can be offered to friendly countries.

“No production version is required to be developed separately. The present version is a platform-independent design, but a few modifications may be required as per platform interfacing and data exchange between missile and aircraft,” a source said when asked if any changes need to be made for export.

But the source added that integration of the Astra missile on an aircraft needs some changes in the fighter too, and hence, the LCA ‘Tejas’ will be a good platform to export, so that all technical expertise will be within the country.

<https://theprint.in/defence/india-working-on-next-astra-missile-with-160-km-range-as-mk1-is-integrated-in-iaf-navy/566699/>



Wed, 16 Dec 2020

Indian Navy to acquire 38 extended range BrahMos missiles for new warships soon

The missiles are to be fitted on the under-construction Vishakhapatnam class warships of the Indian Navy which are going to join active service in the near future

New Delhi: In a bid to enhance the firepower of its warships, the Indian Navy has moved a proposal to acquire 38 extended range BrahMos supersonic cruise missiles which would be able to hit targets at around 450 kilometres.

The missiles are to be fitted on the under-construction Vishakhapatnam class warships of the Indian Navy which are going to join active service in the near future.

“A Rs 1,800 crore proposal for acquiring 38 extended range BrahMos supersonic cruise missile is with the Defence Ministry and is expected to be approved soon,” government sources told ANI.

The BrahMos would be the main strike weapon of the warships and is already installed on several warships of the maritime force.

The Indian Navy had also carried out the test firing of the Brahmos missile from its warship INS Chennai to showcase its capability to strike targets at ranges more than 400 km in high seas.

India is also working on finding export markets for the supersonic cruise missile which has been indigenised to a large extent by the DRDO under its project PJ 10.

After the launch of the joint venture between India and Russia in the late 90s, the Brahmos supersonic cruise missile has become a potent weapon for all three armed forces which are using them for different roles.

<https://www.hindustantimes.com/india-news/indian-navy-to-acquire-38-extended-range-brahmos-missiles-for-new-warships-soon/story-MUTG8uzcRywCWZwmsleYAM.html>



The BrahMos would be the main strike weapon of the warships and is already installed on several warships of the maritime force.(PTI)

Extended range BrahMos missiles to be fitted with new warships of Indian Navy

The BrahMos supersonic cruise missiles would be fitted on the under-construction Vishakhapatnam class warships of the Indian Navy which are going to join active service in the near future
Edited By Arun Kumar Chaubey

Highlights

- 1. The Indian Navy had also carried out the test firing of the Brahmos missile from its warship INS Chennai**
- 2. India is also working on finding export markets for the supersonic cruise missile**
- 3. After the launch of the joint venture between India and Russia, the Brahmos supersonic cruise missile has become a potent weapon for all three armed forces**

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Image courtesy: ANI

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Notably, the BrahMos would be the main strike weapon of the warships and is already installed on several warships of the maritime force.

<https://zeenews.india.com/india/extended-range-brahmos-missiles-to-be-fitted-with-new-warships-of-indian-navy-2331055.html>



Webinar on 'DRDO Technologies for Northeast India' organized in Tezpur

Prime Minister Narendra Modi has launched the concept of Aatma Nirbhar Bharat which will play a vital and important role in boosting the Indian economy as well as the global economy

Tezpur: Prime Minister Narendra Modi has launched the concept of Aatma Nirbhar Bharat which will play a vital and important role in boosting the Indian economy as well as the global economy. The proposed theme for India International Science Festival 2020 is 'Science for self-reliant India and global welfare'. Under this theme, Defence Research Laboratory (DRL, DRDO), Tezpur, conducted a webinar on 'DRDO Technologies for North-East India' under the India International Science Festival 2020 (IIFS) recently.

The event was organized as a virtual conference with the coordination of the Directorate of Information Technology and Cyber security (DIT & CS). DrSanjai K Dwivedi, Director, DRL inaugurated the curtain raiser event for the benefit of students, researchers and faculties and delivered introductory briefings to all the participants.



The event was organized by Dr. PK Raul, Scientist (coordinator) and Dr. B Das (Deputy Coordinator) in association with other scientists, technical officers, staffs and research scholars of DRL (DRDO). During the events, several lectures on DRL developed technologies and products were delivered lucidly for easy comprehensiveness of versatile age/qualification of participants. Around 900 participants registered and were benefited by these lectures covering wide range of topics like nanotechnology for removal of water contaminants, wastewater management, bio-toilet, prevention of mosquitoes borne disease, wild edible fruits, animal handling and mushroom technology for socio economic uplift of remote and border areas of high altitude region of Northeast India.

<https://www.sentinelassam.com/north-east-india-news/assam-news/webinar-on-drdo-technologies-for-northeast-india-organized-in-tezpur-516330?infinitemscroll=1>

DRDO's Sardar Vallabh Bhai Patel COVID-19 hospital selects DPMI students

The hospital is open to anyone who has contracted COVID-1

The Defence Research and Development Organisation associates with Delhi Paramedical & Management Institute (DPMI) for the Lab Technicians, OT Technicians and Nursing staff for DRDO built Sardar Vallabh Bhai Patel COVID-19 Hospital, Delhi Cantt. It is a 1,000 bed makeshift hospital spread over 25,000 sq m of Indian Air Force land in Delhi. The hospital is open to anyone who has contracted COVID-19.

Aruna Singh, Principal, Delhi Paramedical and Management Institute said it is a proud moment for DPMI that DRDO has given an opportunity to our students to serve humanity, during these unprecedented times. DPMI students are highly motivated and working relentlessly towards defeating COVID-19.

Delhi Paramedical & Management Institute has successfully completed 24 years in the field of imparting skill based technical education in the field of paramedical Sciences. The core intent of DPMI is to promote Paramedical Sciences, Health Education, Hospitality Management etc. sectors in our country. It aims at providing quality education with advanced programs rewarding the students to think in a creative manner which eventually creates a pool of well-trained professionals.



<http://bweduction.businessworld.in/article/DRDO-s-Sardar-Vallabh-Bhai-Patel-COVID-19-Hospital-Selects-DPMI-Students/15-12-2020-353869/>

LegendNews

DRDO के कोविड-19 अस्पताल में DPMI के छात्रों का चयन

नई दिल्ली: DRDO की ओर से दिल्ली कैंट में बनाए गए सरदार वल्लभ भाई पटेल कोविड-19 हॉस्पिटल के लिए लैब टेक्निशियन, ऑपरेशन थिएटर टेक्नीशियन और नर्सिंग स्टाफ मुहैया कराने के लिए डिफेंस रिसर्च एंड डेवलपमेंट ऑर्गेनाइजेशन (डीआरडीओ) ने दिल्ली पैरामेडिकल एंड मैनेजमेंट इंस्टीट्यूट (डीपीएमआई) के साथ समझौता किया।

यह अस्पताल दिल्ली में भारतीय वायु सेना की भूमि के 25 हजार वर्ग मीटर में फैले एक हजार बिस्तरों वाला अस्पताल है। कोविड-19 से ग्रसित होने वाले किसी भी आमजन के लिए इस अस्पताल में ऑक्सीजन, पीपीई किट, वेंटिलेटर, कोरोना टेस्ट सुविधा और दूसरे लैब के साथ सभी मेडिकल सुविधाएं मुहैया कराई गई हैं।

इस मौके पर दिल्ली पैरामेडिकल एंड मैनेजमेंट इंस्टीट्यूट की प्रिंसिपल अरुणा सिंह ने कहा कि यह डीपीएमआई के लिए यह बड़े गर्व की बात है कि डीआरडीओ ने हमारे छात्र श्वेता कुमारी, सुफियान अहमद, किशन प्रजापति, अरविंद कुमार को इस अभूतपूर्व समय के दौरान मानवता की

सेवा करने का अवसर दिया है। उन्होंने कहा कि डीपीएमआई के छात्र अत्यधिक प्रेरित हैं और मुझे पूरा भरोसा है कि कोविड-19 को हराने की दिशा में छात्र अथक प्रयास करेंगे।

दिल्ली पैरामेडिकल एंड मैनेजमेंट इंस्टीट्यूट ने पैरामेडिकल साइंसेज के क्षेत्र में कौशल आधारित तकनीकी शिक्षा प्रदान करने में सफलतापूर्वक 24 वर्ष पूरे कर लिए हैं। डीपीएमआई का मुख्य उद्देश्य हमारे देश में पैरामेडिकल साइंसेज, हेल्थ एजुकेशन, हॉस्पिटैलिटी मैनेजमेंट आदि क्षेत्रों को बढ़ावा देना है। इसका उद्देश्य छात्रों को रचनात्मक तरीके से सोचने के लिए पुरस्कृत कार्यक्रमों के साथ गुणवत्तापूर्ण शिक्षा प्रदान करना है जो अंततः अच्छी तरह से प्रशिक्षित पेशेवरों का एक समूह तैयार करना है।

<http://legendnews.in/selection-of-dpmi-students-in-drdo-maintained-covid-19-hospital/>

Business Standard

Wed, 16 Dec 2020

Disinvestment will now gain a lot of momentum: Finance Minister Sitharaman

Finance Minister Nirmala Sitharaman said the pace of disinvestment will now gain a lot of momentum, and those which have already found cabinet approval will be taken up with all earnestness

Finance Minister Nirmala Sitharaman on Tuesday said the pace of disinvestment will now gain a lot of momentum, and those which have already found cabinet approval will be taken up with all earnestness. Speaking on Day 1 of ASSOCHAM Foundation Week, via video conferencing, Sitharaman said.

