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The Tribune

Thu, 26 Aug 2021

DRDO developing new electro-optical system to detect drones

The project is being undertaken by Instruments Research and Development Establishment, Dehradun

By Vijay Mohan

Chandigarh: With close monitoring of unmanned aerial vehicles (UAV) movement becoming imperative in the backdrop of the government opening up the skies to privately owned UAV's and the growing security threat posed by rouge drones, the Defence Research and Development Organisation (DRDO) is developing a new electro-optical system for tracking such flying objects.

The project is being undertaken by Instruments Research and Development Establishment (IRDE), Dehradun, which has recently embarked on another project to develop an electro-optical system for coastal and harbour surveillance.



For representation only.

This is the second known project by DRDO to develop a surveillance system to track drones. Last year, the Electronics and Radar Development Establishment (LRDE) at Bengaluru had fielded a counter-drone system which had been deployed as part of the security cover for Republic Day and Independence Day celebrations in the capital.

LRDE's system has also been demonstrated to the armed forces as well as border guarding forces. The technology for its manufacture has been transferred to the industry for commercial production.

According to DRDO sources, the system to be developed by IRDE is required to detect a four-foot long UAV flying at about 300 kph from a distance of 3 km and a drone having a size of about one foot and flying at about 70 km from a distance of 2 km.

The system will employ thermal Imagers, high-resolution video cameras, laser illuminators and laser range finders to detect and track drones. It will also be capable of being integrated with airspace surveillance radars.

Given the small size, the miniscule radar signature, the low operating altitude and the slow speed of most drones, conventional air defence systems or standalone equipment are not effective to detect them.

DRDO sources said that a combination of several types of systems including electromagnetic and radio emission, the reflection of microwave, infrared and visible light through optical instruments is required to detect, track and identify drones. Options to neutralize them include soft-kill such as jamming or hacking their radio signals or hard-kill like shooting them down.

While small drones are increasingly being used to carry out commercial or personal tasks such as the delivery of goods, aerial survey or photography over the past few years, the threat of drones being used by terrorists, rogue elements or hostile nations has also enhanced significantly.

The recent incident in which two drones were used to cause explosions inside the Jammu Air Force Station is a stark example of the threat posed by drones, which allow a perpetrator to reach any target in any location without exposing himself to personal risk.

Besides, cross border smuggling of weapons, narcotics or contraband, espionage and intelligence gathering through drones is another area of concern. While there are frequent reports of drones being spotted in border areas, an Air Force officer revealed that after the airstrike on terror camps in Balakote across the Line of Control, a number of unidentified drones were spotted in the vicinity of the Srinagar Air Force Station, which may have been used to gather information on activity inside the airbase, which was then the hub of IAF operations.

<https://www.tribuneindia.com/news/nation/drdo-developing-new-electro-optical-system-to-detect-drones-301981>



Thu, 26 Aug 2021

DRDO's advanced chaff technology provides passive jamming against infra-red, radar threats

Earlier, Union Defence Minister Rajnath Singh had lauded the DRDO, IAF and the industry for indigenous development of this critical technology

Jodhpur: The DRDO on August 25 said its latest advanced chaff technology to safeguard IAF's fighter jets provides passive jamming against infra-red and radar threats.

In collaboration with the Pune-based facility of the DRDO, the Defence Laboratory in Jodhpur has developed the advanced chaff material and chaff cartridge.

At a press conference, Director of Defence Lab in Jodhpur Ravindra Kumar said chaff is a critical defence technology used to protect fighter aircraft from hostile radar threats.

"In today's electronic warfare, survivability of fighter aircraft is of prime concern because of advancement in modern radar threats. To ensure survivability of aircraft, Counter Measure Dispensing System (CMDS) is used which provides passive jamming against Infra-Red and radar threats," Mr. Kumar said.

He said the importance of this technology lies in the fact that very less quantity of chaff material deployed in the air acts as a decoy to deflect enemy's missiles for ensuring safety of the fighter aircraft.

Mr. Kumar said the technology has been given to the industry for production in large quantities to meet the annual rolling requirement of the Indian Air Force.

Earlier, Union Defence Minister Rajnath Singh had lauded the DRDO, IAF and the industry for indigenous development of this critical technology, terming it as one more step of DRDO towards 'Atma Nirbhar Bharat' in strategic defence technologies.

Secretary Department of Defence R&D and Chairman DRDO Dr G Satheesh Reddy had also congratulated the teams associated with the successful development of this advanced technology aimed at strengthening the Indian Air Force.

<https://www.thehindu.com/news/national/drdo-advanced-chaff-technology-provides-passive-jamming-against-infra-red-radar-threats/article36094107.ece>



A view of the newly developed Advanced Chaff Technology to safeguard fighter aircraft of Indian Air Force against hostile radar threats, by DRDO's Defence Laboratory in Jodhpur. | Photo Credit: PTI

DRDO ने अब भारत में ही तैयार कर ली 'वो' टेक्नोलॉजी, जो मिसाइलों के हमले से Fighter Planes को बचाएगी

DRDO ने अब भारत में ही वो टेक्नोलॉजी (Advanced Chaff Technology) डेवलप की है, जो मिसाइलों के अटैक से लड़ाकू विमानों की रक्षा करेगा। अभी इस टेक्नोलॉजी को खरीदने के लिए अरबों डॉलर खर्च करने पड़ते थे। यानी आत्मनिर्भर भारत की दिशा में यह एक जबर्दस्त पहल है। इससे भारत की मुद्रा बचेगी।

जोधपुर: जोधपुर की रक्षा प्रयोगशाला व अनुसंधान संगठन (DRDO) ने भारतीय विमानों, खासकर लड़ाकू विमानों को मिसाइलों के अटैक से बचाने चैफ टेक्नोलॉजी को डेवलप किया है। DRDO इसका प्रॉडक्शन भी करेगा। चैफ टेक्नोलॉजी एक विशेष मेटल फाइबर से विकसित की गई है। इसके यूज से रडार बेस्ड मिसाइल विमान को ट्रैक नहीं कर पाएगी। अभी इस टेक्नोलॉजी के लिए भारत दूसरे देशों पर निर्भर है। जोधपुर स्थित DRDO की रक्षा प्रयोगशाला ने देश की वायुसेना की सालाना एक लाख कार्टिज(Cartridge) की खपत को पूरा करने के लिए चैफ प्रॉडक्शन प्लांट लगा दिया है। यहां नेवी के लिए भी प्रॉडक्शन होगा। अभी इस टेक्नोलॉजी को खरीदने के लिए अरबों डॉलर खर्च करने पड़ते थे। यानी आत्मनिर्भर भारत की दिशा में यह एक जबर्दस्त पहल है। इससे भारत की मुद्रा बचेगी।



एयरफोर्स सीधे देगा ऑर्डर

इंडियन एयरफोर्स (IAF) Cartridge खरीदने सीधे ऑर्डर देगा। चैफ खरीदने पर एयरफोर्स सालाना 100 करोड़ से भी ज्यादा खर्च करता है, अब आधे पैसे ही खर्च होंगे। अभी ये एयरफोर्स के जगुआर विमान में उपयोग में आएगा। DRDO, जोधपुर के डायरेक्टर डॉ. रविन्द्र कुमार ने बताया कि हमने इसे विकसित करने के लिए 4 वर्ष की समय सीमा तय की थी, लेकिन हमारी टीम ने अथक प्रयास से इसे सिर्फ ढाई वर्ष में ही तैयार कर दिया गया। इससे न केवल समय पर देश में विकसित चैफ मिल सकेगा, बल्कि विदेशी मुद्रा की बचत भी होगी। इसके निर्यात की भी भरपूर संभावना है, हालांकि इस बारे में फैसला सरकार करेगी।

यह है चैफ तकनीक

सही मायने में यह फाइबर है। बाल से भी पतले इस फाइबर की मोटाई महज 25 माइक्रोन होती है। फाइटर प्लेन से इसके छोटे-छोटे टुकड़ों को दागा जाता है। इससे करोड़ों-अरबों टुकड़े आसमान में एक निश्चित ऊंचाई पर जाकर आपस में मिलकर बादलों के समान एक समूह बना लेते हैं। इस समूह से दुश्मन के रडार में फाइटर का आभास होता है। ऐसे में विमान की ओर दागी जाने वाली मिसाइल अपना लक्ष्य भटक कर इस समूह से टकरा जाती है। चैफ को दागने के लिए विमान के पिछले हिस्से में लगाया जाता

