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Fri, 22 Oct 2021

India among select few countries developing hypersonic missiles: U.S. Congressional report

CRS said that although the U.S., Russia and China possess the most advanced hypersonic weapons programmes, a number of other countries, including India are developing hypersonic weapons technology

Washington: India is among the select few countries which are developing hypersonic weapons, an independent Congressional report has said, amidst a media report which claimed that China recently tested a nuclear-capable hypersonic missile which circled the globe before missing its target, demonstrating an advanced space capability that caught U.S. intelligence by surprise.

The independent Congressional Research Service (CRS), in a latest report this week, said that although the U.S., Russia and China possess the most advanced hypersonic weapons programmes, a number of other countries, including Australia, India, France, Germany and Japan, are also developing hypersonic weapons technology.

While Australia has collaborated with the U.S., India has collaborated with Russia on this, the CRS said in its report.

India has collaborated with Russia on the development of BrahMos II, a Mach 7 hypersonic cruise missile, the CRS report said.

“Although BrahMos II was initially intended to be fielded in 2017, news reports indicate that the programme faces significant delays and is now scheduled to achieve initial operational capability between 2025 and 2028.”

“Reportedly, India is also developing an indigenous, dual-capable hypersonic cruise missile as part of its Hypersonic Technology Demonstrator Vehicle programme and successfully tested a Mach 6 scramjet in June 2019 and September 2020,” the CRS said.

India operates approximately 12 hypersonic wind tunnels and is capable of testing speeds of up to Mach 13, said the Congressional report which is prepared by independent subject area experts for members of the U.S. Congress.

The Financial Times this week reported that China has tested hypersonic missiles. However, China denied it, saying it tested a hypersonic “vehicle” and not a nuclear-capable hypersonic “missile” as reported by the leading British newspaper which also said that the missile missed its target by about two-dozen miles.

The report said that China tested the nuclear-capable hypersonic missile in August that circled the globe before speeding towards its target, demonstrating an advanced space capability that caught U.S. intelligence by surprise.



A Hypersonic Air-breathing Weapons Concept (HAWC) missile is seen in an artist's conception. Photo: Defense/Handout via Reuters

According to the CRS, since 2007, the U.S. has collaborated with Australia on the Hypersonic International Flight Research Experimentation (HIFiRE) programme to develop hypersonic technologies.

The most recent HIFiRE test, successfully conducted in July 2017, explored the flight dynamics of a Mach 8 hypersonic glide vehicle, while previous tests explored scramjet engine technologies, it said.

HIFiRE's successor, the Southern Cross Integrated Flight Research Experiment (SCIFiRE) programme, is to further develop hypersonic air-breathing technologies.

SCIFiRE demonstration tests are expected by the mid-2020s.

In addition to the Woomera Test Range facilities, one of the largest weapons test facilities in the world, Australia reportedly operates seven hypersonic wind tunnels and is capable of testing speeds of up to Mach 30, the report said.

Like India, France has also collaborated and contracted with Russia on the development of hypersonic technology. And Japan is developing the Hypersonic Cruise Missile (HCM) and the Hyper Velocity Gliding Projectile (HVGPP), it said.

The CRS said that in recent years, the U.S. has focused such efforts on developing hypersonic glide vehicles, which are launched from a rocket before gliding to a target, and hypersonic cruise missiles, which are powered by high-speed, air-breathing engines during flight.

The Department of Defence (DOD) is currently developing hypersonic weapons under the Navy's Conventional Prompt Strike programme, which is intended to provide the U.S. military with the ability to strike hardened or time-sensitive targets with conventional warheads, as well as through several Air Force, Army and DARPA programmes, the CRS said.

According to the CRS, unlike programmes in China and Russia, U.S. hypersonic weapons are to be conventionally armed.

“As a result, U.S. hypersonic weapons will likely require greater accuracy and will be more technically challenging to develop than nuclear-armed Chinese and Russian systems,” it added.

<https://www.thehindu.com/news/international/india-among-select-few-countries-developing-hypersonic-missiles-us-congressional-report/article37119764.ece>

Atmanirbhar Bharat in Defence Sector: A dream comes true

By Col (Dr.) P K Vasudeva

Its strong economy and strong army know a nation's strength. As far as India is concerned, it has a strong economy but not a strong army so far. It is doubtful to withstand joint operations from China and Pakistan supported by Taliban Afghanistan, as the full support from the US is doubtful. India has to therefore become self-reliant – Atmanirbhar – to defeat the enemy.

The Indian Army accounts for more than half of the total defence budget of India, with most of the expenditure going to the maintenance of cantonments, salaries and pensions, instead of critical arms and ammunition.

The military budget or defence budget of India is the portion of the overall budget of Union budget of India that is allocated for the funding of the Indian Armed Forces. The military budget finances employee salaries and training costs, maintenance of equipment and facilities, support of new or ongoing operations, and development and procurement of new technologies, weapons, equipment, and vehicles.



The Indian Army accounts for more than half of the total defence budget of India, with most of the expenditure going to the maintenance of cantonments, salaries and pensions, instead of critical arms and ammunition.

Atmanirbhar Bharat in Defence Sector: A Dream Comes True

Presenting her second and Narendra Modi Government's seventh regular budget on February 1, 2020, Finance Minister Nirmala Sitharaman earmarked Rs. 4,71,378 crore (US\$ 66.9 billion) for the Ministry of Defence (MoD), stating that national security is a top priority of the government. Of the MoD's total allocations, Rs. 3,23,053 crore (\$45.8 billion) has been provided under the Defence Services Estimates (DSE), an annual publication of the finance wing of the MoD that primarily deals with the expenses of the three armed forces and the Defence Research and Development Organisation (DRDO), and is popularly considered as India's defence budget. The balance allocation is distributed between defence pensions (Rs. 1,33,825 crore or \$19.0 billion) and MoD (Civil) (Rs. 14,500 crore or \$2.1 billion). Representing a growth of 9.4 per cent, MoD's overall allocation translates into an increase of Rs. 40,367 crore. This raises the question, how would this increase affect India's defence and modernisation in particular?

This budget is just 1.7 per cent of the GDP, which is just not sufficient for the modernisation of defence forces keeping in view of the threat perception from China and Pakistan especially after the independence of Afghanistan with Taliban at the helms of affairs.

India emerged as the second-largest importer of arms transferred between 2016-20, with a share of 9.5 per cent of global arms imports India's arms imports fell 33 per cent between 2011-15 and 2016-20, said a report released by the Stockholm International Peace Research Institute (Sipri) at a time the country has taken a raft of measures to cut dependence on imported military hardware.

The new companies now have an order book of Rs 65,000 crore. These orders were in the pipeline and have been shifted to the new entities.

To make India self reliant in the defence sector, the Ordnance Factory Board (OFB) has been split into seven different companies. Prime Minister Narendra Modi has dedicated these seven companies to the nation on the auspicious occasion of Vijayadashmi. The new Defence PSUs are 100 percent government owned corporate entities and will help in improving the country's self-reliance in defence preparedness.

Business in the seven new entities started from October 1, 2021. These new companies are: Troop Comforts Limited (TCL); Yantra India Limited (YIL); Gliders India Limited (GIL); India Optel Limited (IOL); Advanced Weapons and Equipment India Limited (AWE India); and Armoured Vehicles Nigam Limited (AVANI).

Paying tributes to Dr APJ Abdul Kalam, Prime Minister Modi said that Dr Kalam had dedicated his life to the cause of a strong nation. “Restructuring of Ordnance Factories and creation of seven companies will give strength to his dream of a strong India,” the PM added. According to him the new companies are a part of the various resolutions, which the country has been pursuing to build a new future for them and these, would play an important role in import substitution, in line with the vision of ‘Atmanirbhar Bharat’.

The new companies now have an order book of Rs 65,000 crore. These orders were in the pipeline and have been shifted to the new entities. The PM in his address cited Defence Corridors in Tamil Nadu and Uttar Pradesh as examples of the new approach. In the last five years the defence exports, according to the Prime Minister, have touched 325 percent and due to policy changes new opportunities have emerged for the youth in the MSMEs.

In the 21st century, since the growth and brand value of any company or nation is based on its R&D and innovation, through his address he appealed to the new companies to take the lead in future technologies. These new companies have complete functional autonomy and the interests of the employees are fully protected.

The Centre, in May 2020, had announced increasing the FDI limit from 49 per cent to 74 per cent under the automatic route in the defence sector.

