

Nov
2020

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

खंड : 45 अंक : 269 20 नवंबर 2020
Vol.: 45 Issue : 269 20 November 2020



रक्षा विज्ञान पुस्तकालय
Defence Science Library
रक्षा वैज्ञानिक सूचना एवं प्रलेखन केंद्र
Defence Scientific Information & Documentation Centre
मेटकॉफ हाउस, दिल्ली - 110 054
Metcalf House, Delhi - 110 054

CONTENTS

S. No.	TITLE	Page No.
	DRDO News	1-7
	DRDO Technology News	1-7
1.	Despite the pandemic blow, missile scientists held on to the hypersonic dream HSTDV series Part-2	1
2.	DRDO developing indigenous Advanced Self Protection Jammer (ASPJ) Pod for IAF	3
3.	After US Navy, Now India demonstrates capability to shoot-down mid-air targets	4
4.	As LCA Tejas gets ready, Indian Air Force inducts last overhauled Russian-Origin MiG-21 Bison	5
5.	BSF joins staff at Sardar Vallabhbhai Patel hospital to fight raging Covid pandemic in Delhi-NCR	7
	Defence News	8-17
	Defence Strategic National/International	8-17
6.	IAF Chief RKS Bhaduria undertakes sortie in Apache attack helicopter at Western Air Command airbases	8
7.	Southern Naval Command Chief inaugurates Naval Communication Network Centre	9
8.	To lease or buy?: Option to lease military platforms has experts divided	9
9.	Army selects 422 women officers for permanent commission	11
10.	Will continue dialogue through military, diplomatic channels: MEA on Ladakh border standoff with China	12
11.	Why the Chinese are unlikely to disengage anytime soon	13
12.	China's first stealth jet looks an awful lot like the US's first stealth fighter — here's how the J-20 and the F-22 stack up	14
13.	China's Malacca dilemma: How India controls Indian Ocean chokepoints	16
	Science & Technology News	17-25
14.	India's Shukrayaan orbiter to study Venus for over four years, launches in 2024	17
15.	Universal three-dimensional crosslinker for all-photopatterned electronics	19
16.	Researchers describe previously unknown mechanism for inducing electron emission in highly oriented pyrolytic graphite	21
17.	Going beyond the anti-laser may enable long-range wireless power transfer	22
18.	Researchers invent novel vertical-cavity surface-emitting laser	24
	COVID-19 Research News	25-26
19.	Coronavirus Oxford University COVID-19 vaccine 'encouraging' for older age groups: study	25



Fri, 20 Nov 2020

Despite the pandemic blow, missile scientists held on to the hypersonic dream | HSTDV series Part-2

By Anantha Krishnan M

Bengaluru: Over a decade of complex R&D invested in India's Hypersonic Technology Demonstrator Vehicle (HSTDV) helped India develop several critical technologies.

In this part of the Onmanorma series 'HSTDV Story', we take a look at the new technologies developed, the work undertaken and the challenges posed by the recent successful mission.

In the last one decade, missile scientists have made several design changes on HSTDV, mainly in panel separation and cruise vehicle (CV) ejection mechanisms.

A top scientist who is part of the HSTDV mission told Onmanorama that till 2016, the scientists carried out extensive ground testing.

"There were innumerable tests, and we were all excited at the challenges the mission offered. The tests were mainly for the thermo-structural testing of the launch vehicle and cruise vehicle airframes, static and dynamic tests for upper stage panel separation and for cruise vehicle ejection mechanism."



From 2016 to 2020, the flight hardware sections were realized, and the assembly and integration work was carried out.

"The 'one vehicle into another vehicle' concept was successfully attempted in mechanical integration. In the last two years, extensive ground resonance testing was carried out to understand the structural dynamics of the twin vehicle system. Finally, the recent successful flight testing validated our efforts," the scientist said.

Key Technologies

There were several challenging technologies that India needed to master to make the HSTDV mission successful. The key technologies are listed below:

- Aero-propulsion integrated design (with specific emphasis on flow path of the vehicle, hypersonic intake design and aerodynamic design of the cruise vehicle).
- Scramjet engine technology, including scramjet engine flow path, engine attachment and single expansion ramp nozzle, fuel injection strategies, and flame holding schemes.
- Aerothermodynamics design of cruise vehicle (hot structures design with emphasis on thermal stresses).
- Panel separation mechanism in hypersonic regime.
- Twin vehicle (one into another) concept (attachment of cruise vehicle to booster, modal prediction).

- Thermal barrier coating technology

Asked to explain the HSTDV mission in layman's terms, the scientist said that the objective is to demonstrate the free-flying mode of a hypersonic vehicle flight.

“Reach long distances — say 2,000 km in 16 minutes. Or to travel from Bengaluru to Delhi in 16 minutes! The speed is very high for these vehicles. Thrust is produced by burning hydrocarbon fuel in a rectangular duct and expanding the burnt gases through a nozzle to produce thrust,” he added.

Many Lessons

The HSTDV team said that understanding the structural dynamics of airframe was the thin line between failure and success.

We learnt many lessons from the previous test. We relocated certain critical rate sensors, carried out design modifications based on dynamical behaviour of one airframe section and provided adequate support features for the cruise vehicle during the ascent phase. Mere design changes and other minor changes weren't adequate unless we tested them. So, we carried out extensive ground resonance testing of the integrated vehicle to build confidence. This resulted in the success of the mission,” said the Scientist.

Among the key challenges posed by the latest mission, another core team member said that the work the work during Covid-19 pandemic period was unforgettable.

“When the entire world was trying to be safe at home, there was a highly motivated team of DRDO scientists which kept working during the pandemic. A small team of scientists worked tirelessly, bringing lunch boxes and water bottles from home, as there was complete shutdown of canteen facilities in the lab. The great support extended by their families despite of the fear of Covid-19 should be appreciated,” the scientist recalled.

Most scientists with whom Onmanorama interacted said that working in DRDL always gave a homely feeling even during the Covid-19 time, but their biggest fear was travelling to Dr A P J Abdul Kalam Island in Odisha, especially inside the closed hangar.

“We kept working all through the day and at the island as D-day approached. In the last one week (ahead of the September 7 launch), when the final integration work was kicking off, one of the scientists hailing from Uttar Pradesh lost his father. The scientist preferred to stay at the island and completed the integration work. We were all touched by his gesture,” a scientist recalled.

Team Spirit

While the HSTDV team went through the grind, overcoming every hurdle, the DRDO top management ensured that the mission did not lack any kind of support whatsoever.

DRDO Chairman Dr G Satheesh Reddy, who is said to have given a fresh impetus to the mission, constantly reviewed various technological goals of the project.

M S R Prasad, DG (MSS), DRDO and Dr Dasharath Ram, Director, DRDL provided extensive technical support towards solving many technical issues.

B H V S Narayana Murthy, Director, RCI and M R M Babu, Director, ASL monitored the technical activities to ensure the success of the mission.

“The support and encouragement motivated the team. Considering the magnitude of the flight test, the team was well aware that the success of this mission would put India in the forefront of hypersonic technology,” the scientist said.

The present HSTDV team consists of 12 scientists and around 15 technical engineers. The average age of the scientists is around 43 years and of technical engineers, around 28 years.

Interestingly, most of the HSTDV team members are avid sports lovers.

(The writer is an independent aerospace and defence journalist, who blogs at Tarmak007 and tweets @writetake.).

<https://www.onmanorama.com/news/nation/2020/11/19/hstdv-part-2-missile-scientists-hypersonic.html>

DRDO developing indigenous Advanced Self Protection Jammer (ASPJ) Pod for IAF

Here's the brand new Advanced Self Protection Jammer (ASPJ) Pod by DRDO for our fighter jets. The ASPJ contributes to full-dimensional protection by improving individual aircraft probability of survival.

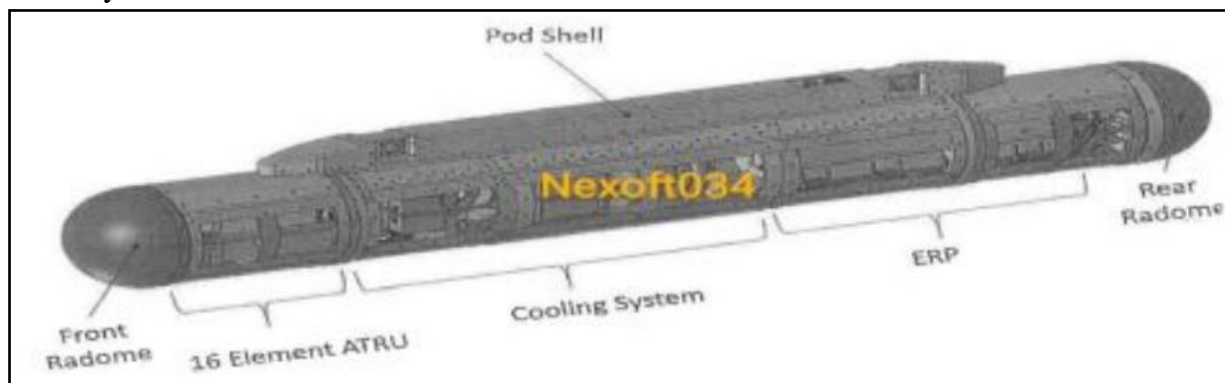


Image Courtesy: NexOfT Alam

Believed to be enabled with Gallium Nitride tech along with Digital Radio Frequency Memory, it shall compliment IAF's EL/L 8222 ASPJ which successfully jammed multiple PAF F16 AMRAAMs during PAF's failed raid after IAF's Balakot airstrike.

DARE had developed the Trap, Trumpet, Tempest, Tusker Pod based jammers which are in use with IAF Mig-27s. They are primarily noise jammers coupled with the Tarang RWR. Being noise jammers they had serious limitations with respect to power consumption, vulnerability to enemy detection, effectiveness against frequency hopping emitters.

