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CONTENTS

DRDO News

DRDO Technology News

Firstpost.

Thu, 25 Nov 2021

Defence Ministry clears proposal for GSAT-7C satellite for IAF: A look at other military satellites in India

The GSAT-7C, which will be launched in another two-three years, will enhance the Indian Air Force's global operations and network-centric warfare capabilities

The Ministry of Defence on Tuesday approved a proposal to procure a GSAT-7C satellite and related equipment for the Indian Air Force (IAF) at a cost of Rs 2,236 crore. The decision to clear the procurement was taken at a meeting of the Defence Acquisition Council (DAC) chaired by Defence Minister Rajnath Singh.

File photo of Indian Space Research Organisation's PSLV-C45 carrying EMISAT and 28 other satellites lifting off from the Satish Dhawan Space Center in Sriharikota. PTI

In a statement, the defence ministry said that the induction of the GSAT-7C satellite and ground hubs for software-defined radios (SDRs) will enhance the ability of our armed forces to communicate beyond Line of Sight among one another in all circumstances in a secure mode.

Here's a look at some of the other Indian military satellites.

GSAT 7A

Launched on 19 December 2018, this is a dedicated communication satellite for the Indian Air Force and Indian Army. The satellite helped in expanding the communication capabilities of the IAF in many ways.Firstly, it allows cross-connectivity between different ground radar stations, airbases and Airborne early warning and control (AWACS) aircraft like the Beriev A-50 Phalcon and DRDO AEW&CS. It also gave a big push to drone operations in the Indian military by helping the Navy reduce its reliance on ground-based control stations and switch to satellite-controlled unmanned aerial vehicles (UAVs).

Cartosat-2E satellite

Known as 'the eye in the sky', the Cartosat-2E satellite was designed to collect high-resolution, large scale imagery. Launched by ISRO in 2017, the satellite provides India with an edge in warfare with clearer images -- it can accurately spot objects within a square of 0.6 metres by 0.6 metres. However, the Cartosat-2E isn't a dedicated military satellite and is also used for urban planning, infrastructure development and traffic management.

Electromagnetic Intelligence Satellite (EMISAT)

The Indian Space Research Organisation gave India's military a huge boost when it launched the Defence Research Development Organisation-designed Electronic Intelligence Satellite, EMISAT, on 1 April 2019. EMISAT detects electronic signals on ground, especially hidden enemy radars. This capacity will help India in surgical warfare. EMISAT is primarily based on the famous Israeli spy satellite called SARAL (Satellite with Argo and Altika) and conduct sharp electronic

surveillance across the length and breadth of India. It has been developed under DRDO's project Kautilya which aims to boost India's space surveillance capacity. The satellite can detect and gather electronic intelligence from enemy radar across the borders as it circles the globe roughly pole to pole every 90 minutes.

RISAT 2BR1

Part of India's RISAT series of SAR imaging satellites, the RISAT-2BR1 was launched on 11 December 2019 from the Satish Dhawan Space Centre in Sriharikota. It is an Indian radar reconnaissance satellite, giving India the capability to accurately identify two objects separated by just 35 cm.

Hyper spectral Imaging satellite (HySIS)

HySIS, launched on 29 November 2018, provides the country with hyperspectral imaging of agriculture, forestry, coastal zones, and inland waterways. Its data is also accessible to defence forces.

Microsat-R Satellite

A dedicated military satellite for the Indian Armed Forces, it was launched on 24 January 2019. The 760 kg imaging satellite was launched using PSLV C-44 rocket. It later served as a target during India's anti-satellite weapon experiment, Mission Shakti. With Mission Shakti, India became the fourth country in the world — behind the United States, Russia and China — to have an anti-satellite weapon. *With inputs from agencies*

https://www.firstpost.com/india/defence-ministry-clears-proposal-for-gsat-7c-satellite-for-iaf-a-look-at-other-military-satellites-in-india-10160861.html

Firstpost.

Thu, 25 Nov 2021

How INS Visakhapatnam gives Indian Navy an advantage over China in Indian Ocean

China's geographical advantage against the valiant Indian Army in the Himalayas will now be neutralised by our advantage in the Indian Ocean

By Raja Menon

On Sunday, the Indian Navy commissioned its tenth destroyer, the Indian Naval Ship (INS) Visakhapatnam, built by Mazagon Dock Shipbuilders Limited in Mumbai. The Vishakhapatnam is a 7,500-tonne warship whose main offensive armament is the BrahMos surface-to-surface missile, eight of which will be clustered in two quadruple vertical launch systems. With a range of 290 km, supersonic speed and pinpoint accuracy, it can be fired against both ships and land targets, making it a fearsome weapon.

The Indian Navy commissioned its tenth destroyer, the INS Visakhapatnam, on Sunday. News18.

Against submarines, it has Indian sensors guiding the Indian-built *Brahmastra* heavyweight torpedo and long-range anti-submarine rocket launchers. It also carries the famous Israeli Barak anti-aircraft and anti-missile system, probably the best in its class in the world. Its sensor suite is world-class, as even a glance at its photograph will confirm, and it can direct our own fighter aircraft by means of a long-range aircraft direction radar. Fitted with the most modern Indian-Israeli electronic warfare suite, it can conduct soft kills on enemy sensors.

In a nuclear age and the decreasing probabilities of open conventional war, a factor that contributes to being a successful warship is its longevity. Things look good for INS Visakhapatnam, for an earlier class of destroyer fitted with similar gas turbine main engines is still

going strong in their fourth decade. However, the most potent weapon onboard the ship may not be the BrahMos missiles, but the single package helicopter, fitted with submarine search sonar and anti-ship missiles.

