

EXPAND

Extreme Plasma Network for Advanced Discovery

COST ACTION CA24149

Anna Grassi - Grant Awarding Coordinator for EXPAND



European Cooperation in Science & Technology



COST Actions

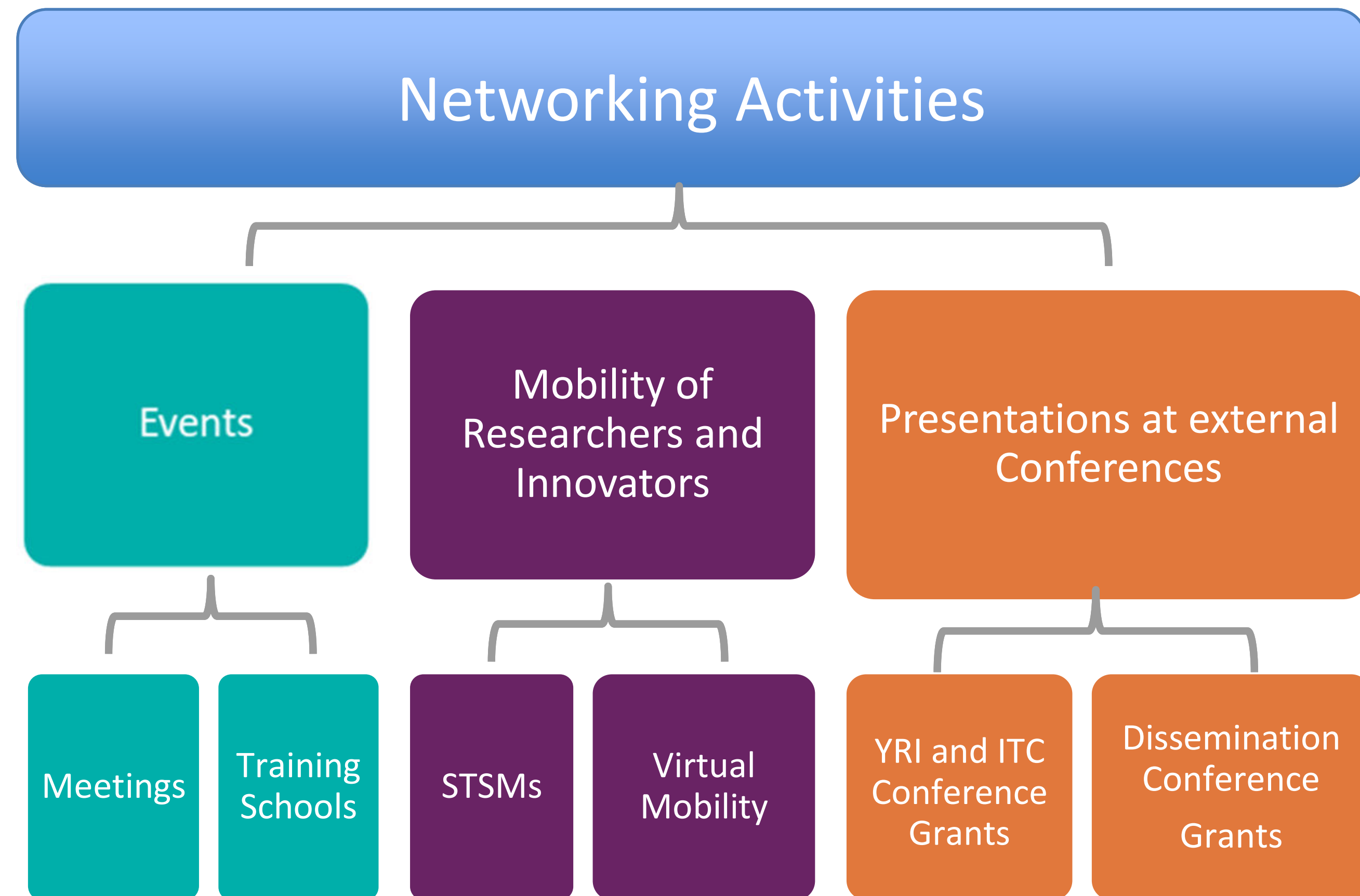
AN EFFICIENT NETWORKING TOOL

COST provides funding

for research coordination
and capacity building
activities

COST does not fund research,
but pools resources
to achieve research results
by networking

