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समाचार पत्रों से चयित अंश Newspapers Clippings

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Press Information Bureau
Government of India

Ministry of Defence

13 NOV 2020 6:34PM

QRSAM Missile System Achieves Major Milestone

Quick Reaction Surface to Air Missile (QRSAM) System has achieved a major milestone by a direct hit on to a Banshee Pilotless target aircraft at medium range & medium altitude.

The missile launch took place from ITR Chandipur on 13th Nov 2020 at 1550 hrs off the Odisha Coast. The missile is propelled by a single stage solid propellant rocket motor and uses all indigenous subsystems. The Missile is canisterised for transportation and launch using a mobile launcher capable of carrying 6 canisterised missiles.

All QRSAM weapon system elements like Battery Multifunction Radar, Battery Surveillance Radar, Battery Command Post Vehicle and Mobile Launcher were deployed in the flight test. The system is capable of detecting and tracking targets on the move and engaging target with short halts. The system is designed to give air defence coverage against strike columns of Indian Army.

The radar tracked the Banshee target from farthest range and missile was launched when target was within kill zone and achieved the direct hit with terminal active homing by RF Seeker guidance. Various DRDO labs DRDL, RCI, LRDE, R&DE(E), IRDE, ITR have participated in the test.

The weapon system elements have been realized through Defence PSUs BEL, BDL and private industry L&T. The missile system is fully indigenous with active RF Seekers, Electro Mechanical Actuation (EMA) systems sourced from various industries. The Radar is four walled Active Phased Array Radar. All range Tracking stations, Radar, EOTs & Telemetry Stations monitored the flight parameters.

Raksha Mantri Shri Rajnath Singh and Secretary DD R&D & Chairman DRDO Dr G Satheesh Reddy congratulated DRDO Scientists for the achievement.

<https://pib.gov.in/PressReleaseDetail.aspx?PRID=1672694>



13 NOV 2020 6:34PM

क्यूआरएसएम मिसाइल प्रणाली ने एक महत्वपूर्ण उपलब्धि हासिल की

क्विक रिएक्शन सरफेस टू एयर मिसाइल (क्यूआरएसएम) प्रणाली ने मध्यम रेंज और मध्यम ऊंचाई पर एक पायलट रहित लक्ष्य विमान पर सीधा प्रहार करके एक बड़ा मील का पत्थर पार किया है।

इस मिसाइल का प्रक्षेपण 13 नवंबर 2020 को ओडिशा तट पर आईटीआर चांदीपुर से 1550 बजे हुआ। यह मिसाइल एक एकल चरण वाले ठोस प्रणोदक रॉकेट मोटर द्वारा प्रक्षेपित किया गया और इसमें सभी स्वदेशी उप-प्रणालियों का उपयोग किया गया। इस मिसाइल को 6 कैनिस्ट्राइज्ड मिसाइलों को ढोने में सक्षम मोबाइल लॉन्चर के सहारे परिवहन और प्रक्षेपण के लिए लाया गया।

क्यूआरएसएम हथियार प्रणाली के बैटरी युक्त बहुआयामी रडार, बैटरी युक्त निगरानी रडार, बैटरी युक्त कमांड पोस्ट वाहन और मोबाइल लॉन्चर जैसे सभी तत्व को उड़ान परीक्षण में तैनात किया गया था। यह प्रणाली गतिशील लक्ष्यों का पता लगाने एवं उनपर नज़र रखने और छोटे व्यवधानों के जरिए लक्ष्य से निबटने में सक्षम है। इस प्रणाली को भारतीय सेना के प्रहार कॉलमों के बरक्स हवाई रक्षा कवरेज देने के लिए डिज़ाइन किया गया है।

परीक्षण के दौरान रडार ने दूर की रेंज से लक्ष्य की टोह ले लिया और लक्ष्य के मारक क्षेत्र के भीतर आने पर मिसाइल को दाग दिया गया। और फिर टर्मिनल एक्टिव होमिंग के साथ आरएफ सीकर गाइडेंस द्वारा सीधा प्रहार का लक्ष्य हासिल कर लिया गया। रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) की विभिन्न प्रयोगशालाओं- डीआरडीएल, आरसीआई, एलआरडीई, आर एंड डीई (ई), आईआरडीई, आईटीआर - ने इस परीक्षण में भाग लिया।

रक्षा से संबंधित सार्वजनिक उपक्रम बीईएल, बीडीएल और निजी उद्योग एलएंडटी के माध्यम से इस हथियार प्रणाली के तत्वों की आपूर्ति हुई है। यह मिसाइल प्रणाली एक्टिव आरएफ सीकर, विभिन्न उद्योगों से हासिल इलेक्ट्रो मैकेनिकल एक्टिवेशन (ईएमए) प्रणाली के साथ पूरी तरह से स्वदेशी है। यह रडार चार दीवार वाले एक्टिव फेज्ड ऐर रडार है। सभी रेंज ट्रैकिंग स्टेशन, रडार, ईओटी और टेलीमेट्री स्टेशनों ने उड़ान संबंधी मापदंडों की निगरानी की।

रक्षा मंत्री श्री राजनाथ सिंह और सचिव, डीडी आरएंडडी एवं अध्यक्ष, डीआरडीओ डॉ. जी सतीश रेड्डी ने डीआरडीओ के वैज्ञानिकों को इस उपलब्धि के लिए बधाई दी।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1672765>



Sat, 14 Nov 2020

QRSAM achieves direct hit on pilotless target aircraft at medium range, altitude

The QRSAM, like many modern missiles, is a canister-based system, which means that it is stored and operated from specially designed compartments

By Sushant Kulkarni

Pune: In an important step towards its induction, the indigenously developed Quick Reaction Surface-to-Air Missile (QRSAM) achieved a direct hit on to a pilotless target aircraft at medium range and altitude in a test conducted by Defence Research and Development Organisation (DRDO) on Friday.

The launch on Friday took place from the Integrated Test Range at Chandipur, off Odisha coast around 3.30 pm. It achieved a direct hit on a Banshee pilotless target aircraft at medium range and

altitude, DRDO said. During the test, radars tracked the pilotless target from the farthest range and the missile was launched when target was within kill zone, achieving direct hit.

Defence Research and Development Laboratory and Research Centre Imarat in Hyderabad; Electronic and Radar Development Establishment, Bangalore; Research and Development Establishment (Engineers), Pune; Instruments Research and Development Establishment, Dehradun; and Integrated Test Range, Chandipur, took part in the test. The DRDO said the test was a “major milestone” achieved by the QRSAM.

Officials said the weapons system elements have been manufactured through public sector undertakings — Bharat Electronics Ltd, Bharat Dynamics Ltd and private player L&T. They added that the missile system was fully indigenous with active radio frequency seekers, electro-mechanical actuation systems sourced from various industries.



Quick Reaction Surface to Air Missile (QRSAM) System has achieved a major milestone by a direct hit on to a Banshee Pilotless target aircraft at medium range and medium altitude. The missile launch took place from ITR Chandipur, Odisha (PIB/PTI Photo)

The QRSAM, like many modern missiles, is a canister-based system, which means that it is stored and operated from specially designed compartments. In the canister, the inside environment is controlled, thus along with making its transport and storage easier, the shelf life of weapons also improves significantly.

Defence Minister Rajnath Singh and DRDO Chairperson Dr G Satheesh Reddy congratulated scientists after the test. Friday’s trial was in continuation of a series of missile tests conducted by DRDO over the past two months.

The QRSAM is a short range surface-to-air missile (SAM) system, primarily designed and developed by DRDO to provide a protective shield to moving armoured columns of the Army from enemy aerial attacks. The entire weapon system has been configured on a mobile and manoeuvrable platform and is capable of providing air defence on the move. It has been designed for induction into the Army and has a range of 25 to 30 km.

The QRSAM weapon ensemble, which functions on the move, consists of a fully automated command and control system, two radars — Active Array Battery Surveillance Radar, Active Array Battery Multifunction Radar — and one launcher. Both radars have a 360-degree coverage with “search on move” and “track on move” capabilities. The system is compact, uses a single stage solid propelled missile and has a mid-course inertial navigation system with two-way data link and terminal active seeker developed indigenously by DRDO.

After prior successful tests in December 2019, DRDO said QRSAM’s developmental trials were completed with that test and the weapon system would be ready for induction by 2021.

<https://indianexpress.com/article/india/india-successfully-test-fires-quick-reaction-surface-to-air-missiles-7050901/>

India successfully test-fires quick reaction surface-to-air missiles off Odisha coast

The QRSAM system has achieved a major milestone by directly hitting a pilotless target aircraft at medium range and medium altitude, officials said

New Delhi: According to the Defence Ministry, Quick Reaction Surface-to-Air Missile (QRSAM) system were successfully test-fired at an integrated test range of around 30 kilometres in Chandipur off the Odisha coast on Friday.

By directly hitting a pilotless target aircraft (PTA) at medium range and medium altitude, the QRSAM system has achieved a major milestone. The state-of-the-art missile was launched from the Integrated Test Range (ITR) at Chandipur in Odisha's Balasore at 3.50 pm.

"The successful test-firing of the QRSAM paves the way for its commercial production. The system has achieved a major milestone by a direct hit on a Banshee pilotless target aircraft at medium range and medium altitudes," it said in a statement.



The missile system is designed to give air defence coverage against strike columns of the Indian Army. (Photo: Twitter / @DRDO_India)

Can detect, track targets on the move

The system is capable of detecting and tracking targets on the move and engaging targets with short halts. It is designed to give air defence coverage for strike columns of the Indian Army. "The missile is propelled by a single-stage solid propellant rocket motor and uses all indigenous subsystems... It is capable of detecting and tracking targets on the move and engaging targets with short halts. The system is designed to give air defence coverage against strike columns of Indian Army," the ministry said.

Propelled by a single stage solid propellant rocket motor, the sophisticated missile used all indigenous subsystems. It is canisterised for transportation and launch using a mobile launcher which is capable of carrying six canisterised missiles.

All QRSAM weapon system elements like battery multifunction radar, battery surveillance radar, battery command post vehicle and mobile launcher were deployed in the flight test. The radar tracked the target — Banshee PTA — from the farthest range and the missile was launched when the target was within kill zone and achieved the direct hit with terminal active homing by RF seeker guidance, according to the statement.

Various laboratories of Defence Research and Development Organisation (DRDO) such as DRDL, RCI, LRDE, R&DE(E), IRDE and ITR participated in the test. The weapon system elements have been realised through defence PSUs BEL, BDL and private industry L&T.

