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THE ASIAN AGE

Wed, 20 Jan 2021

Tejas decision a good one, but much more left to do

*The first rollout is expected in 2023-24, and then on 16 aircraft
are to be manufactured every year on present reckoning*

In a historic decision, the Cabinet Committee on Security on January 13 approved the country's largest-ever indigenous defence deal when it cleared the procurement of 83 Light Combat Aircraft (LCA) Tejas Mk 1-A — ten of which are to be trainers — for the Indian armed forces from Hindustan Aeronautics Ltd at an approximate cost of Rs 47,000 crore, closing the circle that began with the commissioning of the LCA project in the 1980s.

The first rollout is expected in 2023-24, and then on 16 aircraft are to be manufactured every year on present reckoning. To start with, the indigenous content is to be 50 per cent, to be stepped up to 60 per cent within a short timeframe. HAL would be outsourcing the job to more than 550 domestic vendors.

This gives us an idea of the technological and economic spinoffs of the LCA programme for the Indian economy as a whole, going beyond the military aspect of acquiring a fighter jet at home which is billed as the workhorse of the future for the Indian Air Force, filling the gap left by the hoary MiG-21s of Soviet manufacture, which have been phased out.



If high-level efficiency is ensured in the production of the Tejas Mk 1-A by HAL, the country will make valuable savings of foreign exchange spent on importing costly fighter jets from Western sources. What's more, in time, the Tejas will be ready for export too. Some countries are said to have evinced an interest. The realisation of sale will, of course, depend on a host of political, strategic and economic considerations, and the prospect of readying the fighter for export will potentially add to India's strategic muscle and offer a certain latitude in dealing with the world.

The Tejas Mk1-A — a fourth-generation fighter — is a single-engine, lightweight, highly agile, all-weather, multi-role fighter aircraft capable of air-to-air refuelling. It has Beyond Visual Range (BVR) missile capability, and updated avionics and flight control software. The good news is that the LCA Mk-2 version with a bigger engine is in its design stage and is expected to be ready for trials next year. As of 2019, the IAF is committed to procuring 324 Tejas MK1-A fighters of different variants. That signifies the workhorse role visualised for this sophisticated fighter.

The domestic manufacture of the Tejas Mk 1-A is a signpost of enormous value, although it has been more than three decades in the making, starting from the conception stage when the Aircraft Development Agency (ADA) was set up in 1984. The ADA designed Tejas in collaboration with Aircraft Research and Design Centre (ARDC) of HAL.

To find true liberation from imports in the strategic sphere of fighter aircraft manufacture, it is now crucial to look at the propulsion aspect for upgrade. India's LCA is fitted with the GEF-404 engine. In the wake of the 1998 nuclear test, the United States had held up the supply of these engines. It is therefore important to return special focus to the development of the indigenous Kaveri engine, which has been in the works for decades.

To achieve cent per cent indigenous content, radars and avionics will also need to be manufactured domestically. Only a country that can grow its own food and has the ability to defend itself can ultimately avoid being at anyone's beck and call.

<https://www.asianage.com/opinion/edit/190121/tejas-decision-a-good-one-but-much-more-left-to-do.html>



The Sentinel
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Wed, 20 Jan 2021

CRPF's 'Rakshita' for insurgency-hit areas

From Monday onwards, 'Rakshita' — a bike ambulance developed indigenously — will save lives of injured CRPF

New Delhi: From Monday onwards, 'Rakshita' — a bike ambulance developed indigenously — will save lives of injured CRPF personnel deputed in remote and inhospitable areas like the Maoist-hit states or insurgency affected Northeast regions of the country.

Carefully custom built to the needs of emergency evacuation, 'Rakshita' is built on a Royal Enfield Classic 350CC bike.

It comes with a quick fit in and fit out casualty evacuation seat (CSE) that has customised design reclining, hand immobilizer and harness jacket, physiological parameter measuring equipment with monitoring capability and auto warning system for driver. Dashboard mounted LCD for measuring vital parameters, air splint medical and oxygen kit, saline and oxygen administration on the move, adjustable footrest, and hand and foot strap for safety are among the other features of 'Rakshita'.



These equipment make 'Rakshita' an on the spot medical care and injured transport system which is not just indigenous and cost effective, but can also reach inaccessible or remote locations by traversing unmotorable roads, narrow streets, congested or unpaved roads that are otherwise inaccessible by the conventional four wheeled ambulances, CRPF Deputy Inspector General M. Dhinakaran said.

The bike ambulance is developed by Defence Research and Development Organisation's (DRDO) Nuclear Medicine and Allied Sciences (INMAS) in collaboration with Central Reserve Police Force (CRPF) for golden-hour lifesaving aid and evacuation.

Similar 21 'Rakshita' bike ambulances were inducted into the CRPF — a 3.5 lakh strong force, on Monday. These bike ambulances were launched at the CRPF Headquarters here in presence of CRPF Director General A.P. Maheshwari and A.K. Singh, DS & DG (LS), DRDO.

Launched by the CRPF and INMAS, the bike ambulance will be used for evacuation of injured personnel of the Central Armed Police Force, which is mandated to ensure internal security in the country.

"Many times, late evacuation results in loss of precious lives of CRPF bravehearts. To mitigate this, in 2018 CRPF approached INMAS with the idea of developing an ambulance on motor bikes which is frequently used by CRPF for patrolling in these theaters," Dhinakar said. The official said INMAS promptly put up a team of scientists and experts to make the idea a reality. "The team developed a prototype and improved it with the feedback from CRPF personnel deployed in disturbed areas."

Director General CRPF expressed his gratitude to team INMAS for their unrelenting efforts put in developing the bike ambulance and commended their tireless dedication and professional efficiency.

While expressing his deepest gratitude to the DG CRPF for working together, giving regular inputs throughout the journey of the development of this life-saving bike and entrusting INMAS with this innovation, A.K. Singh promised to cooperate perpetually with CRPF for further improvements in 'Rakshita'. (IANS)

<https://www.sentinelassam.com/national-news/crpf-rakshita-for-insurgency-hit-areas-521325?infinitescroll=1>



Wed, 20 Jan 2021

DRDO-developed Rakshita bike ambulance handed over to CRPF | Know key features of this emergency vehicle

DRDO bike ambulance: In what could be a boon for the patients stuck in congested areas and remote locations, DRDO has developed a unique motor bike ambulance

Edited By Harish Dugh

DRDO bike ambulance: In what could be a boon for the patients stuck in congested areas and remote locations, DRDO has developed a unique motor bike ambulance. This bike ambulance is quicker, can access narrow passages and could be useful in evacuating patients from low intensity conflict areas.

The Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi-based DRDO laboratory, handed over Rakshita, a bike-based casualty transport emergency vehicle, to the Central Reserve Police Force (CRPF).

The unique ambulance was handed over to the CRPF in a ceremony held at CRPF HQ in New Delhi on Monday, January 18. DS & DG (LS), DRDO, Dr AK Singh handed over the model of Rakshita to DG CRPF, Dr AP Maheshwari, followed by the flagging off the contingent of 21 bikes on the occasion.



DRDO bike ambulance: The Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi-based DRDO laboratory, handed over Rakshita, a bike-based casualty transport emergency vehicle, to the CRPF. Source: PIB

Here are top features of 'Rakshita'

- The bike ambulance will help in overcoming the problems faced by Indian security forces and emergency healthcare providers. It will provide life-saving aid for evacuation of injured patients from low intensity conflict areas.
- This will be handy in congested streets and remote locations, where access through ambulance is difficult and time consuming. The bike can respond to a medical emergency need of patients faster than a four-wheeler due to its functionality and integrated emergency medical support system.
- Rakshita is fitted with a customized reclining Casualty Evacuation Seat (CES), which can be fitted in and taken out as per requirement.
- Other major features are the head immobilizer, safety harness jacket, hand and foot straps for safety, adjustable footrest, physiological parameter measuring equipment with wireless monitoring capability and auto warning system for driver. The vital parameters of the patient

can be monitored on the dashboard mounted LCD. It is also equipped with air splint, medical and oxygen kit for on spot medical care.

- This bike ambulance is useful not only for the paramilitary and military forces but has potential civil applications too.

Secretary DD R&D and Chairman DRDO Dr G Satheesh Reddy appreciated the efforts of scientists for this indigenous and cost-effective solution to a common challenge faced by our security forces.

