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# समाचार पत्रों से चयित अंश Newspapers Clippings

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology

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*Tue, 13 April 2021*

## India readies for future warfare

*By Sarosh Bana*

‘When nations go to war, the nation with better technology will win,’ India’s Defence Minister Rajnath Singh said in 2019, and perhaps taking that cue, the country’s defence planners are embarking on their next-generation modernisation program in a quest to be future-ready.

The transforming geopolitical landscape is driving preparations the world over for future wars that will be waged less with the bullet than with cyber technology, artificial intelligence, cloud computing, quantum computing, augmented and virtual reality, robotics, big-data analytics, unmanned drones, small-satellite constellations for 5G and 6G telecommunications, information acquisition, 3D printing, nanomaterials and human augmentation devices.

Multi-domain, or cross-domain, operations will comprise ‘centaur’ teams, where human will bind with machines to optimise the performance of both. These human–machine teams will harness AI for military applications that will transform decision-making on the battlefield.

The Indian Armed Forces’ demand for just such a ‘connected’ soldier may be met by a public–private partnership under the government’s defence public sector undertakings (DPSU) program between Bharat Electronics Limited (BEL) and Hyderabad’s Grene Robotics, a niche private-sector player in AI and robotics, which are jointly developing an advanced man-portable surface-to-air missile.



A key to its effectiveness is an ‘autonomous MANPAD data link’ which allows commanders to give real-time firing orders to a soldier in a forward area using augmented reality and virtual reality robotics, says Grene Robotics director Gopi Krishna Reddy.

Abhishek Verma, partner and lead for aerospace and defence infrastructure at KPMG India, believes that while the private sector is being marshalled for indigenous defence production, DPSUs anchored by the Defence Research and Development Organisation (DRDO) will be instrumental in developing cutting-edge technologies for the Indian Armed Forces through its 52 laboratories.

India has long been a leading arms importer and has increased its purchases since the clashes on the border with China erupted last year.

There’s now a push to balance this overreliance on overseas technologies by investing in technologies developed at home. To make the armed forces future-ready, the Indian government has removed budgetary constraints for capability development and other requirements. The

Ministry of Defence has also opened up the defence sector to private enterprise, both Indian and global, by raising the foreign direct investment limit from 49% to 74%.

Top-level research and development is underway to equip India with indigenous future warfare technologies, and much of that vital work has been carried out by private-sector companies, which have sunk considerable capital into defence manufacturing.

Facing hostility from both China and Pakistan, India is feeling pressured to prepare for a two-front war. The military hierarchy is putting increasing emphasis on digital technologies to underpin network-centric warfare and on disruptive technologies.

Officials from India's Integrated Defence Staff say it's imperative to strengthen R&D while bridging technology and capability gaps with local equipment that can replace imports. The organisation integrates policy, doctrine, warfighting and procurement.

The use of AI is largely driven by DRDO's Centre for AI and Robotics (CAIR), whose mission is to develop security solutions and a range of C4I2SR (command, control, communications, computers, intelligence, information, surveillance and reconnaissance) systems.

The Indian Army is focusing on bettering its C4I2SR capabilities while being mindful of the need for interoperability among the three services. As future operations will necessarily be joint, interoperability is a major objective of the newly created Department of Military Affairs that will form theatre commands.

BEL and CAIR are developing an artillery combat, command and control system, while BEL, the Electronics Corporation of India and the Tata Group's CMC are setting up a tactical command, control, communications and information system for field formations and ground-based electronic warfare projects.

The MoD recently ordered from BEL four-channel multi-mode and multi-band shipborne radio equipment, known as a software-defined radio tactical system, developed in partnership with DRDO's Defence Electronics Applications Laboratory. The system supports the simultaneous operation of all very high and ultra-high frequency and lower band channels.

Other programs nearing development are the Swathi mobile artillery-locating phased array radar, the naval airfield integrated security system, BEL's battlefield surveillance system for high-altitude operations and the DRDO-designed USHUS-2 integrated submarine sonar system.

There's also the DRDO-designed Rohini 3D central acquisition radar for use with India's Akash surface-to-air missile that is capable of tracking 150 targets, the Maareech homing system for India's Varunastra heavy-weight torpedo, the Monopulse secondary surveillance radar, and DRDO's ship-to-shore communication system. The Mahindra Defence Systems and Telephonics Corporation joint venture manufactures the RDR series of airborne weather radars.

It's a major effort to prepare the nation for an increasingly uncertain strategic environment.

<https://www.aspistrategist.org.au/india-readies-for-future-warfare/>

## HAL AMCA: Why India needs its own Lockheed-Martin to develop 5th-Gen, Stealth Fighter Aircraft?

*The Indian government is expected to grant approval to the Indian Air Force's (IAF's) Advanced Medium Combat Aircraft (AMCA), the country's fifth-generation fighter program, in the second half of 2021*

*By Younis Dar*

India's Defence Research and Development Organisation (DRDO) has set an aggressive target for the program, with the futuristic stealth aircraft going into production by 2027 to 2030, according to a statement from IAF chief RKS Bhaduarua earlier this year.

Talking to Hindustan Times in February this year, Bhaduarua didn't rule out the possibility of the stealth fighter being equipped with directed energy weapons, including the integration of sixth-generation technologies and superior anti-missile systems.

AMCA will come with fifth-generation stealth design features, although "a lot more can happen with the sensors, weapons, overall reach, and the aircraft's capability," he added.

IAF plans to deploy around 120 stealth aircraft to its fleet by 2032 when AMCA is expected to be ready for induction. Stealth will form an important element of air combat, with the dominance of electromagnetic warfare playing a central role in future warfare.



Indian Defence Minister Rajnath Singh inspecting AMCA model (file photo)

Assisted through AI-based systems, AMCA will come with multi-sensor data fusion (MSDF) and 3D audio for enhanced situational awareness, characteristic of fifth-generation warfare.

The homegrown fifth-generation fighter will also feature an advanced cockpit with a large area display (LAD), touchscreen, and 3D display for an excellent user interface.

Additionally, AMCA will be equipped with a quadruplex digital fly-by-wire control system with a HOTAS-configured side-stick controller and unified throttle for a smooth flying experience.

