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

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COVID-19: DRDO's Contribution**THE TIMES OF INDIA***Sat, 19 Sept 2020*

162 armoured ambulances double up as mini hosps

Hyderabad: Soldiers at the frontline can get immediate medical care onboard specialised Armoured Ambulance Tracked (AAT) vehicles, 162 of which have already been delivered to the army. The vehicles are being manufactured at Ordnance Factory Medak in Sangareddy district near Hyderabad. Order has been placed for 288 such vehicles.

“The vehicle has provision for performing some emergency procedures. There is oxygen supply, ventilators, and also emergency medicines. The soldiers can be treated even while they are being shifted out from the place, however, difficult the terrain may be,” Ordnance Factory Medak (OFM) general manager Alok Prasad told TOI.

In a situation where a soldier needs critical medical care, the armoured ambulance which can travel on any terrain, can come to their rescue to provide medical assistance. Since response time is important in critical cases, the ambulance will be a minihospital with all critical equipment to save lives by giving immediate medical care.

The ambulance is a variant of the BMP2 Infantry Combat Vehicle (ICV) which India got from erstwhile Soviet Union. Christened ‘Sarath’ in India, the country has developed variants to serve different purposes with the transfer of technology (ToT). DRDO’s Combat Vehicles Research & Development Establishment (CVRDE) at Chennai developed the Armoured Ambulance Tracked (AAT) vehicle on a modified BMP-II chassis. The armoured ambulance has been designed with provisions to carry four patients on stretchers or two patients on stretchers and four seated patients or eight seated patients with two medical attendants. It is equipped with a defibrillator for continuous ECG monitoring, automatic external defibrillation and pacing, NIBP and pulse oximetry, ventilator for artificial ventilations, suction unit for removal of abdominal fluids, refrigerator and conventional medical equipment, according to a description of the vehicle on DRDO’s website.

It may be mentioned here that the infantry combat vehicles manufactured at the OFM have the ability to move on any terrain at a speed of 70 km/hr and also float in water at 7-8 km/hr.

<https://timesofindia.indiatimes.com/city/hyderabad/162-armoured-ambulances-double-up-as-mini-hosps/articleshow/78195316.cms>



Sun, 20 Sept 2020

DRDO has set up 8 tech centres for research on futuristic military applications: Govt

New Delhi: India's premier defence research institute DRDO has set up eight advanced technology centres to carry out research on futuristic military applications, the government said on Saturday. Minister of State for Defence Shripad Naik, replying to a question in Rajya Sabha, said these centres will also provide support to academia to undertake research on new technologies in niche areas for military use.

“The Defence Research and Development Organisation (DRDO) has created eight advanced technology centres across India to carry out research activities in the identified futuristic/new technology areas,” he said.

In August, the DRDO had set in motion a long-awaited process to usher in mega reforms as well as to create enabling infrastructure for developing futuristic military weapons.

A committee headed by Prof V Ramagopal Rao, Director of Delhi IIT, has been appointed to suggest measures to improve efficiency of the DRDO laboratories across the country with an aim to boost the domestic defence production.

At present, the DRDO has over 50 laboratories across the country which are engaged in developing defence technologies covering disciplines like aeronautics, armaments, combat vehicles, engineering systems, missiles, advanced computing and naval systems.

The DRDO has contributed significantly in developing various key weapons and military platforms for all the three services in the last six decades.

However, there has been a view in the government that the DRDO should enhance its efficiency further in the sync with the government's focus on making India self-reliant in defence manufacturing.

Replying to a separate question, Naik said the proposed corporatisation of the Ordnance Factory Board (OFB) will improve its autonomy, accountability and efficiency. “The Cabinet Committee on Security in its meeting held on July 29 has approved to convert OFB, a subordinate office of ministry of defence, into one or more than one 100 per cent government-owned corporate entities,” he said.

The nearly 200-year-old OFB operates 41 ammunition production facilities across the country. At present, the government has to shell out around Rs 5,000 crore annually to pay salaries of the OFB employees. Additionally, it gives around Rs 3,000 crore to OFB as operational cost, according to officials.

“An Empowered Group of Ministers (EGoM) has been constituted under the chairmanship of minister of defence to oversee and guide the entire process of corporatisation of OFB, including transition support and redeployment plan of employees while safeguarding their wages and retirement benefits,” Naik said.

<https://www.deccanherald.com/national/drdo-has-set-up-8-tech-centres-for-research-on-futuristic-military-applications-govt-889927.html>



Shripad Naik. Credit: PTI/file photo.

Indian Army to use double-humped camels for transportation, patrolling in Ladakh

DRDO is rearing double-humped camels which will be deployed at DBO and Depsang in eastern Ladakh to be used by the Indian Army for patrolling and transportation

Double-humped camels will now be used for transportation and patrolling by the Indian Army in eastern Ladakh's treacherous terrain. This plan originally from three years ago will come into effect amid the India-China standoff along the Line of Actual Control (LAC).

Areas like Daulat Beg Oldie or DBO and Depsang where these camels will be deployed at more than 17,000 feet are among locations where armies of both countries have mobilized in great numbers.

The animal is also known as Bactrian camel and is found in the Nubra valley of Ladakh at heights of over 12,000 feet. It is natural for the terrain. These camels are being reared at the defence institute of high altitude research in Leh by the Defence Research and Development Organisation (DRDO).

Among those reared and trained is young Rangoli, a female camel born to Chinku and Tinku as part of the breeding programme undertaken by the institute in Leh.

After carrying out trials and doing a comparative study with a single-humped camel brought from Rajasthan, it was found that the double-humped camel is better suited for the task at hand.

Breeding of the camels will be done in Leh to ensure that the Army gets the required numbers. A source said current estimate is that of about 50 such camels will be commissioned for the Army.

"The double-humped camels are best suited for these conditions. They can carry loads of 170 kgs at more than 17,000 feet which is much more than the ponies that are being used as of now. They can survive without water for at least 72 hours," said Col Manoj Batra, a veterinary officer of the Indian Army.

"These will be used for transportation and patrolling and should be handed over to the Army in the next five-six months," he added.

The trials for these animals were carried out on Daulat Beg Oldie to test the abilities, officials said.

The double-humped camel was used as a material part of the trade for transport on the traditional silk route between Tibet and Ladakh.

A breed called Zanskar ponies were being used until now but it was felt that they are not as swift-footed for sandy terrains. The ponies, however, are good for climbing mountains and can carry loads of up to 40-50 kgs much lesser than the double-humped camel.

With numbers restricted to only 350-400 in Ladakh, the double-humped camels are rare.

The breeding will ensure that numbers keep increasing as per the requirement and that old ones can be replaced with the new born. The army is looking at enhancing its logistics and patrolling capabilities in the remotest of areas where there has been tension which includes DBO and Depsang plains.

The project was introduced soon after the Doklam faceoff of 2016 between the Indian and Chinese armies on the India-Tibet-Bhutan tri-junction in Sikkim.

<http://www.indiandefensenews.in/2020/09/indian-army-to-use-double-humped-camels.html>



Double-humped camels being reared by DRDO in Leh

पूर्वी लद्दाख में LAC पर चीन का सामना करने में भारतीय सेना की मदद करेंगे दो कूबड़ वाले ऊंट

भारत ने पैंगोंग झील के दक्षिणी तट पर कई पर्वत चोटियों पर तैनाती की और किसी भी चीनी गतिविधि को नाकाम करने के लिये क्षेत्र में फिंगर 2 और फिंगर 3 इलाकों में अपनी मौजूदगी मजबूत की है। चीन फिंगर 4 और फिंगर 8 के बीच के इलाकों पर कब्जा कर रहा है।

लेह: वास्तविक नियंत्रण रेखा (LAC) पर भारत का चीन (India China Faceoff) के साथ गतिरोध जारी है। दोनों देशों के करीब एक लाख सैनिक सीमा पर तैनात हैं। इस बीच बदलते मौसम और आगे के कुछ महीनों में आने वाली कड़ाके की सर्दियों के लिए भारतीय सेना की तैयारी जारी है। सर्द मौसम में सीमा पर लंबे समय तक के लिए टिके रहने के लिए वहां चिकित्सा, सैन्य और अन्य जरूरी सामान पहुंचाए जाने के लिए बर्फीले रास्तों को जारी रखने और पुलों को मजबूत किया जा रहा है।

इसी कड़ी में रक्षा अनुसंधान एवं विकास (DRDO) संगठन ने डबल हंप कैमेल यानी दो कूबड़ों वाले ऊंट पर अपना रिसर्च पूरा कर लिया है और आने वाले दिनों में सीमा की अग्रिम चौकियों पर सैनिकों को राशन और हथियार पहुंचाने में मदद करेगा। बीते साल वायुसेना में शामिल हुआ चीनूक एक ओर जहां टैंक ले जाएगा, वहीं ये ऊंट छोटे हथियार और रसद लेकर जाएंगे।



डबल हंप कैमेल करेगा लद्दाख में भारतीय सेना की मदद

इन ऊंटों की आने वाले दिनों में बड़ी भूमिका हो सकती है। ये ऊंट 17 हजार फीट की ऊंचाई तक ये 170 किलो के राशन और हथियार ले जाने में सक्षम हैं। इसके साथ ही ऊंट पेट्रोलिंग में मदद करेंगे। कर्नल मनोज बत्रा ने News18 इंडिया के संवाददाता अरुण कुमार सिंह के सवाल का जवाब देते हुए जानकारी दी कि ये ऊंट इस परिवेश में ढला हुआ है ऐसे में सेना को इनसे काफी मदद मिलेगी।

कर्नल बत्रा ने बताया कि जिन इलाकों में हम सामान नहीं पहुंचा पा रहे थे वहां हथियार, रसद, साज-ओ-सामान लेकर ये ऊंट लेकर जा सकते हैं। ये ऊंट तीन दिन तक बिना पानी के रह सकते हैं और आर्मी एनिमल के तौर पर फिट है। बताया कि इनकी मदद से हमारी सैन्य क्षमता बढ़ जाएगी। उन्होंने कहा कि आने वाले 6 महीने के भीतर ये ऊंट तैनात कर दिए जाएंगे।

सरकार ने पूर्वी लद्दाख में संपूर्ण स्थिति, अभियानगत तैयारियों की व्यापक समीक्षा की

वहीं सरकार ने पूर्वी लद्दाख में भारत की अभियानगत तैयारियों सहित क्षेत्र में संपूर्ण स्थिति की शुक्रवार को व्यापक समीक्षा की। सरकारी सूत्रों ने यह जानकारी दी। उन्होंने बताया कि चीनी सेना के लगातार आक्रामक रुख अपनाये रखने और क्षेत्र में भारतीय सैनिकों को फिर से डराने की कोशिश किये जाने के मद्देनजर यह बैठक की गई।

सूत्रों ने बताया कि उच्चाधिकार प्राप्त 'चाइना स्टडी ग्रुप' की करीब 90 मिनट चली बैठक में रक्षा मंत्री राजनाथ सिंह, राष्ट्रीय सुरक्षा सलाहकार अजीत डोभाल, प्रमुख रक्षा अध्यक्ष जनरल बिपिन रावत और तीनों सेनाओं के प्रमुखों ने अरुणाचल प्रदेश और सिक्किम सेक्टरों समेत करीब 3,500 किलोमीटर लंबी वास्तविक नियंत्रण रेखा (एलएसी) के पास सतर्कता और बढ़ाए जाने पर भी विचार किया।

बताया कि थलसेना प्रमुख जनरल एम एम नरवणे ने बैठक में पेंगोंग झील के उत्तर एवं दक्षिण किनारे पर भारतीय एवं चीनी बलों के फिर से आमने-सामने होने के संबंध में जानकारी दी और इस प्रकार की कोशिशों से प्रभावशाली तरीके से निपटने के लिए उठाए गए कदमों के बारे में बताया। एक सूत्र ने कहा, 'चाइना स्टडी ग्रुप की बैठक में हालात के सभी पहलुओं की समीक्षा की गई।'

<https://hindi.news18.com/news/nation/india-china-standoff-double-hump-camel-to-help-indian-army-in-facing-china-3245678.html>

ThePrint

Sun, 20 Sept 2020

'Like lighting a match in cyclone' — Beauty of India's hypersonic flight tech is in its engine

DRDO's successful test of a Hypersonic Technology Demonstrator Vehicle this month is a result of several indigenous tech achievements and know-how obtained over two decades

By Duvvuri Subrahmanyam

Bengaluru: The successful test of the Hypersonic Technology Demonstrator Vehicle (HSTDV), conducted by the Defence Research and Development Organisation (DRDO) earlier this month, puts India in an elite group of nations that possess hypersonic cruise-vehicle technology.