According to Defence Minister Raj Nath Singh, the move to create new companies is a reflection of the government’s commitment to Atmanirbhar Bharat. And stating the objective of the restructuring of the OFB, he said, “It is to transform the Ordnance Factories to improve expertise in product range; profitable and productive assets; ensure self reliance; enhance cost effectiveness and improve quality and increase competitiveness.”

He also voiced the government’s resolve of creating India as a defence manufacturing hub and net exporter. This can be achieved through the active participation of the private sector, setting up of defence manufacturing units as well as creating joint ventures. According to the defence minister, “To enhance preparedness of the armed forces, the public and private sectors are working hand-in-hand.”

The members of Society of Indian Defence Manufacturers (SIDM) welcomed the creation of seven new companies and expressed that the industry is looking forward to doing business with them. These new companies will adopt corporate standards for their commercial activities. This includes tendering, contracting to payment systems etc. and vendor development.

The Centre, in May 2020, had announced increasing the FDI limit from 49 per cent to 74 per cent under the automatic route in the defence sector. The government has been emphasising boosting indigenous defence manufacturing. The Ministry has set a goal of a turnover of \$25 billion (Rs 1.75 lakh crore) in defence manufacturing by 2025 that included an export target of \$5 billion (Rs 35,000 crore) worth of military hardware.

The delay in announcing the corporatising of 41 ordnance factories is understandable, given its antiquity and the powerful and entrenched unions that they have with 81,500 employees.

India has the dubious reputation of being the second-largest importer of conventional arms (9.5 per cent) as per the SIPRI 2021 report.

The current arrangement of the government is significantly different since the four proposed public sector undertakings (PSUs) will continue to handle gliders, parachutes, optics, components and ancillaries, and products designed for troop comfort. This will perpetuate poor quality, delay and high price in products that can easily be sourced from private players at better price and quality. While this strategy made sense during the world wars, when the private sector’s capability was inadequate, India after 1991 with its thrust on liberalisation, privatisation and globalisation, must not perpetuate making these low tech, non-strategic items in captive ordnance factories.

While the level playing field doctrine advocated by Kelkar has encouraged companies like L&T, Mahindra & Mahindra, Godrej & Boyce, Tatas and a number of IT companies to come in, the paltry 26 per cent FDI hardly enthused any major OEM to set up a production base in India. The government then announced an offset policy in 2006 to leverage India's big-ticket acquisition to get outsourcing, export orders and critical technology from major global defence manufacturers. The experience so far has been dismal, except for some outsourcing orders for low-tech items.

Despite these initiatives, India's military industry capability shows a sorry picture and the private sector is still not being treated as a partner in India's quest for higher self-reliance. A GE 404 engine from the US powers the much-hyped indigenous Light Combat Aircraft (LCA), while the radar is sourced from ELTA, Israel. The Kaveri engine development by the Gas Turbine Research Establishment (GTRE) has been an unmitigated disaster. German MTU engines power the Main Battle Tank (MBT), the showpiece indigenous tank. Despite the significant hike in FDI, the inflow has only been \$300 million from April to September 2020. This is largely due to the number of caveats for allowing 76 per cent FDI.

India has the dubious reputation of being the second-largest importer of conventional arms (9.5 per cent) as per the SIPRI 2021 report. The Kalam Committee assessed our Self Reliance Index (SRI) in 1993 as 30 per cent, with a road map to increase it to 70 per cent in a decade's time. The committee had identified a number of critical subsystems like the focal plane array, passive seekers, stealth, AESA radar, RLG and carbon fibres where India's design and development quality needs to be significantly ramped up. Weapons, propulsion and sensors remain the main bugbears of India's design capability in the DRDO and India's SRI has not inched forward.

The government clearly prefers the private sector. A major development has been the ToT contract with Tatas rather than with HAL for building 40 C-295 transport aircraft.

Technology transfer has been India's major policy mosaic to build major systems and platforms since 1963 (in the aftermath of the MiG-21 aircraft). HAL has been producing Sukhoi Su-30 on the basis of technology transfer documents from Russia. Similar is the story of the T90 produced in the Avadi tank factory, based on technology transferred from Russia. From this, it is evident that manufacturing is based on foreign design, rather than indigenous design. The general diatribe against defence PSUs is that they are good integrators of imported subparts rather than manufacturers in the true sense. No wonder, value addition of HAL in Su-30 production is less than 20 per cent.

The major problem afflicting the OFB is not the lack of autonomy or accountability but the wherewithal to improve capability. The R&D spending in OFB is as low as 0.7-0.8 per cent of their turnover. The other big drag has been expenditure on new capital, which is less than 1 per cent of their revenue expenditure. The capital expenditure is also a measly 3-5 per cent of total expenditure. While the ordnance factories have a well-run renewal and replacement budget to replace obsolete machines, they invest very little in state of the art capital and machinery.

The Corporatisation of the OFB has to be seen in the overall context of improving India's military industry capability, self-reliance quotient, design capability in critical systems and quality, time and cost-effectiveness and involvement of private players in defence manufacturing as partners in tandem with OEMs and design houses. The shift from MMRCA transfer of technology (ToT) contract with HAL (buy and make) to buying aircraft from Dassault Aviation in France directly is a clear demonstration of how HAL has not been meeting user expectations and also of the ToT partner.

The government clearly prefers the private sector. A major development has been the ToT contract with Tatas rather than with HAL for building 40 C-295 transport aircraft. This is the first time that a major ToT is being availed of by a private company. Research cannot be the monopoly of the DRDO. The private sector, academia and reputed design houses must be part of this process, which will improve India's design capability significantly.

<https://www.thenorthlines.com/atmanirbhar-bharat-in-defence-sector-a-dream-comes-true/>

Armed Forces' tactical info-communication network: key to India's warfighting capability

The tactical communication networks possess highly formatted message structures for information exchange to achieve interoperability using optimum bandwidth

By Milind Kulshreshtha

In a modern battlefield the availability of accurate critical real-time tactical information decides the outcome of the military operations. This information is carried over a tactical info-communication network for a particular area of operation to provide a synergized command and control over the deployed war-fighting units. These digital communication networks form the essence of an Action Information Organisation to ensure the latest common situational awareness picture for each of the participating units. The info-communication networks too are integrated with the higher echelons at local and central headquarter levels as per pre-defined permission protocols. Each node in the warfighting capacity has an access to the real-time information for improved decision making and to eliminate the risk of friendly fire in a high intensity multi-dimensional conflict zone.



The traditional hardware-based radios have cross-functionality limitations and can only be modified through physical changes.

The tactical communication networks possess highly formatted message structures for information exchange to achieve interoperability using optimum bandwidth. The primary capabilities required relate to concurrent operations of multiple tactical networks and obtain tactical information from all units to correlate with the local picture and update friendly units' weapons computations. The management of such a network against challenges like message conflicts and gridlock etc. are overcome continuously for achieving a flexible architecture. The interfacing of legacy systems with the latest generation tactical data links has never been an easy task.

India's Tactical Info-Communication Network

In India, the three services have been independently pursuing the design and development of tactical info-communication networks, each network tailored to meet the challenges of their individual battlefield characteristics. Various governmental organizations like DoT, DRDO, Defence PSUs and some selected private players have been integral to these efforts by the three services. The decision to proceed indigenously in this effort is a difficult path but the most secure from a long-term perspective.

Indian Navy has its own ambitious programme to evolve a ship borne indigenous info-communication Tactical Data Link to maximize the data throughput with minimum latency. This datalink system has an aircraft version for Naval aviation units for a close operation with the warships and submarines at sea. Meanwhile, IAF has independently been upgrading its operational Datalink system to keep itself enabled as a network-empowered force, especially when operating fighter jets from Russia, France etc.

The Indian Army is rapidly progressing towards creating ASCON (Army Static Switched Communication Network) as an integrated communication network along with other systems like Tactical Communication System (TCS), tropo-scatter communication etc. to achieve a multi-layered Tactical Info-communication Network. Indian Army's Combat Net Radio (CNR) has always been the backbone of communication for the land battlefield operations. The technical work

towards enhancement of CNR for data transmission features has been an ongoing activity to achieve C4I capabilities.

Software Defined Radios (SDRs) as a Technological Breakthrough

The traditional hardware-based radios have cross-functionality limitations and can only be modified through physical changes. The SDRs are a special kind of advanced Radio system where the physical layer functions are implemented using the software code. SDRs have the flexibility to operate over a large portion of the spectrum and support multiple protocols and are multimode, multi-band and multi-functional Radios. The SDRs are software configurable by simply downloading the latest version over the existing hardware and, thus, are adaptable throughout the lifespan of the hardware. SDRs enhance the data transmission capability, voice improvement and data transmission quality even in a spectrally noisy environment. They operate in clear and secure mode using multiple waveforms thereby providing a greater system security and survivability.

