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# समाचार पत्रों से चयित अंश Newspapers Clippings

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

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## DFRL to offer processing solutions for farm produce

*Expert team visits Anantapur to study the requirements of farmers*

Anantapur: Mysuru-based Defence Food Research Laboratory (DFRL) will extend technical support for finding a solution to manage the abundant tomato and sweet lime produce in certain seasons in Anantapur district.

Anantapur MP Talari Rangaiah had worked towards getting a 'Kisan Rail' from Anantapur to transport the produce to other places, but it did not work out in late December when the tomato prices were very low both in the district and in the Azad Market in New Delhi where the produce was supposed to be transported.

Mr. Rangaiah on Wednesday met Defence Research and Development Organisation (DRDO) Chairman G. Satheesh Reddy to thank him for sending a team of experts to Anantapur for two days last week and studying the requirements of the farmers and understanding the profile of the district when it came to horticultural produce.

### Transport subsidy

In October last year, the Ministry of Food Processing Industries (MOFPI) sanctioned ₹2.9 crore for subsidising 50% of the transport cost of tomatoes and sweet lime, along with other farm produce through the 'Kisan Rail'. However, concerns were raised as to why the money was not being spent on establishing processing industries for tomato or sweet lime in Anantapur district.

A private trust was also established to subsidise train freight for the farmers who are sending their produce by the 'Kisan Rail', but finding a solution pertaining to value-addition of produce was the view point of many.

### Detailed project report

"During their two-day interaction with the district horticulture officers, the DFRL team was urged to provide an executable detailed project reports for establishing 1,000-tonne or 5,000-tonne capacity processing units for groundnut, sweet lime and tomatoes at Kadiri, Kalyandurg and Anantapur regions," Deputy Director Horticulture K. Padmalatha told *The Hindu*.

<https://www.thehindu.com/news/national/andhra-pradesh/dfrl-to-offer-processing-solutions-for-farm-produce/article33522837.ece>



Anantapur MP Talari Rangaiah at a meeting with DRDO Chairman G. Satheesh Reddy in New Delhi.

## DRDO to assist in establishing processing units for agriculture produce

*DFRL scientists from Mysore had recently visited fields of Anantapur district and had interacted with farmers*

Anantapur: Defence Research and Development Organisation (DRDO) has come forward to assist in the manufacture of agriculture equipment for processing of horticulture produces through its Defence Food Research Laboratory to benefit farmers in drought-hit areas.

DRDO chairman Sathish Reddy responded positively to be part of measures aimed at uplift of the farming community through cost-effective innovations.

Anantapur MP Talari Rangaiah met the DRDO chairman on Wednesday and explained the situation in drought-hit areas, especially Anantapur.

DFRL scientists from Mysore had recently visited fields of Anantapur district and had interacted with farmers into horticulture and agriculture.

Responding to representations by farmers and officials, the DFRL team agreed to set up processing units of tomato paste and sauce in Anantapur, Kadiri and Kalyanadurgam and other parts of the district.

The team also opined that horticulture and agriculture produce should have marketing facilities through processing units in the non-season while tomato price could be seen in the range of Rs. 1 to Rs.100 per a kg in the market.

“The processing units would help to provide attractive support price for farmers”, Rangaiah observed and added that he had asked the district horticulture and marketing officials to prepare a project report for submitting to DRDO within fifteen days.

Rangaiah sought a pilot project for processing units in Anantapur district.

Rangiah told DC that the DRDO chairman was positive towards improving the lot of farmers in drought-hit regions and introducing equipment and machines through small scale industries.

Horticulture officials observed that the farmers were earning meagre profits during peak seasons while the processing units could help get attractive prices for produce even during normal seasons.

Rapthadu MLA T. Prakash Reddy observed that the processing units should have capacity to store tomatoes even for 30-40 days so that they could be exported to Middle East countries.

<https://www.deccanchronicle.com/nation/in-other-news/070121/drdo-to-assist-in-establishing-processing-units-for-agri-equipment.html>



Rapthadu MLA T. Prakash Reddy observed that the processing units should have capacity to store tomatoes even for 30-40 days so that they could be exported to Middle East countries. — Pixabay

## **Explained: All about Akash Missile**

*Central Government has given its nod to the export of Akash missile which is indigenous defence artillery that is Made in India. Know all about Akash missile here*

*By Tulika Tandon*

### **Why in News?**

To increase the defence export, the Central Government has given its nod to the export of Akash missile which is indigenous defence artillery that is Made in India.

### **Significance:**

This would help India to achieve the target of \$5 billion in defence exports. It would also help in improving strategic relations with friendly countries.

The move has been approved by the Cabinet Committee on Security (CCS)

### **About Akash Missile:**

1. Akash is a surface to air missile system.
2. It would be the first-ever weapon platform to be exported by our country.
3. India has been building fast patrol boats, helicopters and ammunition and radars for global customers.
4. The range of the missile is from 1.8 to 2.5 Mach.
5. It can be launched through tanks which are stable or even moving surfaces like warships and trucks.
6. The missile has already been inducted in the Indian Air Force in 2014 and the Indian Army in 2015.
7. It has a range of 25 km which aids in keeping the helicopters, fighters and drones from attacking critical installations.
8. Almost 96% of the missile manufacturing process is done indigenously.
9. The missile is capable of engaging in multiple targets in both group mode and autonomous mode in real-time.
10. There is a built-in Electronic Counter-Counter Measures (ECCM) system.
11. The system is configured on various mobile platforms.
12. The missile is solely designed by DRDO and has been produced by defence PSU Bharat Electronics Ltd (BEL).



Akash Missile

### **Special features**

1. This nuclear-capable missile, Akash can fly at a speed of up to Mach 2.5 that is almost 860 meter per second and also at a maximum height of 18 km.
2. The missile is capable of targeting aerial targets like fighter jets, drones, cruise missiles, air-to-surface missiles, ballistic missiles from almost a distance of 30 km.

### **History**

1. The first test flight of Akash happened in 1990, with further development flight tests conducted upto March 1997.
2. Two Akash missiles were tested to intercept simultaneous targets in engagement mode in 2005.

3. The Akash Mk-II came up which is of a longer-range, is faster and is more accurately developed SAM. The missile has an intercept range of 40 km with the missile's guidance system being more accurate now along with the fire control system.
4. The development of the Akash-NG or Next Generation was approved in September 2016 with a funding of ₹470 crores.

Akash missile was developed under the integrated guided-missile development programme/IGMDP. which involved the development of the Nag, Agni and Trishul missiles, as well as the Prithvi ballistic missile.

<https://www.jagranjosh.com/general-knowledge/explained-all-about-akash-missile-1610010611-1>

## Defence News

## Defence Strategic: National/International

THE HINDU

Fri, 08 Jan 2021

### CDS Rawat, IAF Chief visit Arunachal in quick succession

*Visits follow reports of increased activities across the LAC in Tibet,  
including the laying of a railway track to Lyingchi near the border*

Chief of the Air Staff Air Chief Marshall R.K.S. Bhadauria on Thursday concluded his two-day visit to air bases and advanced landing grounds (ALGs), mostly in Arunachal Pradesh, under the Eastern Air Command of the Indian Air Force.

His visit to the frontier States in the northeast was close on the heels of Chief of Defence Staff General Bipin Rawat's tour of forward air bases in Arunachal Pradesh on January 2-3.

The Shillong-headquartered Eastern Air Command's Air Officer Commander-in-Chief Air Marshall Amit Dev too had inspected the forwarded bases and ALGs of Assam and Arunachal Pradesh in December.

During his visit, the Air chief met Arunachal Pradesh Governor Brigadier B.D. Mishra (retd.) and Chief Minister Pema Khandu to discuss national security and the safeguarding of the borders, besides assuring the IAF's support to the State.

"The proposal to construct an ALG in Dirang (West Kameng district) and Anini (Dibang Valley, bordering Tibet) was also discussed with the Chief of Air Staff," a spokesperson from the Chief Minister's Office said on Thursday.

#### Rawat's visit

A Defence spokesperson said Gen. Rawat visited Arunachal Pradesh to mark a year of his appointment as the Chief of Defence Staff on January 1, 2000.

"He interacted with the Army, Indo-Tibetan Border Police and Special Frontier Force soldiers deployed at the air-maintained forward posts in Dibang Valley and Lohit sectors of Arunachal Pradesh," the spokesperson added.



General Bipin Rawat. File photo

Prior to his visit, Air Marshall Dev toured the State to assess the “ongoing modern infrastructure development projects aimed at improving the combat potential of the bases” as well as ALGs.

There are eight ALGs in Arunachal Pradesh — one each at Vijayanagar, Pasighat, Mechuka, Walong, Tuting, Ziro, Along and Tawang. These were renovated and upgraded by 2019.

The frequent visits by the heads of armed forces to Arunachal Pradesh followed reports of increased activities in Tibet across the Line of Actual Control, including a railway track laid up to Lyingchi near the border with the State.

There has been a high alert and massive deployment of troops and equipment along the LAC following the stand-off with China in eastern Ladakh last year.

<https://www.thehindu.com/news/national/other-states/cds-rawat-iaf-chief-visit-arunachal-in-quick-succession/article33524287.ece>



Fri, 08 Jan 2021

## Army Chief in Pune on 3-day visit, to review operational preparedness of Southern Command

*Officials said that General Naravane will interact with top officials of the command and will visit various military installations as part of the visit*

Pune: Chief of Army Staff General M M Naravane arrived in Pune on Thursday on a three-day visit to the headquarters of the Southern Command. He is slated to review the operational preparedness of the command, among other things.

A tweet from the Southern Command of the Indian Army read, “General MM Naravane, Chief of Army Staff, arrived at Pune on a three-day visit to Headquarters Southern Command to review the operational preparedness, assistance provided during Covid, flood relief and initiatives taken to improve quality of life of troops.”



Army Chief Gen MM Naravane. (File)

Officials said that General Naravane will interact with top officials of the command and will visit various military installations as part of the visit. Various formations of the Pune- headquartered Southern Command undertook many humanitarian aid and disaster relief operations during floods and cyclones in the recent past. The Army Chief is slated to review these operations.

The Southern Command is geographically the largest Command of the Indian Army and is spread over 11 states and four union territories, covering nearly 40 per cent of India’s geographical area. The Southern Command had proactively undertaken Operation Namaste ‘to mitigate spread of Covid-19’ in the southern states, which were emerging as hotspots during the peak period of the pandemic. Operation Namaste referred to the practice of greeting with a namaste instead of a handshake to avoid physical contact.

General Naravane’s family is from Pune. His father, Mukund Naravane, was with the Indian Air Force and his mother Sudha Naravane was a writer and news broadcaster with the All India Radio in Pune. The General is an alumnus of the Jnana Prabodhini Prashala and the National Defence Academy at Khadakwasla.