The country's Aeronautical Development Agency (ADA), which is handling the AMCA development program, has chosen the 99 F414 GE jet engine to power the first two squadrons, the

next two are expected to use the indigenous engine. 99 F414 GE was also chosen to power the Mk-II version of the Tejas Light Combat Aircraft (LCA).

With the development of the country's indigenous Kaveri engine halted due to technological challenges, DRDO is reportedly setting up a separate facility to develop the engine for AMCA.

Scientists at the organization are faced with the daunting task of developing a completely new engine to suit the fifth-generation fighter, with the capability to produce a thrust of 110-kilo newton (kN).

While multiple global defense companies have approached India for collaboration to build the engine, the country is reportedly considering a partnership with France's Dassault, which is also said to have offered technology transfer.

"We are signing an agreement related to the technology needed for high thrust engine manufacturing. The technology will be common to the Rafale engines that can be supported by us and would also be useful for the 110 kN engine project," HAL Chairman was quoted by Economic Times as saying in October last year.

The other notable characteristics of AMCA will be the incorporation of supersonic cruise and three-dimensional thrust-vectoring engines for super-maneuverability (expected to come up after initial two squadrons).

It was announced last year that the fighter program will be developed in a joint venture with a private company, a decision that came as a surprise for many as no fighter program has involved private partners so far.

According to reports, AMCA will be developed through a public-private partnership between India's DRDO, Hindustan Aeronautics Limited (HAL), and a private company, the approval of which is being sought with the government.

The AMCA project is currently being pursued at the ADA's Bengaluru campus, with leading defense sources claiming the HAL has been kept out of the development of the fifth-generation fighter, although the country's premier aviation organization will take over the production once the prototype is ready.

The involvement of the private sector is thought to have been necessitated by the need to meet tight production deadlines and build a huge number of aircraft, including LCA Tejas Mk.1A/2A, AMCA, HAL Twin Engine Deck Based Fighter (TEDBF).

The participation of the private sector can help lessen the burden on HAL and DRDO which are already involved with the development of various fighter jet programs.

"While we are supportive of DRDO & HAL's efforts, the numbers involved indicate that involvement of the private sector in manufacturing is essential to ensure timely delivery of indigenous platforms.

We are already low in squadron numbers, & cannot afford to lose our operational potential if our numbers continue to fall," the Air Chief had told a magazine in February this year.

He said the air force was "committed to the development of the LCA versions in parallel to fifth-generation AMCA which will be the mainstay of the IAF fighter fleet in the coming decades."

With IAF critically low in squadron numbers, the force is looking to multiple options and the involvement of many stakeholders – public and private – to maintain a high production capacity.

"Involvement of the private sector in both design and development and manufacture of military aerospace platforms is critical for the development of a sustainable, cost-effective and efficient aerospace industry within the country," Bhaduarua added.

The development of a fifth-generation aircraft (FGFA) will place India in a select list of countries with the ability to design, develop and operate such fighters. There are only four combat-ready FGFA aircraft in the world today – Lockheed Martin's F-22 Raptor & F-35 Lightning II, Chinese Chengdu J-20 and Russian Su-57.

<https://eurasianimes.com/hal-amca-why-india-needs-its-own-lockheed-martin-to-develop-5th-gen-stealth-fighter-aircraft/>





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**Government of India**

**Ministry of Defence**

*Mon, 12 April 2021 5:33PM*

### **IAF Commanders' Conference Apr 21**

First bi-annual IAF Commanders' Conference for the year 2021 will be inaugurated by Hon'ble Raksha Mantri on 15 Apr 21 at Air Headquarters (Vayu Bhawan).

The conference of apex level leadership is aimed at addressing the issues of IAF's operational capabilities in the times to come. A series of discussions would be conducted over a period of three days to address strategies and policies related to capabilities that would give IAF a significant edge over its adversaries. Various welfare and Human Resource measures to improve HR and administrative efficiency will also be discussed.

Air Force Commanders' Conference is a bi-annual conference held at Subroto Hall, Air Headquarters, Vayu Bhawan. The Conference provides a forum to the senior leadership of the IAF to discuss critical issues pertaining to Operations, Maintenance and Administration. The conference is attended by the Air Officers Commanding-in-Chief of all Commands of IAF, all Principal Staff Officers and all Director Generals posted at Air HQ.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1711176>



**पत्र सूचना कार्यालय**  
**भारत सरकार**

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*Mon, 12 April 2021 5:33PM*

### **वायुसेना के कमांडरों का सम्मेलन, अप्रैल 2021**

दिनांक 15 अप्रैल 21 को वायु सेना मुख्यालय (वायु भवन) में वर्ष 2021 के पहले द्वि-वार्षिक वायुसेना कमांडर सम्मेलन का उद्घाटन माननीय रक्षा मंत्री द्वारा किया जाएगा।

वायुसेना के शीर्ष स्तर के नेतृत्व के इस सम्मेलन का उद्देश्य आने वाले समय में भारतीय वायुसेना की सामरिक क्षमताओं से संबंधित मुद्दों का समाधान करना है। सम्मेलन के दौरान तीन दिन की अवधि तक भारतीय वायुसेना की क्षमताओं से संबंधित नीतियों एवं रणनीतियों से जुड़े मुद्दों के समाधान हेतु अनेक प्रकार के विमर्श की श्रृंखला का आयोजन किया जाएगा जिनसे भारतीय वायु सेना अपने प्रतिद्वंद्वियों के विरुद्ध बढ़त बना सके। मानव संसाधन और प्रशासनिक दक्षता में सुधार के लिए विभिन्न कल्याणकारी और मानव संसाधन उपायों पर भी चर्चा की जाएगी।

वायुसेना कमांडरों का सम्मेलन वायु सेना मुख्यालय के सुब्रतोहॉल में आयोजित किया जाने वाला द्विवार्षिक सम्मेलन है। यह सम्मेलन भारतीय वायु सेना के वरिष्ठ नेतृत्व को संचालन, रखरखाव और प्रशासन से संबंधित महत्वपूर्ण मुद्दों पर चर्चा करने के लिए एक मंच प्रदान करता है। इस सम्मेलन में भारतीय वायुसेना की सभी कमानों के एयर ऑफिसर्स कमांडिंग-इन-चीफ, सभी प्रिंसिपल स्टाफ ऑफिसर्स और वायुसेना के मुख्यालय में तैनात सभी महानिदेशक भाग ले रहे हैं।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1711212>



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**Ministry of Defence**

*Mon, 12 April 2021 6:42PM*

## **Multinational Military Exercise Shantir Ogroseena Culminates in Bangladesh**

Exercise SHANTIR OGRESENA-2021, a 10 day long multinational military exercise, which started on 04 April 2021, culminated today i.e.12 April 2021 at Bangabandhu Senanibas (BBS), Bangladesh. Troops from four countries participated in this exercise with observers from USA, UK, Russia, Turkey, Kingdom of Saudi Arabia, Kuwait and Singapore.