Observers with nautical scientific knowledge would have grasped that although the BrahMos has a range of 290 km, the range of the ship's own search radar is limited by the curvature of the earth to a maximum of 100 km. So, without what is called over the horizon targeting, the full range of the BrahMos cannot be exploited. That is where pairing the ship with its own helicopter or another search aircraft makes the Visakhapatnam a formidable fighting platform.

Normally it would form part of the escort screen around the aircraft carrier, adding enormously to the defence in depth of the capital ship. But it would also be the leader of a formidably independent task group on a search and destroy mission. It is currently equipped with the Seaking 42B helicopter, but that will be replaced by the new arrival Seahawk helicopters from the US. The ship will inspire Naval Headquarters to expedite the formulation of a new maritime strategy, to replace the dated Mahanian concept of sea lane protection and convoy escorting.

Naval theorists are giving finishing touches on an aggressive grand strategy where the army holds the Chinese at the Himalayan border, while the navy goes on the offensive in the Indian Ocean. Irked by the questions that were raised in the national media during the Galwan crisis as to what could the Navy do to offset Chinese aggression on the Line of Actual Control (LAC), maritime strategists have been working overtime to provide an answering strategy in the Indian Ocean.

China has the advantage of geography in Tibet, which is a plateau. With its huge infrastructure budget, it has been easy to build an intense road network facing the border with India. As a result, it has a six-lane highway connecting its offensive posts opposite Arunachal Pradesh right up to Daulat Beg Oldi and beyond to Xinjiang. The Chinese Army has consequently been able to maintain an offensive strategy against India despite downsizing their army to 9,75,000 — almost 2,50,000 less than the active-duty strength of the Indian Army. Yet, by moving altitude acclimatised troops laterally on the highway, Beijing is able to overwhelm Indian defences, numerically at any point of their choosing. Not any more, after the new maritime strategy is executed.

China's only Achilles' heel is its dependence on oil imports and commodity export on Indian Ocean lanes. However, its naval forces are tied down in the South China Sea by the overwhelming presence of the US 7th fleet, and soon by Australian nuclear submarines. This compulsion leaves very few Chinese naval escorts to defend their sea lanes in the Indian Ocean. In any case, India has immensely favourable geography in the Indian Ocean, while China is greatly disadvantaged by the constraints of the Malacca Straits.

On India suffering casualties in the Himalayas, the Indian Navy will swing into action, after a due diplomatic warning and ultimatum. The Quad's air search assets will be leveraged to keep the Indo-Pacific under minute scrutiny, while naval ships will quarantine China-bound tankers and cargo ships in the Nicobar Islands. With information dominance in the South China Seas and the Malacca Straits, a geographically constrained 'killing zone' will be set up in the Straits, to any intervening or reinforcing Chinese naval units. This is where the 400-km kill range of Visakhapatnam's BrahMos and its search helicopter will be deployed.

China's geographical advantage against the valiant Indian Army in the Himalayas will, at last, be neutralised by our advantage in the Indian Ocean. The more ships Beijing sends to intervene, the worse their casualties will be. For the first time, we are utilising a truly tri-service strategy against an aggressive Chinese hegemon, intent on blocking the rise of an Asian competitor. With the use of the Car-Nicobar airbase, the Malacca Straits can become a truly India-dominated battlespace.

The writer, a former Rear Admiral in the Navy, is the author of 'A Nuclear Strategy for India'. Views expressed are personal.

https://www.firstpost.com/india/how-ins-visakhapatnam-gives-indian-navy-an-advantage-over-china-in-indian-ocean-10160611.html

Firstpost.

Thu, 25 Nov 2021

Indian Navy to commission fourth Scorpene submarine INS 'Vela' today: All you need to know

It is a diesel attack submarine, which is designed to act as a sea denial as well as access denial warfare to the adversary

The INS Vela is the fourth submarine of the first batch of six Kalvari-class submarines for the Indian Navy. It is the country's fourth Scorpene-class submarine, which was delivered to the Indian Navy earlier this week after more than two years of sea trials.

File image of INS Vela. Ministry of Defence

The latest addition to the fleet is to be commissioned on Thursday by the Chief of Naval Staff Admiral Karambir Singh The ship will enhance the Indian Navy's capability, the Defence Ministry said.

The Vela is also the fourth submarine of Project-75 — a programme by the Indian Navy that envisaged building six Scorpene-Class attack submarines.

Features of INS Vela

It is a diesel attack submarine, which is designed to act as a sea denial as well as access denial warfare to the adversary.

It is capable of offensive operations across the entire spectrum of naval warfare including anti-surface warfare, anti-submarine warfare, intelligence gathering, mine laying and area surveillance.

It has a length of 67.5 m (221 ft), a height of 12.3 m (40 ft), an overall beam of 6.2 m (20 ft) and a draught of 5.8 m (19 ft). It can reach a top speed of 20 kn (37 km/h) when submerged and a maximum speed of 11 knots (20 km/h) when surfaced.

It is powered by four MTU 12V 396 SE84 diesel engines, has 360 battery cells (750 kg each), for power and has a silent Permanently Magnetised Propulsion Motor. The hull, fin and hydroplanes are designed for minimum underwater resistance and all equipment inside the pressure hull are mounted on shock-absorbing cradles for enhanced stealth.

Designed on the Scorpene-class, the Exocet missile-carrying submarine may be fitted with DRDO designed air-independent propulsion technology at a later stage as part of its mid-life refit.

The submarine has been slotted to join the Submarine fleet of the Western Naval Command.

