Nov
2021

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खंड : 46 अंक : 217 01 नवम्बर 2021

Vol. : 46 Issue : 217 01 November 2021

रक्षा विज्ञान पुस्तकालय
Defence Science Library
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Delivery of Y 12704 (Visakhapatnam) first ship of Project 15B

Y 12704 (*Visakhapatnam),* the lead ship of Project 15B stealth guided missile destroyers being built at Mazgaon Docks Limited (MDL), was delivered to the Indian Navy on 28 Oct 21. The contract for four ships of Project 15B, as the *Visakhapatnam* class ships are known, was signed on 28 January 2011. This project is a follow-on of the Kolkata class (Project 15A) destroyers commissioned in the last decade.

Designed by Directorate of Naval Design, Indian Navy's in-house design organisation; and built by M/s Mazagon Dock Shipbuilders Ltd, Mumbai; the four ships are christened after major cities from all four corners of the country viz. Visakhapatnam, Mormugao, Imphal and Surat.

The keel of *Visakhapatnam* was laid in October 2013 and the ship was launched in April 2015. The design has largely maintained the hull form, propulsion machinery, many platform equipment and major weapons & sensors as the *Kolkata* class to benefit from series production.

The 163 metres long warship has a full load displacement of 7400 tonnes and maximum speed of 30 knots. The overall indigenous content of the project is approx. 75%. Apart from myriad indigenous equipment in the 'Float' and 'Move' categories, the destroyer is also installed with major indigenous weapons which include: -

1. Medium Range Surface-to-Air Missiles (BEL, Bangalore).
2. BrahMos Surface-to-Surface Missiles (BrahMos Aerospace, New Delhi).
3. Indigenous Torpedo Tube Launchers (Larsen & Toubro, Mumbai).
4. Anti-Submarine Indigenous Rocket Launchers (Larsen & Toubro, Mumbai).
5. 76mm Super Rapid Gun Mount (BHEL, Haridwar).

The delivery of *Visakhapatnam* is an affirmation of the impetus being given by the Government of India and the Indian Navy towards 'Aatma Nirbhar Bharat' as part of 75 years of Indian Independence. The induction of the destroyer, despite the COVID challenges, is a tribute to the collaborative efforts of large number of stake holders and would enhance the maritime prowess of the country in the Indian Ocean Region.

https://pib.gov.in/PressReleasePage.aspx?PRID=1768017

पत्र सूचना कार्यालय
भारत सरकार
रक्षा मंत्रालय

Sun, 31 Oct 2021 9:39AM

परियोजना 15बी का पहला युद्धपोत वाई 12704 (विशाखापत्तनम) भारतीय नौसेना को सौंपा गया

परियोजना 15बी का पहला युद्धपोत वाई 12704 (विशाखापत्तनम) 28 अक्टूबर 2021 को भारतीय नौसेना को सौंप दिया गया। परियोजना 15बी के तहत मझगांव डॉक्स लिमिटेड (एमडीएल) निर्देशित मिसाइल विध्वसंक युद्धपोतों का निर्माण कर रहा है। परियोजना 15बी के चार जहाजों के अनुबंध पर 28 जनवरी 2011 को हस्ताक्षर किए गए थे। इन्हें विशाखापत्तनम श्रेणी के जहाजों के रूप में जाना जाता है। यह परियोजना पिछले दशक में शुरू किए गए कोलकाता श्रेणी (परियोजना 15ए) का अनुवर्ती है।

इस जहाज को भारतीय नौसेना की इन-हाउस डिजाइन संस्था, नौसेना डिजाइन निदेशालय ने डिजाइन किया है और इसका निर्माण मझगांव डॉक शिपबिल्डर्स लिमिटेड, मुंबई ने किया है। देश के चारों कोनों के प्रमुख शहरों के नाम पर इन चार जहाजों का नामकरण किया गया है, जो है- विशाखापत्तनम, मोरमुगाओ, इंफाल और सूरत।

विशाखापत्तनम श्रेणी के इस जहाज की नींव अक्टूबर 2013 में रखी गई थी और जहाज को अप्रैल 2015 में लॉन्च किया गया था। जहाज को बड़े पैमाने प्रणोदन मशीनरी, कई प्लेटफॉर्म उपकरण और प्रमुख हथियार और सेंसर से युक्त बनाया गया है, जिस तरह से कोलकाता श्रेणी के जहाजों को बनाया गया है।

163 मीटर लंबे युद्धपोत में 7400 टन का पूर्ण भार विस्थापन और 30 समुद्री मील की अधिकतम गति है। परियोजना की कुल स्वदेशी सामग्री लगभग 75% है। 'फ्लोट' और 'मूव' श्रेणियों में बड़ी संख्या में स्वदेशी उपकरणों के अलावा, विध्वंसक युद्धपोत को प्रमुख स्वदेशी हथियारों से लैस किया गया है जो इस प्रकार हैं: -

(ए) मध्यम दूरी की सतह से हवा में मार करने वाली मिसाइलें (बीईएल, बेंगलुरु)।

(बी) ब्रह्मोस सतह से सतह पर मार करने वाली मिसाइलें (ब्रह्मोस एयरोस्पेस, नई दिल्ली)।

(सी) स्वदेशी टारपीडो ट्यूब लॉन्चर (लार्सन एंड टुब्रो, मुंबई)।

(डी) पनडुब्बी रोधी स्वदेशी रॉकेट लॉन्चर (लार्सन एंड टुब्रो, मुंबई)।

(इ) 76 एमएम सुपर रैपिड गन माउंट (भेल, हरिद्वार)।

विशाखापत्तनम श्रेणी की इस जहाज की डिलीवरी भारतीय स्वतंत्रता की 75वीं वर्षगाँठ के उपलक्ष्य में 'आत्मनिर्भर भारत' बनाने की दिशा में भारत सरकार और भारतीय नौसेना द्वारा किए जा रहे कार्यों की अभिपुष्टि है। कोविड चुनौतियों के बावजूद विध्वंसक युद्धपोत का समावेशन बड़ी संख्या में हितधारकों के सहयोगात्मक प्रयासों के प्रति एक सम्मान है। यह हिंद महासागर क्षेत्र में देश की समुद्री शक्ति को बढ़ाएगा।

https://pib.gov.in/PressReleasePage.aspx?PRID=1768096

THE HINDU

Mon, 01 Nov 2021

Navy takes delivery of guided missile destroyer Visakhapatnam

It's equipped with BrahMos supersonic cruise missiles and long-range Surface-to-Air missiles

The first ship of the four Project-15B state-of-the-art stealth guided missile destroyers, Visakhapatnam, being built at the Mazgaon Docks Limited (MDL), was delivered to the Navy last Friday. Delayed by three years, the ships will be commissioned very soon.

"The 163-metre-long warship has a full load displacement of 7,400 tonnes and a maximum speed of 30 knots. The overall indigenous content of the project is approximately 75%," the Navy said on Sunday.

These ships are equipped with BrahMos supersonic cruise missiles and long-range Surface-to-Air missiles (SAM).

The contract for the construction of the ships was signed in January, 2011 at a project cost of about ₹29,643.74 crore. The design of the ships has been developed in-house by the Directorate of Naval Design and are a follow-on of the Kolkata class (Project 15A) destroyers. The four ships are christened after major cities from all four corners of the country — Visakhapatnam, Mormugao, Imphal and Surat, the Navy said.

The keel of Visakhapatnam was laid in October 2013 and the ship was launched in April 2015. These ships are equipped with BrahMos supersonic cruise missiles and long-range Surface-to-Air missiles (SAM).

The ship has several indigenous weapons systems like medium range SAMs, indigenous torpedo tube launchers, anti-submarine indigenous rocket launchers and 76-mm super rapid gun mount, the Navy said.

"The induction of the destroyer, despite the COVID challenges, is a tribute to the collaborative efforts of a large number of stake-holders and would enhance the maritime prowess in the Indian Ocean Region."