The aim of the exercise was to strengthen defence ties and enhance interoperability amongst neighbourhood countries to ensure effective peace keeping operations. The Armies of all participating nations shared their wide experiences and enhanced their situational awareness through robust information exchange platforms.

The exercise culminated with a validation phase and closing ceremony organised on the theme of Robust Peace Keeping Operations jointly undertaken by contingents of Indian Army, Royal Bhutanese Army, Sri Lankan Army and Bangladesh Army, preceded by an Army Chiefs Conclave.

General MM Naravane, Chief of the Army Staff witnessed the validation phase of the exercise. He had also delivered a Keynote Address on “Changing Nature of Global Conflicts: Role of UN Peacekeepers” on 11 April 2021. The COAS also interacted with the senior officers of the participating nations and Military Observers from other countries.

The contingents displayed highest standards of professionalism during the exercise and also displayed their skills in volleyball, firing and cultural activities.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1711202>







पत्र सूचना कार्यालय  
भारत सरकार

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Mon, 12 April 2021 6:42PM

## बांग्लादेश में बहुराष्ट्रीय सैन्य अभ्यास शांतिर अग्रसेना का समापन

दिनांक 04 अप्रैल 2021 से शुरू होकर 10 दिन तक चलने वाले बहुराष्ट्रीय सैन्य युद्धाभ्यास शांतिर अग्रसेना-2021 का आज यानी दिनांक 12 अप्रैल 2021 को बंगबंधु सेननिबास (बीबीएस), बांग्लादेश में समापन हुआ। चार देशों के सैनिकों ने अमेरिका, ब्रिटेन, रूस, तुर्की, सऊदी अरब, कुवैत और सिंगापुर के पर्यवेक्षकों की मौजूदगी में इस अभ्यास में भाग लिया।

इस अभ्यास का उद्देश्य रक्षा संबंधों को मजबूत करना और प्रभावी शांति अभियानों को सुनिश्चित करने के लिए पड़ोस के देशों के बीच अंतरसंचालनीयता को बढ़ाना था। सभी प्रतिभागी देशों की सेनाओं ने अपने व्यापक अनुभवों को साझा किया और मजबूत सूचना आदान-प्रदान प्लेटफार्मों के माध्यम से अपनी स्थितिजन्य जागरूकता को बढ़ाया।

अभ्यास में भाग लेने वाले देशों के सेना प्रमुखों के सम्मेलन के पहले इस अभ्यास का समापन भारतीय सेना, रॉयल भूटानी सेना, श्रीलंकाई सेना और बांग्लादेश सेना की टुकड़ियों द्वारा संयुक्त रूप से किए गए मजबूत शांति अभियानों के विषय पर आयोजित सत्यापन चरण और समापन समारोह के साथ हुआ।

सेनाध्यक्ष जनरल एम एम नरवणे ने अभ्यास के सत्यापन चरण को देखा। उन्होंने 11 अप्रैल 2021 को "वैश्विक संघर्षों की बदलती प्रकृति: संयुक्त राष्ट्र शांतिरक्षकों की भूमिका" पर एक मुख्य भाषण भी दिया था। सेना प्रमुख ने प्रतिभागी राष्ट्रों के वरिष्ठ अधिकारियों तथा अन्य देशों के सैन्य पर्यवेक्षकों से बातचीत भी की।

सैन्य टुकड़ियों ने अभ्यास के दौरान व्यावसायिकता के उच्चतम मानकों को प्रदर्शित किया और वॉलीबॉल, फायरिंग और सांस्कृतिक गतिविधियों में अपने कौशल का भी प्रदर्शन किया।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1711240>



## IAF brass to hold key strategic meet

- **Defence minister Rajnath Singh will inaugurate the biannual IAF commanders' conference on April 15**

The Indian Air Force's top commanders will assemble in the capital later this week for a three-day conference focusing on strategies to scale up its capabilities to have an edge over its adversaries, the defence ministry said on Monday.

Defence minister Rajnath Singh will inaugurate the biannual IAF commanders' conference on April 15.

The meeting comes at a time when India and China have been locked in a standoff for over 11 months and are currently negotiating a withdrawal of troops and weapons from friction points on the contested Line of Actual Control (LAC). IAF remains in a high state of readiness in the Ladakh sector.

"The conference of apex-level leadership is aimed at addressing the issues of IAF's operational capabilities in the times to come. A series of discussions will be conducted to address strategies and policies related to capabilities that will give IAF a significant edge over its adversaries," an official statement said.

The conference also comes at a time when IAF gearing up to raise its second squadron of Rafale fighter jets at the Hasimara airbase in West Bengal.

As India and China negotiate a complex disengagement process in the Ladakh sector, the air forces of both countries are deployed in the theatre as they were when the border row was at its peak last year, as previously reported by Hindustan Times.

India and China have held 11 rounds of military talks so far to resolve border tensions that began last May.

At the latest 11th round of military talks with China on April 9, the Indian Army told the People's Liberation Army (PLA) that completion of disengagement at all friction points was must for de-escalation of the border conflict.

Apart from deploying fighter jets at bases in the Ladakh-Tibet theatre, PLA Air Force has positioned a large number of radars and missiles in the sector.

IAF has projected its capability to carry out day-and-night, all-weather combat missions in the Ladakh sector, with front-line fighter jets, attack helicopters and multi-mission choppers deployed there. It also deployed its new Rafale fighter jets in the sector as part of India's overarching plan to strengthen its military posture in the region.