<https://www.zeebiz.com/india/news-drdo-developed-rakshita-bike-ambulance-handed-over-to-crpf-know-key-features-of-this-emergency-vehicle-146385>



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Governor BD Mishra briefed on bio-toilets by DRL Scientist

*Scientist from the Defence Research Laboratory (DRL) in
Assam under Defence Research and Development Organization*

Itanagar: Scientist from the Defence Research Laboratory (DRL) in Assam under Defence Research and Development Organization (DRDO) Dr Soumya Chatterjee called on Arunachal Pradesh Governor Brig (retd) Dr B.D. Mishra at the Raj Bhavan here recently, and gave a PowerPoint presentation about the latest technologies developed by DRL in bio-toilets.

Dr Chatterjee briefed the Governor on the various types of bio-toilets developed by the DRL, suitable for various terrains, including high altitudes, hill areas and plain regions.

Dr Mishra appreciated the scientific achievement of the DRDO and suggested for construction of bio-toilets in Arunachal Pradesh. He reiterated that such a proactive role of DRDO would promote Prime Minister Narendra Modi's national cleanliness campaign of 'Swachh Bharat' Abhiyan.



The Governor, who has been one of the torch bearers in conducting and participating in cleanliness drives, emphasised on promoting bio-toilets for maintaining the pristine environment of the state, an official communiqué informed.

He said that without a proper toilet system, the sludge of toilets reaches the streams and rivers which results in water pollution and spread of diseases. The Governor requested the Tezpur-based DRL to launch a pilot programme by installing some bio-toilets in the extended complex near Lower Birup Colony here, so that other citizens in the state could also adopt such innovative projects. Vice Chancellor of Rajiv Gandhi University Prof. SaketKushwaha, who has been carrying out cleanliness campaigns in RGU campus was also present in the meeting, the communiqué added.

<https://www.sentinelassam.com/north-east-india-news/arunachal-news/governor-bd-mishra-briefed-on-bio-toilets-by-drl-scientist-521308?infinite-scroll=1>

IAF's R-Day Tableau: Look out for models of indigenous aircraft and missiles

There will be scaled-down models of Light Combat Aircraft 'Tejas'; Light Combat Helicopter, Sukhoi-30 MKI and the Rohini Radar

By Huma Siddiqui

Indian Air Force (IAF) during the Republic Day is going to display its Airpower on its tableau which is being fabricated on a 50 feet long platform. This, according to the official spokesperson Wing, Commander Indranil Nandi, will be consisting of a trailer which will be towed by a tractor. The motto 'Touch the Sky with Glory' will be displayed in the IAF colours.

What to look for on the tableau?

There will be scaled-down models of Light Combat Aircraft 'Tejas'; Light Combat Helicopter, Sukhoi-30 MKI and the Rohini Radar.

Also, there will be indigenously developed Rudram Next-Generation Anti Radiation Missile (NGRAM) and Dhuravastra. They will be displayed on LCA and LCH.

On the Sukhoi-30 MKI the indigenously developed Astra and BrahMos Missiles will be displayed and the indigenously developed Akash Missiles along with the Rohini Radar too.

More about the LCA 'Tejas'

It is a single engine, fourth generation, and a multirole light fighter aircraft. It has been designed by Aeronautical Development Agency (ADA) and Aircraft R&D Centre (ARDC) of state-owned Hindustan Aeronautics Limited (HAL) and is equipped with Air to Air Refuelling. It also has a New Generation Anti Radiation Missile (RUDRAM) this is the first indigenous anti-radiation missile of the country and has been developed for IAF.

This missile according to officials will be a potent weapon for IAF for Suppression of Enemy Air Defence (SEAD) effectively from large stand-off ranges.

More about LCH

This helicopter has the capability to operate in high altitude and is armed with Dhruvastra anti-tank guided missile. As has been reported earlier, with the help of 4 twin launchers around eight missiles can be attached to the helicopter. And in addition, this helicopter can be equipped with 20 mm turret guns and 70 mm rockets.

Rohini Radar

It is a Medium Range Surveillance Radar, and is used for Air Space Surveillance to detect and track air targets under hostile EW operational environment. And is deployed for early warning and also as a sensor for Akash SAM system.

Akash Missile

This is a medium-range mobile surface-to-air missile defence system. And has the capability to neutralise aerial targets like aircraft, helicopters and various other missiles. This missile is also in operational service in the Indian Army as well.

Countries from across the globe including UAE, Saudi Arabia, Kenya, Philippines, Indonesia, Bahrain, and Algeria have expressed interest in importing these Made in India missiles.



There will be scaled-down models of Light Combat Aircraft 'Tejas'; Light Combat Helicopter, Sukhoi-30 MKI and the Rohini Radar.

Astra Missile

This is also indigenously designed all-weather beyond-visual-range air-to-air missile. And it has the capability of engaging targets at varying ranges and altitudes.

<https://www.financialexpress.com/defence/iafs-r-day-tableau-look-out-for-models-of-indigenous-aircraft-and-missiles/2173905/lite/>

Defence News

Defence Strategic: National/International



Press Information Bureau
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Ministry of Defence

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Curtain Raiser: Indo-French Exercise Desert Knight-21

Indian Air Force and French Air and Space Force (*Armée de l'Air et de l'Espace*) will conduct a bilateral Air exercise, Ex Desert Knight-21 at Air Force Station Jodhpur from 20 to 24 Jan 21.

French side will participate with Rafale, Airbus A-330 Multi-Role Tanker Transport (MRTT), A-400M Tactical Transport aircraft and approximately 175 personnel. The Indian Air Force aircraft participating in the exercise will include Mirage 2000, Su-30 MKI, Rafale, IL-78 Flight Refuelling Aircraft, AWACS and AEW&C aircraft.

The exercise marks an important milestone in the series of engagements between the two Air forces. As part of Indo-French defence cooperation, Indian Air Force and French Air and Space Force have held six editions of Air Exercises named 'Garuda', the latest being in 2019 at Air Force Base Mont-de-Marsan, France. As measures to further the existing cooperation, the two forces have been gainfully utilising available opportunities to conduct 'hop-exercises'. The French Air and Space Force deployment while ferrying to Australia for Ex Pitchblack in 2018 was hosted by IAF at Air Force Stations Agra and Gwalior for exercise with fighters and MRTT aircraft. Presently, the French detachment for Ex Desert Knight-21 is deployed in Asia as part of their 'Skyros Deployment' and will ferry in forces to Air Force Station Jodhpur.

The exercise is unique as it includes fielding of Rafale aircraft by both sides and is indicative of the growing interaction between the two premier Air Forces. As the two detachments commence their air exchange from 20 Jan onwards, they will put into practice operational experience gained across terrains and spectrums and endeavour to exchange ideas and best practices to enhance interoperability.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1689893>



पत्र सूचना कार्यालय
भारत सरकार
रक्षा मंत्रालय

Tue, 19 Jan 2021 11:22AM

भारत - फ्रांस वायुसैनिक अभ्यास डेजर्ट नाइट -21

भारतीय वायु सेना और फ्रांसीसी वायु एवं अंतरिक्ष सेना (आर्मी डी डे'एर एट डी'स्पेस) 20 से 24 जनवरी, 2021 तक जोधपुर के वायु सेना स्टेशन पर आयोजित एक द्विपक्षीय वायु अभ्यास एक्स डेजर्ट नाइट-21 में हिस्सा लेंगी। जिसमें दोनों देशों के लड़ाकू विमान शामिल होंगे।

फ्रांस की तरफ से राफाल, एयरबस ए-330 मल्टी-रोल टैंकर ट्रांसपोर्ट (एमआरटीटी), ए-400एम सामरिक परिवहन विमान और लगभग 175 वायुसैनिक इस अभ्यास में भाग लेंगे। वहीं भारत की ओर से हिस्सा लेने वाले वायु सेना के विमानों में मिराज 2000, सु -30 एमकेआई, राफाल, आईएल -78 फ्लाइट के दौरान ईंधन भरने वाले विमान, एडब्ल्यूएसीएस तथा आईडब्ल्यू एंड सी विमान शामिल होंगे।

यह सैन्य अभ्यास दोनों वायु सेनाओं के बीच सहयोग की दिशा में एक महत्वपूर्ण मील का पत्थर है। भारत और फ्रांस के बीच रक्षा सहयोग के हिस्से के रूप में, भारतीय वायु सेना और फ्रांसीसी एवं अंतरिक्ष सेना ने मिलकर 'गरुड़' नाम के वायुसैनिक अभ्यास के छह संस्करणों का आयोजन किया है। आखिरी 'गरुड़' अभ्यास जुलाई 2019 में फ्रांस के मॉंट-द-मारसन एयरबेस में आयोजित किया गया था।