"Disinvestment will be happening, corporatisation of not just the defence, DRDO related labs but also banks - where I want them to run a lot more professional, they should also be able to raise money from the market," she said.

Sitharaman said that the Union Budget for 2021-22 would emphasise on sustaining high public expenditure on infrastructure to revive the economy.

"We shall definitely sustain the momentum on public spending in infrastructure. The budget-related inputs which you gave me... I am quite happy and eager to take on board... Something that certainly will feature is we shall definitely sustain the momentum on public spending on infrastructure because that is the one way we are sure that multipliers will work and the economic revival will be sustainable," she said.

The Finance Minister said that this has been an unusual year and borrowing has been kept at levels so that the government can quickly put the money back in projects. "This emphasis that the public infrastructure spending should have to be kept up has been fully recognised," she added.

She further asserted that the National Investment and Infrastructure Fund (NIIF) is doing its best to attract foreign money.

(Only the headline and picture of this report may have been reworked by the Business Standard staff; the rest of the content is auto-generated from a syndicated feed.)

https://www.business-standard.com/article/finance/disinvestment-will-now-gain-a-lot-of-momentum-finance-minister-sitharaman-120121600085_1.html



Nirmala Sitharaman

 **The Indian EXPRESS**

Wed, 16 Dec 2020

Defending the last bastion

As India's armed forces prepare for an overhaul to deal with 21st-century challenges, they must prepare personnel to shoulder responsibilities at all levels of the new joint/unified commands

By Arun Prakash

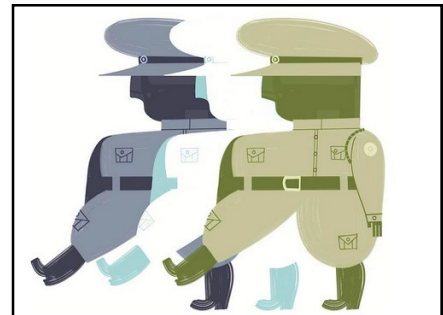
The year 2020 will, no doubt, earn the title of annus horribilis on account of the Chinese-origin COVID-19. But for India, it brought a “triple whammy” in the form of the near-simultaneous onset of an economic crisis, a health pandemic and a military confrontation. As the three crises unfold, their management by India’s decision-makers is being closely watched by a concerned populace. Overlaid on this anxiety is a nagging worry that activities like law enforcement, the dispensation of justice and unbiased media-coverage — whose proper discharge undergirds a healthy democracy — are faltering on account of political pressures.

In this bleak scenario, the one institution that has justified public faith as an apolitical, incorruptible and steadfast upholder of the Constitution is the Indian military. Therefore, when a recent document claiming to provide insights into the “Indian military’s organisational culture, doctrine and strategic world-view” raises some controversial issues, we must pause for reflection.

The Wellington Experience; A Study of Attitudes and Values Within the Indian Army is a monograph compiled by retired US Army Colonel David Smith. Extrapolating the feedback and personal opinions of US military officers who attended India’s Defence Services Staff College (DSSC) course in Wellington, between 1979 and 2017, Smith offers “analytical insights” into a host of issues, including the college curriculum, calibre of faculty and students, Indo-US relations, nuclear deterrence, etc. for the benefit of US policymakers.

While the Indian armed forces are well aware of their strengths and weaknesses, some of the author’s conclusions deserve note by our leadership, civilian as well as military, for two reasons. Given the current and future security challenges that we face, and the prospect of growing interaction with foreign militaries, not only must we take cognisance of their perceptions (even if biased), we must also, without being excessively touchy, initiate corrective actions wherever required. I will focus on just three of Smith’s observations which, if valid, call for introspection at many levels.

US students, while reporting that the DSSC course syllabus was designed to prepare graduates “to fight World War II” with rehashed British-era doctrines, noted a culture that discourages unorthodox thinking and stresses rote-memorisation and regurgitation. An inflexible approach to doctrine demands answers to military problems compliant with the “Wellington solution” even if obtained from attendees of previous courses and unethically replicated. Smith’s caustic comment that “Wellington solutions” will not be available in actual combat situations bears note.



It is disheartening to note Smith’s comment about the ‘utter failure of DSSC to impart a true sense of jointness in its graduates’. (Illustration by C R Sasikumar)

The Indian army's use of the DSSC course for evaluating a student's promotion-potential rather than for imparting high-quality professional military education attracts Smith's criticism. The desperate quest for high grades has, according to him, led to a widespread practice of cheating in examinations and exercises, which US officers inform him "must be considered a part of the DSSC's institutional culture". This is a devastating comment for this prestigious establishment as well as for the Indian military, whose ethos considers cheating or plagiarising as "conduct unbecoming an officer" and a punishable offence.

Finally, it is disheartening to note Smith's comment about the "utter failure of DSSC to impart a true sense of jointness in its graduates". This is ironic because the very *raison d'être* of the DSSC is to inculcate inter-service synergy and to produce "joint staff officers" who can hold appointments in any of the three services. US officers have attributed the pervasive "army-centricity" of the college and "a single-service approach to warfare" to a belief that "the Indian army is not an expeditionary force" and "inter-service liaison at a personal level" is an adequate substitute for jointness.

Its merits apart, The Wellington Experience comes at a time when the Indian armed forces stand poised at a crucial juncture awaiting major restructuring, which would enable them to face 21st-century threats. A government directive of December 2019, which created a Department of Military Affairs (DMA) headed by a newly constituted Chief of Defence Staff (CDS), enjoins him with "facilitation of restructuring of military commands... by bringing about jointness in operations, including through establishment of joint/theatre commands". Even though the government has not stipulated any deadlines, the CDS and DMA seem to be proceeding post-haste with proposals for the creation of theatre commands.

While the need for due deliberation and in-depth consultation amongst the three services before embarking on such a momentous re-organisation needs no emphasis, there is another critical factor to be borne in mind — the requirement to prepare personnel to shoulder responsibilities at all levels of the new joint/unified commands. This calls for a major overhaul of our system of professional military education as well as doctrines. The first step in this process should have been the transformation of the DSSC into a genuine Joint Staff College so that its graduates would emerge qualified to fill billets in a unified/joint HQ. At the top-end, another vital step should have been to revive the long-dormant proposal for a National Defence University.

Today, India alone, among major powers, suffers from the lack of an institutional process which generates defence reviews, policy white papers and national security strategies. This lacuna has inhibited our capacity to predict threats, evolve appropriate responses and fund vital military capabilities. It is, therefore, unclear whether accurate strategic assessments — both of adversary capabilities/intentions as well as of our own strengths and weaknesses — are available to the civilian leadership for correct decision-making.

It is in this context that a final word needs to be said about the DMA's attempt to trim the pension budget, via measures which appear self-defeating and are likely to sap morale. The government's logic that the MoD/DMA must find ways and means to fund military modernisation is seriously flawed on two counts. First, it is universally acknowledged that the "first charge" on a nation's exchequer is national defence, and if you want security, you must find the money to fund it. Second, pension hikes (including "one rank one pension") are, typically, devices used by political parties to garner votes and must not become an instrumentality for arm-twisting the military subsequently.

(The writer is a retired Chief of Naval Staff)

<https://indianexpress.com/article/opinion/columns/india-armed-forces-defence-budget-army-navy-air-force-modernization-7106428/>

China constructing heliport in occupied Aksai Chin, reveals satellite imagery

With no end to the India-China faceoff in sight, latest satellite images covering occupied areas of Aksai Chin indicate that China's People's Liberation Army has been constructing a heliport within the contested area

