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DRDO Technology News

THE HINDU

Wed, 13 Jan 2021

DRDO Chairman asks students to do output-driven research

Satheesh Reddy was delivering convocation address at the Hindustan Institute

Chennai: The Hindustan Institute of Technology and Science held its 11th convocation on Monday. G. Satheesh Reddy, Chairman of Defence Research and Development Organisation and Secretary of the Department of Defence R&D, delivered the convocation address.

Mr. Reddy exhorted students to participate in output-driven research to create first-of-its-kind systems that can be sold in the international market and contribute to Atmanirbhar Bharat.

Institute's Chancellor Elizabeth Verghese, Pro-Chancellor Anand Jacob Verghese, Vice-Chancellor S.N. Sridhara and senior officials of the institute participated in the event.

A total of 1,588 students from undergraduate, postgraduate, and Ph.D programmes received their certificates. As many as 68 rank holders received merit prizes.

Dr. Reddy also inaugurated the Centre for Automation and Robotics (ANRO), Motion Control Laboratory, and Human Machine Interaction Lanboratory. The ANRO developed service robot Sevili that assisted frontline staff during COVID-19. It also developed Shuzali, an air-purifying respirator that was installed at the Chengalpattu Medical College to protect staff from viral and bacterial infections while working in the ICU.

https://www.thehindu.com/news/cities/chennai/drdo-chairman-asks-students-to-do-output-driven-research/article33562634.ece

The Arunachal Times

Wed, 13 Jan 2021

Governor calls for promoting bio-toilets in Arunachal

Itanagar: Governor BD Mishra requested the Tezpur-based Defence Research Laboratory (DRL), under the Defence Research Development Organization (DRDO), to install a few bio-toilets developed by it in Itanagar on pilot-basis.

The governor said the bio toilets may be installed in the extended complex near the Lower Birup colony in Itanagar so that other people of the state can also adopt the innovative project.

He made the request during a meeting with Dr Soumya Chatterjee, a scientist from the Tezpur-based DRL at the Raj Bhawan here on Tuesday.

During the meeting, Dr Banerjee briefed the governor on the latest technologies developed by the Tezpur-based DRL in bio-toilets and various types of bio-toilets developed by it, which are suitable for high altitudes, hills and plain areas.

Commending the scientific achievement of the DRDO, Mishra said such a proactive role of DRDO will bolster the nation-wide cleanliness campaign under Swachh Bharat Abhiyan.

"Without a proper toilet system, the sludge of toilets reaches the streams and rivers, which results in water pollution and spread of diseases," he said.

The governor emphasized on promoting bio-toilets in Arunachal to maintain the state's pristine environment.

Rajiv Gandhi University VC Prof Saket Kushwaha was also present in the meeting. (PRO to Raj Bhawan)

https://arunachaltimes.in/index.php/2021/01/13/governor-calls-for-promoting-bio-toilets-in-arunachal/

Arunachal24.in

Wed, 13 Jan 2021

Arunachal: Governor takes up Bio-Toilet initiative

Itanagar: Dr. Soumya Chatterjee, a scientist from the Defence Research Laboratory (DRL), Defence Research and Development Organization (DRDO), Assam called on the Governor of Arunachal Pradesh Brig. (Dr.) B.D. Mishra (Retd.) at Raj Bhavan, Itanagar on 12th January 2021. Dr. Chatterjee gave a PowerPoint Presentation about the latest technologies developed by DRL in bio-toilets and briefed about various types of bio toilets developed by DRL, DRDO suitable for various terrains, including high altitudes, hill areas and plain regions.

The Governor appreciated the scientific achievement of the DRDO and suggested for construction of bio-toilets in Arunachal Pradesh. He reiterated that such a proactive role of DRDO will promote Hon'ble Prime Minister Narendra Modi ji's national cleanliness campaign of 'Swachh Bharat' Abhiyan.

The Governor, who has been one of the torch bearers in conducting and participating in cleanliness drives, emphasised on promoting bio-toilets for maintaining the pristine environment of the State. He said that without a proper toilet system, the sludge of toilets reaches the streams and rivers which results in water pollution and spread of diseases.

The Governor requested the DRL, DRDO, Tezpur to launch a pilot programme by installing some bio-toilets in the extended complex near lower Birup Colony, Itanagar so that other citizens in the State can also adopt such innovative projects.

Prof. Saket Kushwaha, Vice Chancellor, Rajiv Gandhi University, Doimukh, who has been carrying out cleanliness campaigns in RGU Campus was present in the meeting.

https://arunachal24.in/arunachal-governor-takes-up-bio-toilet-initiative/

Defence News

Defence Strategic: National/International

FINANCIAL EXPRESS
Read to Lead

Wed, 13 Jan 2021

Defence services, organisations purchase from MSMEs on GeM up 72%: Defence Secretary Ajay Kumar

Ease of Doing Business for MSMEs: Importantly, the biggest jump in defence procurement from MSMEs was recorded between FY18 and FY19 with order value witnessing a massive increase of 210 per cent from Rs 555 crore worth goods purchased on the GeM platform to Rs 1,725 crore during the said period

By Sandeep Soni

Ease of Doing Business for MSMEs: Online procurement of goods on the government's digital marketplace, Government e-Marketplace (GeM) by defence services and organisations under the Ministry of Defence grew 72 per cent by end of December FY21 from around the year-ago period, according to Defence Secretary Ajay Kumar. "Defence Services & organizations are adopting Government eMarketplace in their procurements rapidly. 72% growth in 2020-21 over 2019-20," said Kumar sharing data on microblogging site Twitter. From goods procured worth Rs 1,406 crore as of November 30, 2019, the order value grew to Rs 2,425 crore, as per data shared on New Year's Day. The overall procurement by defence organisations and departments for FY20 stood at Rs 2,810 crore.

The number of MSME vendors of Defence Public Sector Enterprises/Ordnance Factory Board increased from 7,591 in FY18 to 8,643 in FY19. (File image)

Importantly, the biggest jump in defence procurement was recorded between FY18 and FY19 with order value witnessing a massive increase of 210 per cent from Rs 555 crore worth goods purchased on the GeM platform to Rs 1,725 crore during the said period. Launched on August 9, 2016, to enhance speed and transparency in the government buying process to benefit small businesses, the marketplace saw procurement of defence-related goods worth Rs 19 crore during FY17.

Financial Express Online had in December reported the overall transaction value on GeM crossing Rs 74,552 crore as of December 30, 2020. The marketplace had 17.6 lakh listed products, 9 lakh sellers and service providers, and 11,543 product categories. The number of micro and small sellers on the GeM platform had crossed the 1.5 lakh mark in November last year – up 158 per cent from around 60,000 in November 2019 with 57.50 per cent share in total order value. As of January 12, 2021, 4.1 lakh sellers were MSEs out of 9.44 lakh total sellers on the GeM platform.

In July 2020, the government had said that MSMEs will be prime-tier vendors in the procurement of defence equipment by the government from the industry for Rs 31,130 crore approved by Defence Acquisition Council (DAC) on July 2, 2020. DAC in its meeting headed by

Defence Minister Rajnath Singh had approved proposals worth around Rs 38,900 crore for "capital acquisition of various platforms and equipment required by the Indian Armed Forced."