This is a result of several indigenous technological achievements and know-how obtained over the past two decades. This development assumes added significance in the backdrop of the ongoing tensions at the Line of Actual Control (LAC).

Given that the Agni missiles and Indian Space Research Organisation (ISRO) launch vehicles already achieve hypersonic speeds (greater than Mach 5, or five times the speed of sound), one may wonder what makes HSTDV a big deal.

To answer this, we take a closer look at the scramjet engine that powers HSTDV.

Ramjets and Scramjets

Typical engines on airplanes, rockets, and missiles burn a mixture of fuel and oxidiser (combustion) to generate power (in a manner broadly similar to that observed in automobile engines), which is then used to create thrust forces to propel the vehicle.

Missiles and other flight systems designed for supersonic speeds (above Mach 1 and below Mach 5) commonly use a ramjet engine.

Unlike the gas turbine engines found on commercial transport airplanes, ramjets have no moving or rotating mechanical parts. At supersonic speeds, a stream of fast-moving air from the atmosphere, which contains oxygen, rushes into the engine.

Fuel is injected into this airstream inside the engine, and a fast-moving mixture of fuel and oxygen is created. This mixture is ignited to initiate combustion and generate thrust.

The ramjet engine is what powers the Brahmos cruise missile.

A scramjet — short for supersonic combustion ramjet — works on similar concepts as a ramjet, but is designed for operation at even higher flight speeds, going into the hypersonic territory.

One of the key challenging aspects of a scramjet is that the air ingested by the engine flows through at very high speeds — this internal air-flow speed is itself supersonic. In this scenario,



The Hypersonic Technology Demonstrator Vehicle was launched from APJ Abdul Kalam testing range in Odisha's Balasore | By special arrangement

proper injection of fuel into the airstream, holding of a steady flame, and ensuring complete fuel combustion in the engine is an immensely challenging engineering task — one that demands a good scientific understanding of supersonic flow and combustion mechanics.

It's like lighting and holding a matchstick flame in the open during a cyclone with intense winds, as goes an analogy often used in aerospace engineering classrooms.

The flame inside the engine, which initiates and sustains combustion, can very easily be extinguished by the high-speed airstream (known as flame blowoff), and this basically shuts down the engine, leading to immediate loss of thrust and thereby control of the vehicle.

HSTDV is powered by a scramjet, where the challenges mentioned above have been met through intricate design that performs careful conditioning of the internal airstream, and promotes a stable and continuous combustion process for steady engine operation.

This was demonstrated during a recent test flight, where the vehicle cruised at Mach 6 (nearly 7,200 kmph) in free flight for more than 20 seconds powered solely by its scramjet.

In recent years, ISRO has also been engaged in independent efforts to develop scramjet technology. In August 2016, it completed a successful flight experiment designed to test scramjet engine technology developed in-house.

Unlike the HSTDV test, where an entire flight vehicle was demonstrated, the ISRO tests were focused on the engine alone — two scramjet engines were bolted as add-ons to a rocket and operated in parallel to the rocket engine. These tests comprehensively demonstrated the workings of a scramjet over a range of Mach speed numbers and altitudes.

The scramjet advantage

The Agni missiles use a solid propellant that contains both fuel and the oxidiser needed for combustion. Similarly, ISRO space-launchers also carry both fuel and oxidiser onboard.

In comparison, a scramjet engine draws oxygen from the atmosphere, resulting in significant savings in terms of the weight of oxidiser that does not have to be carried onboard.

These savings directly translate to higher payload capacity, and/or extended flight range for the vehicle.

Also, unlike solid-propellant engines, scramjets allow for a certain level of on-demand acceleration and deceleration by regulating the fuel burn rate, thereby enabling the vehicle to cruise in a controlled manner.

The manoeuvrability of a scramjet-powered hypersonic vehicle adds a large degree of unpredictability to its flight path, making interception much harder than for a ballistic missile like Agni.

This aspect naturally provides significant tactical advantages in certain operational scenarios.

What next?

While this milestone is certainly a boost to India's drive towards greater self-reliance in meeting defence needs, there may be further technology gaps that need to be bridged in order to indigenously realise a field-ready hypersonic cruise vehicle platform.

In addition to its own resources, the DRDO can leverage the leading scientific and academic research institutions in India to pursue an aggressive timeline for developing such a platform for strategic deterrence.

Private industry can also play a role in this endeavour, not just as manufacturing partners but, potentially, as technology and product development entities.

In the long term, creation of an ecosystem that enables synergy between industry and government-funded organisations/institutes for building advanced field-ready technologies augurs well for realising the vision of an Atmanirbhar Bharat.

(Dr Duvvuri Subrahmanyam (@mangaloreman on Twitter) is an assistant professor of Aerospace Engineering at the Indian Institute of Science (IISc) in Bengaluru. His academic research interests lie broadly in the areas of experimental aerodynamics and fluid mechanics. Views expressed here are personal.)

Defence News

Defence Strategic: National/International



Sat, 19 Sept 2020

भारत-चीन सीमा विवाद: रक्षा मंत्री राजनाथ सिंह, एनएसए अजित डोवाल समेत सेना के अफसरों के बीच डेढ़ घंटे चली मीटिंग, पूर्वी लद्दाख के हालात का रिव्यू किया गया

- भारत-चीन के बीच लद्दाख में बीते 6 महीने से तनाव, 15 जून को गलवान में हिंसक झड़प हुई थी
- 29-30 अगस्त की रात चीन ने पैंगॉन्ग झील इलाके की एक पहाड़ी पर कब्जे की कोशिश की थी

नई दिल्ली: सरकार ने पूर्वी लद्दाख के हालात को लेकर शुक्रवार को विस्तार से रिव्यू किया। सरकार के सूत्रों के मुताबिक, मीटिंग में चीनी सेना के आक्रामक रवैये और ताजा उकसावे की कार्रवाई को ध्यान में रखते हुए भारत की ऑपरेशनल तैयारियों की भी समीक्षा की गई। मीटिंग करीब डेढ़ घंटे चली।

इस दौरान हाई-पावर चीन स्टडी ग्रुप, रक्षा मंत्री राजनाथ सिंह, नेशनल सिक्योरिटी एडवाइजर अजित डोवाल, चीफ ऑफ डिफेंस स्टाफ जनरल बिपिन रावत और तीनों सेनाओं के प्रमुख मौजूद थे। मीटिंग में अरुणाचल प्रदेश और सिक्किम सेक्टर समेत लाइन ऑफ एक्चुअल कंट्रोल (एलएसी) पर सतर्कता बढ़ाने को लेकर चर्चा हुई।

आर्मी चीफ ने मीटिंग में दी जानकारी

सूत्रों के मुताबिक, आर्मी चीफ जनरल एमएम नरवणे ने मीटिंग को पैंगॉन्ग झील के उत्तरी और दक्षिणी किनारे पर भारत और चीन सैनिकों के ताजा फेस-ऑफ के बारे में बताया। उन्होंने हालातों से निपटने के लिए भारतीय सेना द्वारा उठाए गए कदमों के बारे में भी ब्रीफ किया। सूत्रों के मुताबिक, चीन स्टडी ग्रुप की मीटिंग में हालात के सभी पहलुओं का रिव्यू किया गया।

मीटिंग में पूर्वी लद्दाख और अन्य संवेदनशील इलाकों में भीषण सर्दियों में भी सैनिकों और हथियारों के वर्तमान स्तर को बनाए रखने के लिए किया जा रहे प्रबंधों पर भी चर्चा की गई।



लेह में उड़ान भरते एयरफोर्स के एयरक्राफ्ट की फोटो मंगलवार की है। चीन से तनाव को देखते हुए लद्दाख में सेना का मूवमेंट बढ़ गया है।

कॉर्प्स कमांडर लेवल की मीटिंग अगले हफ्ते संभव

सूत्रों के मुताबिक, चीन की पीपुल्स लिबरेशन आर्मी (पीएलए) की तरफ से कॉर्प्स कमांडर लेवल की अगले राउंड की मीटिंग को लेकर कोई जवाब नहीं दिया गया है। मीटिंग अगले हफ्ते होने की उम्मीद है। सूत्रों के मुताबिक, पूर्वी लद्दाख के तनाव वाले इलाकों के साथ-साथ पैंगॉन्ग झील के उत्तरी और दक्षिणी किनारों पर हालात अब भी तनावपूर्ण बने हुए हैं।

अब तक 5 राउंड की मीटिंग्स हो चुकीं

भारत-चीन के आर्मी अफसरों के बीच पहले 5 राउंड की मीटिंग्स का कोई अहम नतीजा नहीं निकला। पूर्वी लद्दाख के फिंगर-4 इलाके से चीन पीछे नहीं हटा है, बल्कि उसने सैनिकों की संख्या और बढ़ा दी है। न्यूज एजेंसी के मुताबिक भूटान में चीन के बिल्डअप को लेकर सरकार ने कुछ दिन पहले भी चर्चा की थी।

चीन बार-बार घुसपैठ की कोशिश कर रहा

भारत-चीन के बीच अप्रैल-मई से ही तनाव बना हुआ है। चीन के सैनिक पूर्वी लद्दाख में गलवान घाटी से लेकर फिंगर एरिया और पैंगॉन्ग झील इलाके में कई बार घुसपैठ की कोशिश कर चुके हैं। 15 जून को गलवान में भारत-चीन की झड़प भी हुई थी। 29-30 अगस्त की रात चीन ने पैंगॉन्ग झील के दक्षिणी छोर की पहाड़ी पर कब्जा करने की कोशिश की थी, लेकिन भारतीय जवानों ने नाकाम कर दी।

<https://www.bhaskar.com/national/news/india-china-ladakh-border-tension-latest-news-update-ministers-and-indian-army-officers-today-meet-today-after-firing-incidents-lac-in-eastern-ladakh-127729938.html>

Business Standard

Sat, 19 Sept 2020

Industry executives relieved by restrictions in new defence FDI policy

*Raised FDI cap is not on offer to companies that already have
government approval for 49 per cent FDI in a joint venture*

By Ajai Shukla

New Delhi: In May, Finance Minister Nirmala Sitharaman, while announcing a Rs 20 lakh crore (Rs 20 trillion) stimulus for the coronavirus-hit economy, said a decision had been taken to raise the foreign direct investment (FDI) cap in defence production from the existing 49 per cent (under the automatic route) to 74 per cent.

On Thursday, the Department for Promotion of Industry and Internal Trade (DPIIT) issued Press Note No. 4 (2020 series), which stated: “FDI up to 74 per cent under automatic route shall be permitted for companies seeking new industrial licenses.”

The raised FDI cap is not on offer to companies that already have government approval for 49 per cent FDI in a joint venture (JV). “Proposals for raising FDI beyond 49 per cent from such companies will require government approval”, said the note.

If an overseas defence vendor (referred to as a foreign original equipment manufacturer, or FOEM) who already has government approval for FDI wishes to raise its stake to 49 per cent, the FOEM is only required to file a declaration with the Ministry of Defence (MoD) within 30 days of the change in equity/shareholding pattern.

Setting up a JV with 74 per cent FDI is contingent on the FOEM bringing in end-to-end technological capability. “Investee company should be structured to be self-sufficient in the areas



of product design and development. The investee/JV company along with the manufacturing facility, should also have maintenance and life cycle support facility of the product being manufactured in India,” states the press note.

Business Standard learns the Swadeshi Jagran Manch (SJM) pressured the government to mandate the inflow and retention of intellectual property (IP) in defence technologies. “This will be implemented strictly, to avoid a domestic backlash,” said a source close to the SJM.

The government’s dual objective in permitting higher FDI in defence is to boost manufacture and facilitate the inflow of high technology. On March 4, the MoD told Parliament: “By allowing higher FDI in the defence sector, the global companies having high-end technologies can be encouraged to set up their manufacturing base in India in collaboration with Indian companies, thereby resulting in creation of employment opportunities, saving of foreign exchange and increasing indigenisation.”

Many Indian defence company executives are relieved the liberalised FDI caps come with these restrictive conditionalities. “Allowing FOEMs 74 per cent FDI through the automatic route, and treating them as Indian companies and thus eligible to participate in the “Make in India” categories of procurement – such as “Buy – Indian Designed, Developed and Manufactured”, “Buy (Indian)” and “Make” categories of procurement would have been disastrous for the fledgling Indian defence industry. The FOEMs have the deep pockets needed to wipe out the truly indigenous defence firms,” says Jayant Patil, Larsen & Toubro’s defence chief.