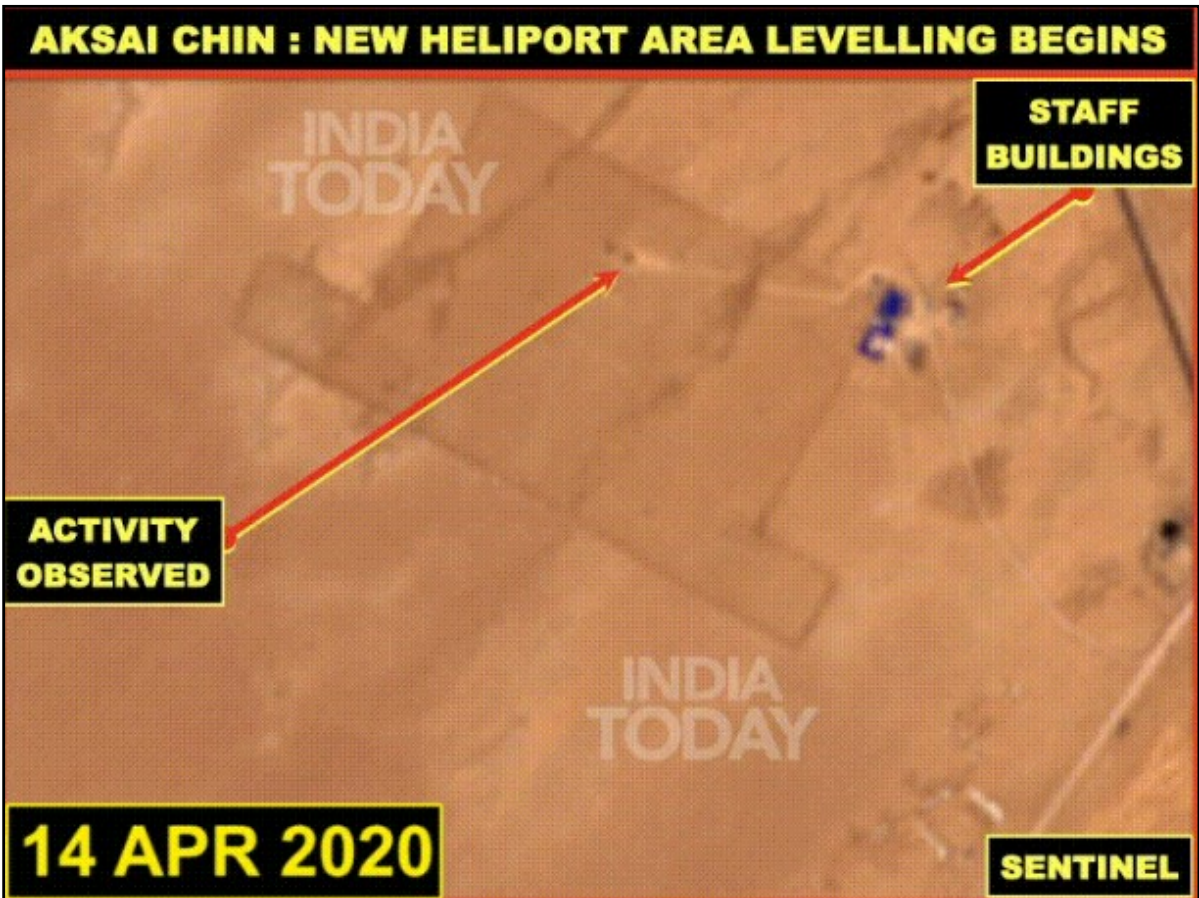
By Col Vinayak Bhat (Retd)

New Delhi: The Chinese People's Liberation Army (PLA) has been continuously upgrading its infrastructure in occupied Eastern Ladakh since the last nine months. Satellite images over Tibet and East Turkestan (Xinjiang), especially along the Indian borders, indicate that China has been rushing to upscale its military facilities in Eastern Ladakh since the last three months amid the standoff between Indian and Chinese troops in the region.



India Today had earlier detailed surface-to-air missiles (SAM) locations from Ladakh to Arunachal Pradesh. In fact, China had planned an ingress into Eastern Ladakh as early as August 2019 as indicated by satellite images.

India Today OSINT team now investigates the PLA's latest construction of a heliport inside occupied Eastern Ladakh through high-resolution satellite images received from **Chris Biggers**, a satellite imagery analyst based in Washington.





The heliport construction is opposite India's Daulat Beg Oldie (DBO) airbase, and at 16,700 feet, is extremely close to the Line of Actual Control (LAC) and the 255-km Darbuk-Shyok-DBO road, and one of the reasons that sparked the standoff in early May this year. The road runs parallel to the LAC, connecting Leh to DBO, and is strategically important for India.

The airbase and the new road are extremely close to the LAC, enhancing India's logistics capabilities, but irking China.

The new heliport

Latest satellite images covering occupied areas of Aksai Chin indicate that PLA has been constructing a heliport within the contested area. The heliport area was earmarked in the month of August 2019 and preparations began in October 2019.

Satellite images from Sentinel suggest that although preparations had begun and area marked for the heliport, construction was stalled till the beginning of April 2020, when the first activity was observed on satellite imagery.

The heliport's construction incidentally coincides with China's military build-up that started in mid-April. The Chinese actions were not just a spontaneous reaction to India's road construction, but a well-planned move as the unusual activities by Chinese were reported in mid-April at least three weeks before the first clashes took place during face-offs.

Work progressed steadily after May 2020 when hectic activity of bulldozers levelling the area and clearing the surroundings was observed. Construction work progressed at a fast pace since the last three months even as military and diplomatic dialogue continued to end the deadlock.

Heliport runway, taxiway and apron

Satellite images reveal that the heliport is likely to have a runway of a length of 1,000 metres. However, only 700 metres of the runway is being graded, probably due to the winters

A taxiway-cum-apron in semi-circular inverted D shape is seen being constructed with a 600-metre apron parallel to the runway. Eight large areas are being prepared for construction of possibly 24 hangars around the taxiway.



The eastern end has a large area that is being graded, probably for larger transporter helicopters to park. It could be developed as a technical area for the repair of aircraft.

Underground command-and-control centre

China is also making efforts to harden the heliport in occupied territory. Just behind the main building that is likely to have the air traffic controller, PLA has started preparing underground constructions for a proper command-and-control centre.

Satellite images indicate that the underground construction was started in mid-August this year.

High-resolution satellite imagery provided by Planet Labs indicates a large underground construction, which will be a deeply buried complex, possibly with all modern facilities.

The underground construction of the command-and-control module indicates that China is fully preparing itself for a high-end war in occupied Eastern Ladakh.

The stalemate

India and China have been involved in the standoff for eight months now with both sides deploying troops, artillery guns, tanks and armoured vehicles in close proximity.

Tensions started with skirmishes in Pangong Lake in May when troops came to blows on more than one occasion, leaving many injured on both sides. On June 15, in an ugly clash in another area called Galwan Valley, 20 Indian soldiers died, while the Chinese never made their casualty public.

There have been eight rounds of military talks at the Corps Commander level to find a solution to the standoff that started early May but the deadlock continues.

Despite the previous talks on November 6 discussing a disengagement plan, there has been no forward movement, and no further dialogue has taken place to implement measures discussed to ease out tensions. *(Inputs by Abhishek Bhalla)*

<https://www.indiatoday.in/news-analysis/story/china-constructing-heliport-in-occupied-aksai-chin-reveals-satellite-imagery-1749503-2020-12-14>

Explained: What is the S-400 deal? Why is India cautious as US sanctions Turkey?

While India has got a waiver from the outgoing Trump administration on the S-400 air defence system, Delhi hopes that the incoming Biden administration would not work towards reversing the decision

By Shubhjit Roy

The United States has imposed sanctions on Turkey on Monday over Ankara's acquisition of Russian S-400 air defence systems. Ankara acquired the Russian S-400 ground-to-air defenses in mid-2019 and says they pose no threat to NATO allies. Washington has long been threatening sanctions on Turkey and had removed the country from an F-35 jet program last year.

With India set to get the consignment of the S-400 air defence system early next year, New Delhi is watching Washington's moves closely. While it has got a waiver from the outgoing Trump administration, Delhi hopes that the incoming Biden administration would not work towards reversing the decision.

What is the S-400 air defence missile system? Why does India need it?

The S-400 Triumf, (NATO calls it SA-21 Growler), is a mobile, surface-to-air missile system (SAM) designed by Russia. It is the most dangerous operationally deployed modern long-range SAM (MLR SAM) in the world, considered much ahead of the US-developed Terminal High Altitude Area Defense system (THAAD).

The system can engage all types of aerial targets including aircraft, unmanned aerial vehicles (UAV) and ballistic and cruise missiles within the range of 400km, at an altitude of up to 30km.

The system can track 100 airborne targets and engage six of them simultaneously.

It represents the fourth generation of long-range Russian SAMs, and the successor to the S-200 and S-300. The S-400's mission set and capabilities are roughly comparable to the famed US Patriot system.

The S-400 Triumf air defence system integrates a multifunction radar, autonomous detection and targeting systems, anti-aircraft missile systems, launchers, and command and control centre. It is capable of firing three types of missiles to create a layered defence.

The S-400 is two-times more effective than previous Russian air defence systems and can be deployed within five minutes. It can also be integrated into the existing and future air defence units of the Air Force, Army, and the Navy.

The first S-400 systems became operational in 2007 and is responsible for defending Moscow. It has been deployed in Syria in 2015, to guard Russian and Syrian naval and air assets. Russia has also stationed S-400 units in Crimea to strengthen Russia's position on the recently annexed peninsula.

From India's point of view, China is also buying the system. In 2015, Beijing signed an agreement with Russia to purchase six battalions of the system. Its delivery began in January 2018.

China's acquisition of the S-400 system has been viewed as a "game changer" in the region. However, its effectiveness against India is limited. According to experts, even if stationed right on



The Russian-built S-400 Triumf — identified by NATO as the SA-21 Growler — is the world's most dangerous operationally deployed modern long-range surface-to-air missile system. (Source: Wikimedia Commons)

the India-China border and moved into the Himalaya mountains, Delhi would be at the limit of its range.

India's acquisition is crucial to counter attacks in a two-front war, including even high-end F-35 US fighter aircraft.

In October 2015, Defence Acquisition Council considered buying 12 units of S-400 for its defence needs. But, on evaluation, in December 2015, five units were found adequate. The deal is worth about USD 5 billion.

The deal is near fruition, and negotiations are at an "advanced stage", and now it is expected to be signed before a summit meeting between Prime Minister Narendra Modi and Russian President Vladimir Putin.

Turkey and Saudi Arabia are negotiating a deal with Russia, while Iraq and Qatar have expressed interest.

What is CAATSA, and how did the S-400 deal fall foul of this Act?

Countering America's Adversaries through Sanctions Act (CAATSA) was passed unanimously by the US Congress and signed reluctantly by US President Donald Trump. Enacted on August 2, 2017, its core objective is to counter Iran, Russia and North Korea through punitive measures.