The number of MSMEs in the domestic defence production sector had increased 21 per cent till Q2 FY20 from the entire FY19, according to the data shared by the MSME Minister Nitin Gadkari in Rajya Sabha in March last year. The number of MSME vendors of Defence Public Sector Enterprises/Ordnance Factory Board stood at 7,591 MSME vendors in FY18. This had increased to 8,643 vendors in FY19 and further to 10,506 till Q2 FY20.

https://www.financialexpress.com/industry/sme/msme-eodb-defence-services-organisations-purchase-from-msmes-on-gem-up-72-defence-secretary-ajay-kumar/2169421/

Press Information Bureau
Government of India

Ministry of Defence

Mon, 12 Jan 2021 3:28PM

13th India-Vietnam Defence Security Dialogue

Defence Secretary Dr Ajay Kumar, co-chaired the 13th India-Vietnam Defence Security Dialogue along with his Vietnamese co-chair Sr Lt Gen Nguyen Chi Vinh, Deputy Defence Minister, Socialist Republic of Vietnam on 12 January 2021. During their virtual interaction, Defence Secretary and the Deputy Defence Minister expressed satisfaction at the ongoing defence cooperation between the two countries in spite of the limitations imposed by COVID 19.

During the virtual interaction, Defence Secretary and the Deputy Defence Minister exchanged views on the plan of action that has emanated from the recently concluded Virtual Summit between Prime Minister Shri Narendra Modi and Prime Minister of the Socialist Republic of Vietnam H.E. Nguyen Xuan Phuc in December 2020. New areas of defence cooperation were also discussed.

They expressed satisfaction at the growing defence ties between the two countries. Both the sides reviewed the progress on various bilateral defence cooperation initiatives and expressed commitment to further elevate engagements between the Armed Forces under the framework of the Comprehensive Strategic Partnership. Both sides agreed that in the recent past our respective countries have made notable strides in Defence Industry and Technology cooperation and look forward to even greater cooperation in this field.

https://pib.gov.in/PressReleasePage.aspx?PRID=1687915

पत्र सूचना कार्यालय
भारत सरकार
Ministry of Defence
रक्षा मंत्रालय

Tue, 12 Jan 2021 3:28PM

भारत और वियतनाम के बीच 13वां रक्षा संवाद

आपसी रक्षा सहयोग को मजबूत बनाने के उद्देश्य से भारत और वियतनाम के बीच आज 13 वीं रक्षा वार्ता आयोजित की गई। इस द्विपक्षीय वार्ता में भारत की ओर से रक्षा सचिव डॉक्टर अजय कुमार और वियतनाम की ओर से वहां के उप रक्षा मंत्री लेफ्टिनेंट जनरल गुएन चिन विन्ह ने भाग लिया। वर्चुअल रूप से आयोजित इस बैठक में दोनों ने कोविड महामारी के कारण सीमित हो गए अवसरों के बावजूद मौजूदा रक्षा सहयोग की स्थितियों पर संतोष व्यक्त किया।

रक्षा सचिव और वियतनाम के उप रक्षामंत्री ने इस अवसर पर प्रधानमंत्री श्री नरेन्द्र मोदी और वियतनाम के प्रधानमंत्री गुयेन जुआन फुक के बीच दिसंबर 2020 में संपन्न हुए वर्चुअल शिखर सम्मेलन के परिणामस्वरुप तैयार की गई कार्ययोजना पर विचार-विमर्श किया। इसमें रक्षा सहयोग के नए क्षेत्रों पर भी चर्चा की गई।

उन्होंने दोनों देशों के बीच बढ़ते रक्षा संबंधों पर संतोष व्यक्त किया। दोनों पक्षों ने द्विपक्षीय रक्षा सहयोग के लिए की गई विभिन्न पहलों की प्रगति की समीक्षा की और व्यापक रणनीतिक साझेदारी के तहत सशस्त्र बलों के बीच आगे सहयोग बढ़ाने के लिए प्रतिबद्धता व्यक्त की। दोनों पक्ष इस बात पर सहमत हुए कि हाल के दिनों में दोनों देशों ने रक्षा उद्योग और प्रौद्योगिकी सहयोग में उल्लेखनीय प्रगति की है और इस क्षेत्र में और भी अधिक सहयोग के लिए तत्पर हैं।

https://pib.gov.in/PressReleasePage.aspx?PRID=1688027

TIMESNOWNEWS.COM

Wed, 13 Jan 2021

After visit to Ladakh, CDS Bipin Rawat meets J&K L-G Manoj Sinha in Jammu; discusses security management

General Rawat and the L-G YK Joshi discussed several issues regarding the present security situation in the Union Territory of Jammu and Kashmir

Jammu and Kashmir: Chief of Defence Staff General Bipin Rawat, accompanied by Army Commander, Northern Command Lieutenant General YK Joshi met Lieutenant Governor Manoj Sinha at Raj Bhawan in Jammu on Tuesday.

Chief of Defence Staff General Bipin Rawat met Lieutenant Governor Manoj Sinha at Raj Bhawan in Jammu today. | Photo Credit: ANI

General Rawat and the L-G discussed several issues regarding the present security situation in the Union Territory. The two also discussed the important issues pertaining to internal and external security management, he said.

Rawat completed his two-day visit to the forward military posts in Ladakh sector along China border today and interacted with Army soldiers. He complimented them for their high morale and enhanced operational readiness, as per Headquarters Integrated Defence Staff.

On the second day of his visit, Rawat reviewed the operational preparedness of the forces deployed there. The CDS was briefed by local commanders on the prevailing operational situation.

No change in status quo in Eastern Ladakh

Army chief General MM Naravane, who also visited the forces in Ladakh, on Tuesday hoped for an amicable resolution of the military standoff with China through talks based on "mutual and equal security". He said India will have to be prepared to deal with a "two-front" threat scenario due to the potent and collusive threat from China and Pakistan.

Naravane added that the Indian troops are fully prepared to deal with any eventuality along the Line of Actual Control (LAC) and will hold their ground as long as it takes to achieve the "national goals and objectives."

The Chief of Army Staff was addressing a news conference ahead of the Army Day on January 15, where he said that through the medium of talks with China, India is trying to reach a solution that is "acceptable and not detrimental" to the national interests, adding "if the talks get prolonged, so be it."

https://www.timesnownews.com/india/article/after-visit-to-ladakh-cds-bipin-rawat-meets-jk-l-g-manoj-sinha-in-jammu-discusses-security-management/706445

THE TIMES OF INDIA

Wed, 13 Jan 2021

Ready to meet any eventuality: Army Chief on LAC standoff with China

New Delhi: Army Chief General Manoj Mukund Naravane on Tuesday addressed the annual conference where he addressed key matters relating to the threat India faces from hostile neighbours and Army's preparedness for any eventuality. Here are the highlights from Naravane's presser:

On India and China border standoff in Eastern Ladakh

- India is hopeful that the border confrontation with China in eastern Ladakh will find a peaceful solution but the Army is also prepared for any eventuality, said Naravane.
- The Army chief said that all logistics have been taken care of in case of any eventuality and the Army has maintained a high state of alertness all along the northern borders.
- All along the northern borders, we have remained vigilant. Friction points are there in the central and eastern sectors of the LAC where China has developed infrastructure. We keep monitoring it and factor it in our strategy.
- There was indeed a requirement of rebalancing towards northern borders and that is what we have put in place now. We are prepared to hold our ground as long it takes to achieve our national goals and objectives.
- Talks (between India and China) will be used to address the issues on the basis of mutual and equal security. I am confident that we will be able to resolve the issue.

On Reducing strength in Eastern Ladakh

- Every year People Liberation Army (PLA) troops come to traditional training areas. With winter and completion of training period, training areas have been vacated.
- It is fair to assume those troops who were in-depth areas in the Tibetan Plateau have gone back and that is the reduction in strength on the plateau.
- There has been no decrease in strength either on their side (China) or our side as far as the friction points are concerned.
- Naravane said the Army will hold on to its positions in eastern Ladakh.
- His statement comes in the backdrop of the Chinese Army moving back around 10,000 troops from the depth areas near the Line of Actual Control in Eastern Ladakh but the deployment in the frontline areas has remained the same.
- The chief said, "Even though we have more troops at high altitude, cold injury casualties this year have remained constant with the past. It was 0.13 per cent last year and is 0.15 per cent this year."