Other executives disagree. Rahul Chaudhry, former chief of Tata Power (Strategic Engineering Division), who now heads his own consultancy, points out that the decision to liberalise FDI is in line with the General Financial Rules (GFR) changes announced in May 2017. “The new rules mandate that an indigenous product is not defined by the equity structure of the manufacturer, but by domestic value addition of at least 50 per cent.

Chaudhry says it is incorrect that technology will flow to Indian defence JVs by permitting foreign ownership above 51 per cent. “Defence technology flows are regulated by governments, not by companies. A foreign government would control the IP flowing to a 100 per cent-owned subsidiary in India as rigorously as it would to an Indian subsidiary in which it owns a much smaller stake,” says Chaudhry.

There has been only limited success in attracting foreign investment into defence since it was first permitted in 2001. In March, the MoD told Parliament that, between 2001 and the end of 2019, Rs 1,834 crore in FDI had flowed to 79 Indian aerospace and defence companies. By June this year, investment has risen to Rs 3,454 crore, the MoD told Parliament on Monday.

FDI in defence was first permitted in May 2001, when defence manufacture, earlier reserved for the public sector, was opened up to 100 per cent for Indian private sector participation, with Foreign Direct Investment (FDI) up to 26 per cent permitted, both subject to licensing.

In 2016, Press Note No. 5 (2016 Series) permitted FDI up to 49 per cent under the automatic route, and above 49 per cent through the government route, provided it was likely to result in access to modern technology or for other reasons to be recorded.

FDI in defence is also subject to licensing under the Industries (Development & Regulation) Act, 1951. The manufacture of small arms and ammunition is regulated under the Arms Act, 1959.

In addition, foreign investment in the sector is subject to security clearance by the Ministry of Home Affairs, with guidelines issued by the MoD. “Government reserves the right to review any foreign investment in the Defence Sector that affects or may affect national security,” says the new policy.

https://www.business-standard.com/article/defence/industry-relieved-by-restrictions-in-new-defence-fdi-policy-120091801271_1.html

चीन से तनातनी के बीच बड़ी भारतीय सेना की ताकत, अब अंधेरे में भी दुश्मन को तहस-नहस करेगा 'सारंग'

*चीन (China) से तनातनी के बीच भारतीय सेना (Indian Army) की ताकत में बड़ा इजाफा हुआ है।
दरअसल देश की उन्नत तोपों में शामिल सारंग अब इंडियन आर्मी के हवाले कर दी गई है।*

नई दिल्ली: चीन (China) से तनातनी के बीच भारतीय सेना (Indian Army) की ताकत में बड़ा इजाफा हुआ है। दरअसल देश की उन्नत तोपों में शामिल सारंग अब इंडियन आर्मी के हवाले कर दी गई है।

जबलपुर की व्हीकल फैक्ट्री से 3 सारंग तोपों (Sarang Cannon) को शुक्रवार को फ्लैगिंग सेरेमनी में सेना के हवाले कर दिया गया। सूत्रों के मुताबिक, ये तोप जल्द ही सरहद पर तैनात की जा सकती हैं। गौरतलब है कि देश की सबसे ताकतवर तोप धनुष के बाद उन्नत तोपों में गिना जाने वाला नाम सारंग का ही है। इसकी मारक क्षमता 40 किलोमीटर की है।



अपग्रेड होने के बाद यह अंधेरे में भी सटीक निशाना लगाने में सक्षम है। इसका बैरल 155 एमएम 45 कैलिबर का है। खास बात यह है कि लंबे समय से इसका परीक्षण भी जबलपुर के एलपीआर रेंज में किया जा रहा था और इसका निर्माण व्हीकल फैक्ट्री जबलपुर समेत गन फैक्ट्री जबलपुर में जारी है। मेक इन इंडिया की तर्ज पर ऑर्डिनेंस फैक्ट्री खमरिया ने इस पर काम करते हुए इसे स्वदेशी रूप में आधुनिक और विकसित किया है।

यहां जानिए सारंग तोपों की खूबियां

- सारंग, मूल रूप से एक रशियन गन थी
- जिसे पहले सॉल्टन के नाम पर पहचाना जाता था
- इसकी पहले मारक क्षमता 27 किलोमीटर हुआ करती थी
- इसका बैरल पूर्व में 130 एम एम का था जिसे करीब 25 एमएम बढ़ा दिया गया है
- कुल 300 सारंग गनों को मॉडिफाई कर सेना को सुपुर्द करने का टारगेट रखा गया है
- जबलपुर की व्हीकल फैक्ट्री और गन कैरिज फैक्ट्री को इसका काम सौंपा गया है
- पहले फेज़ में 180 सारंग तोपों को अपग्रेड कर भेजा जाना है
- प्रोजेक्ट की कुल लागत 200 करोड़ है

<https://hindi.newsroompost.com/india/sarang-cannon-were-handed-ove-to-the-army/554142.html>

NSG & ITBP allow foreign bidders for sniper rifles, months before embargo kicks in

The 7.62x51mm sniper rifle is one of 101 items on the negative import list issued in August. Its import embargo kicks in December

By Snehesh Alex Philip

New Delhi: The elite National Security Group (NSG) and the Indo-Tibetan Border Police (ITBP) have come out with open tenders for 7.62x51mm sniper rifles that allow foreign purchases, despite the item figuring in the negative import list put out by the Modi government last month.

The negative import list sets December 2020 as the cut-off date for the rifle, which means its foreign-manufactured versions should not be bought after that date.

The NSG came out with a tender for six sniper rifles on 15 September, also seeking accessories. The NSG tender does not allow direct participation of foreign Original Equipment Manufacturers (OEM). “However, the Indian agent can participate in the tender and import the rifles and supply to the NSG,” an industry source said.



An NSG commando | Representational image | Photo: Manisha Mondal | ThePrint

The ITBP tender was issued on 10 August, a day after the negative import list came out, and seeks 358 sniper rifles of the 7.62x51mm variant.

No corrigendum has been issued by the ITBP for this tender except for an extension of the dates to close the bid. A source said foreign OEMs can’t directly apply, but any Indian company that serves as their agent/representative can import the item.

The sniper rifle is one of 101 items on the negative import list issued in August, with different embargo dates — running up to 2025 — for different products.

Defence Ministry officials had last month played down fears that embargo dates until 2025 will allow the armed forces to import all their demand by then, and defeat the purpose of the initiative, ie, to encourage domestic industry.

‘Backdoor entry’

Sources in the know of the tenders said the NSG and the ITBP should have gone for Indian manufacturers. The fact that the sniper rifles have been mentioned by the defence ministry in the negative list, they added, shows that they are reasonably confident about the domestic production of the 7.62x51mm sniper rifles.

“When the item is mentioned in the negative list, they have issued a tender allowing foreign players when there are Indian manufacturers of the same kind. There are companies that are also making the rifle in India in partnership with foreign players with large indigenous content,” said a source.

When it was pointed out that the import embargo for sniper rifles only kicks in December, the source said the tender is in violation of the spirit of the negative import list, “which is to push forward indigenous content”.

A second source said, in spirit, tenders like the NSG and the ITBP’s amount to “backdoor entry” since Indian agents of foreign OEMs are allowed to bid.

The defence ministry had, earlier this month, decided to scrap two deals that were being pursued under foreign procurement — carbines from the UAE and Self-Propelled Air Defence Gun Missile System (SPAD-GMS) from South Korea — and route them through the ‘Make in India’ initiative.

The deal for the new close quarter battle (CQB) carbines had been in the works since 2017. A UAE firm, Caracal International, finished as ‘L-1’ or the lowest bidder in September 2018 for a contract that was supposed to be fast-tracked.

However, pricing issues and representations by the Defence Research and Development Organisation (DRDO) and the domestic small arms industry, which wanted a shot at the deal, finally spelt the end of the road for the deal.

(This is an updated version of the report)

<https://theprint.in/defence/nsg-itbp-allow-foreign-bidders-for-sniper-rifles-months-before-embargo-kicks-in/506224/>



Sun, 20 Sept 2020

No decision on selling only ‘Made in India’ products in military canteens:Govt

In an address to the nation in May, Modi spoke extensively on the need to focus on a “self-reliant India” and called for promoting products made in India with a larger aim of making Indian economy stronger

The defence ministry has not taken any decision on selling only “Made in India” products in military canteens run by it across the country, the government said on Saturday.

“No decision has been taken in this regard,” Minister of State for Defence Shripad Naik said in Rajya Sabha.

He was replying to a question on whether the defence ministry will consider using and selling only “Made in India” products in its stores in light of Prime Minister Narendra Modi’s focus on self-reliance and “vocal for local”.

In an address to the nation in May, Modi spoke extensively on the need to focus on a “self-reliant India” and called for promoting products made in India with a larger aim of making Indian economy stronger.

In his reply, Naik also said that the total turnover of defence canteens in 2017-18 was Rs 17,190 crore and it went up to Rs 18,917 crore in 2018-19. The total turnover was reported at Rs 17,588 in 2019-20.

In the current fiscal, the figure has been recorded at Rs 3,692 crore till August, he said.

In reply to a separate question on whether government signed a contract with a private company to modernise 37 airfields, he replied in the affirmative.

“Modernisation of airfield infrastructure has enhanced the capability in terms of facilitating operation in poor weather conditions including night operations, enhanced enroute navigation infrastructure and enhanced traffic handling capabilities,” he said.

To a separate question, Naik said 86 military airbases are functioning in the country.

<https://www.hindustantimes.com/india-news/no-decision-on-selling-only-made-in-india-products-in-military-canteens-govt/story-PTahKMusXBxF4Sr5EqY77M.html>



Minister Shripad Naik was replying to a question on whether the defence ministry will consider using and selling only “Made in India” products in its stores.(PTI)

Explained: How Indian Army is screening women officers for Permanent Commission

The Army has recently tweaked its physical fitness policy for women officers, who are no longer exempt from Battle Physical Efficiency Test (BPET)

By Man Aman Singh Chhina

Chandigarh: The Army has constituted a special screening board to select women officers for Permanent Commission. This follows the Supreme Court's landmark verdict in February this year, allowing all women officers to seek Permanent Commission in the Army.

Here is a look at what this means for the women officers wearing the olive greens:

How is the screening board for women officers constituted?

The Number 5 Selection Board has been constituted by the Army pursuant to the Supreme Court's February 2020 order, directing the Army to induct all eligible women officers as permanent commission officers. The special board came into effect on September 14. The board is headed by a Senior General Officer and includes a woman officer of the rank of Brigadier. Women officers have been permitted to witness the proceedings as observers in order to add transparency to the process.

Women officers who qualify in the screening process will be granted Permanent Commission subject to being in the acceptable medical category.

What was the matter under adjudication in the Supreme Court?

Induction of women officers in the Army had been initiated in 1992, when the then government set the ball rolling for induction of women officers in select non-combat branches.

In 2008, the then government extended the Permanent Commission to women in two branches — Army Education Corps and Judge Advocate General.

In 2010, the Delhi High Court awarded the Permanent Commission to women officers in all branches in which they were serving but the government appealed against this order in the Supreme Court. The verdict in the matter came in February this year.

It is pertinent to mention here that the present government has granted Permanent Commission to women in all ten branches in which they were serving in March 2019, but this offer was not to be implemented retrospectively. This meant that a large number of women officers still serving as Short Service Commission (SSC) officers would not be eligible for the Permanent Commission. As SSC officers they could serve for a maximum of 14 years in the Army, however, the SC order paved the way for them to be considered for Permanent Commission. A screening board has, therefore, been constituted for the purpose.

How many women officers are currently serving in the Army and in what branches?

According to recent figures, there are 1,653 women officers currently serving in the Army out of a total of nearly 43,000 officers. Apart from the Judge Advocate General's branch and Army Education Corps where Permanent Commission was already given, the eight other branches to get women officers as permanent commissioned officers are Signals, Engineers, Military Intelligence, Army Air Defence, Army Ordnance Corps, Army Service Corps, Army Aviation Corps and Corps of Electronics and Mechanical Engineering.



According to recent figures, there are 1,653 women officers currently serving in the Army out of a total of nearly 43,000 officers.

What are the physical fitness standards required for women officers seeking Permanent Commission?

The Army has recently tweaked its physical fitness policy for women officers after the Supreme Court verdict. Changing its policy regarding applicability of Battle Physical Efficiency Test (BPET) for women officers/women cadets/women recruits, the Army has made it mandatory for all women officers, including those commissioned before 2009 and above 35 years of age, who were earlier exempt from it.

The BPET is a series of physical tests that are meant to test the physical fitness of an officer or a jawan to perform military tasks. For women officers, this includes a five-km run, a 60-metre sprint, climbing vertical rope up to a certain height, traversing horizontal rope up to a certain distance and jumping 6-feet ditch.