Vela is the fourth Submarine of the Kalvari-class vessels in various phases of construction and induction, and has completed most of its trials and is combat-worthy and ready to take on operational tasking. *With inputs from agencies*

https://www.firstpost.com/india/indian-navy-to-commission-fourth-scorpene-submarine-ins-vela-today-all-you-need-to-know-10160541.html

THE HINDU

Thu, 25 Nov 2021

MSME stakeholders eye college campuses for defence start-ups

Truchi: MSME stake-holders in Tiruchi look forward to optimising the facilities in higher educational institutions in the process of deriving utility of simplified 'Make-II' procedure of the Centre envisaging a major boost to 'Make in India' in the defence sector.

"Establishing start-ups on the campuses of universities and institutions of national importance will also pave way for establishing a robust eco-system for incubation activity. MSME organisations in the region anticipate progress in Tiruchi, one of the five nodes for the proposed Tamil Nadu Defence Industrial Corridor, on this trajectory," Founder-Chairman of Tiruchi Trade Centre N. Kanagasabapathy said.

A few industries in Tiruchi have been supplying components for defence equipment for long. There is now more components to choose from for indigenous production, Mr. Kanagasabapathy said.

The 'Simplified Make II' procedure was designed by the Defence Acquisition Council during 2018 for greater participation of industry, thereby enabling import substitution and promoting innovative solutions.

The potential 'Make-II' projects will be approved by a collegiate comprising DRDO, HQ (IDS), Department of Defence under a committee chaired by Secretary (Defence Production). Based on the in-principle approval agreed by the committee, the projects will be hosted on the Ministry of Defence/Department of Defence Production's website inviting industry to take part.

There will be no limit to the number of industries who may respond to the EoI for development of the prototype subject to meeting the minimum qualification criteria. The design and development time of 12 to 30 weeks is granted to industry to offer the prototypes. The industry developing the product will retain the title and ownership and all other rights in intellectual property. However, for some specified reasons like national security, the government shall have 'March-in' rights. Projects involving developmental cost of less than three crores will be reserved for MSME.

Acknowledging MSMEs as backbone of the Tamil Nadu Defence Industrial Corridor, the State government has exhorted the sector to derive the utility of the special provisions under the 'Make II' procedure for indigenous defence manufacturing.

https://www.thehindu.com/news/cities/Tiruchirapalli/msme-stakeholders-eye-college-campuses-for-defence-start-ups/article37671843.ece

Defence News

Defence Strategic: National/International

The Indian EXPRESS

Thu, 25 Nov 2021

Explained: The importance of India, Maldives and Sri Lanka trilateral exercise 'Dosti'

For many years after it was first launched in 1991, these exercises were bilateral, involving the Indian and the Maldives Coast Guards. In 2012, however, Sri Lanka joined these exercises for the first time

By Neha Banka

Kolkata: The 15th edition of the biennial trilateral coast guard exercise 'Dosti' involving India, the Maldives and Sri Lanka is underway in the Maldives. 2021 marks 30 years since these exercises were first launched. Indian Coast Guard vessels, the ICGS Vajra and ICGS Apoorva joined the Sri Lanka Coast Guard, SLCGS Suraksha for the five-day exercise that started on November 20 and will conclude today.

These exercises help during joint operations and missions undertaken by countries and also help enhance interoperability. (Twitter/Ministry of Defence)

In a statement, the Indian High Commission in the Maldives said, "The aim of India-Maldives-Sri Lanka tri-lateral exercise 'Dosti' is to further fortify the friendship, enhance mutual operational capability, and exercise interoperability and to build cooperation between the Coast Guards of Maldives, India and Sri Lanka." Both the Maldives and Sri Lanka are of strategic importance to New Delhi and to its maritime security interests.

Why this is important

"India does have these kinds of military exercises with other countries. Sometimes it is multilateral, sometimes it is trilateral. For many years these exercises were bilateral," said Dr. Gulbin Sultana, a research analyst at the Manohar Parrikar Institute for Defence Studies and Analyses, whose area of research includes the Maldives.

For many years after it was first launched in 1991, these exercises were bilateral, involving the Indian and the Maldives Coast Guards. In 2012, however, Sri Lanka joined these exercises for the first time and since then, it has been a trilateral exercise.

These exercises help during joint operations and missions undertaken by countries and also help enhance interoperability, Dr. Sultana told indianexpress.com. Although piracy is not a major issue in this part of the Indian ocean, these kinds of exercises also help coast guards with training for possibilities.

What it involves

The scope of these exercises are wide-ranging. "If there is a maritime accident, or if there is an ecological disaster like an oil spill, sometimes the coast guard of one nation cannot tackle it alone," she explained.

These exercises help develop a better understanding of the other nation's coast guard operations and how to enhance coordination during different kinds of missions. "Maritime security is a kind

of thing where you need cooperation and one nation, one coast guard can't do much," Dr. Sultana explained.

There are limitations and regulations involving international law, for instance the Exclusive Economic Zones (EEZ). Then there is the continental shelf which also has specific rules. Under international law, as stated in Article 76 of the Law of the Sea Convention, this maritime zone consists of the seabed and subsoil that extends to the outer edge of the continental margin, or to a distance of 200 nautical miles if the outer edge of the continental margin does not extend up to that distance.

According to a document issued by the US State Department, "The continental shelf and the exclusive economic zone (EEZ) are distinct maritime zones." The extended continental shelf is not an extension of the EEZ, the document states. "Some of the sovereign rights that a coastal state may exercise in the EEZ, especially rights to the resources of the water column (e.g., pelagic fisheries), do not apply to the ECS."

There are various provisions and clauses that state the circumstances in which a nation can enter these zones in waters of other nations, and joint exercises help with developing an understanding of these specifics, Dr. Sultana said. "The countries join when there are common threats in the Indian Ocean. At that time, interoperability is important."