Enhanced stealth features

The design of Project 15B has largely maintained the hull form, propulsion machinery, many platform equipment and major weapons and sensors as the Kolkata class to benefit from series production. However, these ships feature enhanced stealth features over the earlier class through shaping of hull and use of radar transparent deck fittings which make them difficult to detect and also feature significant advances in automation and networking.

These ships are propelled by four gas turbines in Combined Gas and Gas (COGAG) configuration and have maximum endurance of 4000 nm at economical speed of 14 knots, the Navy had said earlier.

https://www.thehindu.com/news/national/navy-takes-delivery-of-guided-missile-destroyer-visakhapatnam/article37270547.ece

The Statesman

Mon, 01 Nov 2021

Indian Navy receives its first stealth guided missile destroyer warship

The work for the ship Y 12704, which is a lead war ship of Project 15 B, was started in October 2013.

New Delhi: Indian Navy received first of the four 15 B project stealth guided-missile destroyers warships, most of which was designed and developed indigenously to enhance India's sea line security.

The work for the ship Y 12704, which is a lead warship of Project 15 B, was started in October 2013. The design has largely maintained the hull form, propulsion machinery, many platform equipment, and major weapons & sensors as the Kolkata class to benefit from series production, said a senior officer of the Defence Ministry here on Sunday.

representational image (iStock photo)

"Designed by Directorate of Naval Design, Indian Navy's in-house design organization; and built by M/s Mazagon Dock Shipbuilders Ltd, Mumbai; the four ships are christened after major cities from all four corners of the country viz. Visakhapatnam, Mormugao, Imphal, and Surat," the Defence Ministry said.

The 163 meters long warship has a full load displacement of 7400 tonnes and a maximum speed of 30 knots. The overall indigenous content of the project is approx. 75%.

Apart from myriad indigenous equipment in the 'Float' and 'Move' categories. The destroyer is also installed with major indigenous weapons which include: -Medium Range Surface-to-Air Missiles (BEL, Bangalore), BrahMos Surface-to-Surface Missiles (BrahMos Aerospace, New Delhi), Indigenous Torpedo Tube Launchers (Larsen & Toubro, Mumbai), Anti-Submarine Indigenous Rocket Launchers (Larsen & Toubro, Mumbai), and 76mm Super Rapid Gun Mount (BHEL, Haridwar), the Ministry said.

"The delivery of Visakhapatnam is an affirmation of the impetus being given by the Government of India and the Indian Navy towards 'Aatma Nirbhar Bharat' as part of 75 years of Indian Independence. The induction of the destroyer, despite the COVID challenges, is a tribute to the collaborative efforts of a large number of stakeholders and would enhance the maritime prowess of the country in the Indian Ocean Region," the Ministry said.

https://www.thestatesman.com/india/indian-navy-receives-first-stealth-guided-missile-destroyer-warship-1503022162.html

INDIA TODAY

Mon, 01 Nov 2021

Agni-V and the end of India's northeastern dilemma

The missile brings all of China within the range of India's delivery systems and enhances its credible nuclear deterrence

By Sandip Unnithan

New Delhi: On October 27, India tested the 5,000-km range Agni V intermediate range ballistic missile. This was the first 'user trial' of the missile by the Strategic Forces Command (SFC) that deploys India's nuclear arsenal. The Agni V can carry a 1.5 tonne payload, possibly a boosted-fission device tested in 1998.

File photo of Agni 5 intercontinental ballistic missile; (PTI Photo)

Until now, the 3,500 km Agni III, first tested in 2006, served as the backbone of the Indian nuclear deterrent against China. It could target all of Pakistan but only parts of mainland China. Even so, the rail-mobile Agni III would need for the SFC's train-based ballistic missiles to travel for a launch to northeast India—closest to eastern and southern China. Ground-based invasions like the one China launched in 1962 can be halted by over 200,000 soldiers currently deployed by the army's Kolkata-based Eastern Command—two Army Corps with two divisions each and a Mountain Strike Corps--for limited cross-border offensives. Indian military planners have continued to worry about the vulnerability of the 22-km-wide Siliguri corridor to a Chinese offensive from the Chumbi Valley. (The army's Eastern Command recently conducted a week-long media tour to demonstrate its enhanced military posture.)

An Indian nuclear deterrent, operating along the road and rail axis in the sliver of India's northeast, however, is vulnerable to tactical counter-force strikes (enemy attacks targeting the nuclear deterrent).

The Agni V has a range of between 5,000 and 5,500 km (even longer with a lighter payload) and allows Indian nuclear weapons to be launched from mainland India. Its induction thus ends the strategic dilemma Indian strategic planners face—a belligerent nuclear-armed China which could inflict punitive missile strikes all along the Indian mainland from the Tibetan plateau but whose own industrial heartlands and population centres, further away on the east coast, remain shielded from retaliatory strikes. This dilemma dates back to the 1960s when Indian strategic thinkers had begun advocating nuclear weaponisation to counter Maoist China.

Sometime in 1968, Indira Gandhi's influential principal secretary P.N. Haksar made a strong case for India to go nuclear. Haksar was conscious of the formidable natural barrier in the million square kilometres of Chinese-occupied Tibet. Hence, he called for 'the making of nuclear arms in the shape of medium range (2,000-3,000 miles) capable, from sites within India's frontiers, of striking with success not only a few chosen targets in Tibet but ranging as far afield as the industrial heart of China in Manchuria and in the great river valleys south of it which include some of her principal industries and urban centers of population'.

Scholar Vivek Prahladan reproduced this startling policy document, titled 'Need for India in a changing world to reassess her national interests and foreign policy', in his 2017 book *The Nation Declassified*. In one of the earliest references on the need for nuclear-powered ballistic missile

submarines (SSBNs), Haksar also called for 'the development simultaneously of submarines driven by nuclear power fitted to carry nuclear missiles'.

Haksar's note came just six years after the border war with China and four years after the country had tested a nuclear weapon in the sandy wastes of Lop Nor in Xinjiang. It is not unreasonable to believe that the paper became the basis for India's nuclear force planning.

Haksar had long discussions with Indira Gandhi, which apparently changed her views on the nuclear issue. The former bureaucrat, who passed away in 1998, gave a rare interview to senior journalist Raj Chengappa, which was reproduced in his insightful 2000 book, *Weapons of Peace*, on the shaping of India's nuclear deterrent. Haksar quotes a passage from the historian L.V. Namier's book *In The Margins of History* to Mrs Gandhi: 'The weight of argument greatly depends on him who uses it: that of the strong has 'force' and carries 'conviction'; that of the weak, if unanswerable, is called quibble and apt to cause annoyance.'

India first nuclear test in 1974 was followed by over a decade of nuclear dormancy before the Rajiv Gandhi government revived it in the 1980s. Yet, without long- range delivery systems, nuclear weapons in themselves are useless. The missile development path has followed a slow curve of increasing range in the face of international opprobrium. The Agni technology demonstrator was test-fired in 1989 but further tests were shelved after US pressure in the mid-1990s. It was revived only after the nuclear tests of 1998 when Agni-II, with a range of approximately 2,200 km, was tested on April 11, 1999.

India's security establishment had been careful not to mention China as the primary focus of its nuclear arsenal, though this had begun changing by the 1990s. In 1998, the then defence minister George Fernandes called China India's 'potential threat number one'.

In an off the record conversation with a few Indian journalists in London in 2000, Fernandes recommended they read the BBC journalist's Humphrey Hawksley's 1997 novel *Dragon Strike*, where a hawkish Chinese despot launches a nuclear attack on India.