These new directions supersede the directions issued by Army Headquarters in March 2011, which said, “Lady officers, who are commissioned before April 2009 and are above 35 years of age, will be excused from BPET and only Physical Proficiency Test (PPT) will be applicable for them.”

Are there any other eligibility conditions for grant of Permanent Commission to women officers?

After the Supreme Court order on February 17, 2020 granting Permanent Commission to all women officers with all consequential benefits, the Army has started detailing women officers of the rank of Lt Colonels for Junior Command (JC) course at Army War College, Mhow, so that they are eligible for Permanent Commission. Women officers had been asked to attend the courses being conducted at the college between July and October this year.

This course, which is normally attended by male officers with five to 10 years of service, will now see women officers of much senior service bracket — 15 and 16 years of service and more — attending it. According to the directions of the Director General Military Training (DGMT), consequent to the SC order, the women officers considered for Permanent Commission will have to undergo mandatory courses of their respective branches along with JC course.

<https://indianexpress.com/article/explained/explained-how-army-is-screening-women-officers-for-permanent-commission-6602770/>

ThePrint

Sat, 19 Sept 2020

China, India signal each other on might in Indian Ocean Region, amid tensions on land

A PLA Navy task force is understood to have entered Indian Ocean Region as China seeks to project its dominance. India is keeping a close watch on waters around the country

By Snehash Alex Philip

New Delhi: The People’s Liberation Army Navy’s 36th escort task force, comprising a guided-missile destroyer, a missile frigate and a supply vessel, is understood to have entered the Indian Ocean Region (IOR) after having set sail on 3 September, ThePrint has learnt.

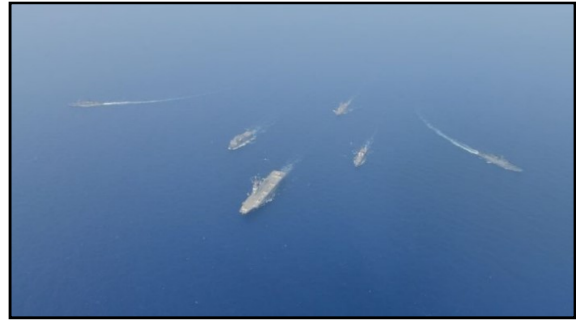
While the ships are meant for anti-piracy operations, the deployment comes as the PLA seeks to project its dominance in the IOR even as tensions run high between India and China along the Line of Actual Control in Ladakh.

Sources in the defence and security establishment said the task force is understood to have entered the IOR. The sources refused to comment if the Chinese deployment is being tracked, but said the Indian Navy keeps a close watch on waters around India.

Both India and China have been signalling to each other about their reach and ability in the waters. New Delhi asserts itself as the next security provider in the IOR.

On Monday, Chinese state media *Global Times* reported that a PLA Navy vessel escorted an Indian oil tanker carrying 31 crew members to a designated sea area in the Gulf of Aden.

The Indian defence and security establishment immediately took note of this development. Escort services are provided by all navies operating in the region, including Indian Navy, but the Chinese sought to play this up in what was seen as China's projection about its ability and presence in the region.



Indian Navy warships | Representational image | Twitter | @indiannavy

“Therein lies the difference between a hegemon and a status-quo maritime power like India. While the Indian Navy has been protecting maritime trade in the Indo-Pacific without consideration of Flag-State or nationality, the CCP (Chinese Communist Party) Navy only senses opportunities to threaten global oceanic trade,” a source said.

Immediately after this, the Indian Navy was reported to be tracking a Chinese research vessel. Yuan Wang, a satellite tracking vessel, had entered IOR from Malacca Straits in August. The ship was being constantly monitored by Indian Navy warships and the P8i long range maritime aircraft deployed in the region.

The sources said the Indian Navy keeps a close watch on all warship movements in the IOR, especially of the Chinese.

Indian Navy's moves

Amid the ongoing stand-off in Ladakh, the ‘silent service’ of the Indian armed forces has been making deft moves in the maritime sphere, said the sources.

It was reported in July that a large number of ships under the Eastern and Western Naval Commands were deployed in the IOR to send out a clear “message” to China.

“Late August, reports said that Indian Navy's warships were now present in the South China Sea, a subtle yet significant change in India's maritime posture vis-à-vis China. This change in operating philosophy showcases the graded approach being applied by the government, and was reinforced during Defence Minister Rajnath Singh's statement in Parliament this Tuesday — seek peace, while displaying resolve,” said a source.

As the reports of Indian warships in South China Sea came, *Global Times* carried an editorial claiming India was looking to distract China's attention from the border issue by exerting pressure on the high seas. It added that escalation in the South China Sea by the Indian Navy could not be ruled out.

The new strategy

The sources explained that the Indian Navy has been following its new stratagem of Mission Based Deployments since 2017, which entails deployment of combat-ready warships extending to the far reaches of the IOR.

Citing recent examples of India's reach and ability, the sources pointed out that in the month of September itself, Nireekshak, a deep-diving mission vessel was deployed in Mauritius to assist in salvage of MV Wakashio. Guided-missile destroyer Ranvijay and fleet tanker Shakti also undertook complex maritime exercises (INDRA-2020) with Russian Navy warships in the Bay of Bengal over a period of two days.

“Sahyadri, a stealth frigate has been operating off the coast of Sri Lanka to assist in salvage of very large crude carrier MT New Diamond for the last two weeks while Talwar, a stealth frigate undertook fuelling from a US Navy fleet tanker Yukon whilst Mission Deployed in the Northern Arabian Sea,” said the source quoted above.

“In addition, the Indian Navy has also stated that it continuously maintains presence of a warship in the Gulf of Aden for anti-piracy patrol and in the Persian Gulf for Op Sankalp (protection of Indian-flagged merchant vessels),” the source said.

The gravity of these deployments is not lost on the PLA Navy, which is aware that India’s central position astride the main International Shipping Lanes accords distinct advantages.

<https://theprint.in/defence/china-india-signal-each-other-on-might-in-indian-ocean-region-amid-tensions-on-land/505440/>

Army Technology

Sat, 19 Sept 2020

India vs China: Indian Army and People’s Liberation Army Ground Force (PLAGF) compared

The Indian Army has the world’s largest ground force, currently comprising 1.4 million personnel while the People’s Liberation Army

Ground Force (PLAGF) is estimated to have a deployed force of 975,000 troops

The Indian Army has the world’s largest ground force, currently comprising 1.4 million personnel while the People’s Liberation Army Ground Force (PLAGF) is estimated to have a deployed force of 975,000 troops.

Despite good economic and trade ties, multiple issues continue to impact Sino-Indian relations. Both nations continue to establish military infrastructure along the Line of Actual Control (LAC).

Chinese Army holds a huge inventory of weapons and hardware in most of the categories except tanks when compared to the Indian Army. On the other hand, the Indian Army’s combat experience in high-altitude battles and the acquisition of advanced armament from Russia and the US make it strong to resist potential threats from China.

Army Technology compares the capabilities of Indian and Chinese armies amid the current border tensions between the two countries.

Composition: PLAGF vs Indian Army

PLAGF is the land-based service branch of the People’s Liberation Army and is the biggest and oldest branch among the Chinese armed forces. Commanded by the Central Military Commission (CMC), the Chinese Army is divided into five theatre commands.

PLAGF’s regular forces include 13 corps-size army units comprising combined-arms brigades of up to 5,000 soldiers each.

The group armies include armoured divisions, mechanised infantry divisions, infantry and motorised infantry divisions, artillery divisions, and amphibious assault divisions. The Brigade units are made up of mechanised and motorised infantry brigades, armoured brigades, artillery brigades, anti-aircraft artillery missile brigades, and army aviation regiments.

Commanded by the Chief of Army Staff (COAS), the Indian Army is the largest service of the Indian Armed Forces and has 37 Divisions under six operational commands and a training command.



Indian and China continue to establish military infrastructure along the Line of Actual Control (LAC). Image courtesy of Aritra Deb/Shutterstock.

Each division includes up to four Brigades commanded by Corps. Each Brigade is made up of three battalions and support elements, while each battalion is further divided into companies, batteries, platoons, and sections.

Equipment: Chinese vs Indian Army

The PLAGF holds an inventory of main battle tanks (MBTs), light tanks, infantry fighting vehicles, armoured personnel carriers, self-propelled and towed artillery systems, rocket launch systems, and surface-to-air missile (SAM) systems.

Its tank force includes Type 99A, Type 99, Type 96, Type 96A, Type 96B MBT, and Type 15 light tank.

The PLAGF's armoured vehicle fleet is mainly composed of ZBD-09 IFV, ZBD-04 IFV, ZTD-05, and ZBD-11 amphibious assault vehicles while anti-tank weapons include PTL-02 wheeled assault gun system, HJ-8, HJ-9, and HJ-10 anti-tank guided missile systems.

The field and anti-aircraft artillery systems constitute PLZ-05, PLZ-07, and PLZ-83 self-propelled tracked howitzers, as well as a PHL-03 multiple rocket launcher, PP-87 and PP-89 mortars, PGZ-04 air defence system, PGZ-07 anti-aircraft artillery, and HQ-7B air defence missile system.

The Type 95, also known as QBZ-95 automatic assault rifle, is the service rifle of the Chinese Army.

On the other hand, the Indian Army's weapons inventory includes T-72, T-90 and Arjun main battle tanks, BMP series IFVs, anti-tank guided missiles, fast reconnaissance vehicles, self-propelled artillery, and air defence missile systems.

The INSAS assault rifle serves as the standard service rifle of the Indian Army.

Army Aviation: PLAGF vs Indian Army

The army aviation branch of the PLAGF operates Harbin Z-19 reconnaissance/attack helicopter, Z-9WA and Z-10 attack helicopters, Mil Mi-8/Mil Mi-17 and Mil Mi-26 transport helicopters as well as Shaanxi Y-8, Shaanxi Y-9, and Xian Y-7 military transport aircraft.

The Army Aviation Corps of India operates a fleet of HAL Dhruv, Chetak and Cheetah utility/liaison helicopters, as well as HAL Rudra attack helicopters.

To be inducted into service in 2020/2021, the AH-64E Apache, the world's most modern multi-mission attack helicopter, will become a force multiplier for the Indian Army.

Defence spending: India vs China

According to the Stockholm International Peace Research Institute (SIPRI), China is the world's second-biggest military spender with annual defence expenses totalling up to \$261bn in 2019. On the other hand, India spent \$71.1bn in 2019 for its defence to counter potential threats from neighbouring Pakistan and China. China spent \$2.07tn on its military in the last ten years, whereas the cumulative defence spending of India for the same period was \$590bn.

PLAGF's efforts to implement massive modernisation and re-structuring resulted in the reductions in the number of personnel while the Indian Army is suffering from the burden of pensions and salaries that eat a major chunk of the army's budget, leaving less scope for spending on the modernisation of weapons and technology.

Combat capabilities: PLAGF vs Indian Army

China holds an inventory of 3,500 tanks, whereas the Indian Army with more than 4,200 MBTs outperforms its counterpart. The Type 96A and Type 99 third-generation tanks lead the PLAGF's tank formations, while T90 Bhishma and Arjun Mark II third-generation MBTs form the backbone of the Indian Army tank force.

PLAGF has 33,000 armoured vehicles, which is more than four times the Indian Army's inventory of over 8,000 armoured vehicles.

China operates more than 3,800 self-propelled and 3,600 towed artillery systems, and more than 2,600 rocket launchers while India owns in excess of 230 self-propelled and over 4,000 towed artillery systems and approximately 270 rocket launchers.

The Russian-made S-400 Triumf is a cornerstone of the Chinese air-defence missile systems, while India also signed a contract with Russia to field the S-400 system as an effective stand-off weapon against air attacks.

PLAGF, thus, sits on a huge stockpile of weapons when compared with the Indian Army. Troop readiness will play a key role in case of a war, however, since Chinese troops have not fought a major battle after the Sino-Indian War in 1962 and Sino-Vietnamese War, a brief border war with Vietnam in 1979.