Networking Tools



COST Membership

41 Full COST Members

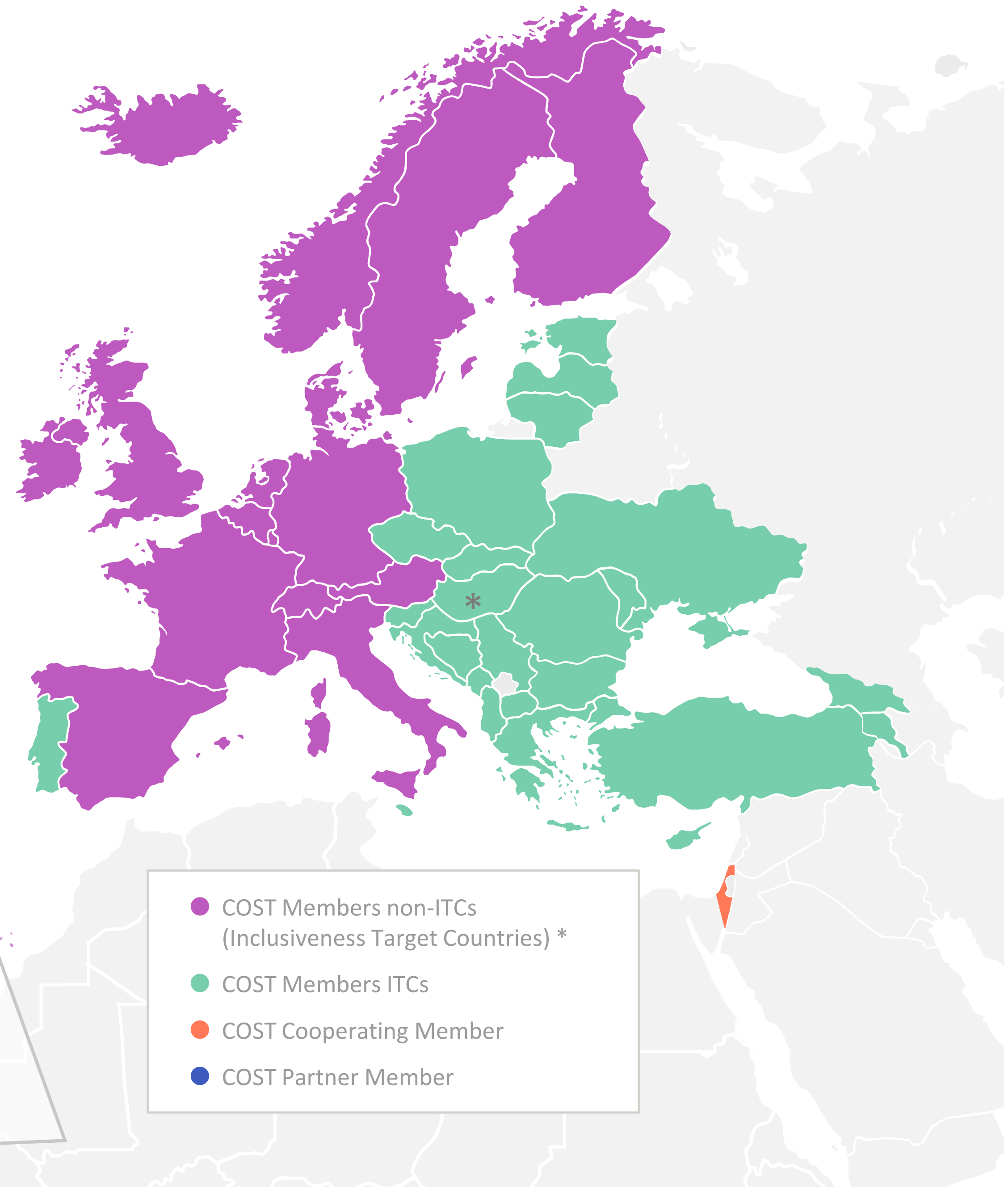
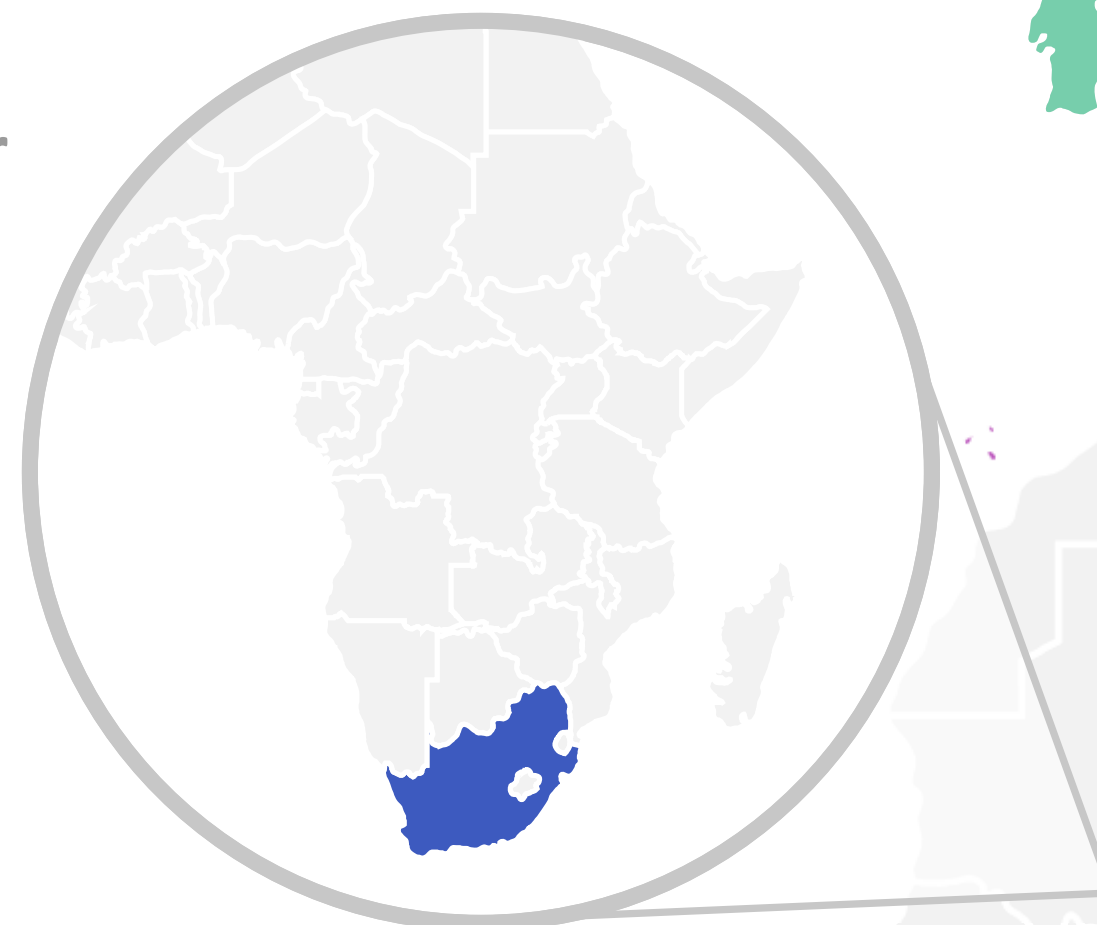
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| ● Albania | ● Germany | ● Norway |
| ● Armenia | ● Greece | ● Poland |
| ● Austria | ● Hungary* | ● Portugal |
| ● Belgium | ● Iceland | ● Romania |
| ● Bosnia and Herzegovina | ● Ireland | ● Serbia |
| ● Bulgaria | ● Italy | ● Slovakia |
| ● Croatia | ● Latvia | ● Slovenia |
| ● Cyprus | ● Lithuania | ● Spain |
| ● Czech Republic | ● Luxembourg | ● Sweden |
| ● Denmark | ● Malta | ● Switzerland |
| ● Estonia | ● The Republic of Moldova | ● Türkiye |
| ● Finland | ● Montenegro | ● Ukraine |
| ● France | ● The Netherlands | ● United Kingdom |
| ● Georgia | ● The Republic of North Macedonia | |

1 Cooperating Member

- Israel

1 Partner Member

- South Africa



- COST Members non-ITCs (Inclusiveness Target Countries) *
- COST Members ITCs
- COST Cooperating Member
- COST Partner Member