है। निश्चित दूरी पर विस्फोट होते ही चैफ के पार्टिकल आसमान में बिखर जाते हैं। थोड़ी देर में ये करोड़ों पार्टिकल आपस में मिलकर एक समूह के रूप में छा जाते हैं। जहाज की तरफ बढ़ रही मिसाइल इन्हें अपना लक्ष्य मान दिशा बदल इन पर टूट पड़ती है।

बेहतर रहा रिजल्ट

DRDO, जोधपुर के डायरेक्टर डॉ. रविन्द्र कुमार ने बताया कि इसके अब तक किए गए सारे परीक्षणों के नतीजे संतोषजनक रहे हैं। चैफ टेक्नोलॉजी के इस्तेमाल के लिए आधा सेकेंड से भी कम का समय मिलता है। हालांकि ऐसे में पायलट को विशेष प्रशिक्षण की जरूरत पड़ेगी। इसके लिए अब हम वर्चुअल सिस्टम तैयार कर रहे हैं, ताकि सीधे विमान पर जाने से पहले पायलट वसूली प्रशिक्षित हो जाए।

<https://hindi.asianetnews.com/national-news/drdo-invented-advanced-chaff-technology-to-protect-fighter-planes-from-attack-of-radar-based-missile-gye466>

Business Standard

Thu, 26 Aug 2021

BrahMos Aerospace seeks 200-acre land in Lucknow

*About 500 engineers and technical people will get direct employment in the
BrahMos Production Centre which will be built by investing Rs 300 crore*

By Ajai Shukla

New Delhi: For over two decades, the supersonic BrahMos cruise missile has been portrayed as a triumph of Indo-Russian co-development and co-manufacture. Even the missile's name — BrahMos — is derived from combining the names of a major river from each country: India's Brahmaputra and Russia's Moskva.

Numerous analysts have expressed scepticism that India has played a role in designing the BrahMos. They say the missile is based entirely on Russian technology, while India merely manufactures the missile from blueprints provided by Russia.

On Wednesday, the Uttar Pradesh (UP) government, which is trying to become a defence manufacturing hub, issued a statement that said the BrahMos missile "is based on the technology of Russia's P-800 Oniks cruise missile".

Later in the statement, the UP government changed tack, stating: "The missile has been designed, developed and produced by BrahMos Aerospace — a joint venture of the Defence Research and Development Organisation (DRDO) and of NPO Mashinostroyeniya (NPOM)."

This was in the context of a request from BrahMos Aerospace Chief Sudhir Misra to the UP Expressways Industrial Development Authority (UPEIDA) and UP government seeking 200 acre of land for a facility to build the BrahMos. A delegation from BrahMos Aerospace also met UP Chief Minister Yogi Adityanath on Tuesday.

The current version of the BrahMos cruise missile is assembled at a facility in Hyderabad. But UPEIDA is aiming to manufacture the new, improved BrahMos cruise missile.

"UP may soon start manufacturing the Next-Gen state-of-the-art BrahMos missile," stated a UP government release on Wednesday. More than 100 BrahMos missiles are planned to be built in the next three years.



The current version of the BrahMos cruise missile is assembled at a facility in Hyderabad.

“About 500 engineers and technical people will get direct employment in the BrahMos Production Centre which will be built by investing Rs 300 crore on the land to be allotted for making BrahMos missiles at Lucknow node,” stated the release.

“Apart from this, about 5,000 people will get indirect employment and 10,000 people will get work through the production centre. The work of setting up the BrahMos production centre is likely to start soon,” said the UP government.

Prime Minister Narendra Modi had announced the creation of two “Defence Manufacturing Corridors”, one each in UP and Tamil Nadu, during DefExpo 2018 in Chennai.

This project got a substantial boost during the DefExpo 2020, which was held in Lucknow. Since then, the Ministry of Defence (MoD) has announced that numerous defence manufacturers had signed memorandum of understanding (MoU) worth Rs 50,000 crore for investment in the corridor. Most of these MoUs have been signed for the defence corridor being built around Aligarh.

Defence manufacturers, including several who are still to manufacture any defence items, have been attracted to these industrial zones by the promise of allocation of real estate.

“11 companies in the Lucknow node, six in the Jhansi node, and eight in Kanpur node have requested to provide land (sic) for setting up factories. Acting on the proposals received from various companies, UPEIDA has so far allotted 55.4 hectares of land in Aligarh node to 19 international companies,” announced the UP government on Wednesday.

“About four acres of land has been allotted to two companies in Kanpur node and 15 acres of land to one company in Jhansi. Whereas in Lucknow node, it has been agreed to give 200 acres of land to build BrahMos Production Centre,” said the UP government.

“In the last three years, over 65 big companies have requested the government to provide land in the Defence Industrial Corridor to set up their factories, of which around 19 big companies have been allotted 55.4 hectares of land by UPEIDA recently,” the UP government said.

Land in the UP corridor is being allocated to companies that have little, or no, profile in defence manufacturing, but are promising big investments.

In the Aligarh node, two of the 19 companies which have been allotted land are promising to invest Rs 581 crore to make drones. One of them, Anchor Research Lab LLP, which has undertaken to invest Rs 550 crore, has been allotted 10 hectares of land by UPEIDA. Another firm, Allan and Alvan, which has promised to invest Rs 30.75 crore, has been allotted eight acres of land.

Similarly, land has been allotted to other little-known firms that are jumping into defence manufacturing, on the strength of a promised investment.

https://www.business-standard.com/article/companies/brahmos-aerospace-seeks-200-acre-land-in-lucknow-121082600038_1.html

Explained: Why Indian Army's indigenous 'Multi-Mode Hand Grenades' is a shining example of 21st-century defence arsenal

For the first time in the Indian defence ecosystem, the Indian Army has received the first consignment of Multi-Mode Hand Grenades (MMHG), manufactured by Nagpur-based ammunition firm Economic Explosives Limited (EEL) following Transfer of Technology from Terminal Ballistics Research Laboratory of Defence Research & Development Organisation (DRDO) in the presence of Defence Minister Rajnath Singh.

The subsidiary of Solar Industries India Limited was awarded the Rs 400 crore contract of manufacturing 10 lakh grenades for the Indian Army and Indian Air Force. The first batch of indigenous Multi-Mode Hand Grenades (MMHG) will replace British era vintage Grenade No 36 of World War I. The first consignment consists of 40,000 made-in-India grenades and other deliveries will be made over the span of the next two years.



Addressing the ceremony in Nagpur, Defence Minister Rajnath Singh termed the handing over of MMHG as a shining example of public-private partnership to achieve self-reliance in defence manufacturing and a big step towards self-reliance in the defence sector.

“Today is a memorable day in the history of the Indian defence sector. Our private industry is coming of age when it comes to defence production. It is an important milestone not only in the field of defence manufacturing but also in achieving ‘AatmaNirbhar Bharat’ as envisioned by our Prime Minister Narendra Modi,” the Defence Minister said.

The Raksha Mantri also lauded DRDO & EEL for the speedy delivery of the order amidst COVID-19 restrictions.

Multi-mode grenades: The perfect match for India's 21st-century arsenal

The new advanced Multi-mode grenade could be termed as India's big leap in the 21st century defence sector as these grenades offer multiple advantages to soldiers in terms of safety and penetration attack as compared to the vintage hand grenades.

The advanced grenade has dual-mode – defensive and offensive. In the offensive mode, the grenade doesn't have a fragment sleeve and is used for low-intensity attacks as it offers stunning effects. The mode is used when the soldier targets the attack within five meters from the point of burst.

In defensive mode, the grenade is assembled with its fragmenting sleeve. This mode of the grenade is used when the soldier is in the shelter and the enemy is in the open area. Its lethal radius has a capacity to target eight meters from the point of burst.

Salient features of the grenade

- To ensure high reliability, the grenade comes with twin delay tubes.
- The new advanced Multi-mode grenade has a minimum 0.5 second arming delay for the safety of soldiers.
- For a deep penetration attack, the grenade has 3,800 unique fragmentation patterns.

Defence Initiatives: Journey towards self-reliance

At the ceremony, the Defence Minister listed out a plethora of the initiatives undertaken by the Government of India to transform the defence sector into a self-reliant industry, which can cater to the present and the future endeavours of our Armed Forces.

These initiatives include setting up of 'Defence Industrial Corridors' in the states of Uttar Pradesh and Tamil Nadu, formulation of draft 'Defence Production and Export Promotion Policy' (DPEPP) 2020, earmarking nearly 64 percent of its modernisation funds under capital acquisition budget for 2021-22 for procurement from domestic defence firms, notifying two 'Positive Indigenisation Lists of over 200 defence items' to promote self-reliance & defence exports, Corporatisation of Ordnance Factory Board (OFB), increasing FDI limit from 49 to 74 per cent under automatic route among others.