The missile system is fully indigenous with active RF Seekers, Electro Mechanical Actuation (EMA) systems sourced from various industries. The radar is a four walled active phased Array radar. All range tracking stations, radar, EOTs and telemetry stations monitored the flight parameters.

Defence minister Rajnath Singh, and Defence Research and Development Organisation (DRDO) chairman G Satheesh Reddy congratulated DRDO scientists on the successful test-firing of the missile. In the last two months, India has test-fired a number of missiles including a new

version of the surface-to-surface supersonic cruise missile BrahMos and an anti-radiation missile named Rudram-1.

<https://www.indiatoday.in/india/story/india-successfully-test-fires-quick-reaction-surface-to-air-missiles-off-odisha-coast-1740891-2020-11-14>

THE TIMES OF INDIA

Sat, 14 Nov 2020

Hyderabad DRDO labs participate in successful QRSAM missile test

Hyderabad: The Quick Reaction Surface to Air Missile (QRSAM) system developed by defence PSUs achieved a major milestone on Friday by a direct hit on to a Banshee Pilotless target aircraft at medium range & medium altitude.

Various DRDO labs, including the DRDL and RCI located in Hyderabad, LRDE, R&DE(E), IRDE, ITR participated in the test. The missile launch took place from ITR Chandipur off the Odisha coast. The missile is propelled by a single stage solid propellant rocket motor and uses all indigenous subsystems. The missile is canisterised for transportation and launch using a mobile launcher capable of carrying six canisterised missiles.



All QRSAM weapon system elements like battery multifunction radar, battery surveillance radar, battery command post vehicle and mobile launcher were deployed in the flight test. The system is capable of detecting and tracking targets on the move and engaging target with short halts. The system is designed to give air defence coverage against strike columns of Indian Army, defence authorities said.

The radar tracked the Banshee target from farthest range and missile was launched when target was within kill zone and achieved the direct hit with terminal active homing by RF Seeker guidance.

The weapon system elements have been realized through Defence PSUs BEL, BDL and private firm L&T. The missile system is fully indigenous with active RF Seekers, Electro Mechanical Actuation (EMA) systems sourced from various industries. The radar is four walled Active Phased Array Radar. All range tracking stations, radar, EOTs and telemetry stations monitored the flight parameters

Union defence Minister Rajnath Singh and Secretary, DD R&D & Chairman, DRDO Dr G Sathesh Reddy congratulated DRDO scientists for the achievement.

<https://timesofindia.indiatimes.com/city/hyderabad/hyd-drdo-labs-participate-in-successful-qrsam-missile-test/articleshow/79216186.cms>

India's QRSAM achieves major milestone, hits pilotless target aircraft

India has achieved a major milestone with its Quick Reaction Surface to Air Missile System Edited By Ananya Das

Highlights

- **India has achieved a major milestone with its Quick Reaction Surface to Air Missile System.**
- **It made a direct hit on to a Banshee Pilotless target aircraft at medium range and medium altitude**

India's Quick Reaction Surface to Air Missile (QRSAM) System on Friday achieved a major milestone by a direct hit on to a Banshee Pilotless target aircraft at medium range and medium altitude. The missile launch took place from ITR Chandipur at 3.50 pm off the Odisha Coast.

The missile is propelled by a single-stage solid-propellant rocket motor and uses all indigenous subsystems. The missile is canisterised for transportation and launch using a mobile launcher capable of carrying six canisterised missiles.

Union Defence Minister Rajnath Singh and Secretary DD R&D and Chairman DRDO Dr G Satheesh Reddy congratulated DRDO Scientists for the achievement.

All QRSAM weapon system elements like Battery Multifunction Radar, Battery Surveillance Radar, Battery Command Post Vehicle and Mobile Launcher were deployed in the flight test. The system is capable of detecting and tracking targets on the move and engaging target with short halts. The system is designed to give air defence coverage against strike columns of Indian Army.



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The weapon system elements have been realized through Defence PSUs BEL, BDL and private industry L&T. The missile system is fully indigenous with active RF Seekers, Electro-Mechanical Actuation (EMA) systems sourced from various industries. The Radar is four-walled Active Phased Array Radar. All range Tracking stations, Radar, EOTs & Telemetry Stations monitored the flight parameters.

<https://zeenews.india.com/india/india-successfully-test-fires-quick-reaction-surface-to-air-missile-qrsam-system-hits-pilotless-target-aircraft-2324601.html>

हवा में 30 किमी तक मार करने वाली QRSAM मिसाइल का सफल परीक्षण, लंबे समय से चल रहे थे ट्रायल

बीते डेढ़ महीनों में डीआरडीओ (DRDO) ने कम से कम 12 मिसाइलों के टेस्ट किए हैं। माना जा रहा है कि आने वाले समय में कुछ और टेस्ट भी किए जाने हैं। QRSAM ने ट्रायल में लक्ष्य पर सटीक निशाना लगाया है।

नई दिल्ली: काफी समय से चले आ रहा क्विक रिएक्शन सर्फेस टू एयर मिसाइल्स (Quick Reaction Surface-to-Air Missile (QRSAM)) के ट्रायल्स शुक्रवार को पूरे कर लिए गए हैं। भारत ने इन मिसाइलों का सफल परीक्षण कर लिया है। ट्रायल्स के अगले दौर में सेना कम रेंज वाली मिसाइल का परीक्षण करेगी। यह ट्रायल्स उड़ीसा के बालासोर तट पर किए गए हैं। ट्रायल के दौरान मिसाइल ने अपने लक्ष्य पर एकदम सटीक निशाना लगाया है।

मिसाइल को डिफेंस रिसर्च एंड डेवलपमेंट ऑर्गेनाइजेशन (DRDO) ने तैयार किया है। मिसाइल को परीक्षण के लिए दोपहर 3:40 पर एक मोबाइल लॉन्चर के जरिए दागा गया। मामले के जानकार बताते हैं कि मिसाइल ने अपने टारगेट को पूरी तरफ खत्म कर दिया था। यह मिसाइल हवा में उड़ते हुए टारगेट को आसमान में 30 किमी तक मार सकती है। खास बात है कि जिस मोबाइल वाहन पर यह मिसाइल रखी गई थी, उसमें एक पर मिसाइल होती है और दूसरे पर एक रडार होता है। इसकी वजह से इसे हमले के वक्त एक जगह से दूसरी जगह आसानी से ले जाया जा सकता है। QRSAM का पहला ट्रायल 4 जून 2017 को किया गया था।



QRSAM का पहला ट्रायल 4 जून 2017 को किया गया था. (फोटो: ANI)

तेजी से ट्रायल्स कर रही है डीआरडीओ

बीते डेढ़ महीनों में डीआरडीओ ने कम से कम 12 मिसाइलों के टेस्ट किए हैं। माना जा रहा है कि आने वाले समय में कुछ और टेस्ट भी किए जाने हैं। खास बात है कि टेस्टिंग की इतनी तेज रफ्तार ऐसे समय में आई है जब लद्दाख में भारत और चीन के बीच एक्चुअल लाइन ऑफ कंट्रोल (Line of Actual Control) पर तनाव जारी है।

अंग्रेजी अखबार द इंडियन एक्सप्रेस से बातचीत में डीआरडीओ के एक वरिष्ठ अधिकारी ने कहा था कि इतने कम समय में टेस्ट की संख्या निश्चित रूप से सबसे ज्यादा है। बड़े स्तर पर तीनों सेनाओं के लिए मकसद, रेंज के हिसाब से मिसाइल तैयार की जा रही हैं। विकसित की जा रही मिसाइलें अलग-अलग स्टेज पर हैं, जहां उनके डेवलपमेंट ट्रायल्स किए जाएंगे।

<https://hindi.news18.com/news/nation/successful-test-of-qrsa-missile-that-hit-30-km-in-air-3337177.html>

Meet the NAG: How does India's anti-tank missile stack up?

In 2018, the Indian Defence Ministry had cleared the acquisition of 300 Nag missiles and 25 NAMICAs for the Indian Army. But just how good are they?

By Peter Suci

India and China have continued to move men and material to the Ladakh Valley near the Line of Actual Control before winter sets in, and this has included a significant number of tanks and other armored vehicles. In some cases, the tanks and troops are just 400 meters apart. India has ferried in equipment via heavy-lift, and that included numerous T-72 and T-80 tanks, along with BMP-2 armored personnel carriers (APC). All of the vehicles have been modified and adapted to run on a special fuel mix designed specifically for the high altitudes and low temperatures of the region.

Last month the Indian military also conducted tests of its latest variant of the NAG anti-tank missiles near the Pokhran Test Range in the western state of Rajasthan. During the tests, the third-generation, all-weather, fire-and-forget anti-tank guided missiles (ATGM) reportedly destroyed the target with extremely high accuracy in both desert terrain and rugged frontier hills—terrain that is similar to that of the Ladakh region.

"This is the final test and the NAG program will begin to be deployed to all units in the military," the Indian Defense Ministry said in a statement.

Defence Aviation Post reported that the NAG is a product of Defence Research and Development Organisation Agency of India (DRDO).

The missile, which first underwent successful tests in September 1997 and January 2000, is equipped with an advanced passive navigation system, and it was designed to destroy modern tanks and heavy armored targets, and has a night strike capability. It has been launched from a ground-based launch pad or an airbase. During the test in January 2016, a NAG missile successfully destroyed a thermal weapons system (TTS) at a range of 4 km at the Pokhran range. This anti-tank missile also underwent the last of the practical tests in different weather conditions earlier this year—likely in preparation for deployment to the Himalayas.

The ground version, also known as the "Prospina," can also be mounted on a NAMICA (BMP-2 platform), which is among the armored vehicles deployed along the border with China.

The NAG missiles are constructed of lightweight and highly durable composite materials. These can be installed with four rockets, spread and length 1.85, diameter 0.20m, a wingspan of 0.4m and weighs 43kg. The missile is fitted with a targeting guidance system, while the middle body contains many compact sensors and warheads. The platform can fire six missiles in just 20 seconds, and it is designed to destroy or defeat enemy tanks equipped with composite and reactive armor.

Army Technology reported that Defence PSU Bharat Dynamics Limited (BDL) will produce the missile while Ordnance Factory Medak will manufacture the NAMICA. Indian Defence Minister Rajnath Singh congratulated the Indian Army and DRDO for the completion of the trial.



In 2018, the Indian Defence Ministry had cleared the acquisition of 300 Nag missiles and 25 NAMICAs for the Indian Army.