आपस में मौजूदा सैन्य सहयोग को और आगे बढ़ाने के उद्देश्य से दोनों देशों की सेनाओं ने 'होप-एक्सरसाइज' के संचालन के लिए उपलब्ध अवसरों का लाभकारी रूप से उपयोग किया है। 2018 में पिचब्लैक अभ्यास के लिए ऑस्ट्रेलिया की उड़ान भरते समय फ्रांसीसी वायु एवं अंतरिक्ष सेना की तैनाती आगरा और ग्वालियर वायुसेना स्टेशनों में लड़ाकू विमानों और एमआरटीटी विमानों के साथ अभ्यास के लिए की गई थी। मौजूदा समय में डेजर्ट नाइट -21 अभ्यास के लिए फ्रांसीसी टुकड़ी एशिया में अपने 'स्काईरोस डिप्लॉयमेंट' के हिस्से के रूप में तैनात है और जोधपुर वायु सेना स्टेशन में उड़ान भरेगी।

यह अभ्यास अपने आप में महत्वपूर्ण है क्योंकि इसमें राफेल विमान दोनों ही देशों की वायु सेनाओं में शामिल है और यह दो प्रमुख वायु सेनाओं के बीच बढ़ते हुए सहयोग का संकेत है। चूंकि दोनों वायु सेनाओं की टुकड़ियों के बीच 20 जनवरी से हवाई अभ्यास सहयोग शुरू होना है, इसलिए इलाकों और कालांतर में प्राप्त परिचालन अनुभव को ध्यान में रखा जाएगा तथा परस्पर व्यवहार को बढ़ाने के लिए विचारों एवं सर्वोत्तम प्रक्रियाओं का आदान-प्रदान करने का प्रयास भी होगा।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1690040>

IAF to deploy Rafale, Sukhoi, Mirage 2000 jets in exercise with French air force

New Delhi: The Indian Air Force will deploy its Rafale, Sukhoi and Mirage 2000 combat jets besides other key assets in a five-day mega air exercise with French air and space force that begins near Jodhpur on Wednesday.

The Indian Air Force (IAF) said its deployment at the "Ex-Desert Knight 21" will also include IL-78 flight refuelling aircraft as well as airborne warning and control system (AWACS).

"The French side will participate with Rafale, Airbus A-330 Multi-Role Tanker Transport (MRTT), A-400M Tactical Transport aircraft," it said, adding around 175 French personnel will be part of the exercise.

The IAF deployment in the exercise will include Mirage 2000, Su-30 MKI, Rafale, IL-78 flight refuelling aircraft and the AWACS.

The drill is taking place at a time the IAF has been keeping all its frontline bases across the country in a high state of operational readiness in view of the Sino-India border row in eastern Ladakh.

"The exercise is unique as it includes fielding of Rafale aircraft by both sides and is indicative of the growing interaction between the two premier air forces," the IAF said in a statement.

"As the two detachments commence their air exchange from January 20 onwards, they will put into practice operational experience gained across terrains and spectrums and endeavour to exchange ideas and best practices to enhance interoperability" it said.

The French and Indian air forces have been conducting "Garuda" exercises for the last several years as part of efforts to boost operational cooperation. So far, six editions of "Garuda" have taken place with the last one being held in 2019 at Mont-de-Marsan in France.

"As measures to further the existing cooperation, the two forces have been gainfully utilising available opportunities to conduct "hop-exercises"... Presently, the French detachment for Ex-Desert Knight-21 is deployed in Asia as part of their "Skyros Deployment" and will ferry in forces to air force station Jodhpur," the IAF said.

In a boost to its strike capability, the IAF received the first batch of five Rafale jets in July last year, nearly four years after the government inked an agreement with France to procure 36 of the aircraft at a cost of Rs 59,000 crore. A second batch of three Rafale fighter jets joined the IAF in November.

The Rafale jets, manufactured by French aerospace major Dassault Aviation, are India's first major acquisition of fighter planes in 23 years after the Sukhoi jets were imported from Russia.

The newly inducted fleet has been carrying out sorties in eastern Ladakh. PTI MPB NSD

Disclaimer: This story has not been edited by Outlook staff and is auto-generated from news agency feeds.

Source: PTI

<https://www.outlookindia.com/newscroll/iaf-to-deploy-rafale-sukhoi-mirage-2000-jets-in-exercise-with-french-air-force/2013365>

Indian Army Shows Off Drone Swarm of Mass Destruction

By David Hambling

At a live demonstration for India's Army Day last week, the Indian military showed off a swarm of 75 drones destroying a variety of simulated targets in explosive kamikaze attacks for the first time. The commentary accompanying the demonstration claimed that the swarm is capable of autonomous operation. You can see a video of the event here. While the swarm's exact capabilities are not clear, the event is a clear indication of how the technology is developing — and proliferating.

The 75-drone swarm shows the current state of the art, but India's goal is a 1,000-drone swarm. Swarms of small drones have the potential to overwhelm air defenses, and their low cost means they can be deployed in far greater numbers than existing systems. While massed drones in spectacular lightshows are all controlled centrally, in a true swarm each of the drones flies itself, following a simple set of rules to maintain formation and avoid collisions with algorithms derived from flocking birds. A thousand-drone swarm could hit a vast number of targets — enough for analyst Zak Kallenborn — Research Affiliate at the Unconventional Weapons and Technology Division at the National Consortium for the Study of Terrorism and Responses to Terrorism (START) — to argue that it would constitute a weapon of mass destruction.



The Indian Army drone swarm demonstration included 75 unmanned vehicles of three different types PTI VIA TWITTER

In the demonstration, scout drones investigated the targets, then mothership drones released explosive-laden kamikaze units which carried out the attacks. Kallenborn noted several significant features of the demonstration.

“The Indian Army appears to be using three types of UAV: a quadcopter probably for sensing, a six-rotor mothership drone, and the small quadcopters with explosives on them,” Kallenborn told me. “National security discourse in the United States around drones often emphasizes a large homogenous swarm, but India's work shows this is a mistake.”

So far U.S. efforts — like the Perdix demonstration of a swarm of 103 air-launched drones, and DARPA's Gremlins swarm — have all used drone of a single type. A mix of drones with heavyweight carriers, reusable scouts with advanced sensors and expendable attack drones may be more flexible and capable. Kallenborn also notes that the claim of an autonomous swarm is plausible, but it is not clear how much of this has been achieved so far.

“The question in my mind is how sophisticated the autonomous capabilities are,” says Kallenborn. “The announcer notes in the beginning the drones are programmed to carry out these attacks. What's not clear is how well the system would function in actual combat environment where the drones will need to adapt to rapid changes, a complex environment, and mobile targets. Notably, the targets used in the demonstration were all stationary.”

While new technologies and in particular AI and edge computing will drive drone swarms, the key element is the swarming software. This has developed rapidly recently and is proliferating; IAI now offer a drone swarm package for commercial users allowing multiple drones to be controlled from a smartphone app.

“The most critical aspect is academic: how do you design algorithms to manage the increasing complexity of the swarm? In terms of both more drones and different types of drone,” says Kallenborn. “The challenge with drone swarms comes from how the drones communicate and coordinate their actions, which is primarily a programming problem.”

India has been collaborating with the U.S. to develop swarming drones since 2018 under the Defence Technology Trade Initiative, although few details have been released.

According to the commentary, the drone swarm is capable of attacking targets from a range of 50 kilometers. In addition to reconnaissance and attack, Indian drone swarms will also be able to carry out resupply missions, with a 75-drone swarm delivering over 1,200 pounds of supplies to troops in the battle zone.

India is also developing drone swarms that can be deployed from fast jets. A Jaguar strike aircraft will carry four pods each containing each of the Air-Launched Flexible Asset (Swarm) or ALFA-S drones, which are capable of attacking air defenses. This project was fast-tracked last year in response to China’s deployment for surface-to-air missiles across the Ladakh border.

India is not the only country pursuing attack swarms. Last year China showed off a truck-mounted ‘barrage swarm launcher’ capable of putting 48 attack drones into the air, and the Turkish military took delivery of 500 Kargu kamikaze drones claimed to have swarming capability.

“Proliferation of basic swarming technology is inevitable,” warns Kallenborn. “The likelihood of U.S. forces encountering swarms is 100%. The question is not if, but when and where.”

Exactly how well the American military can deal with drone attacks is open to question. A new Pentagon strategy paper on counter-drone defense warns that previous hurried efforts have resulted in a patchwork of incompatible weapons and sensors and that a co-ordinated approach is needed. The paper highlights drone swarms as a particular challenge for defenses.

The Indian demonstration was a staged event and not an operational capability. But carrying out any sort of technology demonstration in front of a live audience is a risky business (especially with armed drones), and the fact that the Indian Army was confident enough to show off their swarm suggests it may not be long before such drones are used in action. First use may quite possibly in the border conflict with Pakistan. And, as elsewhere, they may prove to be a game changer.