In a letter to US President Bill Clinton (which appeared in the *New York Times* on May 13, 1998), Prime Minister A.B. Vajpayee hinted at the 'deteriorating security environment, specially the nuclear environment' as one of the unstated reasons for India's May 11, 1998 nuclear tests. 'We have an overt nuclear weapon state on our borders, a state which committed armed aggression against India in 1962,' the letter elaborated. 'Although our relations with that country have improved in the last decade or so, an atmosphere of distrust persists mainly due to the unresolved border problem. To add to the distrust that country has materially helped another neighbour of ours to become a covert nuclear weapons state.' The Agni V is thus an antidote for India's worries over a collusive two-front security threat.

https://www.indiatoday.in/india-today-insight/story/agni-v-and-the-end-of-india-s-northeastern-dilemma-1871754-2021-10-31

NEWS 18

Mon, 01 Nov 2021

Explained: India's ballistic leap as China goes hypersonic. What it means for the missile arsenals

Months after China tested a hypersonic missile, India held a trial of its first ICBM, Agni-V, whose 5,000-km range covers most of mainland China

By Kenneth Mohanty

Locked in a months-long standoff at the Line of Actual Control (LAC) in Ladakh, India and China have both recently tested advanced weapons that considerably bolster their strategic capabilities. If China went ahead in August with a trial of a hypersonic missile, India tested its own long-range Agni-V ballistic missile in October. The missiles represent superior achievements in rocketry for the two countries, both of which strictly adhere to a “no first use" policy.

What Kind Of Missile Is The Agni-V?

Following the October 27 test of Agni-V, reportedly the first “user trial" of the missile by the Strategic Forces Command, the Defence Ministry said its development was “in line with India’s stated policy to have ‘credible minimum deterrence’ that underpins the commitment to ‘No First Use'". The missile, the ministry added, uses a three-stage solid fuelled engine and is capable of striking targets at ranges up to 5,000 kilometres “with a very high degree of accuracy".

Agni-V missile is India's first ICBM and has a range of 5,000-km.(Representational image from AFP)

Its range puts Agni V practically in the category of Intercontinental Ballistic Missiles (ICBMs), making it the first such weapon in India’s arsenal. Agni-V has been under development for more than a decade. After its fifth test firing in January 2018, the Ministry of Defence had said that all the objectives for the test of the “long-range surface-to-surface ballistic missile… have been successfully met" and it “reaffirms the country’s indigenous missile capabilities and further strengthens our credible deterrence".

However, although reports have said that the missile was to be inducted into the Armed forces after two more tests the same year — in June and December — making it seven successful tests in total, another test was lined up, which got delayed, however, due to the Covid-19 pandemic.

A range of 5,000-plus kilometres brings most of the Chinese mainland within the reach of Agni-V, enhancing India’s strategic deterrence vis-a-vis Beijing.

What Is A Ballistic Missile?

According to the Nuclear Threat Initiative (NTI), India has the “capacity to deploy short-, medium-, and long-range ballistic missiles". It says that the country “views its nuclear weapons and long-range power projection programmes as the key to maintaining strategic stability in the Asia-Pacific region".

It lists the Prithvi-II, Agni-I, Agni-II, Agni-III, and Agni-IV as “India’s fully operational land-based ballistic missiles", noting that the country also has submarine launched ballistic missiles (SLBMs).

Arms Control Association, another US-based organisation, says that ballistic missiles are “powered by rockets initially but then they follow an unpowered, free-falling trajectory towards their targets". It notes that as of December 2017, there were 31 countries that had such missiles

with only nine among them known or suspected to possess nuclear capabilities — China, France, India, Israel, North Korea, Pakistan, Russia, UK, US.

What Is A Hypersonic Missile?

China is reported to have in August tested a hypersonic missile that caught the US by surprise for what it revealed about the country's capabilities when it comes to the advanced weapons platform. Hypersonic missiles are seen as being the cutting edge of missile technology given that they can evade existing missile defence systems, thus imparting considerable strategic advantage to countries that possess them.

Hypersonic speeds are those that exceed five times the speed of sound, that is, anything that can move at speeds of Mach 5 or above, which means at least at 1.6km per second. A hypersonic missile is faster than a cruise missile and can hit the same initial speeds as ballistic missiles, experts say.

Hypersonic missiles though fly through the atmosphere — which subjects them to atmospheric drag that can blunt their speed — whereas ballistic missiles avoid atmospheric drag by first flying into outer space and then dropping towards their target at high speed. Hypersonic missiles take a more direct path to their target and are seen as representing marked improvement in missile tech.

There are two types of hypersonic missiles. Hypersonic cruise missiles are the ones that use rocket or jet propellant through their flight and are regarded as being just faster versions of existing cruise missiles. Then there is the hypersonic glide vehicle (HGV) — the kind that China tested in August — that first go up into the atmosphere on a conventional rocket or ballistic missile before being launched towards their target.

What Are The Advantages Of A Hypersonic Missile?

Traditional platforms like cruise and ballistic missiles have been around for long, giving the leading military powers enough time to develop substantial capabilities to detect and intercept them. But hypersonic missiles, by combining the speed of ballistic missiles and the stealth of cruise missiles, impart an ability for evading such anti-missile defences.

They can fly low, as cruise missiles do, while hitting speeds comparable to ballistic missiles. Hypersonic missiles are also manoeuvrable during flight, unlike ballistic missiles, which makes their trajectory highly unpredictable. Experts say the low altitude flight of which hypersonic missiles are capable, allow them to fly under the radar.

But some experts point out that the advantage conferred by hypersonic missiles can be matched by the conventional missile systems with the simple expedient of "firing more missiles than the adversary has interceptors, or by using countermeasures, like decoys".

Interestingly, experts point out that the speed at which a hypersonic missile travels means it can achieve "devastating kinetic energy on its target, compensating for a smaller explosive warhead".

What Did China's Test Achieve?

The ability of missile defence systems to counter cruise and ballistic missiles greatly compromises the strategic advantage provided by such weapons. The development of hypersonic missiles, though not new, has seen renewed interest as the major powers sought to regain the strategic upper hand in the military sphere.

Reports say that China has been aggressively developing hypersonic missile technology to counter the progress made by the US on that front amid a deterioration of ties between the two top superpowers.

The Financial Times quoted sources as saying that China sent up the hypersonic missile mounted on a Long March rocket, which is the mainstay of its space programme. The test, done in August, was not announced. The report said that the nuclear-capable missile circled the Earth at low orbit before descending toward its target. However, the missile is said to have been off the mark by more than 32 km.

Which Countries Have Developed Hypersonic Missiles?

Reports say that while the likes of the US and Russia are leaders in the field, several countries are working on hypersonic missiles and even North Korea claims to have developed one. The Chinese hypersonic missile test report said that it had caught US officials by surprise with the indication it gave of how advanced China's missile programme had become.

In September last year, India's Defence Research and Development Organisation (DRDO) had successfully tested a Hypersonic Technology Demonstrator Vehicle (HSTDV) that officials said would lay the foundation for the development of a hypersonic cruise missile system.

But while the lack of an operational hypersonic missile defence shield makes such systems attractive, experts say there are several challenges that lie in the path of developing such wepaons, including its propulsion system and the extreme heat these missiles generate while flying low through the atmosphere.

DRDO chief G Satheesh Reddy had said that it would take the agency about four-five years to "realise a complete missile system working for some good amount of range".

https://www.news18.com/news/explainers/explained-indias-ballistic-leap-as-china-goes-hypersonic-what-it-means-for-their-missile-arsenals-4386428.html

The EurAsian Times

Mon, 01 Nov 2021

Tejas Mk-2 – India's new superfighter is now one of top 4 Light Combat Aircraft in the world along with 'Idol' Saab Gripen

Tejas Mk-2 is single-engine aircraft designed by India's Aeronautical Development Agency (ADA) and Hindustan Aeronautics Limited (HAL). The Tejas jet has been touted as one of four leading light combat aircraft (LCA) in the world today, according to a latest research report.

There is much excitement surrounding the 4.5-generation Tejas Mk-2 aircraft's specifications and how it fares against its competitors.