The Elta EL/L-8222 Airborne Self Protection Jammer (ASPJ) pods are a standard fit on the SU-30MKI, Jaguar, Mig-21, Mig-27 with the LCA also tested with it. It operates on the Digital Radio Frequency Memory (DRFM) principle where it receives, detects, classifies the signal waveforms, stores them, adds a delay and sends it back to the adversary emitter to be picked up, thereby giving incorrect range data and even azimuth if the scan patterns are known. In comparison with noise jammers they have lower power consumption and are difficult to detect and counter. DRFM jammers severely degrade adversary radars and missile seekers.

<http://www.indiandefensenews.in/2020/11/drdo-developing-indigenous-advanced.html>

After US Navy, Now India demonstrates capability to shoot-down mid-air targets

India's Defence Research and Development Organisation (DRDO) has successfully test-fired a quick-reaction surface-to-air missile (QRSAM) system for the second time in five days.

The QRSAM tracked the aerial target accurately and successfully neutralized it, the defense ministry said in a statement.

The QRSAM shot down an aerial target called 'Banshee', which simulates an aircraft, from the Integrated Test Range at Chandipur off the Odisha coast on Tuesday. A similar test was carried out on 13 November.

Revealing the details, the ministry said, the radars acquired the target from a long-range and tracked it till the mission computer automatically launched the missile. Radar data link continuously provided the guidance.

It stated that the missile entered the terminal active homing guidance and reached the target close enough for proximity operation of warhead activation. Defense Minister Rajnath Singh congratulated DRDO for achieving this feat.

"The flight test was conducted in the deployment configuration of the weapon system consisting of the launcher, fully automated command and control system, surveillance system and multi-function radars," the defense ministry said.

Developed by the DRDO, QRSAM can receive enemy radars. With a strike range of 25 to 30 km, it is capable of destroying aerial targets, tanks, bunkers, and short-range missiles. It is also equipped with electronic countermeasures against jamming by aircraft radars.

The all-weather and all-terrain missile can be mounted on a truck and stored in a canister. The DRDO has carried out a series of weapons tests during the last three months in the wake of the India-China border standoff.

The key tests include the supersonic missile-assisted release of a torpedo (SMART) to target submarines at long ranges, a new version of the nuclear-capable hypersonic Shaurya missile with a range of 750 km, and the anti-radiation missile to take down enemy radars and surveillance systems.

Like the United States, Russia, and China, India is also using technologies to field fast-maneuvering hypersonic missiles that fly at lower altitudes and are extremely hard to track and intercept. The new class of ultra-modern weapons can travel six times faster than the speed of sound (Mach 6) and penetrate any missile defense.

Earlier, as EurAsian Times reported, the US Missile Defense Agency shot down an intercontinental ballistic missile (ICBM) in space for the first time using an interceptor missile fired from a warship in a successful test.

The ICBM target missile launched from a test range in the Marshall Islands was shot down in space by a US destroyer at sea in the Pacific Ocean. This is the first time an ICBM test has been conducted from a sea-based vessel, the ICBM intercept tests were only conducted using ground-based launchers in Alaska and California by the country.

<https://eurasianimes.com/after-us-navy-now-indian-drdo-shoots-down-aerial-target-mid-air-by-surface-to-air-missile/>



Congratulations to @DRDO_India for conducting two successful test trials of Quick Reaction Surface to Air Missile. Via Twitter

As LCA Tejas gets ready, Indian Air Force inducts last overhauled Russian-Origin MiG-21 Bison

By Jayanta Kalita, Ayush Jain

The Indian Air Force on Wednesday received its last overhauled MiG-21 Bison from the state-owned enterprise, Hindustan Aeronautics Limited. The aircraft was handed over in a virtual event adhering to the pandemic guidelines.

This marks the successful completion of the MiG project, and the last airframe numbered CU-2780 was received by Air Marshal Vibhas Pande, Air Officer-in-Charge, Maintenance of the IAF.

The last delivery marks an important milestone for India's MiG-21 replacement efforts. MiG-21 is expected to serve till late 2021 or early 2022 and further in reserve units. The aircraft is expected to be replaced by

India's own Light Combat Aircraft 'Tejas', which is still only in limited series production and HAL is expecting an additional order for 83 aircraft in the Mk-1A configuration.



MiG-21

The MiG-21

The MiG-21, also known as Fishbed, is perhaps one of the most respected fighter jets by aviationists around the world, and the aircraft was the most advanced of its type when it made its first flight in 1955. The Fishbed is also the most produced supersonic fighter aircraft with about 11,500 units manufactured worldwide.

The aircraft was developed following the success gained by producing the venerable MiG-17 and MiG-19 by the erstwhile Soviet Union. It was a time when the Soviets and the Americans were in a race to develop better and more potent aircraft.

The MiG-21 was the first successful Soviet aircraft combining fighter and interceptor characteristics in a single aircraft. It was a lightweight fighter, achieving Mach 2 with a relatively low-powered afterburning turbojet, and is thus comparable to the American Lockheed F-104 Starfighter and Northrop F-5 Freedom Fighter and the French Dassault Mirage III. Earlier, due to the lack of information in the West, the aircraft was often confused with the Sukhoi Su-9.

MiG-21 has been in service with over 60 countries around the world. India was the first major customer for the aircraft, and the deal had a huge importance in securing the Indo-Soviet relations at the time. In 1961, the Indian Government chose the MiG-21 after extensive trials, and three years later in 1964, the aircraft became the first supersonic fighter jet to enter service with the Indian Air Force.

The aircraft saw limited operational deployment in the 1965 India-Pakistan war owing to a dearth of trained pilots. Nevertheless, the defensive sorties conducted during the war became a valuable learning experience for the IAF to develop the tactics and allowed it to mature faster than other countries operating the MiG-21. The positive feedback from IAF pilots during the 1965 war prompted India to place more orders for the fighter jet, and also invest heavily in building the MiG-21's maintenance infrastructure and pilot training programs.

The aircraft's next combat sorties were seen in the 1971 India-Pakistan war (Bangladesh liberation war), which resulted in a humiliating defeat for the latter. The Indian Air Force managed to shoot down four Pakistani F-104As, two PAF Shenyang F-6, one PAF North American F-86 Sabre, and one PAF Lockheed C-130 Hercules. According to one Western military analyst, the MiG-21FLs had clearly "won" the much-anticipated air combat between the MiG-21FL and the F-104A Starfighter.

Because of the performance of India's MiG-21s, several nations, including Iraq, approached India for MiG-21 pilot training. By the early 1970s, more than 120 Iraqi pilots were trained by the Indian Air Force.

The MiG-21 has had its share of controversies as well, especially since the past two decades when the alleged hindrance of aircraft's upgrade programs led to losses of many fighter planes. Compared to the modern digitally controlled fly-by-wire systems, the MiG-21 is older-generation mechanically-controlled and requires a very high-level of pilot experience. Only the veteran pilots are given the command of this supersonic interceptor. This, coupled with the aircraft's age, resulted in the criticism.

During the 1999 Kargil war, one MiG-21 piloted by Sqn. Ldr. Ajay Ahuja was shot down by Pakistani forces using a Stinger MANPADS, when he was trying to trace a crashed IAF aircraft flown by Flt. Lt. K Nachiketa (his MiG-27 suffered engine flameout). While Sqn. Ldr. Ahuja ejected safely within the Indian side of Line of Control, he was later killed by the Pakistani regulars in staunch neglect of the Geneva Conventions.

In the same year, MiG-21s of the Indian Air Force intercepted and shot down a Pakistani Atlantic Maritime Patrol Aircraft in what came to be known as the "Atlantic Incident".

While the development of indigenous Light Combat Aircraft was delayed, the Indian Air Force pushed for the upgrade of the platform, and the current serving MiG-21s in India are highly up-gunned variants and the most advanced MiG-21 types in service globally.

While the MiG-21s are often dubbed 'Flying Coffins' because of a series of accidents over the years, the aircraft's Chinese copy (Chengdu J-7) is itself in service in large numbers with the Pakistan Air Force, which continues to operate many third-generation Mirage-III and Mirage-V fighter jets.

The Indian MiG-21 earned the name 'Falcon Slayers' when, during the famous dogfight on 27 February 2019, the aircraft scored a kill against a much more advanced F-16C operated by the Pakistani Air Force piloted by Wg Cdr Shahaz Ud-Din (who was reportedly lynched by Pakistani villagers mistaking him to be an Indian airman).

However, the Indian Mig-21 was itself shot down in the process by another PAF F-16, piloted by Wg Cdr Nauman Ali Khan. The Indian pilot, Wg. Cdr. Abhinandan Varthaman was taken as a PoW and later released by Pakistan. He was made a national hero by the media.

Currently, about 54 MiG-21s are in active service with the Indian Air Force. The aircraft type, along with the Jaguars, would be replaced by the Light Combat Aircraft 'Tejas', while complementing with the newly-acquired Rafale fighter jets from France.

<https://eurasianimes.com/as-lca-tejas-gets-ready-indian-air-force-inducts-last-overhauled-russian-origin-mig-21-bison/>

BSF joins staff at Sardar Vallabhbhai Patel hospital to fight raging Covid pandemic in Delhi-NCR

The Defence Research and Development Organisation has said that more medical professionals are expected to join from other paramilitary forces in this battle against the pandemic

Key Highlights

- **The DRDO is expected to add 250 ICU beds to the existing 250, in addition to creating 35 BIPAP beds, in the next 3-4 days at its hospital**
- **The Union Home Ministry has constituted 10 multi-disciplinary teams to visit over 100 private hospitals in Delhi and assess bed utilisation and testing capacity**

New Delhi: In order to boost the counter attack against the raging Covid-19 pandemic in the National Capital Region, the Border Security Force on Thursday pressed in additional healthcare staff to Sardar Vallabhbhai Patel Hospital in Delhi.