COST Membership

41 Full COST Members

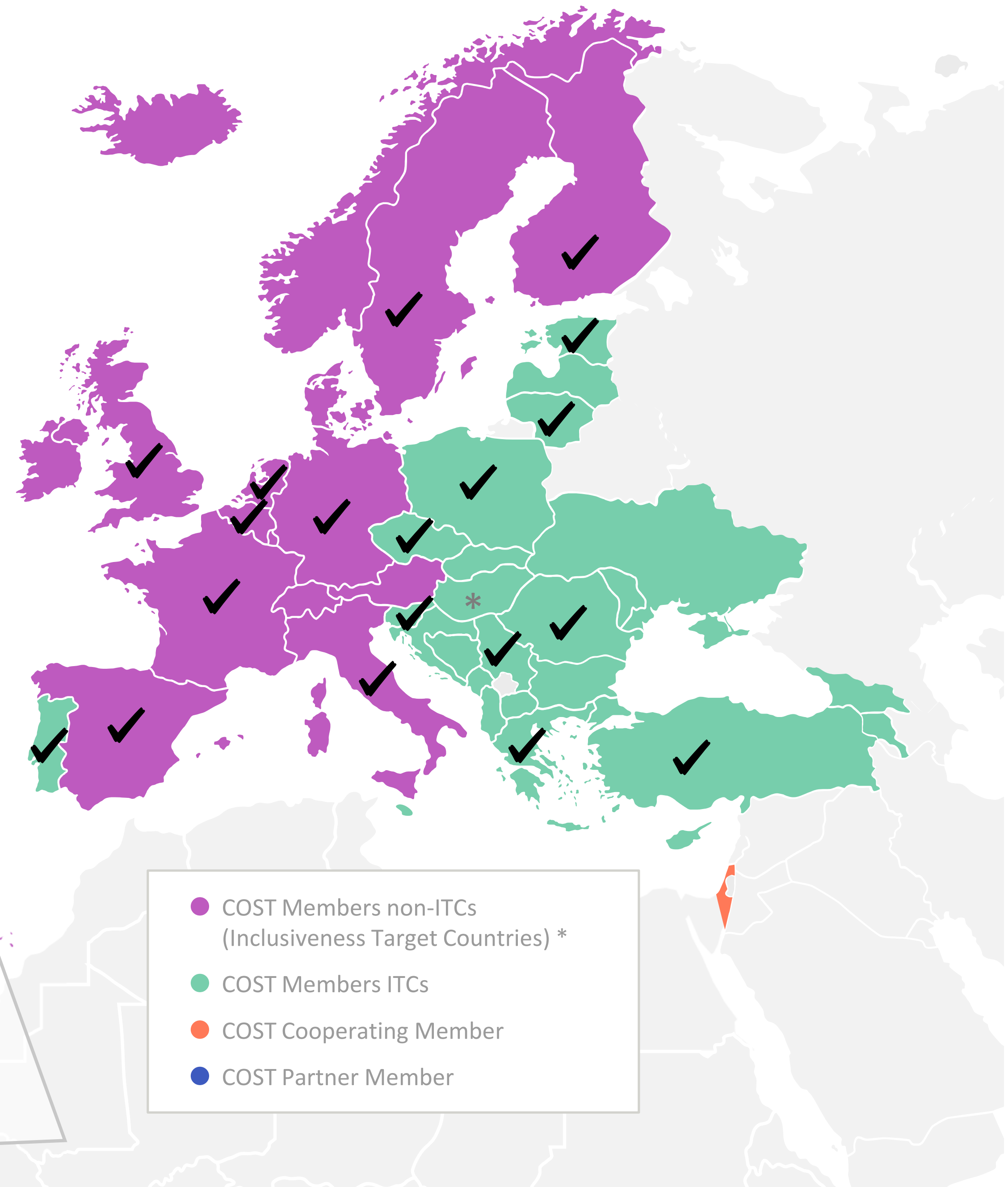
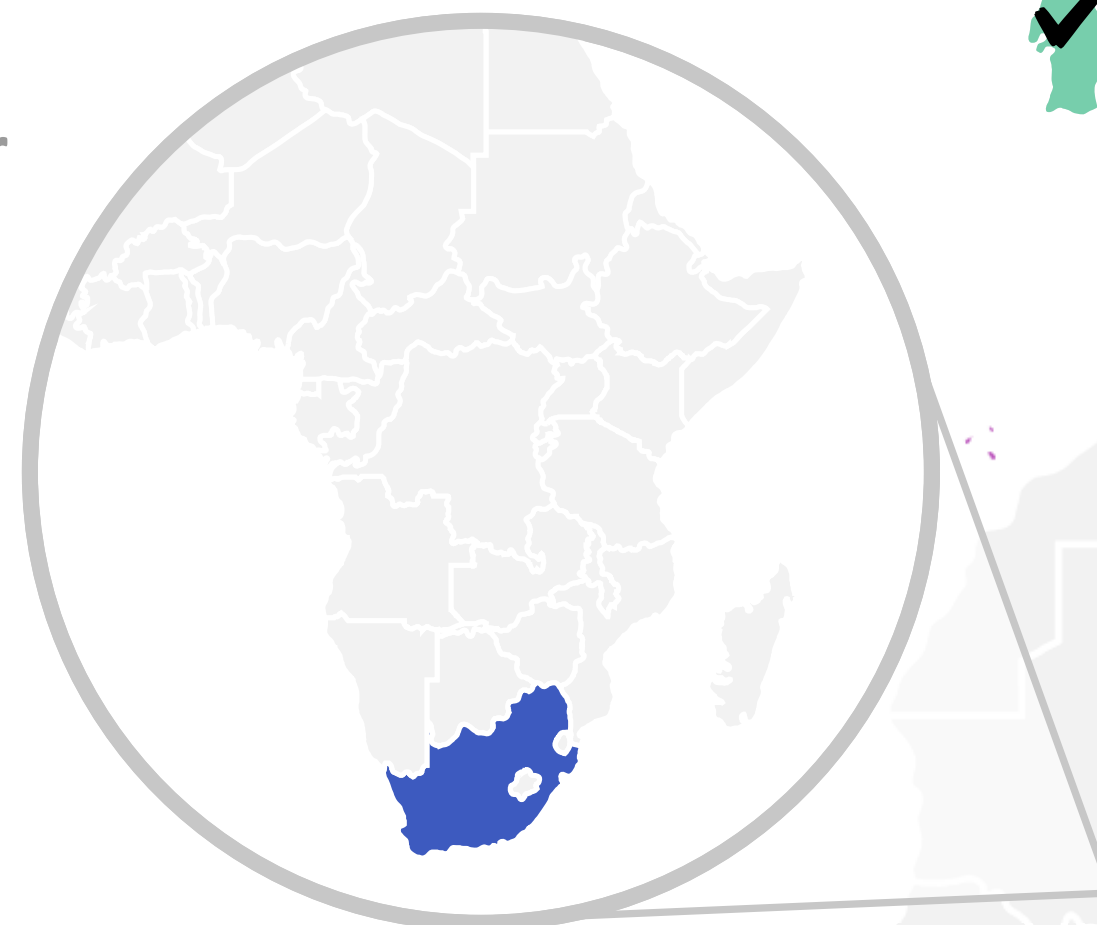
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1 Cooperating Member