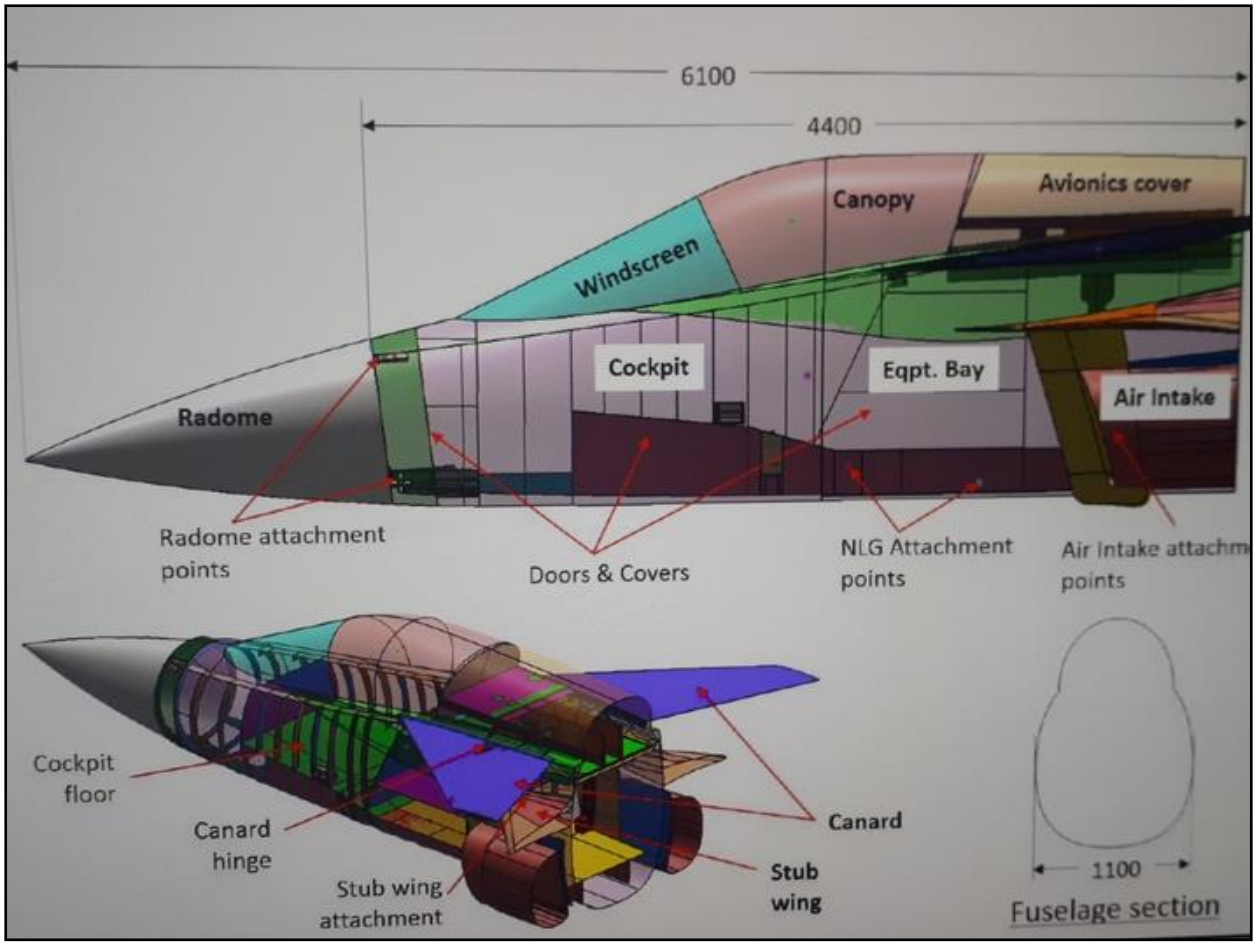
The aircraft had recently made headlines when the new Indian Air Force (IAF) chief, Air Chief Marshal VR Chaudhari stated that seven squadrons of the Tejas Mk-2 are projected for induction into the service in the coming years. Chaudhari was then discussing the future roadmap of the IAF.

Currently, the Tejas Mk-2 fighter jet is in the Critical Design Review (CDR) phase, which involves multi-disciplinary technical review to ensure that a system can proceed to fabrication, demonstration, and testing to meet desired performance standards while keeping up with the schedule and cost restrictions. This stage is expected to be completed by the end of 2021.

Reports suggest that the Preliminary Design Review (PDR) stage was concluded earlier this year. This is the phase where new technologies are tested, and if they are found to be mature enough, are integrated into the product subsystem.

More than 60% of the work prior to the flight tests has been finished. The progress made so far includes the completion of finalization of cockpit configuration, sensors, antennae, process finalization for drawing release, procurement of raw materials and their availability assessment, detailed design of various subsystems, finalization of SOPs for Mk-2's first flight.

The first prototype of the aircraft will roll out by August 2022. Following this, next on the schedule will be the commencement of the flight tests from 2023 onwards.



An open-source diagram showing internal features of Tejas Mk-2. (via Twitter)

Girish S Deodhare, Programme Director (combat aircraft) and Director, ADA, was quoted as saying by The Hindu: "The detailed design is complete. In fact, we are in the critical design review stage and metal cutting should start very shortly. The rollout of the aircraft (Mk2) is planned for next year and the first flight in early 2023. We are well on track to achieve these goals."

Tejas Mk-2 – Salient Features

Like its sister variants, the MK2 is also a medium-weight delta-wing aircraft. It boasts greater maneuverability and technological sophistication when viewed in comparison to previous versions. These differences seem to be consistent with generational gaps the variants have had with respect to one another.

The Tejas Mk-2 will feature enhanced range and endurance. It will flaunt canards and have the ability to carry a payload of 6,500 kg. This is almost double the capacity of LCA Tejas, which could handle a payload of 3,500 kg.

Reportedly, the aircraft will also be outfitted with a multi-sensor data fusion system that will include an active electronically scanned array (AESA) radar and infrared search and track along with a missile approach warning system.

The radar that will guide the MK-2 is called the Uttam AESA and is a 'Made in India' product. This indigenous radar is believed to be advanced enough to have an edge over the Israeli-origin radars that are currently in use onboard other Tejas variants.

The Uttam radar is believed to have the capability of countering enemy electronic warfare (EW) attempts as well.

The most interesting aspect of the aircraft is an onboard oxygen generation system. For its weaponry, the Tejas Mk-2 will feature heavy weapons of the class of Scalp, Crystal Maze, and Spice-2000.

Also quite unique is the continuous health monitoring and transmission system that is being worked on for the aircraft by scientists at the Defence Institute of Advanced Technology (DIAT), Pune.

Another notable feature is the high-definition touchscreen providing a 50cmx20cm wide area display. This will allow data fusion and intelligent display of information across the entire length.

Earlier this year, HAL chairman R Madhavan had said the MK-2 variant would be much superior to Tejas Mark-IA, 73 of which are being procured by the Indian Air Force from the HAL under a Rs 48,000 crore deal that was approved by the government on January 13, 2021, according to PTI.

Tejas Mk-2 – Leading Light Combat Aircraft

A recent study by 'Research And Markets' on light combat aircraft revealed that India is competing with China & Sweden in this particular arena. The study also observed a rising trend in the global arms race that is reminiscent of the Cold War with international military expenditure reaching $1.98 trillion for 2020.

With this as the background, the report described and analyzed four leading light combat aircraft that are vying for the top spot: Sweden's Saab JAS 39 E/F Gripen, India's HAL manufactured Tejas Mark I/II, China's Chengdu J-10, and the joint Chinese and Pakistani JF-17.

China began the development of the J-10 – a new modern multirole aircraft – in the 1980s. It was slated to be the successor to the country's J-8 and J-9 aircraft.

This Chinese workhorse was introduced as an answer to the Russian MiG-29 and the US F-16. The single-engine, lightweight multirole fighter has the capability to perform all-weather operations, and was specifically designed for air-to-air combat, and fulfilling strike missions.