Title II of the Act primarily deals with sanctions on Russian interests such as its oil and gas industry, defence and security sector, and financial institutions, in the backdrop of its military intervention in Ukraine and its alleged meddling in the 2016 US Presidential elections.

Section 231 of the Act empowers the US President to impose at least five of the 12 listed sanctions — enumerated in Section 235 of the Act — on persons engaged in a "significant transaction" with Russian defence and intelligence sectors.

As part of Section 231 of the Act, the US State Department has notified 39 Russian entities, dealings with which could make third parties liable to sanctions. These include almost all of the major Russian companies/entities such as Rosoboronexport, Almaz-Antey, Sukhoi Aviation, Russian Aircraft Corporation MiG, and United Shipbuilding Corporation which are active in manufacturing defence items and/or their exports.

However, mere naming of 39 Russian entities by the US authorities or dealings by any country with these entities does not automatically lead to the imposition of sanctions under the CAATSA provisions. The key determinant for imposing sanctions is "significant transaction" between the named Russian entity and an outside agency.

CAATSA, if implemented in its stringent form, would have affected India's defence procurement from Russia.

Russian maker of S-400s — Almaz-Antey Air and Space Defense Corporation JSC — is on the list of 39 Russian entities.

Apart from the S-400 air defence system, Project 1135.6 frigates and Ka226T helicopters will also be affected. Also, it will impact joint ventures, like Indo Russian Aviation Ltd, Multi-Role Transport Aircraft Ltd and Brahmos Aerospace. It will also affect India's purchase of spare parts, components, raw materials and other assistance.

But why does the US have a law like CAATSA to begin with? And what does it mean for India's defence landscape?

Following the US elections and allegations of Russian meddling — some call it collusion — in the US elections, the strain between Washington and Moscow has reached a new level. Angry with Moscow's actions around the world, US lawmakers are hoping to hit Russia where it hurts most, its defence and energy business, through CAATSA.

"As per the Stockholm International Peace Research Institute (SIPRI) Arms Transfer Database, during the period 2010-17, Russia was the top arms supplier to India. The Russian share in India's arms imports during the same period has declined to 68 per cent, from an all-time high of 74 per cent during the 2000s, whereas the combined share of the US and Israel has increased from nine to 19 per cent.

Between 2013 and 2017, Russia's share declined further to 62 per cent, whereas the combined share of US and Israel increased to 26 per cent.¹³ Accounting for about 15 per cent, the United States is the second biggest supplier of arms to India during the five year period ending 2017. Between 2000-2009 and 2010-17, US arms deliveries to India have increased by a whopping 1470 per cent.

Most of India's weapons are of Soviet/Russian origin – nuclear submarine INS Chakra, the Kilo-class conventional submarine, the supersonic Brahmos cruise missile, the MiG 21/27/29 and Su-30 MKI fighters, IL-76/78 transport planes, T-72 and T-90 tanks, Mi-series of helicopters, and Vikramaditya aircraft carrier," an exhaustive paper on "Implications of CAATSA for India's Defence Relations with Russia and America" by Laxman K Behera, a Research Fellow at Institute for Defence Studies and Analyses (IDSA), said in April '2018.

How did the exemption for India come about?

CAATSA impacts Indo-US ties and dents the image of the US as a reliable partner. At a time when the US is projecting India as a key partner in its Indo-Pacific strategy, with the US National Security Strategy 2017 explicitly supporting New Delhi's vital role in this regard.

Admiral Harry Harris, Commander of the US Pacific Command, referred to a classified letter written by Secretary of Defense James Mattis to the concerned members of the Senate Committee on Armed Services, wherein Secretary Mattis has requested for "some relief from CAATSA" for countries like India.

In his argument, Admiral Harris has also favoured relief citing the "strategic opportunity" that India presents to the US and also the opportunity "to trade in arms with India."

After months of six months of hectic lobbying – CAATSA came into force in January this year — on Tuesday, a US Congressional committee has proposed waivers for India from stringent sanctions under Countering America's Adversaries Through Sanctions Act (CAATSA). This is directed against those doing business with Russia's defence industry.

The Senate and House Armed Services Committee in a joint conference report to the National Defense Authorisation Act (NDAA)-2019 provided a modified waiver to section 231 of CAATSA. A conference report refers to the final version of a Bill that is negotiated between the House of Representatives and the Senate via a conference committee.

The NDAA-2019 now moves to the Senate and the House for formal passage before it can be sent to the White House for President Donald Trump to sign into law.

The portion of the bill — National Defense Authorisation Act — that amends CAATSA does not mention any country, but the intended beneficiaries of the amended waiver are India, Vietnam and Indonesia.

What's in it for Washington?

The US sees India as a major market for the US defence industry. In the last one decade, it has grown from near zero to USD 15 billion worth of arms deals.

"Since 2008, the US has bagged more than \$15 billion in arms deals including for the C-17 Globemaster and C-130J transport planes, P-8 (I) maritime reconnaissance aircraft, M777 light-weight howitzer, Harpoon missiles, and Apache and Chinook helicopters.

Between 2013-14 and 2015-16, the US has won 13 contracts worth Rs 28,895 crore (\$4.4 billion). Both in term of the number and value of contracts, the US is way ahead of other major suppliers. In percentage terms, the US share of Indian arms imports total 23 per cent in terms of the number of contracts and 54 per cent by value," Behera wrote, in his paper in IDSA.

This value is all set to increase further with the US likely accepting an Indian request for Sea Guardian drones.

In addition, US defence contractors, including Lockheed Martin and Boeing, are also strong contenders for a number of high-profile arms deals, including the recently floated tender notices for 110 fighter planes for the Indian Air Force, 57 Multi-Role Carrier Borne Fighters for the Indian Navy, and 234 naval utility and multi-role helicopters.

Does the exemption for India also have a wider global significance in which Russia and China are factors?

This exemption means that growing defence and security cooperation that prompted India to sign a logistics pact with the US, the US designating India as a Major Defence Partner, and both countries coming together on Indo-Pacific strategy, the newly formed Quad, are on a stable footing.

It also makes a point on principles that, as a sovereign country, India cannot be dictated about its strategic interests by a third country.

With uncertainties in the global power landscape shifting, with the Trump administration being unpredictable, China being more assertive and Russia finding new partners, this waiver or “carve-out” would mean India has been able to hedge its bets.

It also shows the need for India to be nimble-footed in its diplomacy when it comes to its key major power relationships – and one cannot be sacrificed at the cost of another.

How does these new sanctions on Turkey complicate the issue?

Senior US officials said that Ankara’s purchase of the S-400s and its refusal to reverse its decision, despite repeated pleas from Washington, left the United States with no other choice.

The sanctions target Turkey’s top defence procurement and development body Presidency of Defence Industries (SSB), its chairman Ismail Demir and three other employees.

The measures, which received a bipartisan welcome from the U.S. Congress, were announced under the CAATSA- the first time the act has been used against a fellow member of the NATO alliance.

Turkey condemned the sanctions as a “grave mistake” and urged Washington to revise its “unjust decision”. It said sanctions would inevitably harm mutual relations and threatened unspecified retaliatory steps.

“The United States made clear to Turkey at the highest levels and on numerous occasions that its purchase of the S-400 system would endanger the security of U.S. military technology and personnel and provide substantial funds to Russia’s defense sector,” US Secretary of State Mike Pompeo said.

Pompeo has told Turkey its purchase of the S-400 missile defense system will endanger the US military.

Christopher Ford, US Assistant Secretary of State for International Security and Nonproliferation, said Washington had sought a solution but Ankara rejected all offers.

The sanctions, near the end of Trump’s presidency are likely to weigh on Ankara’s ties with Democrat Joe Biden’s administration when he takes over as president next month.

So, is India off the hook?

India hopes that Washington understands New Delhi’s security imperatives, especially with a hostile China along the border. This is more important since Indian and Chinese soldiers have been in a face-off situation for more than six months now, with no resolution in sight.

In January this year, a senior US official had said that the US administration does not want to make a decision that “degrades the defence capabilities” of India which is its ‘Major Defence Partner’. The official was referring to the potential sanctions under CAATSA which prohibits countries from purchasing significant military equipment from Russia.

How the Biden administration acts will also be reflective of how much it appreciates and understands India’s concerns on China, and whether it is going to support New Delhi against a belligerent Beijing. It could well turn out to be the litmus test.

<https://indianexpress.com/article/explained/explained-what-is-the-s-400-deal-why-is-india-cautious-as-us-sanctions-turkey-7106036/>

India needs more than Quad to secure the Indo-Pacific

By Gaurie Dwivedi

A few days back, Moscow-due to its strategic pact with Beijing- raised questions about New Delhi's alignment with Washington on the issue of Quad. Since its rebirth in 2017, the Quad has been upgraded and now signifies a coalition of 'like-minded' democracies who want to keep international waters free. While India has rebuffed Russia's comments, it needs to work on a holistic policy for the Indo Pacific region. Limiting its vision only to the Quad exposes it to political uncertainties in the US, Japan and Australia.