BEL,DRDO, CDAC, WESEE (Naval R&D Lab) and other service arms have been working towards the development of a family of modular and interoperable Software Defined Radios (SDRs) versions (like Naval Combat (SDR-NC), Tactical (SDR-TAC), Airborne (SDR-AR), Manpack (SDR-MP) and SDR-HH (Hand Held)). Here, the SDR-Tac is a four Channel nineteen inch ship rack mountable unit to support simultaneous operations of all four V/UHF and L band to achieve ship-to-ship, ship-to-shore and ship-to-air voice and data communication. In order to support ad hoc networking operations, the MANET (Mobile ad-hoc Network) waveform is used in UHF and L-band, and SDR is capable of multiple types of waveforms for narrowband and wideband applications. Indian Army has been in the process of replacing the legacy radios with the indigenously developed V/UHF Manpack SDRs under Make-II category since Feb' 2021. The CNR for Armoured Fighting Vehicles (CNR-AFV) too shall be SDR based in the future.

Interoperability Challenges

The complexity in the tactical networks is caused by multiple reasons, like the dynamic integration with multiple systems for critical data exchange. The designed analytics within such systems assists in deriving intelligence from the data links for interoperability and secure data exchange between land combatants, warships, submarines and fighter jets. With the evolution of the Theatre Commands, a larger commonality and synergy amongst the tri-services' Tactical Info-Communication Network is more required now than ever before. Accordingly, steps towards achieving jointness amongst the Armed Forces are being looked at by developing a Joint Services Interoperable SDR Waveforms.

For operating in a multi-national Task Force environment and for an inclusive closer participation in combat activities, a bridge between Indian Tactical info-communication Network and that of the NATO forces is much desired. NATO and US Tactical Data Links are Link-11, Link-16, IJMS (Interim Joint Tactical Information Distribution System Message Specification), JREAP (Joint Range Extension Applications Protocol), ATDL-1 (Advanced Tactical Data Link). The presently operational Link-22 combines these efforts to achieve NATO standard for tactical information exchange amongst the military units. Even the US has been facing a challenging time to operationalize and upgrade its Tactical Data Link network. The development of Link-22 commenced in 1992 to replace the legacy Link-11 system (like low data rate, susceptibility to electronic interference and lack of robustness) and enhance the allied forces interoperability. The Standardized NATO Agreement (STANAG) 5522 specifications are the guidelines for Link-22.

Way Ahead

The challenges ahead are not only limited to the backward compatibility with the legacy systems, but also the ever evolving 'real-time' constraints and voluminous data-sets of the future battlefields. With the advent of Artificial Intelligence in Combat Management System Onboard Fighter jets' cockpit, warship or a combat vehicle, the scale and latency constraints on data availability has already multiplied manifold. Furthermore, the ongoing and future technological advancements like 5G, General Atomics' Mercury-ion atomic clock in space (for GPS and Deep Space communication improvement), free-space Quantum communication etc. shall continue to be

the drivers for the progression. Thus, the Tactical Info-communication Networks of the Indian Armed Forces shall not only remain an interoperability challenge but also an evolutionary military science in the 21st century. An integrated tri-services led Tactical Info-communication Network Project Management team with support from DPSUs, DRDO and other private agencies under the ambit of Atmanirbhar Bharat initiative may be a suitable way forward to keep the Armed Forces future ready.

(The author is a Strategic Analyst with a keen interest in technology related to C4I solutions and Multiplatform Multi-sensor Data Fusion (MPMSDF). Views expressed are personal and do not reflect the official position or policy of Financial Express Online.)

<https://www.financialexpress.com/defence/armed-forces-tactical-info-communication-network-key-to-indias-warfighting-capability/2353884/lite/>



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Eastern Ladakh situation required stretching of equipment to limits: IAF Chief

On a question on the eastern Ladakh situation last year, he said that in the last one year, due to the challenges faced in the harsh atmosphere of the region, "we have realised, where we fell short" whether it was in terms of adequate clothing, shelters for people to live there

The situation that developed in eastern Ladakh last year required acclimatisation of a large number of IAF personnel and stretching of equipment to limits, but the force is "much better prepared" now in case there is a "long haul", Chief of Air Staff Air Chief Marshal V R Chaudhari said on Thursday.

In an interaction at a defence conclave here, he also said it was a matter of concern that depleting number of fighters is continuous, whereas the induction is some way off, and asserted that it should be ensured that drawdown of fighter squadron is quickly compensated by new induction, so "we don't lose our overall capabilities".

On a question on the eastern Ladakh situation last year, he said that in the last one year, due to the challenges faced in the harsh atmosphere of the region, "we have realised, where we fell short" whether it was in terms of adequate clothing, shelters for people to live there.

"The situation that developed in eastern Ladakh last year was something that we were not very familiar with, particularly in the kind of environment that we needed to operate. It required acclimatisation of a large number of personnel at short notice, required stretching our equipment to limits, which some of it were not cleared for," he said.

The IAF chief said, "We have moved equipment to altitude, well above the altitudes they were tried and tested for, when we acquired those systems." Following the escalation in tension in eastern Ladakh in mid-June last year, the IAF deployed almost all its frontline fighter jets like Sukhoi 30 MKI, Jaguar and Mirage 2000 aircraft as well as its attack helicopters in the key air bases in eastern Ladakh and elsewhere along the Line of Actual Control.

At the conclave held at the Constitution Club of India, the IAF chief, in response to a question, also shared other challenges faced by the air force in the region.



Chief of Air Staff Air Chief Marshal V R Chaudhari.
Image source: ANI

There was also the challenge of continuously rotating the manpower, to take care of their health, he said.

"As a result, over the last one year, we have realised, where we fell short, whether it was in terms of adequate clothing, shelters for people to live there. So, we have overcome all those shortages now, and I think, we are better prepared, in case there is a long haul, we are prepared this winter, much better than what we were last year," he said.

During the 89th IAF Day speech at Hindon Airbase on October 8, Air Chief Marshal Chaudhari had asserted that the IAF's prompt actions in response to developments in eastern Ladakh last year were a testament to its combat readiness.

The year gone by was "quite challenging yet extremely rewarding", he had said. In response to another question on threats faced by India, he said, "I can assure you that we are fully aware of the threats that we face, and our acquisitions, training, and tactics developed to counter such a threat".

"I can say with some degree of confidence that the way we go about analysing the threat perception, carrying out global scan of the political situation, of the acquisitions and modernisation of the adversaries, and to counter that we plan are our own acquisition for air force, and linked to that is training, and development of new tactics," he said.

He also spoke about the contract signed with state-run Hindustan Aeronautics Limited to deliver 83 Light Combat Aircraft (LCA) Tejas aircraft to the IAF.

"We are in the process of acquiring 12 additional Su-30s, 21 additional MiG-29s. And, we have placed our trust and given our commitment in acquiring the AMCA, and beginning next decade, we will probably start inducting the AMCA (next-generation advanced multi-role combat aircraft)," the IAF chief added.

He also mentioned about the 56 C-295 medium transport aircraft which will replace Avro-748 planes of the IAF. "The vision of being Atmanirbhar has been enunciated. And, we are very clear on the future course planning, to be based largely on indigenous efforts... This is where I find there is a large scope for the Indian industry to stand up and meet the challenges, to meet our requirements," he added.

He said that the IAF has upgraded some of the foreign platforms like MiG-21, MiG-29 the Jaguar, but "we are now focussing on procuring and upgrading most of the systems within the country".

Also, to add, when it comes to ground system, almost every radar that is operating on ground, is made in India or is largely made in India, the IAF chief said.

On planned theaterisation, he said, "We have proposed some alternative models that can capitalise on the three aspects, strengths of three forces, reducing decision-making cycles, and being future-ready." Air Chief Marshal Chaudhari said he was "satisfied" with the quality of intake of airmen and officers, adding, as they pass out, "we ensure that personnel are quite future-ready and capable of handling high technology and understanding network and data".

<https://www.moneycontrol.com/news/india/eastern-ladakh-situation-required-stretching-of-equipment-to-limits-iaf-chief-7610791.html>

India is optimistic to build an indigenous stealth fighter

The effort is being led by India's Defence Research and Development Organisation and Hindustan Aeronautics Limited. The Advanced Medium Combat Aircraft (AMCA) program has its roots in an Indian effort to modernize the Indian Air Force's (IAF) stock of older fighters, including the SEPECAT Jaguar and Dassault Mirage 2000. The AMCA project has undergone multiple iterations, but the core requirement is for a stealth, single-seat multi-role multirole fighter.