Like the Mk-2, the J-10 features a large delta wing. It also has two canards right behind the cockpit to provide it with increased maneuverability. The weapons payload on this aircraft is similar to the MiG-29 and F-16. There are three weapon pylons on each wing, with another three on the belly.

The JF-17 Thunder is also a single-engine, lightweight, multipurpose combat aircraft. It is well known that this jet is the product of a partnership between China's Chengdu Aircraft Industry Corporation (CAC) and the Pakistan Aeronautical Complex (PAC).

With a maximum speed of 1,909 km per hour and with ammunitions such as 2 mm GSh-23-2 twin-barrel cannon, 57mm, 90mm unguided rocket pods, short-range air-to air-missiles like the AIM-9L/M, PL-5E, and PL-9C, and beyond visual range missiles like the PL-12 / SD-10, the JF-17 is definitely serving as a tough competitor for Tejas.

Saab's Gripen E, on the other hand, comes equipped with a wide area display and a panoramic high-resolution screen in its smart cockpit. The Skyward-G infrared search and track (IRST) is installed onboard the Gripen E. The MK-2 has an IRST system developed by Bharat Electronics Limited.

Gripen E is also slated to have 3 fuselage pylons, 4 under-wing pylons, and 2 wing-tip stations along with a right air intake station for electronic countermeasures (ECM) pod. The Indian aircraft, on the other hand, has 2 fuselage pylons, 6 under-wing pylons, and 2 wing-tip stations. It is to have a left air intake for an ECM pod.

The Saab Gripen is a powerful, versatile aircraft that not only meets Swedish requirements but has also been sold to various other nations including Brazil. Its aim of being affordable compared to other fighers doesn't mean it compromises on lethality and has been a market leader in light combat aircraft.

The Gripen doesn't require an enormous servicing infrastructure, it offers exceptional availability, and it can be maintained by a small team of engineers. Even Indian HAL was in talks with Saab to collaborate on the upgraded version of Tejas combat jets.

Tejas Mk-2 is expected to beat Gripen probably in terms of cost, even though the exact price per piece for the jet hasn't been revealed yet, only time will tell if India's indigenous aircraft can overpower 'idol' Saab JAS 39 Gripen.

For now, one thing is for sure, Tejas is there to lead and dominate and with the Mk-2 version, it should race ahead of Chinese-origin fighters.

https://eurasiantimes.com/tejas-mk-2-indias-new-superfighter-top-light-combat-aircraft/

WION

Mon, 01 Nov 2021

Going extremely well, says Indian Navy Chief on sea trials of indigenous aircraft carrier

By Siddharth MP

Story highlights

India's Navy chief admiral Karambir Singh said that the LCA had already landed on the operational carrier INS Vikramaditya and served as a technology demonstrator.

Chennai: The mega project of constructing India's first indigenous aircraft carrier to be commissioned in 2022 as INS Vikrant has resulted in immense learning and capacity building for Indian industry and state-run entities, said admiral Karambir Singh, India's Navy chief.

Admiral Karambir Singh also added that the previous and ongoing trials of the aircraft carrier has been going extremely well. The Navy chief and Sarbananda Sonowal, minister for ports, shipping was on a short visit to the 40,000 tonne vessel that is undergoing its second sea trial off the Kochi coast.

Minister Sarbananda Sonowal shared his immense gratitude towards the Indian Navy Photograph:(WION)

Referring to the first sea trial of the IAC-1, admiral Singh said that the ship had performed at 100 per cent power in a short duration and had undergone tests for its endurance, hull and sea-keeping.

He expressed confidence that the Navy could take delivery of the carrier in April 2022 and commission it by August. Commending the IAC project and its implementation thus far, the Navy chief said that the carrier was 76 per cent indigenous and had been realised within budget. It involved 550 Indian industries and provided work opportunities for 13,000 persons, besides the main shipbuilder, state-run Cochin Shipyard Limited (CSL).

When queried regarding the key learnings from the IAC project and also the overall production timelines of ships facing delays and whether India could catch up to China's speed of shipbuilding. The Navy chief replied, "There was a very steep learning curve and we learnt fairly quickly and learnt a lot. We developed important capabilities. We have a dry dock meant for 65,000tonne class ships coming up, we have mastered the indigenous DMR249 ship-grade steel and all our upcoming ships are built using it. There have been delays, but there are many payoffs as well."

The Navy chief added how the Indian industry and shipbuilders picked up modern techniques including integrated construction and had seen the immense growth and success of the Navy's Directorate of Naval Design.

Additionally, he pointed out that almost all of the 42 ships that were ordered by the Indian Navy (Ministry of Defence) were made indigenously. Notably, the chief emphasised that India could cut short the timelines of ship production in the coming years owing to the experience gained thus far.

On the role of the aircraft carrier, he said that the carrier battle group was central to Naval operations.

“Submarines are key to sea-denial(to enemy) and carriers are key to complete control and domination of a region. Nearly 90 per cent of India’s trade is via the sea route, hence carriers are crucial to protect our maritime interests and to prevent the enemy from reaching and interfering(in our waters and sea lanes of communication)."

When queried on the indigenous fighter aircraft LCA Tejas’ Naval variant being used on India’s carriers, the Navy chief replied that the LCA had already landed on the operational carrier INS Vikramaditya and served as a technology demonstrator.

He elaborated that the landing on a carrier deck and landing on-shore was different and how carrier-borne aircraft needed to be built differently from their land counterparts. He also added that the Indian Navy was looking for a twin-engine deck-based fighter aircraft. However, when queried if approval was granted for the much-talked-about third aircraft carrier, the Navy Chief replied that it wasn’t granted.

Minister Sarbananda Sonowal shared his immense gratitude towards the Indian Navy, Cochin Shipyard Limited and all other stakeholders, ancillary units for realizing such a mega project, within the country.

He said that India’s shipbuilders had developed the ability, confidence, infrastructure and team spirit for serving the nation. He added that Cochin Shipyard Limited had built India’s largest ship which opens up more opportunities for the state-run shipbuilder and also to the private sector owing to the growing push for *Atmanirbhar Bharat* (Self-reliant India).

https://www.wionews.com/india-news/going-extremely-well-says-indian-navy-chief-on-sea-trials-of-indigenous-aircraft-carrier-425648

Defence News

Defence Strategic: National/International

Mon, 01 Nov 2021

Territorial ambitions of China & Pak require India's Armed Forces to remain alert round the year: CDS Bipin Rawat

Rawat said history is witness to the fact that whenever a country neglects its armed forces, the external powers are quick to exploit it.

The territorial ambitions of China and Pakistan require the Indian armed forces to remain alert and deployed along disputed borders and coastal areas round the year, Chief of Defence Staff (CDS) Bipin Rawat said on Sunday. The CDS stated this while delivering the Sardar Patel Memorial Lecture at All India Radio.

The CDS stated this while delivering the Sardar Patel Memorial Lecture at All India Radio. (File photo: PTI)

"The quintessential visionary that Sardar Patel was, he had assertively voiced the need of an independent Tibet as a buffer state between India and China, as can be found in his correspondence with the then Prime Minister Pandit Jawaharlal Nehru," he said. Rawat said history is witness to the fact that whenever a country neglects its armed forces, the external powers are quick to exploit it.

In the 1950s, India overlooked this important lesson of history and allowed the security apparatus to drift and the Chinese shook the country up in 1962, Rawat said. "We had to relearn this lesson through an ignominious experience. Post-1962, we have had several skirmishes against the Chinese — at Nathu La in Sikkim in 1967, at Wangdung in 1986, at Doklam in 2017 and the recent skirmishes in the eastern Ladakh," he noted.

The outcomes have made it clear that the Indian armed forces are alert and determined to defend national territory, he said. This, he said, has helped the Chinese and our leaders to pursue agreements for maintaining peace and tranquility along the Line of Actual Control (LAC) and several other confidence-building measures to improve relations.