Indo Pacific – and not Asia- Pacific as it was earlier called- signifies the centrality of the role that India plays- or is expected to play in the region. It needs to work towards two goals- cementing its position in the Indian Ocean Region (IOR) and towards building long term partnerships with the littorals. External affairs Minister S Jaishankar in his book highlighted New Delhi's I-P strategy with IOR at the core and the Pacific Islands in the Far East at the periphery, indicating order of priority. To execute this vision, there are three important policy decisions/directions that are needed.

In the IOR, New Delhi – despite its historical and cultural ties with Maldives, Mauritius, Seychelles – has lost out to the concerted plan by Beijing to buy influence and malign India. China- which did not even have an embassy in Male till 2011- is now Maldives' largest lender with an exposure of \$3.1 billion. While relations with India have been on the rise since Mohd. Ibrahim Solih came to power; New Delhi needs to do more. A recent 'India Out' campaign by opposition points out to the deep inroads made by Beijing in Maldives and exposes New Delhi's limited clout. India – which needs to work on deepening its defence and security relationship with Maldives – should focus on training navies of IOR littorals. For Seychelles, where its proposal to jointly develop Assumption Island has now fallen apart, India needs to show more patience and willingness to revise alternatives and bring in more transparency. In Mauritius, New Delhi can double down on its investments, on the back of its goodwill. In August 2020 as the pandemic tore the tourism-dependent economy, Mauritius declared a state of emergency. New Delhi should assist its small neighbor in its hour of crisis.

IOR littorals are acutely aware of their geostrategic importance and maritime value and will look to maximize their gains between India and China. While China will entice these smaller nations with more funds, Indian government needs to continuously highlight the pitfalls of taking Chinese money. As Former Maldivian President Modh Nasheed , in reference to the enormous debt pile from China recently said, 'even if we sell our grandmother's jewellery, we cannot repay the debt.' Besides, India will have to continue to offer funds- in the form of grants and assistance for development projects. However, New Delhi does not have the economic heft that Beijing has; more so after coronavirus has caused enormous economic damage. India needs to get onto the high growth trajectory to create enough funds to fuel its regional ambitions. India can offer a perfect counter to China's debt trap model by creating long lasting partnerships and boosting the local economy, without any ecological damage.

Of course, there will be hiccups as the return of Rajapaksa – a China champion in Sri Lanka–highlight. While India may not be able to wean Sri Lanka out of Chinese influence, the possibility of a US-India-Sri Lanka exercise could provide an opportunity for Indian policymakers to rebuild ties. The US has a large presence in Diego Garcia – south of Sri Lanka and has sought logistics support from Colombo. New Delhi could use this opportunity.

Secondly, India must move forward decisively on its roadmap for Andaman and Nicobar Islands- presently only geared towards reconnaissance. India's projection of power play into the

Western Pacific to counter China begins from the Andaman and Nicobar Islands which houses the first joint military command. There has to be a shift towards a more active engagement and collaboration with other navies-including the US Navy. India must shed its hesitation that any partnership with world powers to take on China would further increase tensions between Beijing and New Delhi. China does not suffer from any such compunctions. As recently as December 2019, Chinese research vessels violated India's exclusive economic zone by entering in it. Beijing's intentions regarding the Bay of Bengal are clear from its strategic partnerships with Myanmar, Bangladesh and Thailand. For India to have a long term response, it needs to further build on its nuclear-armed submarine capabilities housed in Andaman and Nicobar Islands- which is the flank of Bay of Bengal.

Lastly, India needs to move out of its mindset of its security policy having a continental orientation. This mindset must adapt itself to respond to present challenges. Between the period 2000-2018, China built more frigates, submarines, corvettes and destroyers than India, Japan and South Korea combined. In the last 5 years, the total tonnage of new warships and auxiliary launched by China exceeds the total tonnage of Indian Navy since independence. Even the present order book-which is woefully inadequate- is delayed by 12 years due to lack of sufficient warship building capacity. This asymmetry needs immediate attention and fund allocations.

For India to be in a commanding position in the Indo Pacific region, it needs to do more. In a post-corona economic recovery, there are competing claims for reduced government revenues and there may be legit ground to avoid a bump up in defence spends. But in a post pandemic world order, the theatre of any hostilities has shifted squarely to the seas. Can India afford to be complacent? The answer is crystal clear.

Disclaimer: Views expressed above are the author's own.

<https://timesofindia.indiatimes.com/blogs/beyond-the-obvious/india-needs-more-than-quad-to-secure-the-indo-pacific/>



Wed, 16 Dec 2020

अंतरिक्ष में अब भारत की बढ़ेगी ताकत, सेमी क्रायोजेनिक इंजन टेस्टिंग पर मेकॉन ने शुरू किया काम

मृत्युंजय श्रीवास्तव

अंतरिक्ष के क्षेत्र में भारत लगातार अपनी क्षमता बढ़ा रहा है। पहले जो सेमी क्रायोजेनिक इंजन विदेशों से आता था अब भारत में ही उसका निर्माण भी शुरू हो गया है। रांची स्थित मेकॉन कंपनी ने सेमी क्रायोजेनिक इंजन टेस्टिंग फैसिलिटी तैयार की है। देसी इंजन टेस्टिंग फैसिलिटी से अंतरिक्ष में राकेट द्वारा पेलोड ले जाने की क्षमता में बढ़ोतरी होगी।

इस मुश्किल काम को सच कर दिखाया है रांची स्थित भारत सरकार के उपक्रम मेकॉन के इंजीनियरों ने जिसकी बदौलत अब सेमी क्रायोजेनिक इंजन की टेस्टिंग भारत में ही हो सकेगी।

भारतीय अंतरिक्ष अनुसंधान संगठन(इसरो) ने मेकॉन को क्रायोजेनिक इंजन टेस्टिंग डिज़ाइन तैयार करने की जिम्मेदारी सौंपी थी।

महेन्द्रगिरि स्थित इसरो के सेंटर के लिए डिज़ाइन तैयार किया गया है। अब सेमी क्रायोजेनिक इंजन के टेस्टिंग के लिए दूसरे देशों पर निर्भर नहीं रहना पड़ेगा जिससे पैसे की भी बचत होगी। देसी इंजन का जो डिज़ाइन तैयार किया गया है उससे अंतरिक्ष में जाने वाले रॉकेट के पेलोड ले जाने की क्षमता भी बढ़ जाएगी।

अबतक अंतरिक्ष में जाने वाले रॉकेट सिर्फ चार टन ही उपकरण ले जा सकता था। अब देसी इंजन बनने से सामान ले जाने की क्षमता छह टन हो जायेगी। इस रॉकेट को अगस्त 2021 में लांच करने की तैयारी हो रही है। मेकॉन के सीएमडी अतुल भट्ट ने कहा इसरो ने मेकॉन को सेमी क्रायोजेनिक इंजन टेस्टिंग डिज़ाइन तैयार करने की जिम्मेदारी सौंपी थी। महेन्द्रगिरि स्थित इसरो के सेंटर के लिए डिज़ाइन तैयार किया गया है। अब सेमी क्रायोजेनिक इंजन के टेस्टिंग के लिए दूसरे देशों पर निर्भर नहीं रहना पड़ेगा।

मेकॉन देश की नामी सरकारी डिजाइनिंग उपक्रम है। इसका मुख्यालय झारखण्ड की राजधानी रांची में ही है। मेकॉन ने ही चंद्रयान 2 की लॉन्चिंग पैड का डिज़ाइन तैयार किया था। कुछ साल पहले तक घाटे में रहने वाली मेकॉन कंपनी अब मुनाफा देने वाली केंद्र सरकार की उपक्रम बन गयी है। कोरोना काल में मेकॉन को 1600 करोड़ का वर्कआर्डर मिला है।

मेकॉन के सीएमडी अतुल भट्ट ने बताया कि केंद्र सरकार ने 2030 तक स्टील के क्षेत्र में 300 मीट्रिक टन उत्पादन का जो लक्ष्य निर्धारित किया है उसमें विदेशों से साज़ो सामानों को मंगवाने में 25 बिलियन डॉलर विदेशी मुद्रा खर्च होगी, लेकिन मेकॉन रांची में ही साज़ो सामानों को बनवाने की क्षमता रखती है जिससे 25 बिलियन डॉलर की इकोनॉमी विदेश जाने से बच जायेगी।



मेकॉन में उन सामानों का डिज़ाइन तैयार होगा और केंद्र की रांची स्थित उपक्रम एचईसी में उत्पादन किया जायेगा। इससे कई MSME का भी उद्धार होगा। इससे देश का तो विकास होगा ही झारखंड का भी चौतरफा विकास होगा। मेकॉन को कई रक्षा उत्पाद बनाने का भी आर्डर जल्द ही मिल सकता है।

<https://www.aajtak.in/trending/photo/rockets-cryogenic-engine-will-be-made-in-india-mecon-started-work-on-isros-project-tstk-1177176-2020-12-15-1>



Wed, 16 Dec 2020

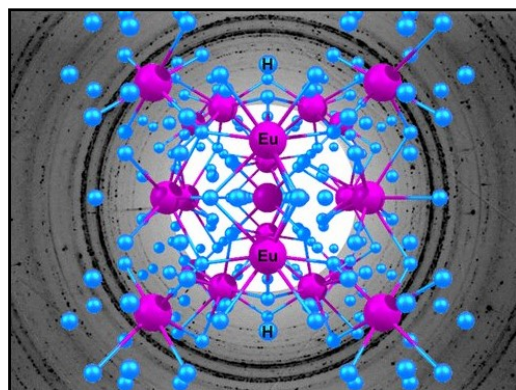
Scientists discover a new complex europium hydride

A team of researchers from Russia, the United States and China led by Skoltech Professor Artem R. Oganov have discovered an unexpected very complex europium hydride, Eu_8H_{46} . The paper detailing the discovery has been published in the *Journal of Physical Chemistry Letters*.