The NAD is not the only missile platform that has been undergoing testing. Earlier this month, the Indian Ministry of Defence also announced the flight test of the new generation anti-radiation missile. Dubbed the RUDRAM, it is the first locally developed anti-radiation missile of the country. Additionally, last month, DRDO announced that it tested the Hypersonic Technology Demonstrator Vehicle (HSTDV).

<https://nationalinterest.org/blog/buzz/meet-nag-how-does-india%E2%80%99s-anti-tank-missile-stack-172626>

Business Standard

Fri, 13 Nov 2020

After minor hiccups, indigenous artillery gun is ready to fire again

Sanctioned in September 2012, the ATAGS gun first fired in December 2016, taking just four years in development

By Ajai Shukla

Pune: Sanctioned in September 2012, the ATAGS gun first fired in December 2016, taking just four years in development. In subsequent firing trials the ATAGS demonstrated it was a world-class gun, consistently exceeding the ranges the army demanded.

The gun is unique in its ability to fire a five-round burst, while no other contemporary gun exceeds three-round bursts. This brings down a greater quantity of explosive onto the target before enemy soldiers can take cover.

Before entering large-scale production, the ATAGS was readying for hot weather trials in the Pokhran Field Firing Ranges (PFFR) from 15th May to 15th June, followed by cold weather trials and mobility trials in Sikkim in January 2021.

The Defence Research & Development Organisation (DRDO) scientists in the ATAGS project were confident. The gun had already performed well in high altitude trials in January 2018 at the 12,000-foot-high Menla Firing Range in Sikkim, where night time temperatures drop to minus 16 degrees Centigrade.

But their hopes of a smooth path into operational service for ATAGS were scuttled by two events. First, summer trials were called off because of the Covid-19 pandemic. Then, when the gun went for trials in September, a gun barrel burst while being fired.

Now, after a detailed probe by a multi-agency Failure Investigation Committee, the gun has undergone changes and is ready to fire again. *Business Standard* was briefed on the ATAGS programme at the Armament R&D Establishment Pune.

ATAGS Project Manager, Shailendra Gade, explained that the gun's ability to achieve a world-record breaking range of 48 kilometres comes from a specially designed gun chamber that has a unique 25-litre capacity.

In other contemporary 155 millimetre guns, chamber capacity is never more than 23 litres. As a consequence, other guns can use a maximum of six modules (measures) of propellant to hurl the projectile to the target. The ATAGS' additional two-litre chamber capacity has space for a seventh propellant module. This hurls the projectile an additional distance.



Looking at the ATAGS in the ARDE's weapons bays is enough to discern that it is an unusually beefy artillery gun. Weighing in at 19-tonnes, it is a full two tonnes heavier than comparable 155 millimetre, 52 calibre Nexter and Elbit towed guns the artillery has evaluated.

But the army has willingly accepted the reduced mobility that comes with greater weight. The additional propellant it fires requires a heavier barrel, breech and recoil system.

The weight of the ATAGS has also risen because of its all-electric drive – another unique feature of the gun. This electrically powers 11 moving parts, such as the automatic ammunition loader. In other guns, these systems are operated through hydraulic systems, which are messy and unreliable, require hydraulic drives, oil tanks for hydraulic fluid and rubber gaskets that have to be changed frequently. Hydraulic systems also require more maintenance than electrical systems and are less sensitive.

Electrical systems have added an estimated two tonnes to the weight of ATAGS because an extra actuator and motor is required for each of the 11 moving parts. The ATAGS' stack of electrical batteries also adds to the weight of the gun.

Another advantage of electrical systems is that the gun can fire without switching on the engines – essential for powering hydraulic systems. In the ATAGS the gun can fire in “silent mode”, with the batteries providing sufficient electrical power to fire the gun for an hour, without the engine running.

The ATAGS is towed by the standard, in-service Ashok Leyland Stallion field artillery tractor (FAT). However, it can be decoupled from the gun, and then move for short distances powered by its on-board engine, built by Pune-based firm, Cummins.

The ATAGS has a world-class, digital control and communications system. Each battery command post issues commands to the six guns it controls through state-of-the-art software defined radio (SDR). The command & control and communications systems have been developed by two DRDO laboratories: Defence Electronics Applications Laboratory (DEAL), Dehradun and Centre for Artificial Intelligence and Robotics, Bangalore (CAIR).

There is significant “Make in India” prestige riding on the ATAGS. It has been displayed to the public during the Republic Day Parade. Numerous VIPs have witnessed it firing, including Nirmala Sitharaman, who travelled to Pokhran in September 2017, two weeks after taking over as defence minister.

But, most importantly, the ATAGS has a major place in the army's Field Artillery Rationalisation Plan, which envisages the acquisition of about 3,000 155 millimetre, 52-calibre guns. At least half of these are to be ATAGS.

https://www.business-standard.com/article/current-affairs/after-minor-hiccups-indigenous-artillery-gun-is-ready-to-fire-again-120111300056_1.html

Business Standard

Sat, 14 Nov 2020

Navy Chief Admiral Karambir Singh visits naval air station in Campbell Bay

The air station, INS Baaz, keeps an eye on several critical international sea lanes passing through the Indian Ocean Region

New Delhi: Navy Chief Admiral Karambir Singh on Friday visited a strategically located naval air station at Campbell Bay in Great Nicobar Island and reviewed the Indian Navy's operational preparedness in the region, officials said.

The air station, INS Baaz, keeps an eye on several critical international sea lanes passing through the Indian Ocean Region, they said.

Commander-in-Chief of the Andaman and Nicobar Command Lt General Manoj Pande briefed Admiral Singh about various operational matters.

"The Chief of Naval Staff was briefed on the operational preparedness and infrastructure aspects of the Command, including readiness in the prevalent security scenario," an Indian Navy Spokesperson said.

"The visit was aimed to express solidarity with personnel on the occasion of Deepawali," he added.

The Andaman and Nicobar Command is India's only tri-services command which has been playing a major role in defending the country's strategic interests in the Indian Ocean, a region that has witnessed increasing forays by Chinese warships in the last couple of years.

(Only the headline and picture of this report may have been reworked by the Business Standard staff; the rest of the content is auto-generated from a syndicated feed.)

https://www.business-standard.com/article/current-affairs/navy-chief-admiral-karambir-singh-visits-naval-air-station-in-campbell-bay-120111301437_1.html



Chief of Naval Staff, Admiral Karambir Singh, addresses a press conference in New Delhi | PTI

चीन से तनाव के बीच निकोबार के नौसैनिक वायु अड्डे की तैयारियों की नौसेना प्रमुख ने की समीक्षा

हिंद महासागर में स्थित यह क्षेत्र अंतरराष्ट्रीय समुद्र मार्गों के गुजरने का अहम स्थान है। इसके चलते इस क्षेत्र में सर्वाधिक सैन्य तैनाती है। अभियानों की तैयारी और कमांड के आधारभूत ढांचे का ब्योरा उन्हें अंडमान और निकोबार कमांड के कमांडर इन चीफ लेफ्टिनेंट जनरल मनोज पांडे ने दिया।

By Arun Kumar Singh

नई दिल्ली: चीन से सीमा विवाद को देखते हुए भारतीय नौसेना के प्रमुख एडमिरल करमबीर सिंह ने ग्रेट निकोबार द्वीप की कैंपबेल खाड़ी में खड़े आइएनएस बाज का दौरा करके सैन्य अभियान संबंधी तैयारियों की समीक्षा की। शुक्रवार को उन्होंने दिवाली की पूर्वसंध्या पर नौसैनिकों को शुभकामनाएं भी दीं। भौगोलिक रूप से सामरिक महत्व वाले क्षेत्र में स्थित इस नौसैनिक वायु अड्डे पर आइएनएस बाज तैनात है। हिंद महासागर में स्थित यह क्षेत्र अंतरराष्ट्रीय समुद्र मार्गों के गुजरने का बेहद अहम स्थान है। इसी के चलते इस क्षेत्र में सर्वाधिक सैन्य तैनाती है। इस दौरान अभियानों की तैयारी और कमांड के आधारभूत ढांचे का ब्योरा उन्हें अंडमान और निकोबार कमांड के कमांडर इन चीफ लेफ्टिनेंट जनरल मनोज पांडे ने दिया।

उन्होंने एडमिरल करमबीर सिंह को सुरक्षा के संकट के समय उठाए जाने वाले कदमों का भी ब्योरा दिया। इस मौके पर एडमिरल करमबीर सिंह ने इस अहम सैन्य बेस को हर वक्त ऑपरेशनल रखे जाने पर सभी सैनिकों का आभार व्यक्त किया। अस अवसर पर सैन्य अड्डे पर भारतीय सेना, भारतीय वायुसेना, तटरक्षक, डीएससी और जीआरईएफ के सदस्य मौजूद थे। यहां तक कि रक्षा क्षेत्र में काम करने वाले सिविलियन भी उपस्थित रहे।

इस नौसैनिक वायु अड्डे से युद्धक विमान बंगाल की खाड़ी के दक्षिणी क्षेत्र, दक्षिणी अंडमान सागर, मल्लका धारा और दक्षिणी हिंद महासागर की निगरानी की जाती है। दक्षिणी हिंद महासागर में आइएनएस बाज आपदा की स्थिति में स्थान खाली कराने, मानवीय सहायता, राहत कार्य और तलाशी अभियान और बचाव कार्यों में भी अहम भूमिका निभाता है।

<https://www.jagran.com/news/national-naval-chief-reviews-the-preparations-for-the-naval-air-fleet-of-nicobar-amid-tension-from-china-21060534.html>



हिंद महासागर में स्थित यह क्षेत्र अंतरराष्ट्रीय समुद्र मार्गों के गुजरने का अहम स्थान है। इसके चलते इस क्षेत्र में सर्वाधिक सैन्य तैनाती है। अभियानों की तैयारी और कमांड के आधारभूत ढांचे का ब्योरा उन्हें अंडमान और निकोबार कमांड के कमांडर इन चीफ लेफ्टिनेंट

Why India, China want to disengage at LAC, & how standoff has changed the strategic picture

In episode 617 of 'Cut The Clutter', ThePrint's Editor-in-Chief Shekhar Gupta explains the bargaining chips India has in the negotiations with China

New Delhi: In the backdrop of the eighth round of corps commanders meeting between India and China last week over the standoff in Eastern Ladakh, ThePrint's Editor-in-Chief Shekhar Gupta explains that to reach a favourable outcome in a negotiation, one should have some strengths — chips to put on the table.