- Israel

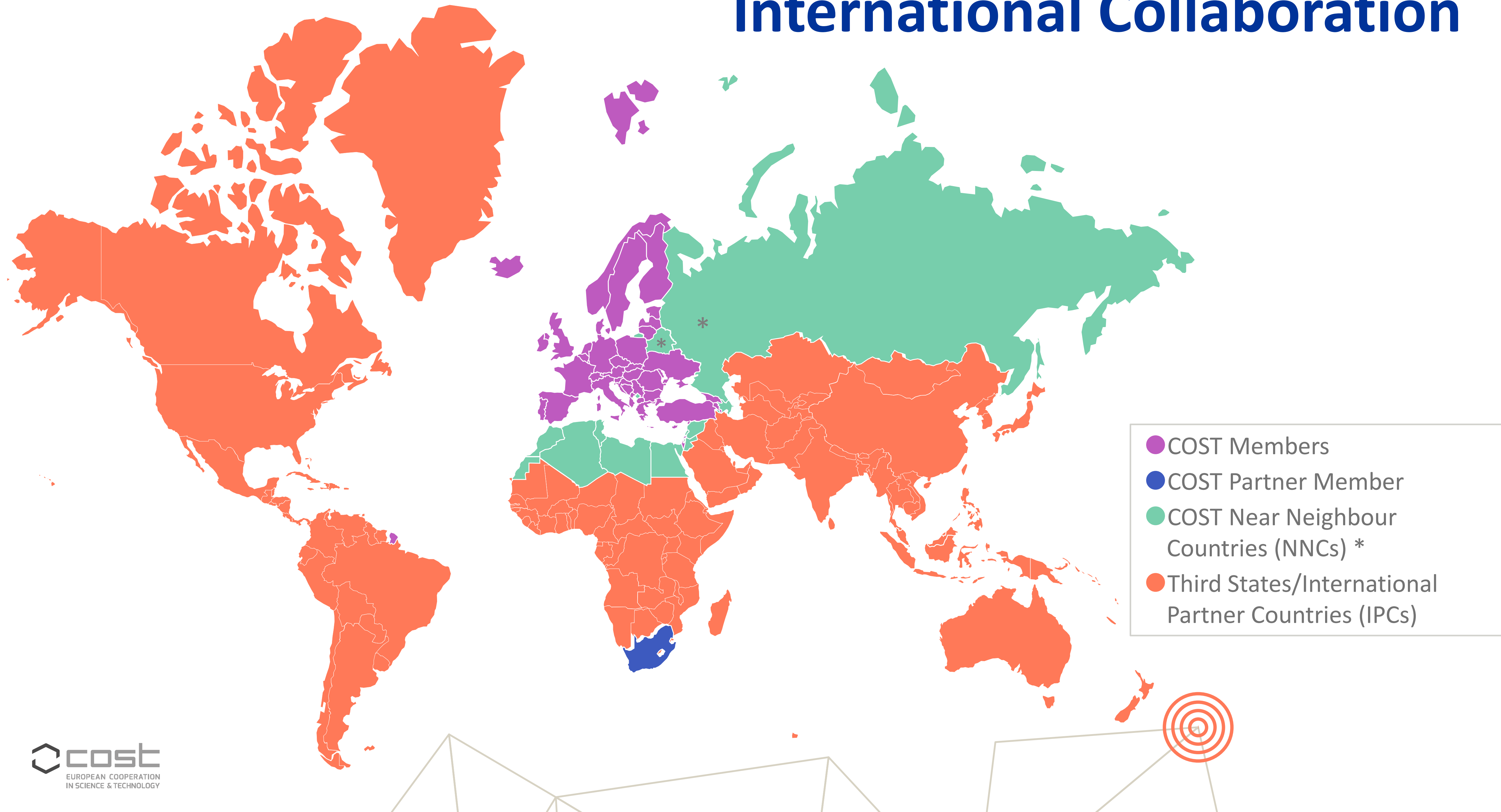
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- South Africa



- COST Members non-ITCs (Inclusiveness Target Countries) *
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- COST Partner Member

International Collaboration



Leadership Positions

Mandatory positions – CORE GROUP

MC members:

Action Chair (AC)



F. Fiuza
(IST, Lisbon)

Vice Chair (VC)



J. Nättilä
(Univ. of Helsinki)

Grant Holder Scientific
Representative (GHSR)

A. S. Miranda
(IST, Lisbon)

Leadership Positions

Mandatory positions – CORE GROUP

MC members:

Action Chair (AC)

Vice Chair (VC)

Grant Holder Scientific Representative (GHSR)

Working Group or
MC members:

Grant Awarding
Coordinator

Science
Communication
Coordinator

Working Group Leaders



A. Grassi
(LULI, Sorbonne)



D. Groselj
(Univ. of Leuven)

EXPAND: Extreme Plasma Network for Advanced Discovery

WG1: Radiative QED Plasmas
Interplay of radiative and QED processes with plasma physics

