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CONTENTS

S. No.	TITLE	Page No.
DRDO News		1-11
DRDO Technology News		1-11
1.	Indian armed forces script history, conduct four tests of BrahMos in 8 days	1
2.	Successful Test Firing of BrahMos by Indian Navy	2
3.	India successfully tests anti-ship version of BrahMos supersonic cruise missile	3
4.	Indian Navy test-fires anti-ship version of BrahMos supersonic cruise in Andaman Nicobar Islands	4
5.	भारत की सबसे खतरनाक मिसाइल का बंगाल की खाड़ी में हुआ सफल परीक्षण, मिनटों में अपने दुश्मन को किया ढेर	5
6.	Indian Navy की ताकत बढ़ी, एंटी शिप मिसाइल Brahmos का सफल परीक्षण	6
7.	India to develop new anti-terror technology: Israeli media	7
Defence News		8-13
Defence Strategic National/International		8-13
8.	Who's afraid of the Maritime Theatre Commander? India Today Insight	8
9.	Sailing expeditions propel Indian Navy's rise into a blue-water force	10
10.	China continues construction along Indo-Tibet border; crosses India's red lines drawn during Doklam standoff	11
11.	China and Pakistan sign military deal amid tensions with India	12
Science & Technology News		13-23
12.	India to launch Shukrayaan Venus mission in 2024 after pandemic delays: reports	13
13.	China's unmanned spacecraft Chang'e 5 makes successful landing on the Moon	14
14.	Nonlinear beam cleaning in spatiotemporally mode-locked lasers	16
15.	Pumping a nanoparticle to lase at low power	18
16.	Researchers identify new process to produce ammonia with a much smaller carbon footprint	19
17.	A new lesson about phase transitions and criticality	20
18.	Researchers peer deep inside tissue with new high-resolution techniques	21
COVID-19 Research News		23
19.	Phase 2/3 trials of Covid-19 vaccine Sputnik V commence in India	23

Indian armed forces script history, conduct four tests of BrahMos in 8 days

For the first time, the world's most potent and fastest operational missile was flight tested by the three services of the Indian armed forces - Army, Air Force and Navy

By Hemant Kumar Rout

Bhubaneswar: Indian armed forces scripted history by successfully conducting four tests of supersonic cruise missile BrahMos in eight days. The latest trial conducted by the Navy from a guided stealth destroyer hit the target ship in the Bay of Bengal with pin-point accuracy on Tuesday.

For the first time, the world's most potent and fastest operational missile was flight tested by the three services of the Indian armed forces -- Army, Air Force and Navy as part of combat readiness of the weapon system. This was the fourth test in eight days and the seventh mission this year.

"No other country has so far executed a mission like this earlier. All three forces of India conducted live trials of the surface-to-surface version of the missile that destroyed targets after performing highly complex manoeuvres," a senior defence official told *The New Indian Express*.

The anti-ship version of the missile fired from INS Ranvijay, an SNF class destroyer at about 9 am, hit the target, a decommissioned ship at maximum range.

Defence sources said, all telemetry and tracking stations including naval ships near the terminal point have confirmed the success trial. The first in the series was on November 24 when the Army had test-fired a land-attack version of the missile. This was followed by two trials of the land version separately by the Army and Air Force from different angles on one target, next day.

"The tests were conducted in complete coordination of all three services amid logistic and operational challenges that the armed forces face during wars. However, the back-to-back successful trials have re-established the reliability and operational expertise," the official said.

A joint venture of India and Russia, BrahMos is known for its precision strike capabilities as it has hit the bull's eye with 99.9 per cent accuracy during more than 80 trials conducted so far making it the world's best cruise missile in its class.

Commissioned since 1988, INS Ranvijay is equipped with dual anti-ship missile complexes, including four Styx systems in inclined launchers and eight BrahMos missiles in vertical launching system besides the dual air defence systems and one anti-submarine launcher.

"With the successful mission, the Indian armed forces once again proved its capability to knock down enemy targets at any complex conditions. Never in the history such feat has been



BrahMos cruise missile being test fired from INS Ranvijay. (Photo) EPS

accomplished by any other weapon system and we are proud to complement the armed forces with the best missile system,” CEO and MD of BrahMos Aerospace Sudhir Kumar Mishra said.

The nine meter long missile can travel at thrice the speed of sound and carry a conventional warhead weighing upto 300 kg. Its strike range has been extended from 290 km to 450 km. The missile can effectively engage ground targets from an altitude as low as 10 metre.

The missile has established itself as a major force multiplier in modern-day complex battlefields with its impeccable anti-ship and land-attack capabilities besides the multi-role and multi-platform abilities. It has been deployed in all the three wings of the Indian armed forces.

The first launch of Brahmos took place in 2001 and till date numerous launches have taken place from various ships, mobile autonomous launchers and Sukhoi-30 MKI aircraft, making it a versatile weapon.

Secretary of Defence Research and Development department and Chairman of DRDO Dr G Satheesh Reddy congratulated Indian Navy for the successful test.

<https://www.newindianexpress.com/states/odisha/2020/dec/02/indian-armed-forces-script-history-conduct-four-tests-of-brahmos-in-8-days-2230593.html>



Press Information Bureau
Government of India

Ministry of Defence

Tue, 01 Dec 2020 6:15PM

Successful Test Firing of BrahMos by Indian Navy

BrahMos Supersonic Cruise Missile in Anti-Ship mode was successfully test fired today at 0900 hrs against a decommissioned Ship. The test firing was carried out by Indian Navy. The missile performed highly complex manoeuvres and hit Bull's eye of the target.

BrahMos is the supersonic cruise missile jointly developed by DRDO and NPOM of Russia as a Brahmos Aerospace joint venture, which became Brahmos Aerospace Private Limited. The missile has established itself as a major force multiplier in modern-day complex battlefields with its impeccable anti-ship and land-attack capabilities with multi-role and multi-platform abilities and has been deployed in all the three wings of the Indian Armed Forces.

The first launch of Brahmos took place in 2001 and till date numerous launches have taken place from various ships, Mobile Autonomous Launchers and Su-30 MKI aircraft, making it a versatile weapon.

Secretary DDR&D & Chairman DRDO Dr G Satheesh Reddy congratulated Indian Navy for the successful test.

<https://pib.gov.in/PressReleaseDetail.aspx?PRID=1677433>

India successfully tests anti-ship version of BrahMos supersonic cruise missile

By Rajat Pandit

New Delhi: The Naval version of the BrahMos supersonic cruise missile was successfully tested from a warship in the Bay of Bengal on Tuesday, concluding “live firings” of the “precision-strike weapon” over the last week amid the ongoing military confrontation with China in eastern Ladakh.

The 290-km range BrahMos missile launched from destroyer INS Ranvijay successfully hit the target, a decommissioned ship, “at maximum range with pinpoint accuracy after performing complex manoeuvres” at about 9 am on Tuesday.

DRDO Chairman Dr G Satheesh Reddy congratulated the Navy for the successful test. BrahMos Aerospace Chief Dr Sudhir Kumar Mishra, in turn, said: “All the four missiles launched over the last week precisely hit their targets. We are proud that our armed forces have the BrahMos missile system, which is the best in its class in the world.”

The armed forces have already inducted the 290-km range land-attack and anti-ship variants of the BrahMos missile, which flies at almost three times the speed of sound at Mach 2.8, in large numbers undercontracts worth over Rs 36,000 crore inked till now.

A few Sukhoi-30MKI fighter jets are also armed with the sleeker version of the air-breathing BrahMos missiles. On October 30, in a cross-country mission, a Sukhoi had also taken off from Punjab to launch a BrahMos missile at a target in the Bay of Bengal. With a combat radius of almost 1,500-km without mid-air refueling, the Sukhois combine with the BrahMos missiles to constitute a formidable weapons package.

The enhanced version of BrahMos with a strike range of almost 450-km, which has been successfully tested three to four times, is on course to be made operational soon. There are also plans underway for India and Russia to test an even longer version of BrahMos, with 800-km range, by middle of next year, as was first reported by TOI.

“Multi-platform launch capability of BrahMos missile can be used for pinpoint strikes on an adversary’s economic and strategic assets located deep inside its territory. Similarly, high-value military targets like warships or aircraft carriers on the high seas can also be targeted from long stand-off distances,” said an official.

<https://timesofindia.indiatimes.com/india/india-successfully-tests-anti-ship-version-of-brahmos-supersonic-cruise-missile/articleshow/79512436.cms>



Indian Navy test-fires anti-ship version of BrahMos supersonic cruise in Andaman Nicobar Islands

The BrahMos supersonic cruise missile is the world's fastest operational system in its class

Edited By Ritesh K Srivastava

Highlights

1. **Indian Navy test-fired anti-ship version of BrahMos supersonic cruise in Andaman Nicobar Islands**
2. **A land-attack version of the BrahMos supersonic cruise missile was also successfully test-fired**
3. **The BrahMos supersonic cruise missile is the world's fastest operational system in its class.**

New Delhi: The Indian Navy on Tuesday test-fired the anti-ship version of the BrahMos supersonic cruise missile from the Andaman and Nicobar Islands territory. According to news agency ANI, the test was conducted as part of the trials being conducted by the Indian Navy.