(The Author is a South London-based technology journalist, consultant and author)

<https://www.forbes.com/sites/davidhambling/2021/01/19/indian-army-shows-off-drone-swarm-of-mass-destruction/?sh=7b02f6d22384>

S-400 air defence systems: Indian team to leave for Russia soon for training

- *Around 100 Indian military personnel are leaving for Russia this month for the S-400 training programme, officials said*
- *Russia is expected to start delivery of the S-400 missile systems later this year.*

New Delhi: A group of Indian military personnel is leaving for Russia in the next few days to undergo training on key operational aspects of the S-400 air defence systems as Moscow looks at supplying the first batch of the missile to India later this year, officials said on Tuesday.

Russian Ambassador Nikolay R Kudashev interacted with the group at an event in the Russian embassy on Tuesday during which he said the S-400 programme is one of the flagship projects in further boosting military cooperation between the two countries.

He said Indo-Russia military and military-technical ties were based on "ever growing extraordinary mutual interest", coherence, consistency and complementarity.

In October 2018, India had signed a \$5 billion deal with Russia to buy five units of the S-400 air defence missile systems, notwithstanding a warning from the Trump administration that going ahead with the contract may invite US sanctions.

India made the first tranche of payment of around \$800 million to Russia for the missile systems in 2019. The S-400 is known as Russia's most advanced long-range surface-to-air missile defence system.

Recently, the US imposed sanctions on Turkey under the Countering America's Adversaries Through Sanctions Act (CAATSA) for purchase of S-400 missile defences from Russia.

Around 100 Indian military personnel are leaving for Russia this month for the S-400 training programme, officials said.

Kudashev said military cooperation has been the main pillar of the special and privileged strategic partnership between the two countries and that the overall Indo-Russia friendship has become an important factor of stability in the region and the globe, according to a Russian embassy release.

"It is based on mutual trust and reflects the true spirit of our bilateral and multilateral commitments in the framework of our vision towards just and equal relations based on the international law and the UN Charter," he said.

"Coming out of the bipolar world and successfully proceeding through the current establishment of the polycentric order, our partnership is becoming even stronger, experiencing new areas and forms of mutually beneficial and forward-looking cooperation," the ambassador said.

Russia is expected to start delivery of the S-400 missile systems later this year.

Along with S-400 systems project, Kudashev said both sides are successfully moving towards implementation of AK-203 Kalashnikovs contract, the Ka-226 helicopters programme as well as cooperation in the areas of combat aviation including the Su-30MKI project.

He said both sides are also moving forward in several other projects like the main battle tanks (T-90), frigates, submarines and missiles and joint production of "unique Brahmos".

In October 2016, India and Russia had finalised a broad agreement to set up a joint venture between Hindustan Aeronautics Ltd (HAL) and two Russian defence majors for procuring 200 Kamov Ka-226T choppers for Indian armed forces.



In Oct 2018, India had signed a \$5 billion deal with Russia to buy five units of the S-400 air defence missile systems (Photo: Reuters)

According to the understanding, 60 Kamov-226T helicopters will be supplied to India in fly-away condition, while 140 will be manufactured in India. Russia had agreed to ensure transfer of technologies to India as part of the pact.

India and Russia finalised the deal for manufacturing AK-203 rifles during Defence Minister Rajnath Singh's visit to Moscow last year. More than 700,000 rifles are to be produced at an Indo-Russian joint production facility in India.

"Looking forward to an early implementation of the spare parts joint production agreement, which also fits well in Make in India and Atmanirbhar Bharat (self-reliant India) programmes. Work also is going on the mutual logistics support agreement, strengthening maritime cooperation, including in the Indian Ocean," the Russian ambassador said.

He said Russia intends to be one of the biggest exhibitors at the Aero-India in Bengaluru in February.

"We plan to demonstrate Su-57, Su-35 and MiG-35 fighter jets, helicopters Ka-52, Ka-226, Mi-17B-5, Mi-26 as well S-400 systems and many other new items and equipment," he said.

<https://www.livemint.com/news/india/s400-air-defence-systems-indian-team-to-leave-for-russia-soon-for-training-11611054529797.html>



Wed, 20 Jan 2021

China's PLA may ramp up military activity in Ladakh in 2 months

India does hope that the incoming Biden administration will stand by its commitments on China, South China Sea, Taiwan or Indo-Pacific at large but New Delhi is not dependent on the US for handling the PLA on land frontiers

By Shishir Gupta

With Indian Army and People's Liberation Army (PLA) frozen in their positions in East Ladakh sector's polar winter, national security planners expect China to ramp up military activity at the friction points when the snows melt in late March. There has been no withdrawal of any PLA troops from the contested points and China has used the stand-off to build advanced landing grounds across the Daulet Beg Oldi sector in Tianwendian, humongous shelters to house personnel and a shorter link from Hotan airbase to Karakoram pass. "There could be military pressure north of Depsang bulge," said a senior commander.

According to people familiar with the matter, the dates of the ninth round of military talks are expected to be decided soon to top the good progress made by both sides in disengagement and de-escalation plan. This view is in sharp contrast to the view within a section of the government, who believe that the PLA is in no mood to move out of the contested points at least till paramount leader Xi Jinping delivers his address to the celebrations to mark 100 years of Chinese Communist Party's rule. "This is the unfortunate record," said a senior official.



Many Indian officials believe that China's will not move out of the contested points in East Ladakh sector till President Xi Jinping delivers his address to mark 100 years of Communist Party of China (AFP)

While the Indian Army is prepared to sit out in East Ladakh for as long as it takes, the Chinese moves may also be influenced by the tone and tenor of the incoming Joe Biden administration towards Beijing. Although many believe that the incoming US administration could strike a

balance by its de facto recognition of China as the other superpower, this new G-2 factor will hurt former superpowers like Russia.

India, on its part, believes that it is a multi-polar world and New Delhi is not dependent (much to the chagrin of western strategists) on Washington to deal with China to protect its frontiers. And hence, the strategy of Atmanirbhar Bharat in developing indigenous technologies in areas of drones, fighter aircraft and stand-off weapons with the involvement of the public and private sector. The onus lies on DRDO and HAL to roll-out the Tejas Mark I A on April 1, 2024, along with a prototype of the twin-engine indigenous fighter or AMCA as the government has shot down Mark II project.

According to senior officials familiar with the national security deliberations, India does hope that the incoming Biden administration will stand by its commitments on China, South China Sea, Taiwan or Indo-Pacific at large but New Delhi is not dependent on the US for handling the PLA. The fact is that the US has indeed increased Indian awareness of the Indo-Pacific by providing access to information, the same cannot be said about the Ladakh stand-off. This approach is contrary to China's perception that sees India through the prism of the US and as an adversary.

With PLA ramping up border infrastructure all along the 3,488 kilometre Line of Actual Control (LAC), India is alive to the distinct possibility that China could open up fronts in Arunachal Pradesh and around the Sikkim-Bhutan-India tri-junction area. However, after the Galwan flare-up on June 15 and significant casualties on the PLA side, China will engage India with stand-off weapons and not repeat the mistake of engaging Indian Army in hand-to-hand combat in a worst-case scenario.

