SENSORS AND ELECTRONICS TECHNOLOGY PANEL

SET NEWSLETTER

FEBRUARY 2024 | ISSUE 6

IN THIS ISSUE

WELCOME MESSAGE

from the SET Panel Chair

Dear SET Panel friends,

Welcome to this sixth edition of our SET Newsletter to provide you with the most relevant recent information about the SET Panel.

I really enjoyed our last PBM in Copenhagen, Denmark. I would like to express my gratitude once more to the Danish Ministry of Defense and Mr. Steen Sondergaard for graciously hosting the PBM and for their hospitality throughout the entire week. The PBM in Copenhagen has also marked the handover from Frank van den Bogaart to myself as new SET Panel Chair. Please, let me thank the Italian MoD for nominating me for this position and the SET Panel voting members and their Nations for electing me and putting their trust in me. I can ensure you that I will do my absolute best to serve the SET Panel and the NATO STO for the next two years.

I would also like to take this opportunity to thank Mr. Frank van den Bogaart for his three-year service as SET Panel Chair. Frank has superbly fulfilled his role and led the SET Panel to a very high standard, and I can only hope to continue his legacy.

The SET Panel is doing extremely well, and I hope that the new CPoW2023 goals will pave the way for us to improve our standards and continue in our mission to provide the best collaboration platform for hundreds of scientists across the Alliance. Moreover, the SET Panel is very active in implementing policies to attract young scientists and women in STEM and will continue to advance along this way to make sure that there will be a solid and balanced generation of scientists in the years to come.

In addition, we have just introduced a very important topic in the SET PoW, namely "Underwater Sensing Technology", which is now part of the MSE-FG's PoW. Strategic discussions are ongoing with the CMRE, which will see a strong relationship with the SET Panel growing in the future to advance technology in this field.

We are now excited and busy preparing for the next PBM, which will be held in Amsterdam in April, where we will review our PoW and discuss future activities. We will have varied guests and briefings that will fill our plenary and focused sessions. The Spring PBM will be accompanied by the SET-318 Specialists' Meeting on "AI/ML and Cognitive Radar". Registration for both events are already open.

Enjoy reading this 6th SET Newsletter. I kindly invite you to contribute to the next issue, please do not hesitate to come up with creative and challenging ideas. Finally, for those who will attend the next PBM, please do not forget to book your trip to Amsterdam, I have already booked my hotel. I look forward to seeing you again.

Best wishes,

Marco Martorella
SET Panel Chair

SET PANEL QUICK FACTS

Panel Mission

To foster co-operative research, exchange of information, and the advancement of science and technology among the NATO Nations in the field of sensors and electronics for defense and security.

Panel Members since January 2024

77 Members – 31 Nations (28 NATO – 2 PfP – 1 Global Partner), 3 NATO Bodies

NATO Nations

Associated Members

Partner Nations

New Members

Ms. Liza DIRRIX (NLD) – Principal
Ms. Daniela DEIANA (NLD)
Lt.Col. Piotr SERAFIN (POL) – Principal
Prof. Agostino MONORCHIO (ITA)
Dr. Michael BRANDFASS (DEU) – MaL
Mr. Soren Stentoft HAMMERICH (DNK)
Lt.Col. Thorsten RITTER (ACT)

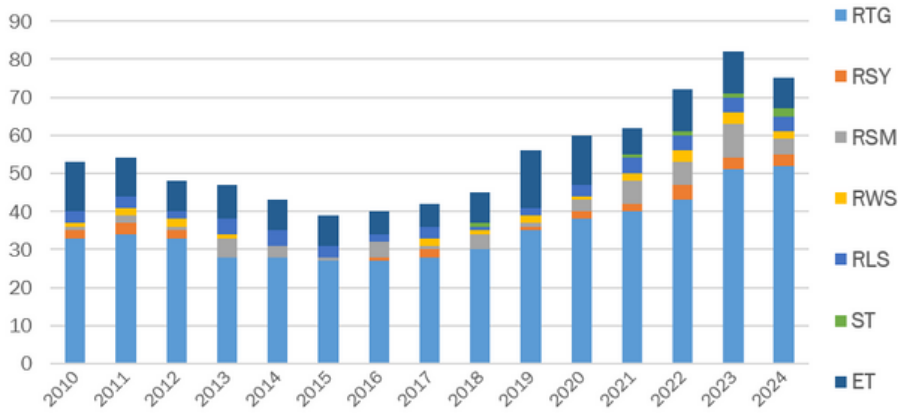
A special mention to Frank van den Bogaart, our former Chair, who left the SET Panel after 18 years, playing the roles of Panel Member, Focus Group Coordinator, Panel Vice-Chair and Panel Chair.