Making the announcement on social media, the Defence Research and Development Organisation (DRDO) said that more medical professionals are expected to join from other paramilitary forces in this battle against the pandemic.

“In continuing efforts to deal with the surge in Covid cases in Delhi/NCR, 23 doctors and 40 nursing staff from BSF India have joined DRDO’s Sardar Vallabhbhai Patel Covid Hospital and are offering their yeoman service round the clock. More medical professionals are expected to join from other paramilitary forces,” the DRDO said.

The rising coronavirus cases in Delhi have been attributed to the ongoing festive season, non-compliance of Covid-19 safety protocols and rising pollution levels.

A Home Ministry spokesperson had on Wednesday said that 45 doctors and 160 para-medics from paramilitary forces have arrived in Delhi for deployment at a DRDO hospital near the Delhi airport and at a Covid care centre at Chhatarpur.

The DRDO is expected to add 250 beds in intensive care units (ICUs) to the existing 250, in addition to creating 35 BIPAP beds, in the next 3-4 days at its hospital.

The developments have come in the wake of the 12 decisions taken during a high-level meeting chaired by Union Home Minister Amit Shah, along with Delhi Chief Minister Arvind Kejriwal, on Sunday after Delhi saw a fresh spike in Covid-19 cases.

The Union Home Ministry has also constituted 10 multi-disciplinary teams to monitor more than 100 private hospitals in Delhi and assess their bed utilisation, testing capacity and identify extra ICU beds.

Meanwhile, the Indian Railways is also providing additional coaches with 800 beds at the Shakur Basti railway station, while doctors and medics from the paramilitary forces will man the coaches that act as Covid care-cum-isolation facilities.

<https://www.timesnownews.com/delhi/article/bsf-joins-staff-at-sardar-vallabhbhai-patel-hospital-to-fight-raging-covid-pandemic-in-delhi-ncr/684050>



Representational Image

IAF Chief RKS Bhadauria undertakes sortie in Apache attack helicopter at Western Air Command airbases

The Air Chief Marshal undertook visited airbases under the Western Air Command on November 17-18 and interacted with the air squadrons serving at these bases

Key Highlights

- *The last five of the 22 Apache helicopters were handed over to the IAF at the Hindon Air Force Station on July 10*
- *The Apache helicopter is highly equipped for reconnaissance, security, peacekeeping operations, and lethal attack in various environments*

New Delhi: Indian Air Force Chief RKS Bhadauria on Thursday undertook sorties in the newly-inducted Apache attack helicopters during a two-day visit to air bases in the Western part of the country.

The Air Chief Marshal undertook visited airbases under the Western Air Command on November 17-18 and interacted with the air squadrons serving at these bases, apart from flying the sortie with the Apache Squadron.

The Indian Air Force had received the delivery of all new AH-64E Apache and CH-47F(I) Chinook military helicopters on July 10 when the last five of the 22 Apache helicopters were handed over to the IAF at the Hindon Air Force Station.

The Apache helicopter is highly equipped for reconnaissance, security, peacekeeping operations, and lethal attack in various environments and weather conditions.

During the ongoing flare-up between Indian and Chinese forces along the Line of Actual Control, the central government has pressed the Apache attack helicopters, along with the Sukhoi 30 MKI fighter jets, to track the movement of People Liberation Army troops, while the CH-47 Chinook helicopters have been mobilised to provide logistics support to the Indian Army.

Earlier this year in March, Boeing had handed over India the final five of the 15 CH-47F (I) Chinook heavy-lift helicopters to the Air Force.

<https://www.timesnownews.com/india/article/iaf-chief-rks-bhadauria-undertakes-sortie-in-apache-attack-helicopter-at-western-air-command-airbases-pics/683960>



IAF Chief RKS Bhadauria in the Apache attack helicopter. | | Photo Credit: Twitter

Southern Naval Command Chief inaugurates Naval Communication Network Centre

Coimbatore: Vice Admiral A.K. Chawla, Flag Officer Commanding-in-Chief, Southern Naval Command (SNC), inaugurated a new Naval Communication Network Centre at the INS Agrani, the Leadership and Management Training Establishment of the Indian Navy, here on Thursday.

The SNC chief reviewed the training infrastructure of the establishment and received the guard of honour, said an official release. He was on a two-day annual inspection visit to INS Agrani which concluded on Thursday.

During the visit, he interacted with naval personnel, including defence civilian employees, and highlighted the important role played by the unit in imparting leadership and management skills to the under-trainees, the release said.

Sapana Chawla, president of Navy Wives Welfare Association, Southern Region, who accompanied the Vice Admiral, inaugurated the newly constructed multi-purpose audio-visual room-cum-computer lab at the Navy Children School, Coimbatore.

She also inaugurated the Single Officers' in-living accommodation at the Naval Officers Mess, Agrani, and interacted with the women of the establishment, said the release.

<https://www.thehindu.com/news/cities/Coimbatore/southern-naval-command-chief-inaugurates-naval-communication-network-centre/article33136387.ece>



Vice Admiral A.K. Chawla, Flag Officer Commanding-in-Chief, Southern Naval Command, receiving the guard of honour at INS Agrani, Coimbatore, on Thursday.

THEWEEK

To lease or buy?: Option to lease military platforms has experts divided

IAF and Navy are in the process of getting multiple platforms on lease

By Pradip R Sagar

Amidst the debate of prioritising its requirements due to budgetary constraints, the ministry of defence, in March, had given the go-ahead to armed forces to procure military platforms on rent from friendly countries.

Since then, both Indian Air Force and Navy are in the process of finalising multiple platforms that can be procured on lease till indigenous platforms under development are inducted into service. The Army, however, is yet to look into this option.

However, some experts believe that the option to lease has always turned out to be a costly affair compared to outright purchase. While addressing the annual presser last month, IAF Chief Air Chief Marshal R.K.S. Bhaduria had said the Air Force could acquire midair refuellers on lease under the government's new leasing policy. He, however, clarified that

"leasing" has got nothing to do with budgetary constraints, but is an evolution of the defence acquisition processes and procedures. "It will give the service some flexibility. IAF has been trying to acquire its critical need of mid-air refuellers for long time," he added.

Apart from refueller aircraft, the IAF is looking at leasing its trainer aircraft and even the Light Utility Helicopters (LUH) for short duration.

While unveiling the Draft Defence Procurement Procedure 2020 (DPP-2020), Defence Minister Rajnath Singh had introduced the "lease" category that gives flexibility to military to procure equipment on rent instead of buying it from the Original Equipment Manufacturer (OEM). Platforms like transport fleet, trainers, simulators and machinery required for search and rescue missions have, so far, been permitted to be procured on lease.



On Wednesday, Deputy Chief of IAF Air Marshal Sandeep Singh, in a webinar organised by Federation of Indian Chambers of Commerce and Industry (FICCI), confirmed that the IAF is in the process of sending out Request for Information (RFI) for leasing trainer aircraft for a relatively short period. HTT- 40 trainer jets are being developed by the HAL, as trainer fleet of Kiran jets have crossed their age. Air Marshal Singh added that trainer jets can be procured for four-five years till HAL completes its final trials of HTT-40 jets.

At the same event, Vice Chief of Navy Vice Admiral Ashok Kumar said that to meet its critical requirement, the Navy can also go for leasing of operational support assets and auxiliaries. This is done to avoid huge investments in manning and maintaining them. The Indian Navy operates a Russian nuclear-powered attack submarine on lease, Chakra. Efforts are on to get another nuke powered submarine, as India signed a \$3 billion deal with Russia last year. It is expected to come by 2025.

Speaking in favour of leasing option, a defence ministry official maintained that "Leasing provides means to possess and operate the asset without owning and is useful to substitute huge initial capital outlays with periodical rental payments." He added that the lease option would not only be useful in gaining experience for operational exploitation of an equipment, but also a better option compared to a one-time acquisition cost.

However, the finance division of ministry of defence believes there is lots to be done. Some feel that before going in for the lease option, cost benefit analysis—a detailed evaluation of the benefits and costs of leasing versus an outright purchase—has to be done.

Countering the argument of faster process of acquisition through leasing route, Gargi Kaul, who retired as secretary, defence finance, last month, pointed out that the leasing route follows the similar process of usual acquisition. "DPP 2020 states even in leasing option, process like going through the acceptance of necessity (AON), request for information (RFI) etc., which is similar to the regular acquisition process," Kaul said, and added that it is still unclear whether the armed forces will get brand new equipment or old ones in the leasing option.

Kaul emphasised that leasing always turns out to be more expensive than outright purchase if we include maintenance and insurance clause. She felt that the lease option should be considered for high-end costly military platforms, and not transport aircraft or vehicles. "With my experience, I can say that net purchase price is always cheaper than a lease," Kaul said, while adding that she is apprehensive about an Original Equipment Manufacturer (OEM) will agree to lease option.

Kaul had reservations over leasing companies coming to India, as she felt that there are no incentives for leasing firms. "It will not be viable for a leasing company to come in without any incentive. This is a major issue that needs to be addressed."

<https://www.theweek.in/news/india/2020/11/19/to-lease-or-buy-thats-the-question-option-to-lease-military-platforms-has-experts-divided.html>

Army selects 422 women officers for permanent commission

According to the results of the selection board, 57 women officers who were found fit for permanent commission have opted not to take it. Sixty-eight women officers who have not been granted permanent commission will now be released from service with pension

By Man Aman Singh Chhina

Out of the 615 women officers considered for permanent commission in the Army, 422 have been found fit, according to results of a special selection board released by the Army on Thursday.