"Territorial ambitions of China and Pakistan require India's armed forces to remain alert and deployed along disputed borders and also along the coastal regions round the year," he asserted. The current border standoff between the Indian and Chinese militaries erupted in May last year following a violent clash in the Pangong lake areas of eastern Ladakh and both sides gradually enhanced their deployment by rushing in tens of thousands of soldiers as well as heavy weaponry.

As a result of a series of military and diplomatic talks, India and China completed the disengagement process in the Gogra area in August and in the north and south banks of the Pangong lake in February. Each side currently has around 50,000 to 60,000 troops along the LAC in the sensitive sector.

Rawat, in his speech, also recalled the role of the Indian armed forces in controlling the post-partition violence in India. “No one had fathomed that the scale of mayhem due to the communal frenzy that was unleashed due to the partition of our nation.

“Large scale violence between people who once lived as one community resulted in the loss of thousands of innocent lives in 1947," he said. The police force was limited in numbers, not fully trained or equipped, and was suffering from the trauma of communal fighting, he mentioned.

“The communal frenzy of that time was beyond the control of the police. The armed forces were then called in to control the furious rioting and enforce civil order," he added.

https://www.news18.com/news/india/territorial-ambitions-of-china-pak-require-indias-armed-forces-to-remain-alert-round-the-year-cds-bipin-rawat-4388054.html

The Indian EXPRESS

Mon, 01 Nov 2021

Air Marshal Sanjeev Kapoor takes over as new NDA Commandant

Air Marshal Kapoor joined the Flying branch of the Indian Air Force in December 1985. He has over 7,800 hours of accident/incident-free flying on various trainer, transport and strategic aircraft

Pune: Air Marshal Sanjeev Kapoor took over charge as the Commandant of the National Defence Academy (NDA) on Sunday from Lt Gen Asit Mistry, who retired after serving in the Indian Army for 39 years.

Lt Gen Asit Mistry and Air Marshal Sanjeev Kapoor

Air Marshal Kapoor joined the Flying branch of the Indian Air Force in December 1985. He has over 7,800 hours of accident/incident-free flying on various trainer, transport and strategic aircraft. He is an alumnus of the NDA, besides the Defence Services Staff College, Flying Instructor School, College of Defence Management and the National Defence College. His educational qualifications include MSc in Defence Studies, Master of Management Studies and MPhil. He is presently pursuing his PhD from Osmania University.

The officer has participated in numerous flying exercises and operations in India and abroad. As a flying instructor, he has done instructional tenures at the Air Force Academy and the Fixed Wing Training Faculty, Yelahanka. He has experience in high altitude, VVIP, air-to-air refuelling and combat operations. Air Marshal Kapoor is one of the pioneers in aerial-refuelling operations in the Indian Air Force and he received training abroad from the original equipment manufacturer.

Air Marshal Kapoor’s staff appointments include Director and Principal Director (Operations) at Air Headquarters, Head of the faculty and Senior Air Force Instructor at the College of Defence Management, Secunderabad, Assistant Chief of the Air Staff Operations (Transport and Helicopters) and Assistant Chief of the Staff (Personnel Airmen and Civilian) at Air Headquarters and Commandant of the Air Force Academy.

He has been awarded with Vayu Sena Medal and Ati Vishisht Seva Medal.

https://indianexpress.com/article/cities/pune/air-marshal-sanjeev-kapoor-nda-commandant-7600819/

Hindustan Times

Mon, 01 Nov 2021

Indian firm edges out Israeli rival, set to upgrade army's AK-47s

Bengaluru-based SSS Defence has edged out Israel's Fab Defense that produces tactical equipment and weapon accessories

By Rahul Singh

A four-year-old Indian weapons company has emerged as the lowest bidder for a contract to upgrade a small number of Indian Army's AK-47 assault rifles, beating off competition from an established Israeli rival and getting a toehold in the Indian small arms market, officials familiar with the development said on Sunday.

Bengaluru-based SSS Defence has edged out Israel's Fab Defense that produces tactical equipment and weapon accessories, and has upgraded Kalashnikov rifles for the Indian Army, said one of the officials cited above. SSS Defence is a manufacturer of small arms, ammunition and weapon accessories.

AK-47s previously upgraded by Israeli firm Fab Defense. (Rahul Singh/HT Photo)

The Indian firm will upgrade an initial lot of 24 AK-47 assault rifles held by an army unit under the Jaipur-based South Western Command, with more orders likely to follow, said a second official.

SSS Defence's AK-47 retrofit system covers tactical flashlights, laser sights, flash hider, dust cover, hand guards and a variety of grips, the official added. "The upgrade will make the AK-47 more lethal and a little easier to work with," he said.

The AK-47 retrofit systems have met the army's exacting requirements. They are capable of being used across all AK-47 platforms in service with the army including those of Russian, Romanian, Bulgarian, Polish and Czech origin.

Experts said the development would provide thrust to the Make in India initiative at a time when the government has sharpened its focus on promoting self-reliance in the defence manufacturing sector and positioning itself as an exporter of military hardware.

The AK-47 is a basic weapon and requires modifications to improve its capabilities, said former Northern Army commander Lieutenant General BS Jaswal (retd).

"An Indian firm upgrading the weapon is a great leap forward, given that indigenisation is a top focus area for the government. It will also result in savings," Jaswal added.

The government has taken a raft of measures to boost self-reliance in the defence sector over the last two years. These include raising foreign direct investment (FDI) in defence manufacturing, creating a separate budget for buying locally-made military hardware and notifying two lists of weapons/equipment that cannot be imported.

India has set aside ₹70,221 crore this year for domestic defence procurement, accounting for 63% of the military's capital budget. Last year, the ministry spent over ₹51,000 crore, or 58% of the capital budget, on domestic purchases.

On October 15, Prime Minister Narendra Modi said one of the country's key goals under the Atmanirbhar Bharat (self-reliant India) campaign was to emerge as one of the most powerful militaries and develop a modern defence industry in the country on its own steam.

https://www.hindustantimes.com/india-news/indian-firm-edges-out-israeli-rival-set-to-upgrade-army-s-ak47s-101635702384964.html

TIMESNOWNEWS.COM

Mon, 01 Nov 2021

[Exclusive] India's special forces to get 716 general purpose Machine Guns from United States

The machine guns are being purchased for the SF units for about Rs 400 crore through the American FMS or Foreign Military Sales route

By Srinjoy Chowdhury

New Delhi: India's special forces-- the paratroopers and commandos-- are getting new much-needed weaponry. The additional firepower comes in the form of 716 General Purpose Machine Guns from the United States. These could be very useful as the special forces units in Jammu and Kashmir are always there to fight off terror attacks.

The machine guns are being purchased for the SF units for about Rs 400 crore through the American FMS or Foreign Military Sales route.

India has purchased a large number of weapon systems from the USA, including a large consignment of light howitzers that can be deployed in the mountains, using the FMS route. This is a direct government-to-government transfer of weaponry without any tenders and then, long-winded procedures. While the weapons may cost a little more, they will arrive quite soon.

The purchase is likely to be cleared at the next meeting of the Defence Procurement Board, headed by defence secretary Ajay Kumar, and if necessary, the meeting of the apex Defence Acquisition Council headed by defence minister Rajnath Singh.

https://www.timesnownews.com/india/article/indias-special-forces-to-get-716-general-purpose-machine-guns-from-united-states/828190

ScienceDaily

Sat, 30 Oct 2021

Researchers set 'ultrabroadband' record with entangled photons

Thin-film nanophotonic device could advance metrology, sensing, and quantum networks

Summary:

Researchers take advantage of quantum entanglement to generate an incredibly large bandwidth using a thin-film nanophotonic device that could lead to advances in metrology, sensing and quantum networks for information processing and communications.