On Pakistan resorting to terror

- Naravane said that India has sent a clear message to Pakistan of zero-tolerance towards terrorist activities.
- "Pakistan continues to embrace terrorism. We have zero-tolerance for terror. We reserve our right to respond at a time and place of our own choosing and with precision," he said.

Can Pakistan and China team up against India?

- Without mixing words, the Army chief said that India cannot wish away collusion among threat countries.
- "Pakistan and China together form a potent threat and the threat of collusivity cannot be wished away," he said, adding, that the Army keeps modifying its preparedness based on geopolitical developments.

- There is increased cooperation between China and Pakistan in both military and non-military sectors. The two-front threat is something that we should be prepared to deal with, said the chief.

2020 was a year of challenges

- Reflecting on the year gone by, Naravane said that the last year was full of challenges.
- We had to walk the talk and meet the challenges. We did so and came out on the top. The main challenge was CO19 and the situation at the northern borders said the chief.
- We need to restructure and enhance our capabilities considering what has happened last year, said Naravane.

On Jammu and Kashmir

- As far as internal security duty is concerned, terror continues abated in J&K. Although the situation in the hinterland has improved, it has not reached a level in which we can even contemplate moving troops out of the UT of J&K.

Army bringing in new tech

- A broad roadmap has been prepared to bring in all the new technologies to develop a technology-enabled army to meet challenges of future, said the chief.

On Women officers in Army aviation

- Last month, I had initiated a proposal that women officers can be recruited to Army aviation. We are thinking that in the next course in July 2021, we will admit women officers for pilot training.

On United Service Institution of India (USI) report

- I'd say that the sample size of 400 is not adequate. For 99 per cent accuracy, at least 19,000 samples should have been taken. We have taken a number of measures to deal with stress in jawans. The number of suicides have reduced year-on-year, said the Army chief.

Honours and awards

- It is not just for officers & jawans who are martyred at Galwan but throughout the past year, there have been many gallant actions carried out by our men, said Naravane.
- All those who have contributed to upholding the security and sanctity of the country, their acts will be recognised in some way or the other, he said.
- All these actions, citations have been received and they will be evaluated on their merits and recommendations to honour all those who have performed acts of gallantry & valour have been forwarded to the ministry for final approval, said the chief.

(With inputs from agencies)

https://timesofindia.indiatimes.com/india/ready-to-meet-any-eventuality-army-chief-on-lac-standoff-with-china/articleshow/80227849.cms

Business Standard

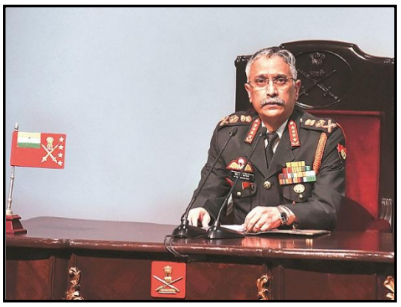
Wed, 13 Jan 2021

Will confront China till acceptable solution is found, says Army Chief

Naravane claims his troops took the Chinese by surprise on Ladakh Range

By Ajai Shukla

New Delhi: Chief of Army Staff (COAS) General MM Naravane made it clear on Tuesday that the army will continue confronting China's People's Liberation Army (PLA) on the Ladakh-Tibet border, rather than caving in on the dialogue table.



Chief of Army Staff (COAS) General MM Naravane

Addressing his annual press conference in the run-up to Army Day on January 15, Naravane stated: "Eight rounds of talks have taken place. Each of these rounds have preceded or been followed by diplomatic parleys. We will ensure that, through the medium of talks, we reach a solution that is acceptable and is not detrimental to our interests."

He said the army was awaiting the scheduling of the ninth round of senior officers' dialogue.

Naravane confirmed *Business Standard's* report last week (January 7, *Army's pivot to the north*), stating: "As events in eastern Ladakh show, there was indeed a requirement of carrying out rebalancing of the northern border. That is what we have put in place."

The COAS was referring to the allocation of a new operational responsibility to 1 Corps, one of the army's three mechanised strike corps, which is now tasked to prepare for offensive tasks across the Line of Actual Control (LAC) in Ladakh.

For now, however, Naravane said the situation in Ladakh remained frozen. "There has been no change in the status quo. The situation is the same as last year. Disengagement from friction areas and overall de-escalation in the forward areas are the way ahead," he said.

The army chief admitted that the Chinese military had taken the Indian Army by surprise last April-May when PLA troops, which had ostensibly mobilised for training to the border area adjoining Ladakh, suddenly wheeled west and occupied several pockets of land on the Indian side of the LAC.

"The PLA mobilization last year was an annual affair as they come [at this time] for exercises. We were fully aware of their deployment but they had a first mover's advantage," he said.

Naravane said that Indian troops enjoyed the same "first mover's" advantage in August when they occupied dominating heights on the Ladakh Range, taking the Chinese by surprise south of the Pangong Tso lake.

The COAS downplayed reports of the withdrawal of some 10,000 PLA troops, which had deployed close to the LAC to back up Chinese units that were face to face with Indian soldiers. He said there was no dilution of PLA troop numbers or of their posture at any of the points of confrontation.

The army chief dismissed a think tank report that more than half the army was suffering from stress of various kinds. "Even I am stressed", he quipped, pointing out that the report had been drawn from a very small base.

Asked whether the Ladakh deployment had placed an unbearable burden on the army, Naravane pointed out that, despite having a greater number of troops deployed at high altitude, cold-related casualties had remained broadly the same. Last year 0.13 per cent of troops deployed became casualties and this year the figure is 0.15 per cent.

Asked about the fiscal squeeze, the COAS said the army was confident that it would receive additional funds under the revenue head. He said the army had been allocated the budget that was needed last year to enhance capability."

https://www.business-standard.com/article/current-affairs/will-confront-china-till-acceptable-solution-is-found-says-army-chief-121011201697_1.html

The EurAsian Times

Wed, 13 Jan 2021

Indian Air Force base near China gets 'fighter shelters' that can withstand 2000-pound bomb

The Indian Air Force also has another technology to repair damaged runways in a few hours. The combination of the hardened shelters and capability to repair damaged runways quickly gives India an operational edge in combat with China

By Aakriti Sharma

The Indian Air Force is believed to have completed the construction of next-generation hardened aircraft shelters (NGHAS) at the Chabua Air Force Station in Assam, close to the China border. The specialized structures are capable of withstanding a 2000-pound bomb.

These structures comprise layers of reinforced concrete, sand, and steel. They can protect aircraft from direct hits by a 2,000-pound bomb. In 2019, the Indian government had given the nod to construct 108 modern shelters to house fighter aircraft in the forward areas close to India's northern borders.

A representational image of a hardened aircraft shelter.

Satellite images shared by open-source intelligence Twitter handle @detresfa_ show the newly developed NGHAS at the Chabua Air Force Station in Assam. "After supporting operations during World War II and the 1962 India-China tensions, the Chabua Air Force Station in Assam looks to be completing its new NGHAS specialized structures," it says.

This assumes significance as it comes in the backdrop of massive infrastructure development being undertaken by China in the Tibet Autonomous Region opposite Arunachal Pradesh in India's Northeast. The two countries have been locked in a border standoff since May 2020.