Security context

In August this year, during a virtual meeting of top security officials, India, Sri Lanka and the Maldives agreed to work on what they called the "four pillars" of security cooperation. These involved the areas of marine security, human trafficking, counter-terrorism and cyber security.

Nine months prior to this meeting in August, India's National Security Adviser Ajit Doval had visited Colombo for deliberations with Secretary to Sri Lanka's Ministry of Defence, Kamal Gunaratne, and Defence Minister of the Maldives, Mariya Didi, during which the three nations had agreed to expand the scope of intelligence sharing. This meeting between the three top security officials was important because it had marked the revival of NSA-level trilateral talks on maritime security in the Indian Ocean region after six years.

This NSA-level maritime security cooperation is important for relations between India and the Maldives and India and Sri Lanka. "It is always better if the navies (and the coast guards) of the three countries understand how they each operate. So this is why these exercises are important," said Dr. Sultana.

Diplomatic context

These exercises come at a time when the Defence Minister of the Maldives, Mariya Didi, is on a six-day visit to India. Didi will be the first foreign Defence Minister to review the passing out parade at the Indian Naval Academy. India's High Commissioner to the Maldives, Munu Mahawar met with Didi prior to her departure.

Didi's visit to India comes two days after Mahawar met with Didi to discuss bilateral ties between India and the Maldives. During her visit in India, Didi will also be meeting with Maldives National Defence Force personnel undergoing training in India, the High Commission of India in the Maldives had said. "During Didi's visit, there may be discussion with her counterparts on enhancing security and defence cooperation," said Dr. Sultana.

https://indianexpress.com/article/explained/importance-of-india-maldives-sri-lanka-trilateral-exercise-dosti-7639328/

Business Standard

Thu, 25 Nov 2021

When it comes to building warships, China is sailing far ahead of India

India has just one aircraft carrier against China's two; just 10 destroyers against China's 42 larger vessels; just 13 frigates against the PLA(N)'s 44; and barely 28 corvettes against China's 71

By Ajai Shukla

New Delhi: On Thursday, naval chief Admiral Karambir Singh will commission *INS Vela*, the fourth Scorpene-class conventional submarine built by Mazagon Dock Ltd, Mumbai (MDL) under Project 75I. This comes just four days after Defence Minister Rajnath Singh commissioned *INS Visakhapatnam*, the first destroyer that MDL has completed under Project 15B.

In March, MDL had delivered *INS Karanj*, the third Scorpene submarine of its class. That took the number of indigenously built capital warships commissioned this year to three – a figure not surpassed over the preceding decade.

Even so, navy admirals are bemused over the euphoria at this year's warship-building numbers. They point to China's People's Liberation Army (Navy), or PLA(N), which routinely builds and commissions over a dozen warships each year, with the number rising to 23 warships last year and 17 this year.

That accounts for why India has just one aircraft carrier against China's two; just 10 destroyers against China's 42 larger vessels; just 13 frigates against the PLA(N)'s 44; and barely 28 corvettes against China's 71.

Capital warships acquisitions: China

Type of warship	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Current total^
Jin-class SSBN	1	-	-	-	-	-	-	1	-	1	6
Shang/Han-class SSN	1	-	-	1	-	2	-	-	-	-	6
Diesel-electric submarines	6	-	-	1	1	1	1	2	-	2	57
Aircraft carriers	1	-	-	-	-	-	-		1	-	2
Cruisers/destroyers	-	2	2	3	1	2	3	3	4	8	42
Frigates	4	3	-	4	3	2	3	2	-	-	44
Corvettes	-	8	10	5	7	8	4	5	18	6	71
	13	**13**	**12**	**14**	**12**	**15**	**11**	**13**	**23**	**17**	**228**

^ Total current numbers, including warships dating back to before 2012

Capital warships acquisitions: India

Type of warship	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Current total^
Arihant-class SSBN	-	-	-	-	1	-	-	-	-	-	1
SSN	1*	-	-	-	-	-	-	-	-	-	1*
Diesel-electric submarines	-	-	-	-	-	1	-	1	-	2	17
Aircraft carriers	-	1	-	-	-	-	-	-	-	-	1#
Cruisers/destroyers	-	-	1	1	1	-	-	-	-	1	10
Frigates	3	1	-	-	-	-	-	-	-	-	13@
Corvettes	-	-	1	-	1	1	-	-	1	-	28
	4	**2**	**2**	**1**	**3**	**2**	**-**	**1**	**1**	**3**	**71**

* On lease from Russia

^ Total current numbers, including warships dating back to before 2012

One more, INS Vikrant, likely to be delivered in 2022

@ Seven more frigates being constructed in India under Project 17A; and four more under ToT from Russia

Cruisers/destroyers

The PLA(N) has long regarded frigates as an instrument for exercising sovereignty over its claimed maritime area, given that these medium-sized vessels can flexibly combine multi-role capability with large numbers for persistence.

Over the last decade, however, with the growing prospect of having to take on the US Navy's sophisticated and heavily armed warships, the thrust of the PLA(N)'s warship building has switched from light frigates to heavy destroyers.

The PLA(N)'s destroyers are now switching from the 7,500-tonne vessels of the Luyang, Luzhou, Luhai and Luhu class to the beefier 13,000-tonne, Type 055 Renhai-class destroyers, which are actually the size of cruisers. These massive warships are capable of not just handling a range of multi-dimensional threats from underwater, surface and air, but can also function as the flagships of naval task groups.

With the PLA(N) already fielding 42 destroyers, there is an expectation that ramped up production of Renhai-class destroyers is likely to increase these numbers further.