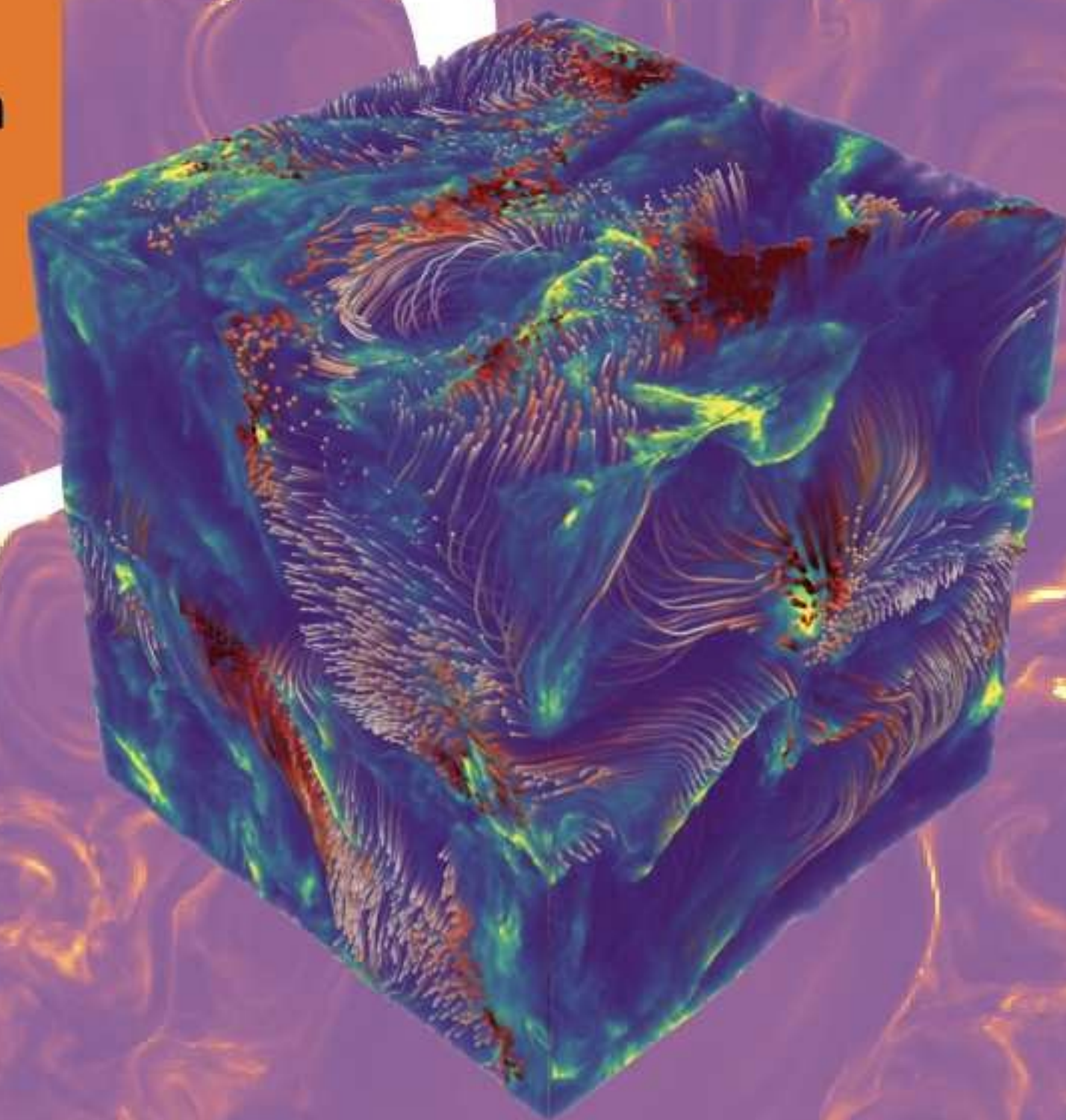
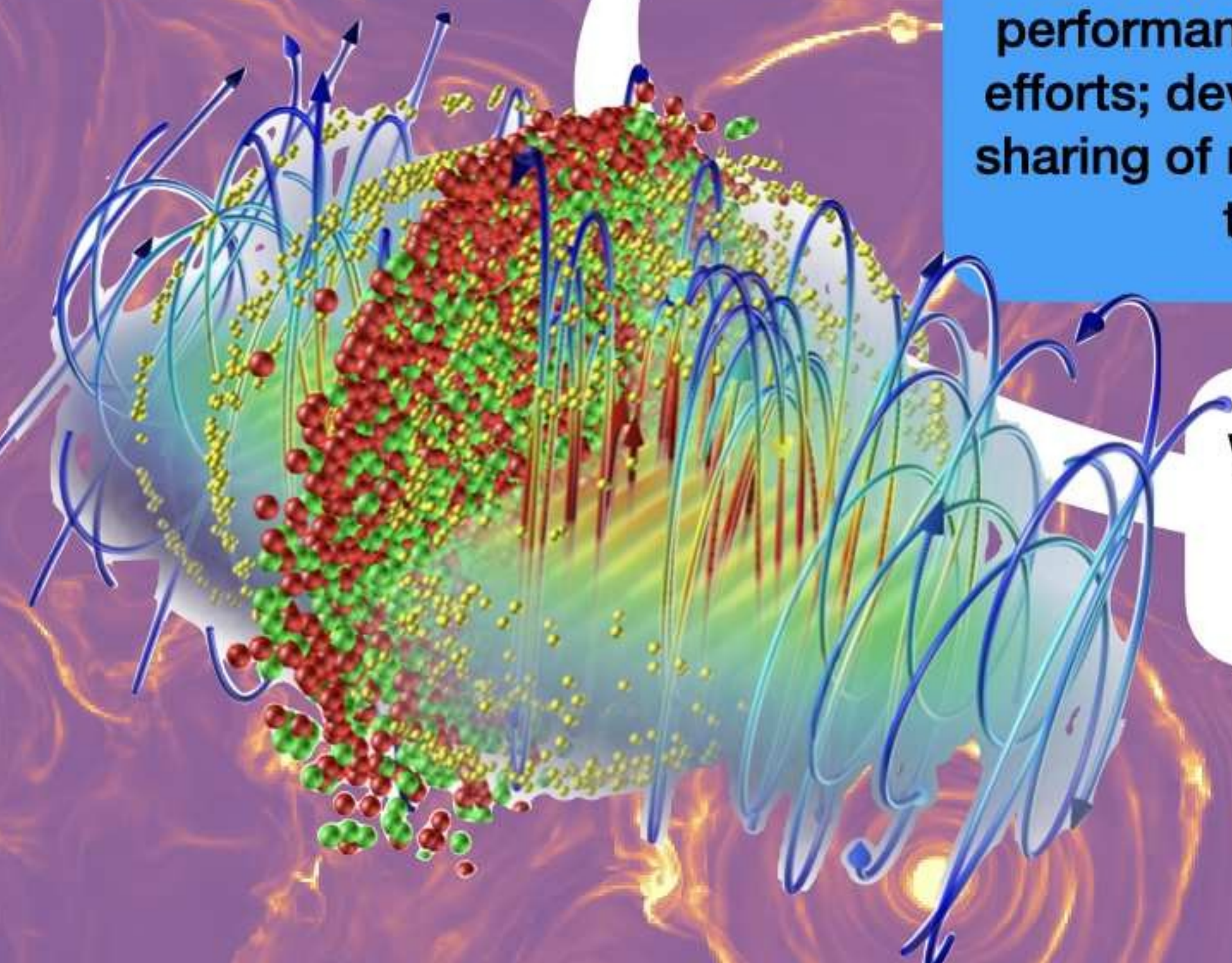
WG2: Strong-field QED Plasmas
Plasmas in ultra-strong (above-Schwinger) electromagnetic fields