A land-attack version of the BrahMos supersonic cruise missile was also successfully test-fired from the Andaman and Nicobar Islands territory earlier this week.

"The test was conducted by the Indian Army which has many regiments of the Defence Research and Development Organisation-developed Missile system. The strike range of BrahMos missile has now been enhanced to over 400 km," sources told ANI.

During the test held today around 0925 hours, the DRDO-developed BrahMos supersonic cruise missile with a strike range of 300 Km was launched from Indian Navy's INS Ranvijay and it successfully hit its target ship near the Car Nicobar Islands in the Bay of Bengal, the sources said.



The BrahMos supersonic cruise missile is the world's fastest operational system in its class. The DRDO recently extended the range of the missile system from the existing 298 km to around 450 km.

The fastest cruise missile in its class, BrahMos has a speed of 2.8 Mach or almost three times the speed of sound. Jointly developed by Russia and India, the successful integration of BrahMos with air, land and sea platforms is also being viewed as a major leap towards indigenization.

This assumes importance on the backdrop of the government's repeated emphasis on its flagship Make in India scheme and the more recent call for an 'Aatmanirbhar' Bharat.

Over the past few months, India has conducted a series of tests across land, air and sea. The tests may be viewed against the ongoing Chinese aggression along the Line of Actual Control (LAC) in Eastern Ladakh where the Indian and Chinese People's Liberation Army (PLA) troops have been locked in a bitter standoff.

Chinese expansionist designs are also evident in the Indian Ocean Region (IOR) and Pacific, where Beijing has been violating globally accepted maritime laws and exerting territorial claims.

<https://zeenews.india.com/india/indian-navy-test-fires-anti-ship-version-of-brahmos-supersonic-cruise-in-andaman-nicobar-islands-2327768.html>

भारत की सबसे खतरनाक मिसाइल का बंगाल की खाड़ी में हुआ सफल परीक्षण, मिनटों में अपने 'दुश्मन' को किया ढेर

Brahmos Anti Ship Missile: इस सुपरसोनिक क्रूज मिसाइल को INS रणविजय से लॉन्च किया गया। यह मिसाइल नौसैनिक जहाज आईएनएस रणविजय से दागी गई और इसने अपने टारगेट को पूरी सटीकता से अधिकतम रेंज में ध्वस्त कर दिया।

By Sudhendra Singh

हाइलाइट्स:

- ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के नौसैन्य संस्करण का हुआ कायमाब परीक्षण
- बंगाल की खाड़ी में INS रणविजय की दागी गई एंटी शिप ब्रह्मोस मिसाइल ने अपने टारगेट पर लगाया सटीक निशाना
- ब्रह्मोस एंटी शिप मिसाइल ने पूरी सटीकता से अधिकतम रेंज में लक्ष्य को बनाया निशाना

नई दिल्ली: भारतीय नौसेना (Indian Navy) ने ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के नौसैन्य संस्करण (Anti-ship version of BrahMos) का बंगाल की खाड़ी में एक विध्वंसक पोत से मंगलवार को कामयाब परीक्षण किया। आधिकारिक सूत्रों ने परीक्षण के बारे में जानकारी दी। सेना के तीनों भागों (जल, वायु, धल) में इस मिसाइल का परीक्षण किया जा रहा है। इसी के तहत ब्रह्मोस मिसाइल के नौसैन्य संस्करण का परीक्षण किया गया। भारतीय नौसेना ने छह सप्ताह पहले अरब सागर में भी मिसाइल का इसी तरह का परीक्षण किया था।

भारतीय नौसेना के प्रवक्ता कमांडर विवेक मढवाल ने बताया, "आईएनएस रणविजय (INS Ranvijay) से जहाज रोधी ब्रह्मोस मिसाइल का कामयाब परीक्षण किया गया। इस मिसाइल ने पूरी सटीकता से अधिकतम रेंज में लक्ष्य को निशाना बनाया है।"

ब्रह्मोस मूल मिसाइल की रेंज 290 किलोमीटर

भारत-रूस के संयुक्त उपक्रम ब्रह्मोस एरोस्पेस ने सुपरसोनिक क्रूज मिसाइलों का निर्माण किया है। इन मिसाइलों को पनडुब्बी, जहाज या जमीनी प्लेटफॉर्म से छोड़ा जा सकता है। भारतीय थल सेना ने 24 नवंबर को सतह से सतह पर मार करने में सक्षम मिसाइल का परीक्षण किया था। इसकी रफ्तार आवाज की गति से करीब तीन गुना तेज या 2.8 मैक की है। मिसाइल के जमीन से छोड़े जाने वाले संस्करण की रेंज को भी 400 किलोमीटर तक बढ़ाया गया है। मूल मिसाइल की रेंज 290 किलोमीटर है।

चीन से लगी सीमाओं के ब्रह्मोस मिसाइल तैनात कर चुका है भारत

भारत, लद्दाख और अरुणाचल प्रदेश में चीन से लगी वास्तविक नियंत्रण रेखा के पास कई महत्वपूर्ण रणनीतिक स्थानों पर मूल ब्रह्मोस मिसाइलों को तैनात कर चुका है। पिछले ढाई महीने में भारत ने एंटी-रेडिएशन मिसाइल रुद्रम-1, समेत कई मिसाइलों का परीक्षण किया है। रुद्रम-वन को सेवा में 2022 तक शामिल किए जाने की संभावना है।



आईएनएस रणविजय से दागी गई एंटी शिप ब्रह्मोस क्रूज मिसाइल

सुखोई में ब्रह्मोस सुपरसोनिक क्रूज मिसाइलों को लगाने की प्लानिंग भारतीय वायु सेना ने 30 अक्टूबर को बंगाल की खाड़ी में सुखोई लड़ाकू विमान से मिसाइल का परीक्षण किया था। वायु सेना अपनी क्षमता को बढ़ाने के लिए 40 से ज्यादा सुखोई लड़ाकू विमानों में ब्रह्मोस सुपरसोनिक क्रूज मिसाइलों को शामिल करने वाला है।

<https://navbharattimes.indiatimes.com/india/brahmos-anti-ship-missile-was-successfully-launched-by-ins-ranvijay-striking-the-target-ship-at-maximum-range-with-pinpoint-accuracy-in-the-bay-of-bengal-indian-navy/articleshow/79516642.cms>



Wed, 02 Dec 2020

Indian Navy की ताकत बढ़ी, एंटी शिप मिसाइल Brahmos का सफल परीक्षण

भारतीय नौसेना ने ब्रह्मोस सुपरसोनिक क्रूज मिसाइल के एंटी शिप वर्जन का सफल परीक्षण किया है। ये परीक्षण सैन्य ताकत के लिहाज से काफी अहम माने जा रहे हैं।
कृष्णमोहन मिश्रा

खास बातें

1. एंटी शिप ब्रह्मोस मिसाइल का सफल परीक्षण किया गया
2. आईएनएस रणविजय से बंगाल की खाड़ी में दागी गई मिसाइल
3. अधिकतम दूरी पर मौजूद टारगेट पर सटीक निशाना लगाया

नई दिल्ली: भारतीय नौसेना (Indian Navy) को एक और कामयाबी मिली है। भारतीय नौसेना ने मंगलवार को ब्रह्मोस सुपरसोनिक क्रूज मिसाइल (Brahmos supersonic cruise missile) के एंटी शिप वर्जन का सफल परीक्षण किया है। इस मिसाइल का परीक्षण अंडमान और निकोबार द्वीप समूह में किया गया। एंटी शिप ब्रह्मोस मिसाइल (Anti ship version of Brahmos) आईएनएस रणविजय से बंगाल की खाड़ी में दागी गई। जहां अधिकतम दूरी पर मौजूद टारगेट पर सटीक निशाना लगाया गया।

नौसेना की ताकत में लगातार इजाफा

भारतीय वायु सेना और भारतीय नौसेना (Indian Navy) की ताकत में लगातार इजाफा हो रहा है। इसी क्रम में पिछले तीन महीनों के दौरान एक के बाद एक कई क्रूज और बैलेस्टिक मिसाइलों का परीक्षण किया जा चुका है। सुपरसोनिक क्रूज मिसाइल ब्रह्मोस (Brahmos supersonic cruise missile) के भी अलग-अलग संस्करणों के परीक्षण किए गए हैं। ये भारत और रूस के संयुक्त प्रयासों से बनाई गई मिसाइल है। माना जा रहा है कि अभी आने वाले समय में सुपरसोनिक क्रूज मिसाइल (supersonic cruise missile) के और अलग-अलग संस्करणों के परीक्षण किए जाने हैं।

दुनिया की सबसे तेज गति वाली मिसाइल

भारत-रूसी संयुक्त उद्यम ब्रह्मोस एयरोस्पेस के जरिए लगातार सफलता पूर्वक सैन्य शक्ति को बढ़ावा दिया जा रहा है। ब्रह्मोस अपनी श्रेणी में दुनिया की सबसे तेज गति वाली मिसाइल है। डीआरडीओ



एंटी शिप ब्रह्मोस मिसाइल का सफल परीक्षण.