Superhydrides of rare-earth metals are interesting compounds that form under pressure: Some exhibit high-temperature superconductivity that scientists have been chasing for over 100 years, and some possess magnetic properties. Although devoid of superconductivity, europium hydrides are very interesting in view of chemical anomalies that make europium different from other rare earth atoms.

Armed with the efficient and reliable USPEX crystal structure prediction tool developed by Oganov and his students, the team predicted the structure of the remarkably complex compound Eu_8H_{46} , which helped explain the experimental data.

"I am pleasantly surprised that USPEX has easily predicted a highly complex structure of 54 atoms, which is quite a lot. Curiously enough, our colleagues obtained this hydride in experiment earlier but got the structure and composition wrong, assuming it was EuH_5 . Now we know that the compound is much trickier," Oganov comments.



Credit: Journal of Physical Chemistry Letters

"Such unusual compounds can be predicted in theory and proved by experiment, but there is no simple rule for identifying probable chemical compositions of stable compounds without performing arduous calculations," says Dmitrii Semenov, the first author of the paper and a Ph.D. student at Skoltech.

More information: Dmitrii V. Semenov et al. Novel Strongly Correlated Europium Superhydrides, *The Journal of Physical Chemistry Letters* (2020). DOI: [10.1021/acs.jpcclett.0c03331](https://doi.org/10.1021/acs.jpcclett.0c03331)

Journal information: *Journal of Physical Chemistry Letters*
<https://phys.org/news/2020-12-scientists-complex-europium-hydride.html>

'Chaotic' way to create insectlike gaits for robots

Researchers in Japan and Italy are embracing chaos and nonlinear physics to create insectlike gaits for tiny robots—complete with a locomotion controller to provide a brain-machine interface.

Biology and physics are permeated by universal phenomena fundamentally grounded in nonlinear physics, and it inspired the researchers' work.

In the journal *Chaos*, the group describes using the Rössler system, a system of three nonlinear differential equations, as a building block for central pattern generators (CPGs) to control the gait of a robotic insect.

"The universal nature of underlying phenomena allowed us to demonstrate that locomotion can be achieved via elementary combinations of Rössler systems, which represent a cornerstone in the history of chaotic systems," said Ludovico Minati, of Tokyo Institute of Technology and the University of Trento.

Phenomena related to synchronization allow the group to create very simple networks that generate complex rhythmic patterns.

"These networks, CPGs, are the basis of legged locomotion everywhere within nature," he said.

The researchers started with a minimalistic network in which each instance is associated with one leg. Changing the gait or creating a new one can be accomplished by simply making small changes to the coupling and associated delays.

In other words, irregularity can be added by making individual systems or the entire network more chaotic. For nonlinear systems, a change of output is not proportional to a change of input.

This work shows that the Rössler system, beyond its many interesting and intricate properties, "can also be successfully used as a substrate to construct a bioinspired locomotion controller for an insect robot," Minati said.

Their controller is built with an electroencephalogram to enable a brain-computer interface.

"Neuroelectrical activity from a person is recorded and nonlinear concepts of phase synchronization are used to extract a pattern," said Minati. "This pattern is then used as a basis to influence the dynamics of the Rössler systems, which generate the walking pattern for the insect robot." The researchers tap into the fundamental ideas of nonlinear dynamics twice.

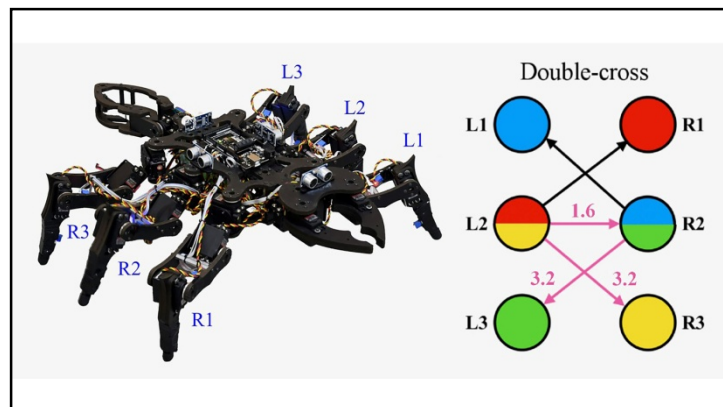
"First, we use them to decode biological activity, then in the opposite direction to generate bioinspired activity," he said.

The key implication of this work is that it "demonstrates the generality of nonlinear dynamic concepts such as the ability of the Rössler system, which is often studied in an abstract scenario," Minati said, "but is used here as a basis to generate biologically plausible patterns."

More information: "Generation of diverse insect-like gait patterns using networks of coupled Rössler systems," *Chaos* (2020). [aip.scitation.org/doi/10.1063/5.0021694](https://doi.org/10.1063/5.0021694)

Journal information: *Chaos*

<https://phys.org/news/2020-12-chaotic-insectlike-gaits-robots.html>



Researchers in Japan and Italy are embracing chaos and nonlinear physics to create insectlike gaits for tiny robots -- complete with a locomotion controller to provide a brain-machine interface. View of their experimental robot and coupling schemes for its gaits. Credit: Ludovico Minati

Team reveals possibilities of new one-atom-thick materials

New 2-D materials have the potential to transform technologies, with applications from solar cells to smartphones and wearable electronics, explains UMBC's Can Ataca, assistant professor of physics. These materials consist of a single layer of atoms bound together in a crystal structure. In fact, they're so thin that a stack of 10 million of them would only be 1 millimeter thick. And sometimes, Ataca says, less is more. Some 2-D materials are more effective and efficient than similar materials that are much thicker.

Despite their advantages, however, 2-D materials are currently difficult and expensive to make. That means the scientists trying to create them need to make careful choices about how they invest their time, energy, and funds in development.

New research by Daniel Wines, Ph.D. candidate in physics, and Ataca gives those scientists the information they need to pursue high-impact research in this field. Their theoretical work provides reliable information about which new materials might have desirable properties for a range of applications and could exist in a stable form in nature. In a recent paper published in *ACS Applied Materials and Interfaces*, they used cutting-edge computer modeling techniques to predict the properties of 2-D materials that haven't yet been made in real life.



Left to right: Fatih Ersan, Can Ataca, Gracie Chaney, Jaron Kropp, and Daniel Wines, all members of Ataca's research group, discuss their work on 2D materials. These materials are one-atom-thick sheets that can have useful properties for applications from computers to solar cells and wearable electronics. Credit: Marlayna Demond for UMBC

"We usually are trying to stay five or so years ahead of experimentalists," says Wines. That way, they can avoid going down expensive dead ends. "That's time, effort, and money that they can focus on other things."

The perfect mix

The new paper focuses on the stability and properties of 2-D materials called group III nitrides. These are mixtures of nitrogen and an element from group III on the periodic table, which includes aluminum, gallium, indium, and boron.

Scientists have already made some of these 2-D materials in small quantities. Instead of looking at mixtures of one of the group III elements with nitrogen, however, Wines and Ataca modeled alloys—mixtures including nitrogen and two different group III elements. For example, they predicted the properties of materials made of mostly aluminum, but with some gallium added, or mostly gallium, but with some indium added.

These "in-between" materials might have intermediate properties that could be useful in certain applications. "By doing this alloying, we can say, I have orange light, but I have materials that can absorb red light and yellow light," Ataca says. "So how can I mix that so that it can absorb the orange light?" Tuning the light absorption capabilities of these materials could improve the efficiency of solar energy systems, for example.

Ataca and Wines also looked at the electric and thermoelectric properties of materials. A material has thermoelectric capability if it can generate electricity when one side is cold and the other is hot. The basic group III nitrides have thermoelectric properties, "but at certain

concentrations, the thermoelectric properties of alloys are better than the basic group III nitrides," Ataca says.

Wines adds, "That's the main motivation of doing the alloying—the tunability of the properties."

They also showed that not all of the alloys would be stable in real life. For example, mixtures of aluminum and boron at any concentrations were not stable. However, five different ratios of gallium-aluminum mixtures were stable.

Once production of the basic group III nitrides becomes more reliable and is scaled up, Wines and Ataca expect scientists to work on engineering the materials for specific applications using their results as a guide.

Back to basics...with supercomputers

Wines and Ataca modeled the materials' properties using supercomputers. Rather than using experimental data as input for their models, "We are using the basics of quantum mechanics to create these properties. So the good part is we don't have any experimental biases," Ataca says. "We're working on stuff that doesn't have any experimental evidence before. So this is a trustable approach."

To get the most accurate results requires huge amounts of computing power and takes a long time. Running their models at the highest accuracy level can take several days.

"It's kind of like telling a story," Wines says. "We go through the most basic level to screen the materials," which only takes about an hour. "And then we go to the highest levels of accuracy, using the most powerful computers, to find the most accurate parameters possible."

"I think the beautiful part of these studies is that we started at the basics and we literally went up to the most accurate level in our field," Ataca adds. "But we can always ask for more."