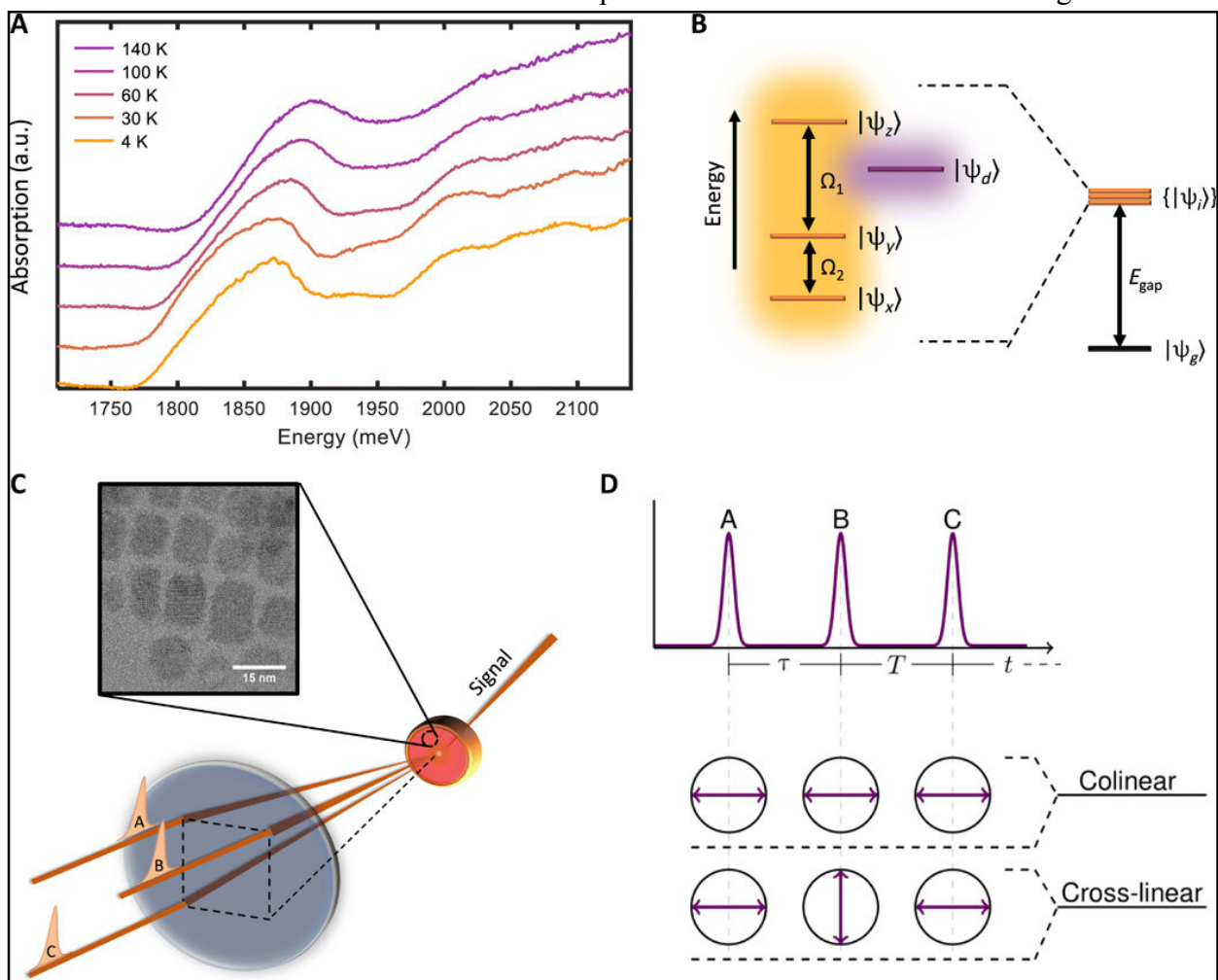
But there is a downside to such an engagement and China is acutely aware of it. Much as China would like to teach a lesson to Indian Army as its state media often warns, Beijing is well aware that the political leadership under Prime Minister Narendra Modi has the capacity to retaliate like it did on 29-30 August 2020 on the south bank of Pangong Tso. For a country that sees itself as a contender to the superpower slot now occupied by the US, any military loss of face to India will take the wind out of that claim.

<https://www.hindustantimes.com/india-news/india-preps-for-fresh-chinese-military-activity-in-east-ladakh-from-march-101611038975489.html>

Multidimensional coherent spectroscopy reveals triplet state coherences in cesium lead-halide perovskite nanocrystals

By Thamarasee Jeewandara

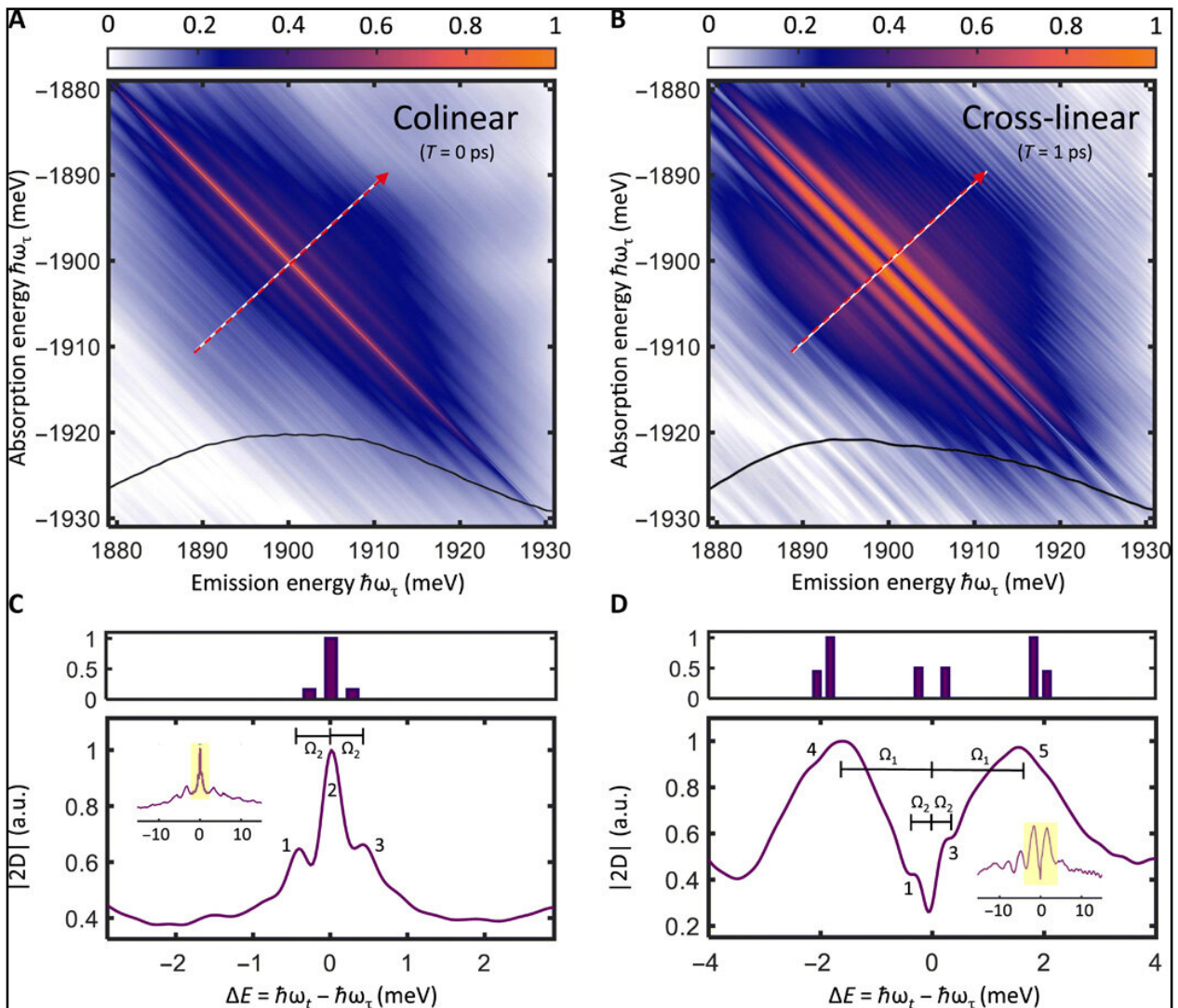
Advanced optoelectronics require materials with newly engineered characteristics. Examples include a class of materials named metal-halide perovskites that have tremendous significance to



CsPbI₃ perovskite NCs studied via MDCS. (A) Perovskite NC absorption spectra as a function of temperature. (B) Energy level diagram of the nondegenerate bright triplet states $\{|\Psi_i\rangle = x, y, z\}$ that comprise the band-edge transitions to and from $|\Psi_g\rangle$. The dark singlet state $|\Psi_d\rangle$ is shown to lie between states $|\Psi_y\rangle$ and $|\Psi_z\rangle$. (C) Schematic of the MDCS experiment. Three pulses {A,B,C} are focused onto the sample with varying time delays. Inset shows a transmission electron micrograph of representative CsPbI₃ NCs. (D) Excitation pulse sequence and excitation polarization schemes used to acquire one-quantum and zero-quantum spectra, in which double-sided arrows in circles denote the polarization of each pulse. Pulses A and C are horizontally polarized, and pulse B is either horizontally or vertically polarized, which corresponds to an emitted signal of either horizontal or vertical polarization respectively. a.u., arbitrary units. Credit: Science Advances, doi: 10.1126/sciadv.abb3594

form perovskite solar cells with photovoltaic efficiencies. Recent advances have also applied perovskite nanocrystals in light-emitting devices. The unusually efficient light emission of cesium lead-halide perovskite may be due to a unique excitonic fine structure made of three bright triplet states that minimally interact with a proximal dark singlet state. Excitons are electronic excitations responsible for the emissive properties of nanostructured semiconductors, where the lowest-energy excitonic state is expected to be long lived and hence poorly emitting (or 'dark').