The Army had constituted Number 5 Selection Board, whose proceedings were held from September 14 to 25, to screen short service commissioned women officers for permanent commission. This was done following an order of the Supreme Court in February, which directed the Army to induct all eligible women short service commissioned officers in permanent commission.

The five-member board included a woman Brigadier from the Army Medical Corps.

According to the results of the selection board, 57 women officers who were found fit for permanent commission have opted not to take it. Sixty-eight women officers who have not been granted permanent commission will now be released from service with pension.

A total of 106 officers who have not been recommended for permanent commission will be allowed to serve till 20 years of service to earn a pension and then released from service.

A total of 42 officers have had their candidature postponed because they are in a temporary low medical category and have been given time. The result of six officers has been withheld due to non-receipt of requisite medical documents while the result of 40 officers has been withheld on administrative grounds.

There are also a number of women officers who have not been granted permanent commission and will be released from service in the near future after completing the terms of their engagement under short service commission.

The women officers who have been selected for permanent commission belong to branches such as Engineers, Signals, Intelligence Corps, Army Air Defence, Army Aviation Corps, Army Ordnance Corps, Army Service Corps and Corps of Electronics and Mechanical Engineering. There are approximately 1,653 women officers serving in the Army currently out of a total of nearly 43,000 officers.

With permanent commission being granted to women officers in these branches, they would now be eligible for promotion to higher ranks. However, there is still ambiguity on whether they will be offered commands of units and regiments as many who are senior in age and service have not been able to do essential courses as they were not open to them as short service commissioned officers.

Induction of women officers started in the Army in 1992 in select non-combat branches. In 2008, the then government extended permanent commission to women officers in the Judge Advocate General's Branch and Army Education Corps.



The Army had constituted Number 5 Selection Board, whose proceedings were held from September 14 to 25, to screen short service commissioned women officers for permanent commission.

In 2010, the Delhi High Court awarded permanent commission to women officers in all branches in which they were serving at the time. The government appealed against this verdict in the Supreme Court, which finally upheld the High Court order in February this year.

The present government extended permanent commission to women officers in March 2019 but this offer was not implemented retrospectively.

<https://indianexpress.com/article/india/army-selects-422-women-officers-for-permanent-commission-7057855/>



Fri, 20 Nov 2020

Will continue dialogue through military, diplomatic channels: MEA on Ladakh border standoff with China

At an online media briefing, he also recalled the eighth round of talks between senior military commanders of India and China in Chushul on November 6

New Delhi: India on Thursday said it will continue dialogue and communication through military and diplomatic channels with China on the border standoff in eastern Ladakh and that both sides have agreed to hold another round of talks soon.

External Affairs Ministry Spokesperson Anurag Srivastava while referring to the ongoing military talks between the two countries also rejected as "baseless" a report in a British daily 'The Times', which quoted a Chinese professor to claim that the Chinese PLA had used "microwave weapons" to force Indian soldiers to leave positions in eastern Ladakh.

He said the objective of the military talks is to ensure complete disengagement and full restoration of peace and tranquillity along the Line of Actual Control (LAC) in the western sector.

At an online media briefing, he also recalled the eighth round of talks between senior military commanders of India and China in Chushul on November 6.

These discussions were candid, in-depth and constructive and both sides exchanged views on disengagement at all friction points along the LAC in the western sector of the India-China border areas, he said "The objective of these discussions is to ensure complete disengagement and full restoration of peace and tranquillity along the LAC in the western sector.

"We will continue our dialogue and communication through military and diplomatic channels and have also agreed to have another round of talks soon with a view to achieve this objective," the spokesperson said. Nearly 50,000 Indian Army troops are currently deployed in a high state of combat readiness in various mountainous locations in eastern Ladakh in sub-zero conditions as multiple rounds of talks between the two sides have not yielded any concrete outcome yet to resolve the military standoff that erupted in early May. China has also deployed an equal number of troops, according to officials.

Asked about the report relating to the People's Liberation Army (PLA) in the British daily, Srivastava said: "I think you would have seen the response from the Army Spokesperson who has conveyed that these reports are not true and they are completely baseless."

<https://www.newindianexpress.com/nation/2020/nov/19/will-continue-dialogue-through-military-diplomatic-channels-mea-on-ladakh-border-standoff-with-chi-2225524.html>



Image of an Indian Army soldier used for representational purposes (Photo | PTI)

Why the Chinese are unlikely to disengage anytime soon

By Vicky Nanjappa

New Delhi: There is every indication that China is readying for a long haul along the Line of Actual Control (LAC).

While talk between the two military commanders is expected to take soon, there appears to be no change in China's position at the border. The manner in which the Chinese PLA is sending in reinforcements, it does not appear that the standoff is going to die down anytime soon.

Officials tell OneIndia that China continues to build up its troops and is adding infrastructure at the border to keep up the pressure with India even as the two sides continue dialogue on disengagement and de-escalation.

Further, the Indian side has noticed that the Chinese PLA is undertaking road construction for faster deployment on the LAC. This is being done to focus on the DBO sector as well as the Depsang Bulge area.

Further, there are containers, each accommodating six PLA soldiers. Apart from this new hospital facilities have come up in the depth areas. This has been done to cater to those soldiers who are suffering from altitude sickness.

India is well aware that it needs to be prepared for a long haul. However, it is also important that the two sides keep talking so that there is no accident at the border, which could lead to further escalation.

The Indian Army on the other hand worked at a record speed to set up the heated shelters, arctic tents and bunkers. It also acquired specialised winter clothing, gear and other essential supplies for the over 50,000 troops deployed at the friction points along the Line of Actual Control.

Officials say that this was crucial as the temperatures have already dipped to minus 20 degree Celsius. The official said that the Indian Army has been prepping for this situation for long.

This is going to be a test of endurance and the situation along the LAC remains tense, but under control. The official cited above said that the Indian Army is ready for the long winter ahead. It would be a test of endurance, the source said while adding that India has the advantage as it has been sitting on the glaciated heights of the Salto ridge since 1984.

On the other hand India had rushed heavy tanks heavy weaponry, ammunition, fuel, food and essential winter supplies to high-altitude areas in eastern Ladakh to maintain its combat readiness through the treacherous winter of around four months, military sources said.

<https://www.oneindia.com/india/why-the-chinese-are-unlikely-to-disengage-anytime-soon-3178522.html>



Representational Image

China's first stealth jet looks an awful lot like the US's first stealth fighter — here's how the J-20 and the F-22 stack up

By Benjamin Brimelow

- *A high-profile part of China's ongoing military modernization is the J-20, the country's first stealth fighter jet.*
- *The J-20, likely based on stolen US designs, looks a lot like the US Air Force's F-22, but appearance isn't the only similarity between the two fifth-generation fighters.*

Aside from China's aircraft carriers and ballistic-missile programs, no weapon system has captured as much attention as the J-20 Mighty Dragon, China's first stealth fighter.

The aircraft is the world's third operational fifth-generation stealth fighter, the only one in official service that wasn't designed by the US or its allies.

Two J-20s were seen at a Chinese air base near the Indian border after tensions between the two countries spiked, rumors of a twin-seat variant under development have spread on social media,



and last month, two J-20s were shown conducting a fighter drill in footage released by Chinese state media.

Chinese J-20s, left, and an F-22 Raptor. AP Photo/Kin Cheung, REUTERS/Peter Nicholls

Conventional wisdom holds that the J-20 is currently unable to face the US Air Force's F-22 in a straight-up dogfight. But the J-20, and China's stealth program overall, is young, and may very well be maturing.

J-20 vs. F-22

The J-20's development began in earnest after the F-22 was unveiled. Its exact specifications are not known, but it is believed to be capable of a maximum speed close to Mach 2 (1,535mph), a ceiling around 60,000 feet, and a range of almost 700 miles.

The jet, likely based on stolen plans from the American stealth program, made its first test flight in 2011 and entered official service in 2017. It is estimated that 50 to 60 J-20s are in service with an unknown number under construction.

A large internal weapons bay is capable of carrying at least four long-range air-to-air missiles, while two more lateral bays can each hold a single shorter-range missile. The Chinese have also experimented with external hardpoints that enable the J-20 to carry an additional four missiles.

The F-22 Raptor, first flown in 1997 and adopted in 2005, has a main internal weapons bay that can carry six long-range air-to-air missiles, and two lateral bays with single shorter-range missiles. Four external hardpoints allow it to carry more missiles, and it has a 20-mm rotary cannon for close-range combat. There is broad consensus that the F-22 would win a dogfight with a J-20. Its higher speed, operational ceiling, superior stealth technology, and more experienced pilots give it an edge over the J-20. But that advantage may soon slip away.

"There are numerous factors that are in China's favor as time goes on," Timothy Heath, a senior defense researcher at the Rand Corporation, told Insider

A development gap

Much of the F-22's advantage is based on something that China has always had difficulty with: high-end engines.

China's first attempts at an engine for the J-20 were so bad that they had to use Russian Saturn AL-31 engines for the first production models. Later variants would use the domestically made WS-10, but it is still considered underpowered and unreliable.

But unlike the F-22, which ceased production in 2011, the J-20 program is ongoing — meaning it is constantly undergoing changes and refits.

"China continues to refine and improve on the aircraft as the manufacturing goes on," Heath said. "They'll learn lessons and they can tweak and modify their aircraft, whereas in the US that's obviously much harder to do with all the factories shuttered."

This means that future J-20s will likely close the gap with the F-22.

The Chinese are developing a new engine, the WS-15, which will be significantly more powerful. In the meantime, they have fitted their latest model, the J-20B, with newer Russian-made engines capable of thrust-vectoring, which the WS-15 will also have — an advantage the F-22 will no longer enjoy over the J-20.