<https://www.army-technology.com/features/india-vs-china-indian-army-and-peoples-liberation-army-ground-force-plagf-compared/>

Science & Technology News



Sat, 19 Sept 2020

Lighting the way to infrared detection

By Philippe Roelli

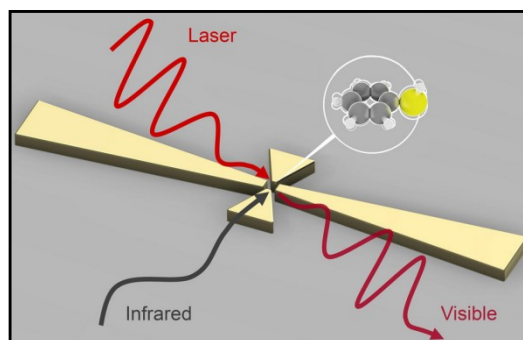
EPFL physicists propose a new path to detect infrared radiation with outstanding sensitivity, allowing detection of signals as low as that of a single quantum of light.

When using our webcam or cell phone camera, we experience the tremendous capabilities of cheap and compact sensors developed in the past decades for the visible region of the electromagnetic spectrum. On the contrary, detection of lower frequency radiation not visible to the human eye (such as mid- and far-infrared radiation) requires complex and costly equipment. Lack of a compact technology impedes widespread access to sensors for the recognition of molecules and the imaging of thermal radiation naturally emitted by our bodies. A new conceptual breakthrough in this field may therefore have tremendous impacts in our daily lives.

The most popular technique currently available to detect mid- and far-infrared radiation consists in bolometers, which are made up of arrays of small thermometers measuring the heat produced by absorption of radiation. They have many limitations, in particular being slow to respond and unable to detect weak levels of radiation.

The novel approach proposed by the EPFL team led by Christophe Galland and Tobias Kippenberg follows a completely different route: first convert the invisible radiation into visible light, and then detect it with existing technologies. At the core of the new concept lie hybrid metal-molecule nanostructures. The metal is tailored to focus infrared radiation on the molecules, which are thereby brought into vibration. Next, the energy of the vibrating molecules is converted again into radiation, but this time at a much higher frequency, in the visible domain. The hybrid nanostructure, designed in collaboration with Diego Martin-Cano (Max-Planck Institute for Light, Erlangen, Germany), allows for high conversion efficiency while reducing the size of the device to dimensions significantly smaller than the wavelength of the infrared light.

Philippe Roelli, lead author on the study, highlights that, among the various conceptual advances envisioned by their scheme, the most intriguing aspect concerns its potential sensitivity: "The low level of noise added by the molecular vibration during the conversion process enables the detection of extremely weak signals at room temperature. With advanced devices, we anticipate to



Credit: P. Roelli (EPFL)

reach quantum limited conversion and have the unique opportunity to resolve the signal of single quanta of infrared light."

The EPFL study will inspire future works at the interface between surface science, nanotechnology and quantum optics to foster the development of novel devices with applications in infrared sensing and imaging.

More information: Philippe Roelli et al. Molecular Platform for Frequency Upconversion at the Single-Photon Level, *Physical Review X* (2020). DOI: [10.1103/PhysRevX.10.031057](https://doi.org/10.1103/PhysRevX.10.031057)

Journal information: *Physical Review X*
<https://phys.org/news/2020-09-infrared.html>



Sat, 19 Sept 2020

Solar storm forecasts for Earth improved with help from the public

Solar storm analysis carried out by an army of citizen scientists has helped researchers devise a new and more accurate way of forecasting when Earth will be hit by harmful space weather. Scientists at the University of Reading added analysis carried out by members of the public to computer models designed to predict when coronal mass ejections (CMEs)—huge solar eruptions that are harmful to satellites and astronauts—will arrive at Earth.

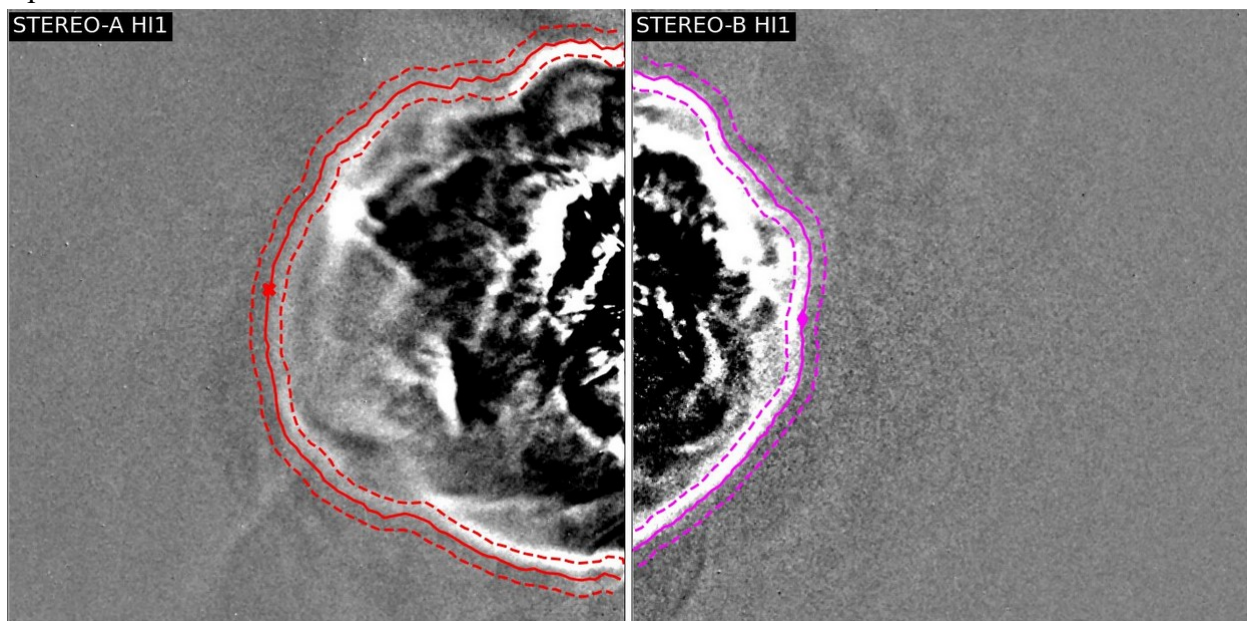


Image shows a CME erupting from the Sun's surface, captured from either side by imaging cameras on board the two STEREO spacecraft. The red and pink lines show the outline as traced by volunteers in the Solar Stormwatch project, which helped add important data about the size and shape of the CMEs into the new forecasting model. Credit: University of Reading/NASA

The team found forecasts were 20% more accurate, and uncertainty was reduced by 15%, when incorporating information about the size and shape of the CMEs in the volunteer analysis. The data was captured by thousands of members of the public during the latest activity in the Solar Stormwatch citizen science project, which was devised by Reading researchers and has been running since 2010.

The findings support the inclusion of wide-field CME imaging cameras on board space weather monitoring missions currently being planned by agencies like NASA and ESA.

Dr. Luke Barnard, space weather researcher at the University of Reading's Department of Meteorology, who led the study, said: "CMEs are sausage-shaped blobs made up of billions of tonnes of magnetised plasma that erupt from the Sun's atmosphere at a million miles an hour. They are capable of damaging satellites, overloading power grids and exposing astronauts to harmful radiation.

"Predicting when they are on a collision course with Earth is therefore extremely important, but is made difficult by the fact the speed and direction of CMEs vary wildly and are affected by solar wind, and they constantly change shape as they travel through space.

"Solar storm forecasts are currently based on observations of CMEs as soon as they leave the Sun's surface, meaning they come with a large degree of uncertainty. The volunteer data offered a second stage of observations at a point when the CME was more established, which gave a better idea of its shape and trajectory.

"The value of additional CME observations demonstrates how useful it would be to include cameras on board spacecraft in future space weather monitoring missions. More accurate predictions could help prevent catastrophic damage to our infrastructure and could even save lives."

In the study, published in *AGU Advances*, the scientists used a brand new solar wind model, developed by Reading co-author Professor Mathew Owens, for the first time to create CME forecasts.

The simplified model is able to run up to 200 simulations—compared to around 20 currently used by more complex models—to provide improved estimates of the solar wind speed and its impact on the movement of CMEs, the most harmful of which can reach Earth in 15-18 hours.

Adding the public CME observations to the model's predictions helped provide a clearer picture of the likely path the CME would take through space, reducing the uncertainty in the forecast. The new method could also be applied to other solar wind models.

The Solar Stormwatch project was led by Reading co-author Professor Chris Scott. It asked volunteers to trace the outline of thousands of past CMEs captured by Heliospheric Imagers—specialist, wide-angle cameras—on board two NASA STEREO spacecraft, which orbit the Sun and monitor the space between it and Earth.

The scientists retrospectively applied their new forecasting method to the same CMEs the volunteers had analysed to test how much more accurate their forecasts were with the additional observations.

Using the new method for future solar storm forecasts would require swift real-time analysis of the images captured by the spacecraft camera, which would provide warning of a CME being on course for Earth several hours or even days in advance of its arrival.

More information: *AGU Advances*, [DOI: 10.1029/2020AV000214](https://doi.org/10.1029/2020AV000214)

Journal information: *AGU Advances*

<https://phys.org/news/2020-09-solar-storm-earth.html>

Engineers produce a fisheye lens that's completely flat

By Jennifer Chu

To capture panoramic views in a single shot, photographers typically use fisheye lenses—ultra-wide-angle lenses made from multiple pieces of curved glass, which distort incoming light to produce wide, bubble-like images. Their spherical, multipiece design makes fisheye lenses inherently bulky and often costly to produce.

Now engineers at MIT and the University of Massachusetts at Lowell have designed a wide-angle lens that is completely flat. It is the first flat fisheye lens to produce crisp, 180-degree panoramic images. The design is a type of "metalens," a wafer-thin material patterned with microscopic features that work together to manipulate light in a specific way.

In this case, the new fisheye lens consists of a single flat, millimeter-thin piece of glass covered on one side with tiny structures that precisely scatter incoming light to produce panoramic images, just as a conventional curved, multielement fisheye lens assembly would. The lens works in the infrared part of the spectrum, but the researchers say it could be modified to capture images using visible light as well.

The new design could potentially be adapted for a range of applications, with thin, ultra-wide-angle lenses built directly into smartphones and laptops, rather than physically attached as bulky add-ons. The low-profile lenses might also be integrated into medical imaging devices such as endoscopes, as well as in virtual reality glasses, wearable electronics, and other computer vision devices.

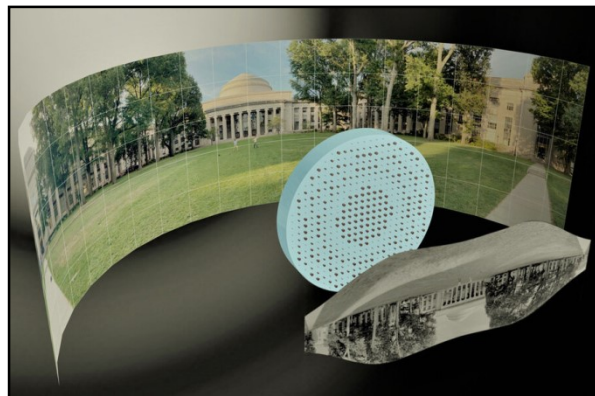
"This design comes as somewhat of a surprise, because some have thought it would be impossible to make a metalens with an ultra-wide-field view," says Juejun Hu, associate professor in MIT's Department of Materials Science and Engineering. "The fact that this can actually realize fisheye images is completely outside expectation.

This isn't just light-bending—it's mind-bending."

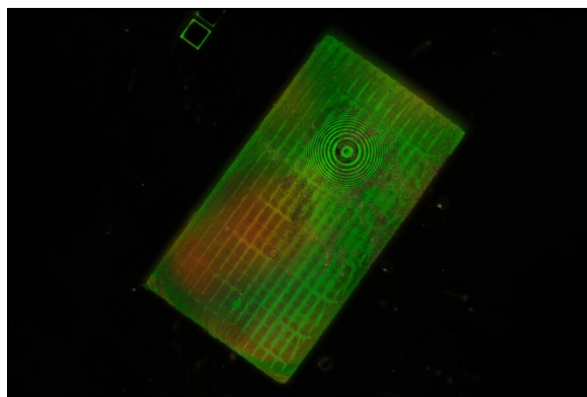
Hu and his colleagues have published their results today in the journal *Nano Letters*. Hu's MIT coauthors are Mikhail Shalaginov, Fan Yang, Peter Su, Dominika Lyzwa, Anuradha Agarwal, and Tian Gu, along with Sensong An and Hualiang Zhang of UMass Lowell.