DRDO's Transfer of Technology (TOT)

The Raksha Mantri also made special mention of another imperative initiative by DRDO's Technology Transfer to Industries as the backbone of the defence industry.

The research arm of defence has been hand holding defence entities as an incubator which is undertaking free of cost TOT as well as providing access to testing facilities to more than 450 entities.

Notably, Innovations for Defence Excellence (iDEX) has also been working towards achieving self-reliance and fostering innovation & technology development in defence and aerospace sectors by engaging Industries including MSMEs, start-ups, individual innovators, R&D institutes and academia.

The journey from defence importer to defence exporter

Commending the Industry for indigenously developing products, Rajnath Singh lauded made-in-India defence products like 'Multi-Mode Grenade', 'Arjun-Mark-1' tank, 'Unmanned Surface Vehicle' and 'See Through Armor'.

"Such products are not just being produced but exported on a large scale. The number of online export authorisations during 2016-17 to 2018-19 was 1,210. It has increased to 1,774 in the last two years. This has resulted in defence exports of over Rs 17,000 crore in the last two years," he added.

Further, impressed by the safety and lethality of Multi-Mode Hand Grenades, Indonesia and other foreign countries have shown their interest to buy the grenades from Solar Industries. Indonesia has already placed an order for the grenades as the Indian government has already given in-principle approval to Economic Explosives Limited to supply the grenades to Indonesia.

The Indian government's bold decision to open up the ammunition manufacturing sector for private agencies is paying rich dividends as until a decade ago, ammunition manufacturing was in the sole domain of government agencies and it was beyond the imagination that the private sector could foray into this field.

<https://newsonair.com/2021/08/25/explained-why-indian-armys-indigenous-multi-mode-hand-grenades-is-a-shining-example-of-21st-century-defence-arsenal/>

HAL surges 17% in 5 days after it signs \$716-mn deal with GE Aviation

Shares of Hindustan Aeronautics (HAL) hit a 52-week high of Rs 1,245.90 after they surged 7 per cent on the BSE in the intra-day trade on Wednesday

Mumbai: Shares of Hindustan Aeronautics (HAL) hit a 52-week high of Rs 1,245.90 after they surged 7 per cent on the BSE in the intra-day trade on Wednesday. The stock of the state-owned company surpassed its previous high of Rs 1,214.95, touched on August 25, 2020. It had hit a record high of Rs 1,424 on August 14, 2020.

HAL is a public sector enterprise, engaged in the design, development, manufacture, repair, overhaul, upgrade and servicing of a wide range of products including aircraft helicopters, aero-engines, avionics accessories and aerospace structures.

In the past five trading days, the market price of HAL has swelled 17 per cent after the company said it has signed \$716 million deal with GE Aviation for procurement of 99 engines for manufacturing 83 LCA Tejas for Indian Air Force (IAF).



Earlier, on February 3, HAL had informed exchanges that the government had formally sealed the deal of around Rs 48,000 crore (inclusive of taxes and duties of around Rs 7,000 crore; infrastructure and design & development cost of around Rs 2,300 crore) for procuring 73 indigenous LCA Tejas Mk-1A fighter aircraft and 10 LCA Tejas Mk-1 trainer aircraft from the company.

The demand in Aerospace and Defence (A&D) manufacturing sector in the country is dominated by the demands from Defence sector. Defence projects, policies and funding of Government of India play crucial role in the growth of A&D industry in India and in-turn HAL, because of the major dependence on the Defence sector.

"There is a strong push from the government through the 'Atmanirbhar Bharat Abhiyan', the policy formulations and reforms post Covid, which is giving significant impetus to self-reliance and local production. This is expected to favorably impact the operations of the company. The Defence Services are looking for more indigenous options as compared to import and HAL is expected to benefit from this as there are a slew of indigenous products like LCA Tejas and its variants," the company had said in its annual report for fiscal year 2019-20 (FY20).

At 01:23 pm, HAL was trading 6 per cent higher at Rs 1,231.60 on the BSE as compared to a 0.19 per cent rise in the S&P BSE Sensex. Trading volumes on the counter jumped over four-fold with nearly 2 million equity shares having changed hands on the NSE and BSE till the time of writing of this report.

https://www.business-standard.com/article/markets/hal-surges-17-in-5-days-after-it-signs-716-mn-deal-with-ge-aviation-121082500561_1.html

Defence Strategic: National/International



Press Information Bureau
Government of India
Ministry of Defence

Wed, 25 Aug 2021 5:11PM

Commander, US Indo-Pacific Command calls on Chief of Defence Staff

Key Highlights:

- *Issues related to peace & security and bilateral defence cooperation discussed*
- *Admiral Aquilino also meets Tri-Service Chiefs & Defence Secretary*

Chief of Defence Staff General Bipin Rawat held a meeting with Commander of the United States Indo-Pacific Command (US INDOPACOM) Admiral John C Aquilino in New Delhi on August 25, 2021. Issues related to peace & security in the region and bilateral defence cooperation were part of the agenda for the meeting. Admiral Aquilino also held meetings with the Tri-Service Chiefs and Defence Secretary Dr Ajay Kumar.

The Commander US INDOPACOM began his visit by paying tribute to the fallen heroes by laying a wreath at the National War Memorial in New Delhi. He is on an official visit to India from August 24-26, 2021.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1748917>



Press Information Bureau
Government of India
Ministry of Defence

Wed, 25 Aug 2021 10:16AM

Indo-Kazakhstan joint training exercise to commence on 30 august 2021

As part of military diplomacy and to strengthen the growing strategic relation with Kazakhstan, the 5th edition of Indo- Kazakhstan Joint Training Exercise, “KAZIND-21” will be conducted at Training Node, Aisha Bibi, Kazakhstan, from 30 August to 11 September 2021. The exercise is a joint training between both the Armies, which will boost the bilateral relations between India and Kazakhstan.

The Indian Army contingent represented by a battalion of The Bihar Regiment consists of a total of 90 personnel led by a Contingent Commander. The Kazakhstan Army will be represented by a company group.

The Exercise will provide an opportunity to the Armed Forces of India & Kazakhstan to train for Counter Insurgency/ Counter Terrorism operation in mountainous, rural scenario under UN mandate. The scope of Joint Exercise includes professional exchange, planning & execution of

operation in Counter terrorism environment at sub unit level and sharing expertise on skills at arms, combat shooting and experiences in Counter Insurgency/ Counter Terrorism operations. The exercise will culminate after a 48 hours long validation exercise which will involve a scenario of neutralization of terrorists in a semi-rural hideout.

The exercise will strengthen mutual confidence, inter-operability and enable sharing of best practices between the Armed Forces of India and Kazakhstan.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1748756>



पत्र सूचना कार्यालय
भारत सरकार

रक्षा मंत्रालय

Wed, 25 Aug 2021 10:16AM

भारत-कजाकिस्तान संयुक्त सैन्य अभ्यास 30 अगस्त 2021 से

कजाकिस्तान के साथ बढ़ रहे रणनीतिक संबंधों को मजबूत करने और सैन्य कूटनीति के एक हिस्से के रूप में 'भारत-कजाकिस्तान संयुक्त प्रशिक्षण प्रयास का 5वां संस्करण' ट्रेनिंग नोड, आइशा बीबी, कजाकिस्तान में 30 अगस्त से 11 सितम्बर, 2021 तक आयोजित किया जाएगा। यह दोनों देशों की सेनाओं के बीच एक संयुक्त प्रशिक्षण अभ्यास है जो भारत और कजाकिस्तान के द्विपक्षीय संबंधों को मजबूत करेगा। इस अभ्यास में भारतीय सेना की टुकड़ी का प्रतिनिधित्व बिहार रेजिमेंट की एक बटालियन करेगी, जिसमें एक टुकड़ी कमांडर की अगुवाई में कुल 90 सैन्य कर्मी शामिल हैं और कजाकिस्तान सेना का एक प्रतिनिधित्व एक कंपनी समूह द्वारा किया जाएगा। यह सैन्य अभ्यास भारत और कजाकिस्तान के सशस्त्र बलों को संयुक्त राष्ट्र के जनादेश के तहत पहाड़ी, ग्रामीण क्षेत्रों में उग्रवाद और आतंकवाद निरोधी अभियानों में दक्ष करने का एक अवसर प्रदान करेगा। इस संयुक्त अभ्यास में दोनों देशों की सेनाओं के बीच पेशेवर रणनीतिक कौशल, उप इकाई स्तर पर आतंकवाद विरोधी माहौल में अभियानों की योजना और उनके क्रियान्वयन, हथियार चलाने संबंधी कौशल और आतंकवाद तथा उग्रवाद संबंधी अभियानों के अनुभवों को साझा किया जाएगा। यह सैन्य अभ्यास 48 घंटों के दीर्घकालीन अभ्यास के समापन के बाद समाप्त होगा, जिसमें आतंकवादियों के अर्धग्रामीण ठिकाने को नष्ट करने का परिदृश्य शामिल होगा।

इस सैन्य अभ्यास से दोनों देशों की सेनाओं के बीच आपसी विश्वास को बढ़ावा मिलेगा और अंतर संचालन तथा बेहतर विधियों को अपनाने में सक्षम होने का अवसर मिलेगा।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1748807>

Quad to kick off Malabar tomorrow, 1st tri-service drills with UK in October

The Quad navies had carried out complex naval drills under the Malabar banner in November 2020 in the Arabian Sea and the Bay of Bengal

By Rahul Singh

India, the United States, Japan and Australia will kick off the latest edition of the Malabar naval drills off the Pacific Ocean island of Guam on Thursday, with the exercise involving destroyers, frigates, corvettes, submarines, helicopters, long-range maritime patrol aircraft and elite special forces elements including the US Navy SEALs and the Indian Navy's marine commandos (MARCOS), top officials familiar with the developments said on Wednesday.