In 2018, India withdrew from the joint Russian-Indian Fifth Generation Fighter Aircraft (FGFA) program to manufacture a new fighter based on Russia's Su-57 fighter jet. Though the IAF had its share of concrete technical reservations with the FGFA—centered mainly on the Su-57's stealth performance and the production challenges facing its bespoke Izdeliye 30 engine—New Delhi's decision to withdraw from the FGFA program was not without its political context. Namely, the FGFA partnership gradually became a liability in light of India's goal to build up its domestic defense industry as part of the government's 2014 Make in India initiative.

The AMCA, then, is as much a technical project as it is part of New Delhi's broader policy effort to reinvest in India's defense sector. The effort is being led by India's Defence Research and Development Organisation and Hindustan Aeronautics Limited and is likewise slated to involve efforts from local contractors.

The details have shifted somewhat in the past decade, but here is where the AMCA project currently stands. As a fifth-generation fighter with "sixth-generation characteristics," the AMCA will boast a very low radar cross-section for superior stealth performance, integration of certain AI-based systems for streamlined operation, and an advanced cockpit display with a touch screen interface. The AMCA's avionics suite will be headlined by a large suite of advanced radars and electronic warfare systems.

The AMCA will also reportedly feature thrust-vectoring engines for superior maneuverability, an impressive feat considering all the other advanced technologies being packed into it. Little is known about the AMCA's armaments, which reportedly will be carried entirely in an internal weapons bay configuration to maximize stealth performance and deep penetration capability. The fighter will feature Beyond-Visual Range missile targeting capability. In addition to the usual crop of air-to-air missiles, standoff weapons, and guided bombs, the fighter will also reportedly support directed-energy weapon (DEW) systems; it is unknown precisely what form the fighter's rumored DEW capability will take.

The AMCA seems more similar to Lockheed Martin's F-35 jet than to Russia's Su-57 jet or China's J-20 jet, in that it's designed as a role-flexible fighter capable of executing a wide range of missions depending on loadout. The AMCA appears to be a complement rather than a replacement, for the IAF's air superiority fighters, serving as a flexible force multiplier with superior penetration capabilities.

The IAF's delivery timeline is liable to change in the coming years as the project moves further along, but the AMCA is currently expected to make its maiden flight by 2025, with serial production to begin by 2028.

<https://www.eletimes.com/india-is-optimistic-to-build-an-indigenous-stealth-fighter>

CRA qualifies indigenously developed weapon corset for land launched version of BrahMos Missile

Noida: After successfully indigenizing and delivering the first lot of Corsets for Air Launched BrahMos Cruise Missile, Combustion Research Associates (CRA) recently successfully qualified the Transportation and Storage Corset for the Land Launched Version of BrahMos Missile. This significant development bolsters the Make-in-India movement and exemplifies the role of MSMEs in showcasing India's engineering and manufacturing capabilities on a global stage. Development of Corsets required significant engineering, indigenization and vendor development.

<https://www.dailypioneer.com/2021/business/briefs-briefs-2021-10-22.html>

Defence Strategic: National/International



Press Information Bureau
Government of India

Ministry of Defence

Thu, 21 Oct 2021 5:30PM

Conclusion of Naval Commanders' Conference – 2021/02

The Naval Commanders' Conference which commenced on 18 October 2021, concluded today after four days of fruitful deliberations.

The Hon'ble Raksha Mantri addressed Naval Commanders on 18 October 2021 and commended the men and women of the Indian Navy for their professionalism and dedication towards maintaining a high operational tempo and safeguarding maritime interests of the nation. He highlighted the importance of India's maritime character and geo-strategic location



which are the twin factors that have played an important role in our growth as a nation and evolution as a civilization. Further, he stressed on the need to have strong Navy due to our increasing dependence on the seas for national development, and for proactive engagement with the world. RM commended Navy to have lived up to the expectation of the Nation by establishing a visible, credible and responsive presence in the IOR. He also complimented the Navy for providing medical aid to South West Indian Ocean Region countries, as part of Mission SAGAR which is in lines with Hon'ble PM's clarion call for Security And Growth for All in the Region; undertaking various HADR Operations in the wake of natural calamities; and providing succour to civil populace during the second wave of COVID-19.

The Hon'ble RM highlighted that Indian Navy has spent more than two-thirds of the Modernisation Budget in the last five years towards indigenous procurement and out of 41 ships and submarines ordered by the Navy, 39 are from Indian shipyards, which is a testament to the Navy's commitment to 'Atmanirbhar Bharat'. He urged IN to maintain the momentum achieved thus far and assured that the steps taken by the Government will give it more strength to increase the lethal strike capability. Hon'ble RM also emphasized that P75(I) project would be one of the largest 'Make in India' projects and complimented IN on the successful maiden Sea Trials of the indigenously designed and built Aircraft Carrier 'Vikrant' by overcoming challenges, including COVID related imponderables. Additionally, the Minister also highlighted training as an effective tool in bolstering naval diplomacy and commended the Navy in providing training to foreign personnel in India for more than four decades. Further, in keeping with the evolving technological transformation world over in unmanned systems, an Integrated Unmanned Roadmap for IN was also promulgated by Hon'ble RM during the conference.

The Commanders interacted with Chief of Defence Staff, Chief of Army Staff and Chief of Air Staff and discussed wide range of issues including ways to enhance tri-services synergy in view of the evolving regional security scenario.

Chairing the conference, the Chief of the Naval Staff Admiral Karambir Singh addressed the Naval Commanders on various important issues pertaining to combat readiness, capability enhancement, credibility as Maritime Force, safety, maintenance, op logistics philosophy, infrastructure development and human resource management. He also drew attention to the prevalent security situation and the increasing mandate of IN in the contested environment of the IOR. The Commanders deliberated on methods to optimize outcomes and fulfill operational requirements within the available resource envelope, in all facets such as operations, acquisitions, infrastructure, maintenance, logistics, HR management and training. This along with placing primacy on the operational assets of the Indian Navy were themes of the Naval Commanders' Conference.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1765507>



पत्र सूचना कार्यालय
भारत सरकार

रक्षा मंत्रालय

Thu, 21 Oct 2021 5:30PM

नौसेना कमांडर सम्मेलन 2021/02 का समापन

18 अक्टूबर 2021 को शुरू हुआ नौसेना कमांडरों का सम्मेलन आज चार दिनों के सार्थक विचार-विमर्श के बाद संपन्न हुआ।

रक्षा मंत्री श्री राजनाथ सिंह ने 18 अक्टूबर 2021 को नौसेना कमांडरों को संबोधित किया और भारतीय नौसेना की उच्च अभियानगत गति को बनाए रखने और राष्ट्र के समुद्री हितों की सुरक्षा करने के लिए उनके समर्पण की सराहना की। उन्होंने भारत के भू-



रणनीतिक स्थान के महत्व पर प्रकाश डाला। उन्होंने एक राष्ट्र के रूप में विकास तथा एक सभ्यता के रूप में विकास की महत्वपूर्ण भूमिका पर प्रकाश डाला। इसके अलावा उन्होंने राष्ट्र के विकास के लिए और दुनिया के साथ सक्रिय जुड़ाव के लिए समुद्र पर हमारी बढ़ती निर्भरता के कारण मजबूत नौसेना की आवश्यकता पर जोर दिया। रक्षा मंत्री ने हिंद महासागर क्षेत्र में एक दृश्यमान, विश्वसनीय और उत्तरदायी उपस्थिति स्थापित करके देश की उम्मीदों पर खरा उतरने के लिए नौसेना की सराहना की। उन्होंने मिशन सागर के अंतर्गत दक्षिण पश्चिम हिंद महासागर क्षेत्र के देशों को चिकित्सा सहायता प्रदान करने के लिए नौसेना की भी सराहना की, जो माननीय प्रधानमंत्री के क्षेत्र में सभी के लिए सुरक्षा और विकास के आह्वान के अनुरूप है तथा जिसमें प्राकृतिक आपदाओं के मददेनजर विभिन्न मानवीय सहायता एवं आपदा राहत क्रियाकलाप किए गए हैं तथा कोविड-19 की दूसरी लहर के दौरान नागरिक आबादी को सहायता प्रदान की गई है।