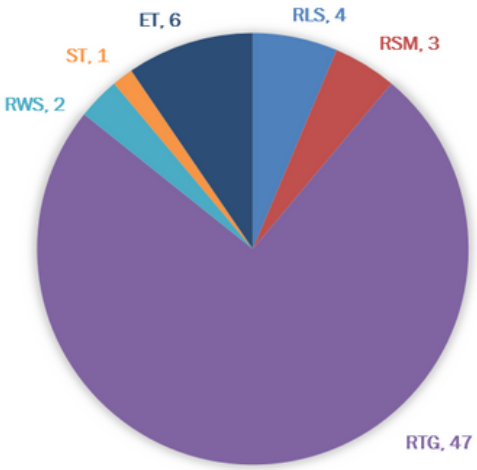
SET PANEL QUICK FACTS

Programme of Work

On the left, the SET Panel Programme of Work (PoW) has consistently increased over the past years. On the right, you can see the current SET PoW per Activity type, with 63 Activities (plus 15 Activities awaiting publication), ranging from Exploratory Teams (ET) and Research Task Groups (RTG) to Research Workshops (RWS), Research Specialists' Meetings (RSM), Research Lecture Series (RLS) and one Specialists' Team (ST).

SET PoW Makeup and Growth





SET Programme of Work by Activity Type (Jan 2024)

In the table below there is the number of TAPs proposed in the last PBMs. As you can see, we are now at the same level as before the corona pandemic. Also, the total sum of running activities is at the top level.

	RTG	ET	RSM	RLS	RWS	RSY	ST	Total
42PBM - Fall 2018	4	5	1					**10**
43PBM - Spring 2019	5	4	3	1	1	1	1	**16**
44PBM - Fall 2019	10	2	1	1	1			**15**
45PBM - Spring 2020	5	2	2	1				**10**
46PBM - Fall 2020	3	2	1					**6**
47PBM - Spring 2021	3		1		1	1		**6**
48PBM - Fall 2021	3	3			1	1		**8**
49PBM - Spring 2022	2	3	3					**8**
50PBM - Fall 2022	5	2	1	1				**9**
51PBM - Spring 2023	3	2	1					**6**
52PBM - Fall 2023	8	2		3	1		1	**15**

Number of TAPs proposed in the last PBMs

SET PUBLICATIONS

New Reports Published and Pre-Published (since August 2023)

Reference	Status / Title	Date	Classification
Technical Reports			
STO-TR-SET-303	PRE-RELEASE: Military Applications of Extreme Laser Fields	29/1/2024	NATO Unclassified
STO-TR-SET-271	PRE-RELEASE: Airborne Maritime Radar Based Submarine Periscope Detection and Discriminationat High Grazing Angles	19/1/2024	NATO Unclassified
STO-TR-SET-293	PRE-RELEASE: RF Sensing for Space Domain Awareness	12/12/2023	NATO Unclassified
STO-TR-SET-242	PRE-RELEASE: Passive Radar on Moving Platforms	26/10/2023	NATO Unclassified
Meeting Proceedings			
STO-MP-SET-315	Detection, Tracking, ID and Defeat of Small UAVs in Complex Environments	31/1/2024	NATO Unclassified
STO-MP-SET-298	Electronic Attack and Protection for Modern Active/Passive Netted Radars	25/1/2024	NATO Unclassified
STO-MP-SET-308	Trends in Ultrashort Pulse Laser Source Technology Improvements [Executive Summary only]	25/1/2024	Open Access
STO-MP-IST-SET-198	PRE-RELEASE: Quantum Technology	22/1/2024	NATO Unclassified
STO-MP-SET-319	New Mathematical Frontiers for Multi-Dimensional Radar Systems	15/6/2023	NATO Unclassified
Educational Notes			
STO-EN-SET-274	PRE-RELEASE: Cooperative Navigation in GNSS Degraded and Denied Environments	5/10/2023	NATO Unclassified

- All UU and NU Publications are available at the STO Publication Web Site **here**.
  - For NU publications you will be required to log in with your Science Connect credentials.
- Publications with a higher level of classification can be accessed through your National Distribution Centre.