The IAF Commanders' Conference comes at a time India is planning to begin a formal roll-out of its long-awaited theaterisation plan to best utilise its military's resources amid growing security threats, with the Air Defence Command and the Maritime Theatre Command set to be launched by May. India will also have three other integrated commands to secure its western, northern and eastern fronts — these are likely to be rolled out by December 2022.

In addition, a logistics command is in the works to avoid duplication of efforts and resources.

<https://www.hindustantimes.com/india-news/iaf-brass-to-hold-key-strategic-meet-101618252057820.html>



Defence Minister Rajnath Singh (PTI)

Tue, 13 April 2021

## Army Chief attends closing ceremony of multi-lateral counterterrorism exercise in B'desh

Dhaka: Indian Army Chief Gen MM Naravane on Monday attended the closing ceremony of the 10-day-long multilateral UN-mandated counterterrorism exercise held in Bangladesh and praised the members of the Army contingent from India who participated in the drills.

“General MM Naravane #COAS attended the #ClosingCeremony of Multinational Exercise #ShantirOgroseena2021 and addressed the participants of the exercise,” the Indian Army's Additional Directorate General of Public Information (ADG PI) tweeted. During the Shantir Ogrosena 2021 (Frontrunners of Peace) exercise, he also interacted with the members of the Indian Army contingent and lauded them for their high standards of training and professionalism, according to another tweet. There were 30 personnel in the Indian Army contingent. Bangladesh Prime Minister Sheikh Hasina was the Chief Guest of the ceremony, ADG PI said.

The counterterrorism exercise, which commenced on April 4, was participated by the Armed Forces of India, Bangladesh, Bhutan and Sri Lanka along with observers from the US, UK, Turkey, Kuwait, Singapore and Saudi Arabia. The aim of the exercise was to strengthen the procedures and enhance interoperability amongst neighbourhood countries to ensure robust peacekeeping operations in the region.

The armies of all the participating nations shared their valuable experiences and refined their drills and procedures in peacekeeping operations. The exercise culminated with a validation phase and closing ceremony organised on the theme of Robust Peacekeeping Operations jointly undertaken by contingents of Indian Army, Royal Bhutanese Army, Sri Lankan Army and Bangladesh Army, preceded by an Army Chiefs Conclave, a press release issued by the Ministry of Defence said in New Delhi on Monday. The contingents displayed highest standards of professionalism during the exercise and also displayed their skills in volleyball, firing and cultural activities, it said.

Gen Naravane witnessed the validation phase of the exercise.

The Indian Army chief also visited the Bangladesh Institute of Peace Support Operation Training (BIPSOT). He interacted with the members of BIPSOT and appreciated their contribution in imparting training to the peacekeepers. He is on the concluding day of his five-day Bangladesh visit, which started on Thursday last, to further strengthen the close and fraternal ties existing between the Armed Forces of the two nations.

The visit of the Army chief, who is here at the invitation of his Bangladeshi counterpart Gen Aziz Ahmed, comes less than two weeks after Prime Minister Narendra Modi travelled to the neighbouring country and met the top leadership here to strengthen the strategic ties.

The year 2021 marks the 50th anniversary of diplomatic relations between India and Bangladesh, the liberation of Bangladesh from Pakistan and the birth centenary of 'Bangabandhu' Mujibur Rahman.

<https://www.dailypioneer.com/2021/india/army-chief-attends-closing-ceremony-of--multi-lateral-counterterrorism-exercise-in-b-desh.html>

*Tue, 13 April 2021*

## **India closely monitoring Chinese surface-to-air missile batteries deployed close to LAC**

*During high-level talks, the Chinese side showed reluctance in disengaging from the remaining friction points at Gogra Heights, Hot Springs, Depsang plains and CNN Junction near Demchok*

*By Manjeet Negi*

New Delhi: During high-level talks, the Chinese side showed reluctance in disengaging from the remaining friction points at Gogra Heights, Hot Springs, Depsang plains and CNN Junction near Demchok.

The Chinese surface-to-air missile batteries, including their HQ-9 air-defence system with a strike range of 250 km, continue to be deployed close to Indian territory in Ladakh.

Top government sources told India Today TV that the Indian agencies are closely monitoring these air-defence batteries, which may pose threat for Indian fighter aircraft and helicopters operating in the region.

“The Chinese People’s Liberation Army has continued deployment of surface-to-air missiles, including the HQ- and HQ 22, close to the Indian territory,” they said.

The HQ-9 air-defence missile system can track and hit targets at a distance of around 250kms.

“We are keeping a close watch on the air-defence systems and other assets positioned there,” the sources said.

Even though the two countries have disengaged from Pangong Lake area, the deployments by both sides remain firm.

During the high-level talks, the Chinese side showed reluctance in disengaging from the remaining friction points at Gogra Heights, Hot Springs, Depsang plains and CNN Junction near Demchok.

India has also made it clear that it would consider de-escalation only if there is disengagement by the Chinese from the friction points.

The Indian Army and other security forces have also started returning to the summer deployments in the Ladakh and other mountainous areas along the Line of Actual Control. Both the armies have many troops deployed at the border since last year.

The deployment of formations and troops in Sugar sector, Central sector, and north-eastern borders have also been strengthened.

Due to Indian tactical operations along the southern bank of Pangong Tso, Indian Army managed to secure disengagement from the Finger area. The two sides are continuing talks for further disengagement and de-escalation from other friction points in the area.

<https://www.indiatoday.in/india/story/india-china-ladakh-confrontation-surface-to-air-missile-1790116-2021-04-12>



Chinese troops disengaging from banks of Pangong lake in eastern Ladakh in February this year (Photo Credits: PTI)



## **China opens 5G signal station at world's highest radar location near Tibet border**

Beijing: China has opened a 5G signal base at the Ganbala radar station in the remote Himalayan region of Tibet which is the world's highest manually operated radar station at an elevation of 5,374 meters, the Chinese military's official website reported on Monday.

The mountain is located in Nagarze County in Tibet which is in the vicinity of borders with India and Bhutan.

At the end of last year, the People's Liberation Army started to coordinate with civilian enterprises to launch 5G base station construction in Ganbala to solve the difficulty of network access for the border defence troops, the website said.