A new frontier

They have continued to move forward into uncharted scientific territory. In a different paper, published within a week of the first in *ACS Applied Materials and Interfaces*, Theodosia Gougousi, professor of physics; Jaron Kropp, Ph.D. '20, physics; and Ataca demonstrated a way to integrate 2-D materials into real devices.

2-D materials often need to attach to an electronic circuit within a device. An in-between layer is required to make that connection—and the team found one that works. "We have a molecule that can do this, that can make a connection to the material, in order to use it for external circuit applications," Ataca says.

This result is a big deal for the implementation of 2-D materials. "This work combines fundamental experimental research on the processes that occur on the surface of 2-D atomic crystals with detailed computational evaluation of the system," Gougousi says. "It provides guidance to the device community so they can successfully integrate novel materials into traditional device architectures."

Collaboration across disciplines

The theoretical analyses for this work happened in Ataca's lab, and the experiments happened in Gougousi's lab. Kropp worked in both groups.

"The project exemplifies the synergy that is required for science and technology development and advancement," Gougousi says. "It is also a great example of the opportunities that our graduate students have to work on problems of great technological interest, and to develop a broad knowledge basis and a unique set of technical skills."

Kropp, who is first author on the second paper, is thrilled to have had this research experience.

"2-D semiconductors are exciting because they have the potential for applications in non-traditional electronic devices, like wearable or flexible electronics, since they are so thin," he says. "I was fortunate to have two excellent advisors, because this allowed me to combine the experimental and theoretical work seamlessly. I hope that the results of this work can help other researchers to develop new devices based on 2-D materials."

More information: Daniel Wines et al, Engineering the Electronic, Thermoelectric, and Excitonic Properties of Two-Dimensional Group-III Nitrides through Alloying for Optoelectronic Devices ($B_{1-x}Al_xN$, $Al_{1-x}Ga_xN$, and $Ga_{1-x}In_xN$), *ACS Applied Materials & Interfaces* (2020). DOI: [10.1021/acsami.0c11124](https://doi.org/10.1021/acsami.0c11124)

Journal information: *ACS Applied Materials and Interfaces*
<https://phys.org/news/2020-12-team-reveals-possibilities-one-atom-thick-materials.html>



Wed, 16 Dec 2020

New fullerene crystal production method 50 times faster than predecessor

Researchers from Yokohama National University and the University of Electro-Communications in Japan have developed a highly efficient technique for producing a unique fullerene crystal, called fullerene finned-micropillar (FFMP) that is of significant use for next-generation electronics.

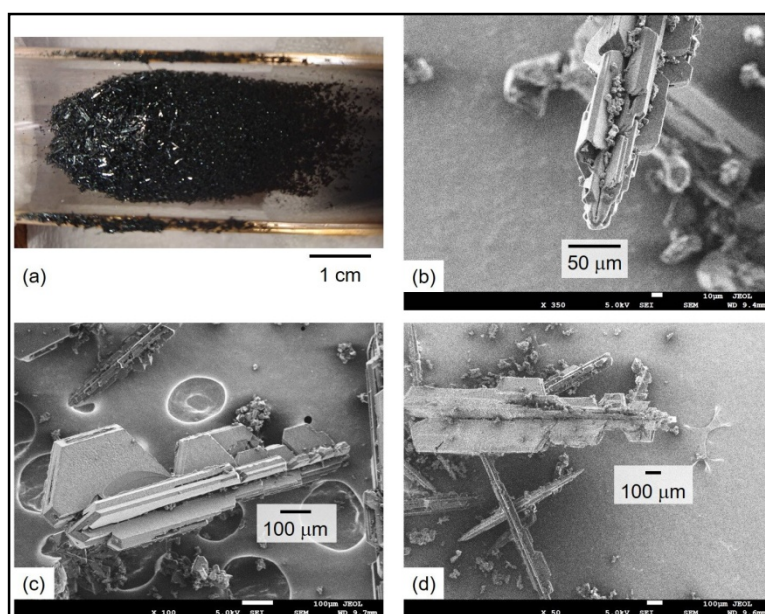
Fullerene is a popular choice for developing technologies not only due to its small size, it is also very durable and contains semiconductor properties, making it a good candidate in devices such as field-effect transistors, solar cells, superconductive materials, and chemical sensors. The material is in use now, however, it is difficult to handle because fullerene is nano-scaled and generally comes in a powdery state. As a solution of this problem, one-dimensional fullerene crystals are produced and used.

"Producing one-dimensional fullerene crystals requires expert skills and takes several days with typical production methods. In this study, we succeeded in developing a very simple fabricating method by using an annealing process," said Dr. Takahide Oya, Associate Professor at Yokohama National University and corresponding author of the study.

In a paper published in *Scientific Reports* in November 2020, the team details how they utilized a small heating apparatus that accepted fullerene and heated it to a temperature of 1,173 Kelvin for about an hour. The fullerene originally deposited in the heating apparatus de-crystallizes due to the heat and subsequently re-crystallizes as the temperature is lowered. This overall process, known as annealing, is over fifty times faster than the older technique for producing fullerene crystals.

"By using our method, mass production of one-dimensional fullerene crystals can be produced in an hour. The produced fullerene crystals that we named 'fullerene finned-micropillar (FFMP)' have a distinctive structure," said Oya.

The team is also confident that the fullerene crystals produced in this new, more efficient production process will have similar qualities to fullerene crystals such as fullerene nanowhiskers produced using the older methods.



(a) Photo of produced FFMP on quartz plate and (b)-(d) scanning electron microscope images of samples. Credit: Yokohama National University

"FFMP is expected to have electrical conductivity and n-type semiconductor functionality," Oya said.

More tests are required to confirm that FFMP does indeed retain the qualities so useful for electronic implementation, but positive results could mean solar cells with much higher efficiency, extremely small circuits integrated in flexible devices for example.

The team has already examined this annealing under different environmental conditions, temperatures, and heating time. Having studied the process, the team now has their sights set on characterizing the FFMP in the context of an electrical component. "As the next step of this study, confirming and obtaining the electrical conductivity and the n-type semiconductor functionality is expected, because the ordinary fullerene has such properties. In addition, developing 'fullerene-finned nano pillar (FFNP)' by modifying the process is also expected. We believe that FFMPs (or FFNPs) will be useful for field-effect transistors, organic photovoltaics, and so on in the near future," said Oya.

This will not be the first time Oya and his team have tackled special, small scale materials for use in electronics.

"We have already had a technique for making carbon nanotube, or CNT—one dimensional nano-carbon material—composite papers and CNT composite threads/textiles as unique CNT composite materials," said Oya. "Therefore, we will develop FFMP composite materials along with their applications. We believe the useful FFMP composites (and the combination with CNT composites) will be used in our daily life in near future."

More information: Taku Onishi et al, Simple annealing process for producing unique one-dimensional fullerene crystal named fullerene finned-micropillar, *Scientific Reports* (2020). [DOI: 10.1038/s41598-020-76252-6](https://doi.org/10.1038/s41598-020-76252-6)

Journal information: [Scientific Reports](https://www.nature.com/journal/scientific-reports)

<https://phys.org/news/2020-12-fullerene-crystal-production-method-faster.html>



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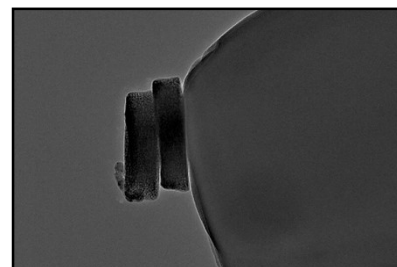
Catalytic activity of individual cobalt oxide nanoparticles determined

Precious metal-free nanoparticles could serve as powerful catalysts in the future, for example for hydrogen production. To optimize them, researchers must be able to analyze the properties of individual particles. A new method for this has been suggested by a team from the Center for Electrochemistry at Ruhr-Universität Bochum (RUB) and the Institute of Inorganic Chemistry at the University of Duisburg-Essen (UDE).

The group developed a method using a robotic arm that allows them to select individual particles under an electron microscope and place them on a nanoelectrode for electrochemical analysis. The method is described in the journal *Angewandte Chemie*, published online in advance 19 November 2020.

Using a robotic arm to deposit nanoparticles onto electrode

For the studies, the scientists used hexagon-shaped particles of cobalt oxide with diameters of 180 to 300 nanometers, which the Duisburg-Essen team consisting of Professor Stephan Schulz and Sascha Saddeler had synthesized. In the experiment, the particles catalyzed the so-called oxygen evolution reaction. During the electrolysis of water, hydrogen and oxygen are formed, with the limiting step in this process currently being the partial reaction in which the oxygen is formed. More efficient catalysts for the oxygen evolution reaction would simplify the efficiency for



Two cobalt oxide particles on a carbon nanoelectrode. Credit: T. Quast, RUB

electrochemical water splitting under formation of hydrogen. Nanoparticle catalysts are supposed to help with this. Since their catalytic activity often depends on their size or shape, it is important to understand the properties of individual particles in order to find the optimal catalysts.

The Bochum team consisting of Thomas Quast, Dr. Harshitha Barike Aiyappa, Dr. Patrick Wilde, Dr. Yen-Ting Chen and Professor Wolfgang Schuhmann analyzed selected cobalt oxide particles first microscopically, then electrochemically. "Using a movable robotic arm, we can pick out individual nanoparticles under the electron microscope," Schuhmann explains. "The selected particle, which we then already know microscopically, we place on a tiny electrode to test what it can do as a catalyst." The researchers then use electrochemical methods to measure its catalytic activity for the oxygen evolution reaction.