<https://indianexpress.com/article/cities/pune/army-chief-in-pune-on-3-day-visit-to-review-operational-preparedness-of-southern-command-7137469/>

## India building economic, defence corridors to take infrastructure to global standard: PM Modi

New Delhi: Just like freight corridors, India is also building economic and defence corridors for industries in the country, which would help in taking Indian infrastructure to the global standard, said Prime Minister Narendra Modi while inaugurating 306-kilometre long Rewari-Madar section of the western dedicated freight corridor on Thursday.

"It is the demand of time that India develops its infrastructure that matches the global standards. Today, connectivity of highway, airway and waterways are spread throughout the country. We are focussing on multimodal connectivity. Just like freight corridors, we are developing economic and defence corridors for industries," said the Prime Minister.



PM Modi said the growth of individual and industry in the country will have a positive impact on India's image in the eyes of the global communities.

"The effect of this positive impact is witnessed in our surging foreign direct investment (FDI) and the global faith on India," PM Modi stated.

He also thanked 'Japan and its people' for standing with India as a trustworthy friend throughout its development journey.

"Throughout India's development journey, Japan and its people have stood by us like a trustworthy friend. In the construction of the western dedicated freight corridor as well, Japan provided us with financial and technological assistance," he added.

As per an official statement, the Rewari-Madar section of the western dedicated freight corridor is situated between Haryana and Rajasthan and consists of nine newly built DFC stations, in which six are crossing stations namely New Dabla, New Bhagega, New Sri Madhopur, New Pachar Malikpur, New Sakun and New Kishangarh while the other three in Rewari, New Ateli and New Phulera are junction stations.

Earlier the 351-km New Bhaupur-New Khurja section of the eastern dedicated freight corridor (EDFC) was dedicated to the nation by the Prime Minister on December 29, 2020.

<https://timesofindia.indiatimes.com/business/india-business/india-building-economic-defence-corridors-to-take-infrastructure-to-global-standard-pm-modi/articleshow/80151528.cms>

## Business Standard

### Army's pivot to the north

*An overhaul of an Indian strike corps' operational role constitutes a strategic signal that will resonate equally in Beijing and Rawalpindi*

*By Ajai Shukla*

New Delhi: Not since the bleak year-end of 1962, when China had just finished drubbing India, has New Delhi contemplated a new year studded with such daunting security challenges. Besides having to deal with an emboldened Pakistan, the Kashmiri separatist insurgency has drawn in a new generation of local youth.

The economic crash caused by the Covid-19 pandemic threatens to limit defence budgetary allocations for years to come and will complicate even routine military functioning. Finally, there is the extended face-off in Eastern Ladakh, where China's People's Liberation Army (PLA) troops crossed the Line of Actual Control (LAC) last May and occupied swathes of territory that have



long been under India's control. Our counter build-up with some two Indian Army divisions (36,000 soldiers) has imposed major financial and personnel costs.

Yet, change is in the air. Last month, without fanfare, Army Headquarters (AHQ) issued written orders for a change in operational role for one of its mechanised strike corps. While the Ambala-based 2 Corps and Bhopal-based 21 Corps would retain their role as tank-heavy forces, equipped and trained to advance deep into Pakistan in wartime, the third strike corps – the Mathura-based 1 Corps – was to become a mountain strike corps that would strike into Chinese territory from Ladakh. The two infantry divisions in 1 Corps will soon begin changing their training patterns and operational plans to conform to their new role. Meanwhile 1 Corps' third division – the Hisar-based 33 Armoured Division, which is not suited for mountain warfare – will become a reserve force, with which AHQ could exploit an advantage or restore an adverse situation.

At the tactical level, switching 1 Corps constitutes a belated recognition of the fact, long ignored by the Indian Army, that its defences in Ladakh are worryingly thin and need urgent reinforcement. In Ladakh, the almost 800-kilometre-long LAC is defended by a single infantry division, its resources stretched to breaking point. In Sikkim and Arunachal, each Indian division on the LAC defends a mere fraction of that frontage. Furthermore, each of the three eastern sector corps have a full division in reserve, ready to react to any breaches. In Ladakh, the thinly held LAC, the large gaps between Indian posts and the absence of any reserves at the corps level created a vulnerability that was waiting to be exploited.

Making this vulnerability a matter of deep concern was China's sensitivity to the growing deployment of Indian troops in Northern Ladakh, especially near the Karakoram Pass and Daulat Beg Oldi (DBO). Furthermore, India's infrastructure building drive, particularly the road from Darbuk, along the Shyok River, to DBO, was seen by the PLA as a threat to China's interests in the Shaksgam Valley (ceded by Pakistan to China in 1963) and the Karakoram Highway that runs from Xinjiang to Pakistan through the Khunjerab Pass, forming the China-Pakistan Economic Corridor (CPEC). For this reason the PLA has – while expressing its readiness to discuss disengagement at all other points – stubbornly refused to even discuss withdrawal from the DBO area, particularly its ingress into the Depsang Plain.

While India's nuclear deterrent makes a full-scale Chinese attack on India impossible, Beijing has long viewed Ladakh as an inviting target for the "limited sectoral war" that PLA doctrine prescribes. India's remote Union Territory is not just lightly defended, but also gets cut off from the rest of India during winter. By the time the roads open again in spring, the army's logistic stockpiles fall to almost zero.

When the PLA crossed the LAC last May, in large numbers and on multiple fronts, it forced India's Northern Command to throw in all the reserves available. The Northern Command's reserve division, as well as AHQ's, were quickly deployed, blocking further PLA ingress. The conflict has expanded over the year, and Indian troops have occupied the Kailash Range, south of the Pangong Lake. This commitment of troops has left both Northern Command and AHQ unbalanced – stretched to the limit and with no further reserves at hand. It has become obvious to army planners that at least two reserve divisions were needed in Ladakh to restore a modicum of operational balance.

Meanwhile, on the India-Pakistan border in the plains sector, the three strike corps were creating little deterrence. Over the preceding three decades, it has become apparent that the threat of strike corps offensives has failed to restrain Pakistan from its proxy war in Kashmir. The prospect of full-scale war with Pakistan is increasingly difficult to contemplate given Pakistan's nuclear deterrent, including the highly destabilizing Nasr tactical nuclear weapons. This galvanized the thinking that there was a need for the Indian army to rebalance its defensive posture from the west to the north.

This rebalance also goes some way towards giving credence to New Delhi's oft-repeated assertion that China, not Pakistan, is its primary military threat. This claim has been hard to sustain, given that until last month more than two-thirds of the Indian Army was deployed against Pakistan. Of 14 army corps, just four-and-a-half faced China, while more than twice that number was ranged against Pakistan. Of the army's 38 divisions, just 12 divisions faced China, while 25

divisions were deployed on the India-Pakistan border and one division was a reserve under AHQ. Even after the reassignment, 14 divisions will face China, 22 will face Pakistan and two will be AHQ reserves.

Even so, shifting an Indian strike corps from the Pakistan border to the border with China constitutes a powerful strategic signal that will resonate in Beijing, as well as other capitals. It will equally resonate in Rawalpindi, given that Pakistani generals have always cited the Indian Army's deployment bias against Pakistan as proof of New Delhi's malintent. While the shift of 1 Corps to Ladakh should provide some strategic reassurance to the Pakistan Army, the dynamics of political control in that country can be expected to block any positive acknowledgement from the corps commanders in Rawalpindi.

A major offset that would accrue from the diversion of 1 Corps to a mountain strike corps role in Ladakh is that, for the first time, there will be clarity on the role of 17 Corps. This was raised almost a decade ago as the first mountain strike corps for the north-eastern border with China but, given troop and funding shortfalls, it was charged with a role in both the eastern and western sectors. Now, with 1 Corps responsible for a strike role in Ladakh, 17 Corps will be free to focus on striking key Chinese vulnerabilities in the eastern sector, such as the Chumbi Valley opposite Sikkim. Meanwhile, 1 Corps can focus on creating deterrence in Ladakh, where – from Depsang to Demchok – there have been clear Chinese targets to strike, but not enough troops to do this.

[https://www.business-standard.com/article/opinion/army-s-pivot-to-the-north-121010701572\\_1.html](https://www.business-standard.com/article/opinion/army-s-pivot-to-the-north-121010701572_1.html)

## ThePrint

Fri, 08 Jan 2021

### **Army's human rights dept must be autonomous. Else, its head will just warm the chair in HQ**

*Indian Army's creation of a human rights cell alone won't fix the systemic collapse of checks and balances that result in indiscipline and extreme violations*

*By Lt Gen H S Panag (Retd)*

On 31 December 2020, the Indian Army appointed Major General Gautam Chauhan as the first head of its newly created human rights Additional Directorate General. Chauhan will function as Additional Director General under the Vice Chief of Army Staff. The Army has a stellar record in upholding human rights, and with this appointment, it is reiterating its commitment to bring in transparency and a more focussed approach towards investigating cases of human rights violation.

An Indian Police Service (IPS) officer of SSP/SP rank will also serve on deputation with the additional directorate.

In a related development, on 1 January 2021, the Army set up a feedback and grievance helpline number – [9484101010](tel:9484101010) – in the Kashmir Valley under the 15 Corps. It is presumed that it will allow people to report cases of human rights violation.

The detailed charter, organisation and functions of the Additional Directorate General (Human Rights) have not yet been spelt out. This will be the real challenge because the existing system of investigation and disciplinary action with respect to human rights violations suffers from serious flaws that have put a question mark over its credibility.

#### **The existing system**

Any army that adopts a laissez faire approach towards human rights violation in counter insurgencies does so at its own peril and invariably comes to grief. The defeat of US and Pakistan militaries in Vietnam and East Pakistan are classic examples.

The Indian Army doctrinally, and based on its 65 years of experience of fighting insurgencies in the northeast, Punjab and Jammu and Kashmir, is committed to upholding human rights and

conducting people-friendly operations against the terrorists. Even while conducting counter-terrorist operations, it adheres to the law of the land and international conventions. It understands that in an insurgency, the people are the centre of gravity. Nothing alienates them more than human rights violations, which bring the Army down to the level of terrorists. What, then, is the problem? Why is there a question mark on the stellar reputation of the Army with respect to upholding human rights.

The Army has elaborate rules, regulations and laws, supported by command guidance to deal with human rights violations. It is the relative failure to enforce these and the systemic collapse of checks and balances that result in indiscipline and extreme violations.

This is due to a convoluted sense of nationalism since 2014, safeguarding honour/reputation or notching it up through successes/awards, and for the sake of “soldiers’ morale”. The desire to protect unit/regiment/formation/personal reputation leads to cover-up/condoning of violations. Conversely, the zeal to notch up the same through successes and decorations leads to rogue actions. With respect to Jammu and Kashmir, due to religious factor, neo nationalism makes no distinction between terrorists and protesting masses. This thinking seems to have crept into the Army. Rogue actions have been lauded and awarded. The pattern is predictable to a fault — denial, obfuscation, delay, opacity of investigations and shelter of the Armed Forces Special Powers Act (AFSPA). Internal corrective mechanisms have been diluted to the point of becoming dysfunctional.