The stable and high-speed 5G signal enables the soldiers in the deep mountains to keep up with the information society, leaving the monotonous and boring life on the border, it said.

It is part of efforts to improve training and on-duty conditions for soldiers stationed in border areas, it added.

<https://timesofindia.indiatimes.com/business/international-business/china-opens-5g-signal-station-at-worlds-highest-radar-location-near-tibet-border/articleshow/82034152.cms>



### Science & Technology News



## **Researchers find bubbles speed up energy transfer**

*By Elaina Hancock*

Energy flows through a system of atoms or molecules by a series of processes such as transfers, emissions, or decay. You can visualize some of these details like passing a ball (the energy) to someone else (another particle), except the pass happens quicker than the blink of an eye, so fast that the details about the exchange are not well understood. Imagine the same exchange happening in a busy room, with others bumping into you and generally complicating and slowing the pass. Then, imagine how much faster the exchange would be if everyone stepped back and created a safe bubble for the pass to happen unhindered.

An international collaboration of scientists, including UConn Professor of Physics Nora Berrah and post-doctoral researcher and lead



Credit: Unsplash/CC0 Public Domain



author Aaron LaForge, witnessed this bubble-mediated enhancement between two helium atoms using ultrafast lasers. Their results are now published in *Physical Review X*.

Measuring energy exchange between atoms requires almost inconceivably fast measurements, says LaForge.

"The reason why shorter time scales are needed is that when you look at microscopic systems, like atoms or molecules, their motion is extremely fast, roughly on the order of femtoseconds ( $10^{-15}$  s), which is the time it takes them to move a few angstroms ( $10^{-10}$  m)," LaForge says.

Laforge explains these measurements are made with a so-called free-electron laser, where electrons are accelerated to nearly the speed of light, then using sets of magnets, the electrons are forced to undulate, which causes them to release short wavelength bursts of light. "With ultrafast laser pulses you can time-resolve a process to figure out how fast or slow something occurs," says LaForge.

The first step of the experiment was to initiate the process, says LaForge: "Physicists probe and perturb a system in order to measure its response by taking fast snapshots of the reaction. Thus, essentially, we aim to make a molecular movie of the dynamics. In this case, we first initiated the formation of two bubbles in a helium nanodroplet. Then, using a second pulse, we determined how fast they were able to interact."

With a second laser pulse the researchers measured how the bubbles interact: "After exciting the two atoms, two bubbles are formed around the atoms. Then the atoms could move and interact with one another without having to push against surrounding atoms or molecules," says LaForge.

Helium nanodroplets were used as a model system, since helium is one of the simplest atoms in the periodic table, which LaForge explains is an important consideration. Even though there are up to roughly a million helium atoms within a nanodroplet, the electronic structure is relatively simple, and the interactions are easier elucidate with fewer elements in the system to account for.

"If you go to more complex systems, things can get more complicated rather quickly. For instance, even liquid water is pretty complicated, since there can be interactions within the molecule itself or it can interact with its neighboring water molecules," LaForge says.

Along with bubble formation and the subsequent dynamics, the researchers observed energy transfer, or decay, between the excited atoms, which was over an order of magnitude faster than previously expected—as fast as 400 femtoseconds. At first, they were a bit perplexed about how to explain such a fast process. They approached theoretical physicist colleagues who could perform state-of-the-art simulations to better understand the problem.

"The results of our investigation were unclear but collaboration with theorists allowed us to nail down and explain the phenomenon," says LaForge.

He points out that an exciting aspect of the research is that we can push the envelope further in understanding the fundamentals of these ultrafast processes and pave the way for new research. The big innovation is being able to create a means to measure interactions down femtosecond or even attosecond ( $10^{-18}$ s) timescales. "It's really rewarding when you can perform a rather fundamental experiment that can also be applied to something more complex," says LaForge.

The process the researchers observed is called Interatomic Coulombic Decay (ICD), and is an important means for atoms or molecules to share and transfer energy. The bubbles enhanced the process, demonstrating how the environment can alter the speed at which a process occurs. Since ICD plays an important role in how living tissues react to radiation exposure—by creating low energy electrons which can go on to cause damage within tissues—these findings are of biological importance, because it is likely that similar bubbles would form in other fluids, like water, and with other molecules like proteins.

"Understanding the timescale of energy transfer at the microscopic scale is essential to numerous scientific fields, such as physics, chemistry, and biology. The fairly recent development of intense, ultrafast laser technology allows for time-resolved investigations with unprecedented detail, opening up a wealth of new information and knowledge," says Berrah.

**More information:** A. C. LaForge et al, Ultrafast Resonant Interatomic Coulombic Decay Induced by Quantum Fluid Dynamics, *Physical Review X* (2021). DOI: [10.1103/PhysRevX.11.021011](https://doi.org/10.1103/PhysRevX.11.021011)

**Journal information:** *Physical Review X*  
<https://phys.org/news/2021-04-energy.html>

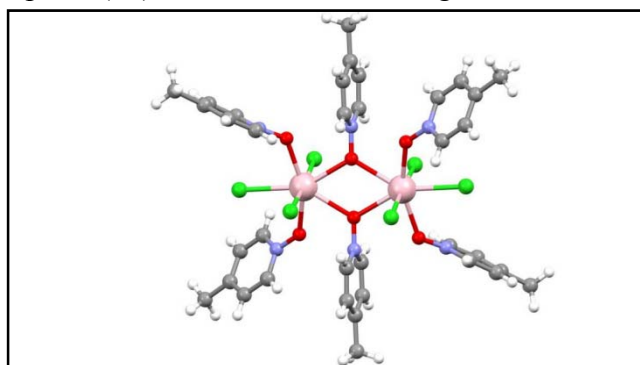


Tue, 13 April 2021

## A novel light-spin interface with Europium (III) molecule advances development of quantum computers

Light can be used to operate quantum information processing systems, e.g. quantum computers, quickly and efficiently. Researchers at Karlsruhe Institute of Technology (KIT) and Chimie ParisTech/CNRS have now significantly advanced the development of molecule-based materials suitable for use as light-addressable fundamental quantum units. As they report in the journal *Nature Communications*, they have demonstrated for the first time the possibility of addressing nuclear spin levels of a molecular complex of europium (III) rare-earth ions with light.