The majority of the hardened shelters have been designed to house the Russian-made Su-30MKi jets. While MiG-21s are already deployed in the region, French-made Rafale fighters are likely to join soon.

The Indian Air Force also has another technology to repair damaged runways in a few hours. The combination of the hardened shelters and capability to repair damaged runways quickly gives India an operational edge in combat with China.

Earlier, there were blast pens only in the western sector along the border with Pakistan. The blast pens are an E-shaped double bay to protect the aircraft from strikes by enemy jets or missiles.

According to Air Marshal VK 'Jimmy' Bhatia (Retd), the NGHAS are of much better quality, offering much better protection to the parked aircraft than the existing pens in the IAF. He is of the opinion that "aircraft parked in these shelters would be able to withstand a nuclear attack outside ground zero without losing their operational capability for mounting retaliatory strikes".

India and China have ramped up infrastructure construction along the loosely demarcated Line of Actual Control. Both sides have amassed troops and weapons at important bases amid the border standoff that began in May 2020.

India is building 73 strategic roads and 125 bridges on the Indian side of LAC. The government has also approved nine "strategic" rail lines – including the Missamari-Tenga-Tawang in the northeast and the Bilaspur-Mandi-Manali-Leh sections in the north –along the border with China to facilitate the movement of the armed forces.

While Chinese experts claimed that the PLA can launch a barrage of early long-range missile strikes against Indian airbases to incapacitate, a study by Belfer Center Study of Harvard Kennedy School refutes such claims.

A senior IAF officer quoted in the study states that China needs 220 ballistic missiles to keep one airfield shut for 24 hours. India has a large number of airfields (from Leh to Pasighat), hence if the PLA air force attacks just three airbases, it will require 660 ballistic missiles per day for attacking the runway and taxi track alone, the study says.

In case that happens, India's proven capacity to repair the runways within six hours maximum will put the airbase back on track to attack, the study suggests.

https://eurasiantimes.com/indian-air-force-base-near-china-gets-fighter-shelters-that-can-withstand-2000-pound-bomb/

THE WIRE

Wed, 13 Jan 2021

In 2021, India's military faces myriad challenges

While the standoff with China will dominate the operational agenda for all three services in 2021, they will also have to cope with equipment and resource shortages

By Rahul Bedi

New Delhi: The operational prognosis for India's military in the New Year is, to put it mildly, perilous.

It faces enhanced and relentless deployment along its unresolved and restive frontiers against belligerent nuclear and military allies, China and Pakistan and will continue to be hobbled by enduring critical equipment, ammunition and ordnance shortages. It also has to battle a declining defence budget and reorient its outdated doctrinal and warfighting strategies to meet 21st century challenges.

Army soldiers stand guard at snow-bound Zojila Pass, situated at a height of 11,516 feet, on its way to frontier region in Ladakh. Photo: PTI

Indisputably, the continuing military standoff with China along the disputed Line of Actual Control (LAC) in eastern Ladakh, will dominate the gruelling operational agenda for all three services in 2021, especially that of the Indian Army (IA).

Presently, over 40,000 IA personnel and varied platforms including main battle tanks, howitzers, missile batteries, amongst other force multipliers, are deployed in a heightened state of alert along the LAC's freezing desert frontage over a 350-400 km frontage, at heights above 14,000 feet. Their burdensome task in the rarefied environment is to thwart further ingress by the People's Liberation Army (PLA) into territory claimed by India as its own, in temperatures that currently average minus 40 degrees Celsius.

To make matters worse, indicators denote that this formidable and skulking threat is unlikely to dissipate anytime soon. Senior military planners concede that hereafter, the IA's heightened LAC deployment will duplicate its perennial, enervating and financially draining employment along the

Line of Control (LoC) against Pakistan in Jammu and Kashmir and across the 76 km long 17,700 feet high Siachen Glacier.

And though the LAC deployment is likely to exclude the frequent artillery, mortar and small arms firefights that define the LoC engagement, it is challengingly offset by its vast expanse, comparative lack of infrastructure for troops and above all, unfamiliarity with the lesser-known and better-accoutred enemy.

"The IA will have to remain in a state of constant operational readiness on the LAC in Ladakh for an extended period to counter the PLA's unrelenting aggressive posture," said military analyst Major General A.P. Singh (retired). Under the circumstances, the IA's deployment here is almost certain to become permanent in order to prevent a duplicitous China from seizing additional territory, added the two-star officer who was earlier posted in Ladakh.

Defence minister Rajnath Singh hinted as much in a recent interview to ANI in which he declared that no "meaningful solution" had emerged from diplomatic and military level talks with China to resolve the LAC impasse. He stated that a "status quo" of mutual army deployments had emerged at the LAC May onwards, a euphemism for the 'new normal' along the inhospitable frontier in 2021 and beyond.

Senior IA officers too remain sceptical over anything positive emerging from talks with the PLA, through which India is futilely seeking to restore the 'status quo ante' that prevailed along the LAC before its siege commenced in April 2020. "The eight previous rounds of military talks between India and China have merely been talks about talks with little or nothing emerging from them," said a one-star IA officer, declining to be identified.

India, he cautioned, cannot harbour illusions regarding an unconditional PLA pullback from the LAC, as that would be a major loss of face for Beijing, and one which it simply cannot countenance because of its own internal dynamics. Hence, the overstretched, inadequately-equipped and underfunded IA faces formidable resource and manpower challenges, ensuring a demanding year ahead. Other veterans said that the PLAs incursions will also enduringly 'tie down' the IA on the LAC, leaving it inadequate reserves to counter challenges elsewhere. The IA's force levels, they warned, will need to be seriously re-evaluated and revamped over the coming months.

At present, the IA is re-orienting its Mathura-based 1 strike corps – one of three such 'sword arm' formations, with the other two headquartered at Ambala (2 Corps) and Bhopal (21 Corps) – to convert it into a mountain strike corps to counter the PLA along the 800 km long LAC in Ladakh. According to newly formulated plans, two of its infantry divisions are to be trained in mountain warfare before being gradually deployed to Ladakh in summer.

For several decades, a resource-strapped and diffident India has pursued the path of least resistance against China, sheltering behind multiple bilateral border treaties and confidence building measures to somehow secure peace with its more powerful neighbour. China, for its part, already embarked by the early 1990s on its path to global economic dominance, patronised India by lulling it into a false sense of security through these pacts which, in hindsight were little better than delaying tactical stratagems by Beijing.

Successive governments in Delhi remained in denial over possible military adventurism by China, driven in fact by the reality that India simply could not afford significant force deployment along the LAC other than the Leh-based 14 Corps. This situation persisted despite repeated PLA infiltrations of varying periods across the LAC in Chumar, Depsang in 2013 and 2014, and thereafter in Doklam in 2017. And though this lacuna is now being redressed after the PLA presented its fait accompli over nine months ago in Ladakh, analysts said that the IA continues to concentrate the bulk of its forces against Pakistan. Twenty two of its 38 divisions are earmarked for Pakistan, whilst 14 divisions are ranged against China, the obviously more formidable of India's two adversaries. The remaining two divisions are, for now, earmarked as Army Headquarter reserves.

Air Force and Navy also stretched

Conversely, the Indian Air Force's (IAF's) capacities too, like those of the IA, continue to be stretched as its transport and heavy-lift helicopter fleets endeavour to keeps the army's logistics chain in Ladakh operational by ferrying personnel, equipment and assorted supplies to the LAC and its environs. Simultaneously, its depleted fighter squadrons, marginally boosted by the induction of eight French Rafale multi-role combat platforms, will also need to continue conducting combat patrols over Ladakh in 2021 to counter the PLA Air Force's (PLAAF's) threatening drills over the Tibetan plateau.