In a new report now published in *Science Advances*, Albert Liu and a team of scientists in physics and chemistry at the University of Michigan, U.S., and Campinas State University, Brazil, used multidimensional coherent spectroscopy at cryogenic (ultra-cold) temperatures to study the fine structure without isolating the cube-shaped single nanocrystals. The work revealed coherences (wave properties relative to space and time) involving the triplet states of a cesium lead-iodide (CsPbI_3) nanocrystal ensemble. Based on the measurements of triplet and inter-triplet coherences, the team obtained a unique exciton fine structure level ordering composed of a dark state, energetically positioned within the bright triplet manifold.

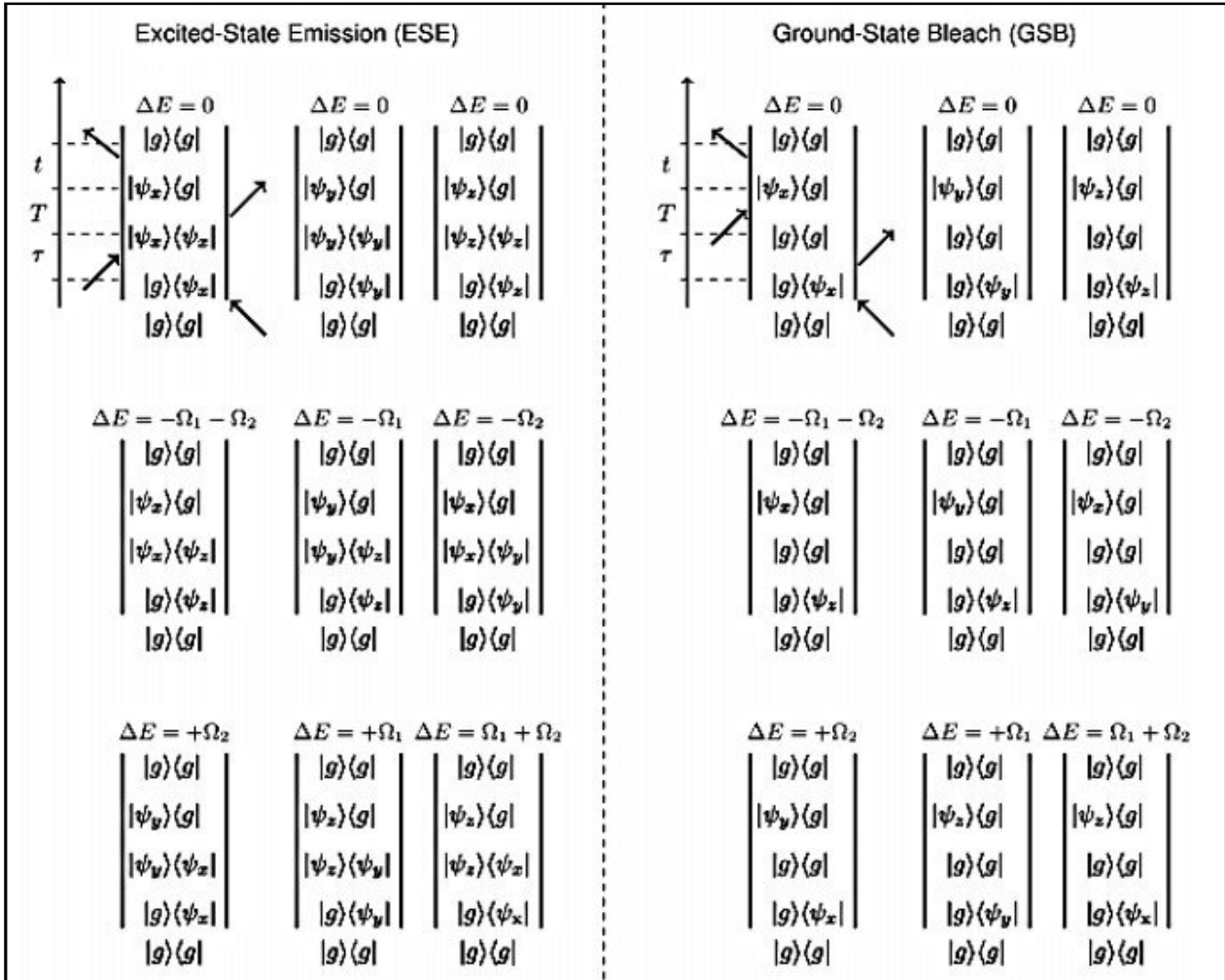


Optical triplet coherences in one-quantum spectra. (A and B) Magnitude one-quantum spectrum at 4.6 K with (A) colinear and (B) cross-linear excitation. The white/red dashed arrows and solid black lines indicate the cross-slice locations and laser pulse spectra, respectively. (C and D) Bottom plots show normalized cross-slices centered at $|\hbar\omega_e| = |\hbar\omega_a| = 1900$ meV of the (C) colinear and (D) cross-linear excitation one-quantum spectrum. Top plots show theoretically calculated relative peak strengths in the NC reference frame (see the Supplementary Materials). Numbers label peaks arising from electronic interband coherences and populations. Credit: *Science Advances*, doi: 10.1126/sciadv.abb3594

Constructing an ensemble of cesium lead-halide nanocrystals

In this work, Liu et al. extracted crucial figures of information processing to construct an ensemble of cesium lead-iodide nanocrystals (CsPbI_3) at cryogenic temperatures. The first

synthetic cesium lead-halide perovskites were developed more than a century ago with a general chemical formula of CsPbX_3 (where X= chlorine—Cl, bromine—Br, or Iodine—I) and a recent production formed CsPbX_3 nanocrystals that combined the advantages of perovskites with those of colloidal nanocrystal materials. The perovskite nanocrystals exhibited luminescence with quantum yield to reach nearly unity in contrast to chalcogenide nanocrystals with a gradient shell.



Double-sided Feynman diagrams of quantum pathways. Double-sided Feynman diagrams representing accessible quantum pathways in perovskite nanocrystals. Nine ESE and GSB diagrams each are possible, which involve an intermediate excited-state population/coherence and ground-state population respectively. The peak position of each diagram in one-quantum spectra is labeled above. Credit: Science Advances, doi: 10.1126/sciadv.abb3594

The unusual brightness of perovskite nanocrystals originated from an optically active, non-degenerate triplet state that emits efficiently despite the presence of a dark singlet state. The unique exciton fine structures of perovskite nanocrystals improved the potential of colloidal nanocrystals for quantum information processing applications. However, researchers require intimate knowledge of the coherent dynamics in perovskite nanocrystals to engineer the exciton superposition states as information carriers, which were not well understood. Liu et al. therefore used multidimensional coherent spectroscopy to measure the triplet state excitons and presented evidence for a mixed bright-dark level ordering, which rendered the triplet state excitons to only be partially bright. The team then used perovskite nanocrystals as a potential material platform for quantum applications through bottom-up engineering methods.

Triplet state quantum pathways and Feynman diagrams

To conduct multidimensional coherent spectroscopy, the team used a multidimensional optical nonlinear spectrometer that focused three laser pulses on to the perovskite nanocrystal ensemble as a function of three different time delays (τ , T , and t). During the experiments, the scientists Fourier transformed the emitted four-wave mixing signal as a function of two or all three of the time delays in a multidimensional spectrum. They commonly referred to the resulting sequences of light-matter

interactions as quantum pathways. The team conceptually represented the quantum pathways using double-sided Feynman diagrams. The diagrams contained vertically arranged sequences of density matrix elements that began with an initial ground state population where time advanced upward, with changes introduced in the density matrix by interactions with each excitation pulse. They noted three types of quantum pathways defined as "excited-state emission" (ESE), "ground-state bleach" (GSB) and "excited-state absorption" (ESA), and only considered ESE and GSB pathways during this work.

Fourier transforming studies had previously revealed new electronic properties of various perovskite materials. In order to experimentally probe different quantum pathways, the team chose the polarization of the second laser pulse in the setup to either align parallelly or orthogonally to the collinear polarization of the two other pulses. They obtained a single-quantum spectrum at a temperature of 4.6 K with colinear and cross-linear excitation. The spectra revealed numerous peaks elongated in the diagonal direction to reflect inhomogeneous spectral broadening. To explain the peak structure for both excitation polarization schemes, Liu et al. theoretically calculated the relative peak strengths for the varying dipole matrix elements and vector orientations of each triplet state transition and drew important conclusions from the calculations. Compared to the integrated four-wave mixing techniques, one-quantum spectra was particularly useful in this work.