Frigates/corvettes

A large component of the PLA(N)'s rapid expansion since the turn of the century has come from building frigates and corvettes in large numbers. These smaller, more agile vessels were regarded as well suited for patrolling the waters of the South China Sea in larger numbers and backing up the Coast Guard in exercising Chinese maritime claims around the nine-dash line.

Towards that end, the PLA(N) commissioned seven frigates in the 2015-2016 period and last year, it commissioned 18 corvettes. India, meanwhile, has commissioned just four frigates in the last decade.

Submarines

In conventional submarines, the PLA(N) fields 18 Yuan-class vessels, along with 13 Song-class boats. In addition to these, it deploys a dozen Russian-origin Kilo-class submarines, while 14 obsolescent Ming-class submarines remain in reserve.

This conventional force is reinforced by the PLA(N)'s six nuclear-powered attack SSNs (nuclear propelled, conventionally armed submarines).

This comfortably outnumbers India's conventional submarine force of 19 boats, which includes four German HDW submarines, nine Russian Kilo-class and four (eventually six) Scorpene boats.

Even after building another six boats with air-independent propulsion that are in the acquisition pipeline under Project 75I, the Indian Navy will only have 25 conventional submarines.

In addition, the navy's only nuclear-powered attack submarine, taken on a 10-year lease from Russia in 2012, was aimed at facilitating the building of an indigenous line of six SSNs.

These, it was planned, would carry out "sea denial", to prevent Chinese warships from using the four straits between the South China Sea and the Indian Ocean. This project is making far slower progress than the PLA(N)'s Shang-class and Sui-class SSN projects.

In addition, the PLA(N)'s underwater nuclear deterrent is based on six obsolescent, 11,000-tonne Jin-class SSBNs (nuclear-propelled, nuclear-armed submarines). These are likely to be replaced by the more modern Tang-class. The first of these was expected to be completed in 2021, but this has not yet happened.

India, meanwhile, has managed to complete just one SSBN, the *INS Arihant*. Delivery of the planned four SSBNs is running well behind schedule. The developers were understood to be facing difficulties in miniaturising the nuclear reactor and also in creating adequate space for housing the larger K-4 ballistic missiles, in place of the relatively shorter range K-15 missile that the *INS Arihant* carries. The resolution of such fundamental challenges could take a significant amount of time.

https://www.business-standard.com/article/current-affairs/when-it-comes-to-building-warships-china-is-sailing-far-ahead-of-india-121112500236_1.html

ARMY TECHNOLOGY

Thu, 25 Nov 2021

CBRNE Defence: Technology trends

In the wake of the Covid-19 experience, demand for counter chemical, biological, radiological, nuclear, and explosives (CBRNE) research investments and procurements are expected to grow.

Breakthrough technologies such as artificial intelligence (AI), internet of things (IoT), advanced materials, nanotechnology and remote sensing will be leveraged in novel CBRNE solutions to speed up reaction time against the threats and mitigate their adverse effects.

Credit: Volodymyr Goinyk/Shutterstock.com

Listed below are the key technology trends impacting the CBRNE defence theme, as identified by GlobalData.

Nanotechnology

Although nanotechnology is relatively new, there have been some breakthroughs in developing and refining new techniques to detect and mitigate the use of biological or chemical weapons. For example, the decontamination of chemicals requires large amounts of water and can produce harmful waste to both humans and the environment. In contrast, nanotechnology can be used in the decontamination process even at room temperature, eliminating the need for thermal destruction and removing potentially harmful vapours.

Detecting the dispersal pattern of a chemical attack as it occurs, or developing better sensors for decontamination efforts, may offer more opportunities to use nanotechnology to reduce the effects of CBRN use.

Nanotechnology still presents some long-term risks, such as being used to aid the spread and distribution process or to hide deadly pathogens. 'Proto-nano-weapons' such as dense inert metal explosives (DIMEs) are designed to make explosives less indiscriminate and more dangerous, shrinking shrapnel to such an extent that medical professionals find it extremely difficult to treat the wounded.

Remote sensing

As the detection and identification of CBRNE threats is an expensive, meticulous, dangerous and painful endeavour for CBRNE protection forces, countries seek novel solutions including remote sensing to develop and improve their CBRNE detection and identification capabilities. Various laser absorption spectroscopy (LAS)-based remote detection techniques have been developed and fielded recently, including differential absorption LiDAR, tunable laser absorption spectroscopy, laser photoacoustic spectroscopy, dual-comb spectroscopy, laser heterodyne radiometry and active coherent laser absorption spectroscopy for chemical detection.

Unmanned vehicles equipped with remote sensors have great potential to monitor environment, detect and identify these threats rapidly and manage the consequences of CBRN attacks. For instance, in 2017, the European Defence Agency (EDA) and the European Space Agency (ESA) initiated an Autonomous Drone Services (AUDROS) project to detect and identify CBRNE threats using satellite and unmanned aerial vehicle (UAV) together.

Similarly, the Australian Defence Science and Technology (DST) Group working with industries including Strategic Elements, Stealth Technologies and Planck Aero systems seek autonomous CBRN sensing and search by deploying Unmanned Ground Vehicle (UGV) and UAV.

https://www.army-technology.com/comment/cbrne-defence-technology-trends/

Hindustan Times

Thu, 25 Nov 2021

Indian, French navies achieve ‘plug and fight’ capability

French air defence frigate Chevalier Paul reached the Mumbai coast after completing various anti-piracy and anti-smuggling operations

By Shankhyaneel Sarkar,| Edited by Poulomi Ghosh

New Delhi: Following the naval drills between FNS Chevalier Paul and Indian Navy Ship Kolkata, French envoy to India Emmanuel Lenain said the exercise demonstrated top performance levels in air defence, anti-submarine and anti-ship warfare. Lenain who was present during the event said in a tweet that both nations are proud that their respective armies are proud of the ‘plug and fight’ capability achieved by both navies.