Likewise, the Indian Navy (IN) will need to sustain its state of perpetual alert that it has maintained in the Indian Ocean Region and surrounding waters over the past few months, in an effort to 'coerce' Beijing into vacating occupied territory and pulling back from the LAC. It recently concluded the Malabar exercises with the Australian, Japanese and US navies amongst assorted manoeuvres with other countries to try and forge an incipient anti-China coalition and leverage its maritime muscle against the PLA Navy. But like the IAF and the IA, the IN will need to reinvigorate its efforts in the New Year to sustain its operational momentum, despite the twin handicaps of equipment and resource shortages.

Meanwhile, the military impasse with the PLA has rendered palpable the advent of the terrifying collusive two-front threat from strategic allies China and Pakistan. Such an alarming scenario that successive Indian service chiefs have periodically, but perfunctorily enunciated, appears to be emerging. In recent months, senior retired military personnel and analysts warned the services and the federal government to abandon its earlier casual theorising regarding such a possibility and to begin seriously planning for a two-front conflict with its nuclear-armed neighbours.

And though the contours of such an engagement are unknown and speculatory, in all probability even to India's antagonists, it presents Delhi an ominous Hobson's choice; treating lightly such a forbidding possibility would be foolhardy, but preparing for it would be equally overwhelming, entailing, at the very least, colossal expenditures which India can ill afford.

Senior military analysts have called upon India's Chief of Defence Staff General Bipin Rawat to oversee the development of operational capabilities to deal with such an apocalyptic challenge by revamping outdated strategies and doctrines. They have stressed the long overdue requirement for all three services-particularly the IA-to abandon WW II concepts of attrition and manoeuvre warfare, familiar to generations of commanders and ones they feel 'comfortable' planning for and executing like in the 1965, 1971 and 1999 wars with Pakistan.

Instead, they recommend that India concentrate on 21st century 'informationalised' instrumentalities that China has been pursuing over nearly three decades for conflict execution and which are on display in Ladakh. In short, Beijing has presented India with a complex and lethal Chinese Puzzle which is going to be tough to resolve in 2021 and for years afterwards.

Military analyst Lieutenant General D.S. Hooda (retired) and strategic affairs expert Happymon Jacob from Jawaharlal Nehru University criticised the country's military for focusing unduly on major platforms like aircraft, ships and tanks and not enough on future technologies like robotics, artificial intelligence, cyber and electronic warfare. In their jointly authored analysis in *The Hindu* in late December, the two bluntly stated that it would indeed be 'prudent' for India to prepare for a two-front threat.

"In preparing for this, the Indian military needs to analyse how this threat could manifest itself and the type of capabilities that should be built up to counter it," they suggested. They also warned that a two-front conflict presented India's military with two dilemmas – of resources and strategy and of deploying both shrewdly and judiciously along putative primary and secondary fronts.

Budget woes

However, the biggest challenge India's military faces is monetary in times of acute indigence and a shrunken economy, hammered further by the ongoing COVID-19 pandemic.

Even in fiscal year 2020-21, when the economy faced none of the prevailing daunting challenges, the Centre was unable to meet the military's monetary demands, leaving a gap of Rs 1,03,535 crore between their requirements and the eventual budgetary allocation.

Already the services have made purchases worth around $2 billion after the Chinese threat emerged under the emergency financial powers accorded to the services. This, in turn, had adversely impacted the perennial shortage of funds for modernisation and other operational expenditure which had soared to keep the LAC manned by over 40,000 troops in extreme climatic conditions.

Without doubt, the military's monetary requirements will be substantially higher in the coming fiscal, adding to the government's woes in the forthcoming financial year.

https://thewire.in/security/india-military-2021-myriad-challenges-china-pakistan-standoff

Business Standard

Wed, 13 Jan 2021

China's PLA completes 3D mapping of its Western border: Official media

China's People's Liberation Army (PLA) recently started deploying the country's first panoramic, high-precision spatial datum that covers the uncharted Western border region of the country

Beijing: China's People's Liberation Army (PLA) recently started deploying the country's first panoramic, high-precision spatial datum that covers the uncharted Western border region of the country, official media here reported on Tuesday.

The system which provides 3D mapping with centimetre level accuracy will contribute to the infrastructure construction as well as combat capability enhancement of Chinese forces in the region, state-run Global Times reported.

China has the longest border spanning 22,000 kms and shares them with 14 countries with 11 of them, including India, in the Western sector.

India and China have 3,488-km long Line of Actual Control (LAC) including the Eastern Ladakh where the armies of the two countries have deployed a large number of troops.

Over the past two years a navigation and mapping unit affiliated with the PLA Western Theatre Command, which looks after the borders with India, traversed over 20,000 kms and established the first panoramic, high-precision spatial datum in the western border region based on 3D geographic information from remote sensing images and joint situational precognition, the Global Times quoted the official China Central Television (CCTV) as saying.

"The panoramic spatial datum is like a multifunctional, highly accurate ruler that can indicate the coordinates of remote sensing images and other geographic data. We can evaluate the data, that can reach centimeter-level accuracy," Wang Yanbin, deputy leader of the navigation and mapping unit, told CCTV.

(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/international/china-s-pla-completes-3d-mapping-of-its-western-border-official-media-121011201496_1.html

Technology

Wed, 13 Jan 2021

Two friends will send India's 1st private Earth-Imaging satellite on ISRO rocket

By Mohit Khanna

Highlights

- ***India's space adventures are often associated with the government-backed space organisation ISRO (Indian Space Research Organization), it looks like startup Pixxel Space will soon join this list***
- ***In case you're wondering that you've heard of Pixxel Space before, it's because a year ago, we got to interact with one of its founders.***
- ***At the time, the rocket was scheduled to launch in March 2020 on a Russian rocket. However, now, the company has announced that it will soon launch its satellite aboard ISRO's PSLV C51 Mission.***
- ***The satellite Pixxel Space has developed is called Anand and it is the first of the many Earth-imaging satellites that it plans to launch in space to offer a new kind of dataset while offering global coverage every 24 hours***
- ***Pixxel is a young aerospace startup from India, started by two BITS Pilani graduates Awais Ahmed and Kshitij Khandelwal in February 2019***

Whenever we hear about private space companies, the first name that comes to our mind is Elon Musk's SpaceX. But very soon, you'll have to make room for India's Pixxel space startup to that list.

While India's space adventures are often associated with the government-backed space organisation ISRO (Indian Space Research Organization), it looks like startup Pixxel Space will soon join this list, as it readies India's first homegrown private, commercial Earth-imaging satellite.

Pixxel is a young aerospace startup from India, started by two BITS Pilani graduates Awais Ahmed and Kshitij Khandelwal in February 2019, and becoming Asia's only space startup to qualify for the 2019 Techstars Starburst Space Accelerator in Los Angeles.

In case you're wondering that you've heard of Pixxel Space before, it's because a year ago, we got to interact with one of its founders. At the time, the rocket was scheduled to launch in March 2020 on a Russian rocket. However, now, the company has announced that it will soon launch its satellite aboard ISRO's PSLV C51 Mission.

The satellite Pixxel Space has developed is called Anand and it is the first of the many Earth-imaging satellites that it plans to launch in space to offer a new kind of dataset while offering global coverage every 24 hours that will allow organisations with access to the satellite to detect, monitor as well as predict global occurrences in real-time.

The space startup has developed software tools that use AI-based algorithms to offer crucial insights that can come in handy in industries like agriculture, oil and gas, agriculture, forestry, climate change monitoring and others.