WG3: Relativistic Plasmas
Dynamics of relativistic plasma flows

WG5: Computing Core
Coordination of high-performance computing efforts; development and sharing of novel modeling tools

WG6: Networking Core
Coordination of the network's education, training, and information dissemination efforts

WG4: Plasmas in Strong Gravity
Plasma dynamics in curved and twisted spacetime



EXPAND: Extreme Plasma Network for Advanced Discovery

WG1: Radiative QED Plasmas
Interplay of radiative and QED processes with plasma physics

Working Group 1: Radiative QED Plasmas

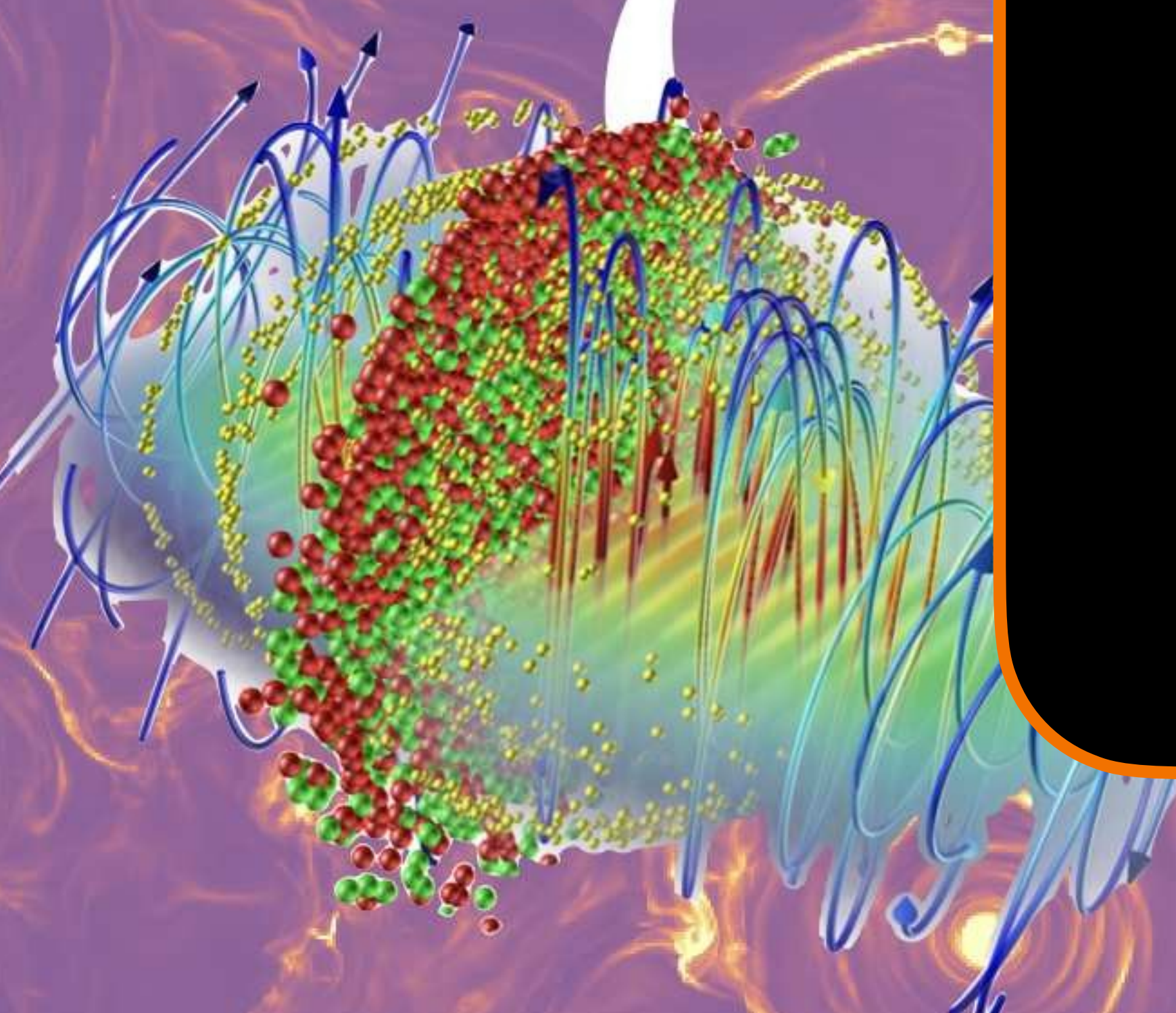
This group focuses on plasmas where radiation and quantum processes strongly influence plasma dynamics in both astrophysical and laboratory environments.