NATO PUBLICATIONS

Please find below the QR code to download the latest STO & ACT Publications (you can scan the QR code or click on the image).

NWCC

NATO WARFIGHTING CAPSTONE CONCEPT

52ND SET PBM

On 11-13 October 2023, the SET Panel successfully concluded its 52nd Panel Business Meeting (PBM) at Eigtveds Pakhus (Warehouse), The Danish Ministry of Foreign Affairs Meeting Facility in Copenhagen (DNK). Held as an “in person” meeting, it brought together 68 people representing 25 NATO and Partner Nations and the NATO Industrial Advisory Group (NIAG).

During the week, the three Focus Groups – Multi Sensors and Electronics (MSE); Radio-Frequency Technology (RFT); and Optical Technology (OT) - drew upon current activities, the revision and decision of the future Programme of Work, the most recent technical developments and the latest emerging technologies. The Panel also heard several Topical Briefings on very interesting and militarily relevant topics, to include Quantum Sensing, Electronic Warfare,

Integrated Photonics for Sensing, results of the Von Kàrmàn Horizon Scanning on Artificial Intelligence and Responsible AI in the Military domain (REAIM).

At the end of the PBM, the SET Panel approved two new Exploratory Team and endorsed, for Board approval, twelve new Technical Teams: seven Task Groups, one Workshop, one Specialists’ Team and three Lecture Series (one of them is a Summer School to be held in 2025 in Great Britain). In addition, several national members indicated their interest in joining Cross-Panel Technical Teams that were proposed through other STO Panels.

We would like to thank the Principal Danish Science & Technology Board Member, Mr. Steen SONDERGAARD, and his staff for their hospitality and the outstanding support given before and throughout our stay in Copenhagen.

52ND SET PBM

Approved / Endorsed Activities

During the PBM the following activities (RTGs, RLSs and RWS) were endorsed by the Panel.

SET-332/RTG on Assessment of Quantum-Based RF and EM Sensing Potential for Military Applications with CAN, FRA, DEU, NLD, TÜR, GBR, USA, SWE

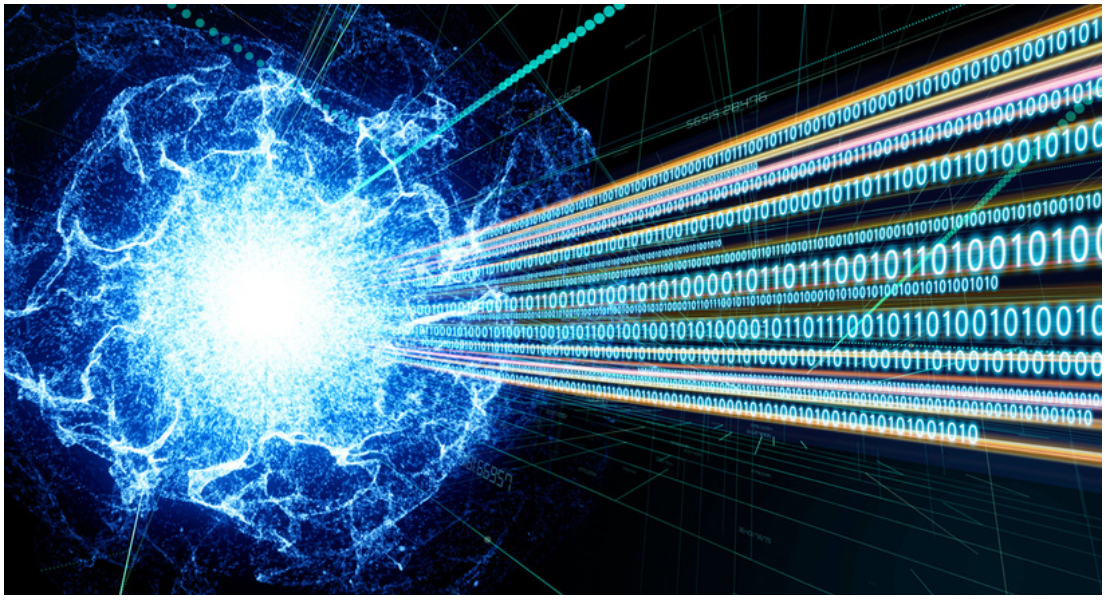
Quantum technologies are being developed for several application areas and these technologies have different maturity levels. The objective of this activity is to evaluate the existing technologies, especially for quantum-based RF and EM sensing, and to assess their technology readiness level (TRL). This may also involve performance tests on laboratory test set-ups (if available). In addition, the military use cases for quantum-based RF and EM sensing need to be identified and appropriate performance requirements need to be defined.