Pixxel Space's efforts have even been lauded by Prime Minister Narendra Modi. He expressed his excitement on Twitter, stating, "Space is the space to be in! I assure you, and several others like you, of the constant support from the Government. The reform trajectory in this sector will also continue."

Surprisingly, Pixxel Space's Anand won't be the only Indian satellite aboard the PSLV C51. The payload consists of two more satellites including 'SATISH SAT' by 'Space Kids India', and 'UNIT-SAT' by a consortium of universities will also be launched as a part of the PSLV-C51 mission.

Reports have also revealed that the primary payload on the Pixxel rocket will house a Brazilian earth observation satellite named Amazonia. PSLV C51 is scheduled to launch sometime in February 2021.

There's no doubt that Elon Musk's company SpaceX has revolutionised the space industry -- but let's cheers the efforts of a couple of young Indians trying to create history and write a new chapter in private space history.

https://www.indiatimes.com/technology/news/pixxel-space-india-1st-earth-imaging-satellite-anand-isro-pslv-c51-531810.html

Wed, 13 Jan 2021

Discovery of quantum behavior in insulators suggests possible new particle

By Tom Garlinghouse

In a surprising discovery, Princeton physicists have observed an unexpected quantum behavior in an insulator made from a material called tungsten ditelluride. This phenomenon, known as quantum oscillation, is typically observed in metals rather than insulators, and its discovery offers new insights into our understanding of the quantum world. The findings also hint at the existence of an entirely new type of quantum particle.

The discovery challenges a long-held distinction between metals and insulators, because in the established quantum theory of materials, insulators were not thought to be able to experience quantum oscillations.

"If our interpretations are correct, we are seeing a fundamentally new form of quantum matter," said Sanfeng Wu, assistant professor of physics at Princeton University and the senior author of a recent paper in *Nature* detailing this new discovery. "We are now imagining a wholly new quantum world hidden in insulators. It's possible that we simply missed identifying them over the last several decades."

The observation of quantum oscillations has long been considered a hallmark of the difference between metals and insulators. In metals, electrons are highly mobile, and resistivity—the resistance to electrical conduction—is weak. Nearly a century ago, researchers observed that a magnetic field, coupled with very low temperatures, can cause electrons to shift from a "classical" state to a quantum state, causing oscillations in the metal's resistivity. In insulators, by contrast, electrons cannot move and the materials have very high resistivity, so quantum oscillations of this sort are not expected to occur, no matter the strength of magnetic field applied.

The discovery was made when the researchers were studying a material called tungsten ditelluride, which they made into a two-dimensional material. They prepared the material by using standard scotch tape to increasingly exfoliate, or "shave," the layers down to what is called a monolayer—a single atom-thin layer. Thick tungsten ditelluride behaves like a metal. But once it is converted to a monolayer, it becomes a very strong insulator.

"This material has a lot of special quantum properties," Wu said.

The researchers then set about measuring the resistivity of the monolayer tungsten ditelluride under magnetic fields. To their surprise, the resistivity of the insulator, despite being quite large, began to oscillate as the magnetic field was increased, indicating the shift into a quantum state. In effect, the material—a very strong insulator—was exhibiting the most remarkable quantum property of a metal.

"This came as a complete surprise," Wu said. "We asked ourselves, 'What's going on here?' We don't fully understand it yet."

Wu noted that there are no current theories to explain this phenomenon.

Nonetheless, Wu and his colleagues have put forward a provocative hypothesis—a form of quantum matter that is neutrally charged. "Because of very strong interactions, the electrons are organizing themselves to produce this new kind of quantum matter," Wu said.

But it is ultimately no longer the electrons that are oscillating, said Wu. Instead, the researchers believe that new particles, which they have dubbed "neutral fermions," are born out of these strongly interacting electrons and are responsible for creating this highly remarkable quantum effect.

Fermions are a category of quantum particles that include electrons. In quantum materials, charged fermions can be negatively charged electrons or positively charged "holes" that are responsible for the electrical conduction. Namely, if the material is an electrical insulator, these charged fermions can't move freely. However, particles that are neutral—that is, neither negatively nor positively charged—are theoretically possible to be present and mobile in an insulator.

"Our experimental results conflict with all existing theories based on charged fermions," said Pengjie Wang, co-first author on the paper and postdoctoral research associate, "but could be explained in the presence of charge-neutral fermions."

The Princeton team plans further investigation into the quantum properties of tungsten ditelluride. They are particularly interested in discovering whether their hypothesis—about the existence of a new quantum particle—is valid.

"This is only the starting point," Wu said. "If we're correct, future researchers will find other insulators with this surprising quantum property."

Despite the newness of the research and the tentative interpretation of the results, Wu speculated about how this phenomenon could be put to practical use.

"It's possible that neutral fermions could be used in the future for encoding information that would be useful in quantum computing," he said. "In the meantime, though, we're still in the very early stages of understanding quantum phenomena like this, so fundamental discoveries have to be made."

More information: Pengjie Wang et al, Landau quantization and highly mobile fermions in an insulator, *Nature* (2021). DOI: 10.1038/s41586-020-03084-9

Journal information: *Nature*

https://phys.org/news/2021-01-discovery-quantum-behavior-insulators-particle.html

PHYS.ORG

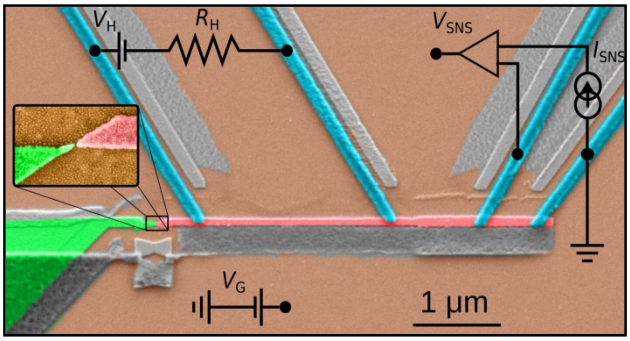
Wed, 13 Jan 2021

The realization of a single-quantum-dot heat valve

By Ingrid Fadelli

While many research teams worldwide are trying to develop highly performing quantum computers, some are working on tools to control the flow of heat inside of them. Just like conventional computers, in fact, quantum computers can heat up significantly as they are operating, which can ultimately damage both the devices and their surroundings.

A team of researchers at University Grenoble Alpes in France and Centre of Excellence—Quantum Technology in Finland has recently developed a single-quantum-dot heat valve, a device that can help to control the flow of heat in single-quantum-dot junctions. This heat valve, presented in a paper published in *Physical Review Letters*, could help to prevent quantum computers from overheating.



A Scanning electron microscope (SEM) image of the researchers' experimental setup. Credit: Dutta et al.

"With the miniaturization of electronic components handling of excess heat at nanoscales has become an increasingly important issue to be addressed," Nicola Lo Gullo, one of the researchers who carried out the study, told Phys.org. "This is especially true when one wants to preserve the quantum nature of a device; the increase in temperature does typically result in the degradation of the quantum properties. The recent realization of a photonic heat-valve by another research group ultimately inspired us to create a heat valve based on a solid-state quantum dot."

One of the key objectives of the recent study carried out by Lo Gullo and his colleagues was to demonstrate the feasibility of controlling the amount of heat that flows across a quantum dot junction, while also enabling the flow of a set amount of electric current. To design their single-quantum-dot heat valve, the researchers placed a gold nanoparticle between two metallic contacts, using it as a junction. This nanoparticle is so small that it can be used to intervene on a single energy level, acting as a bigger artificial atom would with several accessible energy levels.