The killing of three innocent labourers in Shopian on 18 July by Captain Bhupinder Singh, 62 Rashtriya Rifles (RR), is a case in point. This was a straight up rogue action, which his superior commanders failed to distinguish, something that is hard to believe. Each operation is analysed in detail at higher headquarters (HQ) right up to HQ Northern Command. Given their vast experience, commanders can easily assess if any wrongdoing has taken place. The inference has horrendous implications – the hierarchy has become complicit by design or due to incompetence. Yet, only Captain Bhupender Singh is being charged along with two civilians. In my view, disciplinary/administrative action is warranted against Commanding Officer 62 RR, Commander 12 Sector RR, and General Officer Commanding Victor Force.

It is pertinent to mention that very rarely does the army unilaterally order investigations into alleged violations. Most cases have been exposed by the media or through police investigations. Even in such cases, investigations are carried out “in house” on the orders of the Force HQ or at times by the Corps HQ.

And so, the credibility of the investigation is suspect. If that is not enough, the conduct of the court martial is very shoddy due to an inefficient Judge Advocate General’s Corps branch and a sympathetic court comprising “brother officers”. The verdict of the court martial even in high-profile cases fails to withstand the scrutiny of the Armed Forces Tribunal and the Supreme Court. Even the Supreme Court was misinformed to order the Court Martial (which was time barred under the Army Act 1950) of accused in Dangari fake encounter to facilitate their future acquittal.

#### **Additional Director General (HR) must be made autonomous**

Keeping in view the complex shortcomings of the existing system of investigations and prosecution in cases of human rights violation, Additional Director General (HR) must head an autonomous organisation with similarly empowered representatives up to Corps and Force level. If this does not happen, the post will merely become an adjunct of the system whose holder will merely warm the chair in Army HQ.

The investigators under Maj. Gen. Gautam Chauhan must be qualified to carry out legally sustainable investigations and prosecution. He must have the powers to order independent investigations. The armed forces also need to overhaul the Judge Advocate General’s Branch, which uses its expertise these days more for internal squabbles than for enforcement of military law.

Last but not the least, the Army must introspect and reform its leadership. It is a cause of serious worry if the commanders lack the moral courage to adhere to and enforce rules, regulations and law. The very need to create a human rights Additional Directorate General reflects poorly on the leadership standards prevailing in the Army.

*(Lt Gen H S Panag PVSM, AVSM (R) served in the Indian Army for 40 years. He was GOC in C Northern Command and Central Command. Post retirement, he was Member of Armed Forces Tribunal. Views are personal.)*

<https://theprint.in/opinion/armys-human-rights-dept-must-be-autonomous-else-its-head-will-just-warm-the-chair-in-hq/580850/>

# ThePrint

Fri, 08 Jan 2021

## Dassault Aviation eyes Made-in-India Rafale, looks to raise investment in country

*French firm Dassault is looking to manufacture Rafale jets in India, depending on the order size. But India will take a call after the delivery of the first 36 jets*

*By Snehesh Alex Philip*

New Delhi: Looking to increase its investment in India, French defence giant Dassault Aviation is game for manufacturing Rafale fighter jets in the country, and will make a fresh pitch for it to the Narendra Modi government, ThePrint has learnt.

French sources in the know of developments said Diplomatic Advisor to the French President, Emmanuel Bonne, who is on a visit to India, will make a pitch of the French government's offer to make the Rafale fighters in India — if the numbers in play are closer to 100.

If a smaller number comes to pass, the French maker would not manufacture the Rafale in India as a whole but would increase the procurement of parts from the country, sources said.

The offer comes at a time when India is in the middle of induction of the 36 fighter jets ordered in 2016 by the Modi government. While these 36 jets were procured under the emergency clause, the Indian Air Force (IAF) is working on a tender for 114 new fighters.

However, there is speculation in Indian power corridors that it is easier for the country to buy another 36 Rafale fighters, along with indigenous Tejas Mk-2, than to opt for a fresh procurement process.

Top government sources told ThePrint that any call on additional Rafale fighter jets would be taken only after the delivery of the first 36 are complete. However, they noted that the Rafales are expensive.

In October 2020, IAF chief Air Chief Marshal R.K.S. Bhaduria had for the first time officially indicated that the decision to buy two more squadrons of Rafale fighter jets is under consideration.

ThePrint reached Dassault Aviation via email for a comment but there was no response till the time of publishing this report.

### **Made in India Rafale**

Speaking to ThePrint, a source said, “The French government has already told the Indian government that Rafale can be made in India if there are higher numbers. This will also be raised during the strategic level talks and interactions between the two sides at various levels.”



A Rafale jet at the induction ceremony in Ambala. | Photo: Praveen Jain/ThePrint

In 2017, France had written to the Modi government to opt for Make in India route for the Rafale jets.

Sources said Dassault Aviation is working on setting up a third hangar at the Nagpur facility, a joint venture with Anil Ambani's Reliance Defence.

"The idea is to have five hangars in total. Dassault Aviation already manufactures and procures engine doors and the canopy from India. The idea is to scale it up with time," a source said.

On 11 June 2019, ThePrint reported that Dassault Aviation is likely to start manufacturing parts of Rafale fighter jets at its India facility even though it was not part of the original plans.

The Nagpur facility of Dassault Reliance Aerospace Ltd (DRAL) started making cockpits for the French manufacturer's Falcon business jets, besides other parts. The idea is to eventually build the Falcon 2000 entirely in India.

### **Higher order needed**

Dassault Aviation would need a higher order of around 100 aircraft to start a Rafale production facility in India, said the sources. The chief executive of the French firm had said the same during the Aero India show in 2019.

"If that is done, Dassault Aviation will have two production lines, one in France and the other in India. The Indian plant will also produce Rafale for other countries," a source said, pointing out that the fighter is in fray for orders from Greece, Malaysia, Indonesia and Switzerland.

Asked if there is a possibility for Make in India if the French get additional orders for lesser numbers, the sources said it would not be possible but the French firm will increase sourcing of parts from India.

<https://theprint.in/defence/dassault-aviation-eyes-made-in-india-rafale-looks-to-raise-investment-in-country/581249/>



*Fri, 08 Jan 2021*

## **Ladakh LAC standoff: India Army has created catch-22 situation for the Chinese, says an expert**

*Initially assessed as a collective training deployment, the occupation of the Fingers 4 to 8, the deployment in the Depsang plains and DBO was a cause of concern*

*By Huma Siddiqui*

The Chinese People's Liberation Army (PLA) actions along the Line of Actual Control (LAC) in the Ladakh Subsector and along the entire length have successfully been contained by the Indian Army. Initially assessed as a collective training deployment, the occupation of the Fingers 4 to 8, the deployment in the Depsang plains and DBO was a cause of concern. The deployment is likely to continue as each side is unlikely to withdraw to a position which will not allow a Military Commander to fight a cohesive defensive battle.

"Despite eight rounds of talks by the Military Commanders and the last two interactions with the representatives of the MEA have not borne much fruit," says an Indian Army veteran Lt Col Manoj K Channan.

According to him, "In a graduated response to the PLA's aggressive designs, the Indian Government and the Military Commander's engaged in a dialogue at the highest levels on each side, without much



*"Despite eight rounds of talks by the Military Commanders and the last two interactions with the representatives of the MEA have not borne much fruit," says an Indian Army veteran Lt Col Manoj K Channan. (Photo source: ANI)*

success. Ministerial Level talks on the sidelines of the SCO were fruitful in containing the eyeball contact from further escalation. The Indian Government has expressed that the PLA troops should pull back to March 2020 deployment.”

“On the other hand the occupation of dominating heights by the Indian Army has created a Catch 22 situation in which any vacation of the heights will have severe repercussions in case the Chinese occupy them now,” Lt Col Channan tells Financial Express Online.

In his view, “The use of unorthodox weapons from the medieval times is a ruse for psychological purposes, the modern-day soldier is not going to hesitate to “shoot to kill” in case such weapons are engaged in the physical brawls as witnessed in the Galwan Valley.”

“The troops are in Artic Tents with all creature comforts in place and despite the “Passes” being closed due to snow, the aerobridge is functional; in addition to Indian Air Force flights the civil charter flights too have been mustered to send the troops on much deserved leave for rest and recuperation,” he concludes.

### **What does the Ministry of Defence Annual Report say?**

The Indian Army is prepared to fight any eventuality and the troops are “well entrenched” to counter any misadventure by Chinese forces in eastern Ladakh.

For ensuring the sanctity of our claims in eastern Ladakh, the Indian Army troops have given a response in “a firm and non-escalatory way” to the unilateral and provocative actions by the Chinese to change the status quo by force, in more than one area along the LAC.

The report has also said that the troops deployed in those heights are braving inclement weather and Advance Winter Stocking (AWS) and winter preparations for the enhanced strength has been completed.

The report also talks about the preparedness of the Indian Army and efforts to resolve the issue in an amicable manner through talks, even as the PLA escalated the situation and has used “unorthodox weapons” and has been amassing large numbers of troops.

As has been reported last year, the PLA had used clubs and nail-embedded sticks as well as iron rods with machete-like heads in several skirmishes with Indian soldiers in Ladakh. “These were also used in the Galwan Valley clash which took place on June 15, 2020, in which the Indian Army lost 20 soldiers and the Chinese suffered significant casualties.”

Last August, the Indian troops, in ‘a precautionary deployment’, had pre-empted Chinese expansionist designs. They had occupied heights along the southern bank of Pangong Tso, the annual report has said.

### **IAF played a critical role**

The Indian Air Force (IAF), assisted in the mobilisation of the troops in a short span of time as well as moving heavy equipment like guns, tanks and ammunition, clothing and rations for the troops. The IAF is the lifeline for the troops who are deployed in minus 30-40 degrees Celsius temperature.

Besides the transport fleet, the IAF has also deployed its attack helicopters and fighters in the Ladakh sector, the report has stated.

Also, “the IAF engineers have constructed roads, built accommodation shelters and bridges to assist troop deployment,” it added.