The development gap extends to armaments as well.

The J-20's long-range missile, the PL-15, has a range over 200 km and can reach speeds up to Mach 4, outclassing its US counterpart, the AIM-120, which is believed to have a 160 km range.

China is also developing a newer missile that will supposedly have a 300 km range.

A different focus, a different mission

The development gap is due largely to US's focus on fighting insurgencies instead of state actors. "We took our foot of the gas for too long because of Iraq and Afghanistan," Douglas Birkey, executive director for the Mitchell Institute for Aerospace Power Studies, told Insider.

As a result, Birkey added, "you have fifth-generation aircraft hauling third-generation missiles, and that gap has got to close."

In contrast, China — having seen the destruction US airpower wrought in Yugoslavia, Iraq, and Afghanistan — focused its efforts on creating systems capable of taking on US forces. "That was the baseline threat that they organized everything against," Birkey said.

The J-20 is not designed or intended to fight a dogfight in the traditional sense — it doesn't even have a cannon for close-range combat. Rather, it is intended to engage hostile aircraft from very long range with missiles.

"It's almost like an aerial sniper," Heath said. "Instead of two fighters punching each other, these aircraft are designed to fire from very long range, largely launching while undetected."

They are also meant to be integrated into a larger system in which information is passed among aircraft, enabling the J-20 to engage enemies detected by other platforms, like friendly aircraft or ground and naval radars.

Its likely targets would be enemy fighters already engaged in dogfights with other Chinese fighters, unguarded bombers, or support assets like aerial refueling tankers, AWACS and JSTARS command and control aircraft, and surveillance drones.

The F-22 is designed to fight in a similar way.

"Any fifth-generation aircraft is not meant to get into a classic dogfight scenario," Birkey said. "They are supposed to understand the threat environment ahead of the curve, going into it sufficiently such that they can take care of business, get a long-range shot, and get out of there."

Keeping the advantage

Despite the development gap, the US is committing to keeping its advantage.

In addition to updating the AIM-120, a new long-range missile, the AIM-260, is in development. Although production may have ceased, the F-22 is still getting hardware and software upgrades.

Moreover, the F-22 will likely never go into battle alone. It will likely be accompanied by Air Force F-15s and F-16s, Navy F/A-18s, and, of course, the F-35 — the newest stealth fighter, variants of which are in service with the Air Force, Navy, and Marine Corps. "It's good to try to imagine teams of stealth and non-stealth working together with other platforms to try and outmaneuver and defeat the enemy," Heath said.

The US has also "built and flown" a prototype sixth-generation fighter, part of the Next Generation Air Dominance program, years ahead of schedule.

US Air Force pilots and aircraft also have far more experience. US pilots log 50% more flight hours every year on average than Chinese pilots, and the F-22 has actually operated in active war zones.

But China is just as committed. It is developing a lighter stealth fighter, the FC-31, and unlike the US, China's leaders are not as constrained by domestic politics or questions about funding.

"They can develop technology cheaper. They can steal from about anybody with impunity, and they've got mass advantage that we don't have," Birkey said.

China's larger industrial capability, combined with its commitment to become a dominant military power and the US focus elsewhere, may seriously change the calculus going forward.

"We've got to make up for 20 years of taking our eye off the ball," Birkey said. "That was a really bad mistake."

<https://www.businessinsider.in/international/news/chinas-first-stealth-jet-looks-an-awful-lot-like-the-uss-first-stealth-fighter-heres-how-the-j-20-and-the-f-22-stack-up/articleshow/79312691.cms>



Fri, 20 Nov 2020

China's Malacca dilemma: How India controls Indian Ocean chokepoints

Story Highlights

In June, reports hinted at chances of the United States moving its carrier USS Theodore Roosevelt into the Malacca Straits area in a show of support for India.

New Delhi: India has naval capabilities near the Indian Ocean chokepoints especially around the Malacca Strait which connects the Indian Ocean to the Western Pacific, these waters hold a lot of importance for China since it is a crucial route for energy and trade.

India had threatened a naval blockade of Pakistan previously during the 1971 war. New Delhi has never issued any such threat against Beijing. The Indian navy was reportedly placed on high alert following the Galwan Valley clash.

However, there was no official word on whether the Indian Navy was considering a blockade on Chinese shipping or whether it was considering interdicting Chinese tankers near the Andaman and Nicobar islands, or perhaps looking at diverting shipping traffic to and from China.



Vessels from the US Navy, Indian Navy, Japan Maritime Self-Defense Force and the Philippine Navy sail in formation at sea Photograph:(Reuters)

In June, reports hinted at chances of the United States moving its carrier USS Theodore Roosevelt into the Malacca Straits area in a show of support for India. In the same month, the

Global Times was singing praises about China responding by carrying out Naval drills in the South China Sea.

China knows that it is on the backfoot in the Indian Ocean. Beijing knows that Malacca dilemma. India is in a position where it can monitor the traffic at the Malacca Straits or the Lombok and Sunda straits. It can put pressure on the movement of merchant ships while traffic in the high seas that is waters beyond 12 nautical miles from the coast cannot be impeded. This rule will not apply in the event of a war.

China's disadvantage in high seas becomes all the more grave in the South China Sea where China is fighting six countries. Eighty per cent of China's oil imports come through the Malacca Strait. It is also the route for a considerable amount of Chinese trade.

India has been strengthening its maritime cooperation with the Quad countries. In September for the first time, an American P-8 Poseidon long-range maritime patrol aircraft refuelled at an Indian base in the Andaman and Nicobar islands.

In October, New Delhi and Washington signed an agreement to expand military satellite information sharing. India is also planning to strengthen its maritime infrastructure. A deepwater port is being built on the great Nicobar Island for \$1.3 billion.

It is not for nothing that India is working towards building these naval capacities.

<https://www.wionews.com/india-news/chinas-malacca-dilemma-how-india-controls-indian-ocean-chokepoints-344178>

Science & Technology News

SPACENEWS

Fri, 20 Nov 2020

India's Shukrayaan orbiter to study Venus for over four years, launches in 2024

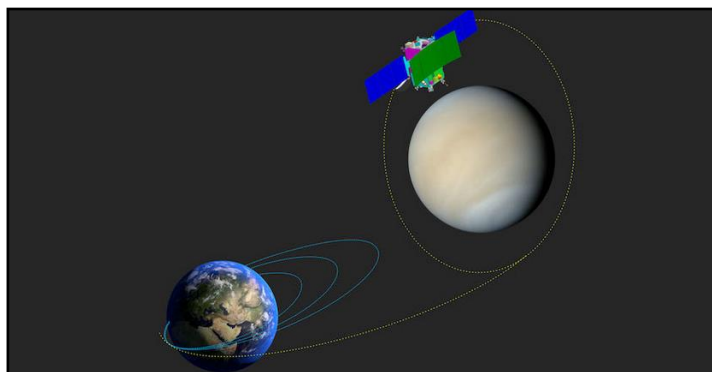
By Jatan Mehta

- **Shukrayaan will be the first mission to map Venus' subsurface**

MUMBAI, India — India's space agency aims to launch its Venus orbiter Shukrayaan in late 2024, more than a year later than previously planned, an ISRO research scientist told a NASA-chartered planetary science planning committee Nov. 10.

T. Maria Antonita of the Indian Space Research Organisation (ISRO) detailed the status of the mission to scientists drafting a new 10-year plan for NASA's planetary science program. Shukrayaan will be India's first mission to Venus and will study the planet for more than four years.

ISRO was aiming for a mid-2023 launch when it released its call for instruments in 2018, but Antonita told members of the National Academies' decadal survey planning committee last week that pandemic-related delays have pushed Shukrayaan's target launch date to December 2024 with a mid-2026 backup date (optimal launch windows for reaching Venus occur roughly 19 months apart).



A not-to-scale representation of ISRO's Venus orbiter mission Shukrayaan. Credit: ISRO

Antonita said Shukrayaan is currently slated to launch on India's GSLV Mk II rocket. However, she said the team is also evaluating the possible use of the more powerful GSLV Mk III rocket, which would allow Shukrayaan to carry more instruments or fuel. A launch vehicle decision, she said, is expected by the time ISRO freezes the mission's configuration and final set of instruments in the next three to six months.

In its current configuration, the orbiter weighs about 2,500 kilograms and will carry a science payload consisting of a synthetic aperture radar and other instruments.

Once launched, Shukrayaan is expected to take a few months to reach Venus, where it will enter a highly elliptical orbit of 500 by 60,000 kilometers around the planet. Over the following year, it will use aerobraking to lower its orbit to 200 by 600 kilometers. This polar orbit will be the final one used for scientific observations.

The mission's primary science objectives are to map Venus' surface and subsurface while studying the planet's atmospheric chemistry and interaction with the solar wind.

Shukrayaan's flagship instrument is an improved version of the dual frequency synthetic aperture radar (SAR) India's Space Applications Centre built for the Chandrayaan-2 spacecraft currently orbiting the Moon. Antonita said Shukrayaan's SAR payload will have up to four times the resolution of NASA's Magellan orbiter, a Venus mapper launched in 1989. Notably, Shukrayaan will also carry a ground penetrating radar, making it the first to map Venus' subsurface. These observations would help scientists better understand Venus' geology and evolution.

Roughly 100 kilograms of Shukrayaan's 2.5-ton mass is set aside for scientific instruments, according to the call for instrument proposals ISRO issued two years ago soliciting payloads from India and abroad. The open call for instruments marks a return to the approach ISRO took with Chandrayaan-1, the lunar orbiter it launched in 2008 carrying six instruments from countries other than India. The 2013 Mangalyaan Mars orbiter and 2019's Chandrayaan-2 lunar orbiter and lander, in contrast, carry only Indian instruments.