Design on the back side

Metalenses, while still largely at an experimental stage, have the potential to significantly reshape the field of optics. Previously, scientists have designed metalenses that produce high-resolution and relatively wide-angle images of up to 60 degrees. To expand the field of view



3D artistic illustration of the wide-field-of-view metalens capturing a 180° panorama of MIT's Killian Court and producing a high-resolution monochromatic flat image." Credit: Mikhail Shalaginov, Tian Gu, Christine Daniloff, Felice Hankel, Juejun Hu



Top-view photograph of the lens showing the fabricated metasurface (green area). Credit: Felice Frankel

further would traditionally require additional optical components to correct for aberrations, or blurriness—a workaround that would add bulk to a metalens design.

Hu and his colleagues instead came up with a simple design that does not require additional components and keeps a minimum element count. Their new metalens is a single transparent piece made from calcium fluoride with a thin film of lead telluride deposited on one side. The team then used lithographic techniques to carve a pattern of optical structures into the film.

Each structure, or "meta-atom," as the team refers to them, is shaped into one of several nanoscale geometries, such as a rectangular or a bone-shaped configuration, that refracts light in a specific way. For instance, light may take longer to scatter, or propagate off one shape versus another—a phenomenon known as phase delay.

In conventional fisheye lenses, the curvature of the glass naturally creates a distribution of phase delays that ultimately produces a panoramic image. The team determined the corresponding pattern of meta-atoms and carved this pattern into the back side of the flat glass.

"We've designed the back side structures in such a way that each part can produce a perfect focus," Hu says.

On the front side, the team placed an optical aperture, or opening for light.

"When light comes in through this aperture, it will refract at the first surface of the glass, and then will get angularly dispersed," Shalaginov explains. "The light will then hit different parts of the backside, from different and yet continuous angles. As long as you design the back side properly, you can be sure to achieve high-quality imaging across the entire panoramic view."

Across the panorama

In one demonstration, the new lens is tuned to operate in the mid-infrared region of the spectrum. The team used the imaging setup equipped with the metalens to snap pictures of a striped target. They then compared the quality of pictures taken at various angles across the scene, and found the new lens produced images of the stripes that were crisp and clear, even at the edges of the camera's view, spanning nearly 180 degrees.

"It shows we can achieve perfect imaging performance across almost the whole 180-degree view, using our methods," Gu says.

In another study, the team designed the metalens to operate at a near-infrared wavelength using amorphous silicon nanoposts as the meta-atoms. They plugged the metalens into a simulation used to test imaging instruments. Next, they fed the simulation a scene of Paris, composed of black and white images stitched together to make a panoramic view. They then ran the simulation to see what kind of image the new lens would produce.

"The key question was, does the lens cover the entire field of view? And we see that it captures everything across the panorama," Gu says. "You can see buildings and people, and the resolution is very good, regardless of whether you're looking at the center or the edges."

The team says the new lens can be adapted to other wavelengths of light. To make a similar flat fisheye lens for visible light, for instance, Hu says the optical features may have to be made smaller than they are now, to better refract that particular range of wavelengths. The lens material would also have to change. But the general architecture that the team has designed would remain the same.

The researchers are exploring applications for their new lens, not just as compact fisheye cameras, but also as panoramic projectors, as well as depth sensors built directly into smartphones, laptops, and wearable devices.

"Currently, all 3-D sensors have a limited field of view, which is why when you put your face away from your smartphone, it won't recognize you," Gu says. "What we have here is a new 3-D sensor that enables panoramic depth profiling, which could be useful for consumer electronic devices."

More information: Shalaginov et al., A single-layer panoramic metalens with $> 170^\circ$ diffraction-limited field of view. arXiv:1908.03626 [physics.optics]. arxiv.org/abs/1908.03626

Journal information: *Nano Letters*
<https://phys.org/news/2020-09-fisheye-lens-flat.html>



Sat, 19 Sept 2020

Resonant tunneling diode oscillators for terahertz-wave detection

A semiconductor device that is promising for both generating and detecting terahertz radiation has been demonstrated by physicists at RIKEN. This may aid the development of high-performance integrated solutions for terahertz imaging and sensing applications as well as for high-speed, next-generation wireless communications systems.

Terahertz radiation is electromagnetic waves with frequencies ranging between 0.1 and 10 terahertz. It falls between microwaves and infrared radiation on the electromagnetic spectrum. This range has been dubbed the terahertz gap because it has been underutilized in applications compared to other regions of the spectrum, which have been extensively used in many applications.

One reason why terahertz radiation has not been used much is that it has been traditionally difficult to generate and detect terahertz radiation. But recent years have seen many advances in this area, and terahertz radiation is gathering interest for imaging for airport security and medical purposes as well as for wireless communications systems that use terahertz waves instead of microwaves as the information carrier.

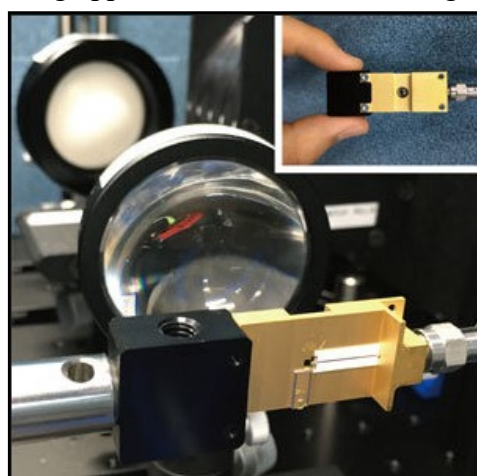
While semiconductor devices known as resonant tunneling diode (RTD) oscillators have been used as terahertz emitters for many years, Yuma Takida and Hiroaki Minamide from the RIKEN Center for Advanced Photonics have now shown that they can also detect terahertz radiation at room temperature.

"Our result demonstrates that terahertz RTD oscillators can be used as sensitive detectors of terahertz waves," says Takida. "This promises to accelerate the development of integrated oscillator and detector single chips, which will pave the way toward real-world terahertz applications."

The RIKEN pair, who collaborated with Safumi Suzuki and Masahiro Asada from Tokyo Institute of Technology, fabricated an RTD that can operate in two detection modes. One of these modes was especially sensitive at detecting terahertz waves, with a performance rivaling that of diode-based detectors.

"RTDs have several key advantages over other detectors," notes Takida. "These advantages include a wider dynamic range owing to resistance to high input power and a higher sensitivity at room temperature. Furthermore, we have shown that a single RTD device can be used as both an oscillator and a detector at terahertz frequencies."

Takida says that the growing demand for terahertz technology and progress in semiconductor technology made the work possible.



Photograph showing the terahertz detector chip based on a resonant tunneling diode oscillator (inset) being used to detect terahertz radiation. Credit: RIKEN Center for Advanced Photonics

The team anticipates that optimizing the design will allow devices to be fabricated that operate anywhere in the 0.1–2 terahertz region. Future work will focus on improving the sensitivity of their RTD detector and demonstrating integrated solutions for broadband heterodyne mixing at terahertz frequencies.

More information: Yuma Takida et al. Sensitive terahertz-wave detector responses originated by negative differential conductance of resonant-tunneling-diode oscillator, *Applied Physics Letters* (2020). DOI: [10.1063/5.0012318](https://doi.org/10.1063/5.0012318)

Journal information: *Applied Physics Letters*
<https://phys.org/news/2020-09-resonant-tunneling-diode-oscillators-terahertz-wave.html>



Sat, 19 Sept 2020

Hot Stuff: Unusual thermal diode rectifies heat in both directions

You can feel it on your laptop and mobile phone. It's behind your refrigerator and office copy machine. While heat is desirable for appliances like a coffee maker, it can jeopardize the reliability and safety of electronic systems in other devices, causing premature failure at best and explosions at worst.

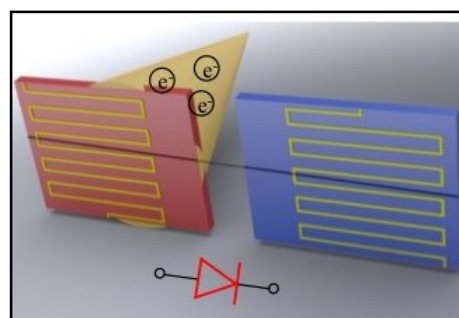
Active control of heat transport, as with thermal switches and thermal diodes, is important for a range of applications in heating and cooling, energy conversion, materials processing, and data storage. In practice, thermal diodes are highly desirable thermal components for many engineering applications because they allow energy systems to transfer heat to designated areas while also protecting them when the surrounding temperatures are too high.

Sheng Shen, a professor of mechanical engineering at Carnegie Mellon University, explores exotic thermal transport phenomena like thermal rectification in his laboratory. He recently led a research team that developed an unusual thermal diode made of polyethylene (PE) nanofiber that rectifies heat in both directions by changing the working temperature. This is significant because until now, achieving a large and adaptable rectification effect required a macroscale size or a great temperature bias. The findings were published in *Nature Communications*.

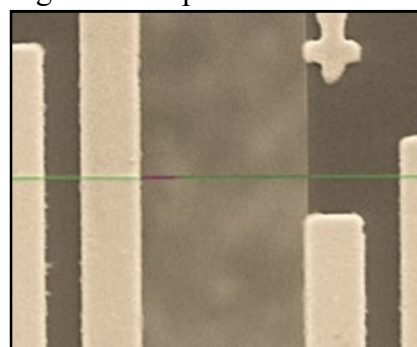
The nanoscale thermal diode developed in this work enables a record high thermal rectification effect beyond any reported experimental values for solid-state thermal rectification, and only requires a small temperature bias of less than 10 Kelvin.

To fabricate this dual-mode solid-state thermal diode, Xiao Luo, Ph.D. student and a co-leading author of the paper, tuned the crystalline PE nanofiber with electron beam irradiation. In its original state, PE nanofiber at a low temperature has high thermal conductivity but its conductivity significantly decreases after it undergoes a temperature-induced phase transition around 450 degrees Kelvin.

Luo irradiated one part of the PE nanofiber, reducing thermal conductivity and shifting the phase transition temperature lower.



Schematic of a nanofiber thermal diode device. Credit: College of Engineering, Carnegie Mellon University



Scanning electron microscopy image of the heterogeneous nanofiber junction as a thermal diode in false colors: purple (irradiated section) and green (pristine section). Credit: College of Engineering, Carnegie Mellon University

The remaining part of the PE nanofiber—the "pristine" part—was left as in the original state, creating a pristine-irradiated junction.

"As a result, we have a hetero-junction, with the two parts of the junction having different properties," said Luo. Because the pristine and irradiated parts undergo their respective phase transitions at different temperatures, heat can be rectified in both directions depending on the specific temperature. The dual-mode thermal rectification can potentially be used to regulate heat flow actively for advanced thermal management and energy conversion—a real game changer for a range of industrial and medical applications.

"As advanced thermal control elements, thermal diodes can be used to protect temperature sensitive electronic or biomedical devices from environmental temperature fluctuations," said Shen. "For instance, the nanofiber thermal diodes developed in this work are fully biocompatible and flexible. They can potentially be used to protect biological samples or biomedical devices from local heat spikes and enable precision temperature stabilization based on the dual-mode thermal rectification effect."

Titled "Dual-Mode Solid-State Thermal Rectification," the paper was a collaborative effort between researchers at Carnegie Mellon University, University of California at San Diego, University of Notre Dame, and the Institute of Materials Research and Engineering. In addition to Shen and Luo, Michael Bockstaller, professor of materials science and engineering, is a co-author.

More information: Ramesh Shrestha et al. Dual-mode solid-state thermal rectification, *Nature Communications* (2020). [DOI: 10.1038/s41467-020-18212-2](https://doi.org/10.1038/s41467-020-18212-2)

Journal information: [Nature Communications](https://phys.org/news/2020-09-hot-unusual-thermal-diode-rectifies.html)
<https://phys.org/news/2020-09-hot-unusual-thermal-diode-rectifies.html>

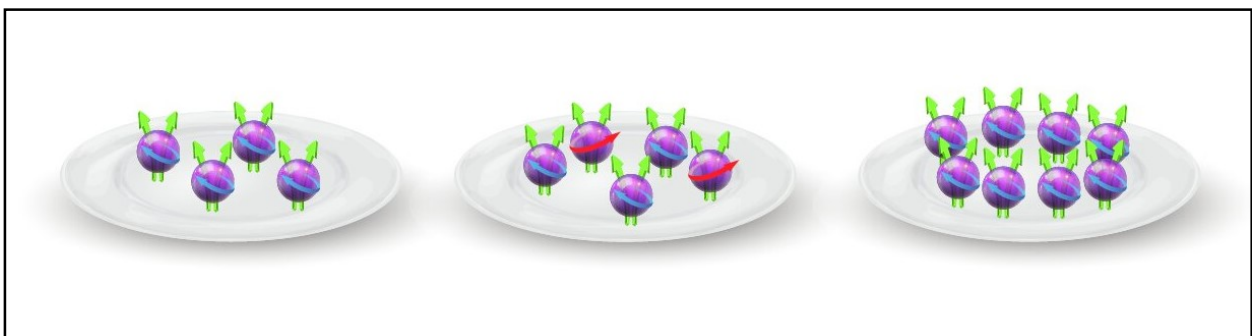


Sat, 19 Sept 2020

The observation of Bloch ferromagnetism in composite fermions

By Ingrid Fadelli

Composite fermions are exotic quasi-particles found in interacting 2-D fermion systems at relatively large perpendicular magnetic fields. These quasi-particles, which are composed of an electron and two magnetic flux quanta, have often been used to describe a physical phenomenon known as the fractional quantum Hall effect.