India is also preparing to conduct its first tri-service exercise with the United Kingdom in the Arabian Sea in October-end, said one of the officials cited above, asking not to be named. The Royal Navy will send a carrier strike group led by HMS Queen Elizabeth for the drills that will be conducted from October 21 to 27. India has so far conducted tri-service drills only with two other countries --- the US and Russia.

The Quad navies had carried out complex naval drills under the Malabar banner in November 2020 in the Arabian Sea and the Bay of Bengal.

Two Indian warships, INS Shivalik and INS Kadmat, will be taking part in the 25th edition of the Malabar exercise along with the P-8I maritime reconnaissance aircraft and MARCOS.



INS Shivalik, one of the two Indian warships that will take part in the 25th edition of the Malabar Naval Drill-2021. (PHOTO: INDIAN NAVY)

“A wide range of surface, sub-surface and air operations will be carried out by the participating navies during the exercise. Special operations teams --- US Navy SEALs, Indian MARCOS and Special Boarding Units of the Japanese Maritime Self-Defence Force (JMSDF) --- will carry out visit, board, search and seizure (VBSS) training and simulated hostage rescue operations,” said a second official.

The US Navy will be represented by an Arleigh Burke-class destroyer, two tankers and P-8A long-range maritime patrol aircraft, the JMSDF will field a helicopter carrier, two destroyers, a submarine and Kawasaki P1 maritime patrol aircraft, and the Royal Australian Navy is taking part in the drills with a frigate. The exercise ends on August 29.

China has been monitoring the activities of the Quad countries. Beijing has been wary of the Quadrilateral Security Dialogue or Quad that was revived in late 2017 by India, the US, Australia and Japan, and these suspicions have increased since the four countries upgraded the forum to the ministerial level in 2019.

Speaking at an Observer Research Foundation (ORF) event in New Delhi on the eve of the Malabar exercise, Admiral John C Aquilino, commander, US Indo-Pacific Command, said, “There is no better ally and no worse adversary than the US (in the Indo-Pacific region).”

An official release issued by US INDOPACOM on Aquilino's India visit quoted him as saying, ‘Our network of allies and partners are our greatest strength and a centre of gravity in the Indo-Pacific. Our relationship with India is based on aligned values and presents an important model for building enduring partnerships. As we increase interoperability, information-sharing, and access with allies and partners across the globe, this partnership enhances our capabilities, improves our coordination, and shows that we are stronger when we stand together.’

The exercise will involve the participation of the US Navy's MH-60R helicopters, which the Indian Navy is also inducting to modernise its ageing helicopter fleet.

A month ago, the US delivered two MH-60R helicopters to the Indian Navy at the Naval Air Station North Island, San Diego. Last year, India ordered 24 Lockheed Martin-Sikorsky MH-60R helicopters from the US to strengthen the navy's anti-submarine/anti-surface warfare and surveillance capabilities. The government-to-government contract for the helicopters is worth around ₹17,500 crore.

The drills planned with the UK in the tri-service format in October will include air defence exercises, anti-submarine warfare drills, anti-surface operations, amphibious operations, humanitarian assistance and disaster relief operations (HADR) in a contested environment and other joint manoeuvres, said a third official.

India and France are also laying the groundwork for a new format of military exercises involving their armies, navies and air forces in what will be a major boost for defence cooperation between the two countries.

In April 2021, France, India, the US, Japan and Australia carried out complex maritime drills, Exercise La Pérouse, in the eastern Indian Ocean Region (IOR) to enhance interoperability among their navies.

“The frequency of our bilateral and multi-lateral exercises has gone up over the years. We are now conducting up to 30 such exercises annually,” said the second official.

From carrying out naval drills with like-minded countries to reaching out to states in the Indian Ocean Region (IOR), the Indian Navy is focusing on checking China's rising ambitions in the region and sending out a strong message that Beijing's power play in South China Sea cannot be replicated in the Indian Ocean.

“We are carefully monitoring Chinese presence in the IOR, including the movement of their warships for anti-piracy deployment in the Gulf of Aden, research ships and intelligence-gathering vessels. On Wednesday, the Indian Navy tracked a Chinese space-tracking ship enter the IOR,” the official added.

Last November, navy chief Admiral Karambir Singh said a “great power competition” was playing out vigorously in IOR, where the navy has stepped up surveillance to check China's ambitions.

<https://www.hindustantimes.com/india-news/quad-to-kick-off-malabar-tomorrow-1st-tri-service-drills-with-uk-in-october-101629906793616-amp.html>

'Aims to increase interoperability': Indian Navy on Malabar Exercise 2021

Named 'Malabar 21,' the 25th edition of the annual exercise will take place in Guam from August 26-29

The Indian Navy on Wednesday laid out the details of this year Malabar Exercise, which is scheduled to take place from August 26 to 29. The 2021 edition of the naval drills, its 25th, is called "Malabar 21."

"The aim this year is to increase the interoperability amongst the participating navies, developing common understanding and SOPs for Maritime Security Operations. Malabar 21 will witness exercises all the three domains covering maritime warfare: live-weapon firing, anti-air and anti-submarine warfare drills, and joint manoeuvres and tactical exercises," the Navy said in a statement, according to news agency ANI.

Malabar 21 will take place in Guam, an unincorporated territory of the United States, which lies off the Pacific Ocean. Two Indian Navy Ships (INS), Shivalik and Kadmatt, arrived in Guam on August 21 for the exercise.

The Indian Navy, along with its counterparts from Australia, Japan and the US, participates in the Malabar drills, which first took place in 1992. The next two editions were in 1995 and 1996. 2002 was the fourth time it took place. Since then, it has taken place annually.

Initially a bilateral event involving only India and the US, it was expanded to Australia, Japan and Singapore joined in 2007. Japan subsequently participated in 2009 and 2011 and, from 2014, has been a regular participant. It became a permanent member in 2015. While Singapore has participated only once, Australia re-joined in 2020, making its second appearance.

Australia, India, Japan and the US together form the "Quad." Malabar 2020 was the first time all four Quad members participated in these drills. The exercise was held in two phases: November 3-6 and November 17-20.

<https://www.hindustantimes.com/india-news/aims-to-increase-interoperability-indian-navy-on-malabar-exercise-2021-101629894944331.html>



Indian Navy Ships (INS) Shivalik and Kadmatt in Guam (<https://twitter.com/indiannavy>)

An Expert Explains: Why is China building missile silos?

Satellite pictures have revealed what appears to be an ongoing Chinese project to prepare vast new fields of missile silos that could possibly be used to launch nuclear weapons at China's adversaries, including the United States and India. Why is China digging these silos?

By **Suyash Desai**

New Delhi: Satellite images have revealed that China is building at least three missile silo fields in Yumen in Gansu province, near Hami in Xinjiang province, and at Hanggin Banner, Ordos City, in Inner Mongolia.

It appears that China is constructing around 120 missile silos at Yumen, around 110 silos in Hami, and 29 in the Hanggin Banner field. Earlier this year, 16 missile silos were detected in the People's Liberation Army Rocket Force's (PLARF) Jilantai training area, also in Inner Mongolia.

The Yumen field was discovered by commercial satellite images obtained by researchers at the James Martin Center for Nonproliferation Studies, California; the Hami field was identified by nuclear experts at the Federation of American Scientists (FAS) using Planet Labs satellite images; the Hanggin Banner field was discovered by researchers at the China Aerospace Studies Institute, Washington DC.