The two-day drill involved air defence, anti-submarine warfare (hunting a target with the help of a P 8 patrol aircraft) and anti-ship warfare(Emmanuel Lenain/Twitter)

“Training in tandem! The 2-day naval drills between FNS Chevalier Paul and INS Kolkata off India's coast demonstrated top performance levels in air defence, anti-submarine and anti-ship warfare. Proud of the "plug and fight" capability achieved by our two Navies,” Lenain said in a tweet.

The two-day drill involved air defence, anti-submarine warfare (hunting a target with the help of a P 8 patrol aircraft) and anti-ship warfare (live firing of shots against a floating target and simulation of coordinating anti-ship missile firing), French officials who attended the event told news agency PTI.

“The two sides also shared a very positive assessment of the results, which confirmed the plug and fight capacity achieved by the two navies,” the French officials said after completion of the exercise.

French air defence frigate Chevalier Paul reached the Mumbai coast after completing various anti-piracy and anti-smuggling operations. The advanced air defence frigate in the French Navy is based in Toulon in southern France and was carrying out operations in the Indian Ocean Region. The ship initially arrived for a three-day goodwill visit.

The Indian Navy also later hosted the visitors for a number of leisure and sports activities which included a friendly football match, a dinner hosted by the Western Fleet, a cultural tour of Mumbai and an Indian food festival. The visitors hosted a reception onboard for Indian Navy personnel and local civilian dignitaries on the first day of its arrival.

https://www.hindustantimes.com/india-news/indian-french-navies-achieve-plug-and-fight-capability-101637766867375.html

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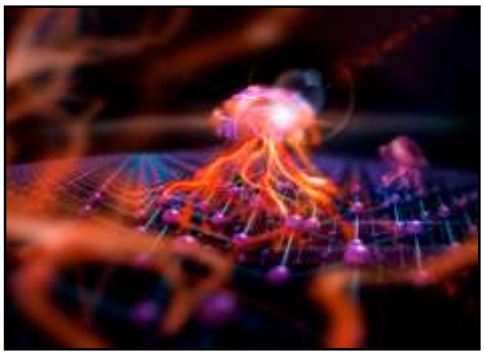
Thu, 25 Nov 2021

A new artificial material mimics quantum-entangled rare earth compounds

Physicists have created a new ultra-thin, two-layer material with quantum properties that normally require rare earth compounds. This material, which is relatively easy to make and does not contain rare earth metals, could provide a new platform for quantum computing and advance research into unconventional superconductivity and quantum criticality.



Physicists have created a new ultra-thin two-layer material with quantum properties that normally require rare earth compounds. Credit: Heikka Valja

The researchers showed that by starting from seemingly common materials, a radically new quantum state of matter can appear. The discovery emerged from their efforts to create a quantum spin liquid which they could use to investigate emergent quantum phenomena such as gauge theory. This involves fabricating a single layer of atomically thin tantalum disulphide, but the process also creates islands that consist of two layers.

When the team examined these islands, they found that interactions between the two layers induced a phenomenon known as the Kondo effect, leading to a macroscopically entangled state of matter producing a heavy-fermion system.

The Kondo effect is an interaction between magnetic impurities and electrons that causes a material's electrical resistance to change with temperature. This results in the electrons behaving as though they have more mass, leading these compounds to be called heavy fermion materials. This phenomenon is a hallmark of materials containing rare earth elements.

Heavy fermion materials are important in several domains of cutting-edge physics, including research into quantum materials. "Studying complex quantum materials is hindered by the properties of naturally occurring compounds. Our goal is to produce artificial designer materials that can be readily tuned and controlled externally to expand the range of exotic phenomena that can be realized in the lab," says Professor Peter Liljeroth.

For example, heavy fermion materials could act as topological superconductors, which could be useful for building qubits that are more robust to noise and perturbation from the environment, reducing error rates in quantum computers. "Creating this in real life would benefit enormously from having a heavy fermion material system that can be readily incorporated into electrical devices and tuned externally," explains Viliam Vaňo, a doctoral student in Liljeroth's group and the paper's lead author.

Although both layers in the new material are tantalum sulfide, there are subtle but important differences in their properties. One layer behaves like a metal, conducting electrons, while the other layer has a structural change that causes electrons to be localized into a regular lattice. The combination of the two results in the appearance of heavy fermion physics, which neither layer exhibits alone.

This new heavy fermion material also offers a powerful tool for probing quantum criticality. "The material can reach a quantum-critical point when it begins to move from one collective quantum state to another, for example, from a regular magnet towards an entangled heavy fermion

material," explains Professor Jose Lado. "Between these states, the entire system is critical, reacting strongly to the slightest change, and providing an ideal platform to engineer even more exotic quantum matter."

"In the future, we will explore how the system reacts to the rotation of each sheet relative to the other and try to modify the coupling between the layers to tune the material towards quantum critical behavior," says Liljeroth.