Schematic evolution of the spin polarization of composite fermions as a function of the density. At large densities, the composite fermions are fully spin polarized (all spinning in one direction). As the density is lowered below $n = 4.2 \times 10^{10} \text{ cm}^{-2}$, the full spin polarization is lost (i.e. some composite fermions are spinning clockwise, and the rest are spinning counterclockwise). At even lower densities $n = 3.51 \times 10^{10} \text{ cm}^{-2}$, however, the composite fermions suddenly become fully spin polarized (all spinning in one direction), signaling a Bloch-like transition. Credit: Md Shafayat Hossain, et al.

Researchers at Princeton University and Pennsylvania State University recently used composite fermions to test a theory introduced by physicist Felix Bloch almost a century ago, suggesting that

at very low densities, a paramagnetic Fermi "sea" of electrons should spontaneously transition to a fully magnetized state, which is now referred to as Bloch ferromagnetism. Their paper, published in *Nature Physics*, provides evidence of an abrupt transition to full magnetization that is closely aligned with the state theorized by Bloch.

"Composite fermions are truly remarkable," Mansour Shayegan, professor of Electrical Engineering at Princeton University and one of the researchers who carried out the study, told Phys.org. "They are born of interaction and magnetic flux, and yet they map such a complex system to a simple collection of quasi-particles that to a large degree behave as non-interacting and also behave as if they don't feel the large magnetic field. One of their most interesting properties is their spin polarization."

When strong magnetic fields are applied to them and the Zeeman energy is predominant, composite fermions are known to become fully spin polarized (i.e., fully magnetized). At lower magnetic fields, on the other hand, they are typically only partly magnetized, as the Coulomb energy plays a considerably larger role.

Fascinated by this unique characteristic of composite fermions, Shayegan and his colleagues set out to probe and investigate it further. To do this, they used a technique for directly measuring spin polarization that relies on the ballistic (collision-free) transport of composite fermions over relatively long distances, of the order of 0.2 micron.

"We saw that as we lowered the density of composite fermions (and hence the magnetic field at which they are formed), they indeed lost their full spin polarization, as expected," Shayegan said. "But then came a completely unexpected surprise: As we lowered the density even more, all of a sudden, the composite fermions became fully spin polarized again. We had a hunch that this may be a result of the weak 'residual' interaction between the composite fermions, but we were unable to prove it."

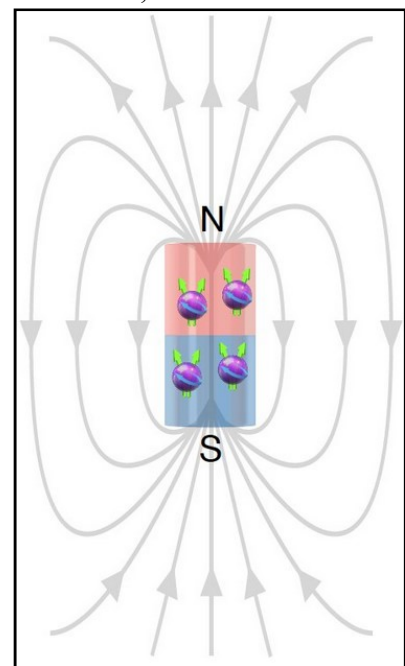
If the phenomenon observed by Shayegan and his team does, in fact, result from the weak residual interactions between different composite fermions, this phenomenon would be highly reminiscent of Bloch ferromagnetism, the state predicted by Bloch in 1929. Remarkably, this effect has so far proved to be very difficult to demonstrate experimentally.

"A key to the success of our experiments was the availability of modulation-doped, gallium-arsenide/aluminum-gallium-arsenide semiconductor structures of extremely high quality," Shayegan said. "These were grown, using molecular beam epitaxy by our Princeton colleague Loren Pfeiffer and his group."

To gain greater insight on whether the phenomenon they observed was actually comparable to Bloch ferromagnetism, Shayegan and his team reached out to Jainendra Jain, a theoretical physicist at Pennsylvania State University. Jain and his students, Tongzhou Zhao and Songyang Pu, carried out a series of calculations aimed at ascertaining the validity of the researchers' hypothesis.

"When my Princeton colleagues first told me about their experimental result, it came as a total surprise," Jain said. "The model of free composite fermions works so well for their Fermi sea at the half-filled Landau level, that I did not expect Bloch type physics here; such behavior was certainly not predicted by any existing theory. This is a very complex problem to tackle theoretically, because it relates to very tiny changes in energy as a function of the density."

To gain a theoretical understanding of the phenomenon observed by Shayegan and his team, Jain and his students used a tool known as 'the fixed-phase diffusion Monte Carlo' method. When



Magnetization of fully-spin-polarized composite fermions at low densities. Credit: Md Shafayat Hossain et al.

they applied this theoretical construct to the problem at hand, they found that the ferromagnetic state was predominant below a critical density.

Moreover, Jain and his students found that the critical density value derived from their calculations was close to the value observed by their colleagues at Princeton. Their results thus support the hypothesis that the observed state resembles Bloch ferromagnetism.

"The underlying physics was revealed to be similar to that for electrons at zero magnetic field," Jain explained. "The interaction energy of composite fermions prefers the ferromagnetic state whereas their kinetic energy the paramagnetic state. As the density is lowered, at some point the interaction energy wins, causing a transition into a fully ferromagnetic phase."

Simple systems with interacting electrons are very common and interacting fermions are found in all metals, so these systems have often been the focus of physics studies. Although they have been widely investigated, Bloch ferromagnetism in these systems has not yet been clearly observed.

This team of researchers was among the first to observe an effect that resembles Bloch ferromagnetism. Moreover, they observed this effect in an unusual set of quasi-particles (i.e., a Fermi sea of composite fermions), which was surprising and unexpected.

"The theory of composite fermions is well-established," Md Shafayat Hossain, the lead author of the study, told Phys.org. "Most phenomenology in theory and experiments involving the composite fermions can be understood without any interaction between the composite fermions. Therefore, this is perhaps the last platform where one expects to find signatures of strong interactions. Surprisingly, however, our experiments reveal that the composite fermions undergo Bloch ferromagnetism, which is a prototypical manifestation of strong inter-fermion interaction."

The recent work by Shayegan, Jain, Hossain and their colleagues yielded a number of interesting results, which have important implications both for the study of Bloch ferromagnetism and composite fermions. On one hand, it demonstrates the existence of an interaction-induced transition to ferromagnetism that is aligned with the phenomenon predicted by Bloch in 1929.

On the other hand, the recent paper enhances the current understanding of composite fermions, as it shows that at very low densities these quasi-particles can have strong interactions with each other. In their next studies, the researchers plan to continue searching for Bloch ferromagnetism in fermions, specifically in conditions characterized by zero magnetic field.

"When an electron system is made sufficiently dilute so that the Coulomb energy dominates over the kinetic (Fermi) energy, the electrons should align their spins and become fully magnetized," Shayegan said. "This is the original problem that Bloch, and later on Edmund Stoner (in 1947), and others discussed; a classic, textbook problem that has eluded experiments. The experimental challenge is to make the electron system very dilute, and yet keep the disorder potential (that competes with the Coulomb interaction and wants to trap electrons at random sites) to a minimum level. We think with new, modulation-doped electron systems, there is a chance to finally nail down the Bloch transition for zero-field electrons."

More information: Bloch ferromagnetism of composite fermions. *Nature Physics* (2020). DOI: [10.1038/s41567-020-1000-z](https://doi.org/10.1038/s41567-020-1000-z).

Journal information: *Nature Physics*
<https://phys.org/news/2020-09-bloch-ferromagnetism-composite-fermions.html>

Pointed tips on aluminum 'octopods' increase catalytic reactivity

By Jade Boyd

Points matter when designing nanoparticles that drive important chemical reactions using the power of light.

Researchers at Rice University's Laboratory for Nanophotonics (LANP) have long known that a nanoparticle's shape affects how it interacts with light, and their latest study shows how shape affects a particle's ability to use light to catalyze important chemical reactions.

In a comparative study, LANP graduate students Lin Yuan and Minhan Lou and their colleagues studied aluminum nanoparticles with identical optical properties but different shapes. The most rounded had 14 sides and 24 blunt points. Another was cube-shaped, with six sides and eight 90-degree corners. The third, which the team dubbed "octopod," also had six sides, but each of its eight corners ended in a pointed tip.

All three varieties have the ability to capture energy from light and release it periodically in the form of super-energetic hot electrons that can speed up catalytic reactions. Yuan, a chemist in the research group of LANP director Naomi Halas, conducted experiments to see how well each of the particles performed as photocatalysts for hydrogen dissociation reaction. The tests showed octopods had a 10 times higher reaction rate than the 14-sided nanocrystals and five times higher than the nanocubes. Octopods also had a lower apparent activation energy, about 45% lower than nanocubes and 49% lower than nanocrystals.

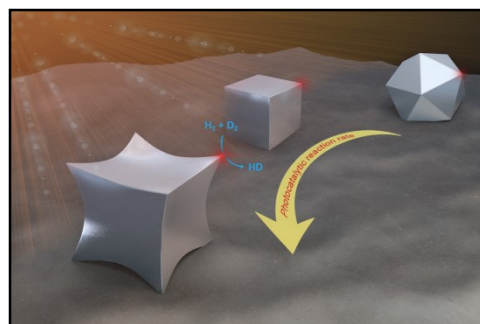
"The experiments demonstrated that sharper corners increased efficiencies," said Yuan, co-lead author of the study, which is published in the American Chemical Society journal *ACS Nano*. "For the octopods, the angle of the corners is about 60 degrees, compared to 90 degrees for the cubes and more rounded points on the nanocrystals. So the smaller the angle, the greater the increase in reaction efficiencies. But how small the angle can be is limited by chemical synthesis. These are single crystals that prefer certain structures. You cannot make infinitely more sharpness."

Lou, a physicist and study co-lead author in the research group of LANP's Peter Nordlander, verified the results of the catalytic experiments by developing a theoretical model of the hot electron energy transfer process between the light-activated aluminum nanoparticles and hydrogen molecules.

"We input the wavelength of light and particle shape," Lou said. "Using these two aspects, we can accurately predict which shape will produce the best catalyst."

The work is part of an ongoing green chemistry effort by LANP to develop commercially viable light-activated nanocatalysts that can insert energy into chemical reactions with surgical precision. LANP has previously demonstrated catalysts for ethylene and syngas production, the splitting of ammonia to produce hydrogen fuel and for breaking apart "forever chemicals."

"This study shows that photocatalyst shape is another design element engineers can use to create photocatalysts with the higher reaction rates and lower activation barriers," said Halas, Rice's Stanley C. Moore Professor of Electrical and Computer Engineering, director of Rice's Smalley-



A study of aluminum nanocatalysts by Rice University's Laboratory for Nanophotonics found that octopods (left), six-sided particles with sharply pointed corners, had a reaction rate five times higher than nanocubes (center) and 10 times higher than 14-sided nanocrystals. Credit: Lin Yuan/Rice University

Curl Institute and a professor of chemistry, bioengineering, physics and astronomy, and materials science and nanoengineering.

More information: Lin Yuan et al, Morphology-Dependent Reactivity of a Plasmonic Photocatalyst, *ACS Nano* (2020). DOI: [10.1021/acsnano.0c05383](https://doi.org/10.1021/acsnano.0c05383)

Journal information: *ACS Nano*

<https://phys.org/news/2020-09-aluminum-octopods-catalytic-reactivity.html>

COVID-19 Research News



Sat, 19 Sept 2020

UV light kills COVID-19 virus without harming people: Study

In a significant breakthrough, researchers have discovered that using Ultraviolet C (UVC) light with a wavelength of 222 nanometres (touted as safer to use around humans) effectively kills the Covid-19 virus

Tokyo: In a significant breakthrough, researchers have discovered that using Ultraviolet C (UVC) light with a wavelength of 222 nanometres (touted as safer to use around humans) effectively kills the Covid-19 virus.