<https://www.financialexpress.com/defence/ladakh-lac-standoff-india-army-has-created-catch-22-situation-for-the-chinese-says-an-expert/2166007/>

# **US National Defence Authorisation Act 2021's implications on Indo-pacific & Indian military- Part 2**

*By Dr. Anil Kumar Lal*

## **NDAA 2021 is focused on China**

5. The 2021 NDAA is focussed on China. It requires reports on Chinese military and security developments (Section 1260) and the U.S. strategy toward China (Section 1261). The NDAA has outlined activities in the South China Sea. Section 1259 prohibits the secretary of defense from involving China in any Rim of the Pacific (RIMPAC) naval exercises until he is able to certify to relevant congressional committees that China has ceased its land reclamation and related military activities for at least a four-year period. Similarly, Section 1262 requires the secretaries of defense and state to name-and-shame China by reporting any significant Chinese reclamation activity, territorial claims, or militarization in the South China Sea to relevant congressional committees and releasing the unclassified core of that report to the public. The US containment policies in the broad region that it nowadays refers to as the "Indo-Pacific" has been highlighted. It'll thus seek to optimize spending and improve the military's positioning, as well as coordinate everything with America's regional allies. In this instance the Indian position in the Himalayas also becomes relevant as already mentioned in this act specifically. India should prevail on the US to provide the best technology and weapons to strengthen the allied Indian position in the high altitude mountains of the Himalayas. In addition it has also mentioned of the so-called "Quad" between USA, Australia, India and Japan as a prominent fixture of regional geopolitics. There is also a provision of sharpening the counterintelligence activities in this region focussed at China. This would also include the area of the CPEC and Gwadar-Baluchistan and such like areas. As regards the counterintelligence aspect, the NDAA has now being refocused against China with a view to counter the Chinese "debt diplomacy", in this region. Pakistan is already falling under debt due to the "China Pakistan Economic Corridor" (CPEC) construction costs.

The USA will highlight and spread risk awareness to deter innocent nations succumbing to China's low-interest and long-term loans trap. The 5G element of next year's proposed military budget is extremely pernicious since it suggests that the US will withhold the deployment of new weapons systems or forces to host countries that haven't taken steps to reduce the supposed threat to American bases from Chinese technology in this sphere. Basically, those countries that are dependent upon (or rather, have been misled into believing that they need) the US' military presence will have to choose between retaining their alliance with America or using low-cost Chinese technology. This zero-sum game intends to force them into sacrificing their interests for the US. This is where India too will have to get off the fence and decide the side. Logically and from India's sovereignty perspective, seeking alliance with US will enable India to create a security deterrence and concentrate on its economy and build a modern state with the idea of a Free World at its centre. All issues of NDAA 2020/2021 can be summarised as given below.

## **Summary of 2020/2021 NDAA**

6. In the fiscal year 2020, military activities had included expansion of the aircraft fleet and the F-35 program. Both these have already added teeth to the American deployment in the Indo-Pacific region. The US National Defence Authorisation Act 2020 had played out for the first time a clear roadmap for leveraging the Indo-Pacific to counter Chinese expansionist moves by developing 'three long-term competitive strategies'. For this purpose, the act had specifically stated that the Pentagon would work closely with the Director of the Office of Net Assessment.

7. In the fiscal year 2021, the Indo-Pacific has been Authorized \$3.58 billion as the basis for the Indo-Pacific Reassurance Initiative to optimize the presence of U.S. forces in the region, strengthen and maintain bilateral and multilateral military exercises and training with United States allies and partner countries, improve infrastructure in the region to enhance the responsiveness of U.S. Armed Forces, enhance the prepositioning of equipment and material of the U.S. Armed Forces, and build the defense and security capabilities, capacity, and cooperation of allies and partner nations. India should be able to make a case for harnessing the above mentioned capacities and cornering at least half of this money for purchase of new military hardware, to thwart China.

8. Finally, Chinese aggression along the LAC in the Himalayas has been brought within the ambit of this act. The Indian-American Congressman Raja Krishnamoorthi said: "Through today's New Year's Day vote in the Senate, Congress has made the National Defence Authorisation Act into law, including elements of my resolution calling on China to end its military aggression towards India and others in the broader Indo-Pacific region". The nuances of the application of this act and its impact on global good are bound to turn the tide away from the tyranny of communist China to a free world. Without doubt the Balance of Power would shift in favour of the Free World.

### **Conclusion**

9. It can be summarised that the Balance of Power, as a concept, is fast altering in favour of a communist China. This balance needs to be immediately tilted back in favour of nations following the rule-based International laws. This can be restored with the landmark NDAA 2021 legislation as explained. There is immediate requirement of America restoring its primacy in the United Nations and promote the 'Collective Security' agenda for survival of the planet. India is holding along the 'Line of Actual Control' (LAC) against China at a huge cost. The same (as already covered above) point needs emphasis again. Thus, there is again a case, which requires, legitimising grants towards the costs of weapons and equipment, which is needed by India for this thankless job. All Developed Western nations need to chip in. This could be by giving one-time grants to India for the defence purchases as well initiate a new process of an "On Lease" method for hiring strategic assets like the Sixth Generation Fighters or other game changing assets like B2 Stealth Bombers etc. The Indian pilots can be trained in peace time to operate the same. Because, India is not only serving as a 'Pivot in Asia' concept but actually is holding PLA'S 20-25 Divisions equivalent, which otherwise would have been available for overwhelming Taiwan or Japan. Thus, India's position in the Himalayas, along the 'LAC' is a new "Geopolitical Pivot" of time. It can be actually coined and named as the 'Pivot of World Peace' (POWP) requiring global support.

10. Further, the 'CPEC' happens to be the flagship project of this 'OBOR' drive. This has shifted China's main effort towards a western land route, where India's Himalayan defences lie. Beyond doubt, both the above theories need to be replaced by a shift of the Geostrategic Pivot of the 21st century to the Indian Himalayas. Here lies the main contest between the three military powers, China, India and America. Management of this 'conflict Zone' will dictate the outcome of tomorrows' global security. Subsequently, this can even become a flash point for nuclear exchanges and the third world war. Let us further understand this argument of this new Himalayan theory. In this context, the 'Indo-US Strategic Partnership' becomes the defining geopolitical event of this century and that the new US President designate has in a way confirmed the same.

11. Therefore, both India & the USA need to work on a more flexible but robust partnership with mutual readjustments so as to allow India, its own geopolitical space and autonomy for India's future growth. This will in turn enable India, to emerge as an independent and strong military power rather than becoming a puppet of the West, as that does not allow inclusive and independent growth. Mutually, both India and the USA have to reach out, to be able to knit a workable Strategic Partnership which gives enough confidence to India to "Get off the Fence towards the West" and avail the best of the NDAA 2021 as already covered above.

<https://timesofindia.indiatimes.com/blogs/rakshakindia/us-national-defence-authorisation-act-2021s-implications-on-indo-pacific-indian-military-part-2/>



## Pakistan successfully test-fires indigenously developed weapons rocket system

*According to Director General of Army, Media Wing, Major General Babar Iftikhar, Fatah-1 weapon system can hit targets up to a range of 140 km*

Islamabad: Pakistan on Thursday successfully conducted the test-flight of an indigenously developed Guided Multi Launch Rocket System, capable of delivering conventional warheads, with a maximum range of 140 km.

According to Director General of Army, Media Wing, Major General Babar Iftikhar, Fatah-1 weapon system can hit targets up to a range of 140 km.

“The Weapon System will give Pakistan Army capability of precision target engagement deep in enemy territory,” said Iftikhar.

President Arif Alvi, Prime Minister Imran Khan, Chairman Joint Chiefs of Staff Committee General Nadeem Raza and the Army Chief Qamar Javed Bajwa congratulated the participating troops and scientists on the successful flight test.

No further details were provided by the Army about the weapon system.

<https://www.newindianexpress.com/world/2021/jan/07/pakistan-successfully-test-fires-indigenously-developed-weapons-rocket-system-2246876.html>

### Science & Technology News

## Solar Group test-fires solid propellant motor for Vikram-1 rocket in city

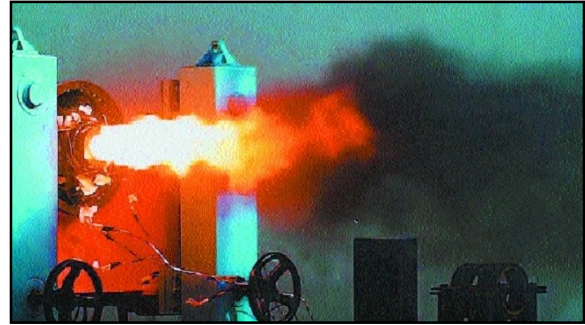
*Solid rocket propulsion stage demonstrator ‘Kalam-5’ testing under way at Solar Group’s testing facility in Nagpur*

*By Kaushik Bhattacharya*

- *The motor ‘Kalam-5’ will be used in India’s first ever privately designed and developed rocket*
- *The company also manufactured and supplied Moulded Plastic Bond, Stage Separation Explosive, for ISRO’s launch vehicles*

Solid rocket propulsion stage demonstrator ‘Kalam-5’ which is going to be used in India’s first-ever privately designed and developed rocket ‘Vikram-1’, has been successfully test-fired by Solar Group’s Economic Explosives Limited (EEL) and Skyroot Aerospace in the Solar Group’s Rocket testing facility in the city recently. Kalam-5 is a solid propellant motor and uses exactly same propellant, materials, and interface as the third stage of the Vikram-1 launch vehicle. The propulsion system provides adequate thrust to beat the gravity and is crucial for the success of any rocket. These are high thrust, low-cost rocket engines with propellant in solid form. In addition to being cost-effective, some changes have made like it has very few moving parts.

It is the first of the five Kalam engines that Skyroot Aerospace plans to test. “Under the leadership of Satyanarayan Nuwal, Chairman Solar Group, and Manish Nuwal, CEO and MD, Solar Group, we have entered into the business of the Propulsion system for space and defence application, which is synergistic with current business of commercial explosives and ammunition. For this, we are working with Skyroot Aerospace India Ltd – a Hyderabad-based Space Start-Up for manufacturing of propulsion system of Space Launch Vehicles,” said Sanjay Singh, Senior General Manager, EEL to The Hitavada. Indian Space Research Organisation (ISRO) is planning to enhance their capacity for launching satellites and other activities and looking for association with private companies.



“ISRO has identified Solar Group as one of the leading partners in the field of Propellant filling, integration of Propulsion Motors, Pyros, etc to meet the expanding demand in the international market for launching a larger number of satellites annually,” said Singh. “We have also successfully manufactured and supplied Moulded Plastic Bond, Stage Separation Explosive, for ISRO’s launch vehicles,” he added. Stage Separation Explosive is that explosive charge which helps to separate each stage of multistage launch vehicles during a space mission. EEL has also emerged as the first private Indian company to successfully test-fire an artillery rocket.

The Pinaka rockets manufactured by EEL were fired at the Pokhran range last year. Similarly, the company has now got technology from Defence Research and Development Organisation (DRDO) for over a dozen items, ranging from multi-mode grenades to propellants for Brahmos missile. “Only two private companies are working on solid propulsion system in the country with ISRO and EEL is one of them. Apart from that we have 40-50 projects lined-up for the Ministry of Defence including Pinaka and Brahmos,” said the Senior General Manager of EEL. Since 2010, the company has emerged as a key player in the defence segment, and now it is notifying its presence in space technology too.