(DRDO) ने इस मिसाइल प्रणाली की सीमा 290 किलोमीटर से बढ़ाकर करीब 450 किलोमीटर कर दी है। ब्रह्मोस मिसाइल (Brahmos missile) को पनडुब्बियों, पोतों, विमानों या जमीन से भी दागा जा सकता है।

महत्वपूर्ण रणनीतिक स्थानों पर ब्रह्मोस तैनात

एलएसी (LAC) पर जारी तनाव के बीच भारत ने पहले ही लद्दाख और अरुणाचल प्रदेश में महत्वपूर्ण रणनीतिक स्थानों पर ब्रह्मोस मिसाइलों को तैनात कर दिया है। एलएसी पर जारी तनाव के बीच भारत की बढ़ती सैन्य ताकत के लिहाज से ये परीक्षण काफी अहम माने जा रहे हैं।

<https://zeenews.india.com/hindi/india/indian-navy-test-fires-anti-ship-version-of-brahmos-supersonic-cruise-missile/797291>



DEFENCE AVIATION POST

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Wed, 02 Dec 2020

India to develop new anti-terror technology: Israeli media

India has been coping with a growing drone threat, a fact that has led the country to develop anti-drone technology. India's Defense Research and Development Organization (DRDO) has designated Bharat Electronics as the lead agency for the development and production of an anti-drone system for the armed forces.

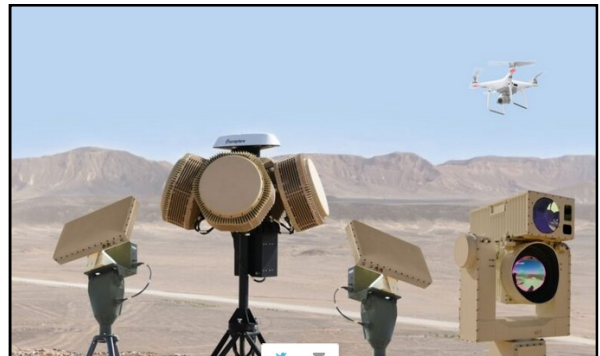
It is understood that anti-drone systems are now a part of Prime Minister Narendra Modi's security detail at his residence and portable ones will be part of his car cavalcade. This has been made mandatory as there has been a drone threat since the beginning of 2020.

With Pakistan-based terrorists using Chinese-made commercial drones to cart weapon payloads and drugs across the Line of Control (LoC) in Jammu and Kashmir and the international border, the DRDO has been able to successfully develop passive and active anti-drone technology to either disable or shoot down enemy drones, according to hindustantimes.com.

The anti-drone system, which was deployed during 2020 Republic and Independence Day, has a range of over 2-3 kilometres with radar capability to pick up the drone and then use frequencies to jam the unmanned aerial vehicle.

The other developed option includes spotting the drone through radar and then targeting it by laser beam.

<https://www.defenceaviationpost.com/2020/12/india-to-develop-new-anti-terror-technology-israeli-media/>



INDIA
TODAY

Wed, 02 Dec 2020

Who's afraid of the Maritime Theatre Commander? | India Today Insight

Among the most hotly debated aspects of the proposed Maritime Theatre Command is its head, a powerful 'C-in-C plus'

By Sandeep Unnithan

One of the most radical proposals in a recently completed Indian Navy report on a new, integrated Maritime Theatre Command is its commander-in-chief (C-in-C). Details of the proposed theatre command, first brought out by INDIA TODAY magazine, describe a three-star naval officer to be based in Karwar who will head all tri-services and coast guard assets which have a bearing on India's maritime domain.

It is the post and the powers of the Maritime Theatre Commander that have piqued the interest of defence analysts across services. For starters, the C-in-C MTC will be more powerful than any of the other theatre commanders. There will be at least three theatre commanders headed by army generals—Western, Northern and Eastern. (The National Air Defence Command to be headed by the IAF is being seen as a functional command and not a theatre command like the others.)

There will however be only one Maritime Theatre Commander. He will effectively be something like a Maritime Chief of Defence Staff, an officer with no operational peers. Two of the Navy's three C-in-C's—Western and Eastern—will report to him for operational matters (the C-in-C South will continue to report to the CNS as it is a training command). The navy chief loses his operational role and focuses only on 'raise, train and sustain' functions. It will take the Navy between nine months to a year to fully set up the MTC after it gets a green signal from the Cabinet Committee on Security (CCS). The MTC is meant to address all of India's maritime threats including those from China and Pakistan. But first it may have to assuage concerns from within the services themselves.

Former Northern Army Commander Lt Gen. D.S. Hooda believes the proposal is simply too big to get off the ground. The Navy, he says, might actually end up scuttling the case for the MTC. "The Navy is asking for the creation of an appointment that is more powerful than the Navy chief," he says. "He will have the army, air force and coast guard under him in addition to all naval assets."

Former naval top brass are worried, but for different reasons. The C-in-C MTC will report not to the Navy Chief, but to the Chief of Defence Staff in his dual hatted role as Permanent Chairman



Navies of India, the United States, Japan, and Australia participate in the second phase of the Malabar naval exercise, in the Arabian Sea, on Nov. 18 (ANI)

Chiefs of Staff Committee. This, they fear, could lead to all maritime assets being placed under someone from the Army.

Interestingly, the Air Force study to recommend a creation of a National Air Defence Command calls for a three-star IAF officer heading this command to report to the Chief of Air Staff and not to the CDS.

This perceived loss of operational control over naval assets is the reason why one former Indian Navy C-in-C who did not want to be named terms it a "regressive proposal". "It will destroy the Navy as an independent service," he says. Coast Guard officials, meanwhile, worry that the Maritime Theatre Commander will subsume them—the study report recommends all operational coast guard assets to be placed under the MTC.

The navy's report is to be shortly submitted to Chief of Defence Staff Gen. Bipin Rawat. It is likely to face further debate and discussion before it is finally approved and implemented, as Gen. Rawat says, by 2022.

Government officials familiar with the report say they have factored all of these anxieties. One of the concerns was whether the C-in-C MTC would need to be a full admiral, a four-star flag officer like the Navy chief. This is because his role and responsibilities are like a 'C-in-C plus' and he will have the three C-in-Cs reporting to him. But importantly, while the navy chief loses his operational role, he will continue to be the face of the navy. Hence, the rank distinction between him and the MTC. The Chief of Naval Staff is part of the Chairman Chiefs of Staff Committee (COSC) and will also therefore be responsible for all operations, they say.

Who will handle operations in the Headquarters Integrated Defence Staff (HQ-IDS), the body reporting to the CDS? The study report recommends the creation of a Vice Chief of Defence Staff Operations. The Commander-in-Chief Andaman and Nicobar Command (CINCAN) billet, the report suggests, will be withdrawn to become the VCDS-Operations. The VCDS-Operations will put his mind to operational matters not only for the MTC but for all theatre commands. He will head the staff who will feed into the COSC and synchronise, allocate forces between the theatre commands.

The CDS and the theatre commands were part of the recommendations of the Group of Ministers which went into the Kargil Review Committee in 2001 and, more recently, the committee of experts headed by Lt Gen. D.B. Shekatkar which submitted its report to the MoD in 2016. Interestingly, the navy representative, a former C-in-C, did not sign the report reportedly because the Navy did not favour the creation of a Chief of Defence Staff (CDS) and wanted only a permanent chairman chiefs of staff committee instead.

<https://www.indiatoday.in/india-today-insight/story/who-s-afraid-of-the-maritime-theatre-commander-1745833-2020-12-01>

Sailing expeditions propel Indian Navy's rise into a blue-water force

He has so far trained over 61 naval officers, including 17 women officers

By Rajesh Abraham

Kochi: As India marks the 50th anniversary of the victory in the 1971 war with a year-long celebration from this month, what stands out is the phenomenal rise of Indian navy from a brown-water troop to a formidable blue-water force with an ability to send ships and smaller vessels into the deep oceans. From a small fleet of 15-20 ships, the Indian navy, which was instrumental in the victory over Pakistan, now commands a 100-plus armada.

The growing respect the Indian navy commands in the oceans was reflected when the Australian navy joined forces with the Indian navy in an international mission to rescue Commander Abhilash Tomy of the Indian navy in September 2018 when the solo skipper was injured seriously after his yacht was damaged in a storm off Western Australia during the round-the-world Golden Globe Race.