Whether in drug development, communication, or for climate forecasts: Processing information quickly and efficiently is crucial in many areas. It is currently done using digital computers, which work with so-called bits. The state of a bit is either 0 or 1—there is nothing in between. This severely limits the performance of digital computers, and it is becoming increasingly difficult and time-consuming to handle complex problems related to real-world tasks. Quantum computers, on the other hand, use quantum bits to process information. A quantum bit (qubit) can be in many different states between 0 and 1 simultaneously due to a special quantum mechanical property referred to as quantum superposition. This makes it possible to process data in parallel, which increases the computing power of quantum computers exponentially compared to digital computers.



Based on the Europium(III) scientists aim to advance the development of Quantum Computers. Credit: S. Kuppusamy, KIT

### Qubit Superposition States Are Required to Persist Long Enough

"In order to develop practically applicable quantum computers, the superposition states of a qubit should persist for a sufficiently long time. Researchers speak of 'coherence lifetime,'" explains Professor Mario Ruben, head of the Molecular Materials research group at KIT's Institute of Nanotechnology (INT). "However, the superposition states of a qubit are fragile and are disturbed by fluctuations in the environment, which leads to decoherence, i.e. shortening of the coherence lifetime." To preserve the superposition state long enough for computational operations, isolating a qubit from the noisy environment is conceivable. Nuclear spin levels in molecules can be used to create superposition states with long coherence lifetimes because nuclear spins are weakly coupled to the environment, protecting the superposition states of a qubit from disturbing external influences.

### Molecules Are Ideally Suited As Qubit Systems

One single qubit, however, is not enough to build a quantum computer. Many qubits to be organized and addressed are required. Molecules represent ideal qubit systems as they can be

arranged in sufficiently large numbers as identical scalable units and can be addressed with light to perform qubit operations. In addition, the physical properties of molecules, such as emission and/or magnetic properties, can be tailored by changing their structures using chemical design principles. In their paper now published in the journal *Nature Communications*, researchers led by Professor Mario Ruben at KIT's IQMT and Strasbourg's European Center for Quantum Sciences—CESQ and Dr. Philippe Goldner at École nationale supérieure de chimie de Paris (Chimie ParisTech/CNRS) present a nuclear-spin-containing dimeric europium(III) molecule as light-addressable qubit.

The molecule, which belongs to the rare earth metals, is designed to exhibit luminescence, i.e., a europium(III)-centered sensitized emission, when excited by ultraviolet light-absorbing ligands surrounding the center. After light absorption, the ligands transfer the light energy to the europium(III) center, thereby exciting it. Relaxation of the excited center to the ground state leads to light emission. The whole process is referred to as sensitized luminescence. Spectral hole burning—special experiments with lasers—detect the polarization of the nuclear spin levels, indicating the generation of an efficient light-nuclear spin interface. The latter enables the generation of light-addressable hyperfine qubits based on nuclear spin levels. "By demonstrating for the first time light-induced spin polarization in the europium(III) molecule, we have succeeded in taking a promising step towards the development of quantum computing architectures based on rare-earth ion-containing molecules," explains Dr. Philippe Goldner.

**More information:** Kuppusamy Senthil Kumar et al. Optical spin-state polarization in a binuclear europium complex towards molecule-based coherent light-spin interfaces, *Nature Communications* (2021). DOI: [10.1038/s41467-021-22383-x](https://doi.org/10.1038/s41467-021-22383-x)

**Journal information:** [Nature Communications](https://www.nature.com/articles/s41467-021-22383-x)  
<https://phys.org/news/2021-04-light-spin-interface-europiumiii-molecule-advances.html>

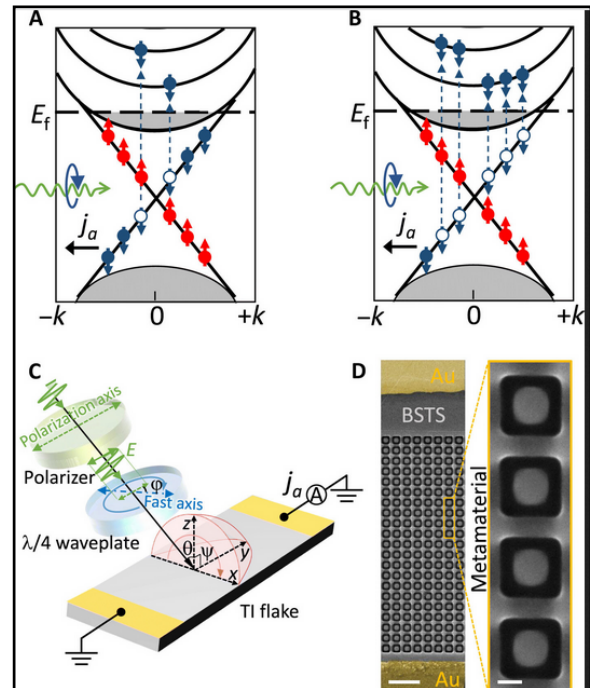
# Topological insulator metamaterial with giant circular photogalvanic effect

By Thamarasee Jeewandara

Topological insulators have notable manifestations of electronic properties. The helicity-dependent photocurrents in such devices are underpinned by spin momentum-locking of surface Dirac electrons that are weak and easily overshadowed by bulk contributions. In a new report now published on *Science Advances*, X. Sun and a research team in photonic technologies, physics and photonic metamaterials in Singapore and the U.K. showed how the chiral response of materials could be enhanced via nanostructuring. The tight confinement of electromagnetic fields in the resonant nanostructures enhanced the photoexcitation of spin-polarized surface states of a topological insulator to allow an 11-fold increase of the circular photogalvanic effect and a previously unobserved photocurrent dichroism at room temperature. Using this method, Sun et al. controlled the spin transport in topological materials via structural design, a hitherto unrecognized ability of metamaterials. The work bridges the gap between nanophotonics and spin electronics to provide opportunities to develop polarization-sensitive photodetectors.