<https://www.thehitavada.com/Encyc/2021/1/8/Solar-Group-test-fires-solid-propellant-motor-for-Vikram-1-rocket-in-city.html>



*Fri, 08 Jan 2021*

## **Researchers repurpose 'damaged' polymer optical fibers to precisely measure magnetic fields**

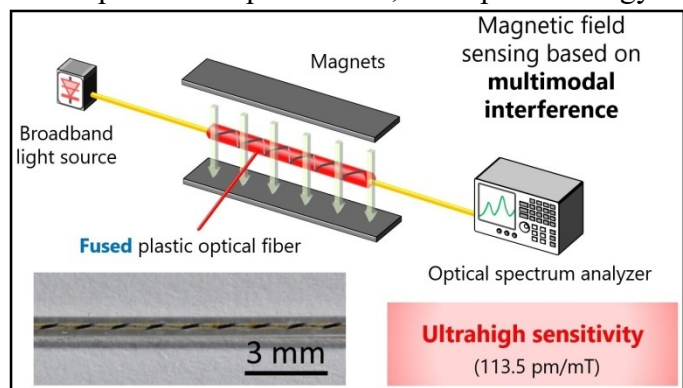
The invention of optical fibers has revolutionized not only telecommunications but also sensing technology. Optical fiber sensors can measure strain, temperature, pressure, and many other physical parameters along the fibers, but they are currently immune to electromagnetic noise—interference from other external electric or magnetic interactions. It is a desirable trait, until the effect of the electromagnetic field on the fibers needs to be measured. Now, an international team of researchers has used what was previously considered a 'damaged' part of an optical fiber to develop such a magnetic field sensor.

They published details of their approach on Nov. 5 in *Advanced Photonics Research*.

"This nature of immunity to electromagnetic noise is a great merit when we measure strain, temperature, etc., under strong electromagnetic field environments," said paper co-author Yosuke Mizuno, associate professor at the Faculty of Engineering, Yokohama National University. "However, it simultaneously means that electromagnetic field sensing using optical fibers is a major challenge, which we tackled in this paper."

The researchers took advantage of a 'fiber fuse' effect, which is induced when high-power light is injected into an optical fiber with tight bends, bad connectors, and other non-ideal conditions. When high-power light is injected into such a compromised optical fiber, the optical energy is 'trapped' in the core of the fiber, generating an optical discharge that propagates toward the light source, permanently damaging the fiber in the process. The research team has found that, when the fiber is made of polymer, this effect results in an electrically conductive carbonized path, which can in turn enable the interactions needed to react to magnetic fields.

"The interactions between the magnetic field and the carbonized—or 'damaged'—regions can lead to variations in optical parameters in the fiber," said lead author Arnaldo Leal-Junior, professor in the Graduate Program in Electrical Engineering, Federal University of Espírito Santo. "By sandwiching a fused polymer fiber between two silica single-mode fibers and inducing what we call multimodal interference, a fiber-optic magnetic field sensor can be implemented."



A magnetic field sensor based on multimodal interference in a "fused" polymer optical fiber achieves an ultrahigh sensitivity of 113.5 pm/mT. Credit: Yokohama National University

The researchers experimentally showed that this sensor can detect a small magnetic field change of 45 microtesla, which is several hundreds of times smaller—or more sensitive—than the 20 millitesla detection by a conventional fiber-optic method. For comparison, a magnetic field of about 100 microtesla is measured an inch away from an operating kitchen microwave.

"Magnetic field sensors are often required in handling various apparatuses in electric power systems, such as generators and motors," Mizuno said. "We anticipate that the merits of our sensor, including electrical insulation and long measurement range, can be exploited in such applications."

Leal-Junior also noted that the proposed sensor can be easily fabricated at a low cost and that their approach paves the way for a novel recycling option by salvaging fused polymer optical fibers for use in magnetic field sensors.

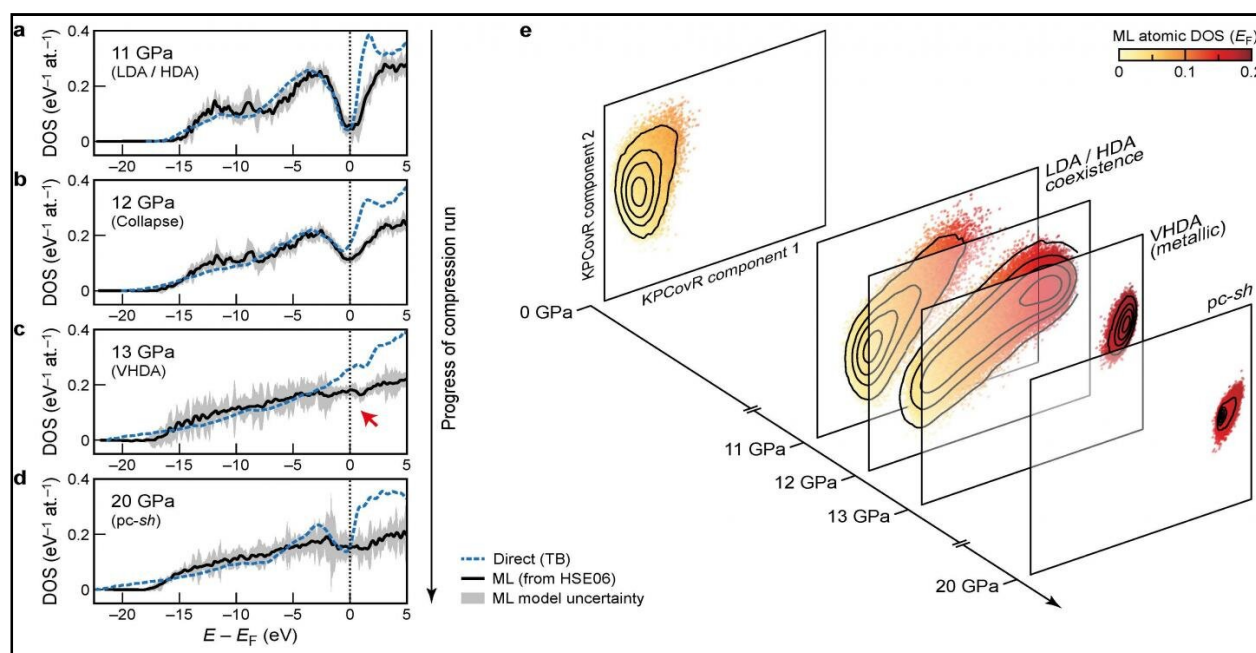
The researchers are planning to improve the measurement accuracy as well as further enhance the sensitivity of the proposed sensor. They will also attempt to use the same approach to demonstrate electric field sensing in the near future.

**More information:** Arnaldo Leal-Junior et al, Highly Sensitive Fiber-Optic Intrinsic Electromagnetic Field Sensing, *Advanced Photonics Research* (2020). DOI: [10.1002/adpr.202000078](https://doi.org/10.1002/adpr.202000078)  
<https://phys.org/news/2021-01-repurpose-polymer-optical-fibers-precisely.html>

# Machine-learning models of matter beyond interatomic potentials

By Carey Sargent

Combining electronic structure calculations and machine learning (ML) techniques has become a common approach in the atomistic modeling of matter. Using the two techniques together has allowed researchers, for instance, to create models that use atomic coordinates as the only inputs to inexpensively predict any property that can be computed by the first-principles calculations that had been used to train them.



Electronic densities of states (DOS) at various stages of the compression run Credit: @Michele Ceriotti

While the earliest and by now most advanced efforts have focused on using predictions of total energies and atomic forces to construct interatomic potentials, more recent efforts have targeted additional properties of crystals and molecules such as ionization energies, NMR chemical shieldings, dielectric response properties and charge density. In the paper "Learning the electronic density of states in condensed matter," Ceriotti and colleagues focus on the electronic density of states (DOS), another quantity that underlies many useful materials properties, some of which can be observed experimentally.

The DOS is essentially the number of different states that electrons can occupy at a particular energy level, and can be used, for instance, to calculate the electronic contribution to heat capacity in metals and the density of free charge carriers in semiconductors. It is an indirect proxy for properties such as the energy band gap, the band energy and the optical absorption spectrum.

"Predicting the DOS is an interesting exercise in itself because it is essentially the simplest possible description of the electronic structure beyond the ground state picture," Ceriotti said. "It's also useful because there are many properties that you can compute starting from the DOS, making it a great example of how the next generation of ML models can be used in a similar way as electronic structure calculations, using them in an indirect way to compute intermediate quantities that can then be easily processed to evaluate properties that are harder to learn directly."

In developing the model, the group looked to assure transferability across different phases as well as scalability to large system sizes. Their ultimate approach, which looks at how different

atomic configurations affect the distribution of energy levels, meets these goals—it was able to learn and predict DFT-computed DOS for a diverse data set of silicon structures, covering a broad range of thermodynamic conditions and different phases. It also scales linearly, rather than with the cube of the number of atoms as with electronic structure calculations, making it applicable to large structures. Finally, the model allowed for an analysis of the local DOS, giving researchers the chance to examine the interplay between structural motifs and electronic structure.

The combination of transferability, and scalability of predictions to large system sizes, make the model applicable to address long-standing open questions in materials science. The new framework has already been used to elucidate the electronic properties of a 100'000-atoms simulation of amorphous silicon, undergoing a series of phase transitions when compressed to 20 Gpa, in a paper published in *Nature* today in collaboration with a team comprising researchers from Oxford, Cambridge, the US Naval Research Laboratory and Ohio University. The predicted DOS is also used to explain how the pressure-induced structural transformations couple to the electronic structure of the material.

Combining the new model with one of the well-established potential energy models also makes it possible to compute the electronic contributions to macroscopic properties such as the heat capacity of metals and to perform simulations that take into account finite-electronic-temperature effects—as demonstrated in another soon-to-be published article discussing the high-temperature properties of nickel. Indeed, the new model is a critical step towards MARVEL's goal of developing integrated machine learning models that augment—and perhaps eventually replace—costly electronic structure calculations.

"There are other properties aside from the electron density of states, such as optical excitations, and NMR response, which we have been able to accurately predict with machine learning." Ceriotti said. "If we can use them all in combination with cheap and accurate interatomic potentials it will allow us to describe all of the properties of materials with the same accuracy achieved with electronic structure calculation, but at a tiny fraction of the cost."