माननीय रक्षा मंत्री ने इस बात पर प्रकाश डाला कि भारतीय नौसेना ने पिछले पांच वर्षों में आधुनिकीकरण बजट का दो-तिहाई से अधिक स्वदेशी खरीद पर खर्च किया है और नौसेना द्वारा ऑर्डर किए गए 41 जहाजों और पनडुब्बियों में से 39 भारतीय शिपयार्ड से हैं, जो 'आत्मनिर्भर भारत' के लिए नौसेना की प्रतिबद्धता का प्रमाण है। उन्होंने अब तक हासिल की गई गति को बनाए रखने का आग्रह किया और यह आश्वासन दिया कि सरकार द्वारा उठाए गए कदम नौसेना की मारक क्षमता को और अधिक बढ़ाएंगे। माननीय रक्षा मंत्री ने इस बात पर भी जोर दिया कि पी75 (आई) परियोजना सबसे बड़ी

'मेक इन इंडिया' परियोजनाओं में से एक होगी और कोविड सहित चुनौतियों पर काबू पाने के लिए स्वदेशी रूप से डिजाइन और निर्मित विमान वाहक 'विक्रान्त' के सफल प्रथम समुद्री परीक्षणों पर बधाई दी। इसके अतिरिक्त रक्षा मंत्री ने नौसेना कूटनीति को मजबूत करने के लिए एक प्रभावी उपकरण के रूप में प्रशिक्षण पर भी प्रकाश डाला और चार दशकों से अधिक समय से भारत में विदेशी कर्मियों को प्रशिक्षण प्रदान करने में नौसेना की सराहना की। इसके अलावा मानव रहित प्रणालियों में दुनिया भर में विकसित हो रहे तकनीकी परिवर्तन को ध्यान में रखते हुए भारतीय नौसेना के लिए एक एकीकृत मानव रहित रोडमैप भी सम्मेलन के दौरान माननीय रक्षा मंत्री द्वारा प्रख्यापित किया गया था ।

कमांडरों ने चीफ ऑफ डिफेंस स्टाफ, थल सेनाध्यक्ष और वायु सेना प्रमुख के साथ बातचीत की और विकसित क्षेत्रीय सुरक्षा परिदृश्य को देखते हुए सेना के तीनों अंगों के तालमेल को बढ़ाने के तरीकों समेत अनेक मुद्दों पर चर्चा की।

सम्मेलन की अध्यक्षता करते हुए नौसेना प्रमुख एडमिरल करमबीर सिंह ने नौसेना कमांडरों को युद्ध की तैयारी, क्षमता वृद्धि, समुद्री बल के रूप में विश्वसनीयता, सुरक्षा, रखरखाव, अभियानगत रसद संबंधी तौरतरीकों, बुनियादी ढांचे के विकास और मानव संसाधन प्रबंधन से संबंधित विभिन्न महत्वपूर्ण मुद्दों पर संबोधित किया। उन्होंने मौजूदा सुरक्षा स्थिति और हिंद महासागर क्षेत्र के विवादित माहौल में भारतीय नौसेना के बढ़ते कर्तव्य की ओर भी ध्यान आकर्षित किया। कमांडरों ने संचालन, अधिग्रहण, बुनियादी ढांचे, रखरखाव, रसद, मानव संसाधन प्रबंधन और प्रशिक्षण जैसे सभी पहलुओं में उपलब्ध संसाधनों के भीतर प्राप्त परिणामों को बढ़ाने और परिचालन आवश्यकताओं को पूरा करने के तरीकों पर विचार-विमर्श किया। *भारतीय नौसेना की परिचालन संपत्तियों पर प्रधानता रखना नौसेना कमांडरों के सम्मेलन के विषय थे।*

<https://pib.gov.in/PressReleasePage.aspx?PRID=1765593>

India now among top 25 nations exporting defence ware: Rajnath Singh

He said the private sector industry, which is only a decade-old, held 80-90 per cent share in the country's defence exports

Bengaluru: Defence Minister Rajnath Singh on Thursday emphasised on the initiatives taken by the Union Government to increase defence exports from India, stressing that the country had emerged in the Top 25 global defence exporting countries for the first time.

A tweet put out by the “Office of the Raksha Mantri/ Defence Minister of India” quoted Singh saying, “According to the 2020 report of Stockholm International Peace Research Institute, India has featured in the list of top 25 defence exporting countries of the world for the first time. The Defence Ministry is making constant efforts so that India can become a global leader in defence exports.”



Defence Minister Rajnath Singh addresses the Consultative Committee of the Defence Ministry, in Bengaluru on Thursday

He said the private sector industry, which is only a decade-old, held 80-90 per cent share in the country's defence exports. “A new strategy has been developed for export of weapons/equipment de-inducted by the services. Such items will be exported to friendly foreign countries after refurbishment by the industry. Its implementation guidelines are being finalised,” he said in the tweet.

Singh on Thursday visited Defence public sector undertakings (PSUs) in Bengaluru and chaired a closed-door meeting of the Consultative Committee of the Defence Ministry. Sources said Singh reviewed the functioning of defence PSUs, discussed the role of the private sector in defence manufacturing and export of defence products from India.

The Centre has set a defence exports target of Rs 35,000 crore by 2020-25 and the government is encouraging the private sector to play a larger role in strengthening the defence manufacturing sector, sources said. The Defence Minister, who arrived in Bengaluru on Thursday on a two-day visit to the state, will be attending the inaugural ceremony of the three-day conclave organized by the Indian Air Force in commemoration of the golden jubilee of the 1971 India-Pakistan war.

Prime Minister Narendra Modi is scheduled to deliver the keynote address in the virtual mode (webcast) at the conclave which is being held at Air Force Station Yelahanka, Bengaluru. The conclave will be attended by senior officers from the Ministry of Defence, including Chief of Defence Staff, General Bipin Rawat, who will speak on “higher directions of war: deriving aim and objectives.”

<https://www.newindianexpress.com/nation/2021/oct/22/india-now-among-top-25-nations-exporting-defence-warerajnath-singh-2374217.html>

What did China test in space, exactly, and why?

These components would probably boost China's nuclear deterrence

By James J. Cameron

The latest reports indicate China may have conducted two tests involving a new type of nuclear-capable strategic missile this summer. The system reportedly completed an orbit of the globe before its hypersonic glider payload descended to Earth.

China has denied the story and security analysts remain unclear about the exact nature of the system Beijing reportedly tested. Here's what we know so far.

What is China supposed to have tested?

If the news reporting is accurate, China tested two distinct capabilities in one weapon: an orbital bombardment system and a hypersonic glide vehicle.

The launch vehicle China used was allegedly an orbital bombardment system (OBS). Unlike an intercontinental ballistic missile (ICBM), which follows a predictable ballistic trajectory in the shape of a parabola (picture an upside-down "U"), an OBS places its payload into orbit around the Earth. This gives the system a theoretically unlimited range and allows it to approach a target from different directions and at lower altitudes than an ICBM.

The missile's payload was allegedly a hypersonic glide vehicle, or HGV. As its name suggests, the HGV travels fast — at more than five times the speed of sound. Its most unique feature, however, is the ability to maneuver in flight, meaning that an HGV can take a more unpredictable path to its target than a standard ICBM warhead.

This system wouldn't give China a new strategic capability

Taken separately, testing these types of components isn't unprecedented.

During the Cold War, the Soviet Union developed a "Fractional Orbital Bombardment System" that could place warheads in orbit — while still remaining in compliance with its arms control commitments. The United States and China are developing HGVs, and Russia has already deployed its Avangard system.

However, assuming the report is correct, this would mark the first time that any country has tested an orbital bombardment system armed with an HGV.

Yet China's tests do not change the basic situation: Beijing already has strategic offensive forces sufficient to overwhelm the existing U.S. missile defense system and strike the U.S. homeland with nuclear weapons.

The Defense Department's 2019 U.S. Missile Defense Review implicitly recognizes this reality, clarifying that "the United States relies on nuclear deterrence to address the large and more sophisticated Russian and Chinese intercontinental ballistic missile capabilities." China's deployment of an HGV-armed OBS would not change this fundamental equation.

Why would China test such a system?

For starters, the characteristics of an HGV-armed OBS would significantly complicate any future U.S. missile defense system's task. And these components would also make China's nuclear deterrent more credible.

China may be concerned that improved U.S. missile defense capabilities, combined with highly accurate offensive forces, could render its nuclear arsenal ineffective. The 2019 Missile Defense Review hinted that the United States has greater long-term ambitions for missile defense against strikes from China or Russia. In the worst case, China may fear that during a severe crisis or conflict, Washington would conduct a first strike on China's offensive forces and then rely on its defensive system to protect itself from a limited retaliation from surviving Chinese missiles.