Marija Vranic
(IST, Lisbon)



Indrek Vurm
(Univ. of Tartu)



EXPAND: Extreme Plasma Network for Advanced Discovery

WG1: Radiative QED Plasmas

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WG2: Strong-field QED Plasmas

Plasmas in ultra-strong (above-Schwinger) electromagnetic fields

WG3: Relativistic Plasmas

relativistic plasma flows

Working Group 2: Strong-Field QED Plasmas

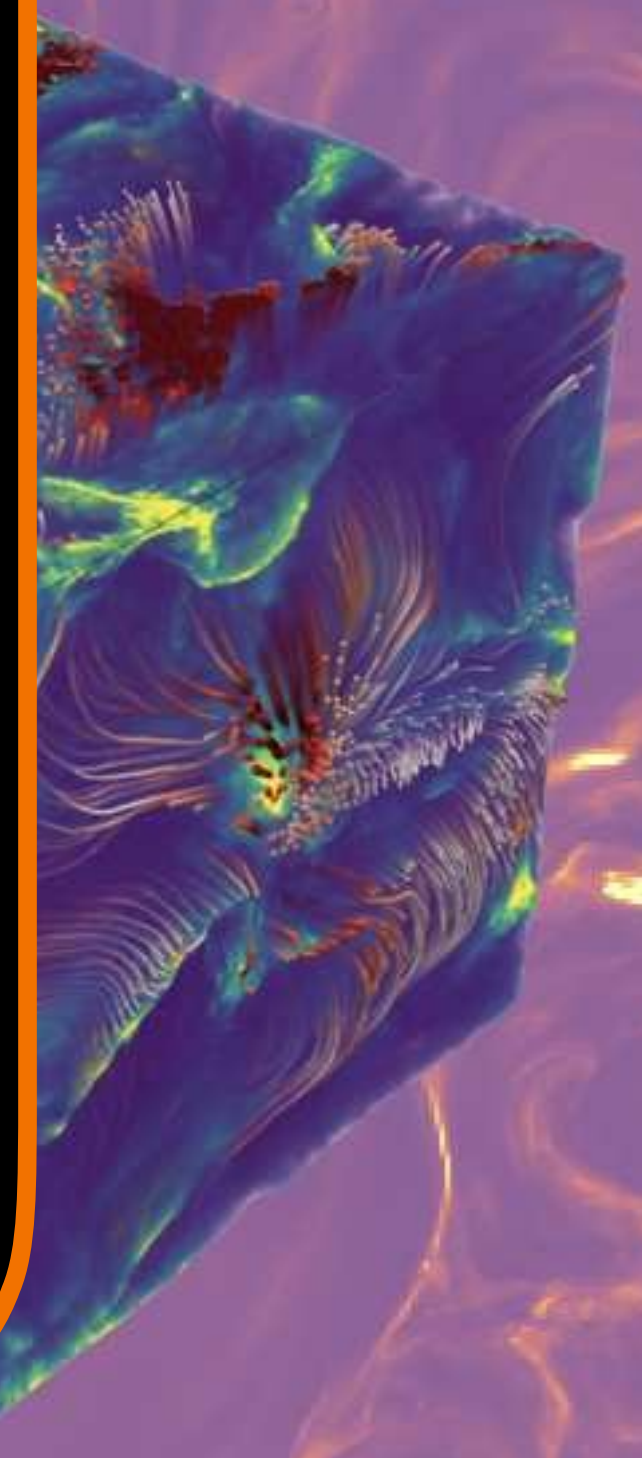
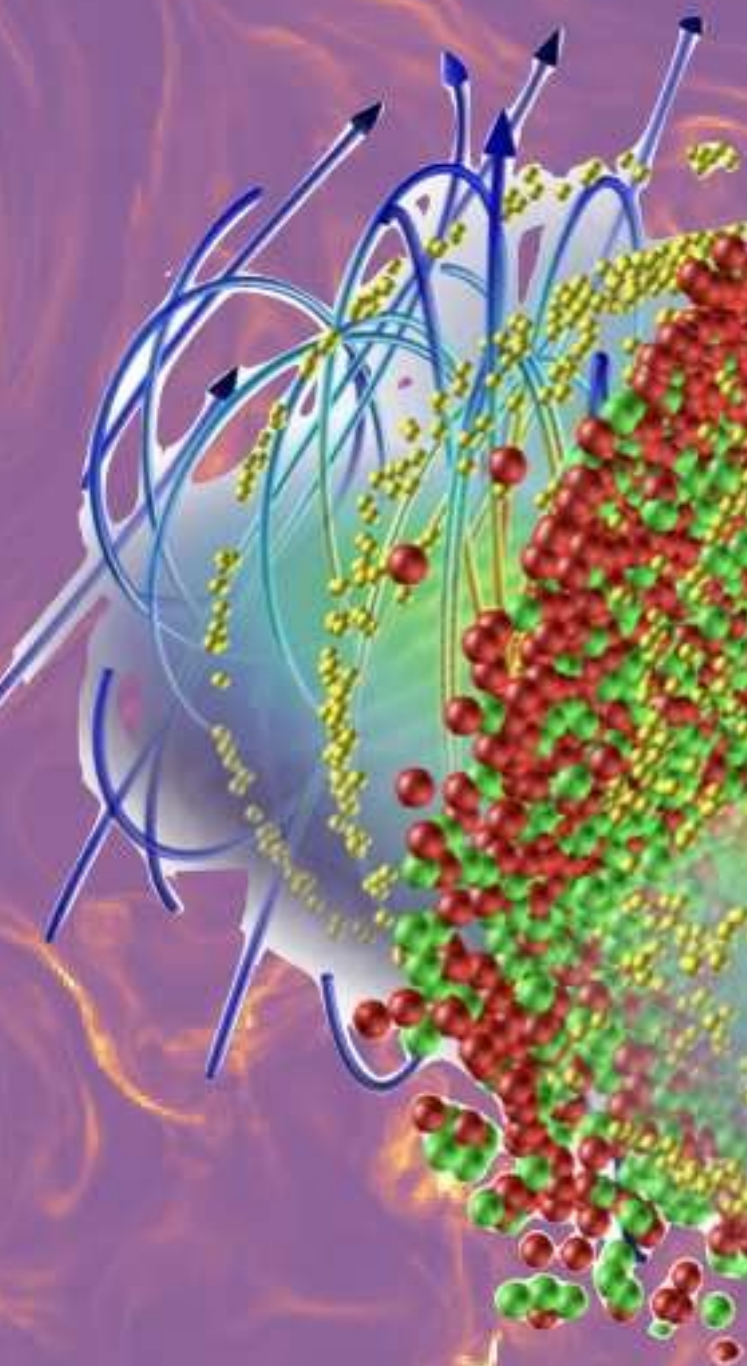
This group focuses on exploring plasmas in ultra-strong electromagnetic fields, where nonlinear quantum electrodynamics effects fundamentally alter plasma behaviour.