The adventure activities by the Indian navy in the seas, which lasts 30-40 days, have risen manifold in a move aimed at helping its officers understand first hand and manage the vagaries of nature, said Captain Atool Sinha who has — in the last four years — covered 22,000 nautical miles on ocean sailing vessels as small as 56 feet or 40 feet.

He said a 'blue-water navy' can sustain itself only if the officers are trained on a first-hand basis.

“To understand the vagaries of nature, one has to be very close to nature. When you are out in the ocean and doing adventure activities, it inculcates a level of camaraderie. It allows us to make better decisions. It helps us in making ourselves more aware of nature and to understand its wrath, and deal with its elements as it occurs,” Captain Sinha told TNIE.

He has so far trained over 61 naval officers, including 17 women officers. Among the 17 are six officers who formed the all-women team that circumnavigated in a voyage that lasted 254 days, from September 2017 to May 2018, on INSV Tarini. Added Commander Tomy: “For generations, sailing has taught things that no school could teach. Maybe that’s the reason why the Indian navy gives so much importance to sailing.”

Besides small-boat sailing, the navy undertook three circumnavigations in the last 10 years exploring the far corners of the earth, he pointed out. That has put India in an exclusive club. “The Navy has used sailing to teach humility, courage, a sense of adventure, self-reliance, patience, character development, boat-handling and less-is-more,” said Commander Tomy.

Lt Commander Tulika Kotnala, officer-in-charge, Indian Naval Watermanship Training Centre, Mumbai, and Lt Surabhi Bhawsar, from INS Dronacharya, are two women officers who have benefitted from the training in sailing. The officers were part of the Indian navy’s Bay of Bengal sailing expedition early this year. “We went from Goa to Port Blair and back to Goa. Initially, the journey was proposed till Thailand. But because of Covid, it ended at Port Blair and we returned,” said Lt Commander Kotnala.



Capt Atool Sinha with Lt Commander Tulika Kotnala and Lt Surabhi Bhawsar pose on board sailing boat Bulbul at the Southern Naval Command, Kochi | Albin Mathew

The two-boat expedition started in February and ended in early April. While Lt Surabhi was in INS Tarini, Lt Commander Tulika was in INSV Mhadei with a total of five crew members in each boat -- three men and two women officers. Capt Sinha said officers come for the training with a basic knowledge, but when they leave, they become confident of handling themselves in difficult situations. "We learn to rely on and communicate with each other, which are important, particularly when we have to become blue-water navy and operate between different nations."

<https://www.newindianexpress.com/nation/2020/dec/02/sailing-expeditions-propel-indian-navys-rise-into-a-blue-water-force-2230622.html>

india.com

Wed, 02 Dec 2020

China continues construction along Indo-Tibet border; crosses India's red lines drawn during Doklam standoff

Even though the Indian Army had tried to stop the Chinese Communist Party's (CCP) from advancing towards the Sharsingma or Yatung valley, the satellite images gives a clearly indication that China has yet again stabbed the international community in the back

New Delhi: Despite the harsh winters, the Chinese troops in eastern Ladakh seems to be adamant to continue with the ongoing standoff along the Line of Actual Control (LAC). Meanwhile, according to a report satellite images suggest that Beijing has also continued the same stance all along the Indo-Tibet border.

As per a report by India Today, the latest satellite images which were released by space firm Maxar Technologies has revealed that China's People's Liberation Army (PLA) has carried out massive construction of roads and civilian settlements, inside Bhutan's territory.

Earlier in March-June 2017, the Chinese PLA had carried out massive incursions to grab Bhutan's territory in and around the Doklam plateau and also threatened India strategically.



Representational image

Even though the Indian Army had tried to stop the Chinese Communist Party's (CCP) from advancing towards the Sharsingma or Yatung valley, the satellite images gives a clearly indication that China has yet again stabbed the international community in the back, especially Bhutan, by grabbing further land along the Amo Chu river, said the report. The images also suggest that these PLA incursions might appear to be critical to Indian forces in Eastern Zone.

Not only these constructions, but China has also clearly crossed the red lines drawn by India during the Doklam standoff. The two main red lines that India will not accept crossing of Doklam Nala to the south and Amo Chu to the east by the PLA, were drawn expecting the PLA never to cross them and were mutually accepted.

But, satellite images from October 28, 2020, clearly shows that China has built a bridge across the Amo Chu River. The bridge located approximately 400m south of the new Pangda Phase-I village is about 40-45m long and about 6m wide.

The bridge that crosses the Indian red line has at least seven piers and eight spans that connects eastern and western banks of Amo Chu river.

However, Bhutan had rejected reports of the Chinese having established villages inside Bhutanese territory in Doklam. “There is no Chinese village inside Bhutan,” Bhutan’s envoy to India, Maj Gen Vetsop Namgyel, had told India Today.

<https://www.india.com/news/world/china-continues-construction-along-indo-tibet-border-crosses-indias-red-lines-drawn-during-doklam-standoff-4235559/>



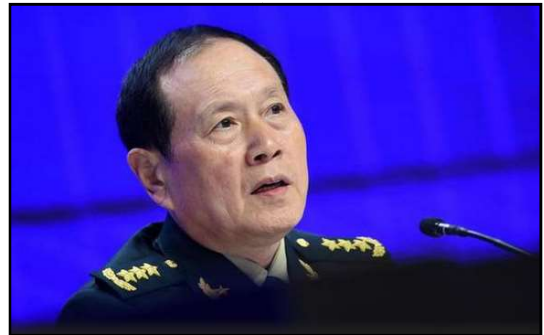
Wed, 02 Dec 2020

China and Pakistan sign military deal amid tensions with India

PLA official calls for higher level ties to jointly cope with various risks and challenges
By Ananth Krishnan

China and Pakistan have signed a new military memorandum of understanding to boost their already close defence relationship, as China’s Defence Minister and People’s Liberation Army (PLA) General Wei Fenghe met Pakistan’s leadership in Islamabad and visited the headquarters of the army at Rawalpindi.

Gen. Wei on Tuesday met Pakistan’s President Arif Alvi and Prime Minister Imran Khan. He called on both countries to “push the military-to-military relationship to a higher level, so as to jointly cope with various risks and challenges, firmly safeguard the sovereignty and security interests of the two countries and safeguard the regional peace and stability,” Chinese State media reported.



China's Defence Minister Wei Fenghe. File. | Photo Credit: AFP

On Monday, the two militaries signed an MoU following Gen. Wei’s meeting with Pakistan’s Chief of the Army Staff, General Qamar Javed Bajwa, at the General Headquarters, according to reports in the Pakistani media. Both “exchanged in-depth views on the international and regional situations, the relations between the two countries and militaries, the equipment and technology cooperation and other issues”, a report in China’s official media said.

While details of the new MoU were not immediately available, it follows another agreement signed last year, when China’s Vice Chairman of the Central Military Commission (CMC) General Xu Qiliang visited Rawalpindi for defence cooperation and “capacity building of the Pakistan Army”.

Gen. Wei also discussed on-going projects under the China Pakistan Economic Corridor (CPEC), in which the Pakistani military is playing an increasingly prominent role.

Prior to Gen. Wei’s visit, recently appointed Chinese envoy to Pakistan Nong Rong conducted a “comprehensive review” of the CPEC projects along with Lt. Gen. Asim Saleem Bajwa (retd.), who is heading the CPEC Authority.

The Chinese Defence Minister also had talks with Pakistan’s Chairman of the Joint Chiefs of Staff Committee General Nadeem Raza, and both sides “reaffirmed their commitment to ‘Iron Brotherhood’ and ‘All-Weather’ friendship”.

President Arif Alvi on Tuesday conveyed Pakistan “firmly supports China’s stand on issues related to the South China Sea, Taiwan, Xinjiang, Tibet and so on”, Chinese State media reported. “We hope that the two countries will further strengthen cooperation in the construction of the CPEC as well as the defence and security fields,” he said.

Prime Minister Imran Khan called for “closer strategic cooperation to raise the iron-clad Pakistan-China brotherhood to a new height”.

Gen. Wei's visit followed his day-long visit to Nepal, where he was the highest ranking Chinese official to visit since President Xi Jinping's visit in October last year. The Communist Party-run Global Times reported Gen. Wei said "China firmly supports Nepal to safeguard its national independence, sovereignty and territorial integrity", with the newspaper noting India's recent territorial dispute with Nepal in Kalapani.

He said China would "continue assisting Nepal's military development, contributing to regional peace and stability". The newspaper reported that military-to-military relations were growing with the PLA Air Force earlier this year sending protective outfits, medical masks and thermometers to the Nepalese military. Nepal's then Defence Minister Ishwar Pokhrel visited Beijing in October 2019 when both sides signed a 150-million yuan (\$22.8 million) deal on military assistance, the Global Times noted, adding that the two militaries have held joint special forces drills for three consecutive years.