More information: Peter Liljeroth, Artificial heavy fermions in a van der Waals heterostructure, *Nature* (2021). DOI: 10.1038/s41586-021-04021-0. www.nature.com/articles/s41586-021-04021-0

Journal information: *Nature*

https://phys.org/news/2021-11-artificial-material-mimics-quantum-entangled-rare.html

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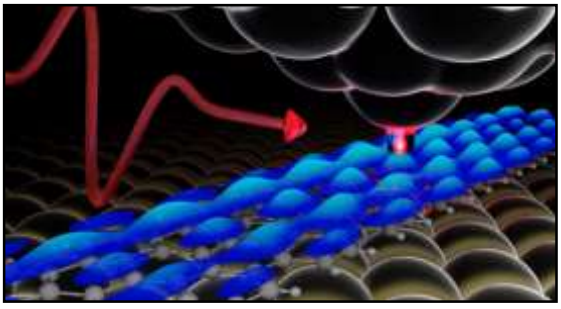
Thu, 25 Nov 2021

Lightwave-driven scanning tunneling spectroscopy of atomically precise graphene nanoribbons

By Matt Davenport

When physicist Tyler Cocker joined Michigan State University in 2018, he had a clear goal: build a powerful microscope that would be the first of its kind in the United States.



A schematic representing a microscopy measurement where a pulse of laser light (red curve) illuminates an atomically sharp needle (top) positioned above the sample surface. The graphene nanoribbon sits on top of a gold substrate. Experimental data is shown in blue, revealing the distribution of electrons above the nanoribbon. Credit: Spencer Ammerman

Having accomplished that, it was time to put the microscope to work.

"We knew we had to do something useful," said Cocker, Jerry Cowen Endowed Chair in Experimental Physics in the College of Natural Science's Department of Physics and Astronomy. "We've got the nicest microscope in the country. We should use this to our advantage."

With its microscope, Cocker's team is using light and electrons to study materials with an unparalleled intimacy and resolution. The researchers can see atoms and measure quantum features within samples that could become the building blocks of quantum computers and next-generation solar cells.

The team has given the world the first glimpse of those capabilities on Nov. 23 in the journal *Nature Communications*, taking snapshots of how electrons are distributed in what are known as graphene nanoribbons.

"This is one of the first demonstrations that this type of microscope can tell you something new," Cocker said. "We're very excited and proud of the work. We also have all these ideas in our heads about where we want to go with it."

Cocker's team is part of a collaboration that's working to develop these nanoribbons into qubits, pronounced "q-bits," for quantum computers. The collaboration spans five institutions and the work is supported by a grant from the Office of Naval Research that will provide more than $1 million to MSU's contribution.

For the *Nature Communications* study, Cocker teamed up with the research group of Roman Fasel, a professor at the Swiss Federal Laboratories for Materials Science and Technology. Fasel invented what's known as the bottom-up growth method for graphene nanoribbons. Fasel's lab has

synthesized molecules that, with the addition of heat, can build themselves into ribbons with a predetermined shape and size.

"You essentially bake the molecules like a cake," Cocker said. "Then the properties of the ribbon you end up with are predefined. You know what you're getting before you start."

The Swiss lab sent the molecules to MSU, where Cocker's lab grew the precision ribbons and then examined them with its microscope. The basis for the instrument is what's known as a scanning tunneling microscope, or STM, that brings a very sharp tip or probe extremely close to the specimen being studied without touching it.

Even though the tip and sample aren't in contact, electrons can still jump or tunnel from the tip to the sample. By recording how the electrons tunnel—for example, how many electrons tunnel and how quickly—the microscope builds high-resolution images of the sample and its properties.

What Cocker and his team have done is couple this conventional STM with extremely short pulses of laser light, which lets them bring the STM's tip even closer to the sample. As a result, they're able to extract more detailed information from a sample than ever before.

"It's almost like we're zooming in by physically bringing the tip closer," he said.

The team could then characterize different nanoribbons with atomic resolution, revealing unprecedentedly clear information about how electrons are distributed within the structure.

In addition to a publication, this work also has earned awards for its Spartan authors. Postdoctoral scholar Vedran Jelic won an award for his poster about the research at a recent workshop in Germany. Graduate student researcher Spencer Ammerman won an award for presenting the work last November at a conference hosted by the Infrared, Millimeter and Terahertz Wave Society, which also awarded Cocker its 2021 Young Scientist Award.

As excited as Cocker and his team are about the new paper and these accolades, they're looking forward to what's next. For example, the team is working on going from still images to movies of samples, showing how electrons move within the ribbons as the nanomaterial absorbs light.

The researchers are also building a second microscope with support from a Department of Defense grant awarded in June, meaning the only two microscopes like this in the U.S. will both be at MSU.

"This paper is very exciting, but it's also just the first step," Cocker said. "We think it's going to open up a lot of possibilities."

More information: S. E. Ammerman et al, Lightwave-driven scanning tunnelling spectroscopy of atomically precise graphene nanoribbons, *Nature Communications* (2021). DOI: 10.1038/s41467-021-26656-3

Journal information: *Nature Communications*

https://phys.org/news/2021-11-lightwave-driven-scanning-tunneling-spectroscopy-atomically.html

Thu, 25 Nov 2021

Energy transition in an artificial atom attained using laser light

Researchers from Basel and Bochum have succeeded in addressing an apparently unattainable energy transition in an artificial atom using laser light. Making use of the so-called radiative Auger process, they were the first team to specifically excite it. In this process, an electron falls from a higher to a lower energy level and, as a result, emits its energy partly in the form of light and partly by transferring it to another electron. The artificial atoms are narrowly defined areas in semiconductors that could one day form the basis for quantum communication. The findings are described by the team from the University of Basel and Ruhr-Universität Bochum together with colleagues from Münster and Wroclaw in *Nature Communications*, published online on 12 November 2021.

Electrons move between energy states

Atoms consist of a nucleus and electrons that travel around the nucleus. These electrons can assume different energy levels. Electrons that are more tightly bound to the nucleus, i.e. closer to it, have a lower energy than electrons that are further away from the nucleus. However, the electrons can't assume any arbitrary energy levels—only certain levels are possible.