An HGV-armed OBS would help guarantee the credibility of China's deterrent by ensuring that Chinese missiles of this type that survived a U.S. first strike would still be able to penetrate future U.S. defenses.

By launching into orbit rather than following a standard ballistic trajectory, an OBS would allow the system to approach the United States from unconventional directions — for example, the south, where U.S. radar coverage is less comprehensive. The low altitude of its orbit would mean that ground-based radars would only be able to detect its approach later in flight, reducing warning times — and the window for defensive countermeasures. And a maneuverable HGV payload could take an unpredictable final approach to its target, complicating attempts to estimate the weapon's path and launch interceptors to neutralize the threat.

China would not be the first to brandish such possibilities. In 2018, Vladimir Putin bragged about Russia's new and exotic weapons. A Chinese test of an HGV-armed OBS could be designed to display Beijing's commitment to overwhelm any defensive system the United States may be able to field in the near future.

As such, a test of this nature could serve broader goals as part of the modernization of China's conventional and nuclear forces.

What does this mean for nuclear stability?

The reported tests come in the middle of the Biden administration's Nuclear Posture Review, which is due to be published in early 2022.

U.S. officials haven't confirmed or denied the Chinese weapons testing, but their statements suggest that any new Chinese capabilities would lead the United States to compete more intensely with Beijing in strategic arms. "If you can conceive of it, if it makes operational sense, if it's within the realms of current technology, then you've got to be worried that [China is] going to do something like that," stated Secretary of the Air Force Frank Kendall III. "We welcome stiff competition with China," White House press secretary Jen Psaki commented, while underlining that the Biden administration did not "want that competition to veer into conflict."

There appear to be few viable ways at the moment to defuse the growing U.S.-China strategic standoff. Beijing has refused past U.S. attempts to engage in arms control discussions and this stance would appear unlikely to change as China modernizes and expands its nuclear forces.

The implications are not entirely negative, however. The United States has an interest in stable nuclear deterrence with all its nuclear-armed adversaries, which would ensure that neither side has an incentive to use nuclear weapons first. Nuclear forces that are "survivable," that is, weapons that can survive a first strike and form part of a retaliatory attack, should make a first strike less likely, and therefore contribute to strategic stability.

What's not clear, at this point, is whether the United States and China have a shared understanding of the forces that each side needs to ensure stability. Without further discussions on nuclear stability, the two powers will find it hard to reach any common ground. Building more and new weapons without a way to defuse the associated tensions isn't likely to lead to a more stable U.S.-China relationship in the years ahead.

*James J. Cameron is a postdoctoral fellow at the Oslo Nuclear Project in the University of Oslo's Department of Political Science. He is the author of *The Double Game: The Demise of America's First Missile Defense System and the Rise of Strategic Arms Limitation* (Oxford University Press, 2017).*

<https://www.washingtonpost.com/politics/2021/10/21/what-did-china-test-space-exactly-why/>

THE TIMES OF INDIA

Fri, 22 Oct 2021

Kidney stone formation to gene marking: 5 experiments shortlisted for ISRO mission; MoUs in place

By Chethan Kumar

Bengaluru: From how kidney stones are formed in fruit flies to study of gene markers, from heat sink functioning in microgravity to crystallisation, an expert committee set up by the Indian Space Research Organisation (Isro) has shortlisted five out of the 28 proposals it received from various institutions to send as payloads to conduct experiments in space, as part of the Gaganyaan uncrewed missions.

S Unnikrishnan Nair, director of Isro's Human Space Flight Centre (HSFC), which is spearheading the human space programme at the agency, said that they had already signed MoUs with institutes for the five payloads that are being built.

"How many of these five will go on the first uncrewed mission and how many on the second will depend on their maturity and readiness. We've already signed memoranda of understanding (MoUs) with institutes that are building the five payloads shortlisted by the experts committee. Apart from these, we will be sending a radiation-measurement payload and a half-humanoid — Vyomitra — as part of the uncrewed missions," Nair told TOI.

Isro chairman K Sivan said the space agency wants to fly Vyomitra in the first crewless mission so as to gain some knowledge on the environment and other aspects.

"...Of the five experiments shortlisted, two will be biological, and we have three non-biological payloads. The institutes we've signed MoUs with are: Indian Institute of Space Science and Technology (IIST), University of Agricultural Sciences (UAS) Dharwad, Tata Institute of Fundamental Research (TIFR), IIT-Patna, the CSIR Indian Institute of Chemical Technology (CSIR-IICT) and Jawaharlal Nehru Centre for Advance Scientific Research (JNCASR)," Sivan added.

Of the biological experiments, IIST and UAS together will send a payload to study "kidney stone formation in *Drosophila melanogaster* (fruit flies)", while TIFR will use the same payload "to study SIRT1 gene marker effects on the fruit flies".

As per papers published globally, the simple but elegant *Drosophila melanogaster* is emerging as a powerful translational model of human disease, including nephrolithiasis and may provide important information essential to our understanding of stone formation.

The study of TIFR is also important because the SIRT1 gene encodes Sirtuin 1, "a protein member of Silent Information Regulator 2 (Sir2) protein family, which has gained considerable attention as an epigenetic regulator for a great area in human physiology". Researchers have so far found that changes in sirtuin expression are critical in several diseases, including metabolic syndrome, cardiovascular diseases, cancer and neurodegeneration.

"The other three experiments are: Study of crystallisation phenomena in microgravity by CSIR-IICT; heat sink to handle very high heat flux in microgravity by IIT-Patna and fluid mixing characteristics study in microgravity by JNCASR," Sivan added.

<https://timesofindia.indiatimes.com/india/kidney-stone-formation-to-gene-marking-5-experiments-shortlisted-for-isro-mission-mous-in-place/articleshow/87191859.cms>

Physicists describe photons' characteristics to protect future quantum computing

By Richard C. Lewis

Consumers need to be confident that transactions they make online are safe and secure. A main method to protect customer transactions and other information is through encryption, where vital information is encoded with a key using complex mathematical problems that are difficult even for computers to solve.

But even that may have a weakness: Encrypted information could be decoded by future quantum computers that would try many keys simultaneously and rapidly find the right one.

To prepare for this future possibility, researchers are working to develop codes that cannot be broken by quantum computers. These codes rely on distributing single photons—single particles of light—that share a quantum character solely among the parties that wish to communicate. The new quantum codes require these photons to have the same color, so they are impossible to distinguish from each other, and the



Credit: Pixabay/CC0 Public Domain

resulting devices, networks, and systems form the backbone of a future "quantum internet."

Researchers at the University of Iowa have been studying the properties of photons emitted from solids and are now able to predict how sharp the color of each emitted photon can be. In a new study, the researchers describe theoretically how many of these indistinguishable photons can be sent simultaneously down a fiber-optical cable to establish secure communications, and how rapidly these quantum codes can send information.

"Up to now, there has not been a well-founded quantitative description of the noise in the color of light emitted by these qubits, and the noise leading to loss of quantum coherence in the qubits themselves that's essential for calculations," says Michael Flatté, professor in the Department of Physics and Astronomy and the study's corresponding author. "This work provides that."

The study, "Suppression of the Optical Linewidth and Spin Decoherence of a Quantum Spin Center in a p-n Diode," was published online Oct. 15 in the journal *PRX Quantum*.

More information: Suppression of the optical linewidth and spin decoherence of a quantum spin center in a p-n diode, arXiv:2008.13289 [cond-mat.mes-hall] arxiv.org/abs/2008.13289
<https://phys.org/news/2021-10-physicists-photons-characteristics-future-quantum.html>

Quantum-encrypted information transmitted over fiber more than 600 kilometers long

By implementing a new signal stabilization technique, researchers were able to achieve secure quantum communication over a record 605 kilometers of fiber using the twin-field quantum key distribution (QKD) protocol. The new demonstration paves the way for transmitting highly secure, quantum-encrypted information over long distances, such as between cities.

Mirko Pittaluga from Toshiba Europe Limited and the University of Leeds, both in the UK, will present the research at the Frontiers in Optics + Laser Science Conference (FiO LS) all-virtual meeting.

"This research extends the range of fiber-based quantum communications beyond 600km for the first time, and we think the techniques we have introduced here may be relevant for other phase-sensitive single-photon applications," said Mirko Pittaluga. "This will allow us to build national and continental scale fiber networks connecting major metropolitan areas. Together with satellite links, we can now envisage truly global quantum networks," continued Andrew Shields, head of the quantum technology division at Toshiba Europe.