In episode 617 of 'Cut The Clutter', Gupta says that the Indian Army holds such chips.

Gupta goes on to explain that after the standoff began on 20 April, the Chinese occupied Finger 4 at Pangong Tso, adding that the Indian Army on 29 and 30 August took positions on the crest line of Kailash range. Thus, he adds, negotiations between the two countries would be focused on whether status quo should be restored to what it was until 20 April or 29-30 August.



Indian Army soldiers atop a T-90 tank in Ladakh | Representational image | ANI

Strategic importance of taking position on Kailash range

Explaining what the Indian Army did on the night of 29-30 August, Gupta says they climbed the entire Kailash range and took all the dominating heights on the Southern Bank of Pangong Tso lake.

Referring to an article by Lt Gen H.S. Panag (retd), Gupta explains that going up to these high locations on the Southern Bank neutralised the advantage the Chinese might have had when they took position at the patrolling points in the Depsang region.

Gupta adds that if the Chinese threaten India through Depsang and the Daulat Beg Oldi, India has the ability to go into the Chinese underbelly through the Spanggur gap and Moldo Garrison. And, he adds, it is also the closest access to China's Xinjiang Tibet Highway.

Calling the Indian Army's actions on 29 and 30 August "heroic and dashing", Gupta says it has now given "India a new bargaining position". And a "bunch of negotiating chips", which India did not have earlier.

According to Gupta, the question was to go back to the status quo ante of April or August, because if it was the former, then India would have to come down from the Kailash range, which some military commanders are anxious about.

Gupta says the Kailash range had never been occupied earlier, adding that people such as General Panag have called for India to sit on the range and if China demands more and wants India to get off these heights, then it would have to make concessions in Depsang.

The worry, Gupta says, is that if India got off the heights (of the Kailash range) then China would never let India get back on as they now know what India is capable of.

Speaking about the Indian Army, Gupta says it is no pushover but in fact a very tough army that can take attrition as well as inflict attrition. And it also has a great deal of expertise in higher altitude warfare.

By taking position on the Kailash range, India is no longer negotiating from a position of weakness.

The benefits of disengagement

Speaking about the benefits of disengagement, Gupta explains that it benefits both countries as India is in a crisis situation in so many other areas, while for the Chinese, the diplomatic, military, and political consequences of this would be phenomenal. And this could also distract them from their priorities in the area of Taiwan or South China Sea, which Gupta says was a “calculation”.

“So, both sides, it seems are now keen on disengagement,” Gupta says.

The next round of talks will focus on withdrawing heavy artillery and armoured tanks and the negotiations will be regarding how far back to take them, Gupta says.

India does not want to scale too far back because if China’s intentions change, it will take India much longer to bring back its artillery and deploy it in the battle zone.

India’s options

Concluding his episode, Gupta reiterates that both China and India knew that in Ladakh the terrain worked to India’s disadvantage. And it is very tough for India to defend Ladakh against a really determined Chinese push. However, the picture was very different in the eastern sector as there the terrain works to India’s advantage.

“So remember that push comes to the shove, India has options. And the Chinese know that,” Gupta says.

He also asserts that theories of the US President being elected out and Joe Biden being elected in (almost), which would result in India’s negotiating position weakening was a “whole lot of nonsense” and “hogwash”. India will not settle for less, he says.

<https://theprint.in/opinion/why-india-china-want-to-disengage-at-lac-how-standoff-has-changed-the-strategic-picture/543555/>

THEWEEK

Sat, 14 Nov 2020

Sail or dive?

Submarines or aircraft carriers? A lively debate is gathering momentum

By Pradip R Sagar

When HMS Hercules joined the Indian Navy as INS Vikrant in 1961, India became the first Asian power to have an aircraft carrier. That single carrier was enough for several decades, since no other Asian power wanted to control the Indian Ocean. Today, though, when the Chinese navy is projecting power with two carriers, while building a third and planning for two more, India is finding itself at sea.

India’s second carrier—Vikrant, which is the first to be made in India—is getting fitted at Cochin Shipyard; naval engineers have been drawing up designs for a third. But in February, Gen Bipin Rawat poured cold water on their blueprint. As chief of defence staff, whose job is to prioritise military procurement, Rawat questioned the wisdom of having three carriers. Carriers, he said, were expensive and vulnerable to torpedoes. He favoured submarines, citing the Navy’s worries about its dwindling underwater capability. Or, he asked, why not develop shore-based capabilities?

“ Shore-based strike has its own place to support naval operations and the aircraft carrier has a completely different role to play. To show that shore-based facility is a replacement of aircraft carriers is a complete fallacy. —Admiral Arun Prakash, former Navy chief

Rawat's idea, apparently, is to build more submarines and develop islands in the Bay of Bengal and the Arabian Sea into "unsinkable strategic hubs". He has left the call to the defence ministry, which he said might review its decision after INS Vikrant becomes operational.

The main argument against carriers is indeed their cost. India's lone carrier in operation, the Russian-made Vikramaditya, cost a whopping 012,500 crore (\$2.35 billion). Vikrant is expected to cost 019,590 crore (\$2.8 billion). Its sister ship, which naval designers have been working on since 2012 and want to name Vishal, is expected to cost between 075,000 crore and 01.5 lakh crore.

Rawat's comments have triggered a debate on whether carriers are white elephants. "They cost a packet and if hit by one enemy torpedo, all this will sink to the bottom of the sea," said a Navy officer.

Abhijit Bhattacharyya, member of the London-based think tank International Institute of Strategic Studies, said: "Between a submarine and an aircraft carrier, the former is comparatively economical and safer to operate, is difficult to be detected, and does not require an accompanying flotilla of surface vessels." He added that the visible deterrence provided by a carrier battle group was something a submarine could not achieve.



Show of might | Aircraft on the deck of INS Vikramaditya, India's only operational aircraft carrier | Getty Images

Unlike submarines, carriers operate in battle groups—with destroyers, corvettes and frigates accompanying them—and thus have no stealth element. They are visible, and therefore vulnerable, to ships, aircraft and submarines. Many maritime strategists, too, have been arguing for a submarinecentric force. The debate is as old as the start of the Cold War, when the US acquired carrier after carrier, while the Soviet Union went for fleet after fleet of silent submarines.

The trends led to two rival maritime doctrines—of sea control (by American carriers) and sea denial (by Soviet submarines). The rivalry and divergence got reflected in the Indian subcontinent, too. While India went for a carrier as far back as 1961, the Pakistan Navy put a premium on submarines. After the 1970s, however, India acquired submarines, too.

The doctrines also evolved out of geopolitical compulsions. India, like the US, has a long coastline and, therefore, can have bases from where carrier battle groups can operate. Pakistan, like Russia, does not have much of a coastline, and thus cannot have many bases.

All the same, most modern navies are seeking to balance both types of assets (carriers and submarines) and doctrines (sea control and sea denial). The oceans now have 41 aircraft carriers that belong to 13 navies. The US operates 11 carriers and 70 submarines. The Russians and the British, having toyed with the idea of making do without carriers for nearly a decade, are coming back with one carrier each. The Royal Navy commissioned the 65,000-tonne HMS Queen Elizabeth and a second carrier, HMS Prince of Wales, is in its last leg of completion. Japan, which did not have any since World War II, now has three. Australia, France, Italy and Spain have one each. Even Thailand, which operates a helicopter carrier, HTMS Chakri Naruebet, may soon upgrade it to carry airplanes.

FLOATING FORTRESSES

THE WORLD'S TOP AIRCRAFT CARRIERS

GERALD R FORD CLASS, THE US

The world's biggest aircraft carriers, reportedly **337m**-long. Full load displacement: one lakh tonnes. They have a **78m**-wide flight deck equipped with an electromagnetic aircraft launch system and advanced arresting gear. Capable of carrying **75** aircraft and **4,539** personnel

NIMITZ CLASS, THE US

Nuclear-powered. World's second largest aircraft carriers; **332.8m**-long. Full load displacement: **97,000 tonnes**. Flight deck: around **18,000sqm**. Capable of carrying over **60** aircraft

QUEEN ELIZABETH CLASS, THE UK

The world's third largest carriers, **280m**-long. Full load displacement: **65,000 tonnes**. Combat operations reportedly require a crew of less than **700**

ADMIRAL KUZNETSOV, RUSSIA

It is heavily armed and has multi-role capability. **305m**-long. Full load displacement: **58,500 tonnes**. Flight deck: **14,700sqm**. Can carry fighters and helicopters

LIAONING, CHINA

The world's fifth largest aircraft carrier. Full load displacement: Over **58,000 tonnes**. Capable of carrying around **50** aircraft, including fixed-wing planes and helicopters

INS VIKRAMADITYA, INDIA

Modified Kiev-class carrier; entered service in 2013. **283.5m**-long. Full load displacement: **45,400 tonnes**. Capable of carrying **36** aircraft, including **26** MIG-29K multi-role fighters and **10** helicopters

CHARLES DE GAULLE, FRANCE

Only nuclear-powered carrier outside the US Navy. Full load displacement: **42,000 tonnes**. Capable of carrying **40** aircraft, including fixed-wing aircraft and helicopters

CAVOUR, ITALY

Has features such as short-range defence systems, guns and decoy launchers. Full load displacement: **30,000 tonnes**. Flight deck: Around **8,000sqm**. Capable of carrying fixed-wing aircraft and helicopters

JUAN CARLOS I, SPAIN

Multi-purpose amphibious assault ship/aircraft carrier. Displacement: **26,000 tonnes**. Flight deck has a ski-jump ramp. It can house **900** naval personnel, and carry a contingent of **1,200** soldiers

USS AMERICA, THE US

Amphibious assault ship. Length: Approximately **257m**. Design is based on the Wasp-class amphibious assault ship USS Makin Island. Has hybrid-electric propulsion



The latest argument against carriers is that even if sea control is the preferred doctrine, it can be achieved by developing islands as bases, from where aircraft, surface ships and submarines can patrol thousands of sea miles around. But carrier enthusiasts argue that carriers are essentially tools for projection of power (“100,000 tonnes of diplomacy,” as Henry Kissinger said), which cannot be achieved with shore-, submarine- or island-based platforms. Also, carriers have full-length flight decks capable of carrying, arming, deploying and recovering aircraft. A carrier battle group (CBG) that has destroyers, frigates, corvettes and submarines provides operational flexibility, with an ability to relocate up to 500 nautical miles in 24 hours. It can sanitise more than 200 nautical miles around it at any given time. Its primary missions can switch dramatically from air defence and strikes against surface ships, to strikes on shore targets and hunting submarines. “The US achieved air superiority in the Gulf War with the use of aircraft from carriers,” said a rear admiral.