**More information:** Chiheb Ben Mahmoud et al, Learning the electronic density of states in condensed matter, *Physical Review B* (2020). DOI: [10.1103/PhysRevB.102.235130](https://doi.org/10.1103/PhysRevB.102.235130)

**Journal information:** *Nature* , *Physical Review B*  
<https://phys.org/news/2021-01-machine-learning-interatomic-potentials.html>



Fri, 08 Jan 2021

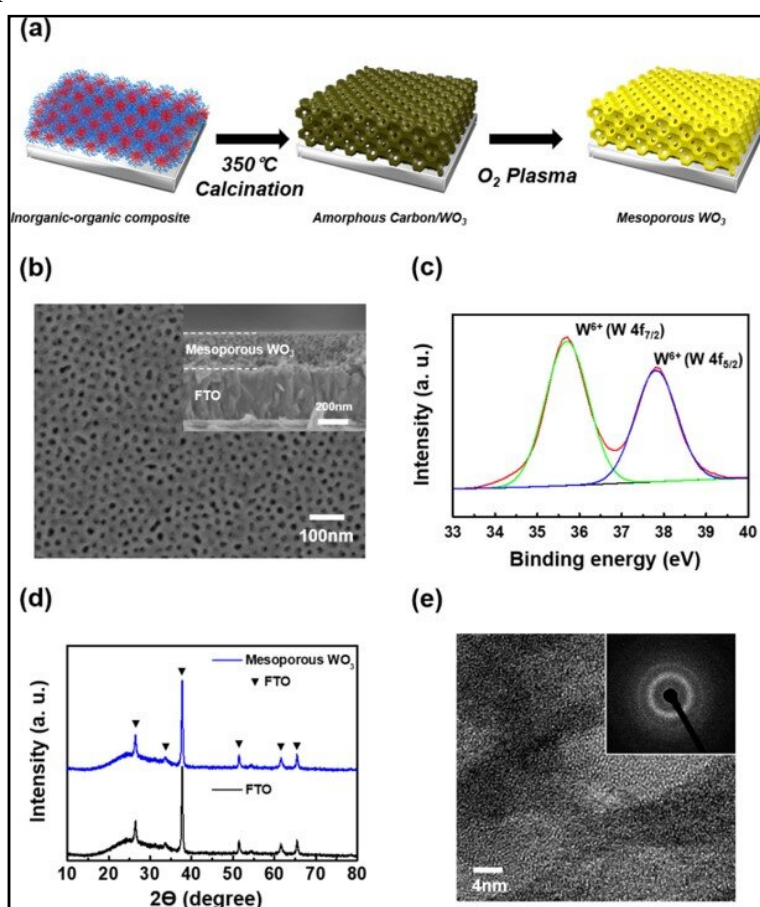
## Extremely fast electrochromic supercapacitors

*By Thamarasee Jeewandara*

During materials engineering, a network of tiny holes or pores can improve the energy storage capacity of materials for applications as smart windows. Smart windows are platforms whose light transmission properties can be altered when light, voltage or heat is applied. Scientists can control the fraction of light passing through the material using an electrical voltage to electrically switch from transparent to opaque materials during charge transfer. While this feature is associated with storage and release of energy, the same materials can be used for energy storage as well. In a new report, Jeon-Woo Kim and a team of scientists at the Pohang University of Science and Technology in South Korea developed and improved electrochromic supercapacitors made from tungsten trioxide (WO<sub>3</sub>). They used an evaporation-induced self-assembly process to deposit a film of tungsten trioxide with pores, where the porous architecture increased the speed of switching and capacitance in the material compared to conventional tungsten trioxide thin films. The work is now published on *Nature Asia Materials*.

## Photonics: smart windows and energy storage

During this work, Kim et al. demonstrated the ultrafast response of electrochromic supercapacitors by exploring the mesoporous structure of the constituent materials. Electrochromic devices (ECDs) can generate reversible color changes that correspond to electricity with promising applications across smart windows, displays and military camouflage. The devices can also control light transmittance to build materials for climate adaptive energy-efficient buildings. The functionality of ECDs can be extended to energy storage devices known as electrochromic supercapacitors (ECS). Such supercapacitors are increasingly under investigation as next-generation electrochemical components capable of changing their own optical properties and storing the energy supplied. Their inherent optical characteristics can therefore directly reveal the real-time energy levels stored within. Researchers had developed such high-performance devices using electrochromic chromophores based on transition metal oxides such as tungsten trioxide due to their superior electrochemical properties. The electrochromic displays developed here can change color based on their stored levels of energy and the product will have broad implications as next-generation smart window materials for buildings and portable energy storage.



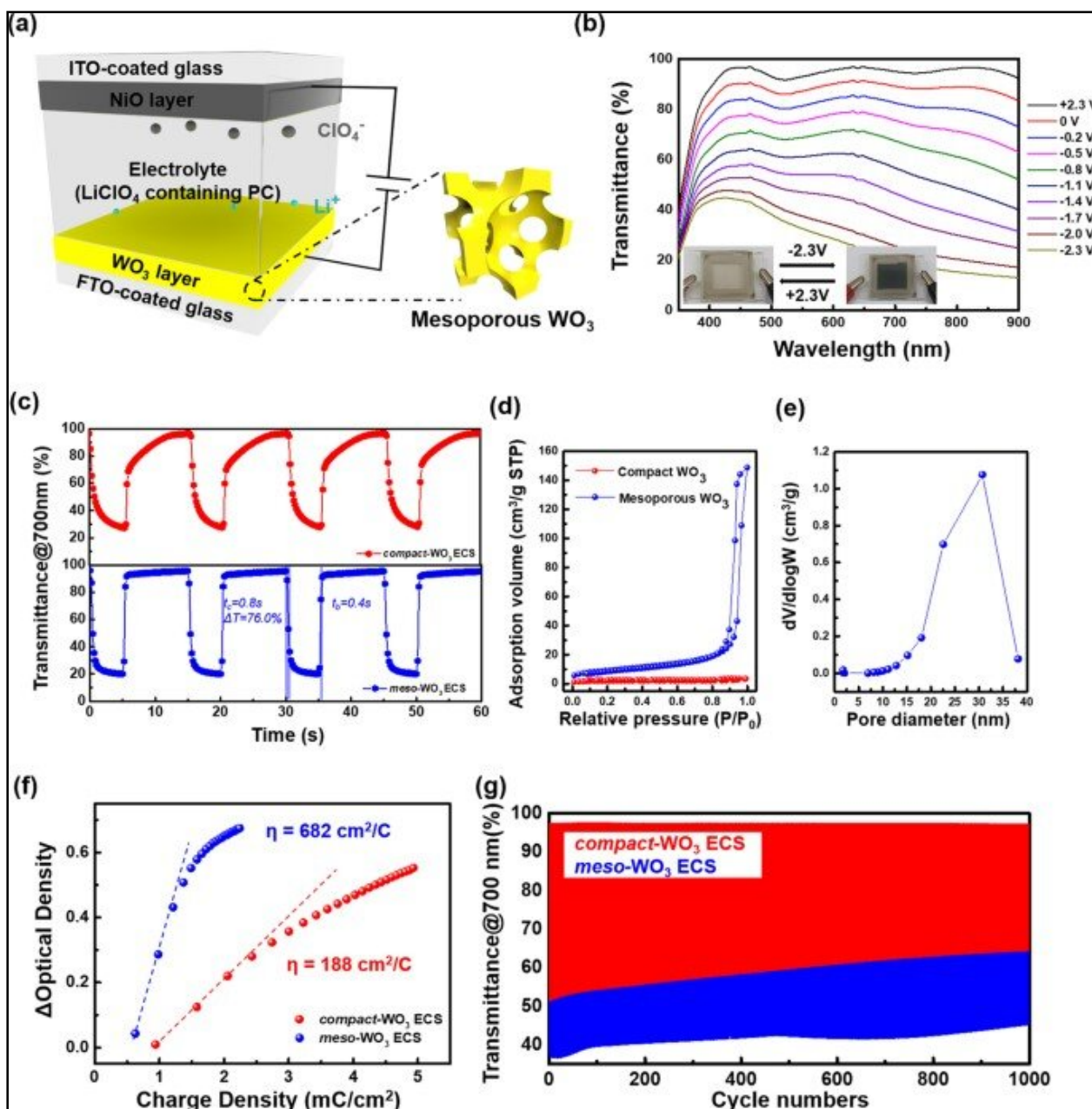
**Fabrication and characterization of mesoporous WO<sub>3</sub> films.** (a) Schematic showing the fabrication process of the mesoporous WO<sub>3</sub> film. (b) Scanning electron microscopy (SEM) image (top view) of the mesoporous WO<sub>3</sub> film (inset: cross-sectional view). (c) W 4f XPS spectra of the mesoporous WO<sub>3</sub> film. (d) XRD patterns of the mesoporous WO<sub>3</sub> film and bare FTO glass. (e) HR-TEM image of the mesoporous WO<sub>3</sub> film (inset: SAED pattern). Credit: NPG Asia Materials, doi: 10.1038/s41427-020-00257-w

### Developing the new materials and building the device

The scientists detailed the fabrication process using a mixed solution of tetrahydrofuran and polystyrene-*block*-polyethylene oxide and ethanol-based tungsten hexachloride (WCl<sub>6</sub>) as a precursor of tungsten trioxide. The resulting film contained inorganic-organic composites. They then calcinated the composite to partially remove the organic components and transform the remainder to amorphous carbon. The inorganic components underwent condensation to form tungsten trioxide and the resulting composite film contained a carbon/tungsten trioxide structure. The team subsequently exposed the film to oxygen plasma to eliminate the amorphous carbon, which they confirmed using Raman spectroscopy. Using scanning electron microscopy (SEM), the scientists supported the mesoporous structure of the resulting tungsten trioxide (WO<sub>3</sub>) film with small pores (less than 30 nm) and a thickness approximating 250 nm.

Kim et al. expected ultrafast dynamics with mesoporous WO<sub>3</sub>-based electrochromic supercapacitors (denoted *meso*-WO<sub>3</sub>-ECs), and for comparison, they also developed a compact device denoted *compact*-WO<sub>3</sub>-ECs using WO<sub>3</sub> nanoparticles. Thereafter they recorded the UV-vis transmittance spectra at various applied voltages to understand the electrochromic behavior of the two devices. When the applied voltage increased, the transmittance gradually decreased across the

entire range of visible light wavelengths due to redox reactions in the setup. The team could then recover the transparent bleached state of the device by applying a 2.3 voltage.



Electrochromic (EC) performance of meso- and compact-WO<sub>3</sub> electrochromic supercapacitors (ECSs). (a) ECS structure employed in this work. (b) Transmittance spectra of the meso-WO<sub>3</sub> ECS as a function of applied voltages (inset: photographs of the colored and bleached states). (c) In situ optical responses of the compact-WO<sub>3</sub> ECS (red line) and the meso-WO<sub>3</sub> ECS (blue line). (d) Nitrogen adsorption-desorption isotherm curves of the mesoporous and compact WO<sub>3</sub>. (e) Pore size distribution of mesoporous WO<sub>3</sub>. (f) Optical density variation as a function of injected charge density. (g) Coloration/bleaching cycling stability of the two ECSs for 1000 cycles. Credit: NPG Asia Materials, doi: 10.1038/s41427-020-00257-w

### Comparing device functionality

To compare the electrochromic dynamic response of the two devices, Kim et al. recorded the transmittance profiles at 700 nm, and at alternating potentials. The *meso*-WO<sub>3</sub>-ECS device showed large optical modulation and ultrafast coloration in 0.8 seconds and a bleaching time of 0.4 seconds, notably faster than previous reports. The team did not obtain a similarly stable state of coloring and bleaching under the same conditions with *compact*-WO<sub>3</sub>-ECS. The results depended on the surface area of the devices, where the *meso*-WO<sub>3</sub>-ECS device consumed less energy compared to the *compact*-WO<sub>3</sub>-ECS.