Credit: CC0 Public Domain

QKD allows two users in different places to establish a common secret string of bits by exchanging photons which are typically transmitted over an optical fiber. Achieving transmission over long distances is one of the biggest challenges for practical implementation of quantum communication because there is a fundamental limit to how far the photons can travel before the signal degrades due to scattering or absorption. While optical repeaters solve this problem for traditional fiber optic data transmission, it has proven difficult to create a reliable repeater for quantum encoded information.

The newly developed twin-field QKD protocol has the potential to overcome the distance limitation, but new methods are needed to use it with fiber lengths over 500 kilometers. In the new work, the researchers developed an experimental setup and phase stabilization technique for twin-field QKD. The stabilization approach, which is based on wavelength division multiplexing, uses two optical reference signals at different wavelengths to minimize the phase fluctuations over long distances.

The research team demonstrated that the new approach could accomplish repeater-like performance while tolerating optical losses beyond the traditional limit of 100 dB over a 605-kilometer-long quantum channel. They were also able to test different variants of the TF-QKD protocol. The new stabilization approach could also be applied to other quantum communication protocols and applications such as improving interferometric telescopes.

These results were obtained in a laboratory environment, but recently obtained experimental evidence confirms the applicability of this stabilization technique on field-deployed fibers. The team is now working to perform a field trial test.

More information: Conference: www.frontiersinoptics.com/home/

Pittaluga's presentation is scheduled for Monday, 01 November at 07:00 EDT (UTC—04:00).

<https://phys.org/news/2021-10-quantum-encrypted-transmitted-fiber-kilometers.html>

Shrinking quantum key distribution technology to a semiconductor chip

Toshiba Europe Ltd today announced it has developed the world's first chip-based quantum key distribution (QKD) system. This advance will enable the mass manufacture of quantum security technology, bringing its application to a much wider range of scenarios including to Internet of Things (IoT) solutions.

QKD addresses the demand for cryptography which will remain secure from attack by the supercomputers of tomorrow. In particular, a large-scale quantum computer will be able to efficiently solve the difficult mathematical problems that are the basis of the public key cryptography widely used today for secure communications and e-commerce. In contrast, the protocols used for quantum cryptography can be proven secure from first principles and will not be vulnerable to attack by a quantum computer, or indeed any computer in the future.

The QKD market is expected to grow to approximately \$20 billion worldwide in financial year 2035. Large quantum-secured fiber networks are currently under construction in Europe and South-East Asia, and there are plans to launch satellites that can extend the networks to a global scale. In October 2020, Toshiba released two products for fiber-based QKD, which are based on discrete optical components. Together with project partners, Toshiba has implemented quantum-secured metro networks and long-distance fiber optic backbone links in the UK, Europe, US and Japan.

Manufacturing advances

For quantum cryptography to become as ubiquitous as the algorithmic cryptography we use today, it is important that the size, weight and power consumption are further reduced. This is especially true for extending QKD and quantum random number generators (QRNG) into new domains such as the last-mile connection to the customer or IoT. The development of chip-based solutions is essential to enabling mass market applications, which will be integral to the realization of a quantum-ready economy.

Toshiba has developed techniques for shrinking the optical circuits used for QKD and QRNG into tiny semiconductor chips. These are not only much smaller and lighter than their fiber optic counterparts, but also consume less power. Most significantly, many can be fabricated in parallel on the same semiconductor wafer using standard techniques used within the semiconductor industry, allowing them to be manufactured in much larger numbers. For example, the quantum transmitter chips developed by Toshiba measure just 2x6mm, allowing several hundred chips to be produced simultaneously on a wafer.

Andrew Shields, Head of Quantum Technology at Toshiba Europe, remarked, "Photonic integration will allow us to manufacture quantum security devices in volume in a highly repeatable fashion. It will enable the production of quantum products in a smaller form factor, and subsequently allow the roll out of QKD into a larger fraction of the telecom and datacom network."

Taro Shimada, Corporate Senior Vice President and Chief Digital Officer of Toshiba Corporation comments, "Toshiba has invested in quantum technology R&D in the UK for over two decades. This latest advancement is highly significant, as it will allow us to manufacture and deliver QKD in much larger quantities. It is an important milestone towards our vision of building a platform for quantum-safe communications based upon ubiquitous quantum security devices."

The details of the advancement are published in the journal *Nature Photonics*.

Technical Summary

QKD systems typically comprise a complex fiber-optic circuit, integrating discrete components, such as lasers, electro-optic modulators, beam-splitters and fiber couplers. As these components

are relatively bulky and expensive, the purpose of this work was to develop a QKD system in which the fiber-optic circuit and devices are written in millimeter scale semiconductor chips.

Toshiba has developed the first complete QKD prototype in which quantum photonic chips of different functionality are deployed. Random bits for preparing and measuring the qubits are produced in quantum random number generator (QRNG) chips and converted in real-time into high-speed modulation patterns for the chip-based QKD transmitter (QTx) and receiver (QRx) using field-programmable gate arrays (FPGAs). Photons are detected using fast-gated single photon detectors. Sifting, photon statistics evaluation, time synchronization and phase stabilization are done via a 10 Gb/s optical link between the FPGA cores, enabling autonomous operation over extended periods of time. As part of the demonstration, the chip QKD system was interfaced with a commercial encryptor, allowing secure data transfer with a bit rate up to 100 Gb/s.

To promote integration into conventional communication infrastructures, the QKD units are assembled in compact 1U rackmount cases. The QRx and QTx chips are packaged into C-form-factor-pluggable-2 (CFP2) modules, a widespread form-factor in coherent optical communications, to ensure forward compatibility of the system with successive QKD chip generations, making it easily upgradeable. Off-the-shelf 10 Gb/s small-form-factor pluggable (SFP) modules are used for the public communication channels.

Taofiq Paraiso, lead author of the *Nature Photonics* paper describing the chip-scale QKD system, says that "we are witnessing with photonic integrated circuits a similar revolution to that which occurred with electronic circuits. PICs are continuously serving more and more diverse applications. Of course, the requirements for quantum PICs are more stringent than for conventional applications, but this work shows that a fully deployable chip-based QKD system is now attainable, marking the end of an important challenge for quantum technologies. This opens a wide-range of perspectives for the deployment of compact, plug-and-play quantum devices that will certainly strongly impact our society."

More information: Taofiq Paraiso, A photonic integrated quantum secure communication system, *Nature Photonics* (2021). DOI: [10.1038/s41566-021-00873-0](https://doi.org/10.1038/s41566-021-00873-0). www.nature.com/articles/s41566-021-00873-0

Journal information: [Nature Photonics](https://www.nature.com)
<https://phys.org/news/2021-10-quantum-key-technology-semiconductor-chip.html>

Novel advanced light design and fabrication process could revolutionize sensing technologies

Vanderbilt and Penn State engineers have developed a novel approach to design and fabricate thin-film infrared light sources with near-arbitrary spectral output driven by heat, along with a machine learning methodology called inverse design that reduced the optimization time for these devices from weeks or months on a multi-core computer to a few minutes on a consumer-grade desktop.

The ability to develop inexpensive, efficient, designer infrared light sources could revolutionize molecular sensing technologies. Additional applications include free-space communications, infrared beacons for search and rescue, molecular sensors for monitoring industrial gases, environmental pollutants and toxins.

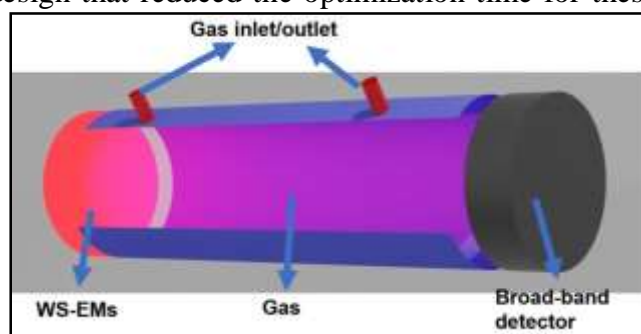
The research team's approach, detailed today in *Nature Materials*, uses simple thin-film deposition, one of the most mature nanofabrication techniques, aided by key advances in materials and machine learning.

Standard thermal emitters, such as incandescent lightbulbs, generate broadband thermal radiation that restricts their use to simple applications. In contrast, lasers and light emitting diodes offer the narrow frequency emission desired for many applications but are typically too inefficient and/or expensive. That has directed research toward wavelength-selective thermal emitters to provide the narrow bandwidth of a laser or LED, but with the simple design of a thermal emitter. However, to date most thermal emitters with user-defined output spectra have required patterned nanostructures fabricated with high-cost, low-throughput methods.