India’s first Vikrant, a 20,000-tonne vessel, played a key role in enforcing the naval blockade of East Pakistan during the 1971 war, and its Hawker Sea Hawk planes struck Chittagong and Cox’s Bazaar. Its crew earned two Maha Vir Chakras and 12 Vir Chakras. Vikrant’s successor, Viraat, did not get a chance to bloody itself in combat, but threatened to starve Pakistan with a blockade of the Arabian Sea during the Kargil war.

General Rawat’s preference for shore-based facilities over carriers, said former navy chief Admiral Arun Prakash, was like comparing apples and oranges. “Shore-based strike has its own place to support naval operations and the aircraft carrier operating in the middle of the Arabian Sea, Bay of Bengal and the Indian Ocean has a completely different role to play. To show that shore-based facility is a replacement of aircraft carriers is a complete fallacy,” he said.

Naval officers say Rawat, being an Army officer, may not understand the imperatives of maritime strategy. “In an increasingly hostile operational environment, the aircraft carrier is the only platform that provides comprehensive access to littoral spaces, for surveillance and effective sea command,” said an officer.

The Navy has been maintaining that it needs at least three carriers to fulfil the increasing demands that are made on it every day. It is now being asked to police not only the Arabian Sea against Pakistan, but also the Bay of Bengal, and virtually the entire Indian Ocean from Malacca Strait to the Persian Gulf against the Chinese and other hostile powers, including pirates, gun-runners and terrorists. While submarines are best for sea denial, carriers control seas and project power. “The carrier sits at the heart of India’s maritime strategy,” said Abhijit Singh, head of maritime policy initiative at the Observer Research Foundation (ORF). “Regardless of the debate surrounding [the new Vikrant], the Navy is unlikely to give up its demand for a third aircraft carrier.”

The Navy says the cost argument is fallacious. The 65,000-tonne Vikrant, it said, will finally cost about 049,000 crore (without the aircraft), but the money has been spent over 15 years. Moreover, as the ship is expected to serve around 45 years (twice the life of any other warship), “the cost is peanuts”, said the officer. Vishal is expected to cost \$7 billion to build, and the fighter jets, helicopters and reconnaissance aircraft will cost another \$5-8 billion. Anticipating the high-cost objection, the Navy has already scaled down the number of fighters from 57 to 36. While India is caught in the desirability debate, China is seeking to permanently position three or four warships and submarines, including a nuclear one, in the Indian Ocean. “It is only a matter of time that this task force is replaced with a CBG,” said an officer. “By 2028, there could even be two Chinese CBGs floating around.”

Said Admiral Prakash: “If China decides to send three aircraft carriers into the Indian Ocean, then no amount of submarines, destroyers or frigates can tackle it. Aircraft carriers are the only answer to such a situation.”

The Navy also points out that building a carrier is in tune with the government’s Make in India policy. Today, only a handful nations—the US, Russia, Britain and France—can design and build heavy (40,000-plus tonnes) carriers; India is one of them. “A carrier-building project generates a lot of industrial skills and jobs, especially in the micro, small and medium enterprises sector,” said

an officer in the Navy's design bureau. The money spent, said the officer, will be mostly ploughed back into the country.

Dr Harsh Pant, research fellow at ORF, said carriers should be prioritised over other capabilities. "It would boil down to an assessment of threat perceptions," he said, "and what capabilities are best suited to manage them in the short to medium term."

The latest argument against carriers is that even if sea control is the preferred doctrine, it can be achieved by developing islands as bases, from where aircraft, surface ships and submarines can patrol thousands of sea miles around.

<https://www.theweek.in/theweek/current/2020/11/13/sail-or-dive.html>

Science & Technology News



Sat, 14 Nov 2020

IIT alumni develop satellite fuel that is 40 times less toxic, lowers costs by 60%

Tushar Jadhav and Ashtesh Kumar have developed less toxic fuel, a new engine and catalyst for a satellite propulsion system called I-Booster
By Himanshu Nitnaware, Edited By Yoshita Rao

India is one of a few countries known to make successful, cost-effective space launches. The Mangalyaan Mars orbiter and Chandrayaan-2 are the best displays of this feat. India has also made a record of launching the largest number of satellites in one go 2017 – 104 of them.

However, launching a satellite and its payload costs almost the same as its manufacturing expenses. Moreover, the fuel used in these satellites, that allows manoeuvring in space, is toxic and hazardous to human health.

A Mumbai-based space startup, Manastu Space Technologies Pvt Ltd, is trying to solve these two major problems in this field with three innovations. The startup claims to bring down the toxicity levels by up to 40 times and make it 25 per cent more efficient.



Tushar Jadhav and Ashtesh Kumar have developed less toxic fuel, a new engine and catalyst for a satellite propulsion system called I-Booster

"Like any vehicle, a satellite consists of fuel, an engine to burn it and a catalyst that functions like a spark plug to ignite the fuel. We have innovated on all the three levels," says Tushar Jadhav, IIT alumni, ex-Defence Research and Development Organisation (DRDO) and co-founder of the startup.

About 40 per cent of the weight in a satellite comprises the fuel, and the remaining is occupied by the payload, which mainly includes instruments to carry out experiments.

The fuel in the satellites ensures efficient working of instruments in extreme temperatures. The fuel gets used for navigation like changing the orbit, increasing or decreasing the speed or changing the orientation of the satellite with thrusters.

The Satellite Innovation

“At present, hydrazine is the fuel used in satellites which are highly toxic. Its toxicity levels are equivalent to potassium cyanide, a life-threatening and carcinogenic chemical.

We are using hydrogen peroxide and additives to reduce the toxicity to the level of common salt,” Tushar says.

“Every material has its own toxicity levels. If consumed in excess, it becomes life-threatening. Many scientists have to work in hazardous and high-risk environments. As the fuel is filled in these satellites, all other work is put on hold and the exercise is conducted in isolation,” says Ashtesh Kumar, an ex-IITian co-founder, specialising in combustion and propulsion.

Ashtesh says the new fuel will pose fewer risks to scientists. He explains, “The second major problem with hydrazine fuel is that it is less efficient. The newly developed fuel is 25 per cent more efficient, similar to what mileage is for a vehicle on earth. As 25 per cent of less fuel will be required the cost to launch the weight per kg will reduce, making it much more effective.” The safer handling of fuel also means reducing the operational costs to 60 per cent.

The combined benefits of the reduced cost on fuel and its high efficiency, they claim, make the overall costs 30 per cent cheaper.

Ashtesh says with less toxicity and more fuel efficiency, they achieved the perfect blend to make space vehicles cost-effective. The duo running a company of 20 employees have now developed a new engine and catalyst.

“A new fuel requires a different engine to burn it. It is the same as having different engines to burn diesel and petrol. So a new engine had to be developed. We also conceived a catalyst to ignite the fuel in the engine chamber,” Ashtesh says.

The I-Booster’s engine built by Manastu produces a thrust of 1 and 10 Newton. At present, India uses catalysts made by other countries. “It is one of the crucial parts in the engine without which it cannot function,” Ashtesh adds.

How it came together

Tushar and Ashtesh studied engineering together at IIT-Bombay for two years. “We worked together on launching a 10 kg satellite, Pratham for Indian Space Research Organisation (ISRO) in 2016,” says Tushar, who was a project manager to build the satellite.

Tushar says he joined DRDO in 2014 and quit after two years. “We both started the company wanting to solve the existing problems in the space industry,” he adds.

The co-founder of the startup says that both of them planned to work in the rocket launch system sector. “However, consulting scientists at ISRO and IIT Bombay, we realised the issues with fuel. We were told that solving small but important problems would help ISRO on a large scale,” he adds.

Tushar says the duo also had few ideas to work around the engine and started working out the solution.



I-Booster thruster developed by Manastu Space Technologies Pvt Ltd



Manastu space winning the S-Booster competition organised by JAKSA

Winning competitions

However, a startup like this would need huge investors who were not confident to come on board.

With no strong financial backing from their family, the founding members of the company relied on existing expertise from IIT-Bombay and worked there as part-time researchers to use their facilities.

“We saved our earnings and worked slowly for a year and a half. It was only in mid-2018 that USA’s Lockheed Martin sponsored us with a Rs 25 lakh grant, which gave them a boost,” Tushar adds.

The startup then participated in various competitions like the S-Booster in Japan and won prize money to remain afloat. The Government of India also awarded them grants at national level competitions.

Manastu is now incubated by Royal Dutch Shell in Bengaluru to support their fuel needs, research labs and other requirements.

“Along with working with ISRO, we also bagged a contract with DRDO this year to work on an Indian military satellite,” Ashtesh says.

Poor finances apart, the startup also struggled to find expertise in a niche field of space technology. “No one had built the catalyst system, or was working around a new fuel that needed the right kind of expertise. For this, we are glad to have received support from IIT-Bombay at all times,” Ashtesh says.

Tushar says the startup is hoping to see their technology getting used at ISRO or DRDO in the next couple of years. “Not much can be disclosed right now due to confidentiality agreements but we are looking for something promising soon,” he concludes.

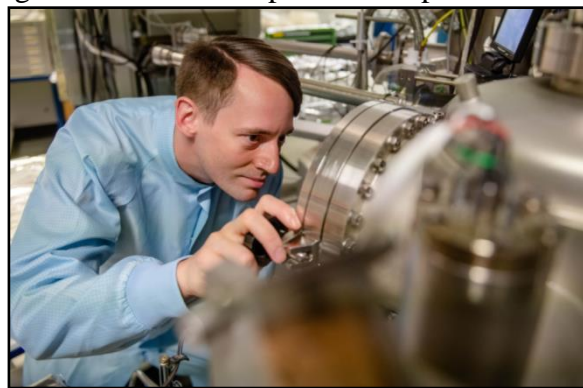
<https://www.thebetterindia.com/241908/manastu-space-mumbai-startup-iit-bombay-isro-drdo-i-booster-satellite-propulsion-system-innovation-him16/>



Sat, 14 Nov 2020

Novel quantum dots facilitate coupling to quantum memory systems

Researchers at the University of Basel and Ruhr-Universität Bochum have realized quantum dots—tiny semiconductor nanostructures—that emit light close to the red part of the spectrum with ultra-low background noise. Quantum dots might one day constitute the basis for quantum computers; the light particles, also called photons, would then serve as information carriers. Quantum dots with adequate optical properties had previously only been obtained for photons with wavelengths in the near-infrared range. Now, the researchers have succeeded in creating low-noise states at wavelengths between 700 and 800 nanometres, i.e. close to the visible red range. This



would, for example, enable coupling to other photonic systems. They outline their findings in the journal *Nature Communications* from 21 September 2020.