Typically, electrochromic supercapacitor devices must maintain cycling stability under fast response conditions. Additional tests under quick switching conditions between coloration and bleaching for 1000 cycles therefore showed how the mesoporous device retained 85.5 percent of their original optical modulation, while the optical modulation of compact devices dropped. The team credited the excellent stability of the mesoporous device to its characteristic architecture with a large surface area, well-suited for dynamic applications that require a fast response.

### **Charge transfer dynamics**

Kim et al. next compared the charge transfer and ion kinetics of the devices and the results showed a smaller contact resistance, smaller charge transfer resistance and lower ion diffusion resistance for the mesoporous devices. The devices showed significantly different charge-storing capabilities as the functional current density increased. The work implied the mesoporous supercapacitors to be more promising compared to the compact devices to form quick charging and discharging devices with outstanding long-term stability. The team then directly viewed the stored energy levels of the supercapacitors. The mesoporous device showed no significant degradation of optical contrast, which they credited to its effective and fast ion transport properties. With compact devices, the optical modulation dramatically decreased while the current density increased, the compact devices were therefore not as efficient for high-rate functionality due to their inefficient ion transport and slow charge transfer.

### **Printing and evaporation-induced self-assembly**

The team then combined printing and evaporation-induced self-assembly to develop the highly functional, energy-storing, electrochromic supercapacitor displays. This printing process produced a micellar structure through the nozzle after evaporation, which they then subjected to sequential calcination and oxygen plasma treatment to form a patterned mesoporous WO<sub>3</sub> device for energy-storing applications. When they charged the device, the patterns turned dark blue to indicate the charged state. To prove its mechanism of action, the team connected the device to a white-light emitting diode (LED) that initially emitted light, when the stored energy was consumed, the device returned to its original transparent state.

### **Outlook: next-generation smart electronics.**

In this way, Jeon-Woo Kim and colleagues developed multifunctional electrochromic supercapacitors based on amorphous mesoporous WO<sub>3</sub> films. Compared to the compact version of electrochromic supercapacitors (*compact*-WO<sub>3</sub>-ECS), the mesoporous electrochromic supercapacitors (*meso*-WO<sub>3</sub>-ECS) showed superior performance. The scientists credited this to its large surface area and amorphous nature. The mesoporous devices functioned rapidly to serve as electrochemical reflective displays and to store electrical charge. This setup can also power other electronic devices, as the color intensity of the pattern on the device indicated the level of stored energy within. The outcomes will have tremendous potential to form next-generation smart electronics.

**More information:** Keon-Woo Kim et al. Extremely fast electrochromic supercapacitors based on mesoporous WO<sub>3</sub> prepared by an evaporation-induced self-assembly, *NPG Asia Materials* (2020). DOI: [10.1038/s41427-020-00257-w](https://doi.org/10.1038/s41427-020-00257-w)

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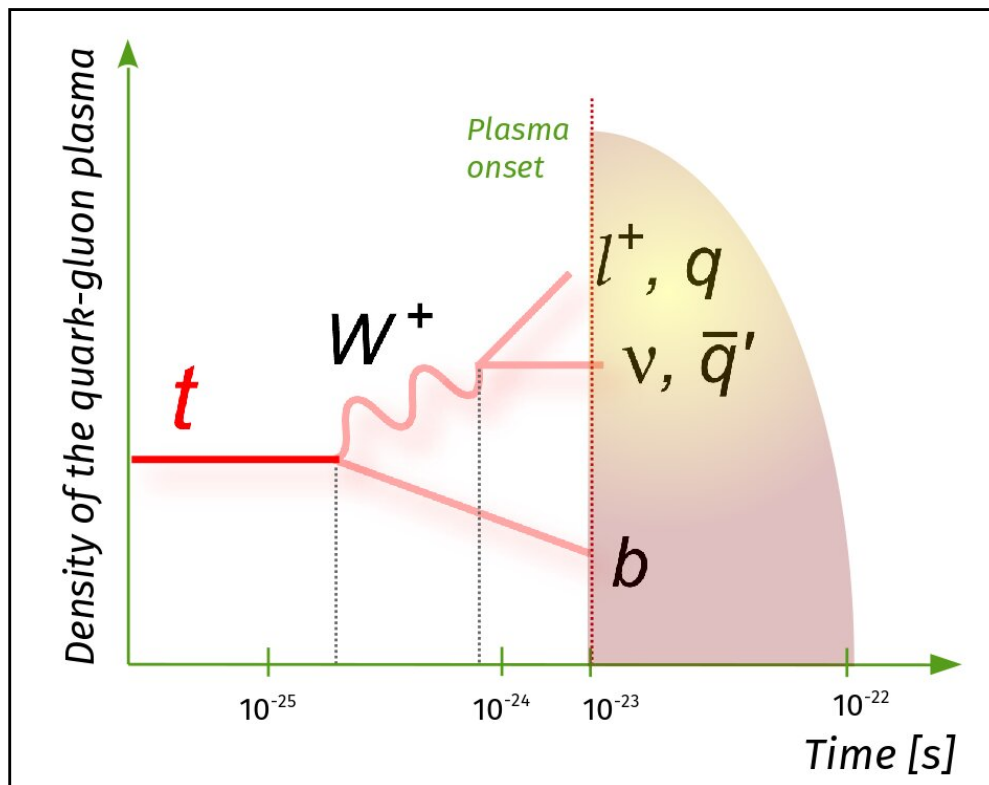
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# The first evidence of top quark production in nucleus-nucleus collisions

By Ingrid Fadelli

The Compact Muon Solenoid (CMS) Collaboration, a large group of researchers from different institutes worldwide, has recently gathered the very first evidence of top quark production in nucleus-nucleus collisions. Their work, outlined in a paper published in *Physical Review Letters*, was based on lead-lead collision data gathered by the CMS particle detector, at CERN's Large Hadron Collider (LHC).



Top quarks almost always decay into a b quark and W boson; the latter further decays into leptons or quarks that can be detected and form the so-called “final state”. The sketch illustrates the process of the top quark decaying to other particles, and the average decay times of each particle are indicated on the x-axis. The quark-gluon plasma density evolution (y-axis) is illustrated as a function of time. Credit: CMS Collaboration.

Up until a few years ago, when CERN's LHC had just started operating, most physicists studying heavy ions (i.e., high mass nuclei that have been fully stripped of electrons for acceleration purposes) were skeptical about the possibility that top quarks, the heaviest elementary particles known to date, could be studied in heavy ion collisions. In fact, at the time, it was still unclear whether the LHC was able to sustain collisions between heavy ions at a sufficiently high collision rate, also known as luminosity. Recently, however, LHC accelerator experts were able to achieve this rate and surpass the initial luminosity goals for heavy ion collisions.

Another reason why studying top quarks in heavy ion collisions seemed less feasible than in proton-proton (p-p) collisions is that when the LHC collides heavy ions, the maximum kinetic energy of individual nucleons is considerably smaller than the corresponding energy in p-p collisions. As the rate of top quark production depends in great part on the collision energy (i.e., the larger the energy, the easier it is to produce quarks), producing these particles in LHC-based heavy ion collisions seemed challenging.

The LHC was also set up to devote less time to heavy ion collisions and more to p-p collisions, reflecting the priorities of the particle physics community. For instance, in one year, it generally spends one month producing heavy ion collisions and six to seven months in p-p collisions.

Finally, heavy ion collisions produce far more particles than more common p-p ones, which can make detecting particles and analyzing heavy ion-related data collected by the LHC very challenging. Collectively, these factors hindered and slowed down the study of top quarks in heavy ion collisions, even if they were often identified in p-p collisions.

Five years ago, researchers at CERN, University of Jyväskylä, and Helsinki Institute of Physics published the first predictions of production rate of top quarks in heavy ion collisions. Despite the relatively low rate of production of the LHC, they argued that top quarks could help to probe the so-called quark-gluon plasma (QGP). QGP is a state of matter that is believed to have existed during the universe's first microsecond of life, which could also reside in the dense core of neutron stars in today's universe. This state of matter can be recreated in laboratory settings by colliding heavy ions, such as lead (Pb).

Top quarks can be useful both to probe QGP and to study the distribution of gluons within nuclei. These two uses, however, require different types of collisions, the former symmetric ones (e.g., lead on lead or Pb-Pb) and the latter symmetric and asymmetric ones (e.g., protons on lead or p-Pb). The LHC collides both symmetric and asymmetric beams, but before it could be applied to QGP and gluon-related studies, researchers had to prove with a high degree of confidence that top quarks can actually be detected in nucleus-nucleus collisions.

"In December 2015, the LHC delivered Pb-Pb collisions with a kinetic energy of 2.51 TeV per nucleon, meaning for the nucleon-nucleon collision, a grand total (center of mass energy per nucleon) of 5.02 TeV," members of the CMS Collaboration told Phys.org via email. "This was a big step over Run 1, but the luminosity was still too limited for top-quark study purposes and, as mentioned before, the heavy ion running time was only one month. So in short, that dataset was too small to claim evidence for top quark production."

After the dataset gathered in 2015 was released, the researchers carried out a series of studies aimed at gathering evidence of top quark production in heavy ion collisions. First, they measured top quark production in a small reference p-p sample taken in 2015 at the same center-of-mass energy of 5.02 TeV, then they measured it in p-Pb collisions recorded in 2016. Ultimately, they performed their analyses on Pb-Pb collisions.

"These new Pb-Pb data were accumulated at the very end of Run 2, in 2018, thanks to the ingenuity of our accelerator colleagues, who introduced improvements in the chain from the Pb ion source down to LHC, and the capability of the CMS experiment to record on tape, the full amount of heavy ion data delivered by LHC," members of the CMS Collaboration explained. "Overall, this resulted in a total accumulated luminosity approximately four times larger than in 2015. The larger data set eventually helped, but by itself, it wouldn't have been sufficient in case no top quark reconstruction improvements were introduced."

In their recent study, the CMS collaboration combined two experimental approaches: one that is affected by the presence of QGP and one that is agnostic to it. The first of these methods exploits the presence of bottom quarks (i.e., the lighter versions of top quarks). Bottom quarks can provide hints of top quark production, as the latter almost always decay into the former. The second approach, on the other hand, focused exclusively on the study of electrons and muons (i.e., heavier relatives of electrons).