SET-333/RTG on Bringing Quantum Sensing from the Laboratories to the Battlefield with FRA, DEU, ITA, NLD, TÜR, USA, SWE

The main objective of the RTG is to establish the concrete potential of quantum sensing, with a special focus on quantum imaging and microwave sensing (i.e. quantum radars), to produce more secure and efficient surveillance systems.

This objective will be achieved through the following steps:

- Generate an overview of the state of the art of quantum sensing, stating advantages and caveats in comparison to classical systems;
- Elaborate military use-cases and identify technological gaps;
- Outline a roadmap for the integration of quantum sensing components into current systems



SET-334/RTG on Military Applications of Extreme Laser Fields with DEU, ESP, TÜR, GBR, USA, AUS

The current state of the art of ultrashort pulse laser technology demonstrates that many military applications as well as potential new threats may be realized in the near future. In a previous RTG (SET-303) number of offensive, defensive and remote sensing areas were identified for further investigation:

1. Directed Energy;
2. Interrogation and Remote Sensing applications;
3. Generation of particle beams and high-energy x-ray sources.

The benefits that this technology adds are new capabilities currently not available or addressed. There is also the potential for a single source that addresses multiple applications.

SET-335/RTG on RFT-OT Data and Sharing Hub (DASH) with DNK, FRA, DEU, ITA, NLD, NOR, POL, USA

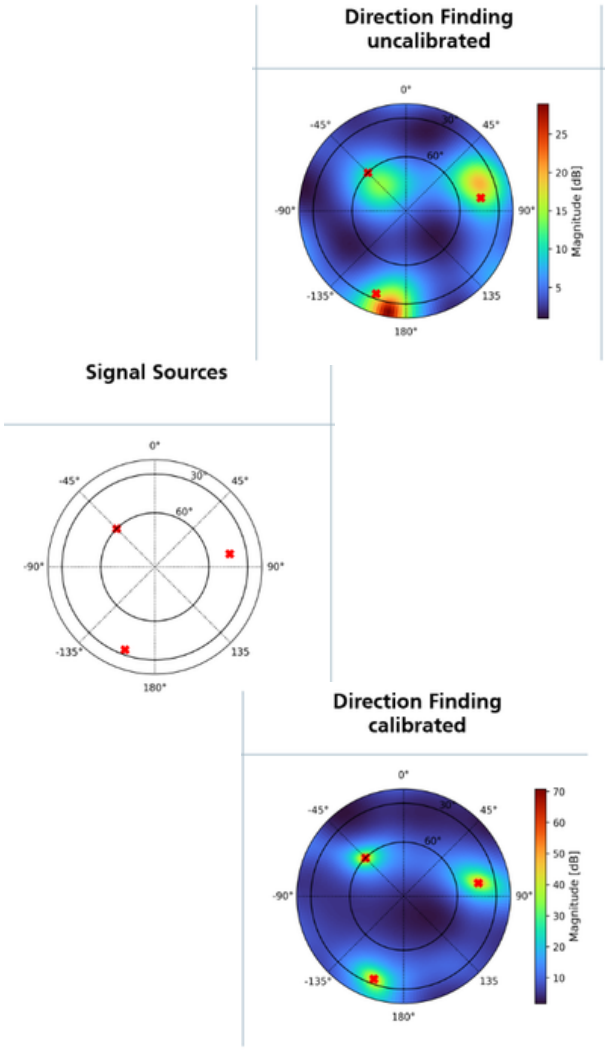
Military missions require advanced technology and real-time data analysis from multiple sensors. However, scarce, fragmented, and small datasets limit the full exploitation of the capabilities of current and future sensors targeted for operation in present and future operational scenarios. A shared database of high-quality datasets will not only enhance collaborative research and algorithmic development but it will also contribute to the education of young scientists. These advances will pave the way for improved mission performance by means of new and/or enhanced sensing capabilities of military equipment, delivering a greater impact in field operations.