Of the proposals, 20 candidate instruments have been shortlisted but the session didn't mention which ones. Antonita did say that Russia, France, Sweden and Germany will have instruments onboard. The French space agency CNES announced in September that the Venus Infrared Atmospheric Gases Linker, or VIRAL, instrument it codeveloped with Russia's space agency will fly on Shukrayaan.

In addition to its flagship radar, Shukrayaan will also carry an instrument suite capable of spectroscopic observations in infrared, ultraviolet and submillimeter wavelengths to study Venus' atmosphere, according to Antonita's slides. The possible detection of phosphine in Venus' upper atmosphere excited many people about the prospects of life there, although some scientists are still skeptical. According to Antonita, the presence of phosphine and other biomarkers in Venus' upper atmosphere could be confirmed using the orbiter's Near Infrared Spectrometer. The instrument will also be used to detect and locate any active volcanism on Venus.

Only three spacecraft have orbited Venus in the past 30 years, but space agencies around the world are showing renewed interest in the second planet from the sun. NASA selected two Venus missions earlier this year for further consideration for launch opportunities in 2025 and 2028. The European Space Agency is considering a Venus orbiter mission called EnVision that would launch by the 2030s. And Russia is working on a Venus orbiter and lander mission concept called Venera-D that would launch no earlier than 2023.

<https://spacenews.com/indias-shukrayaan-orbiter-to-study-venus-for-over-four-years-launches-in-2024/>

Universal three-dimensional crosslinker for all-photopatterned electronics

A research team, affiliated with South Korea's Ulsan National Institute of Science and Technology (UNIST) has succeeded in fabricating highly integrated arrays of PTFTs and logic gates via all-solution processing.

A technology to lower the production cost of electronic devices, such as large-area OLEDs that make large TVs has been developed. Instead of expensive vacuum equipment, this technique uses a series of solution processes for the production of electronic devices.

A research team, jointly led by Professor BongSoo Kim in the

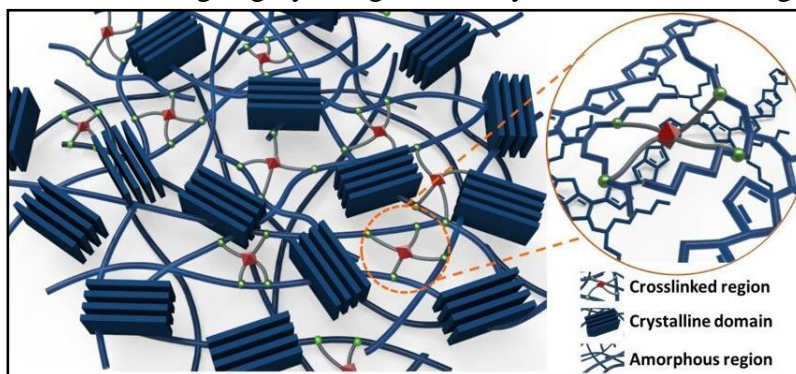


Figure 1. Schematic illustration of a semiconducting polymer in its crosslinked state. Credit: Professor BongSoo Kim, UNIST

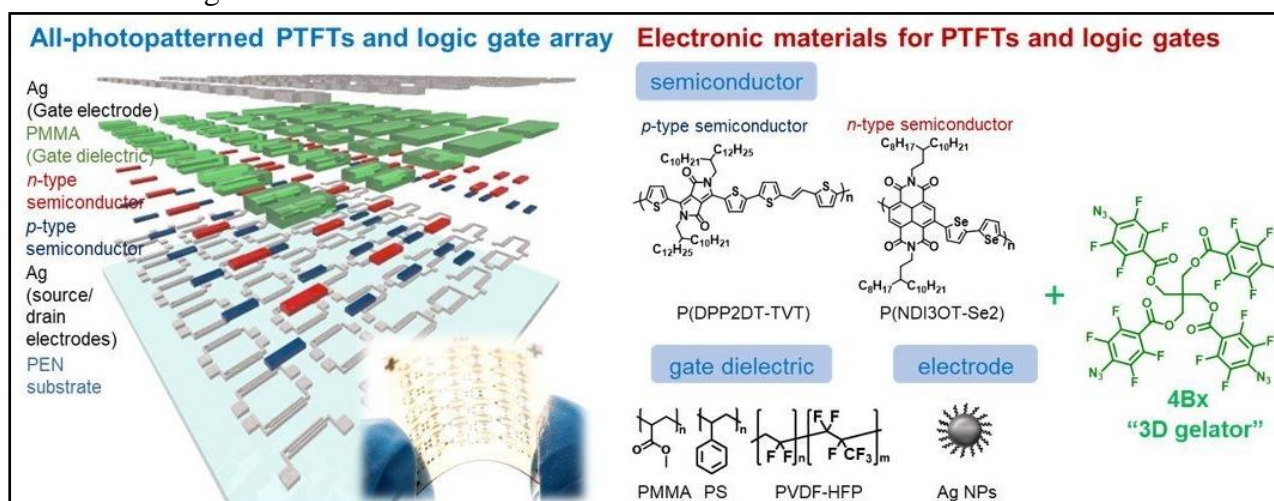


Figure 2. All-solution-processed, all-photopatterned PTFTs and logic circuits. (Left) A Schematic drawing and photographic image of all-photopatterned PTFTs and logic circuits fabricated on a plastic substrate by patterning of semiconducting channel, gate dielectric, and electrode materials. (Right) Chemical structures of electronic materials used in this study. Credit: Professor BongSoo Kim, UNIST

School of Natural Science, Professor Jeong Ho Cho from Yonsei University, Professor Moon Sung Kang from Sogang University has succeeded in fabricating highly integrated arrays of polymer thin-film transistors and logic gates entirely via all-solution processing technique. The key to this technique is that it uses a highly efficient crosslinking agent that does not yield degradation in the electrical properties of the host materials.

Solution processing technique refers to a fabrication method whereby the materials are dissolved in a variety of solvents, and then they can be coated by spin coating for lab-sized experiments or inkjet printing. Such technique is less expensive than vacuum equipment, yet the disadvantage is that there is the possibility for material damage. In general, the manufacturing process of electronic devices requires stacking of various electronic component layers.

And this may increase the risk of material damage, especially when stacking the layers on top of each other by series of solution processing steps. Besides, the heat produced from removing solvents may induce the denaturation of the host materials, which is a major obstacle in realizing all-solution-processed electronic devices.

The research team solved such issues, using a three-dimensional crosslinker in tetrahedral geometry containing four photocrosslinkable azide moieties, referred to as 4Bx. This crosslinking agent links the different types of electronic materials (i.e., polymer semiconductors, polymer insulators, and metal nanoparticles), and thus holding them firmly together, like a bridge. Because the crosslinked electronic component layers are strongly resistant to chemical solvents, micropatterning the layers at high resolution as well as stacking the layers on top of each other by series of solution processing steps is possible.

"Crosslinking agents are electrically non-conductive, and therefore the addition of a large amount of a crosslinking agent leads to a morphological change in the film and deterioration in the electrical and optoelectronic properties of the material," says Professor Kim. "However, the new crosslinker can be applied to the patterning process of various solution-processable materials with use of a very low amount is thus highly desirable. Using a very small amount of 4Bx, the research team has succeeded in fabricating highly integrated arrays of polymer thin-film transistors (PTFTs) and logic circuits via all-solution processing. The results show that the PTFTs based on photocrosslinked polymer films show equivalent performance and better stability compared with those prepared using polymer films without the crosslinker. "Overall, this work demonstrates an effective route to all-solution-processed organic electronic devices based on a single fabrication protocol," says Professor Kim.

The findings of this research have been published in the online version of *Nature Communications*.

More information: Min Je Kim et al. Universal three-dimensional crosslinker for all-photopatterned electronics, *Nature Communications* (2020). DOI: 10.1038/s41467-020-15181-4

Journal information: *Nature Communications*
<https://phys.org/news/2020-11-universal-three-dimensional-crosslinker-all-photopatterned-electronics.html>

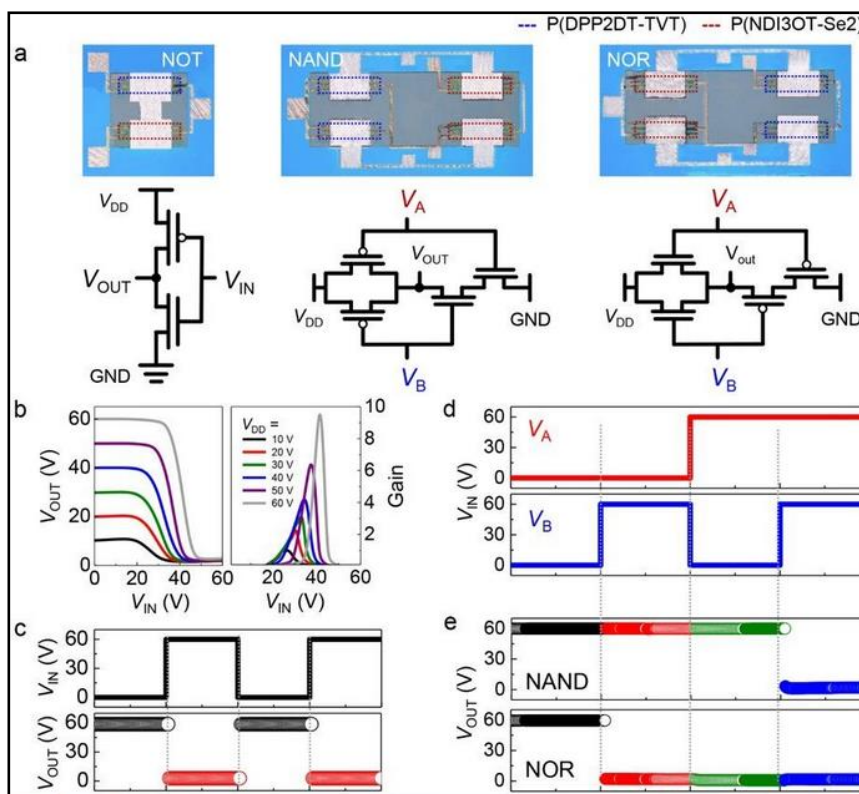


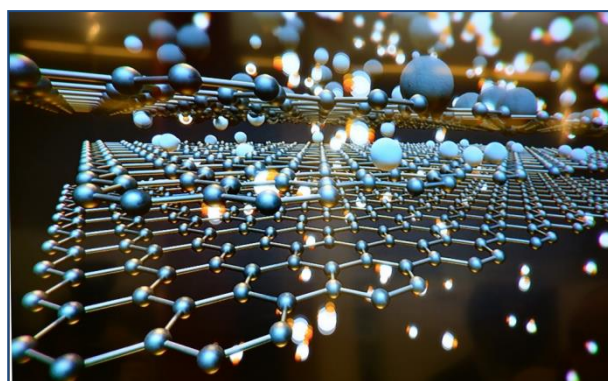
Figure 3. Electrical characteristics of all-photopatterned logic circuits. Credit: Professor BongSoo Kim, UNIST