<https://www.thehindu.com/news/international/china-and-pakistan-sign-military-deal-amid-tensions-with-india/article33219358.ece>

Science & Technology News

SPACE.com

Wed, 02 Dec 2020

India to launch Shukrayaan Venus mission in 2024 after pandemic delays: reports

It will be India's first mission to Venus

By Elizabeth Howell

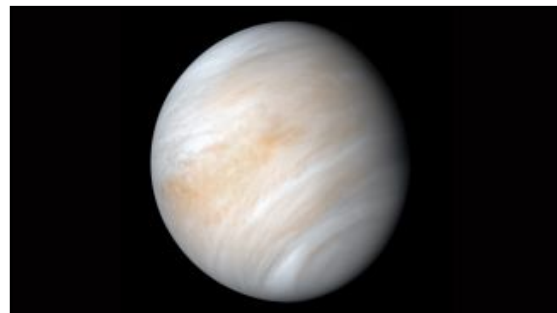
India plans to launch a new orbiter to Venus in 2024, a year later than planned, according to media reports.

The Shukrayaan orbiter will be the first mission to Venus by the India Space Research Organization (ISRO) and will study the planet for four years, according to SpaceNews, which cited a presentation by an ISRO research scientist at a NASA-chartered committee Nov. 10.

ISRO has been soliciting ideas for instruments for a Venus-based mission since at least 2018, according to its website. At the planetary science committee, ISRO's T. Maria Antonita presented more information about Shukrayaan during a discussion about NASA's new 10-year plan for planetary science, SpaceNews reported.

"ISRO was aiming for a mid-2023 launch when it released its call for instruments in 2018, but Antonita told members of the National Academies' decadal survey planning committee last week that pandemic-related delays have pushed Shukrayaan's target launch date to December 2024," SpaceNews stated in a Nov. 19 report.

A backup launch opportunity is available when Venus and Earth are next aligned in mid-2026, in such a way to minimize spacecraft fuel use during the planetary transit, Antonita added.



A view of Venus from NASA's Mariner 10 spacecraft based on data captured in 1974. India is now planning to launch its own Venus orbiter in 2024.

Shukrayaan is set to launch on India's GSLV Mk II rocket, but it may go on the more powerful GSLV Mk III rocket to carry more instruments or fuel, Antonita told the committee. ISRO will make a final decision in the next three to six months.

The spacecraft will carry several instruments to probe the Venusian environment. The flagship instrument will be a synthetic aperture radar to examine the Venusian surface, which is shrouded by thick clouds that make it impossible to glimpse the surface in visible light. An earlier version flew on the Indian Chandrayaan-2 spacecraft now orbiting the moon, Space News reported.

Another instrument will be a Swedish-Indian collaboration known as the Venusian Neutrals Analyzer, which will examine how charged particles from the sun interact with the atmosphere of Venus, according to The Economic Times. An earlier generation of this instrument launched on the Indian Chandrayaan-1 moon mission of 2008-09, studying how the sun's particles affect a world with a far more tenuous atmosphere.

Shukrayaan will also bring an instrument to Venus to examine the planet's atmosphere in infrared, ultraviolet and submillimeter wavelengths, Antonita said. Earlier in 2020, scientists announced the possible detection of phosphine — a life-friendly element — in Venus' atmosphere, although many in the science community remain skeptical of the findings.

In September, the French space agency (CNES) announced it would also fly an instrument on Shukrayaan. The Venus Infrared Atmospheric Gases Linker (VIRAL) is a collaboration with Russian federal space agency Roscosmos. Antonita added that other instruments have been shortlisted and that India plans to fly an instrument from Germany.

Dozens of missions have flown to Venus since the 1960s, but only a few in recent years. For example, the European Space Agency's Venus Express orbited the planet between 2006 and 2014, and Japan's Akatsuki spacecraft entered orbit in 2015 after a previous unsuccessful attempt. Several spacecraft are also performing flybys of Venus in the near future, including NASA's Parker Solar Probe for solar observation, and Europe's BepiColombo en route to Mercury.

<https://www.space.com/india-venus-orbiter-shukrayaan-2024-launch>

india.com

Wed, 02 Dec 2020

China's unmanned spacecraft Chang'e 5 makes successful landing on the Moon

China's Chang'e-5 mission will attempt to collect 2 kg (4-1/2 lbs) of samples in a previously unvisited area in a massive lava plain known as Oceanus Procellarum, or "Ocean of Storms"

Edited By Rajashree Seal

Beijing: China's Chang'e-5 probe has successfully and safely landed on the Moon's surface on Tuesday in a historic mission to retrieve lunar surface samples, said reports. This uncrewed mission is named after the mythical Chinese goddess of the moon, and it aims to collect lunar material to help scientists learn more about the moon's origins. Launched on November 24, Chang'e-5 is one of the most complicated and challenging missions in China's aerospace history, as well as the world's first moon-sample mission for more than 40 years.

The mission will attempt to collect 2 kg (4-1/2 lbs) of samples in a previously unvisited area in a massive lava plain known as Oceanus Procellarum, or "Ocean of Storms".

According to a Reuters report, if the mission is completed as planned, it would make China the third nation to have retrieved lunar samples after the United



States and the Soviet Union. Chang'e-5, comprising an orbiter, a lander, an ascender and a returner, with a total takeoff mass of 8.2 tonnes, is expected to accomplish unmanned rendezvous and docking in lunar orbit, an unprecedented feat. After it enters the lunar orbit, the lander-ascender combination will separate from the orbiter-returner combination.

The lander vehicle that touched down on the moon's surface was one of several spacecraft deployed by the Chang'e-5 probe. Upon landing, a robotic arm will be extended to scoop up rocks and regolith on the lunar surface, and a drill will bore into the ground. About 2 kg of samples are expected to be collected and sealed in a container in the spacecraft.

Then the ascender will take off, and dock with the orbiter-returner in orbit. After the samples are transferred to the returner, the ascender will separate from the orbiter-returner.

When the geometric relationship between Earth and the moon is suitable, the orbiter will carry the returner back to Earth. The returner will reenter the atmosphere and land at the Siziwang Banner in north China's Inner Mongolia Autonomous Region.

The whole flight will last more than 20 days. During the launch of the mission, deputy director of the Lunar Exploration and Space Program Center of the China National Space Administration, Pei Zhaoyu said, "The mission will help promote China's science and technology development, and lay an important foundation for China's future manned lunar landing and deep space exploration."

Pei said if the Chang'e-5 mission succeeds, China's current lunar exploration project would come to a successful conclusion.

Named after Chinese legendary moon goddess Chang'e, China's current three-step lunar exploration program, which began in 2004, includes orbiting and landing on the moon, and bringing back samples.

"Through the programme, China has acquired the basic technologies of unmanned lunar exploration with limited investment," said Pei.

China is drawing up plans for future lunar exploration. To pave the way for manned lunar exploration and deep space exploration, the Chang'e-5 mission will use a sampling method different to those of the United States and the Soviet Union, said Pei.

"Unmanned rendezvous and docking in lunar orbit will be a historic first. It will be very difficult," said Peng Jing, deputy chief designer of the Chang'e-5 probe from the China Academy of Space Technology under the China Aerospace Science and Technology Corporation.

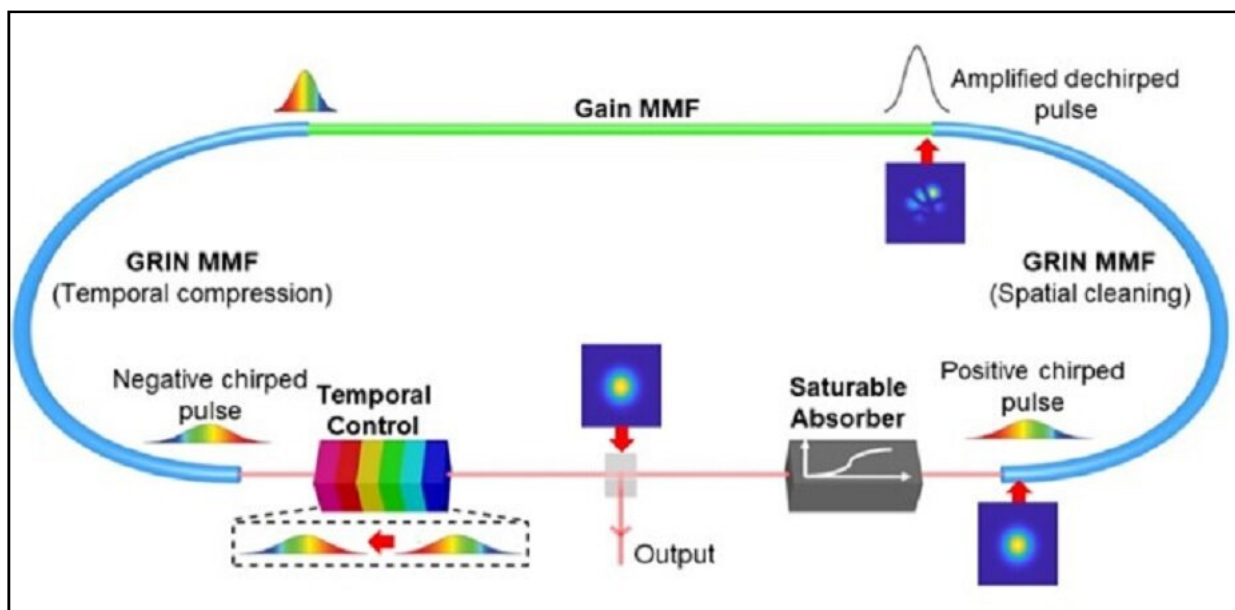
"We could call it a milestone mission. Its success will help us acquire the basic capabilities for future deep space exploration such as sampling and takeoff from Mars, asteroids and other celestial bodies," Peng said.