The research team led by Joshua Caldwell, Vanderbilt associate professor of mechanical engineering, and Jon-Paul Maria, professor of materials science and engineering at Penn State, set out to conquer long-standing challenges and create a more efficient process. Their approach leverages the broad spectral tunability of the semiconductor cadmium oxide in concert with a one-dimensional photonic crystal fabricated with alternating layers of dielectrics referred to as a distributed Bragg reflector.

The combination of these multiple layers of materials gives rise to a so-called "Tamm-polariton," where the emission wavelength of the device is dictated by the interactions between these layers. Until now, such designs were limited to a single designed wavelength output. But creating multiple resonances at multiple frequencies with user-controlled wavelength, linewidth, and intensity is imperative for matching the absorption spectra of most molecules.

Material design has been challenging and computationally intense. Because advanced applications require functionality at multiple resonances, the new process had to drastically shorten design time. A typical device, for example, would contain tens to hundreds of designable parameters, creating high customization demands requiring unrealistic computation times. For instance, in a scenario that independently optimizes nine parameters, sampling 10 points per parameter, the simulations would take 15 days, assuming 100 simulations each second. Yet, with more parameters, the time increases exponentially—11 and 12 parameters would require three and 31 years, respectively.



Schematic of a filterless, non-dispersive infrared sensor enabled by the research team's advanced infrared light source. Credit: Mingze He, Caldwell group

To address this challenge, Ph.D. student Mingze He, lead author of the paper, proposed an inverse design algorithm that computes an optimized structure within minutes on a consumer-grade desktop. Further, this code could provide the ability to match the desired emission wavelength, linewidth, and amplitude of multiple resonances simultaneously over an arbitrary spectral bandwidth.

Another hurdle was identifying a semiconductor material that could allow a large dynamic range of electron densities. For this, the team used doped semiconductor material, developed by Maria's research team at Penn State, that allows intentional design of optical properties.

"This allows the fabrication of advanced mid-infrared light sources at wafer-scale with very low cost and minimal fabrication steps," He said.

This experimental section was conducted with Penn State collaborators while the devices were characterized by He and J. Ryan Nolen, a recent graduate of the Caldwell group. Together, the two teams successfully demonstrated the capability of inversely designed infrared light sources.

"The combination of the cadmium oxide material tunability with the fast optimization of aperiodic distributed Bragg reflectors offers the potential to design infrared light sources with user-defined output spectra. While these have immediate potential in chemical sensing, these also exhibit significant promise in a variety of other applications ranging for environmental and remote sensing, spectroscopy, and infrared signaling and communications." Caldwell said.

Significantly, the Caldwell group has open-sourced the design algorithm, which can be downloaded on the *Nature Materials* site as well as the Caldwell Infrared Nanophotonic Materials and Devices laboratory website.

Their paper, "Deterministic inverse design of Tamm plasmon thermal emitters with multi-resonant control," was published Oct. 21.

More information: Mingze He et al, Deterministic inverse design of Tamm plasmon thermal emitters with multi-resonant control, *Nature Materials* (2021). DOI: [10.1038/s41563-021-01094-0](https://doi.org/10.1038/s41563-021-01094-0)

Journal information: *Nature Materials*
<https://phys.org/news/2021-10-advanced-fabrication-revolutionize-technologies.html>

Why do mental health conditions raise death risk during the pandemic?

- *A study finds that people with mental health issues or intellectual disabilities have been far more likely to die during the pandemic than others.*
- *More people in these groups have died of COVID-19 and other causes.*
- *There are likely several reasons for this disparity.*

According to a new study, people in the U.K. with mental health issues and intellectual disabilities were at about twice the risk of dying than people without those conditions before the COVID-19 pandemic.

The study suggests this difference has increased dramatically during the pandemic, with people with mental health conditions and intellectual disabilities experiencing much higher death rates.

The current study considered “excess deaths,” a general category of deaths during a particular period compared with historical levels.

Says the study’s lead author, Dr. Jayati Das-Munshi of King’s College London in the United Kingdom:

“The results from our study paint a stark picture of how the existing vulnerability of those with mental health conditions and intellectual disabilities has worsened during the COVID-19 pandemic. The higher death rates compared [with] the general population were associated with more deaths from [SARS-CoV-2] infection itself, as well as deaths from other causes.”

Dr. Thomas F. Betzler, executive clinical director of the Montefiore Behavioral Health Center in New York, who was not involved in the study, confirmed for *Medical News Today* that “many of our patients have similar issues.”

Dr. Das-Munshi says the study’s findings warrant a reappraisal of the groups understood to be at high risk of dying from COVID-19:

Far greater risk of mortality

The study’s analysis found an increased likelihood of dying among people with mental health issues and intellectual disabilities in the U.K. during the first COVID-19 lockdown compared with the general population.

Specifically, they found that:

- People with intellectual disabilities were 9.24 times more likely to die of COVID-19.
- People with eating disorders were 4.81 times more likely to die of COVID-19.
- People with dementia were 3.82 times more likely to die of COVID-19.
- People with personality disorders were 4.58 times more likely to die of COVID-19.
- People with schizophrenia spectrum disorders were 3.26 times more likely to die of COVID-19.

These groups experienced a brief respite, relatively speaking, from July to September 2020 during a temporary drop in COVID-19 cases. During these months, their risk returned to the pre-pandemic, already doubled, chances of mortality.

Why this may be happening

MNT asked Holly Kathryn Tabor, Ph.D., an associate professor of medicine at Stanford University, California — who was not involved in the study — why this disparity occurs. She replied that there are likely several reasons.

“It’s very hard for adults with intellectual disabilities to get access to basic healthcare and to other things that are social determinants of health, and they have much poorer health overall,” said Dr. Tabor.

Dr. Tabor also explained that the conditions cited by the study:

“All require you to be able to have a care provider and go get help from them, and also have a safety net. Your care provider isn’t going to do *everything* for you. You have to have people taking care of you and looking in on you. Health is more than just getting a prescription. Health is more than going to the doctor when you have a heart attack. Health is a lot of other things, and [...] because of those conditions, all those people need help getting to a doctor.”

Dr. Betzler pointed out that these groups often experience “medical comorbidities, delayed or poor access to healthcare, living in a group or congregate care setting, and psychiatric hospitalizations.”

The effect of institutionalization

Joseph A. Stramondo, Ph.D., another expert not involved in the study, focuses on the intersection of the philosophy of disability and bioethics at San Diego State University.

Dr. Stramondo told *MNT* about the often damaging effect of institutionalization on some people in these groups. He recalled the 1972 TV exposé of the Willowbrook State School on New York’s Staten Island.

In that coverage, he said, “you just saw horrifying living conditions, and so it’s no wonder that there’s going to be increased mortality for disabled people living in these places.”

Is there bias in who gets treated?

An additional factor may be triage decisions regarding who doctors treat. Early in the pandemic, hospitals in the United States had to devise “crisis standards of care.”

A number of these policies contained language that either overtly or indirectly excluded people with mental health issues or intellectual disabilities, leaving disability advocates “completely justifiably” angry, said Dr. Tabor.

Dr. Stramondo told *MNT* that the attitudes embodied in discriminatory policies “are fundamentally about devaluing disabled lives.”

He explained: “There is this presumption that they have a lower quality of life – that there ought to be less effort put into preserving their lives. And I think that we see that over and over again in various contexts.” However, according to Dr. Tabor, “The advocacy groups and the attorneys generally succeeded in getting most crisis standards of care policies to have at least the explicit and very often the implicit discriminatory language taken out.”

“But,” she cautioned, “a policy is only as good as the people who are implementing it and hopefully doing it right.” So far, only a few states have officially implemented their crisis standards of care policies.

Supporting the vulnerable

The disparities before and during the pandemic are “a judgment on our society,” Dr. Tabor said. “And the fact that the people who are the least well-off in our society also have the poorest health [is] just magnified with COVID-19.”

Dr. Tabor noted that “the ways in which our society is ableist and discriminatory against people with disabilities — that those [biases] existed in the first place pre-pandemic — is a sign and symptom of what already exists in society. And it’s appalling and needs to change, absolutely.”

<https://www.medicalnewstoday.com/articles/why-do-mental-health-conditions-raise-death-risk-during-the-pandemic#Why-this-may-be-happening>