SET-336/RLS on Artificially Intelligent Military Situational Awareness with BGR, DEU, TÜR, USA, SWE

The recently completed von Kármán Horizon Scan on Artificial Intelligence (AI) has brought together leading computer scientists and engineers from Allied and Partner nations. What emerged was an overview of possible future AI-enabled systems to fulfil NATO's mission more effectively, including in decision support and information harvesting. The Lecture Series aims to share these insights in combination with in-depth lectures on related topics with defence planners, military end-users drafting requirements, managers of AI-related defence projects, and defence systems engineers.

SET-337/RLS on Advances in Array Calibration for improved ESM Sensor Performance with DEU, ESP, GBR, USA

Array signal processing techniques for antenna arrays have numerous military applications, including but not limited to transmit-receive beamforming for radar or communication systems, interference rejection using controlled reception pattern antennas (CRPA), radio direction finding, and passive emitter localization. In military applications (air-to-ground, air-to-air, ground-to-air) a precise and time-critical targeting is required. Therefore, precise calibration is of particular importance for military sensor systems in order to achieve high accuracies.



SET-338/RTG on Assessment of Navigation with and without GNSS for Military Applications with FRA, DEU, NLD, NOR, TÜR, USA, SWE

The Global Navigation Satellite System (GNSS) has transformed society. NATO nations and military activities rely on the services GNSS provides. However, GNSS has several vulnerabilities. Above, jamming, spoofing, and incomplete coverage are mentioned. From these vulnerabilities emerges the necessity for securing knowledge of navigational data, ideally without hostile entities being able to intersect the information. Quantum technologies can provide the according advantage. An example for navigation without GNSS is the navigation following Earth's magnetic field. Based on previously produced magnetic field maps, accurate navigation can be achieved, which might just provide the edge necessary during preparation or execution of a military operation.

SET-IST-339/RTG on Investigations of Military Applications of Quantum Computing with CAN, FRA, NLD, TÜR, USA

A new computing paradigm is approaching rapidly: quantum computing. It is expected that quantum computers will solve specific problems much faster than the current and future generations of classical computers. Quantum computers (QC) operate fundamentally differently than classical computers, based on quantum bits (qubits), using the properties superposition and entanglement. One of the major challenges is to discover those applications and problems on which the QC will outperform.

SET-340/RTG on Multistatic RF Sensing for Enhanced Space Domain Awareness with DNK, FIN, FRA, DEU, ITA, NLD, NOR, POL, TÜR, USA

Nowadays NATO operations heavily depend on space. Therefore, a tactical awareness of satellite activity is of great interest and concern. Ground-based optics and radars are the dominant sensors employed for this awareness; however, optical sensing is hampered by inclement weather and by solar exclusion periods where radar has a 24/7 capability. On the other hand, typical disadvantages associated with radar sensors, such as limited operational range, can be overcome using long integration periods and adjunct high gain antenna receivers. Furthermore, the use of a long baseline multi-bistatic configuration represents a strategic advantage and, moreover, allows NATO to fill the gaps in Space Domain Awareness (SDA) over Europe. The proposed activity and its potential outcome could significantly improve the NATO SDA.

SET-SCI-341/RWS on EW Challenge Workshop with CZE, DNK, EST, FIN, DEU, ITA, SVK, ESP, ROU, TÜR, GBR, USA

Electronic Warfare (EW) is a critical capability for NATO but it is recognized that, across NATO and partner nations, there is a shortfall in researchers and developers in this area. This activity will demonstrate how the expertise of the wider academic community can be harnessed to inject new low TRL (Technology Readiness Level) ideas and concepts into the development of solutions to EW challenges and hence reinvigorate EW research and development whilst also contributing to S&T community building. The activity will also contribute to the new Electromagnetic & Electronic Technologies EDT (Emerging and Disruptive Technologies).