High catalytic activity

In this way, the chemists analyzed several individual particles. Since they knew the size and crystal orientation of a particle, they were able to relate the catalytic activity to the number of cobalt atoms. "Here, the particles showed remarkably high activities in the oxygen evolution reaction, and the measured current densities exceeded commercially available alkaline electrolyzers by more than 20 times," says Stephan Schulz.

"We believe that by applying the proposed methodology, single particle analysis of catalyst materials has finally reached the point of reliable and comparatively simple sample preparation and characterization, which are crucial for establishing structure-function relationships," the authors write in conclusion.

More information: Thomas Quast et al. Single-Entity Electrocatalysis of Individual "Picked-and-Dropped" Co₃O₄ Nanoparticles on the Tip of a Carbon Nanoelectrode, *Angewandte Chemie International Edition* (2020). DOI: [10.1002/anie.202014384](https://doi.org/10.1002/anie.202014384)

Journal information: *Angewandte Chemie*, *Angewandte Chemie International Edition*
<https://phys.org/news/2020-12-catalytic-individual-cobalt-oxide-nanoparticles.html>



Wed, 16 Dec 2020

Accurate theoretical modeling unravels changes in molecules interacting with quantum light

A team of researchers from Italy, Norway, and Germany has demonstrated that the properties of molecules undergo significant changes when interacting with quantized electromagnetic fields in optical cavities. Using novel theoretical methodologies and computational simulations, the team revealed that the ground- and excited-state chemistry of molecules can be modified by a confinement in space. They show how the transfer of electrons inside the system can be controlled by modulating the frequency of the cavity field. Their newly-developed methodology could have a profound impact on many chemical and technological applications, such as photovoltaics, photochemistry, and optoelectronic devices. The team's work has now been published in *Physical Review X* and additionally highlighted in a Viewpoint by the journal.

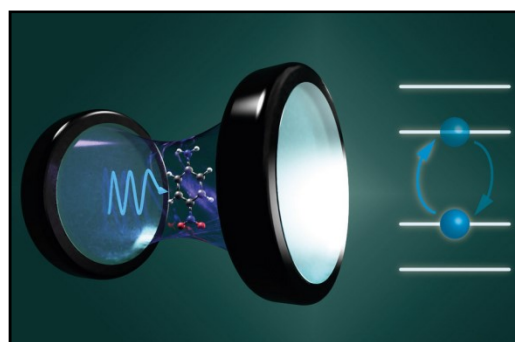


Illustration of a molecule interacting with the quantum vacuum field inside an optical cavity
Credit: Enrico Ronca, Jörg Harms / MPSD

Cavity quantum optics deals with the interactions of photons and molecules inside an optical cavity, for example enclosed between two closely spaced mirrors. Perfect optical cavities can only support certain frequencies of light and they enhance the intensity of the associated electromagnetic field. This causes profound changes in the behavior of molecules which are placed

into an optical cavity. In this situation, photons and molecules can couple and form new hybrid states known as polaritons. Importantly, these hybrid states exhibit properties of both the molecules and the photons. This means that their chemical behavior can be manipulated optically, for instance by tuning the photon energy and the cavity geometry. Hence cavities represent an entirely new lever for controlling molecular properties.

Yet the properties of molecules in cavities need to be better understood. While theoretical modeling in quantum optics offers an elaborate description of the electromagnetic field in the cavity, they provide an insufficient description of the molecule. So far, the only method that treats electrons and photons at the same level of quantization is quantum electrodynamical density functional theory, which is limited to situations where electrons and photons are uncorrelated.

However, the correlation between electrons and photons is crucial for capturing changes in molecular properties, even qualitatively. "These correlation effects were our focus," says Tor Haugland, Ph.D. student at the Norwegian University of Science and Technology and lead author of the paper. "Ours is the first ab initio theory that incorporates strong electron-photon correlation explicitly in a coherent and systematically improvable way."

The researchers extended the well-established coupled cluster theory for electronic structure to include quantum electrodynamics. Using this new framework, they showed that ground state potential energy surfaces are modified by the cavity close to conical interactions.

"This approach paves the way for novel strategies to control molecular chemistry," says co-author Enrico Ronca, a former postdoctoral researcher at the MPSD now based at the Institute for Physical-Chemical Processes of the National Research Council of Italy (IPCF-CNR). "We need solid theoretical methods in order to understand the fundamental processes which can help us to manipulate atoms and molecules with quantum light."

The team's findings could significantly boost the current understanding of the relaxation pathways and photochemistry of molecules.

More information: Tor S. Haugland et al. Coupled Cluster Theory for Molecular Polaritons: Changing Ground and Excited States, *Physical Review X* (2020). [DOI: 10.1103/PhysRevX.10.041043](https://doi.org/10.1103/PhysRevX.10.041043)

Journal information: [Physical Review X](https://phys.org/news/2020-12-accurate-theoretical-unravels-molecules-interacting.html)
<https://phys.org/news/2020-12-accurate-theoretical-unravels-molecules-interacting.html>

Another Indian COVID-19 vaccine candidate will start human trials soon

- *The technology used to develop this vaccine is same as the one used for the Pfizer vaccine, said VK Paul*
- *Currently, the Indian regulators are considering three vaccines to authorise under emergency use*

Dr VK Paul, Member of NITI Aayog, on Tuesday said the Drugs Controller General of India (DCGI) had recently granted clearance for an additional Covid-19 vaccine candidate from Gennova Pharmaceuticals Ltd. Gennova, in association with the Department of Biotechnology, a research agency under the government of India, has developed the vaccine. The technology used to develop this vaccine is same as the one used for the Pfizer vaccine, said Paul.

Earlier, a *Mint* report stated that Pune-based Gennova Pharmaceuticals will start the phase 1 clinical trial of its indigenous vaccine candidate HGCO19 based on messenger RNA platform with enrolment of 120 participants starting from early January.

The company had on Friday received approval from the Drug Controller General of India for conducting a phase 1 and 2 clinical trial for safety and immunogenicity.

However, the storage procedure for this vaccine would not be the same as followed for the Pfizer vaccine or any other vaccine that has been developed so far. If it comes into existence, it will be maintained at normal cold chain conditions, in a normal fridge, said the NITI Aayog member.

Currently, the Indian regulators are considering three vaccines to authorise under emergency use. These vaccines are developed by AstraZeneca, Bharat Biotech and the third vaccine was jointly created by Pfizer Inc and BioNTech.

"There is hope that early licensure is possible for all or any of them", the Union health ministry said on Tuesday. The USA has recently approved the Pfizer-BioNTech vaccine and a nurse in New York was the first to receive it.

In India, six vaccines are undergoing clinical trials and the government is in talks with Moderna, which requires an ultra-cold storage, Paul said.

Paul said the government is also in talks with Moderna, which also has requirements for ultra-cold storage.

There are eight vaccines that are currently at different stages of development in the country. One is Covishield, manufactured by Serum Institute of India (SII) in collaboration with AstraZeneca. Bharat Biotech in association with the ICMR is developing another vaccine, Covaxin.

ZyCOV-D, a vaccine by Cadila Healthcare jointly developed with the Department of Biotechnology. Sputnik-V is the fourth vaccine candidate developed by Dr Reddy's Lab and Gamaleya National Centre in Russia.



Pune-based Gennova Pharmaceuticals will start the phase 1 clinical trial of its indigenous vaccine candidate in January (AFP)

NVX-CoV2373 is another vaccine being developed by SII and Novavax. The sixth vaccine is a recombinant protein antigen-based vaccine manufactured by Biological E and MIT in USA.

HGCO 19, the seventh one is being manufactured by Genovax in Pune in collaboration with HDT, USA. The eighth vaccine is being developed by Bharat Biotech in collaboration with Thomas Jefferson University, USA.

Additionally, the health ministry has released guidelines for the end point of the cold chain and the states have also received the necessary resources of vaccination. Under the multi-level governance mechanism, 36 states and UTs have concluded meetings of the State Steering Committee as well as State Task Force. Among the District Task Forces, 633 districts have concluded their meetings and 23 ministries or departments under the government have been assigned roles to roll out the vaccine.

Vaccine training to the different personnel has been given under the Human Resource Training and Capacity Building. Training modules for medical officers, vaccinator officers/alternative vaccinator officers, cold chain handlers, supervisors, data managers, ASHA coordinators and others.

Training for physical and virtual platforms have begun and national and state Training of Trainers (ToTs) have also completed.

The health ministry has asked the states to have atleast one Adverse Events Following Immunization (AEFI) centre setup in each block. For the AEFI, states have been instructed on infection prevention and control practices during vaccination and management of minor, severe and serious AEFIs. Any fixed health facility including PHC, CHC, private health facilities with medical officers or para medical staff are to be AEFI Management Centres.

For cold chain management, the ministry has issued guidelines for electrical and non-electrical cold chain equipment. 29,000 cold chain points, 240 walk-in coolers, 70 walk-in freezers, 45,000 ice-lined refrigerators, 41,000 deep freezers and 300 solar refrigerators are to be used.

<https://www.livemint.com/news/india/india-gives-nod-to-conduct-trials-of-genovax-s-covid-19-vaccine-11608031317794.html>