The scientific goals of the Chang'e-5 mission include the investigation of the landing area to obtain the on-site analysis data related to the lunar samples, as well as systematic and long-term laboratory analysis of the lunar samples.

<https://www.india.com/technology/science-china-lunar-mission-change-5-probe-spacecraft-lands-on-moon-collect-soil-rocks-samples-4236237/>

Nonlinear beam cleaning in spatiotemporally mode-locked lasers

In the last few decades, only temporal modes have been considered for mode-locked fiber lasers using single-mode fibers. Mode-locked single-mode fiber lasers offer advantages due to their high-gain doping, intrinsically single-spatial mode, and compact setups. However, in terms of power levels, mode-locked fiber lasers suffer from high nonlinearity, which is introduced by the small core size of the single-mode fibers. Researchers from École Polytechnique Fédérale de Lausanne, Switzerland (EPFL) recently developed a new approach for generating high-energy, ultrashort pulses with single-mode beam quality: nonlinear beam cleaning in a multimode laser cavity.



Conceptual outline of dispersion-managed cavity design. Credit: Tecin et al., doi 10.1117/1.AP.2.5.056005

Spatiotemporal mode-locking

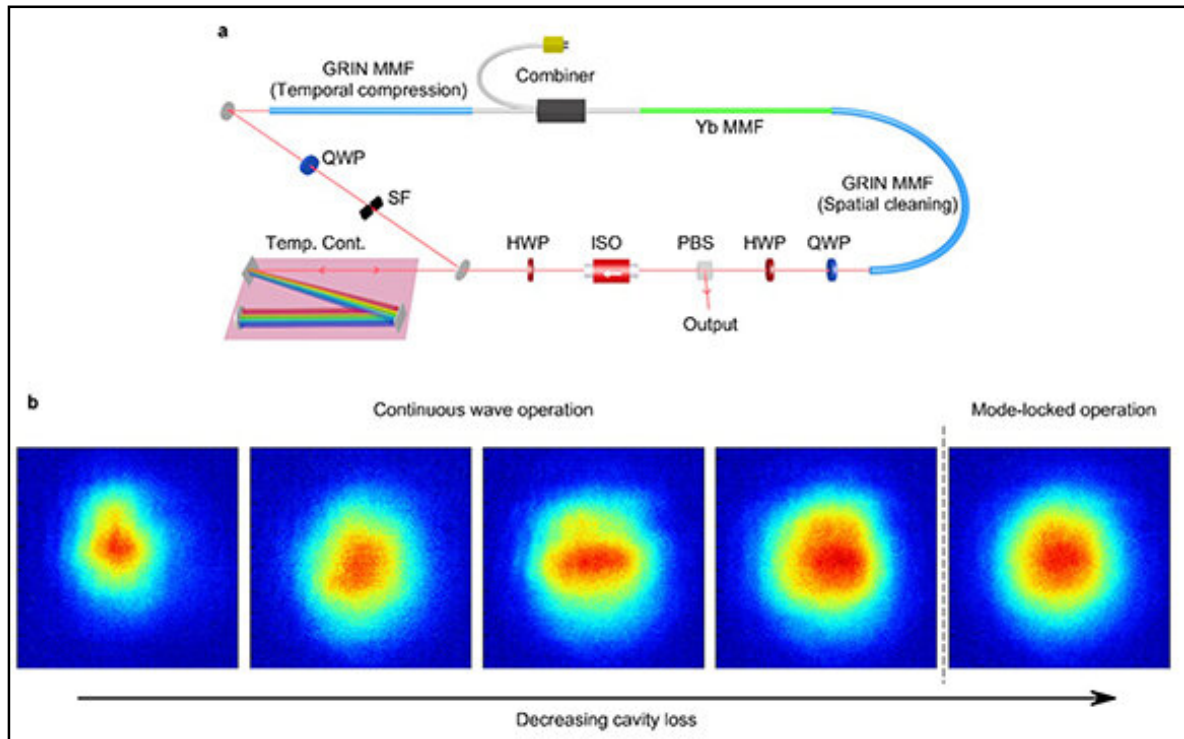
The traditional approach to overcome the power level problem is first to generate low-power ultrashort pulses (so-called laser oscillators), followed by a cascade of amplifiers to increase the power levels. But external amplification increases cost and complexity.

Recently, multimode fibers, particularly graded-index multimode fibers, have attracted attention due to their low modal dispersion and periodic self-focusing of the light inside. Spatial beam cleaning, wavelength conversion, and spatiotemporal mode-locking have been demonstrated with graded-index multimode fibers.

Spatiotemporal mode-locking is a newer approach to generating ultrashort pulses. It creates a balance between spatial and temporal effects within a multimode laser cavity, which supports multiple paths to guide light. The large multimode core diameter of the fiber decreases the nonlinearity of the cavity and allows the system to reach high pulse energies without external amplification. However, due to its multimode nature, high power spatiotemporally mode-locked lasers suffer from a low-quality output beam.

Spatiotemporal mode-locking is a newer approach to generating ultrashort pulses. It creates a balance between spatial and temporal effects within a multimode laser cavity, which supports multiple paths to guide light. The large multimode core diameter of the fiber decreases the nonlinearity of the cavity and allows the system to reach high pulse energies without external

amplification. However, due to its multimode nature, high power spatiotemporally mode-locked lasers suffer from a low-quality output beam.



Schematic of the laser cavity and beam profile measurements. (a) QWP, quarter-wave plate; HWP, half-wave plate; PBS, polarizing beam splitter; ISO, isolator; SF, spatial filter. (b) Evolution of near-field output beam profile for decreasing cavity loss from continuous wave to mode-locked operation for 8 nJ output pulse energy. Credit: Tecin et al., doi 10.1117/1.AP.2.5.056005.

Single-mode beam quality via nonlinear beam cleaning

EPFL researchers demonstrated nonlinear beam cleaning in a multimode laser cavity—a first-ever demonstration—which enables generation of high-energy, ultrashort pulses with single-mode beam quality. Their report, published in the peer-reviewed, open access journal *Advanced Photonics*, shows that engineered intracavity temporal pulse properties enable a route to generate a high-quality beam when mode-locking is achieved.

Their design allows the generation of sub-100 femtosecond pulses with high pulse energy (>20 nJ) and beam quality of M2 value (less than 1.13 without external amplification) in a compact and low-cost form. The team investigated the complex cavity dynamics by mode-resolved simulations and confirmed nonlinear beam cleaning numerically and experimentally.

Lead author Ugur Tecin notes that his team's work presents a new way to harness and control spatiotemporal nonlinear dynamics for ultrashort pulse generation. The results of this research show that good beam quality, high pulse energy, and sub-100 fs pulse duration from a fiber laser can be constructed with commercially available and standard components. The reported method can be extended to fibers with a larger core size for further power scaling while preserving the beam quality of sub-100 fs pulses.

More information: Uğur Teğın et al, Single-mode output by controlling the spatiotemporal nonlinearities in mode-locked femtosecond multimode fiber lasers, *Advanced Photonics* (2020). DOI: [10.1117/1.AP.2.5.056005](https://doi.org/10.1117/1.AP.2.5.056005)
<https://phys.org/news/2020-12-nonlinear-spatiotemporally-mode-locked-lasers.html>

Pumping a nanoparticle to lase at low power

Lasers are used in a range of everyday devices, harnessing the power of light molecules, photons, - lined up to form highly concentrated beams of light—to perform now common tasks such as scanning barcodes and removing tattoos.

As biosensing and bio-imaging research seeks to look deep inside tissue to the intracellular level miniaturizing laser devices poses significant challenges for these nanoscale biological applications. In new research, published in *Nature Communications*, scientists demonstrate how the earlier promising concept of a microcavity laser can produce an energy-saving and user-safe laser emissions requiring low pump power.

Corresponding author Dr. Jiajia Zhou, from the University of Technology Sydney (UTS), said that normally low pump power is insufficient to make nanoparticles to lase but the team was able to "control the luminescent emitters within every single nanoparticle to interact with each other so that the electrons can accumulate at specific energy levels".

"This means that even at a very low power pump the nanoparticles will lase, in fact we demonstrated a two-order of magnitude lower pumping threshold compared to what is usually achieved," she said.