SET-SCI-342/RLS on Future EW Engineer (Summer School) with FIN, DEU, GRC, ITA, SVK, ESP, GBR

Electronic Warfare (EW) is a critical capability for NATO but it is recognized that, across NATO and partner nations, there is a shortfall in researchers and developers in this area. This activity will identify the skillset required for the future EW engineer and organize a Summer School to provide education to early-career and transitioning scientists / engineers in the identified areas. Moreover, the activity should recommend / provide an exemplar of how NATO should be addressing shortfalls in Defence scientists / engineers in critical areas. In this way, it will inform NATO nations in what areas they need to sustain education and training and also highlight EW as a technical career path of choice.

In addition, the Panel approved the following Exploratory Teams:

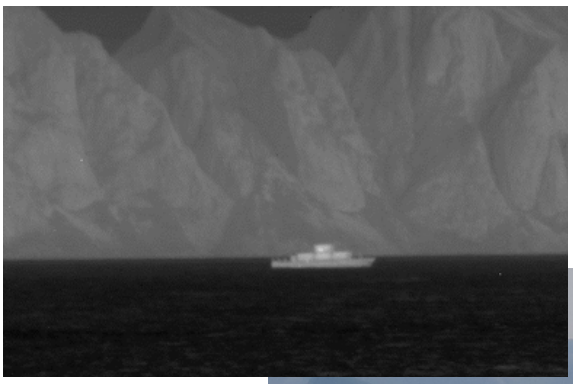
SET-ET-135 on High Angle EO/IR Ship Signatures in an Arctic Environment with FIN, DEU, NLD, NOR, USA, SWE

Every Navy must optimize ship design and operational practices to defend against deployed threats. The modeling and simulations tools used in the analysis must be validated to produce meaningful results. The validation process involves collecting truth data in operationally relevant conditions and quantitatively measuring how well the models predict the measurement. Navies now potentially face threats from sensors observing from higher elevations and are expected to operate in cooler environments than those for which the current models have been evaluated. A task group designed to hold a collaborative trial allows NATO-member nations to combine resources and generate a data product that can be broadly used to validate common or national toolsets. The collaboration enables the use of more resources than can be deployed in a single-nation or bilateral trial, which in theory will result in a more robust data set.

SET-IST-ET-136 on Underwater Optical Wireless Communications with FRA, DEU, NLD, ESP, TÜR, GBR, USA

In the military domain, sound has been used as a primary method for underwater communication. At the same time, data transmission rate of acoustic systems is low (kilobits/sec). A higher bandwidth can be achieved with visible light to transfer data underwater. However, the underwater environment presents challenges for propagation of optical waves.

Measurements of parameters relevant to modelling of oceanic optical channel are scarce or not accessible to the optical community. Therefore, conversion of oceanographic and acoustic data into parameters readily usable by the optical community would greatly enhance the realism of optical propagation models through the Ocean and consequently the accuracy of prediction of performance of underwater communications systems.



SET PANEL NEWS

Recent Kick-off Meetings

SET-325 Research Task Group (RTG) on "Surface and Ground Chemical Contamination Detection and Avoidance"

- The SET-325 Kick-Off Meeting was held in person at the CSO, 15-16 June, with the participation of 10 scientists from 6 Nations (FRA, NOR, SWE, TÜR, GBR and USA).

SET-330 Research Task Group (RTG) on "Surface and Ground Chemical Contamination Detection and Avoidance"

- The SET-330 Kick-Off Meeting was held in hybrid format at the CSO and on Webex, 26-28 September, with the participation of 7 scientists in person and 4 on Webex from 7 Nations (DEU, EST, FRA, GBR, NLD, TÜR and USA).