## Chirality

Chirality is a ubiquitous and fascinating natural phenomenon in nature, describing the difference of an object from its mirror image. The process manifests in a variety of scales and forms from galaxies to nanotubes and from organic molecules to inorganic compounds. Chirality can be detected at the atomic and molecular level in fundamental sciences, including chemistry, biology and crystallography, as well as in practice, such as in the food and pharmaceutical industry. To detect chirality, scientists can use interactions with electromagnetic fields, although the process can be hindered by a large mismatch between the wavelength of light and the size of most molecules at nanoscale dimensions. Designer metamaterials with structural features comparable to the wavelength of light can provide an independent approach to devise optical properties on demand to enhance the light-matter interaction to create and enhance the optical chirality of metamaterials. In this work, Sun et al. showed applications of artificial nanostructuring to improve the chiral photogalvanic response of electromagnetic fields. The resonant nonchiral metamaterials effectively improved the photoexcitation of spin-polarized states. The work showed a giant enhancement of



**Helicity-dependent photocurrent (HDPC) in topological insulators and topological insulator metamaterials. (A)** In an unstructured topological insulator (TI), Dirac electrons with spin coupled to a given circular polarization of incident light (blue) are promoted to higher bands in the  $k$ -space; the excess of spin-momentum-locked surface-state electrons with opposite spin (red) gives rise to an HDPC,  $j_a$  (circular photogalvanic effect). **(B)** In a TI metamaterial, a larger number of spin-polarized electrons are photoexcited upon resonant light absorption, enhancing the HDPC. **(C)** Schematic of the HDPC experimental setup, illustrating the mutual orientation of the electrodes on the TI device relative to the laser excitation beam at incidence angle  $\theta$  and polarization defined by the angle of rotation  $\phi$  of the quarter-wave plate. **(D)** SEM image of the square ring metamaterial carved between the Au electrodes on the surface of a TI flake. Scale bars, 1  $\mu\text{m}$  on the left and 100 nm on the right. Credit: *Science Advances*, doi:10.1126/sciadv.abe5748

the extrinsic chiral photocurrent response of a 3D topological insulator (TI); containing bismuth, antimony, tellurium and selenium in the following ratios:  $\text{Bi}_{1.5}\text{Sb}_{0.5}\text{Te}_{1.8}\text{Se}_{1.2}$ , abbreviated as BSTS.

### **Helicity-dependent photocurrent**

Sun et al. selectively excited surface-carriers in topological insulators by directing circularly polarized light at oblique incidence on the surface of the crystal. They determined the resulting current flow by spin-momentum locking at the carriers. The topological insulator crystal was intrinsically achiral, therefore photoexcitation at normal incidence did not generate any helicity-dependent photocurrent (HDPC). However, when they conducted spin-selective photoexcitation of surface-state carriers using obliquely incident light with a given helicity, they induced chirality as described for metamaterials, via the circular photogalvanic effect (CPGE). The presence of a nanostructure designed on the surface of the topological insulators indicated a resonant absorption at the wavelength of excitation to effectively increase the number of surface induction carriers, promoted to the bulk conduction bands. This process significantly increased the contribution of CPGE (circular photogalvanic effect) to the photocurrent. In the experimental setup, Sun et al. noted how the HDPC (helicity-dependent photocurrent) flowed across two gold contacts on the crystal surface without an applied bias.

### **Optical absorption and metamaterial design**

To understand the enhancement of chirality exclusively via topological surface spin currents, Sun et al. chose a metamaterial design that did not introduce optical chirality intrinsically or extrinsically. The team selected a metamaterial unit cell with patterns carved by focused ion beam milling between two gold electrodes deposited on a flake of BSTS, which they observed using scanning electron microscopy (SEM). The metamaterial geometry did not induce any helicity dependence, which Sun et al. confirmed using maps of electric field intensity for circularly polarized light of opposite handedness. The team next controlled the circular photogalvanic effects in the topological insulator using the metamaterial. They measured the HDPC (helicity-dependent photocurrent) under nearly uniform illumination without an applied bias. The setup resulted in polarization-independent photothermoelectric currents which contributed to the photocurrent background. The component of the current was also sensitive to the position of the excitation beam on the sample.

### **Photocurrent signal**

To measure clear photocurrent signals, Sun et al. next adjusted the laser beam position on the BSTS flake and BSTS metamaterial to obtain the maximum photocurrent. The scientists noted how the surface contributions to the photocurrents were discernible even at room temperature in unstructured BSTS samples, while bulk components overshadowed their dependence on light helicity, while being too small for any practical device or application. When the team patterned the BSTS flake with a square ring metamaterial array, it behaved markedly differently. The resonant metamaterial structure induced larger asymmetry relative to surface conducting bands to increase the net spin current. The team defined the photocurrent circular dichroism induced by spin-polarized surface states and confirmed the surface nature of HDPC in BSTS. The outcomes of the study showed how the metamaterials did not introduce chirality but enhanced the extrinsic chirality of the BSTS surface layer.

### **Electromagnetic modeling**

Sun et al. then discussed the photocurrent behavior of spin-transport metamaterials via electromagnetic modeling. The generated photocurrent was directly proportional to the optical absorption, carrier density, mobility and lifetime of the topological insulator. Based on the assumption that the optical absorption of the BSTS metamaterial increased upon nanostructuring while the transport parameters remained unaltered, Sun et al. mapped the carrier anisotropic optical model of the BSTS topological insulator crystal. The scientists performed full-wave electromagnetic simulations for unstructured and nanostructured BSTS, by replicating the sample illumination conditions used in the experiments, to understand the optical absorption at the surface



of the topological insulator. The electromagnetic modeling agreed well with the experimental HDPC results.

### Outlook

In this way, X. Sun and colleagues provided a method to use metamaterials to control surface transport in topological insulators via structural design. This method provides a powerful toolbox to bridge the gap between nanophotonics and spin electronics. The team showed how resonant nanostructures induced giant enhancement of the extrinsic chiral photocurrent response of a topological insulator. The outcomes can be explored to exert control on spin transport properties of other classes of quantum and topological materials.