The Yumen and Hami fields are identical, and the silos are positioned in a perfect grid pattern, roughly 3 km apart. Some of the silos have dome shelters. The fields are supported by nearby PLARF facilities.

For several decades before these discoveries in 2021, China operated only 20 missile silos for its DF-5 liquid-fuel intercontinental ballistic missile (ICBM). On completion of the ongoing work, China could have 250-270 new missile silos, more than 10 times the number it had maintained for several decades.

The Expert

Suyash Desai is a research associate working on China's defence and foreign policies at The Takshashila Institution, Bengaluru. He also writes a weekly newsletter on the Chinese People's Liberation Army called 'The PLA Insight'.

Why is China building missile silos?

There could be three explanations.

FIRST, some Chinese political scientists believe this could be China's attempt to move towards a launch-on-warning (LOW) nuclear posture. LOW refers to a launch at an adversary on detection of an incoming missile before the adversary's missile hits its target.

China's nuclear strategy has remained largely unchanged since 1964, when it first exploded a nuclear device. It is based on achieving deterrence through assured retaliation. The crucial requirement for this is the survivability of China's nuclear arsenal following the first strike —

CHINA'S MISSILE ARSENAL		
NAME	CLASS	RANGE
BALLISTIC		
DF-41	ICBM	12,000-15,000 km
DF-5	ICBM	13,000 km
DF-31	ICBM	7,000-11,700 km
JL-2	SLBM	8,000-9,000 km
DF-4	IRBM/ICBM	4,500-5,500 km
DF-26	IRBM	4,000 km
DF-21	MRBM	2,150 km
DF-17	HGV	1,800-2,500 km
DF-16	SRBM	800-1,000 km
DF-15	SRBM	600 km
DF-11	SRBM	280-300 km
DF-12/M20	SRBM	280 km
CRUISE		
HN 3	Cruise missile	3,000 km
HN 2	Cruise missile	1,400-1,800 km
HN 1	Cruise missile	50-650 km
YJ-18	Cruise missile	220-540 km

Notes: All missiles are currently operational. ICBM: Intercontinental ballistic missile; MRBM: Medium range ballistic missile; SRBM: Short range ballistic missile; SLBM: Submarine launched ballistic missile; HGV: Hypersonic glide vehicle.

conventional or nuclear — by an adversary. In order to move to the LOW posture, China would have to mate a few warheads with missiles, and keep them in alert status for a quick response. Currently, China stores its warheads and missiles in a de-alerted status separately under different commands.



Satellite image from Planet Labs Inc. shows building of ICBM silo at Yumen.



This image shows four different ICBM silos in different stages of construction. (Credit: Planet Labs Inc)

The 2013 Science of Military Strategy document of the PLA Academy of Military Science noted that China “can” LOW, and the Defence White Paper published by China in 2015 mentioned “rapid response”. Admiral Charles A Richard, Commander of the US Strategic Command (Stratcom) said in his testimony to Senate in April 2021 that “a portion of China’s force has already moved to a LOW posture”.

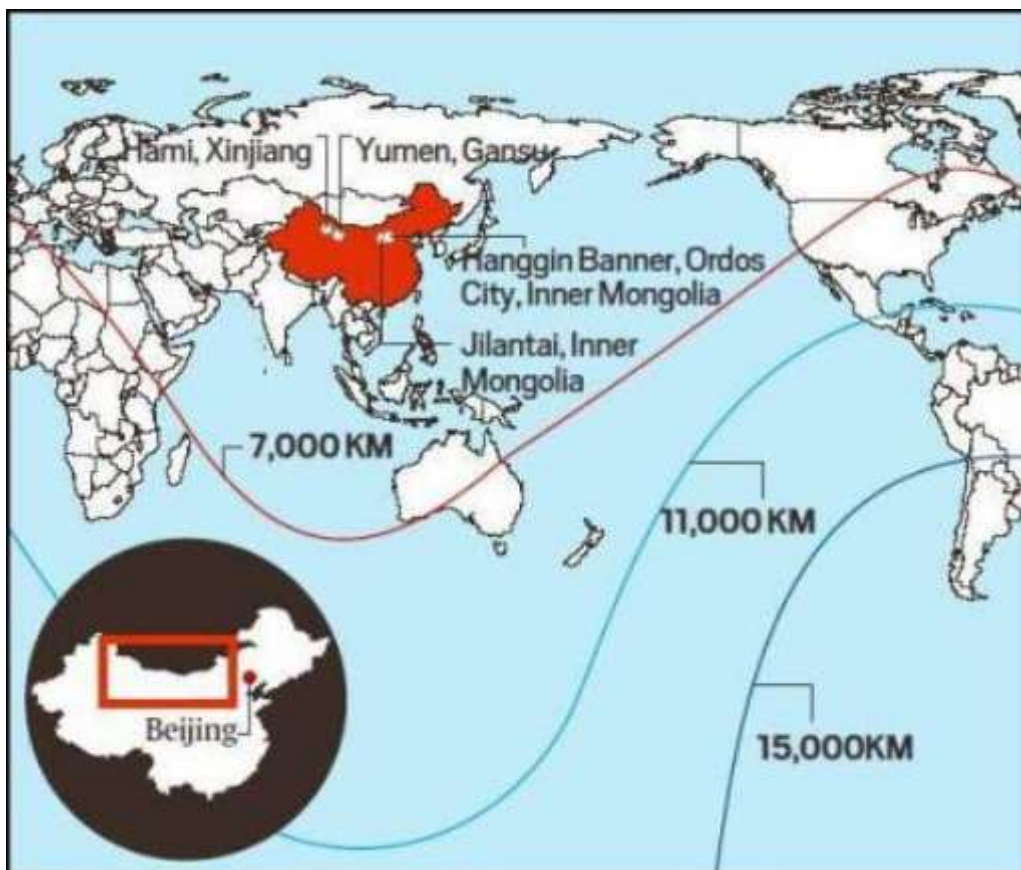
However, silos alone, at such an early stage of construction, are not conclusive evidence of China’s move to LOW.

SECOND, it enables China to achieve its goal of increasing its nuclear warhead stockpile.

China currently has around 350 nuclear warheads. Hans M Kristensen and Matt Korda of the Nuclear Information Project of the nonprofit FAS have estimated that 272 of these 350 warheads are assigned to operational forces; the remaining 78 have been produced for China's new DF-41 solid-fuel road-mobile ICBM.



It appears that China is constructing around 110 silos in Hami. (Credit: Planet Labs Inc)



Source for map and all information: Missile Defense Project, Center for Strategic and International Studies (CSIS).

China has around 150 land-based missiles that can deliver between 180-190 nuclear warheads to some parts of the United States. If all the new silos are loaded with a single-warhead missile, the count would increase to 410-440. If the silos on completion are loaded with the DF-41s, which can carry up to two-three warheads per missile, this count would rise to 930-940 warheads.



Images of Yumen Silo Field, where China may be constructing 120 missile silos. (Credit: Planet Labs Inc)

For this, China would have to increase the number of DF-41s in its inventory, and almost triple its nuclear warheads — unlikely in the immediate future. However, the construction of the silos does indicate an increasing trend in China’s nuclear warheads and DF-41 missiles going forward.

The THIRD guess is that China could use these silos as decoys.

Chinese scholar Tong Zhao of the Nuclear Policy Program at the Carnegie Endowment for International Peace in Beijing has argued that China worries about the improvement in US missile defence systems and conventional precision strike weapons, which could undermine China’s nuclear deterrence. He has claimed that at the National People’s Congress in March 2021, President Xi Jinping directed the military to “accelerate the creation of advanced strategic deterrent” capabilities.

The recently discovered silos could be an initiative to enhance deterrence by keeping the adversary guessing. This could be China’s shell game — where one, some, or all silos could have missiles, forcing the aggressor to target all of them during an escalation. The aggressor would have to waste more warheads or precision-guided weapons to destroy only a few missiles, or perhaps target empty silos.

This would be a cost-effective strategy for China, and could also bolster its image as serious nuclear power and an equal to the US.

How has the US reacted to the discovery of the silos?

On July 28, Stratcom retweeted a report on the silos in The New York Times, saying: “This is the second time in two months the public has discovered what we have been saying all along about the growing threat the world faces and the veil of secrecy that surrounds it.”

In his April Senate testimony, Adm Richard had said China is deploying ICBM silos on a large scale. It is likely Stratcom knew about China’s construction of the silos before they were discovered last month by scholars using satellite pictures.