If an electron acquires energy, for example by absorbing a light particle, i.e. photon, it can be raised to a higher energy level. If an electron falls to a lower energy level, energy is released. This energy can be emitted in the form of a photon. But it can also be transferred to one of the other electrons; in this case, only some of the energy is released as light, the rest is absorbed by the other electron. This process is known as the radiative Auger process.

Exciting a unique energy transition with two lasers

By irradiating light particles, electrons can not only be lifted to a higher energy level; they can also be stimulated to give off energy by an incident light particle. The energy of the incident light particle must always correspond exactly to the difference in the two energy levels between which the electron is to be transferred. The researchers have used two lasers: one moved electrons between a low and a high energy level; the other between the high and a medium energy level. This middle energy level corresponds to a non-equilibrium level: the transfer to the middle level doesn't exist without a radiative Auger process. In addition, a transition between the low and the medium energy level shouldn't have occurred, because the relevant light was not irradiated. However, precisely this seemingly impossible transition occurred in reality due to the energy transfer from one electron to another in the radiative Auger process.

The ultrapure semiconductor samples for the experiment were produced by Dr. Julian Ritzmann at Ruhr-Universität Bochum under the supervision of Dr. Arne Ludwig at the Chair for Applied Solid State Physics headed by Professor Andreas Wieck. The measurements were carried out by a team from the University of Basel run by Clemens Spinnler, Liang Zhai, Giang Nguyen and Dr. Matthias Löbl in the group headed by Professor Richard Warburton.

More information: Clemens Spinnler et al, Optically driving the radiative Auger transition, *Nature Communications* (2021). DOI: 10.1038/s41467-021-26875-8

Journal information: *Nature Communications*

https://phys.org/news/2021-11-energy-transition-artificial-atom-laser.html

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Thu, 25 Nov 2021

Two doses of Covaxin 50% effective against symptomatic covid-19: Lancet

By Neetu Chandra Sharma

- ***The study was conducted during India's second covid-19 surge in a high-exposure population (healthcare workers)***

New Delhi: Two doses of Bharat Biotech's Covaxin result in 50% effectiveness against symptomatic covid-19, as per the first real-world assessment of the India-developed vaccine, published in The Lancet Infectious Diseases journal. The study was conducted during India's second covid-19 surge in a high-exposure population (healthcare workers).

Covaxin developed by Bharat Biotech (India), is a vero cell-derived, inactivated whole-virion vaccine administered in a two-dose regimen, 28 days apart. (AP Photo/Altaf Qadri) (AP)

The researchers assessed 2,714 hospital workers from the All India Institute of Medical Sciences (AIIMS) in Delhi, India, from April 15 to May 15, 2021, who were symptomatic and underwent RT-PCR testing for covid-19. The delta variant was the dominant strain in India during the study period, accounting for approximately 80% of all confirmed covid-19 cases.

"Our study offers a more complete picture of how Covaxin performs in the field and should be considered in the context of covid-19 surge conditions in India, combined with the possible immune evasive potential of the delta variant. Our findings add to the growing body of evidence that rapid vaccine rollout programmes remain the most promising path to pandemic control while public health policies must continue to include additional protective measures, such as mask-wearing and social distancing," said Dr Manish Soneja, additional professor of Medicine at AIIMS in New Delhi.

Covaxin developed by Bharat Biotech (India), is a vero cell-derived, inactivated whole-virion vaccine administered in a two-dose regimen, 28 days apart. In January 2021, BBV152 was approved for emergency use in India for people aged 18. The World Health Organization (WHO) added covaxin to its list of approved emergency use covid-19 vaccines in November 2021.

The study found that the effectiveness of two vaccine doses remained stable over the seven-week follow-up period. Requests for testing gradually declined toward the end of the study period (from May 6 to May 15). The median interval between receipt of the last vaccine dose and the end of the study period (May 15, 2021) for those who had received one dose was 37 days (range 7 to 119) days and 50 days (range 5 to 103) days for those who had received two doses. The adjusted vaccine effectiveness of the first dose, estimated after 7 and 21 days, was low, which is consistent with the performance of other vaccines against the delta variant and indicates the importance of a second dose to achieve vaccine effectiveness.

The majority of eligible participants were tested for SARS-CoV-2 infection during the first 20 days of the 30-day study when the test positivity rate for covid-19 was at its peak in India. "Findings from the study confirm previous research indicating that two doses of covaxin are required to achieve maximum protection and that all vaccine roll-out plans must follow the

recommended dosing schedule. More research is needed to better understand how these findings translate to covaxin's effectiveness against delta and other variants of concern, especially related to severe covid-19 infection, hospitalisation, and deaths," said Dr Parul Kodan, Assistant Professor of Medicine at AIIMS in New Delhi.

The authors note that several factors may be responsible for the lower vaccine effectiveness in this study. Firstly, this study population only included hospital employees who may have a higher risk of exposure to covid-19 infection than the general population. Secondly, the study was conducted during the peak of India's second wave of covid-19 with high test positivity rates for both hospital employees and residents of Delhi. Thirdly, the prevalence of circulating variants of concern, especially delta, may have contributed to covaxin's lower effectiveness.

The authors acknowledge several limitations in the study. Most importantly, this study does not estimate the vaccine effectiveness against hospitalisation, severe disease, and death, which require further assessment. Additionally, the study was not designed to estimate vaccine effectiveness for different time intervals after vaccination or to determine if vaccine effectiveness changed over time. Another limitation was the absence of data on comorbidities and prior covid-19 infection, which may affect health-seeking behaviour as well as vaccine effectiveness.

https://www.livemint.com/news/india/two-doses-of-covaxin-50-effective-against-symptomatic-covid-19-lancet-11637753112447.html