Julian Ritzmann from the Bochum Chair for Applied Solid State Physics © RUB, Marquard

Different wavelengths required

Systems for quantum communication require photons of different wavelengths. For communication over long distances, the main requirement is to avoid signal losses; wavelengths around 1,550 nanometres can be used for this purpose. For short distances, on the other hand, photons are needed that can be detected as effectively as possible and connected to other quantum memory systems. This would be possible with red light, or more precisely with wavelengths between 700 and 800 nanometres. Currently available photon detectors have their highest sensitivity in this range. Moreover, light particles of this frequency could be coupled with a rubidium storage system.

In order for information in a quantum system to be precisely encoded, manipulated and read out, stable optical emission is crucial. This is exactly what the researchers have now achieved for photons near the visible red range.

Lower aluminum content is the key to success

The project was a collaborative venture between a team of young physicists led by Professor Richard Warburton from the Basel-based Nano-Photonics Group and Professor Andreas Wieck, Dr. Arne Ludwig, Dr. Julian Ritzmann and colleagues from the Chair for Applied Solid State Physics in Bochum. The researchers converted the quantum dots in a semiconductor made of gallium arsenide. Since the system has to be cooled with liquid helium, it operates at low temperatures of minus 269 degrees Celsius.

One of the main challenges was to design a diode with gallium-arsenide quantum dots that reliably emits photons at these low temperatures. The Bochum-based team produced aluminum-gallium-arsenide layers with a lower aluminum concentration than usual, which improved the layers conductivity and stability. The Nano-Photonics team then used this material for the experiments in Basel.

Coupled system in progress

In the next step, the researchers are planning to combine the newly developed quantum dots with a rubidium quantum memory device. Such hybrid structures would be a first step towards practical applications in future quantum communication network.

More information: Liang Zhai et al. Low-noise GaAs quantum dots for quantum photonics, *Nature Communications* (2020). DOI: [10.1038/s41467-020-18625-z](https://doi.org/10.1038/s41467-020-18625-z)

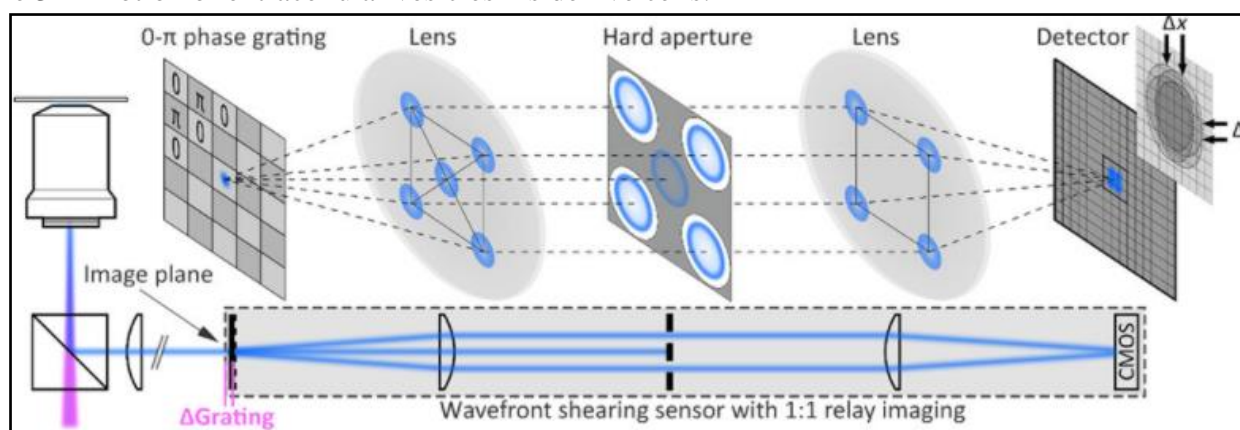
Journal information: [Nature Communications](https://www.nature.com/articles/s41467-020-18625-z)

<https://phys.org/news/2020-11-quantum-dots-coupling-memory.html>

Holographic fluorescence imaging to 3-D track extracellular vesicles

By Thamarasee Jeewandara

Biologists commonly use fluorescence microscopy due to the molecular specificity and super-resolution of the technique. However, the method is withheld by imaging limits. In a new report on *Science Advances*, Matz Liebel and a research team at the Barcelona Institute of Science and Technology and the Massachusetts General Hospital in Spain and the U.S. reported an imaging approach to recover the full electric field of fluorescent light using single-molecule sensitivity. The team experimented with the concept of digital holography for fast fluorescence detection by tracking the three-dimensional (3-D) trajectory of individual nanoparticles using an in-plane resolution of 15 nanometers. As proof-of-concept biological applications, the researchers imaged the 3-D motion of extracellular vesicles inside live cells.



Experimental implementation of single-shot fluorescence holography. Fluorescence shearing holography setup obtained by extending a fluorescence widefield microscope with a wavefront sensor composed of a 2D 0- π phase grating and a relay imaging system mounted at the microscope's exit port. The hard aperture blocks all but the first diffraction orders. Credit: *Science Advances*, doi: 10.1126/sciadv.abc2508

Nano delivery in living tissue

In this work, Liebel et al. developed fluorescence holography-based 3-D particle localization across extracellular vesicles inside live cells and observed strongly confined vesicles with periods of active transport. Delivering cargo transport in vivo is presently a significant challenge, in order to actively implement minimally invasive nanomedicine platforms. Nanoparticles (NPs) and extracellular vehicles can be engineered as promising candidates to deliver as vehicles but scientists do not yet understand the precise journey of such devices in living tissue.

To overcome these challenges, they must develop wide-field three-dimensional (3-D) single-particle imaging methods to track individual particles simultaneously as they travel to their intended destination. Research teams had previously implemented holographic approaches to microscopy, although the incoherence of fluorescent light is not well suited for live cells or single-molecule imaging. In comparison, shearing interferometry is a promising method to accomplish single shot recording of dynamic processes. The underlying idea behind shearing interferometry includes self-interference to access phase gradients down to a single photon level to achieve single shot fluorescence holography. The mechanisms developed in this work therefore serve to observe intracellular translocation across micrometer length scales to provide biologists with deeper insight to intracellular mechanisms.

Imaging principle and system validation for 3-D particle tracking

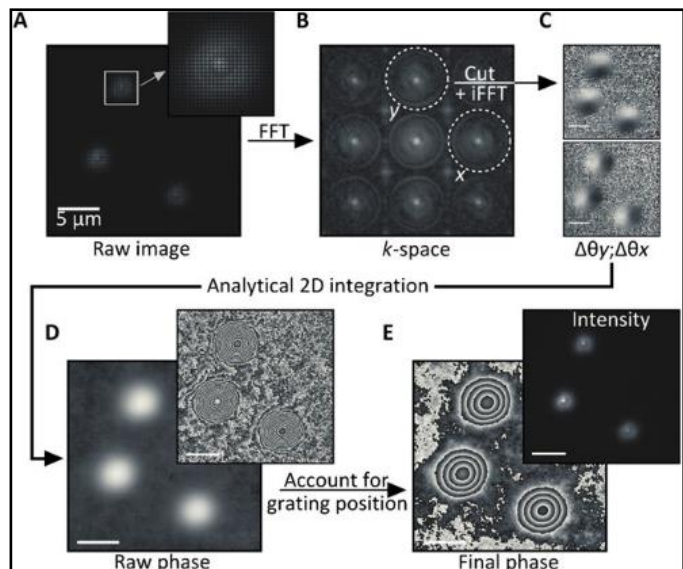
The team used a wide-field fluorescence microscope with a wavefront shearing sensor composed of a relay imaging system. The geometry of the setup ensured that non-zero phase gradients were measured and allowed Liebel et al. to perform single-photon self-interference across an entire image. The team imaged fluorescent polystyrene beads as out-of-focus 200 nm particles and extracted the intensity information as argument modulus of the filtered images for phase gradient extraction. After observing the full electric field, they used Fourier optics to correct complex scattering-induced aberrations or construct images at any plane of choice. The team focused on 3-D localization experiments requiring the recovery of the precise position of an emitter of interest across all dimensions, including the Z-plane. Computational focusing efforts indicated the precise ability to determine the 3-D position of multiple freely diffusing fluorescent particles.

Testing the computational focusing trajectory

To test computational reasoning behind the setup, Liebel et al. generated a known 3-D trajectory and moved a sample containing immobilized fluorescent beads—while recording images along the path. They recovered the phase and amplitude information and determined the 3-D positions of individual particles using numerical propagation. To quantify the accessible Z-range, they experimentally defocused individual particles and then computationally refocused the images to obtain artifact-free measurements across a Z-range of approximately eight μm . It is important to ensure precise nanoscale localization across micrometer-length scales in 3-D to image diffusing nanoscale particles. Fluorescence holography met these requirements. As proof of concept, the scientists imaged the word "holography," where each individual letter of input measured less than 50 nm in width to obtain a well-resolved output, confirming the super-resolution capacity of fluorescent holography.

Single-molecule imaging and the cellular uptake of nanoparticles

The team showed how fluorescence holography functioned under biologically important super-resolution conditions by measuring a sample composed of individual molecules. Despite markedly reduced fluorescence intensities in the experimental setup, the team obtained computational focusing to the diffraction limit even for photon levels as low as 10^4 photons. They visualized intracellular trafficking of inorganic nanoparticles and extracellular vesicles using the system. As a model system, they used fluorescently labeled gold nanorods that are inert and therefore without interference with cellular functions to accumulate in the cytoplasm as verified using dark-field images of live cells. The team followed the trajectories of particles by recording time-lapse fluorescence images and extracted the phase and amplitude terms. The widely varying point spread functions (PSFs) indicated the presence of nanorods at different Z-positions relative to the focal plane.