The research team also had to engineer the binding surface of the nanoparticle matrix to form a cavity surface with a uniform single layer.

Dr. Zhou said that potentially the Near Infra Red (NIR) microcavity laser can be embedded in thick tissues, single cells, and to sense the environmental indicators such as temperature, pH, and refractive index.

"Monitoring the change of these indicators can tell us the health status of the tissues or cells, which sits in the scope of early-stage disease detection," she said.

Senior author, director of UTS Institute for Biomedical Materials & Devices Professor Dayong Jin, said this discovery held great promise for biological applications.

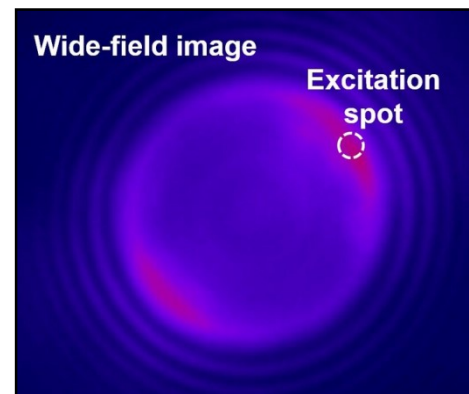
"I think this is definitely a step forward to realizing the dream that just as we use a laser pointer on a powerpoint slide, we could point a tiny device inside a cell, and illuminate an area of interest inside the compartments of a cell.

"Lowering the requirement for the pump power means less tissue damage as the laser penetrates the sample. Also, in this case the laser emission is as sharp as a line, it can sense the indicators more accurately by avoiding the undesired interference which frequently happens in spontaneous fluorescence-based sensing," he said.

"It's not science fiction. We've demonstrated a single nanoparticle, which is smaller than an intracellular compartment, can act like a laser, and at low power but it can still emit a sharp signal. In other words a 'laser pointer' small enough to get inside a cancer cell, and illuminate to stop the engine of that cancer cell," Professor Jin, who is also the director of UTS-SUSTech Joint Research Centre, said.

More information: Yunfei Shang et al, Low threshold lasing emissions from a single upconversion nanocrystal, *Nature Communications* (2020). DOI: [10.1038/s41467-020-19797-4](https://doi.org/10.1038/s41467-020-19797-4)

Journal information: [Nature Communications](https://phys.org/news/2020-12-nanoparticle-lase-power.html)
<https://phys.org/news/2020-12-nanoparticle-lase-power.html>



As biosensing and bio-imaging research seeks to look deep inside tissue to the intracellular level miniaturising laser devices poses significant challenges for these nanoscale biological applications. Credit: Jiajia Zhou

Researchers identify new process to produce ammonia with a much smaller carbon footprint

By Sharon Parmet

Ammonia is the second most commonly produced chemical in the world and an important component of most fertilizers, but current industrial processes to make ammonia produce several millions of tons of carbon dioxide—a potent greenhouse gas—each year.

Now, researchers led by Meenesh Singh, assistant professor of chemical engineering at the University of Illinois Chicago College of Engineering, describe a new process to produce ammonia with a potentially much lower carbon footprint. They report their findings in the journal *ACS Catalysis*.

Nitrogen gas is one of the components used to make ammonia, but because nitrogen bonds in nitrogen gas are very stable, a lot of energy is needed to break them so the nitrogen can bind to hydrogen to produce ammonia.

"Current methods to make ammonia from nitrogen are very energy-intensive and require the burning of fossil fuels to generate enormous amounts of heat, and this produces a lot of greenhouse gas as a byproduct," said Singh.

Singh and colleagues have developed a new method to produce ammonia that relies on the use of a mesh screen coated in copper—a catalyst that helps bind nitrogen to hydrogen to make ammonia. The electrification of the screen helps drive the reactions.

Pure nitrogen gas is pushed through the screen and then interacts with water, which provides the hydrogen. Even though Singh's process uses similar amounts of energy compared to the traditional process, it requires far less fossil fuels than traditional methods—just enough to electrify the screen. "The electricity can come from solar or wind energy, which would really make a huge difference in reducing greenhouse gas emissions," said Singh. "Even modern electricity-generating powerplants are highly efficient, and if the grid is powered conventionally, our process still uses less fossil fuels and generates less harmful greenhouse gases than conventional ammonia production."

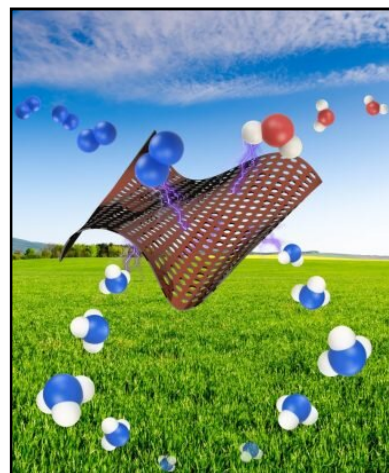
Currently, Singh's process produces 20% ammonia and 80 percent hydrogen gas. "We are hoping to increase the production of ammonia, but our early efforts so far are promising, and the savings in the carbon emissions are still significant if you were to scale up our process to produce large amounts of ammonia," Singh said.

A provisional patent for the new process has been filed by the UIC Office of Technology Management. Singh's group is now looking at using air—instead of purified nitrogen gas—as a source of nitrogen for producing ammonia using their unique method. "Using air would give us even more savings when it comes to greenhouse gases because we're using readily available air instead of nitrogen gas, which needs to be purified and bottled."

More information: Nishithan C. Kani et al, Competing Effects of pH, Cation Identity, H₂O Saturation, and N₂ Concentration on the Activity and Selectivity of Electrochemical Reduction of N₂ to NH₃ on Electrodeposited Cu at Ambient Conditions, *ACS Catalysis* (2020). DOI: [10.1021/acscatal.0c04864](https://doi.org/10.1021/acscatal.0c04864)

Journal information: *ACS Catalysis*

<https://phys.org/news/2020-12-ammonia-smaller-carbon-footprint.html>



The electrochemical reduction of N₂ to NH₃ offers a means for storing solar energy and distributed production of fertilizers. The picture shows continuous capture of N₂ from the air and its conversion to NH₃ at high selectivity using electrocatalytic screens. Credit: Aditya Prajapati and Meenesh Singh

A new lesson about phase transitions and criticality

NUS physicists have discovered a theoretical behavior known as the "critical skin effect" influencing how changes between different phases of matter occur.

Phase transitions are ubiquitous in the world around us, encompassing common processes such as freezing and evaporation. Of particular interest are second-order phase transitions, where the system at the transition point reaches a so-called critical state characterized by long-range order and extreme susceptibility to disturbances. A paradigmatic example is the ferromagnetic transition, where correlated spin clusters grow larger and larger as temperature is lowered, until they coalesce into a single ordered phase with all spins pointing in the same direction. Due to its universal and intuitive appeal, the concept of criticality has also permeated other fields like the modeling of financial market crashes. As a theoretical concept, criticality has also inspired advances in deep topics like conformal field theory, percolation and fractals.

A research team led by Prof GONG Jiangbin and Prof LEE Ching Hua, both from the Department of Physics, NUS has discovered a new form of critical behavior known as the "Critical Skin Effect" (see Figure). This discovery extends the scope of known critical phase transitions to non-equilibrium systems which, unlike conventional equilibrium systems governed by unitary time evolution, are open systems that experience gain or loss due to their external interactions. Lately, it has become widely recognised that non-equilibrium systems can experience dramatic directed long-range amplification that changes the qualitative nature of the system, in a new phenomenon known as the non-Hermitian skin effect (NHSE). This inspired the research team, which includes Dr. LI Linhu (who recently joined Sun Yat-sen University (Zhuhai), China) and Mr MU Sen (Ph.D. student), to ask how the interplay between the NHSE and critical state can result in new physics.

The team discovered that in a non-equilibrium system, even changing system size can profoundly affect its state. For instance, a system can be insulating (gapped) at small sizes, but metallic (gapless) at larger sizes. Or, it can possess topological modes for certain system sizes but not others. This observation is counterintuitive, since we typically do not expect the introduction of additional sites to change the qualitative nature of the state, just like a magnet should not spontaneously demagnetise if we cut it in half. Furthermore, the very concept of the thermodynamic limit is now brought into question, since there exists a new class of states that will become invariably altered as the system size is increased to infinity.