After the discovery of the Yumen field in the first week of July, a State Department spokesperson had said: “The PRC’s nuclear arsenal will grow more quickly, and to a higher level

than perhaps previously anticipated. This buildup is concerning. It raises questions about the PRC's intent." A Pentagon spokesperson told The Washington Post at the end of June that "Defense Department leaders have testified and publicly spoken about China's growing nuclear capabilities, which we expect to double or more over the next decade." The US Department of Defense's 2020 China Military Power Report projected China's nuclear warhead stockpile, currently estimated in the low 200s, to at least double over the next decade.

And what has China said?

Neither the Chinese Ministry of Foreign Affairs nor the Ministry of National Defence has reacted. Some Chinese media have said the silos are wind farms, and accused American academics and journalists of spreading a "China threat theory".

So should India be concerned?

Seen in isolation, these silos appear to be built specifically to enhance deterrence against the US.

But broadly, India should be watchful about China's nuclear ambiguity and its latest DF-26 intermediate-range road-mobile dual-use missiles — of which 16 launchers were deployed in Korla, Xinjiang, during the ongoing standoff. India could be a potential target given the strike ranges of these missiles and the timing of deployment.

Although both China and India have pledged nuclear 'no first use' doctrines, India's modest ballistic missile defence capabilities and China's nuclear ambiguity are matters of concern for India.

What should the world do about these developments?

There isn't an obvious option for the US or anyone else. China has stated that it will not join the NEW START (Strategic Arms Reduction Treaty). Fu Cong, Director-General of the Department of Arms Control of the Chinese Foreign Ministry, recently said that the US and Russia have almost 20 times more nuclear warheads than China, and that "It is unrealistic to expect China to join the two countries in a negotiation aimed at nuclear arms reduction."

Several American arms control scholars have argued for a renewal of the US government-funded US-China track 1.5 nuclear dialogue that was suspended after 15 years in 2019 due to growing friction, "declining value", and the failure to launch track 1 dialogue. Some others have said that the US's newer missile defence capabilities disturb strategic stability and complicate arms control.

<https://indianexpress.com/article/explained/china-missile-silo-test-nuclear-weapons-7471044/>

THE TIMES OF INDIA

Thu, 26 Aug 2021

Gaganyaan: Astronauts prepare to start training, ISRO for mission

By Chethan Kumar

Bengaluru: The four astronaut-elects part of the Gaganyaan programme have begun the debriefing process — about their training in Russia — and are gearing up to start the India leg of their training, even as Isro reviews its preparedness, including the human rating of systems and the launch vehicle.

The four men, all test pilots with the Indian Air Force (IAF) returned from Russia, where they underwent basic astronaut training for a little more than a year, had returned to India earlier this year. While they've been based in Bengaluru since their return, they will be required to go to some of the other Indian cities for their training here.

ISRO Chairman K Sivan said: “The training is expected to begin in the first week of September. At present the astronauts have begun the process of debriefing. There will be multiple sessions of this before they begin their training.”

As reported by TOI earlier, the National Medical Advisory Council, constituted specifically for the programme, has already laid out the protocol to be followed for astronaut training given the pandemic situation.

As part of the first leg of India training the four men will return to their alma mater (IAF) for a two-week flight training, following which they would begin their academic or theory courses. Fitness and other related activities will be a continuous process through their training.

Other Preparations

While the astronaut-elects prepare to begin their training, a long schedule for which is being worked out up to the time of the launch, Isro is working on putting in place everything else needed for the mission.

While work on human rating of systems, including the launch vehicle (GSLV-Mk3) is progressing as per schedule — revised after the pandemic affected the functioning of Isro and its vendors — preparations for the launch of two relay satellites, the uncrewed mission etc are gaining pace.

“If the FAC (failure analysis committee) looking into the GSLV-Mk2 failure from earlier this month concludes that there are some process issues with the cryogenic stage, we may need to revisit some aspects of the Mk3, but that should not affect the programme significantly,” a senior scientist said.

Aside from that, work has also begun on the two relay satellites that Isro will need to launch to be able to track the crew module throughout its orbit in space — it will also be using at least 40 ground stations to track the module.

The first uncrewed mission, as reported by TOI earlier, is now scheduled for mid-2022, following which decisions will be made on how many more such missions may be required before actually launching humans to space. This will, in turn, determine when the human mission could be carried out.

<https://timesofindia.indiatimes.com/home/science/gaganyaan-astronauts-prepare-to-start-training-isro-for-mission/articleshow/85645572.cms>

A new platform for integrated photonics

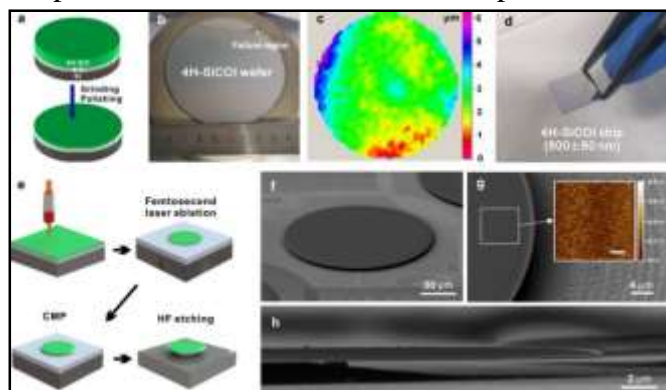
SiC photonics has been developed for over a decade, one of the major obstacles is the difficulty of fabricating ultralow optical loss SiC thin-films. Scientists in China have fabricated an ultralow loss 4H-SiCOI platform with a record-high-Q factor of 7.1×10^6 . Nonlinear photonics process, including second-, third- and fourth-harmonic generations, Raman lasing, and Kerr frequency combs have been observed. This demonstration represents a milestone in the development of SiC photonic devices.

Photonic integrated circuits (PICs) and microresonators have attracted strong interest in photonics community. For applications, achieving low optical loss is crucial. SiC PICs have been in development for over a decade, a lot of works have been carried out on the SiC thin films prepared by heteroepitaxial growth. However, the quality factor of these devices is limited to less than 10^6 due to the high density of crystal defects near growth interface. Up to now, how to further reduce the optical loss of SiC thin films has become the primary problem for scientist to explore the advantages of SiC in PICs applications.

In a new paper published in *Light Science & Application*, a team of scientists, led by Professor Xin Ou from State Key Laboratory of Functional Materials for Informatics, Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences, and co-workers have fabricated an ultralow loss 4H-SiCOI platform with a record-high-Q factor of 7.1×10^6 . The 4H-SiCOI platform prepared by wafer-bonding than thinning techniques, enables the same crystalline quality as bulk high-pure 4H-SiC crystal. The high Q resonators were used to demonstrate various nonlinear processes including generation of multiple harmonics up to the fourth order, cascaded Raman lasing, and Kerr frequency comb. Broadband frequency conversions, including second-, third-, fourth- harmonic generation (SHG, THG, FHG) have been observed. Cascaded Raman lasing with Raman shift of 204.03 cm^{-1} has been demonstrated in SiC microresonators for the first time. Using a dispersion-engineered SiC microresonator, Kerr frequency combs covering from 1300 to 1700 nm have been achieved at a low input power of 13 mW. The demonstration of high Q SiC photonics devices represents a significant milestone in the development of SiC PICs. This work was also highly praised by the reviewers. "In my opinion, this work is novel, sound and important. I believe this work will bring a huge momentum for SiC integrated photonics in the next few years", "I believe this work will be a milestone for SiC photonics", "The presented work here shows microresonator with Q up to 7.1×10^6 , which is certainly a major breakthrough in the development of photonic devices that harness the unique optical properties of SiC".