SET-ET-134 Exploratory Team (ET) on "Existence and Detection of Signal-induced Human Performance Degradation (HPD)"

- The SET-ET-134 Kick-Off Meeting was held in hybrid format at the CSO and on Webex, 18-19 October, with the participation of 12 scientists in person and 1 on Webex from 7 Nations (BEL, CZE, DEU, NLD, ESP, SWE and TÜR).

SET-329 Research Task Group (RTG) on "Surface and Ground Chemical Contamination Detection and Avoidance"

- The SET-329 kick-off meeting was held in hybrid format at the CSO and on Webex, 2-3 November, with the participation of 14 scientists in person and 4 on Webex from 7 Nations (DEU, NLD, NOR, ESP, POL, SWE and TÜR).

SET-HFM-328 Research Task Group (RTG) on "Surface and Ground Chemical Contamination Detection and Avoidance"

- The SET-HFM-328 kick-off meeting was held in hybrid format at the CSO and on Webex, 14-15 November, with the participation of 21 scientists in person and 3 on Webex from 12 Nations (BEL, CAN, DNK, DEU, ITA, NLD, NOR, POL, ESP, GBR, SWE and USA).

Recent SET Events

SET-315/RSY on “Detection, Tracking, ID and Defeat of Small UAVs in Complex Environments”

On 9-10 October, in combination with the 52nd PBM, the SET Panel held a Research Symposium on “Detection, Tracking, ID and Defeat of Small UAVs in Complex Environments”, bringing together 71 participants from 25 NATO and partner nations.

The meeting was hosted by the Danish MoD at Eigtveds Pakhus (Warehouse), The Danish Ministry of Foreign Affairs Meeting Facility in Copenhagen (DNK), and focused on the State-Of-The-Art technologies, developments, concepts, and operational requirements in the area of counter-UAV (C-UAV) technologies and systems.

The Symposium has been opened by Lt. Gen. Kim Jesper JØRGENSEN, Director of Danish Defence Acquisition and Logistic Organization (DALO), who provided a very inspiring overview on the modern threats facing NATO Nations.

A total of 29 papers from 10 Nations and 2 Keynote Speeches were presented, covering different topics ranging from detection, identification, tracking to neutralization of small UAVs.

UPCOMING SET PANEL EVENTS

53rd SET Panel PBM, 17–19 Apr 24, Amsterdam, the Netherlands

As we prepare the Spring 2024 PBM, our SET members are intensifying their efforts to contribute to a valuable and exciting event. The registration is open and can be found on the STO Events page at this **link**.

For security reasons, the General Information Package (GIP), containing all the information needed to make travel and hotel arrangements, is only visible via the STO Events meeting announcement when your registration has been validated and when you are logged in.

We are very much looking forward to meeting you in Amsterdam. We will provide further information as well as reminders regarding the Spring PBM soon.

SET-318/RSM on "AI/ML and Cognitive Radar", 15-16 Apr 2024, Amsterdam, The Netherlands

Intelligence, Surveillance and Reconnaissance (ISR) systems make wide use of sensors, which are required to more reactive to the environment and more intelligent in the use of the spectrum and the signal processing.

AI/ML and cognitive systems will bring these characteristics within ISR systems, therefore impacting dramatically on the ability to perform surveillance and to produce the required intelligence for both tactical and strategic operations.

This RSM will bring together major experts in the field, which will showcase the state of the art and propose future research activities in this area with direct focus onto NATO military interests.

The Specialists' Meeting will be held 15-16 April 2024 in Amsterdam (NLD), in conjunction with the 53rd SET Panel Business Meeting. **The registration is open and can be found on the STO Events page at this link.**

NATO STO SUMMER SCHOOL (SET-326)

Join us in Helsinki next year for the inaugural session of the STO Summer School. This one-week course will cover a wide range of topics related to sensors and electronics technology, with lectures on radar, acoustic and CBRN sensing systems, as well as signal and image processing, technology and military applications. Data fusion, quantum, and emerging and disruptive technologies will be covered, as well.

This is a great opportunity for early-career scientists and researchers to gain an introduction to sensors and electronics technology, and to the STO's work in the field.

The Summer School will be held on 8-12 July 2024, and registration will open in March and can be found on the STO Events page at this **link**.