Terahertz inter-triplet coherences in zero-quantum spectra

Liu et al. next showed many of the quantum pathways to generate sidebands relative to inter-triplet coherences, i.e., quantum coherences between triplet states that are not necessarily dipole-coupled. The inter-triplet coherence time defined the time scale within which the involved superposition states could be coherently manipulated in the experimental setup, which was of practical importance. To directly measure and characterize these coherences, the team used zero-quantum spectra at varying time delays and temperatures ($\tau = 0$ and 20 K). For cross-linear excitation, the researchers isolated the inter-triplet coherence pathways by passing the measured four-wave mixing signal through a vertical polarizer to plot a resulting cross-linear, zero-quantum spectrum at 20 K. The inter-triplet coherences were robust against thermal dephasing (up to 40 K) and the work also showed the electronic nature of the four-wave mixing signal.

In this way, Albert Liu and colleagues measured and characterized the optical frequency triplet coherences and inter-triplet coherences in perovskite lattices. The results were significantly different from those previously reported for other lead-halide nanocrystals. It appears that even a slight change in a single constituent atom of the perovskite lattice could drastically alter the interactions that determined the fine structural-level ordering, which warrants further investigation. The team experimentally and theoretically presented evidence of an exciton band edge whose emission is partially quenched by an intermediate dark state to contribute important insight to the exciton ground states in a variety of perovskite nanocrystals with potential applications for quantum information processing.

More information: Liu A. et al. Multidimensional coherent spectroscopy reveals triplet state coherences in cesium lead-halide perovskite nanocrystals, *Science Advances*, 10.1126/sciadv.abb3594

Becker M. A. et al. Bright triplet excitons in caesium lead halide perovskites. *Nature*, doi.org/10.1038/nature25147

Tamarat P. et al. The ground exciton state of formamidinium lead bromide perovskite nanocrystals is a singlet dark state. *Nature Materials*, doi.org/10.1038/s41563-019-0364-x

Journal information: [Science Advances](https://www.science.org) , [Nature](https://www.nature.com) , [Nature Materials](https://www.nature.com)
<https://phys.org/news/2021-01-multidimensional-coherent-spectroscopy-reveals-triplet.html>

A realistic model of the ITER tokamak magnetic fusion device

By Ingrid Fadelli

Tokamaks, devices that use magnetic fields to confine plasma into torus-shaped chamber, could play a crucial role in the development of highly performing nuclear fusion reactors. The ITER tokamak, which is set to be the largest nuclear tokamak in the world, is particularly likely to shape the way in which nuclear reactors will be fabricated in the future.

ITER is a highly complex technology that uses entirely new strategies, which means that those building it are confronting challenges that have never been faced before. To facilitate the design and operation of the ITER tokamak, scientists worldwide have been conducting what are known as nuclear analyses, which are aimed at theoretically examining its outcomes and potential.

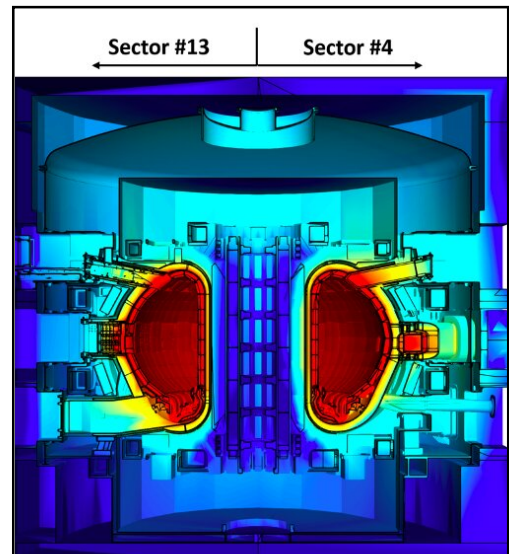
So far, nuclear analyses based on data gathered by the ITER reactor have relied on detailed but partial models that only represent specific parts of the tokamak. However, these models present limitations and unquantified uncertainties that become evident as the design of the machine advances. Those related to its safety and operation are of particular relevance.

With this in mind, researchers at Universidad Nacional de Educación a Distancia (UNED) have recently developed E-lite, a detailed and realistic Monte Carlo N-particle transport (MCNP) model of the ITER tokamak. This model, presented in a paper published in *Nature Energy*, has the potential to dramatically improve the reliability and precision of nuclear analyses assessing this magnetic fusion device.

"Due to the computational limitations of a couple of decades ago, the ITER neutronics community worldwide, including ourselves (the TECF3IR research team at UNED), have so far been working using partial models of the ITER tokamak," Rafael Juarez, one of the researchers who carried out the study, told Phys.org. "Since then, however, computer power has evolved significantly. Furthermore, in recent years, the computational codes that we use have undergone advances as well, some of them enabled by TECF3IR."

The development of more advanced computers and more sophisticated codes has ultimately enabled the creation of increasingly realistic and complex tokamak models. Over the past few years, therefore, researchers worldwide have introduced a number of new partial models to be used for nuclear analysis. Alternatively, simplified models of the full machine were considered, as well, depending on the application. Nonetheless, none of these models captured a full, detailed representation of the machine, which engineers desired to ascertain the safety and operation quality of reactors with high levels of confidence.

"By September 2018, at UNED, we were working on improvements for few partial models in collaboration with ITER Organization and Fusion for Energy and we connected the dots: We realized that we were already in the position to change the approach, rather than improving it," Juarez said. "I would say it was an accumulation of evidence over the years that somebody just needed to link, in order to realize the implications of the tremendous advances made by the whole



Credit: ITER Organization.

community over the past years. This inspired us to create a full model of the ITER for nuclear analysis. We tried it, and it worked."

The MCNP model devised by the researchers is largely inspired by previous partial models, including the so-called C-model. Partial models were conceived to be unkept and tailored by users for specific applications. The new model is arranged in a block structure, with modular parts representing specific components of the ITER tokamak. To develop it, the researchers unfolded the block structure of the previously devised C-model in seven instances, covering 280 degrees of the tokamak, then added a detailed representation of the remaining 80 degrees, which contained the tokamak's neutral beam injectors. Subsequently, they adjusted and revised the model to ensure that it also accounted for some of the machine's asymmetries.

"The blocks were filled with the latest available MCNP representation of specific components of the machine," Juarez said. "Representations of symmetric components, like diverter cassettes, were repeated, while the rest, like diagnostics port plugs, appears in single instances. In general, we can say that E-lite is largely a mosaic of models properly ordered and keeping the philosophy of its predecessors to stand as a maintainable and tunable model."

The key difference between the model devised by Juarez and his colleagues and previous ITER tokamak models is that it does not need boundary conditions to represent the entire device. On the other hand, the new model captures the full geometry of the device, including the asymmetries that shape the radiation fields. Previous models did not account for these asymmetries, which was a source of uncertainty and led to unreliable results.

"Uncertainties in nuclear responses of the ITER Tokamak associated to the use of partial models can now be estimated," Juarez said. "Alternatively, nuclear analysis can be conducted directly in E-lite to avoid this uncertainty. This affects every quantity in general to a different degree, some of them as relevant as the nuclear heat of the superconducting coils, the shutdown dose rate for in-situ maintenance or calibration of the radiation detectors that will measure the plasma power."

Juarez and his colleagues proved that creating a full, heterogeneous MCNP model of the ITER tokamak is now computationally viable. In addition, they showed that such a model would be significantly more reliable and accurate than existing partial models.

The model could soon be used to conduct nuclear analyses, allowing researchers to evaluate the possible safety and reliability of reactors with greater certainty. In addition, this recent study could inspire other research teams worldwide to devise MCNP models of other complex nuclear systems.

"At TECF3IR we have two lines of work, the first of which is related to improving the methods and tools used for nuclear analysis," Juarez said. "We are currently working on a tool to translate from CAD to MCNP (GEO-UNED) and new variance reduction techniques to accelerate the determination of shutdown dose rates in the Monte Carlo approach. We are also working on new and more accurate methods to determine the time evolution of radioactive inventory of fluids subjected to irradiation, of relevance in dozens of applications."

In addition to devising better tools for nuclear analysis-related research, the researchers are currently conducting highly precise nuclear analyses for nuclear facilities worldwide. They thus plan to continue collaborating with the ITER organization, as well as other teams working on nuclear technology worldwide.

"We are also working on diverse projects under the umbrella of the EUROfusion consortium: (i) the IFMIF-DONES facility, a special particles accelerator for fusion-related research, with a long-lasting collaboration of high relevance for us, (ii) JET (Joint European Torus) the most powerful nuclear Tokamak in operation nowadays, with unique activities such as the experimental validation of codes in fusion environments, (iii) the design of the future European reactor DEMO, in which of course, we plan to continue to be involved," Juarez added.

More information: A full and heterogeneous model of the ITER tokamak for comprehensive nuclear analyses. *Nature Energy* (2021). DOI: [10.1038/s41560-020-00753-x](https://doi.org/10.1038/s41560-020-00753-x).