More information: Chengli Wang et al, High-Q microresonators on 4H-silicon-carbide-on-insulator platform for nonlinear photonics, *Light: Science & Applications* (2021). [DOI: 10.1038/s41377-021-00584-9](https://doi.org/10.1038/s41377-021-00584-9)

Journal information: [Light: Science & Applications](https://phys.org/news/2021-08-platform-photonics.html)
<https://phys.org/news/2021-08-platform-photonics.html>



(a) Fabrication process of pristine 4H-SiCOI material platform. (b) Photograph of a 4-inch wafer-scale 4H-SiCOI substrate fabricated using bonding and thinning method, the failure region is marked. (c) Total thickness variation of the 4H-SiCOI substrate. (d) Image of a 4H-SiCOI die. (e) Flowchart of fabricating a SiC microdisk resonator. (f) A scanning electron micrograph (SEM) of the fabricated microdisk resonator. (g) Zoom-in SEM image of the sidewall of the resonator. Inset, the atomic force micrograph (AFM) scan of the top surface of the resonator. (h) Side view SEM image of the fabricated resonator with parabolic-like shaped upper surface. Credit: Chengli Wang, Zhiwei Fang, Ailun Yi, Bingcheng Yang, Zhe Wang, Liping Zhou, Chen Shen, Yifan Zhu, Yuan Zhou, Rui Bao, Zhongxu Li, Yang Chen, Kai Huang, Jiayang Zhang, Ya Cheng and Xin Ou

Cooling technique allows easier measurements of key particle property

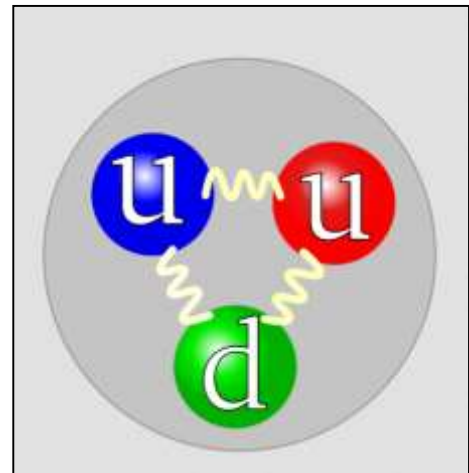
Scientists from the BASE-collaboration, led by RIKEN scientists, have developed a new cooling method that will allow easier measurements of a property of protons and antiprotons called the magnetic moment. This is one of the properties that is being investigated to solve the mystery of why our universe contains matter but almost no antimatter.

Our universe should, under the standard model, have equal amounts of matter and antimatter, but in reality it does not. To find out why, scientists around the world are trying to discover tiny differences between the two that could solve the mystery. One promising avenue is to explore whether there are differences in the magnetic moment of the proton and antiproton, and the BASE experiment, based at CERN, is trying to determine this. Using a sophisticated device—a Penning trap capable of capturing and detecting a single particle—the BASE team in the past was able to improve the precision of proton and antiproton magnetic moment measurements by a factor of thirty and by more than three orders of magnitude, respectively, leading to a test of matter/antimatter symmetry at the level of 1.5 parts in a billion, finding essentially that the magnets in the proton and the antiproton are similar to nine significant figures.

One difficulty—among many—in carrying out such experiments is that to measure the magnetic moments precisely, the particles need to be kept at temperatures close to absolute zero, -273.15°C . In previous experiments the cold temperatures were prepared by using a technique known as "selective resistive cooling," which is time-consuming and, according to the researchers, "similar to throwing a dice with 100 faces, trying to roll a 1."

For the current experiment, published in *Nature*, the BASE collaboration reported the first ever demonstration of "sympathetic cooling" of a single proton by coupling the particle to a cloud of laser-cooled 9Be^+ ions. Sympathetic cooling involves using lasers or other devices to cool one type of particle, and then using those particles to transfer the heat of the particle they wish to cool. With this technique, the group simultaneously cooled a resonant mode of a macroscopic superconducting tuned circuit with laser-cooled ions, and also achieved the sympathetic cooling of a single trapped proton, reaching temperatures close to absolute zero.

The technique described in the recent paper is an important first step towards a considerable reduction of faces on the dice-manifold, with the vision of ideally reducing the surface to just one. "We are reporting an important first step, and the further development of this method will ultimately lead to an ideal spin-flip experiment, in which a single low-temperature proton will be prepared within just a few seconds. This will allow us to determine the particle's spin state in just one measurement that takes about a minute," says Christian Smorra, one of the scientists leading the study. "This is considerably faster than our previous magnetic moment measurements, and will improve both sampling statistics and the resolution of our systematic studies," adds Matthew Bohman, a Ph.D. student at the Max Planck Institute for nuclear Physics, Heidelberg and the first author of the study.



The quark structure of the proton. There are two up quarks in it and one down quark. The strong force is mediated by gluons (wavy). The strong force has three types of charges, the so-called red, green and the blue. Note that the choice of green for the down quark is arbitrary; the "color charge" is thought of as circulating among the three quarks. Credit: Arpad Horvath/Wikipedia

"In addition, the reported achievement has applications not only in proton/antiproton magnetic moment measurements. It adds general new technology to the tool-box of precision Penning-trap physics, and also has potential applications in other nuclear magnetic moment measurements, ultra-precise comparisons of charge-to-mass ratios in Penning traps, or even in enhancing the production of antihydrogen," adds Stefan Ulmer, spokesperson of the BASE collaboration and chief scientist at RIKEN Fundamental Symmetries Laboratory.

The BASE collaboration operates three experiments, one at the antimatter factory of CERN, one at the University of Hannover, and one at the University of Mainz, the laboratory where the new method was actually implemented. The reported study is a result of the joint collaboration between RIKEN, the German Max Planck Society, the Universities of Mainz, Hannover and Tokyo, the German metrology institute PTB, CERN, and GSI Darmstadt. The work was supported by the Max Planck, RIKEN, PTB center for time, constants and fundamental symmetries.

More information: Sympathetic cooling of a trapped proton mediated by an LC circuit, *Nature* (2021). DOI: [10.1038/s41586-021-03784-w](https://doi.org/10.1038/s41586-021-03784-w) , www.nature.com/articles/s41586-021-03784-w

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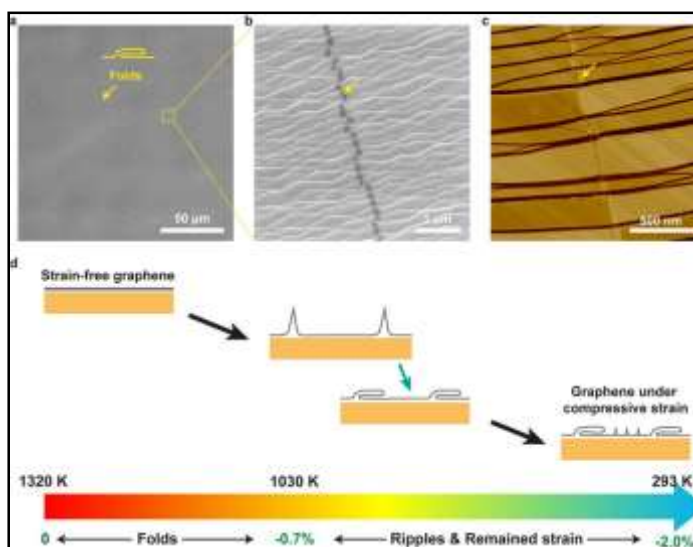
Thu, 26 Aug 2021

Creation of the most perfect graphene

A team of researchers led by Director Rod Ruoff at the Center for Multidimensional Carbon Materials (CMCM) within the Institute for Basic Science (IBS), including graduate students at the Ulsan National Institute of Science and Technology (UNIST), have achieved growth and characterization of large area, single-crystal graphene that has no wrinkles, folds, or adlayers. It may be the most perfect graphene that has been grown and characterized to date. The research has been published in the journal *Nature*.

Director Ruoff says, "This pioneering breakthrough was due to many contributing factors, including human ingenuity and the ability of the CMCM researchers to reproducibly make large-area single-crystal Cu-Ni(111) foils, on which the graphene was grown by chemical vapor deposition (CVD) using a mixture of ethylene with hydrogen in a stream of argon gas." Student Meihui Wang, Dr. Ming Huang, and Dr. Da Luo along with Ruoff undertook a series of experiments of growing single-crystal and single-layer graphene on such "home-made" Cu-Ni(111) foils under different temperatures.

The team had previously reported single-crystal and adlayer-free films of graphene which were grown using methane at temperatures of ~1320 Kelvin (K) degrees on Cu(111) foils. Adlayers refer to small "islands" of regions that have another layer of graphene present. However, these films always contained long "folds" that are the consequence of tall wrinkles that form as the graphene is cooled from the growth temperature down to room



(a, b) SEM images and (c) AFM phase image of graphene folds in an adlayer-free single-crystal graphene film on a Cu(111) foil. (d) Schematic of the mechanism of graphene folds formation during the cooling process. Credit: Institute for Basic Science

temperature. This results in an undesirable reduction in the performance of graphene field effect transistor (GFET) if the "fold" is in the active region of the GFET. The folds also contain "cracks" that lower the mechanical strength of the graphene.

The next exciting challenge was thus eliminating these folds.

CMCM researchers first implemented a series of 'cycling' experiments that involved "cycling" the temperature immediately after growing the graphene at 1320 K. These experiments showed that the folds are formed at or above 1,020 K during the cooling process. After learning this, the team decided to grow graphene on Cu-Ni(111) foils at several different temperatures around 1,020 K, which led to a discovery that large-area, high-quality, fold-free, and adlayer-free single-crystal graphene films can be grown in a temperature range between 1,000 K and 1,030 K. "This fold-free graphene film forms as a single crystal over the entire growth substrate because it shows a single orientation over a large-area *low-energy electron diffraction* (LEED) patterns," noted SEONG Won Kyung, a senior research fellow in CMCM who installed the LEED equipment in the center. GFETs were then patterned on this single-crystal fold-free graphene in a variety of directions by UNIST graduate student Yunqing Li. These GFETs showed remarkably uniform performance with average room temperature electron and hole mobilities of $7.0 \pm 1.0 \times 10^3 \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$.