Quantum entanglement -- or what Albert Einstein once referred to as "spooky action at a distance" -- occurs when two quantum particles are connected to each other, even when millions of miles apart. Any observation of one particle affects the other as if they were communicating with each other. When this entanglement involves photons, interesting possibilities emerge, including entangling the photons' frequencies, the bandwidth of which can be controlled.

Researchers at the University of Rochester have taken advantage of this phenomenon to generate an incredibly large bandwidth by using a thin-film nanophotonic device they describe in *Physical Review Letters*.

The breakthrough could lead to:

- Enhanced sensitivity and resolution for experiments in metrology and sensing, including spectroscopy, nonlinear microscopy, and quantum optical coherence tomography
- Higher dimensional encoding of information in quantum networks for information processing and communications

"This work represents a major leap forward in producing ultrabroadband quantum entanglement on a nanophotonic chip," says Qiang Lin, professor of electrical and computer engineering. "And it demonstrates the power of nanotechnology for developing future quantum devices for communication, computing, and sensing,"

No more tradeoff between bandwidth and brightness

To date, most devices used to generate broadband entanglement of light have resorted to dividing up a bulk crystal into small sections, each with slightly varying optical properties and each generating different frequencies of the photon pairs. The frequencies are then added together to give a larger bandwidth.

"This is quite inefficient and comes at a cost of reduced brightness and purity of the photons," says lead author Usman Javid, a PhD student in Lin's lab. In those devices, "there will always be a tradeoff between the bandwidth and the brightness of the generated photon pairs, and one has to make a choice between the two. We have completely circumvented this tradeoff with our dispersion engineering technique to get both: a record-high bandwidth at a record-high brightness."

The thin-film lithium niobate nanophotonic device created by Lin's lab uses a single waveguide with electrodes on both sides. Whereas a bulk device can be millimeters across, the thin-film device has a thickness of 600 nanometers -- more than a million times smaller in its cross-sectional area than a bulk crystal, according to Javid. This makes the propagation of light extremely sensitive to the dimensions of the waveguide.

Indeed, even a variation of a few nanometers can cause significant changes to the phase and group velocity of the light propagating through it. As a result, the researchers' thin-film device allows precise control over the bandwidth in which the pair-generation process is momentum-

matched. "We can then solve a parameter optimization problem to find the geometry that maximizes this bandwidth," Javid says.

The device is ready to be deployed in experiments, but only in a lab setting, Javid says. In order to be used commercially, a more efficient and cost-effective fabrication process is needed. And although lithium niobate is an important material for light-based technologies, lithium niobate fabrication is "still in its infancy, and it will take some time to mature enough to make financial sense," he says.

Other collaborators include coauthors Jingwei Ling, Mingxiao Li, and Yang He of the Department of Electrical and Computer Engineering, and Jeremy Staffa of the Institute of Optics, all of whom are graduate students. Yang He is a postdoctoral researcher.

The National Science Foundation, the Defense Threat Reduction Agency, and the Defense Advanced Research Projects Agency helped fund the research.

Story Source:

Materials provided by **University of Rochester**. Original written by Bob Marcotte. *Note: Content may be edited for style and length.*

Journal Reference:

1. Usman A. Javid, Jingwei Ling, Jeremy Staffa, Mingxiao Li, Yang He, Qiang Lin. **Ultrabroadband Entangled Photons on a Nanophotonic Chip**. *Physical Review Letters*, 2021; 127 (18) DOI: 10.1103/PhysRevLett.127.183601

https://www.sciencedaily.com/releases/2021/10/211029114005.htm

Sat, 30 Oct 2021

The observation of correlated states and superconductivity in twisted trilayer graphene

By Ingrid Fadelli

When two layers of graphene or of other two-dimensional (2D) materials are stacked on top of each other with a small angle misalignment, the crystal lattices produced by each layer are spatially 'out of synch'. This results in a unique structural pattern known as moiré superlattice.

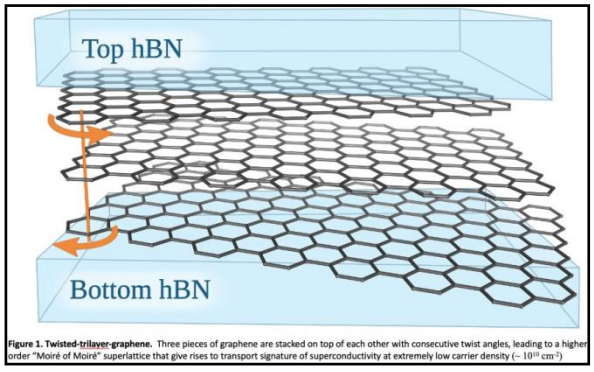


Figure 1. Twisted-trilayer-graphene. Three pieces of graphene are stacked on top of each other with consecutive twist angles, leading to a higher order "Moiré of Moiré" superlattice that give rises to transport signature of superconductivity at extremely low carrier density (~ 10^{10} cm^{-2})

Credit: Zhang et al.

In recent years, many physicists have been investigating the properties and characteristics of moiré superlattices, as they have been found to be particularly promising for the development of new quantum technologies. Most of these studies have focused on twisted bilayer graphene, a material comprised of two layers of graphene stacked on top of each other and rotated by a small twist angle.

Researchers at University of Minnesota and Harvard University have recently carried out a study investigating the properties of twisted trilayer graphene, which consists of three stacked layers of graphene with two consecutive small twist angles. Their paper, published in *Physical Review Letters*, offer evidence of correlated insulating states and the transport signature of superconductivity in the material.

"It was previously demonstrated that twisted bilayer graphene can become superconducting with a precisely-tuned twist angle," Ke Wang, one of the researchers who carried out the study, told Phys.org. "The twisted-bilayers are highly tunable in terms of material parameters and

electrostatics, which allows new insights towards understanding correlated electron physics, and promises new potential quantum electronics applications."

By adding a third layer of graphene, Wang and his colleagues produced a structure that they dubbed 'moiré of moiré' superlattice. They then examined this structure and tried to better understand its properties and characteristics.

"Our recent work adds a 3rd layer of graphene to form a twisted-trilayer," Wang explained. "The two superlattices from layer 1-2 and layer 2-3 are again 'out-of-synch', giving rise to a higher order superlattice, which we refer to as 'moiré of moiré superlattice'. We then cool the system down to low temperature (10mK - 20K) and study its electronic transport behavior."

The higher order 'moiré of moiré superlattice' in twisted-trilayer graphene appears to exhibit highly intricate physics, both structurally and electronically. For instance, the material exhibits the transport signature of superconductivity at an extremely low electron density (~ 10^{10} cm^{-2}), two orders of magnitude smaller than electron densities reported in previous papers.

"Our experimental results also shed important new light on understanding superconductivity in graphene," Wang said. "It was previously believed that electrons need to be energetically isolated before they can give rise to superconductivity in graphene, but our experiment seems to suggest otherwise."

In the future, the new material studied by this team of researchers could prove to be highly valuable for the fabrication of new technology, particularly quantum electronics and computing platforms. Moreover, the findings gathered by Wang and his colleagues could inspire other research teams to also study the potential of twisted trilayer graphene or of other systems that might give rise to a 'moiré of moiré' superlattice.

"The material we unveiled could be a promising atomically-clean superconductor that can be electrostatically tuned with extremely low carrier density change, which is desirable for future quantum electronic devices," Wang added. "To better understand its potential applications, we now plan to study the structural properties of twisted-trilayer graphene using various microscopy techniques and fabricate gate-defined nanostructures to probe and manipulate novel quantum phenomena that could arise from the system."