Electric field reconstruction workflow. (A) Experimentally obtained image of out-of-focus 200-nm fluorescent beads showing shearing-induced spatial modulation of the point spread functions (PSFs). (B) Fast Fourier transformation (FFT) of (A) allows isolation of the interference terms of interest in both the x and the y dimension by means of hard aperture isolation and shifting to zero frequency. (C) Inverse fast Fourier transformation (iFFT) of the terms isolated from (B) yields the desired phase gradients. (D) Analytical 2D integration with a Poisson solver yields the raw phase image. (E) Phase scaling, to account for the grating to camera chip distance, followed by aberration correction results in the final phase and amplitude images. All scale bars are identical, and the $0-2\pi$ phase wrapping is for visualization purposes only; the unwrapped information is directly obtained. Credit: Science Advances, doi: 10.1126/sciadv.abc2508

The team performed 3-D localization of each individual nanorod in the cell and reconstructed particle trajectories across 100 frames of observation to obtain six representative categories, where some particles were immobile during the 200 seconds of observation time, while others freely diffused across several micrometers. The remaining particles showed both bound and diffusing states. In this way, the underlying fluorescence holography method could accurately determine 3-D positions.

Cellular uptake and active transport of extracellular vesicles

Liebel et al. then studied the active 3-D transport of extracellular vesicles (EVs) inside live cells by incubating HeLa cells with fluorescently labeled EVs. They acquired fluorescent holograms every four seconds to reconstruct 3-D trajectories of individual EVs through a combination of automated and manual trajectories, linking the 3-D EV positions. Liebel et al. overlaid time-lapse amplitude projections of fluorescent holograms with simultaneously recorded bright-field images of individual cells, to show how most EVs were localized at the edge of the adherent cells. The observations and calculations suggested that the EVs were trapped inside an area, confining their motion to a specific volume; most likely belonging to the cellular cytoskeleton.

Outlook

In this way, Matz Liebel and colleagues devised a large field-of-view single-shot fluorescence holography method to allow 3-D single-particle tracking across a Z-range approximating eight micrometers. To prove this concept, the team implemented an easy experimental setup with an optimized photon throughput. The optimized features allowed fluorescence holography to be an ideal approach to study particle tracking in real-time. The team showed 3-D single-particle tracking and observed the motion of nanoscale objects in live cells, such as fluorescently labeled gold nanorods and EVs (extracellular vesicles). While gold nanorods only aggregated in the cytoplasm without internalization in the nucleus, the EVs accumulated at the edges of adherent cells in a crowding effect. Liebel et al. expect to conduct additional staining to identify the intracellular cytoskeleton, thereby connecting the intracellular architecture to the motion of extracellular vesicles. These efforts will shed light on the precise mechanisms of cargo transport and particle internalization inside cells with important applications in nanomedicine to answer critical questions in biology and medicine. The mechanism is equally suited to conduct other volumetric imaging methods to track inside tissues and for biochemical calcium imaging.

More information: Matz Liebel et al. 3D tracking of extracellular vesicles by holographic fluorescence imaging, *Science Advances* (2020). [DOI: 10.1126/sciadv.abc2508](https://doi.org/10.1126/sciadv.abc2508)

Mercedes Tkach et al. Communication by Extracellular Vesicles: Where We Are and Where We Need to Go, *Cell* (2016). [DOI: 10.1016/j.cell.2016.01.043](https://doi.org/10.1016/j.cell.2016.01.043)

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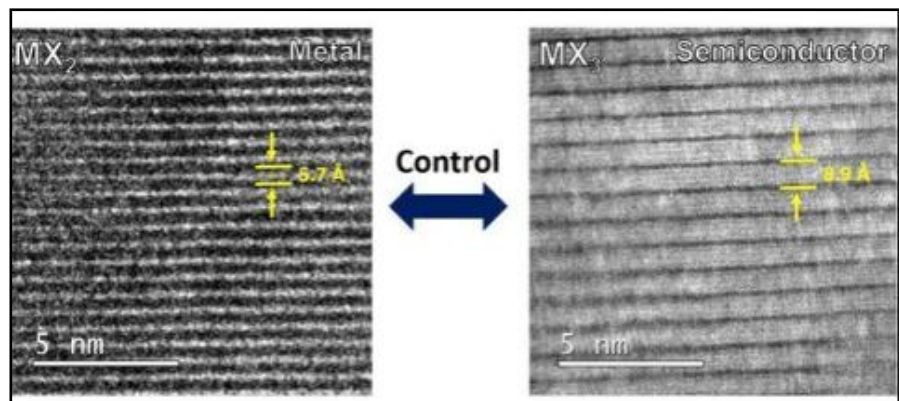
Journal information: [Science Advances](#) , [Cell](#) , [Nature](#)

<https://phys.org/news/2020-11-holographic-fluorescence-imaging-d-track.html>

Producing materials to help break the electronics scaling limit

Ph.D. candidate Saravana Balaji Basuvalingam at the TU/e Department of Applied Physics has developed a new approach to grow, in a controlled and effective way, a library of so-called "TMC materials" with various properties at low-temperatures. This brings the world one step closer to moving beyond silicon-based semiconductor devices.

As the amount of data produced by humanity grows exponentially, with it comes the demand for smaller, faster and cheaper electronic devices to process these data. To address this demand, the semiconductor industry is continuously searching for ways to scale devices below 3 nm. This scale is an important barrier for the industry, because it is near the limits of what can be done with silicon (Si), the most commonly used material for electric circuits. Below that scale, silicon-based devices often suffer from poor performance.



Credit: Eindhoven University of Technology

Certain 2-D materials, of which graphene may be the most well-known example, offer the promise to solve this scaling issue. Characteristic of these materials is that each layer of atoms is free-standing on the layer of atoms below, without any bonds connecting the layers. The 2-D materials classified as transition metal chalcogenides (TMCs) has gained attention for their excellent electrical properties and thickness of less than 1 nm, enabling device performances similar to Si-based devices and a great potential for scaling.

However, several synthesis limitations restrict the implementation of TMCs in industry in a cost-effective way. Basuvalingam's research aimed to solve most of these technical limitations, such as growing the TMCs in a large enough area, at low temperature and with good material property control. To do so, he used a thin-film approach known as the atomic layer deposition (ALD) method. ALD is one of the prominent methods to facilitate the reduction of device dimensions in the semiconductor industry, and the method had already been studied for TMCs which exhibit semiconducting properties.

Basuvalingam was the first to study ALD to grow 2-D TMCs with both semiconducting and metallic properties in a large area at low temperatures, and the first to achieve control over TMC material composition using thin-film synthesis. His approach also made it possible to grow TMCs in a 200mm wafer and to achieve control of the material properties between metallic and semiconducting.

His work expands the library of materials that can be grown using a thin-film method and helps us get one step closer to smaller, more cost-effective electronic devices made of 2-D materials.

More information: Atomic layer deposition of low-dimensional transition metal di- and tri-chalcogenides and their heterostructures. [research.tue.nl/en/publication ... ansition-metal-di-an](https://phys.org/news/2020-11-materials-electronics-scaling-limit.html)
<https://phys.org/news/2020-11-materials-electronics-scaling-limit.html>

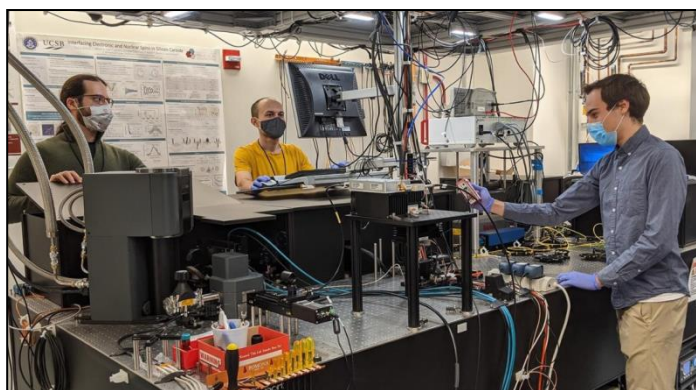
In new step toward quantum tech, scientists synthesize 'bright' quantum bits

By *Emily Ayshford*

Qubits (short for quantum bits) are often made of the same semiconducting materials as our everyday electronics. But an interdisciplinary team of physicists and chemists at the University of Chicago and Northwestern University has developed a new method to create tailor-made qubits: by chemically synthesizing molecules that encode quantum information into their magnetic, or "spin," states.

This new bottom-up approach could ultimately lead to quantum systems that have extraordinary flexibility and control, helping pave the way for next-generation quantum technology.

"This is a proof-of-concept of a powerful and scalable quantum technology," said David Awschalom, the Liew Family Professor in Molecular Engineering at the Pritzker School of Molecular Engineering (PME), who led the research along with his colleague Danna Freedman, professor of chemistry at Northwestern University. "We can harness the techniques of molecular design to create new atomic-scale systems for quantum information science. Bringing these two communities together will broaden interest and has the potential to enhance quantum sensing and computation."



Graduate student Berk Kovos, postdoctoral scholar Sam Bayliss, and graduate student Peter Mintun (left to right) work on qubit technology in the Awschalom lab in the Pritzker School of Molecular Engineering. Credit: Pratiti Deb, University of Chicago

The results were published Nov. 12 in the journal *Science*.

Qubits work by harnessing a phenomenon called superposition. While the classical bits used by conventional computers measure either 1 or 0, a qubit can be both 1 and 0 at the same time.

The team wanted to find a new bottom-up approach to develop molecules whose spin states can be used as qubits, and can be readily interfaced with the outside world. To do so, they used organometallic chromium molecules to create a spin state that they could control with light and microwaves.

By exciting the molecules with precisely controlled laser pulses and measuring the light emitted, they could "read" the molecules' spin state after being placed in a superposition—a key requirement for using them in quantum technologies

By varying just a few different atoms on these molecules through synthetic chemistry, they were also able to modify both their optical and magnetic properties, highlighting the promise for tailor-made molecular qubits.

"Over the last few decades, optically addressable spins in semiconductors have been shown to be extremely powerful for applications including quantum-enhanced sensing," said Awschalom, who is also director of the Chicago Quantum Exchange and director of Q-NEXT, a Department of Energy National Quantum Information Science Research Center led by Argonne National Laboratory. "Translating the physics of these systems into a molecular architecture opens a powerful toolbox of synthetic chemistry to enable novel functionality that we are only just beginning to explore."

"Our results open up a new area of synthetic chemistry. We demonstrated that synthetic control of symmetry and bonding creates qubits that can be addressed in the same way as defects in

semiconductors," Freedman said. "Our bottom-up approach enables both functionalization of individual units as 'designer qubits' for target applications and the creation of arrays of readily controllable quantum states, offering the possibility of scalable quantum systems."