Li says, "Such remarkably uniform performance is possible because the fold-free graphene film is a single crystal with essentially no imperfections."

Importantly, the research team was able to achieve "scaling up" of graphene production using this method. The graphene was successfully grown on 5 foils (dimension 4 cm x 7 cm) simultaneously in a 6-inch diameter home-built quartz furnace. "Our method of growing fold-free graphene films is very reproducible, with each foil yielding two identical pieces of high-quality graphene films on both sides of the foil," and "By using the electrochemical bubbling transfer method, graphene can be delaminated in about one minute and the Cu-Ni(111) foil can be quickly readied for the next growth/transfer cycle," notes Meihui Wang. Ming Huang adds, "When we tested the weight loss of Cu-Ni(111) foils after five runs of growth and transfers, the net loss was only 0.0001 grams. This means that our growth and transfer methods using the Cu-Ni(111) can be performed repeatedly, essentially indefinitely."

In the process of achieving fold-free single-crystal graphene, the researchers also discovered the reasons behind the formation of these folds. High-resolution TEM imaging was performed by student CHOE Myeonggi and Prof. LEE Zonghoon (a group leader in CMCM and professor at UNIST) to observe the cross-sections of the samples grown above 1,040 K. They discovered that the deadhesion, which is the cause of the folds, is initiated at the "bunched step edge" regions between the single crystal Cu-Ni(111) plateaus. "This deadhesion at the bunched step edge regions triggers the formation of graphene folds perpendicular to the step edge direction," noted co-corresponding author Luo. Ruoff further notes that "We discovered that step-bunching of a Cu-Ni(111) foil surface suddenly occurs at about 1,030 K, and this 'surface reconstruction' is the reason why the critical growth temperature of fold-free graphene is at ~1,030 K or below."

Such large-area fold-free single-crystal graphene film allows for the straightforward fabrication of integrated high-performance devices oriented in any direction over the entire graphene film. These single-crystal graphene films will be important for further advances in basic science, which will lead to new applications in electronic, photonic, mechanical, thermal, and other areas. The near-perfect graphene is also useful for stacking, either with itself and/or with other 2D materials, to further expand the range of likely applications. Given that the Cu-Ni(111) foils can be used repeatedly and that the graphene can be transferred to other substrates in less than one minute, the scalable manufacturing using this process is also highly promising.

More information: Single-crystal, large-area, fold-free monolayer graphene, *Nature*, DOI: [10.1038/s41586-021-03753-3](https://doi.org/10.1038/s41586-021-03753-3), www.nature.com/articles/s41586-021-03753-3

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Heart problem more common after Covid-19 than after vaccination, study finds

The research did not assess the risks specifically for young males, who are the most likely to develop the rare side effect

By Emily Anthes and Noah Weiland

The Pfizer-BioNTech Covid-19 vaccine is associated with an increased risk of myocarditis, an inflammation of the heart muscle, a large new study from Israel confirms. But the side effect remains rare, and Covid-19 is more likely to cause myocarditis than the vaccine is, scientists reported on Wednesday.

The research, which is based on the electronic health records of about two million people who are 16 or older, provides a comprehensive look at the real-world incidence of various adverse events after both vaccination and infection with the coronavirus.

Although the study did not break down the myocarditis risks by age or by sex, the median age of people who developed the condition after vaccination was 25, and 19 of the 21 cases were in males, the researchers reported.

In addition to myocarditis, the Pfizer vaccine was also associated with an increased risk of swollen lymph nodes, appendicitis and shingles, although all three side effects remained uncommon in the study. Coronavirus infection was not associated with these side effects, but it did increase the odds of several potentially serious cardiovascular problems, including heart attacks and blood clots.

“Coronavirus is very dangerous, and it’s very dangerous to the human body in many ways,” said Ben Reis, a co-author of the new study and the director of the predictive medicine group at the Boston Children’s Hospital Computational Health Informatics Program.

He added, “If the reason that someone so far has been hesitating to get the vaccine is fear of this very rare and usually not very serious adverse event called myocarditis, well, this study shows that that very same adverse event is actually associated with a higher risk if you’re not vaccinated and you get infected.”

The data arrived in the middle of an intense discussion among federal regulators about the risks of myocarditis and pericarditis, which is inflammation of the lining around the heart, in younger recipients of both the Pfizer-BioNTech and the Moderna vaccines, concerns that very likely led the Food and Drug Administration to negotiate larger pediatric trials with the vaccine makers this summer in the hopes of adequately assessing the risks before a possible emergency authorization for younger children. The companies are studying lower dosing in children to alleviate some of the risk.

In their review of the Pfizer-BioNTech vaccine, regulators paid close attention to an American health care claims database, which found that the risk of the conditions in 16- and 17-year-old vaccinated boys could be as high as 1 in 5,000. The cases in the database were unconfirmed, the F.D.A. cautioned in an analysis published this week, but they were considered a reasonable



Administering a dose of the Pfizer-BioNtech vaccine at a mobile clinic near Moshav Dalton in northern Israel in February. Credit...Jalaa Marey/Agence France-Presse — Getty Images

estimate of the possible risk. Even in the worst-case scenarios of post-vaccination myocarditis and pericarditis modeled by the F.D.A., the benefits of vaccination still outweighed the risks, the analysis said.

The study was one reason the F.D.A. said this week that after its licensure of Pfizer-BioNTech's vaccine, Pfizer would conduct studies of myocarditis and pericarditis risks in people who received the shot, including long-term outcomes for those who fall ill after vaccination.

Israel's vaccination campaign, which relied on the Pfizer vaccine, got off to a fast start; by May 24, nearly five million people, or roughly 55 percent of the nation's population, had received both doses of the vaccine.

The new study, which was published in the *New England Journal of Medicine*, is based on an analysis of the electronic health records of Clalit Health Services, the nation's largest H.M.O.

The researchers assembled a group of roughly 880,000 people, age 16 or older, who had been vaccinated by May 24. To create a control group, they matched each of those individuals to an unvaccinated person who was medically and demographically similar.

"You can think about them as pseudo twins," said Dr. Ran Balicer, the chief innovation officer for Clalit Health Services and the lead author of the new study.

Then the researchers calculated the incidence of 25 different potential adverse events in each group. In a second round of analysis, they calculated the incidence of the same potential side effects in a group of 170,000 people who had tested positive for the coronavirus and in a similar group of uninfected controls.

They found that although myocarditis remained rare, it was more common in the vaccinated group than the unvaccinated one. There were an extra 2.7 cases of myocarditis for every 100,000 people in the vaccinated group, compared with the unvaccinated one, the researchers found.

But the risks were even higher among those who had contracted the virus. There were an extra 11 cases of the condition for every 100,000 people who had been infected with the coronavirus, compared with those who had not.

The study provides critical context for understanding the risks and benefits of vaccination, said Dr. Brian Feingold, an expert on heart inflammation in children at the UPMC Children's Hospital of Pittsburgh who said he fields calls from parents who are concerned about the myocarditis risk.

"And nobody's blowing that off, but I think you just have to look at that in context," he said. "Those risks related to Covid are higher than the risks related to the vaccine."

In addition to myocarditis, coronavirus infection was also associated with an increased risk of heart attacks, irregular heart beat, blood clots in the lungs or legs, kidney injury and bleeding inside the skull. For every 100,000 infections, there were an extra 25 heart attacks and 62 cases of blood clots in the lungs, for instance.

"When you try to make your decision on whether or not you should take the vaccine, one of the things to ask is not only what are the potential adverse events associated with taking the vaccine, but also what am I risking when I think about Covid-19 as the other option," Dr. Balicer said.

Although the study is reassuring, it is important to continue collecting data on the myocarditis risks in young males in particular, scientists said.

"But we're at this red hot moment," said Dr. Sean O'Leary, a pediatric infectious disease expert at the University of Colorado Anschutz Medical Campus. "This is what we've got, and the benefits still consistently appear to greatly outweigh the risks."

In one recent study, which has not yet been published in a peer reviewed journal, researchers calculated that 12- to 17-year-old boys were about six times as likely to develop myocarditis after infection with the virus than after receiving one of the mRNA vaccines.

<https://www.nytimes.com/2021/08/25/health/covid-myocarditis-vaccine.html>