"By properly tuning the external parameters it is possible to allow the electrons in one of the contacts to flow through only one of the levels of this artificial atom and reach the other contact," Lo Gullo explained. "The single-level quantum dot therefore acts as a bridge between the two metallic contacts."

In normal circumstances, the exchange of energy is only possible when the energy level of a quantum dot is in resonance with the energy of the electrons in the contacts. In the device developed by Lo Gullo and his colleagues, however, the presence of the contacts changes the properties of the artificial atom, by broadening its energy levels.

"This effect is at the heart of the heat-valve effect we have studied," Lo Gullo added. "The broadening amounts to the creation of virtual states, which are not classically accessible and allow electrons to flow from one contact to another, by carrying energy and giving rise to the heat-valve effect we reported."

In larger (macroscopic) conductors, researchers have identified a simple and universal relationship between their ability to conduct electrical charge and their ability to conduct heat. This relationship is outlined by a theoretical construct known as the Wiedemann-Franz law.

In quantum devices such as the one developed by Lo Gullo and his colleagues, however, things are not as straightforward. This is due to the quantization of charge and energy, which leads to deviations from the Wiedemann-Franz law.

"Using the most basic quantum mechanical picture (called semi-classical), one would expect a quantum dot junction not to conduct heat at all," Clemens Winkelmann, another researcher involved in the study, told Phys.org. "Our measurements, however, show that this is not true, and the theoretical explanation is related to quantum fluctuations, exactly as in the Heisenberg uncertainty principle, which partly restore the energy and thus the heat flow."

When they were developing their device, the researchers had to overcome a number of technical challenges. For instance, they had to identify a strategy to measure the temperature (and temperature differences) locally inside a quantum device. Ultimately, one of the greatest achievements of their study is that they were able to collect these measurements and thus gain a better understanding of how heat is managed inside quantum devices.

"Electronic devices produce dissipation when they treat information, and this leads to the well-known overheating issues observed in classical processors, which also occur the quantum world," Winkelmann said. "Overheating can perturb the logical operation of the device, leading to errors. Our work provides a better understanding of how heat is generated and can be drained in such a device."

By introducing a strategy to achieve control over the heat flowing through the smallest junctions in quantum devices, the recent paper by Lo Gullo, Winkelmann and their colleagues could open up interesting new possibilities related to an emerging field of study known as solid-state thermotronics. Solid-state thermotronics research investigates the possibility of controlling heat flows through temperature gradients in a similar way to that in which electrical currents and voltages are controlled in existing devices.

"Solid-state thermotronics is a relatively new field, but important progress has been made, such as the realization of heat valves, thermal diodes and transistors, energy harvesters and even the proposals of thermal logic gates," Lo Gullo said. "We provided yet another example of the feasibility of controlling and measuring heat currents and temperatures in solid-state devices."

In the future, the heat valve developed by this team of researchers could improve the reliability and safety of quantum devices, reducing the risk of overheating. In their next studies, Lo Gullo and Winkelmann would like to devise strategies to measure dissipation over time. In other words, instead of focusing on a quantum device's steady-state heating, they plan to examine single, elementary quantum-dissipative processes, such as the tunneling of a single electron or a single 2π slip of the quantum mechanical phase.

"There are many possible directions for future research," Lo Gullo added. "We are currently looking at junctions with a more complex structure to see if they offer some advantages in terms of range of operability. Another appealing possibility is to achieve time-resolved control over the heat flow, thus allowing real time operations in view of applications to thermotronics."

More information: Single-quantum-dot heat valve. *Physical Review Letters*(2020). DOI: 10.1103/PhysRevLett.125.237701.

Journal information: *Physical Review Letters*

https://phys.org/news/2021-01-single-quantum-dot-valve.html

Wed, 13 Jan 2021

Toward exawatt-class lasers

Ultra-intense lasers with ultra-short pulses and ultra-high energies are powerful tools for exploring unknowns in physics, cosmology, material science, etc. With the help of chirped pulse amplification (CPA) (2018 Nobel Prize in Physics), the current record has reached 10 petawatts (or 10^{16} Watts). In a study recently published in *Scientific Reports*, researchers from Osaka University proposed a concept for next-generation ultra-intense lasers with a simulated peak power up to the exawatt class (1 exawatt equals 1000 petawatts).

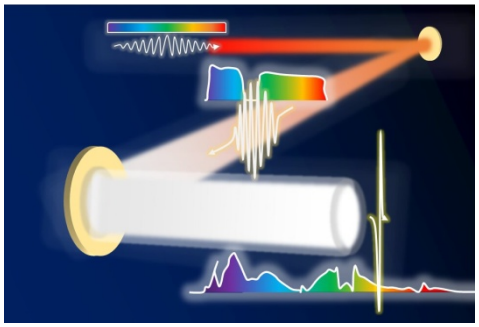


Figure: Concept for exawatt-class lasers. Credit: Osaka University

The laser, which was invented by Dr. T. H. Maiman in 1960, has one important characteristic of high intensity (or high peak power for pulse lasers): Historically, laser peak power has experienced two-stage development. Just after the birth of the laser, Q-switching and mode-locking technologies increased laser peak power to kilowatt (10^3 Watt) and gigawatt (10^9 Watt) levels. After CPA technology was invented by Gérard Mourou and Donna Strickland in 1985, by which material damage and optical nonlinearity were avoided, laser peak power was dramatically increased to terawatt (10^{12} watt) and petawatt (10^{15} watt) levels. Today, two 10-petawatt CPA lasers have been demonstrated in Europe (ELI-NP laser) and China (SULF laser), respectively.

At present, the facility scale of petawatt lasers around the world is very large and project investment is also very high. The next step for future ultra-intense lasers is to further increase the peak power by compressing the pulse duration instead of increasing the pulse energy.

In their previous study (*OSA Continuum*, DOI: 10.1364/OSAC.2.001125), this group developed a new design, wide-angle non-collinear optical parametric chirped pulse amplification (WNOPCPA), to increase the amplified spectrum and accordingly reduce the compressed pulse. The key mechanism of WNOPCPA is to increase the overall bandwidth by using a multiple-beam pump, which corresponds to different amplified spectra. "However, the pump interference, in addition to induced possible damage, is a potential problem in applying WNOPCPA to a huge project," explains corresponding author Zhaoyang Li.

In this newly improved design, by using a two-beam pumped WNOPCPA and carefully optimized phase-matching, pump interference is completely avoided, and an ultra-broadband bandwidth with two broad spectra is accomplished, resulting in <10 fs high-energy laser amplification. When this laser is combined with post-compression technology, the spectral broadening induced by nonlinear effects is significantly enhanced, and the simulation shows the record of the highest peak power can be pushed to the exawatt class.

"This design has two advantages: one is ultra-broadband amplification in WNOPCPA and the other is enhancement of nonlinear spectral broadening in post-compression. This research may provide a possible way to further increase laser peak power, even up to the exawatt class," says Zhaoyang Li.

More information: Zhaoyang Li et al. Simulating an ultra-broadband concept for Exawatt-class lasers, *Scientific Reports* (2021). DOI: 10.1038/s41598-020-80435-6

Journal information: *Scientific Reports*

https://phys.org/news/2021-01-exawatt-class-lasers.html

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Wed, 13 Jan 2021

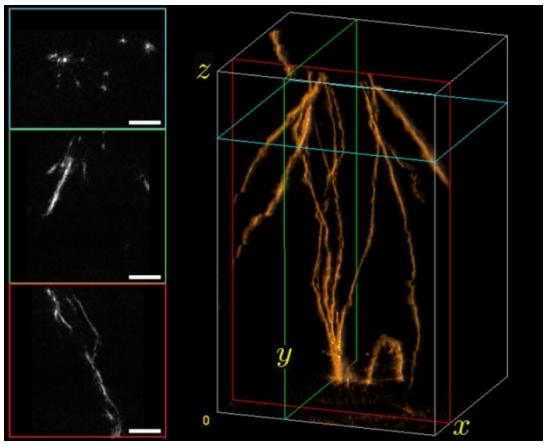
Synergistic collaboration leads to new strategy for biomedical 3-D imaging

By Russell Dickerson

When it comes to getting a three-dimensional look at cells in the human body, it is not much different than figuring out precisely where a firefly is in a field at night. We can tell which direction it is in, but it is challenging to know how far away it is.