NEXT KICK-OFF MEETINGS

Date	Activity and Title	Location
4-5 March 2024	SET-335/RTG on “RFT-OT Data and Sharing Hub (DASH)”	CSO, Neuilly-sur-Seine (FRA)
4-5 March 2024	SET-340/RTG on “Multistatic RF Sensing for Enhanced Space Domain Awareness”	CSO, Neuilly-sur-Seine (FRA)
26-27 March 2024	SET-SCI-341/RWS on “EW Challenge Workshop” together with SET-SCI-342/RLS on “Future EW Engineer (Summer School)”	CSO, Neuilly-sur-Seine (FRA)
9-11 April 2024	SET-ET-135 on “High Angle EO/IR Ship Signatures in an Arctic Environment”	CSO, Neuilly-sur-Seine (FRA)
29-30 April 2024	SET-IST-339/RTG on “Investigations of Military Applications of Quantum Computing”	CSO, Neuilly-sur-Seine (FRA)
22-23 May 2024	SET-332/RTG on “Assessment of Quantum-Based RF and EM Sensing Potential for Military Applications”	CSO, Neuilly-sur-Seine (FRA)

WOMEN & GIRLS IN SCIENCE

WGS2024 Challenge

In celebration of the International Day of Women and Girls in Science on 11 February, the NATO Science and Technology Organization (STO) launched the Women & Girls in Science 2024 (WGS24) challenge, an initiative that holds significant potential for collaboration and will contribute to increasing diversity in defence research careers, raising the visibility of national universities and engaging with youth.

What: The WGS24 challenge, organized by NATO STO in celebration of the UN International Day for Women and Girls in Science, is set to spotlight opportunities in the defence sector for female university students and young researchers under the age of 30, who are nationals of NATO countries.

Why: To highlight the wealth of career opportunities in defence for young women in STEM fields, inspire their pursuit of STEM studies, and contribute to greater diversity in these fields.

How: Participants are invited to submit research proposals that address one or more of the following NATO S&T focus areas (energy security, climate change, human security and societal resilience), guided by the following question: What research idea would you like to see NATO realise over the next five years?

When: Beginning in February 2024, the call for proposals will close on 21 April 2024, 23:59 CET. The challenge will conclude with a final event at NATO HQ on 30 May 2024.

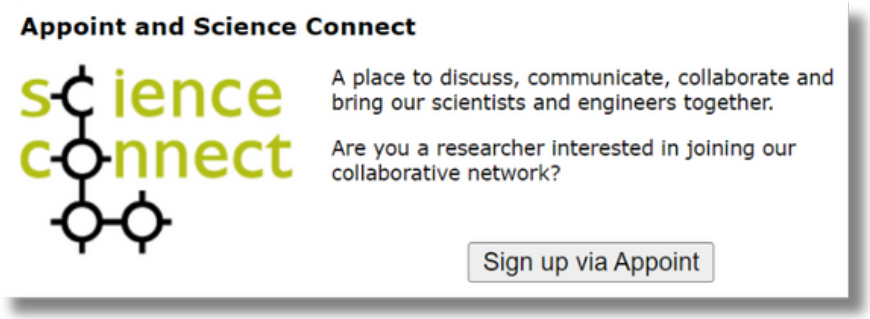
*For more details, please visit the **NATO Website***

APPOINT

STO Digital Appointment System

Joining an SET activity as a new team member? Don't forget to submit your appointment request via the digital STO appointment system called **APPOINT**.

To have access to the STO Publications, individuals are also invited to submit their request through the same **link**.



Your SET activity appointment request is routed as below:

STEP 1
Appointee submits appointment request via APPOINT

STEP 2
In coordination with the Principal SET Panel Member, the National Coordinator verifies the appointment

STEP 3
NATO STO CSO confirms the appointment

FOR CONTENT SUGGESTIONS, CONTRIBUTIONS, OR IF YOU HAVE ANY QUESTIONS:

PLEASE CONTACT
SET@CSO.NATO.INT

SET PANEL CHAIR

Prof. Marco MARTORELLA

SET PANEL VICE-CHAIR

Dr. Jason GUICHETEAU

SET PANEL OFFICE

Lt. Col. Isidoro MARCONE

Ms. Alicia MAHARAJ

"Everything is going to be all right: we sense it."