More information: Correlated insulating states and transport signature of superconductivity in twisted trilayer graphene superlattices. *Physical Review Letters*(2021). DOI: 10.1103/PhysRevLett.127.166802

Journal information: *Physical Review Letters*

https://phys.org/news/2021-10-states-superconductivity-trilayer-graphene.html

PHYS.ORG

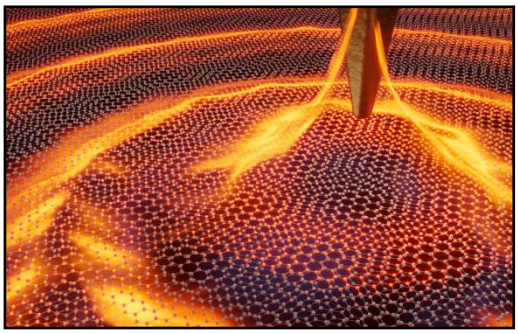
Fri, 29 Oct 2021

Researchers observe interband collective excitations in twisted bilayer graphene

By Ingrid Fadelli

Twisted bilayer graphene is a carbon-based, two-dimensional (2D) material comprising two graphene layers. Although many scientists have recently started exploring its potential for superconductivity and magnetism, so far, there have been very few optical studies examining it.

Twisted bilayer graphene can exhibit vastly different properties than those of single layers of graphene, especially when the two layers it is composed of are rotated relative to each other by a small angle, approximately 1 degree. Investigating and probing these properties could be highly valuable, as it could ultimately enhance the current understanding of superconductivity and facilitate its use for the development of new devices.



Artistic visualization of interband collective excitations launched and propagating in twisted bilayer graphene. Credit: Matteo Ceccanti.

Researchers at the Institute of Photonics Sciences in Barcelona and the Massachusetts Institute of Technology (MIT), as well as other institutes worldwide, have recently carried out a study aimed at probing the collective excitations of twisted bilayer graphene at a spatial resolution of 20 nm, using an optical technique known as mid-infrared near-field optical microscopy. Their efforts, outlined in a paper published in *Nature Physics*, led to the observation of interband collective excitations in the material.

"Twisted bilayer graphene is interesting for optical experiments, especially due to the flat bands combined with the first excited energy band that is also relatively flat," Niels Hesp, one of the researchers who carried out the study, told Phys.org. "As predicted in earlier theoretical works, this allows for a strong interband transition at infrared energies, making it accessible even at room temperature. Our experiments were aimed at studying the collective excitations that are formed from these optical transitions."

Near-field optical microscopy is an advanced technique that can be used to examine the optical properties on a material's surface at a resolution of ~20 nm, which is far below the diffraction limit, the point at which optical systems start imaging objects poorly (i.e., images become blurry). With this technique, light is coupled into a sample via a very sharp tip, which also provides the required momentum to launch interband plasmons.

"Thanks to a long collaboration with Pablo Jarrillo-Herrero's group at MIT, we had early access to their samples," Hesp said. "In fact, one of samples they fabricated for us in 2016 was the first one to show the Mott insulating state. The first observation of interband plasmons in twisted bilayer graphene came as a surprise while running the measurements, as we were not really sure what to expect."

The optical measurements gathered by Hesp and his colleagues unveiled a propagating plasmon mode in charge-neutral twisted bilayer graphene that is markedly different from the intraband plasmon observed in single-layer graphene. In their paper, the team suggests that this could be an interband plasmon associated with the optical transitions between minibands originating from the material's moiré superlattice structure.

"Our work shows that twisted bilayer graphene is equally interesting for optical studies, especially since it is the first system where propagating interband plasmons have been seen with a reasonable quality factor," Hesp said. "This excitation occurs even in an undoped state, meaning that no external voltage is required. While real-world applications are far ahead, it constitutes

another building block to the 'plasmonic toolkit," working towards nanoscale integrated optical circuits."

The observations provide valuable new insight about the distinctive properties of the promising superconducting material twisted bilayer graphene. In the future, their work could thus contribute to the development of various, new optical devices and integrated circuits.

"As twisted graphene structures form a class of materials hosting many fascinating phenomena, we basically just have started the journey," says Prof. Koppens, the leader of the study. "We now aim to access the correlated states at cryogenic temperatures with optics. To this end, we installed a new type of near-field microscope that can operate down to 5K, in which we study the interaction of light with the strongly interacting electrons. This technique turns out to be very sensitive to the electronic properties of TBG, and could potentially point at the physical mechanisms of the superconducting and magnetic phenomena."

More information: Niels C. H. Hesp et al, Observation of interband collective excitations in twisted bilayer graphene, *Nature Physics* (2021). DOI: 10.1038/s41567-021-01327-8

Journal information: *Nature Physics*

https://phys.org/news/2021-10-interband-bilayer-graphene.html

COVID-19 Research News

The Daily Guardian

Mon, 01 Nov 2021

research explores how immune system gets altered by covid-19

Ludwig Maximilian University of Munich researchers say that COVID-19 reduces the numbers and functional competence of certain types of immune cells in the blood.

This could affect responses to secondary infections. The findings were published in the journal PLOS Pathogens. The SARS-CoV-2 coronavirus causes moderate to severe disease in 3-10 per cent of those infected. In such cases, the immune system overreacts to the virus, triggering an aberrant innate immune response that is characterized by systemic inflammation, intravascular blood clotting and damage to the cardiovascular system.

A team led by immunology professor Anne Krug at LMU's Biomedical Center (BMC), which included many researchers based at the BMC and the LMU Medical Center, has carried out a comprehensive study of this phenomenon and uncovered hitherto unknown effects of the virus on the immune system.

In the journal PLOS Pathogens, they report that, following infection with SARS-CoV-2, the numbers of immune cells called dendritic cells in the circulation decline, while the functionality of the remaining fraction is impaired.

The authors believe that this could make patients more susceptible to secondary infections during, and immediately after recovery from a bout of COVID-19.

Dendritic cells (DCs) are responsible for initiating immune responses against invasive pathogens. They do so by activating helper T cells, which in turn stimulate B cells to secrete antibodies directed against the invader. Krug and her colleagues set out to determine the effects of moderate to severe coronavirus infection on this process. They analyzed blood samples obtained from 65 COVID-19 patients who had been treated at the LMU Medical Center.

They found that there were fewer DCs in these samples than in the blood of healthy controls. Furthermore, DCs isolated from the blood of patients showed a reduced ability to activate T cells.

“We had actually expected that DCs isolated from patients infected with SARS-CoV-2 would activate T cells more potently than DCs obtained from healthy donors,” says Krug.

“However, we discovered that, in the course of the disease, the proteins present on the surface of the DCs in patients’ blood were altered in a way that made them more likely to inhibit T cell responses.” In spite of this, by 15 days after diagnosis 90 per cent of these patients had generated antibodies directed against the SARS-CoV-2 spike protein, and many of them had also activated a T cell response. – these responses are the hallmarks of a robust immune reaction against the virus. “So, the drop in the numbers and reduced functionality of DCs does not seem to have a negative impact on the immune response to the coronavirus itself,” Krug says.

However, she is convinced that the reduced number and altered function of DCs is significant. It is conceivable that this might cause the immune system to react less strongly than expected to bacterial or other viral infections following recovery from COVID-19, but this possibility will require further clinical investigation.

What might account for the depletion of DCs in the blood and the decrease in their capacity to stimulate T cells? – Krug has several hypotheses to offer. It could in fact represent an appropriate regulatory process, she suggests. COVID-19 is often associated with vigorous inflammation reactions – so the phenomenon might be part of an attempt to downregulate inflammatory processes.

Dendritic cells might migrate from the blood into inflamed tissues, such as the lung, which could explain the fall in the numbers of DCs in the circulation. “However, we also found that the regeneration of dendritic cells is delayed,” Krug points out.

The authors of the study believe that this phenomenon could weaken the ability of patients to mount effective immune responses to other pathogens during, and in the immediate aftermath of asymptomatic COVID-19 infection. The team will now explore this issue further in an effort to determine whether the effects of SARS-CoV-2 on DCs play a role in long-term COVID.

https://thedailyguardian.com/research-explores-how-immune-system-gets-altered-by-covid-19/