"This second method was less sensitive, but it prevented a potential criticism: We have a relatively imprecise knowledge, so far, of how QGP affects the behavior of bottom quarks, and so in principle, the first method might be biased by still unknown effects," Andrea Giammanco, former coordinator of the Top Quark group of the CMS collaboration, told Phys.org. "As a result of the smallness of the top-quark signal, the large background (e.g., random combinations of unrelated particles, or detector-induced processes that mimic the signal), and the complexity of top quark reconstruction, the analysis was designed with a few unique features."

Initially, the CMS collaboration focused on re-optimizing identification algorithms in order to achieve performances comparable to those attained on p-p collisions, despite the challenges associated with the environment created by Pb-Pb collisions. Subsequently, they used advanced machine learning algorithms, which are promising tools for the analysis of data gathered by the LHC.

Notably, the CMS collaboration was the first to gather measurements that extract top quark signals based on lepton information alone. In addition, they used a new analysis technique that is entirely driven by data to carefully estimate background information.

"To avoid any human bias, our study was designed following a so-called 'blind' analysis procedure, whereby the selection criteria were optimized and fixed first using only a small initial part of the data, before being applied to the full data set," Giammanco said. "In the end, the agreement of the results from the two approaches between them, with the rate extrapolated from p-p collisions, and with the theoretical expectation, gave us confidence in the first concrete evidence for the production of top quarks in nucleus-nucleus collisions. Crucial to this successful outcome has been also the precise estimate of the actual luminosity, a task which our team, with the help of the CMS luminosity group, performed with high priority, too."

Prior to this recent study, the LHC had enabled measurements of various elementary particles with large masses in heavy ion collisions, such as massive carriers of the electroweak force (i.e., W and Z bosons). Nonetheless, there was a lack of evidence for top quark production in heavy ion collisions, even if theoretical predictions suggested that they were produced at a sufficiently high rate. In addition to gathering the first evidence of top quark production in nucleus-nucleus collisions, the recent study by the CMS collaboration measured a collision rate that is aligned with theoretical predictions.

"Actually, our community had never had the chance before for probing such an energy regime (or 'energy scale') close to the top quark mass, putting the theory that bounds together nucleons in nuclei, called the 'strong force,' under stringent tests," Georgios K. Krintiras, co-coordinator of the Luminosity Group of the CMS collaboration, told Phys.org. "Moreover, physics processes used so far, for example, the production of the W and Z bosons and particles of light, the photons, are only sensitive to the properties of QGP integrated over its extremely short lifetime (only a tiny fraction of a second, in technical terms, about seconds). Our paper, following up on recent theory considerations for unveiling the yoctosecond structure of QGP, is just the first step in using the top quark for providing key novel insights into the time structure of the medium created in heavy ion collisions."

The analyses carried out by the CMS collaboration in this recent study deviate from well-established research approaches and could thus open up new possibilities for investigating the time dimension of QGP. This could ultimately prove its existence by assembling the world's shortest movie of its development.

"The exceptionally high mass of top quarks we identified sets a new scale for probing the inner structure of the nuclei too, encoded in the so-called nuclear parton distribution functions (nPDFs)," Krintiras said. "Our current knowledge of how nucleons behave inside a nucleus is limited, mainly because of the lack of data at that scale."

Nucleons are made up of three fundamental particles known as quarks. The interactions between these quarks, which are mediated by a different class of particles known as gluons, are so intense that, theoretically, no external force should be able to affect their behavior, not even the strong forces between different particles inside a nucleus.

Research carried out at CERN in the '80s revealed that nucleons bound in nuclei tend to behave differently than those that are free, a finding that was confirmed by numerous subsequent studies. In this past research, the European Muon Collaboration (EMC) investigated the ratio of data they collected on per-nucleon muon scattering off iron and compared it with that related to the far smaller nucleus of deuterium, achieving surprising results that did not match their predictions.

Similarly, researchers at the LHC are investigating the ratio between the measurements performed during Pb-Pb collisions, comparing it to those collected during p-p collisions.

"In this context, the top quark constitutes a theoretically precise probe of the gluon nPDFs in a poorly explored scale," Krintiras explained. "Precise knowledge of nPDFs is also a key prerequisite to extract detailed information on QGP properties from the experimental data."

The recent work by the CMS collaboration could also have important implications for the understanding and search for new physics. Although the research communities investigating heavy ion interactions and new physics are typically unrelated, this first evidence for the production of top quarks in heavy ion interactions has paved the way for a collaboration between these two physics communities.

"This search has inspired me to join forces with colleagues specialized in new physics, to propose one such search that would take advantage of the unique features of heavy ion collisions, and that could become possible with special heavy ion runs in the future," Giammanco said. "Two years ago, we organized a dedicated workshop, called "Heavy Ions and Hidden Sectors," to which we invited most of the people active in the minuscule niche of new physics searches in heavy ions, but also heavy ion experts who had never worked on new physics, new physics experts who had never worked with heavy ions, and LHC accelerator experts such that they could guide us on what could be possibly achievable in terms of heavy ion beam performance in future LHC runs."

Some of the sophisticated algorithms that the CMS collaboration developed to conduct this search are now being used as an argument within the research community who is searching for new physics. More specifically, it is currently being used to demonstrate that some of the fundamental limitations or challenges associated with searches for new physics can be overcome.

In their future work, the CMS collaboration plans to build on their recent findings to conduct additional searches for top quarks in heavy ion collisions. Moreover, the team would like to further improve the effectiveness of their experimental methods and algorithms.

"In our paper, the so-called 'observed statistical significance' of the signal amounts to 4.0 units of 'standard deviations' ( $\sigma$ ), for both methods," Krintiras said. "In other words, if no top quarks were produced, there would be still a probability of 0.003% (that's the  $4\sigma$  level) that the signal would arise from a background fluctuation. We'd like to decrease this probability further, reaching the higher threshold of  $5\sigma$  that is considered the standard for declaring observation in our community."

To improve the observed statistical significance of the signal they detected and increase the reliability of their findings, the researchers will need to first increase the luminosity in their search. In fact, even if they are aligned with theoretical predictions, the collision rate values extracted in their recent paper are slightly lower than expected values. Increasing the statistical significance could help to determine whether this lower rate is a result of random fluctuations or indicates an underlying systematic trend.

"Notwithstanding the increasing interest in analyses surrounding nPDFs, we are still far from achieving a detailed understanding of the inner structure modifications in bound nuclei," Krintiras said. "The LHC nuclear data are heralded as a game-changer, since they provide the opportunity for a precise formalism of nPDFs for the lead nucleus, including advancements in our knowledge about bound gluons from top quark measurements. We can even foresee additional runs at LHC with higher usable luminosity offering further the chance for colliding one or more lighter nuclei than lead, hence bridging the currently large gap."

There is also a complementarity between the physics programs at LHC and the planned Electron-Ion Collider (EIC) at the Brookhaven laboratory, answering the crucial question of whether nPDFs are functions with universal applicability. Together, these efforts are expected to reveal with precision what the arrangement of the quarks and gluons that make up the protons and neutrons of nuclei is.

"With most of the total luminosity of the LHC Pb-Pb program still to be recorded in the next decade and promising performance projections for the future high-luminosity upgrade of the LHC,

or even future, more powerful, colliders, also recommended by the recent update to the European Strategy for Particle Physics, top quark observables will be measured with ever-increasing precision and even become a precise probe of the QGP," Krintiras added. "This could prove its existence and make assembling the world's shortest movie possible, and even more, with an extremely high resolution."

**More information:** Evidence for top quark production in nucleus-nucleus collisions. *Physical Review Letters*(2020). DOI: [10.1103/PhysRevLett.125.222001](https://doi.org/10.1103/PhysRevLett.125.222001)

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## COVID-19 Research News

mint

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# Roche, Sanofi arthritis drugs reduce death rates among sickest Covid-19 patients

*The findings, which have not yet been peer-reviewed, showed that the immunosuppressive drugs, Actemra and Kevzara, reduced death rates by 8.5 percentage points among patients hospitalised and severely ill with the pandemic disease*

London: Treating critically ill COVID-19 patients with Roche's Actemra or Sanofi's Kevzara arthritis drugs significantly improves survival rates and reduces the amount of time patients need intensive care, study results showed on Thursday.

The findings, which have not yet been peer-reviewed, showed that the immunosuppressive drugs - Actemra, also known as tocilizumab, and Kevzara, also known as sarilumab - reduced death rates by 8.5 percentage points among patients hospitalised and severely ill with the pandemic disease.

That would mean that for every 12 patients treated with one of the two drugs, an extra life would be saved, said Anthony Gordon, an Imperial College London professor of anaesthesia and critical care who co-led the study.

The data will boost confidence that some existing drugs could be repurposed to help with the pandemic that has killed more than 1.87 million people and crushed global economies.

It also comes as countries struggle to contain two variants of the virus found in South Africa and Britain that are more transmissible and have driven a surge in infections.

Drug companies have been scouring their existing portfolios for possible therapies. So far the generic steroid dexamethasone and Gilead's antiviral drug remdesivir have been approved for treating patients with severe symptoms.

The United States has also authorised emergency use of some antibody drugs for non-hospitalised COVID-19 patients.

The data, from around 800 severely ill COVID-19 patients involved in an international study known as the REMAP-CAP trial showed that the two drugs reduced mortality rates from 35.8% in a control group to 27.3% among patients receiving either tocilizumab or sarilumab.

"That's a big change in survival," said Gordon. "They are both lifesaving drugs."



Representational image (AFP)

The results also showed that on average, patients treated with Actemra or Kevzara recovered more swiftly and were able to be discharged from intensive care units around seven to 10 days earlier than those who did not get these drugs, Gordon said.

"This ... could have immediate implications for the sickest patients with COVID-19," he added. "We're seeing the actual benefit in terms of survival and quicker recovery."

Until now, results for Actemra and Kevzara - both a type of drug known as IL-6 receptor antagonists - in treatment trials in patients with COVID-19 have been mixed.

Sanofi said in September that Kevzara - which it produces with partner Regeneron - failed to meet the main goals of a U.S. study testing it in critically ill COVID-19 patients.

In November, Roche said research showed Actemra helped the sickest COVID-19 patients, but it was unclear if it kept people alive or shortened how long they needed intensive care support such as mechanical ventilation, or both.

Gordon noted on Thursday that previous studies had found no clear benefit, but said those trials had included less severely ill patients and started treatment at different stages in the disease course.

"A crucial difference may be that in our study, critically ill patients were enrolled within 24 hours of starting organ support," he said. "This highlights a potential early window for treatment where the sickest patients may gain the most benefit from immune modulation treatment."

Thursday's trial data have not yet been peer-reviewed but were published in online on the medRxiv website.

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