**More information:** Sun X et al. Topological insulator metamaterial with giant circular photogalvanic effect, *Science Advances*, 10.1126/sciadv.abe5748

Hsieh D. et al. A tunable topological insulator in the spin helical Dirac transport regime. *Nature*, [doi.org/10.1038/nature08234](https://doi.org/10.1038/nature08234)

Ma Q. et al. Direct optical detection of Weyl fermion chirality in a topological semimetal, *Nature Physics*, [doi.org/10.1038/nphys414](https://doi.org/10.1038/nphys414)

**Journal information:** [Nature](#) , [Science Advances](#) , [Nature Physics](#)  
<https://phys.org/news/2021-04-topological-insulator-metamaterial-giant-circular.html>

## COVID-19 Research News



Tue, 13 April 2021

# Vaccinated people better protected against Covid but can still transmit disease: Experts

*Experts stressed on the need for masks and physical distance regardless of the vaccination status*

New Delhi: COVID-19 vaccines protect against serious illness but transmissibility can still continue and inoculated people can pass on the infection to others, say scientists, warning against complacency in those who stop maintaining protocol after they get their jabs.

Transmissibility from vaccinated persons can be a risk factor until global coverage is achieved, top experts said as India's Covid numbers escalated sharply, reaching 1,35,27,717 (1.35 crore/13.5 million) with 1,68,912 new cases on Monday to make it the country with the second highest number of cases after the US.

"Vaccination is simply one of the many different strategies we have to deal with in the pandemic. However, it is not a magical one-stop solution," immunologist Satyajit Rath, from the New Delhi's National Institute of Immunology, told PTI.

"None of the vaccines currently available provide protection against transmission of the virus. Statistically speaking, infection post-vaccination is likely to be milder than one without," added Vineeta Bal, an immunologist from Pune's Indian Institute of Science, Education and Research.

As researchers around the world try and figure out how well COVID-19 vaccines prevent vaccinated people from transmitting the virus to others, the experts stressed on the need for masks and physical distance regardless of the vaccination status. This has to continue until the majority of people are vaccinated.

The scientists also batted for universal vaccination, saying it would provide strong community resistance to severe local outbreaks. Cautioning against lowering of the guard even after

vaccination, they said some people who get inoculated early may lose their immunological memory over a period of time and become vulnerable again.

“Vaccination remains an individual protection, not a community protection, until we achieve almost global vaccination coverage. It is possible that vaccine-resistant virus variants will emerge, necessitating steady watchfulness and the rapid development-deployment of next-generation vaccines,” Rath said.

Bal agreed that disease severity will be low in vaccinated individuals as compared to those without vaccination.

“This is likely to be true even with variant viruses. Hence being vaccinated is a better state of affairs at a population level as well as individually,” Bal told PTI.

Rath noted that if an individual is effectively vaccinated, meaning they develop robust long-lasting levels of neutralising antibodies, then reinfection with vaccine-sensitive SARS-CoV-2 strains, even if it happens, is likely to be associated with only mild illness.

On the other hand, he said, a new infection with vaccine-resistant SARS-CoV-2 strains might still cause severe illness in some cases.

“So yes, vaccinated individuals could still pass on the infection, though the chance and the dose passed on would be lower. Of course, if they are infected with a future vaccine-resistant virus strain, then efficient transmission could occur,” he explained.

India’s vaccination drive rolled out on January 16 with healthcare workers (HCWs) getting inoculated. On February 2, vaccination of frontline workers (FLWs) started. . On March 1, the vaccination net was extended to those over 60 and for people aged 45 and above with specified co-morbidities. A month after that, on April 1, vaccination was opened for all people aged more than 45 years.

Amid demands from several quarters that the age limit for COVID-19 vaccination be relaxed in view of the spike in cases, the Centre last week said the aim is to protect those who are most vulnerable and not to “administer the vaccine to those who want it but to those who need it”.

“The basic aim is to reduce death through vaccination. The other aim is to protect your healthcare system,” Union Health Secretary Rajesh Bhushan said during a weekly press conference.

He later clarified his remark, saying the government was following a dynamic supply-demand mapping model.

Last month, Union Health Minister Harsh Vardhan said “every vaccine doesn't require universal immunisation and all these priority groups whom we are vaccinating today like healthcare staff first and then senior citizens and people aged between 45 and 59 years, it will be extended in the coming days -- all these are based on experts' opinion”.

According to Rath, the idea behind this strategy is 'herd immunity', where the transmission cycle of the virus is broken if enough people are effectively vaccinated. And therefore even unvaccinated people no longer get infected, simply because the virus is no longer around.

“The trouble is that we don’t have a very reliable idea of what percentage of the community needs to be vaccinated for effective 'herd immunity' for SARS-CoV-2. So it is hard to see what use this government assertion is in practical terms,” he added.

The scientist explained that universal vaccination would be “nice” since it would provide very strong community resistance to severe local outbreaks.

Bal added that vaccinating almost everybody would be good in an ideal situation. However, robust safety data on pregnant women is not available for every vaccine and most vaccines are not tested on children below 12 years.

“Hence, the direct recommendation for these categories of people are hard to make. Though I feel vaccines made using older platforms such as killed vaccines or pure protein-based vaccines as against mRNA vaccines for example can be considered safe based on the experiences from the past,” she added.

Vaccines generate immunity by mimicking a milder form of an infection and helping the immune system "remember" the pathogen. So they contain some part of an infectious agent that is capable of generating an immune response, such as the viral genetic material, its RNA or DNA, or the proteins in the virus which interact with human cells.

If there are vaccine shots, and if it can be afforded, there is no harm in aiming for universal immunization, Bal said.

"Because by the time that level is achieved some people who got vaccinated early may lose their immunological memory and become vulnerable again. We do not know yet how long vaccine immunity will last for SARS-CoV2," she added.

The two vaccines currently approved in India are Covishield, from the Oxford/AstraZeneca stable manufactured by Pune's Serum Institute of India, and Covaxin, developed by Hyderabad-based Bharat Biotech in collaboration with the Indian Council of Medical Research and the National Institute of Virology (NIV).

On Monday, an expert panel of India's central drug authority recommended approval for Russia's Sputnik V for emergency use with certain conditions.

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

<https://www.livemint.com/science/health/vaccinated-people-better-protected-against-covid-but-can-still-transmit-disease-experts-11618228732681.html>