Researchers describe previously unknown mechanism for inducing electron emission in highly oriented pyrolytic graphite

It is something quite common in physics: Electrons leave a certain material, fly away and are then measured. Some materials emit electrons when they are irradiated with light. These electrons are called photoelectrons. In materials research, so-called Auger electrons also play an important role—they can be emitted by atoms if an electron is first removed from one of the inner electron shells. But now scientists at TU Wien (Vienna) have succeeded in explaining a completely different type of electron emission that can occur in carbon materials such as graphite. This electron emission type has been known for about 50 years, but its cause was previously unclear.

Strange electrons without explanation

"Many researchers have already wondered about this," says Prof. Wolfgang Werner from the Institute of Applied Physics. "There are materials, which consist of atomic layers that are held together only by weak Van der Waals forces, for example graphite. And it was discovered that this type of graphite emits very specific electrons that all have exactly the same energy, namely 3.7 electron volts."



Credit: CC0 Public Domain

Researchers have been unable to find a physical mechanism to explain this electron emission. But at least the measured energy gave an indication of where to look: "If these atomically thin layers lie on top of each other, a certain electron state can form in between," says Wolfgang Werner. "You can imagine it as an electron that is continuously reflected back and forth between the two layers until at some point it penetrates the layer and escapes to the outside."

The energy of these states actually fits well with the observed data—so people assumed that there is some connection, but that alone was no explanation. "The electrons in these states should not actually reach the detector," says Dr. Alessandra Bellissimo, one of the authors of the current publication. "In the language of quantum physics one would say: The transition probability is just too low."

Skipping cords and symmetry

To change this, the internal symmetry of the electron states must be broken. "You can imagine this like rope skipping," says Wolfgang Werner. "Two children hold a long rope and move the end points. Actually, both create a wave that would normally propagate from one side of the rope to the other. But if the system is symmetrical and both children behave the same way, then the rope just moves up and down. The wave maximum always remains at the same place. We don't see any wave movement to the left or right, this is called a standing wave." But if the symmetry is broken because, for example, one of the children moves backwards, the situation is different—then the dynamics of the rope changes and the maximum position of the oscillation moves.

Such symmetry breaks can also occur in the material. Electrons leave their place and start moving, leaving a "hole" behind. Such electron-hole pairs disturb the symmetry of the material, and thus the electrons can suddenly exhibit the properties of two different states simultaneously. In this way, two advantages can be combined: On the one hand, there is a large number of such electrons, and on the other hand, their probability of reaching the detector is sufficiently high. In a

perfectly symmetrical system, only one or the other would be possible. According to quantum mechanics, they can do both at the same time, because the symmetry refraction causes the two states to "merge" (hybridize).

"In a sense, it is teamwork between the electrons reflected back and forth between two layers of the material and the symmetry-breaking electrons," says Prof. Florian Libisch from the Institute of Theoretical Physics. "Only when you look at them together can you explain that the material emits electrons of exactly this energy of 3.7 electron volts."

Carbon materials such as the type of graphite analyzed in this research work play a major role today—for example, the 2-D material graphene, but also carbon nanotubes of tiny diameter, which also have remarkable properties. "The effect should occur in very different materials—wherever thin layers are held together by weak Van der Waals forces," says Wolfgang Werner. "In all these materials, this very special type of electron emission, which we can now explain for the first time, should play an important role."

More information: Wolfgang S. M. Werner et al. Secondary Electron Emission by Plasmon-Induced Symmetry Breaking in Highly Oriented Pyrolytic Graphite, *Physical Review Letters* (2020). [DOI: 10.1103/PhysRevLett.125.196603](https://doi.org/10.1103/PhysRevLett.125.196603)

Journal information: [Physical Review Letters](https://phys.org/news/2020-11-previously-unknown-mechanism-electron-emission.html)
<https://phys.org/news/2020-11-previously-unknown-mechanism-electron-emission.html>



Fri, 20 Nov 2020

Going beyond the anti-laser may enable long-range wireless power transfer

By Dina Genkina

Ever since Nikola Tesla spewed electricity in all directions with his coil back in 1891, scientists have been thinking up ways to send electrical power through the air. The dream is to charge your phone or laptop, or maybe even a healthcare device such as a pacemaker, without the need for wires and plugs. The tricky bit is getting the electricity to find its intended target, and getting that target to absorb the electricity instead of just reflect it back into the air—all preferably without endangering anyone along the way.

These days, you can wirelessly charge a smartphone by putting it within an inch of a charging station. But usable long-range wireless power transfer, from one side of a room to another or even across a building, is still a work in progress. Most of the methods currently in development involve focusing narrow beams of energy and aiming them at their intended target. These methods have had some success, but are so far not very efficient. And having focused electromagnetic beams flying around through the air is unsettling.



Arcs of electricity generated by a Tesla coil.
Credit: Airares/CC BY-SA 3.0

Now, a team of researchers at the University of Maryland (UMD), in collaboration with a colleague at Wesleyan University in Connecticut, have developed an improved technique for wireless power transfer technology that may promise long-range power transmission without narrowly focused and directed energy beams. Their results, which widen the applicability of previous techniques, were published Nov. 17, 2020 in the journal *Nature Communications*.

The team generalized a concept known as an "anti-laser." In a laser, one photon triggers a cascade of many photons of the same color shooting out in a coherent beam. In an anti-laser, the reverse happens. Instead of boosting the number of photons, an anti-laser coherently and perfectly absorbs a beam of many precisely tuned photons. It's kind of like a laser running backwards in time.

The new work, led by UMD Professor of Physics Steven Anlage of the Quantum Materials Center (QMC), demonstrates that it's possible to design a coherent perfect absorber outside of the original time-reversed laser framework—a relaxation of some of the key constraints in earlier work. Instead of assuming directed beams traveling along straight lines into an absorption target, they picked a geometry that was disorderly and not amenable to being run backwards in time.

"We wanted to see this effect in a completely general environment where there's no constraints," says Anlage. "We wanted a sort of random, arbitrary, complex environment, and we wanted to make perfect absorption happen under those really demanding circumstances. That was the motivation for this, and we did it."

Anlage and his colleagues wanted to create a device that could receive energy from a more diffuse source, something that was less beam and more bath. Before tackling the wireless challenge, they set up their generalized anti-laser as a labyrinth of wires for electromagnetic waves to travel through. Specifically, they used microwaves, a common candidate for power transfer applications. The labyrinth consisted of a bunch of wires and boxes connected in a purposefully disordered way. Microwaves going through this labyrinth would get so tangled up that, even if it were possible to reverse time, this still wouldn't untangle them.

Buried in the midst of this labyrinth was an absorber, the target to deliver power to. The team sent microwaves of different frequencies, amplitudes and phases into the labyrinth and measured how they were transformed. Based on these measurements, they were able to calculate the exact properties of input microwaves that would result in perfect power transfer to the absorber. They found that for correctly chosen input microwaves, the labyrinth absorbed an unprecedented 99.999% of the power they sent into it. This showed explicitly that coherent perfect absorption can be achieved even without a laser run backwards in time.

The team then took a step towards wireless power transfer. They repeated the experiment in a cavity, a plate of brass several feet in each direction with an oddly shaped hole in the middle. The shape of the hole was designed so that the microwaves would bounce around it in an unpredictable, chaotic way. They placed a power absorber inside the cavity, and sent microwaves in to bounce around the open space inside. They were able to find the right input microwave conditions for coherent perfect absorption with 99.996% efficiency.

Recent work by a collaboration of teams in France and Austria also demonstrated coherent perfect absorption in their own disordered microwave labyrinth. However, their experiment was not quite as general as the new work from Anlage and colleagues. In the previous work, the microwaves entering the labyrinth would still be untangled by a hypothetical reversal of time. This might seem like a subtle distinction, but the authors say showing that coherent perfect absorption doesn't require any kind of order in the environment promises applicability virtually anywhere.

Generalizing previous techniques in this way invites ideas that sound like science fiction, like being able to wirelessly and remotely charge any object in a complex environment, such as an office building, with near perfect efficiency. Such schemes would require that the frequency, amplitude, and phase of the electric power is custom tuned to specific targets. But there would be no need to focus a high-powered beam and aim it at the laptop or phone—the electrical waves themselves would be designed to find their chosen target.

"If we have an object which we want to deliver power to, we will first use our equipment to measure some properties of the system," says Lei Chen, a graduate student in electrical and computer engineering at UMD and the lead author of the paper. "Based on those properties we can get the unique microwave signals for this kind of system. And it will be perfectly absorbed by the object. For every unique object, the signals will be different and specially designed."