Other studies involving 222 nm UVC, also known as Far-UVC, have so far only looked at its potency in eradicating seasonal coronaviruses, that are structurally similar to the SARS-CoV-2 but not on the Covid-19 causing virus itself.

According to the study, published in the American Journal of Infection Control, in-vitro experiment by Hiroshima University researchers showed that 99.7 per cent of the SARS-CoV-2 viral culture was killed after a 30-second exposure to 222 nm UVC irradiation.

"This study shows the efficacy of 222-nm UVC irradiation against SARS-CoV-2 contamination in an in vitro experiment," said study author Hiroki Kitagawa from Hiroshima University.

Tests were conducted using a UVC lamp. A solution containing the virus was spread onto a plate. The researchers allowed it to dry before placing the UVC lamp 24 cm above the surface of the plates.

According to the researchers, a wavelength of 222 nm UVC cannot penetrate the outer, non-living layer of the human eye and skin so it won't cause harm to the living cells beneath. A nanometer is equivalent to one billionth of a metre.

This makes it a safer but an equally potent alternative to the more damaging 254 nm UVC germicidal lamps increasingly used in disinfecting healthcare facilities.

Since 254 nm UVC harms exposed human tissues, it can only be used to sanitize empty rooms.

But 222 nm UVC can be a promising disinfection system for occupied public spaces including hospitals where nosocomial infections are a possibility, according to the study.



UV light kills COVID-19 virus without harming people: Study

The researchers, however, suggest further evaluation of the safety and effectiveness of 222 nm UVC irradiation in killing SARS-CoV-2 viruses in real-world surfaces as their study only investigated its in-vitro efficacy.

<https://www.indiatvnews.com/science/uv-light-kills-covid-19-virus-without-harming-people-says-study-650413>



Sat, 19 Sept 2020

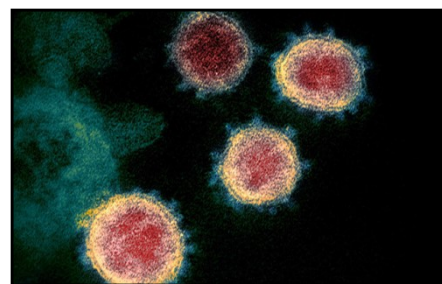
Researchers validate clinical feasibility for CRISPR-based COVID-19 testing at point of care

By Courtney Chandler

In March, researchers in the Department of Biomedical Engineering—a shared department in the schools of Dental Medicine, Medicine, and Engineering—began to develop a new, low-cost, CRISPR-based diagnostic platform to detect infectious diseases, including HIV virus, the novel coronavirus (SARS-CoV-2). Today, the method is one step closer to being a cutting-edge diagnostics technology for rapid detection of infectious diseases.

Lead by associate professor Changchun Liu, the "All-In-One-Dual CRISPR-Cas12a" (AIOD-CRISPR) method enables simple, rapid, ultrasensitive, visual detection of SARS-CoV-2, intended for use at home or in small clinics.

In a paper published in *Nature Communications*, the researchers validated the clinical feasibility of the platform using COVID-19 clinical swab samples. Additionally, the researchers used a low-cost hand warmer as an incubator to detect clinical sample results within 20 minutes.



A colorized scanning electron micrograph of the SARS-CoV-2 virus. Credit: NIAID

"The usage of disposable hand warmers to heat the AIOD-CRISPR assay eliminates need for expensive electric equipment, enabling instrument-free point of care molecular diagnostics of COVID-19," says Liu.

The publication was co-authored by postdoctoral researchers Xiong Ding and Kun Yin; Ph.D. student Ziyue Li; professor and Associate Dean for Research Dr. Rajesh Lalla; Dr. Enrique Ballesteros, associate professor and chair, pathology and laboratory medicine; and Dr. Maroun Sfeir, assistant professor in pathology and laboratory medicine.

Nucleic acid amplification testing (PCR/RT-PCR) is currently the most sensitive and specific method for early detection of pathogens, but is not suitable for rapid point-of-care diagnostics because of the need for specialized laboratory equipment and trained technicians. Highly contagious pathogens, however, need real-time monitoring to prevent spreading from person to person.

In the study, Liu and his team evaluated their AIOD-CRISPR method using the RNA extract of 28 clinical COVID-19 swab samples, which included eight COVID-19 positive samples. To ensure the reliability of detection, each sample was tested twice in two independent trials. All eight of the COVID-19 positive samples were identified as positive in 40 minutes, which was also confirmed by visual detection. The results were also consistent with those of the CDC-approved RT-PCR method.

The researchers also used a low-cost hand warmer as an incubator to detect the patient samples to eliminate the need for an electric incubator. The AIOD-CRISPR tubes were directly placed on an air-activated hand warmer, and the results were visible by the naked eye under LED light. Two

COVID-19 positive samples incubated in the hand warmer bag were visually detected and identified as positive in 20 minutes.

"Such simple, portable and sensitive detection platform has the potential to provide rapid and early diagnostics of COVID-19 and other infectious diseases at home, in doctor's office, and even at drive-thru testing sites," says Liu.

More information: Xiong Ding et al. Ultrasensitive and visual detection of SARS-CoV-2 using all-in-one dual CRISPR-Cas12a assay, *Nature Communications* (2020). [DOI: 10.1038/s41467-020-18575-6](https://doi.org/10.1038/s41467-020-18575-6)

Journal information: [Nature Communications](https://phys.org/news/2020-09-validate-clinical-feasibility-crispr-based-covid-.html)
<https://phys.org/news/2020-09-validate-clinical-feasibility-crispr-based-covid-.html>



Sat, 19 Sept 2020

Q&A: Powerful, double-decker bus-sized microscopes help scientists uncover possible COVID-19 treatment

By Kerry Blackadar

Researchers at UBC's faculty of medicine are working with microscopes—some up to 13 feet tall—to help prevent and treat COVID-19.

The research team, led by Sriram Subramaniam, a professor in UBC's department of biochemistry and molecular biology, is using a powerful imaging technique known as cryo-electron microscopy to take pictures at near-atomic resolution to see how various antibody treatments bind to the virus.

Their hope is to identify critical differences between antibodies that bind and block viral infection, and those that bind but are unable to block infection, providing powerful blueprints for drug and vaccine design. Already, they have helped to uncover how one antibody-based drug, known as Ab8, prevents and neutralizes the virus—a finding recently published in *Cell*.



The microscopes measure up to 13 feet in height, as tall as a double decker bus. Credit: University of British Columbia

How does cryo-electron microscopy work?

The SARS-CoV-2 virus is a hundred thousand times smaller than the size of a pinhead, making it undetectable using a regular light microscope. The proteins on the surface of a virus are even smaller.

To visualize the detailed shapes of viruses and proteins, we use cryo-electron microscopes. This powerful imaging technology uses beams of electrons to visualize shapes of tissues and cells using ultra-cooling, or "cryo" techniques—essentially, the imaging of samples at liquid nitrogen temperatures.

What exactly do your snapshots capture?

We're generating structural images of the viral spike protein, which enables the coronavirus to enter human cells. Ultimately, using these microscopy pictures, we'll be able to better understand the "hotspots" on the spike protein and provide information on how to improve the potency of treatments.

In our lab at UBC, we are able to determine the structures of proteins, such as the viral spike, at atomic detail in less than a day, providing powerful blueprints for drug and vaccine design.

For example, cryo-electron microscopy might be used in evaluating immune responses elicited by early vaccine candidates by characterizing how they bind to the spike protein. The antibodies may also be used as therapeutics themselves in patients actively suffering from COVID-19.

Why is it important to develop antibody-based therapies to treat COVID-19?

Most experts estimate it could take almost a year before there's a vaccine that is effective and widely available. In the meantime, there's an urgent need for antibody-based therapies to stem the progression and spread of COVID-19.

Understanding how these antibodies bind, and neutralize the virus, is crucial because it can be used by researchers who are developing treatments to understand and ultimately reduce drug-related side effects.

This is not just a critical element for treatment though. Knowing which types of antibodies provide protection against virus spread—and which ones are ineffective—will be essential in the evaluation of antibodies produced in vaccine trials.

You recently helped to uncover how one antibody-based drug, known as Ab8, prevents and neutralizes the virus. What is the significance of this finding?

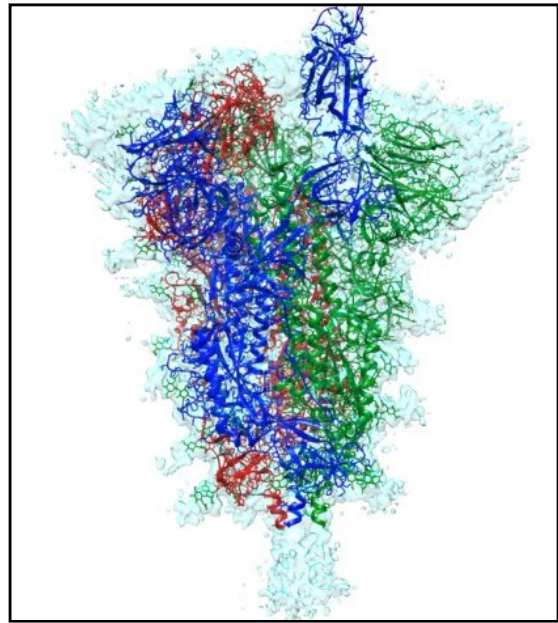
Working with a team of scientists from the U.S., we employed our electron microscopy and advanced computing infrastructure at UBC to help evaluate and understand how this particular drug—constructed from an antibody component 10 times smaller than a full-sized antibody—neutralizes the virus in animal models. We have similar information emerging from our studies with other antibodies. Our expectation is that we will be able to use the structural information we derive about the precise footprints of antibody binding to develop more effective ways to stop SARS-CoV-2 in its tracks.

This particular finding has potential implications for both the prevention and treatment of COVID-19. The drug's tiny size not only increases its potential for diffusion in tissues to better neutralize the virus, but also makes it possible to administer by alternative routes—including inhalation. Importantly, it only binds to the virus, leaving human cells untouched, which is a good sign that it won't have negative side effects in people.

More information: Wei Li et al. High Potency of a Bivalent Human VH Domain in SARS-CoV-2 Animal Models, *Cell* (2020). [DOI: 10.1016/j.cell.2020.09.007](https://doi.org/10.1016/j.cell.2020.09.007)

Journal information: *Cell*

<https://phys.org/news/2020-09-qa-powerful-double-decker-bus-sized-microscopes.html>



Atomic model of the COVID-19 spike protein, captured using cryo-electron microscopy technology at UBC. Credit: University of British Columbia

Identified a potential drug to fight Covid-19

The drug has already been approved for clinical use against other diseases and, hence, easy to apply clinically

After research and study, scientists have identified a potential new drug to intercept or mitigate the symptoms and consequences derived from infection by SARS-CoV-2, the virus responsible for Covid-19.

The research published in the journal *Cytokine and Growth Factors Review* suggested that the preliminary results of the study conducted on animal models showed that the drug 4-Phenylbutiric acid (4-PBA) fully curbs mortality caused by respiratory failure derived from cellular stress.

The inflammatory process, which has been identified in severe cases of coronavirus, causes an uncontrolled and excessive release of cytokines – molecules. These molecules are in charge of organizing the body's defenses- which could even trigger vascular hyperpermeability and multi-organ failure.

Controlling such cytokine “storm”, through those controlling them, that is, the infected cells is precisely what these researchers proposed.

“When cells are stressed by infection, they call the cytokines, and the more stressed they are, the more persistent they become, provoking this uncontrolled inflammation. Hence, one possible treatment for Covid-19 is to reduce cellular stress,” explained one of the lead researchers Ivan Duran, Professor at the University of Malaga in Spain.

According to the researcher, repurposing the 4-PBA anti-stress drug could modulate such cellular stress, which is also present in pathologies like diabetes, aging, or carcinogenesis, which, in turn, are classified as risk factors for Covid-19.

The drug has already been approved for clinical use against other diseases and, hence, easy to apply clinically.

The study also identified the endoplasmic reticulum resident protein “BiP” (Binding Immunoglobulin Protein) – a stress blood marker — as an indicator of cellular stress situations, likely to be explored and measured in affected patients.

This way, BiP levels, apart from determining the efficacy of 4-PBA treatment, could serve as early indicators of Covid-19 risk groups, establishing a correlation between high levels and the inflammatory severity after the viral infection, Duran pointed out.

https://www.thestatesman.com/supplements/science_supplements/identified-potential-drug-fight-covid-19-1502924884.html