Prof Lee, who first connected the dots between the seemingly paradoxical numerical evidence, explained, "The "Critical Skin Effect" provokes a paradigm shift in how we think about critical

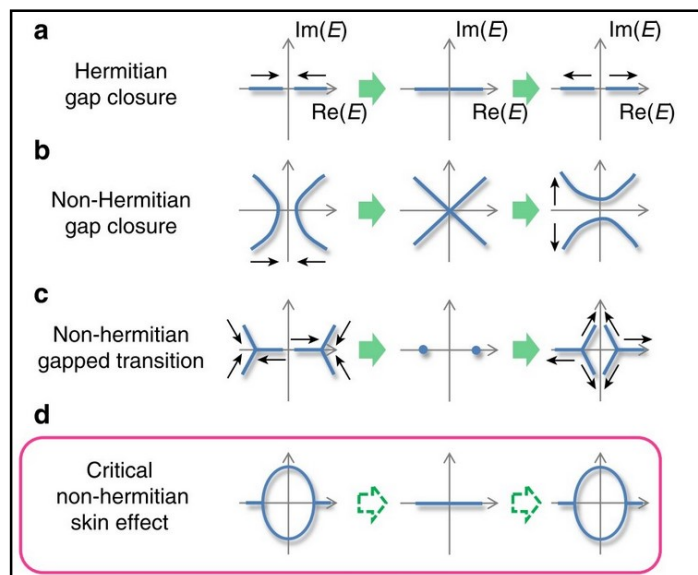


Figure shows a variety of phase transition behaviours in Hermitian and non-Hermitian systems. The left and right columns show the system's spectra on both sides of the transitions, while the middle column shows the intermediate (critical) spectra. (a) Typical Hermitian phase transitions consist of the closure of the spectrum along the real line. (b-d) In non-Hermitian systems, the phase transition can occur via different distinct manners in the complex energy plane. In the "Critical Skin Effect", the intermediate critical spectrum is not even deformable to the spectrum before and after. Credit: Nature Communications

behavior and long-range order. When non-equilibrium effects contribute their share of long-ranged influences, we are forced to reformulate certain concepts usually taken for granted, such as the so-called generalized Brillouin zone."

Interestingly, critical skin states can even exhibit scale-free behavior while decaying exponentially in space, contrary to conventional critical states which are almost synonymous with power-law spatial decay. They also possess unusual size-dependent entanglement entropy behavior, challenging usual approaches for characterizing critical states through their entanglement entropy scaling.

Prof Gong said, "In the past several years, studies of non-Hermitian phenomena from the perspective of condensed-matter physics have increased significantly. Given that even a well-known concept like critical states can now assume new meanings, we cannot afford to limit our imagination about what can come next."

Beyond its theoretical interest, this discovery is also relevant to sensing and switching device applications. For instance, a sensing circuitry can be programmed to detect different types of signals as its effective length is varied through switches. As a proof-of-principle, the team is currently planning to demonstrate this new type of critical phase transition through electronic RLC circuits, where the detailed spectrum can be mapped out through "topoelectrical" impedance measurements.

More information: Linhu Li et al. Critical non-Hermitian skin effect, *Nature Communications* (2020). DOI: [10.1038/s41467-020-18917-4](https://doi.org/10.1038/s41467-020-18917-4)

Journal information: [Nature Communications](https://phys.org/news/2020-12-lesson-phase-transitions-criticality.html)
<https://phys.org/news/2020-12-lesson-phase-transitions-criticality.html>



Wed, 02 Dec 2020

Researchers peer deep inside tissue with new high-resolution techniques

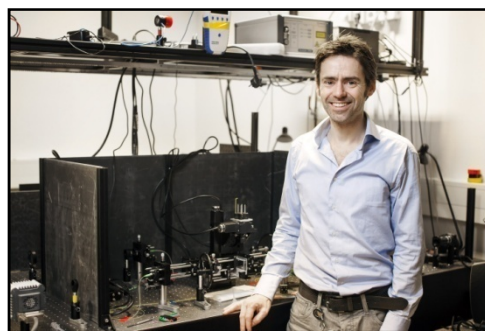
By Jerwin De Graaf

One of the challenges in optical imaging is to visualize the inside of tissue in high resolution. Traditional methods allow researchers to look to a depth of approximately 1 millimeter. Researchers at Delft University of Technology have now developed a new method that can penetrate up to four times as deep, up to around 4 millimeters. The healthcare sector in particular may benefit from the new technique in the future.

The new imaging method brings together a number of existing techniques. The most important of these is optical coherence tomography, a technique ophthalmologists use to image the retina. OCT is similar to acoustic ultrasound, but uses light instead of sound waves while having a higher resolution. Using the information contained in the reflected light waves, an algorithm can create a cross section of the tissue.

Cross section

Unlike a normal OCT scan, the Delft researchers do not make images with reflected light, but send the light right through the tissue. On the other side, a sensor captures it again. The researchers can see which light arrives and when. "The light that travels for a longer period of time is scattered through the tissue and arrives at the detector relatively late," TU Delft researcher Jeroen Kalkman explains. "Usually, this causes the resulting



Researcher Jeroen Kalkman stands next to his new imaging setup. Credit: TU Delft

images to be blurred. But by looking at the arrival time, we can separate this scattered light from the light that went straight through the sample. With the light that arrives early, we can produce a sharp image."

In order to make a cross-section, a so-called tomogram, of the object, the researchers use technologies known from computer tomography, of which the best-known example is the CT scan. "This involves measuring a projection of the X-rays coming through the object at many different angles and positions," says Kalkman. "You can then connect all these different projections together using a computer to create a three-dimensional image. We do the same thing, but with light."

To find out how powerful their technique is, the researchers tested it on dead zebrafish, which they obtained through an ongoing study at Erasmus MC. The maximum penetration depth was found to be about four millimeters, an improvement of a factor of four compared to the current reflection approach in OCT. In addition, the zebrafish organs could be depicted with high contrast by looking at both the strength and the arrival time of the light. Kalkman says, "We've been working on this with a whole team of researchers for almost ten years, so it's a huge thrill that we've finally got it done."

In the future, the new Delft technique could generate valuable information about certain diseases. "With our method, we would be able to follow the development of such a disease very precisely over time," says Kalkman. "That way, we could study the effects of medicines or, conversely, potentially toxic substances on tissue. Doing so could provide us with useful insights that can ultimately lead to better treatments or better protection."

Another application of the new method is the analysis of biopsies, small pieces of human tissue that doctors take from patients for analysis. "Currently, labs often add fluorescent labels to biopsies, or they cut them into small slices and use optical clearing to make them more transparent," says Kalkman. "This takes a long time, and during this process biopsies can deform. We expect our technique to be able to image the biopsies in their three-dimensional form, thus helping doctors make a more accurate diagnosis."

More information: Deep-tissue label-free quantitative optical tomography, Jelle van der Horst, Anna K. Trull, Jeroen Kalkman, *Optica*. [www.osapublishing.org/optica/f ... -7-12-1682&id=444004](http://www.osapublishing.org/optica/fulltext.cfm?uri=optica-7-12-1682&id=444004)

Journal information: [Optica](https://phys.org/news/2020-12-peer-deep-tissue-high-resolution-techniques.html)
<https://phys.org/news/2020-12-peer-deep-tissue-high-resolution-techniques.html>

Phase 2/3 trials of Covid-19 vaccine Sputnik V commence in India

By Swati Bharadwaj

Hyderabad: Dr Reddy's Laboratories Ltd and Russia's sovereign fund Russian Direct Investment Fund (RDIF) on Tuesday said they commenced adaptive Phase 2/3 clinical trials for Sputnik V vaccine in India after receiving the necessary clearance from the Central Drugs Laboratory, Kasauli.

The clinical trials, which are being conducted by JSS Medical Research as the clinical research partner, will be a multicenter and randomized controlled study that will include safety and immunogenicity studies.

Dr Reddy's said it has also partnered with the Biotechnology Industry Research Assistance Council (BIRAC) of the Department of Biotechnology (DBT) for advisory support and for using BIRAC's clinical trial centres for the vaccine.



Commenting on the development, Dr Reddy's Laboratories co-chairman and managing director GV Prasad said: "This is another significant step as we continue to collaborate with multiple entities along with the government bodies to fast-track the process for launching the vaccine in India. We are working towards making the vaccine available with a combination of import and indigenous production model."

On Monday, Dr Reddy's top brass, including Prasad and the company's chairman Satish Reddy had a virtual meeting with Prime Minister Narendra Modi and updated him on the vaccine development front.

Recently, RDIF announced the second interim analysis of clinical trials data, which showed 91.4% efficacy for the vaccine on day 28 after the first dose and over 95% efficacy 42 days after the first dose.

Currently, 40,000 volunteers are taking part in Phase III of Sputnik V clinical trials, out of which over 22,000 have been vaccinated with the first dose of the vaccine and more than 19,000 – with both the first and second doses of the vaccine.

In September 2020, Dr Reddy's and RDIF had entered into a tie-up to conduct clinical trials of Sputnik V and distribution of the first 100 million doses in India.

On August 11, 2020, the Sputnik V vaccine developed by the Gamaleya National Research Institute of Epidemiology and Microbiology was registered by the Ministry of Health of Russia and became the world's first registered vaccine against Covid-19 based on the human adenoviral vector platform.

<https://timesofindia.indiatimes.com/india/phase-2/3-trials-of-covid-19-vaccine-sputnik-v-commence-in-india/articleshow/79513010.cms>