Although this technique shows great promise, much remains to be done before the advent of wireless and plug-less offices. The perfect absorber depends crucially on the power being tuned just right for the absorber. A slight change in the environment—such as moving the target laptop or raising the blinds in the room—would require an immediate retuning of all the parameters. So, there would need to be a way to quickly and efficiently find the right conditions for perfect absorption on the fly, without using too much power or bandwidth. Additionally, more work needs to be done to determine the efficacy and safety of this technique in realistic environments.

Even though it's not yet time to throw away all your power cords, coherent perfect absorption may come in handy in many ways. Not only is it general to any kind of target, it is also not limited to optics or microwaves. "It's not wedded to one specific technology," says Anlage, "This is a very general wave phenomenon. And the fact that it's done in microwaves is just because that's where the strengths are in my lab. But you could do all of this with acoustics, you could do this with matter waves, you could do this with cold atoms. You could do this in many, many different contexts."

In addition to Chen and Anlage, Tsampikos Kottos, a professor at Wesleyan University, was a co-author on the paper.

More information: Lei Chen et al. Perfect absorption in complex scattering systems with or without hidden symmetries, *Nature Communications* (2020). DOI: [10.1038/s41467-020-19645-5](https://doi.org/10.1038/s41467-020-19645-5)

Journal information: [Nature Communications](https://phys.org/news/2020-11-anti-laser-enable-long-range-wireless-power.html)
<https://phys.org/news/2020-11-anti-laser-enable-long-range-wireless-power.html>

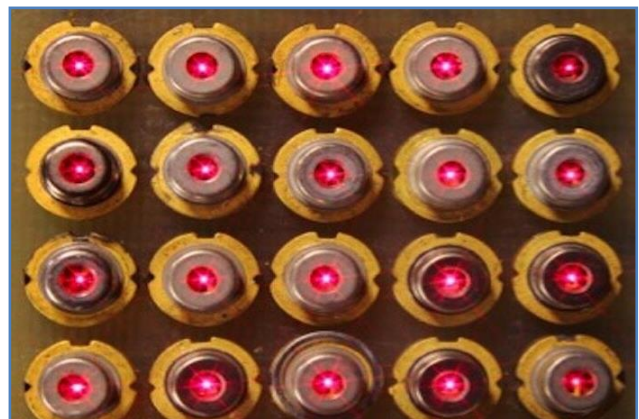


Fri, 20 Nov 2020

Researchers invent novel vertical-cavity surface-emitting laser

Researchers at the George Washington University have developed a new design of vertical-cavity surface-emitting laser (VCSEL) that demonstrates record-fast temporal bandwidth. This was possible by combining multiple transverse coupled cavities, which enhances optical feedback of the laser. VCSELs have emerged as a vital approach for realizing energy-efficient and high-speed optical interconnects in data centers and supercomputers.

VCSELs are a vital class of semiconductor laser diodes accompanying a monolithic laser resonator that emits light in a direction perpendicular to the chip surface. This class of lasers is gaining market importance given their compact size and high optoelectronic performance. As miniaturized lasers, they are used as an optical source in highspeed, short-wavelength communications and optical data networks. Dense traffic and high-speed transmission are key requirements for smart sensor applications in automotive or in data communications, which are enabled by compact and high-speed VCSELs. However, the 3-dB bandwidth, known as the speed limit of VCSELs, is limited by thermal effects, parasitic resistance, capacitance and nonlinear gain effects.



Fast, powerful compact lasers: A novel VCSEL for next-generation datacenters and sensors. Credit: George Washington University

Direct modulation of VCSELs cannot exceed about 30 GHz due to nonlinear optical amplification effects known as gain relaxation oscillations. This invention introduces a

revolutionary novel VCSEL design. Since feedback inside the laser needs to be carefully managed, researchers introduced a multi-feedback approach by combining multiple coupled cavities. This allowed them to strengthen the feedback known as "slow-light," thus extending the temporal laser bandwidth (speed) beyond the known limit of the relaxation oscillation frequency. The innovation is ground-breaking because the direct feedback from each cavity only needs to be moderate and can be controlled precisely via the coupled cavities, allowing for a higher degree of design freedom. Following this coupled cavity scheme, a resulting modulation bandwidth in the 100 GHz range is expected.

"Here we introduce a paradigm-shift in laser design. We utilize a novel coupled cavities approach to carefully control the feedback to the laser achieved by significantly slowing the laser light down. This coupled cavity approach adds a new degree of freedom for laser design, with opportunities in both fundamental science and technology," says Volker Sorger, associate professor of electrical and computer engineering at the George Washington University.

"This invention is timely since demand for data services is growing rapidly and moving towards next generation communication networks such as 6G, but also in automotive as proximity sensor or smart phone's face ID. Furthermore, the coupled cavity system paves a way for emerging applications in quantum information processors such as coherent Ising machines," adds Dr. Hamed Dalir, co-author on the paper and inventor of the technology.

More information: Elham Heidari et al, Hexagonal transverse-coupled-cavity VCSEL redefining the high-speed lasers, *Nanophotonics* (2020). DOI: [10.1515/nanoph-2020-0437](https://doi.org/10.1515/nanoph-2020-0437)
<https://phys.org/news/2020-11-vertical-cavity-surface-emitting-laser.html>

COVID-19 Research News



Fri, 20 Nov 2020

Coronavirus | Oxford University COVID-19 vaccine 'encouraging' for older age groups: study

This means there are now four promising vaccines on the horizon after Pfizer-BioNTech, Sputnik and Moderna already reporting good preliminary data from Phase 3 trials

London: The coronavirus vaccine developed by teams at the University of Oxford has been shown to trigger a robust immune response in healthy adults aged 56-69 and those over 70 years of age.

The findings published in *Lancet* on Thursday based on 560 healthy adult volunteers shows that the ChAdOx1 nCoV-19 vaccine is safe and well tolerated with a lower reactogenicity profile in older adults than in younger adults, meaning the older age groups could build immunity to the disease.

These findings are encouraging because older individuals are at disproportionate risk of severe COVID-19 and so any vaccine adopted for use against SARS-CoV-2 [COVID-19] must be effective in older adults, the researchers note.

"We were pleased to see that our vaccine was not only well tolerated in older adults, but also stimulated



Vial 1 of Box 1. This is the vaccine candidate to be used in Phase 1 clinical trial at the Clinical Biomanufacturing Facility (CBF) in Oxford, Britain, April 2, 2020. Picture taken April 2, 2020. Sean Elias/Handout via REUTERS THIS IMAGE HAS BEEN SUPPLIE

similar immune responses to those seen in younger volunteers, said Dr. Maheshi Ramasamy, an investigator at the Oxford Vaccine Group. “The next step will be to see if this translates into protection from the disease itself,” she said.

This means there are now four promising vaccines on the horizon after Pfizer-BioNTech, Sputnik and Moderna already reporting good preliminary data from Phase 3 trials.

The U.K. has already ordered 100 million doses of the Oxford vaccine, being manufactured by pharma major AstraZeneca. The vaccine also has a tie-up with the Serum Institute of India.

Professor Andrew Pollard, the head of Oxford’s vaccine trial team, said he is “absolutely delighted” with the latest results.

Crucially, the study also found no suspected unexpected serious adverse reactions during this stage of the trial. The 560 healthy adult volunteers who took part in the phase two trials were given two doses of the vaccine candidate, or a placebo.

“Inducing robust immune responses in older adults has been a long-standing challenge in human vaccine research, said Dr. Angela Minassian, an investigator at the University of Oxford and honorary consultant in infectious diseases. “To show this vaccine technology is able to induce these responses, in the age group most at risk from severe COVID-19 disease, offers hope that vaccine efficacy will be similar in younger and older adults.”

The outcomes reported at this stage of the study include the safety of the vaccine and the immune responses of participants in different age groups following vaccination.

It is important to assess how well the vaccine works in older people, as these age groups are more severely affected by COVID-19 disease, the study notes. Sometimes vaccines are less effective in older people, so it is important to find out at an early stage how well the immune system responds to the vaccine in those over the age of 55, it adds.

Antibodies play an important role in the immune response to viruses. The latest trial assessed both the quantity and quality of antibody found in participant blood samples. An ELISA (enzyme-linked immunosorbent assay - a plate-based laboratory technique) was used to detect and measure the quantity of antibodies in the blood that recognise the spike protein.

In addition to measuring the quantity of antibody, the study also examined the quality of antibody, its ability to neutralise the virus. Like the previous study, good levels of neutralising antibodies were produced, and this was consistent across all age groups, the research team notes.

T-cell responses

T-cells play an important role in the immune response to viral infections. Some T-cells are responsible for killing viruses inside infected cells, whilst others are responsible for providing help to other components of the immune response. There is increasing evidence that T-cells play an important role in preventing serious disease with natural infection of the COVID-19 virus. The latest trial shows that after a single vaccination, T-cell responses were highly comparable in all ages and across different doses.

The participants in this study continue to be monitored to assess how well the immune responses are maintained over a longer time period, the research team said.

“To assess whether the vaccine works to protect from COVID-19, the statisticians in our team will compare the number of infections in the control group with the number of infections in the vaccinated group. How quickly we reach the numbers required will depend on the levels of virus transmission in the community. With the current low transmission levels in the U.K., this could take many months,” they add.

The researchers say they have completed recruitment of over 10,000 people to its Phase 2-3 study, which aims to assess the efficacy of the vaccine, and to compare the different dose schedules.

<https://www.thehindu.com/sci-tech/science/oxford-university-covid-19-vaccine-encouraging-for-older-age-groups-study/article33132066.ece>