One potential application for these molecules could be quantum sensors that are designed to target specific molecules. Such sensors could find specific cells within the body, detect when food spoils, or even spot dangerous chemicals.

This bottom-up approach could also help integrate quantum technologies with existing classical technologies.

"Some of the challenges facing quantum technologies might be able to be overcome with this very different bottom-up approach," said Sam Bayliss, a postdoctoral scholar in the Awschalom Group at University of Chicago's Pritzker School of Molecular Engineering and co first author on the paper. "Using molecular systems in light-emitting diodes was a transformative shift; perhaps something similar could happen with molecular qubits."

Daniel Laorenza, a graduate student at Northwestern University and co-first author, sees tremendous potential for chemical innovation in this space. "This chemically specific control over the environment around the qubit provides a valuable feature to integrate optically addressable molecular qubits into a wide range of environments," he said.

More information: S. L. Bayliss et al. Optically addressable molecular spins for quantum information processing, *Science* (2020). DOI: [10.1126/science.abb9352](https://doi.org/10.1126/science.abb9352)

Journal information: [Science](https://www.science.org)

<https://phys.org/news/2020-11-quantum-tech-scientists-bright-bits.html>



Sat, 14 Nov 2020

Scientists discover new family of quasiparticles in graphene-based materials

A group of researchers led by Sir Andre Geim and Dr. Alexey Berdyugin at The University of Manchester have discovered and characterized a new family of quasiparticles named 'Brown-Zak fermions' in graphene-based superlattices.

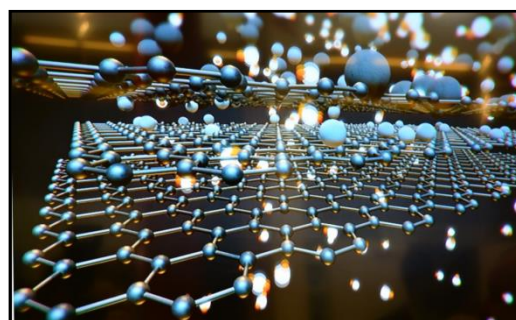
The team achieved this breakthrough by aligning the atomic lattice of a graphene layer to that of an insulating boron nitride sheet, dramatically changing the properties of the graphene sheet.

The study follows years of successive advances in graphene-boron nitride superlattices which allowed the observation of a fractal pattern known as the Hofstadter's butterfly—and today (Friday, November 13) the researchers report another highly surprising behavior of particles in such structures under applied magnetic field.

"It is well known, that in zero magnetic field, electrons move in straight trajectories and if you apply a magnetic field they start to bend and move in circles", explain Julien Barrier and Dr. Piranavan Kumaravadivel, who carried out the experimental work.

"In a graphene layer which has been aligned with the boron nitride, electrons also start to bend—but if you set the magnetic field at specific values, the electrons move in straight line trajectories again, as if there is no magnetic field anymore!"

"Such behavior is radically different from textbook physics." adds Dr. Piranavan Kumaravadivel.



Credit: CC0 Public Domain

"We attribute this fascinating behavior to the formation of novel quasiparticles at high magnetic field," says Dr. Alexey Berdyugin. "Those quasiparticles have their own unique properties and exceptionally high mobility despite the extremely high magnetic field."

As published in *Nature Communications*, the work describes how electrons behave in an ultra-high-quality superlattice of graphene with a revised framework for the fractal features of the Hofstadter's butterfly. Fundamental improvements in graphene device fabrication and measurement techniques in the past decade have made this work possible.

"The concept of quasiparticles is arguably one of the most important in condensed matter physics and quantum many-body systems. It was introduced by the theoretical physicist Lev Landau in the 1940s to depict collective effects as a 'one particle excitation'," explains Julien Barrier "They are used in a number of complex systems to account for many-body effects."

Until now, the behavior of collective electrons in graphene superlattices were thought in terms of the Dirac fermion, a quasiparticle that has unique properties resembling photons (particles with no mass), that replicate at high magnetic fields. However, this did not account for some experimental features, like the additional degeneracy of the states, nor did it match the finite mass of the quasiparticle in this state.

The authors propose 'Brown-Zak fermions' to be the family of quasiparticles existing in superlattices under high magnetic field. This is characterized by a new quantum number that can directly be measured. Interestingly, working at lower temperatures allowed them to lift the degeneracy with exchange interactions at ultra-low temperatures.

"Under the presence of a magnetic field, electrons in graphene start rotating with quantised orbits. For Brown-Zak fermions, we managed to restore a straight trajectory of tens of micrometers under high magnetic fields up to 16T (500,000 times earth's magnetic field). Under specific conditions, the ballistic quasiparticles feel no effective magnetic field," explain Dr. Kumaravadivel and Dr. Berdyugin.

In an electronic system, the mobility is defined as the capacity for a particle to travel upon the application of an electrical current. High mobilities have long been the Holy Grail when fabricating 2-D systems such as graphene because such materials would present additional properties (integer and fractional quantum hall effects), and potentially allow the creation of ultra-high frequency transistors, the components at the heart of a computer processor.

"For this study we prepared graphene devices that are extra-large with a very high level of purity". says Dr. Kumaravadivel. This allowed us to achieve mobilities of several millions of cm^2/Vs , which means particles would travel straight across the entire device without scattering. Importantly, this was not only the case for classical Dirac fermions in graphene, but also realized for the Brown-Zak fermions reported in the work.

These Brown-Zak fermions define new metallic states, that are generic to any superlattice system, not just graphene and offers a playground for new condensed matter physics problems in other 2-D material based superlattices.

Julien Barrier added "The findings are important, of course for fundamental studies in electron transport, but we believe that understanding quasiparticles in novel superlattice devices under high magnetic fields can lead to the development of new electronic devices."

The high mobility means that a transistor made from such a device could operate at higher frequencies, allowing a processor made out of this material to perform more calculations per unit of time, resulting in a faster computer. Applying a magnetic field would usually scale down the mobility and make such a device unusable for certain applications. The high mobilities of Brown-Zak fermions at high magnetic fields open a new perspective for electronic devices operating under extreme conditions.

More information: *Nature Communications* (2020). DOI: [10.1038/s41467-020-19604-0](https://doi.org/10.1038/s41467-020-19604-0)

Journal information: *Nature Communications*

<https://phys.org/news/2020-11-scientists-family-quasiparticles-graphene-based-materials.html>



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Common mutation may make Covid-19 more vulnerable to vaccine, says study

Their study, published in the journal Science, shows the D614G strain replicates faster, and is more transmissible than the virus, originating in China, that spread in the beginning of the pandemic

Washington: A common mutation in the novel coronavirus that has enabled it to spread quickly around the world may also make it more susceptible to a vaccine, according to a study that proves some of the first concrete findings about how SARS-CoV-2, which causes COVID-19, is evolving.

Researchers at the University of North Carolina at Chapel Hill and the University of Wisconsin-Madison in the US noted that the new strain of coronavirus, called D614G, emerged in Europe and has become the most common in the world.

Their study, published in the journal Science, shows the D614G strain replicates faster, and is more transmissible than the virus, originating in China, that spread in the beginning of the pandemic.

While the D614G strain spreads faster, in animal studies it was not associated with more severe disease, and the strain is slightly more sensitive to neutralisation by antibody drugs, the researchers said.

"The D614G virus outcompetes and outgrows the ancestral strain by about 10-fold and replicates extremely efficiently in primary nasal epithelial cells, which are a potentially important site for person-to-person transmission," said Ralph Baric, a professor at the UNC-Chapel Hill.

Researchers believe the D614G strain of coronavirus dominates because it increases the spike protein's ability to open cells for the virus to enter.

The D614G mutation causes a flap on the tip of one spike to pop open, allowing the virus to infect cells more efficiently but also creating a pathway to the virus' vulnerable core, the researchers said.

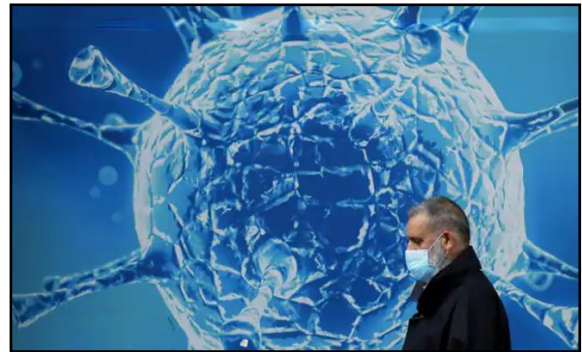
With one flap open, it's easier for antibodies -- like the ones in the vaccines currently being tested -- to infiltrate and disable the virus, they said.

"The original spike protein had a 'D' at this position, and it was replaced by a 'G,'" said Yoshihiro Kawaoka, a virologist at the University of Wisconsin-Madison.

"Several papers had already described that this mutation makes the protein more functional and more efficient at getting into cells," Yoshihiro Kawaoka said.

That earlier work, however, relied on a pseudotyped virus that included the receptor-binding protein but was not authentic, the researchers said.

Using reverse genetics, Ralph Baric's team replicated a matched pair of mutant SARS-CoV-2 viruses that encoded D or G at position 614 and compared basic property analysis using cell lines, primary human respiratory cells, and mouse and hamster cells.



A common mutation in COVID-19 makes it more susceptible to a vaccine, researchers say

The University of Wisconsin-Madison researchers performed replication and airborne transmission studies with both the original virus and the mutated version.

They found that the mutated virus not only replicates about 10 times faster -- it's also much more infectious.

Hamsters were inoculated with one virus or the other. The next day, eight uninfected hamsters were placed into cages next to infected hamsters.

There was a divider between them so they could not touch, but air could pass between the cages.

Researchers began looking for replication of the virus in the uninfected animals on day two. Both viruses passed between animals via airborne transmission, but the timing was different.

With the mutant virus, the researchers saw transmission to six out of eight hamsters within two days, and to all the hamsters by day four.

With the original virus, they saw no transmission on day two, though all of the exposed animals were infected by day four.

"We saw that the mutant virus transmits better airborne than the original virus, which may explain why this virus dominated in humans," Yoshihiro Kawaoka said.

The researchers also examined the pathology of the two coronavirus strains.

Once hamsters were infected, they presented essentially the same viral load and symptoms.

This suggests that while the mutant virus is much better at infecting hosts, it doesn't cause significantly worse illness, they said.

However, the researchers caution that the pathology results may not hold true in human studies. *(Except for the headline, this story has not been edited by NDTV staff and is published from a syndicated feed.)*

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