A firefly emits luminescent, incoherent light. The light waves spread out without propagating along a particular direction, which makes determining the exact location of the firefly difficult.

A bat flying through the night sky would not have the same problem. It can easily locate that poor firefly by launching a sound wave in the direction of the fly and listening for the return echo. The bat's sound wave is coherent and directional, allowing her to pinpoint the location of the firefly with the backscattered sound waves.



3-D reconstruction of fluorescent stained cotton fibers. The blue, green, and red panels are slices of the object from x—y, y—z, and x—z slices, indicated by the colored rectangle in the main figure on the right. Scale bar equals 60mm. Credit: Randy Bartels

Similar coherent wave scattering is used in all sorts of everyday technologies, including ultrasound scans, sonar, radar, and coherent optical diffraction. All of these methods require coherent waves, with well-behaved peaks and valleys of the wave as it propagates. In the world of optics, lasers exhibit the same wave coherence.

Under support of funding from the National Institutes of Health, electrical and computer engineering Professor Randy Bartels' group, in collaboration with Professor Ali Pezeshki, Dr. Jeff Field, Colorado School of Mines Professor Jeff Squier, and graduate student Patrick Stockton, found a way to treat incoherent light emission as if it were coherent light. This new technology allows the team to collect incoherent light emitted by fluorescent molecules and reconstruct 3-D digital models of the object.

"We now have a completely new way to figure out where fluorescent light is coming from that wasn't accessible before," said Bartels.

Creating a model from incoherent light

Published in the journal *Optica*, Bartels' group combined optics and mathematical computations to develop a new strategy that shapes incoherent fluorescent light emitted by an object to form a high-resolution 3-D image.

Bartels compares the strategy to ultrasound imaging that creates an image of a cell or other object within the human body. Ultrasound uses the oscillations of sound waves reflected off an object to create an image, using mathematical computations to work out the differences in distance and time it took to return a wave back to the detector.

The problem with fluorescent light, often used in optical microscopes, is that the light is incoherent. The incoherent fluorescent emission scrambles the phase of the emitted light, which hides the location of the fluorescent emitters.

The collaborative team employed a strategy that mimics coherent light scattering in an image of incoherent light emission, by transferring differences in the phase of spatially coherent beams into a temporal variation of fluorescent light emission. Using a spatial and temporal modulation of the

illumination light, along with a mathematical model of the signal formation, the team created a higher resolution 3-D model through computational inversion of the data.

The process mimics the preservation of coherent oscillation of light in the scattering process, returning measurements of the precise location and brightness of objects emitting incoherent light.

"We have a sequence of shaped light that we use to illuminate the object and then we simply measure the power of the fluorescent coming out of the object. These data when combined with a mathematical model allow us to figure out the 3-D distributions of molecules," said Bartels. "This process mimics coherent scattering much like ultrasound imaging."

Combining math and optics to create models

Taking all of those measurements of light gives data, but it is only useful if the right model can be built to interpret it.

CAT scans and MRIs use similar mathematical models to take data that are low-dimensional representations of the object to build a detailed 3-D image. To use incoherent light to create a 3-D digital model requires a new mathematically-driven strategy.

That's where electrical and computer engineering Professor Ali Pezeshki comes in.

Using data from the total power measurements of shaped light coming out of a fluorescent object, Pezeshki's mathematical models keep noise managed and valuable information from being buried. The three-dimensional distributions of molecules can then be collected as if they were coherent.

Synergistic collaboration

This work is one of the highlights of a productive multidisciplinary collaboration between Bartels' group and the Squier group at the Colorado School of Mines.

"It becomes a synergistic collaboration," said Bartels. "It has to be a conversation between people of different expertise to understand the limitations of the different domains."

Since 2016, the groups have collaborated on nearly a dozen published publications, with more being written. The interdisciplinary efforts of mathematics, science, and engineering enable them to push the boundaries of optical imaging with applications from advanced manufacturing to neuroscience.

"Students really get to see problems from the different perspectives supplied by Randy, Jeff Field, Ali and myself," said Squier. "We have made advances in imaging I suspect none of us foresaw until we launched this collaborative effort and are now applying it across domains that we hadn't envisioned previously."

More information: Patrick A. Stockton et al. Single-pixel fluorescent diffraction tomography, *Optica* (2020). DOI: 10.1364/OPTICA.400547

Journal information: *Optica*

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Holding breath may increase risk of getting COVID-19: IIT Madras research

Holding breath may increase risk of getting COVID-19 infection: IIT Madras research

Researchers at the Indian Institute of Technology (IIT) Madras have found that holding breath may increase the risk of getting COVID-19 infection.

The researchers modelled breathing frequency in a laboratory to better understand how the rate of flow of droplet laden with virus determines its deposition in the lungs. The findings of the study have also been published in the international reputed peer-reviewed journal Physics of Fluids.

According to the team, they modelled the breathing frequency in a laboratory and found that low breathing frequency rises the time of residence of the virus and therefore it increases chances of deposition and consequently the infection. Also, the multiscale lung structure has a significant effect on a person's susceptibility to COVID-19.

"COVID-19 has opened a gap in our understanding of deep pulmonological systemic diseases. Our study unravels the mystery behind how particles are transported and deposited in the deep lung.

"The study demonstrates the physical process by which aerosol particles are transported into the deep generations of the lung," said Mahesh Panchagnula, Professor at Department of Applied Mechanics, IIT Madras. He said that they have found that holding breath and having low breathing rate can increase chances of the virus deposition in the lungs.

The study was conducted to pave the way for developing better therapies and drugs for respiratory infections. The other members of the team included research scholars Arnab Kumar Mallik and Soumalya Mukherjee, IIT Madras.

"Airborne infections such as coronavirus spread immensely through sneezing and coughing as it instantly releases a lot of tiny droplets. The team imitated the droplet dynamics in the lung by studying the movement of droplets in the small capillaries which were of a diameter similar to bronchioles. They took water mixed with fluorescent particles and generated aerosols from this liquid using a nebulizer.

"These fluorescent aerosols were used to track the movement and deposition of particles in the capillaries. They found that the deposition is inversely proportional to the aspect ratio of capillaries, which suggests that the droplets are likely to deposit in longer bronchioles," Panchagnula said.

The researchers also studied how the 'Reynolds Number' a parameter that quantifies the nature of flow - steady or turbulent - and determines the deposition in the capillaries.

"They found that when the flow of aerosol movement is steady then the particles deposit via the process of diffusion, however, if the flow is turbulent then the particles deposit via the process of impaction."In the future, the team intends to continue this work to understand how the virus-laden droplets are transported into lungs as the process by which the virus is transported from the nasal cavity to the deep lung is still unknown," he said.

Panchagnula said an understanding of the physics of this phenomenon could be crucial in mitigating the progression of the disease.

https://www.hindustantimes.com/education/holding-breath-may-increase-risk-of-getting-covid-19-iit-madras-research-101610446405355.html