Journal information: *Nature Energy*
<https://phys.org/news/2021-01-realistic-iter-tokamak-magnetic-fusion.html>

Clocking electron movements inside an atom

By Jenny Witt

Hard X-ray free-electron lasers (XFELs) have delivered intense, ultrashort X-ray pulses for over a decade. One of the most promising applications of XFELs is in biology, where researchers can capture images down to the atomic scale even before the radiation damage destroys the sample. In physics and chemistry, these X-rays can also shed light on the fastest processes occurring in nature with a shutter speed lasting only one femtosecond—equivalent to a millionth of a billionth of a second.

However, on these miniscule timescales, it is extremely difficult to synchronize the X-ray pulse that sparks a reaction in the sample on the one hand and the laser pulse which 'observes' it on the other. This problem is called timing jitter, and it is a major hurdle in ongoing efforts to perform time-resolved experiments at XFELs with ever-shorter resolution.

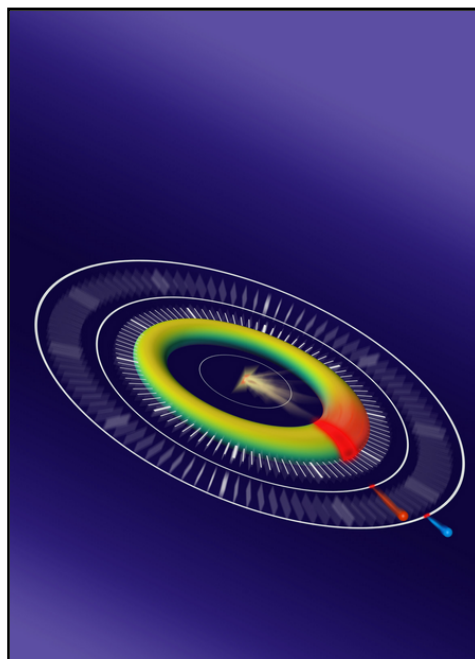
Now, a large international research team involving collaborators from the MPSD and DESY in Hamburg, the Paul Scherrer Institute in Switzerland, and other institutions in seven countries has developed a method to get around this problem at XFELs and demonstrated its efficacy by measuring a fundamental decay process in neon gas. The work has been published in *Nature Physics*.

Many biological systems—and some non-biological ones—suffer damage when they are excited by an X-ray pulse from an XFEL. One of the causes of damage is the process known as Auger decay. The X-ray pulse ejects photoelectrons from the sample, leading to their replacement by electrons in outer shells. As these outer electrons relax, they release energy which can later induce the emission of another electron, known as an Auger electron. Radiation damage is caused by both the intense X-rays and the continued emission of Auger electrons, which

can rapidly degrade the sample. Timing this decay would help to evade radiation damage in experiments studying different molecules. In addition, Auger decay is a key parameter in studies of exotic, highly excited states of matter, which can only be investigated at XFELs.

Ordinarily, timing jitter would appear to preclude time-resolved studies of such a short process at an XFEL. To circumvent the jitter problem, the research team came up with a pioneering, highly precise approach and used it to chart Auger decay. The technique, dubbed self-referenced attosecond streaking, is based on mapping the electrons in thousands of images and deducing when they were emitted based on global trends in the data. "It is fascinating to see how our enhancement of a technique which was originally developed for the characterization of X-ray pulses at Free-Electron Lasers finds new applications in ultrafast scientific experiments," says co-author Christopher Behrens, a researcher in the FLASH photon research group at DESY.

For the first application of their method, the team used neon gas, where the decay timings have been inferred in the past. After exposing both photoelectrons and Auger electrons to an external 'streaking' laser pulse, the researchers determined their final kinetic energy in each of tens of thousands of individual measurements. Crucially, in each measurement, the Auger electrons



Artistic depiction of the experiment. The inherent delay between the emission of the two types of electron leads to a characteristic ellipse in the analysed data. In principle, the position of individual data points around the ellipse can be read like the hands of a clock to reveal the precise timing of the dynamical processes. Credit: Daniel Haynes / Jörg Harms

always interact with the streaking laser pulse slightly later than the photoelectrons displaced initially, because they are emitted later. This constant factor forms the foundation of the technique. By combining so many individual observations, the team was able to construct a detailed map of the physical process, and thereby determine the characteristic time delay between the photo- and Auger emission.

Lead author Dan Haynes, a doctoral student at the MPSD, says: "Self-referenced streaking enabled us to measure the delay between X-ray ionization and Auger emission in neon gas with sub-femtosecond precision, even though the timing jitter during the experiment was in the hundred-femtosecond range. It's like trying to photograph the end of a race when the camera shutter might activate at any moment in the final ten seconds."

In addition, the measurements revealed that the photoionization and the subsequent relaxation and Auger decay must be treated as a single unified process rather than a two-step process in the theoretical description of Auger decay. In previous time-resolved studies, the decay had been modeled in a semiclassical manner.

However, under the conditions present in these measurements at LCLS, and at XFELs generally, this model was found to be inadequate. Instead, Andrey Kazansky and Nikolay Kabachnik, the collaborating theorists on the project, applied a fully quantum-mechanical model to determine the fundamental Auger decay lifetime from the experimentally observed delay between ionization and Auger emission.

The researchers are hopeful that self-referenced streaking will have a broader impact in the field of ultrafast science. Essentially, the technique enables traditional attosecond streaking spectroscopy, previously restricted to tabletop sources, to be extended to XFELs worldwide as they approach the attosecond frontier. In this way, self-referenced streaking may facilitate a new class of experiments benefitting from the flexibility and extreme intensity of XFELs without compromising on time resolution.

More information: D. C. Haynes et al. Clocking Auger electrons, *Nature Physics* (2021). [DOI: 10.1038/s41567-020-01111-0](https://doi.org/10.1038/s41567-020-01111-0)

Journal information: [Nature Physics](https://phys.org/news/2021-01-clocking-electron-movements-atom.html)
<https://phys.org/news/2021-01-clocking-electron-movements-atom.html>

New research: People infected with Covid-19 may be protected for several months

Scientists have concluded that naturally acquired immunity as a result of past infection from the SARS-CoV-2 virus provides 83 per cent protection against reinfection, compared to people who have not had the disease before

New Delhi: A new study conducted by Public Health England (PHE) says that people infected with COVID-19 in the past are likely to be protected against reinfection for several months, supporting similar findings surrounding immunity from this disease.

Even so, experts have warned that even people with immunity may still be able to carry the virus in their nose and throat and therefore have a risk of transmitting it to others. Therefore, it is important that individuals who have acquired the disease and recovered from it continue to take all precautions such as wearing masks, regularly washing their hands, and maintaining a distance of at least two metres from others



Healthcare workers collect swab samples for Covid-19 testing at a bus stand in Thane. (Express Photo: Deepak Joshi)

What is this finding based on?

Researchers from PHE have been testing tens of thousands of healthcare workers across the UK since June for COVID-19 infections as well as the presence of antibodies. Between June 18 and November 24, scientists detected 44 potential reinfections (out of which two were probable and 42 were possible reinfections) from a total of 6,614 participants who tested positive for antibodies. According to the study, the two probable cases of reinfections reported having experienced COVID-19 during the first wave of the pandemic but were not tested. These two patients reported having less severe symptoms the second time.

Importantly, none of the 44 potential reinfections were tested using PCR during the first wave, but tested positive for antibodies subsequently.

From this, scientists have concluded that naturally acquired immunity as a result of past infection from the SARS-CoV-2 virus provides 83 per cent protection against reinfection, compared to people who have not had the disease before. This protection appears to last for a period of five months from the time that the person first became sick from COVID-19, scientists have said.

What we know about immunity from COVID-19

The longevity of immunity against a disease varies from disease to disease and one of the factors influencing this is the amount of neutralising antibodies produced by the infected person. For instance, if a person gets infected with measles, the immunity typically lasts forever. But in case of the flu, people need to get vaccinated every year to remain protected.

This week, another study published in the journal Science, which is based on the analysis of blood samples from 188 patients said that the body's immune response to COVID-19 could last for eight months after the onset of symptoms from the initial infection.

The duration of immunity to Covid-19 has been a subject of research through the pandemic, and studies so far have provided various results. In July last year, a study conducted by researchers from King's College London suggested that immunity might be lost in months.

In November 2020, a study in Pune revealed that nearly 85 per cent of the people who were infected with the virus had developed neutralising antibodies in response to the disease.

<https://indianexpress.com/article/explained/explained-what-does-a-new-study-say-about-immunity-from-covid-19-7146388/>