Arno Vanthieghem
(LUX, CNRS)



Andrey Timokhin
(Univ. of Zielona Gora)



EXPAND: Extreme Plasma Network for Advanced Discovery

Working Group 3: Relativistic Plasmas

This group focuses on plasmas moving at relativistic speeds, such as those in astrophysical jets, and studies them from particle acceleration to large-scale jet dynamics.

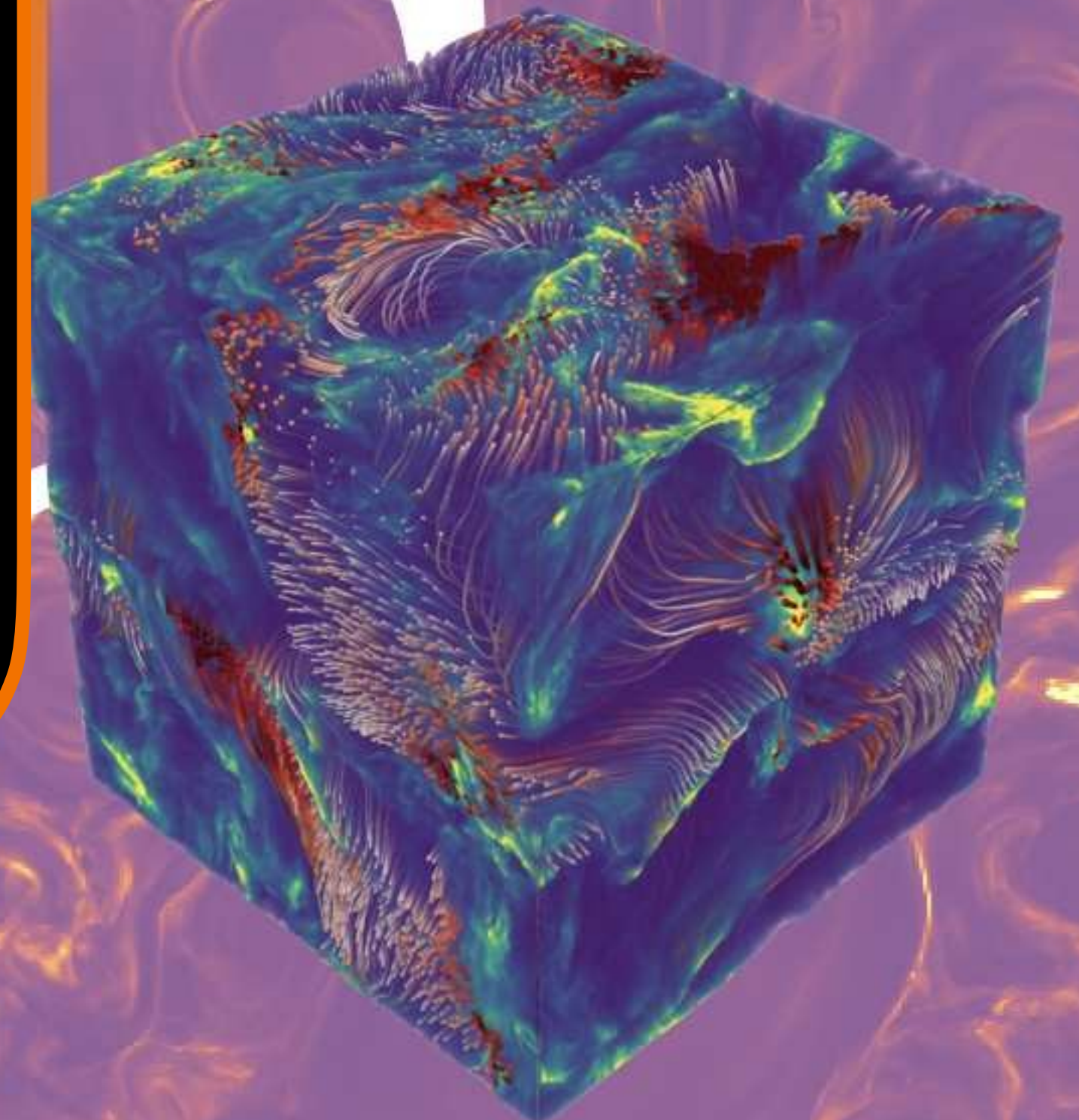


Krzysztof Nalewajko
(Copernicus Astron. Center, Warsaw)



Maria Petropoulou
(Univ. of Athens)

WG3: Relativistic Plasmas
Dynamics of relativistic plasma flows



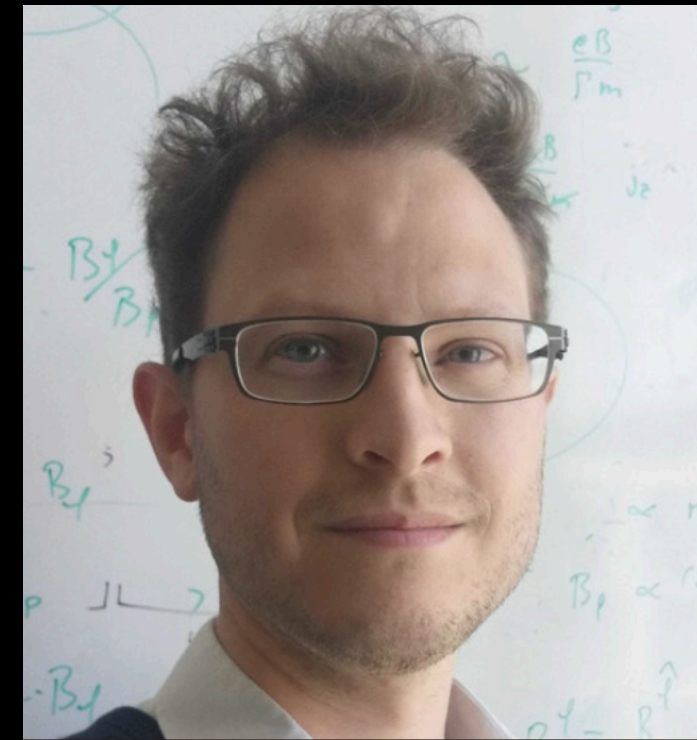
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Working Group 4: Plasmas in Strong Gravity

This group focuses on plasma behaviour in curved spacetime near black holes and neutron stars, where gravity strongly influences plasma dynamics and emission.



Alexandra Veledina
(Univ. of Turku)

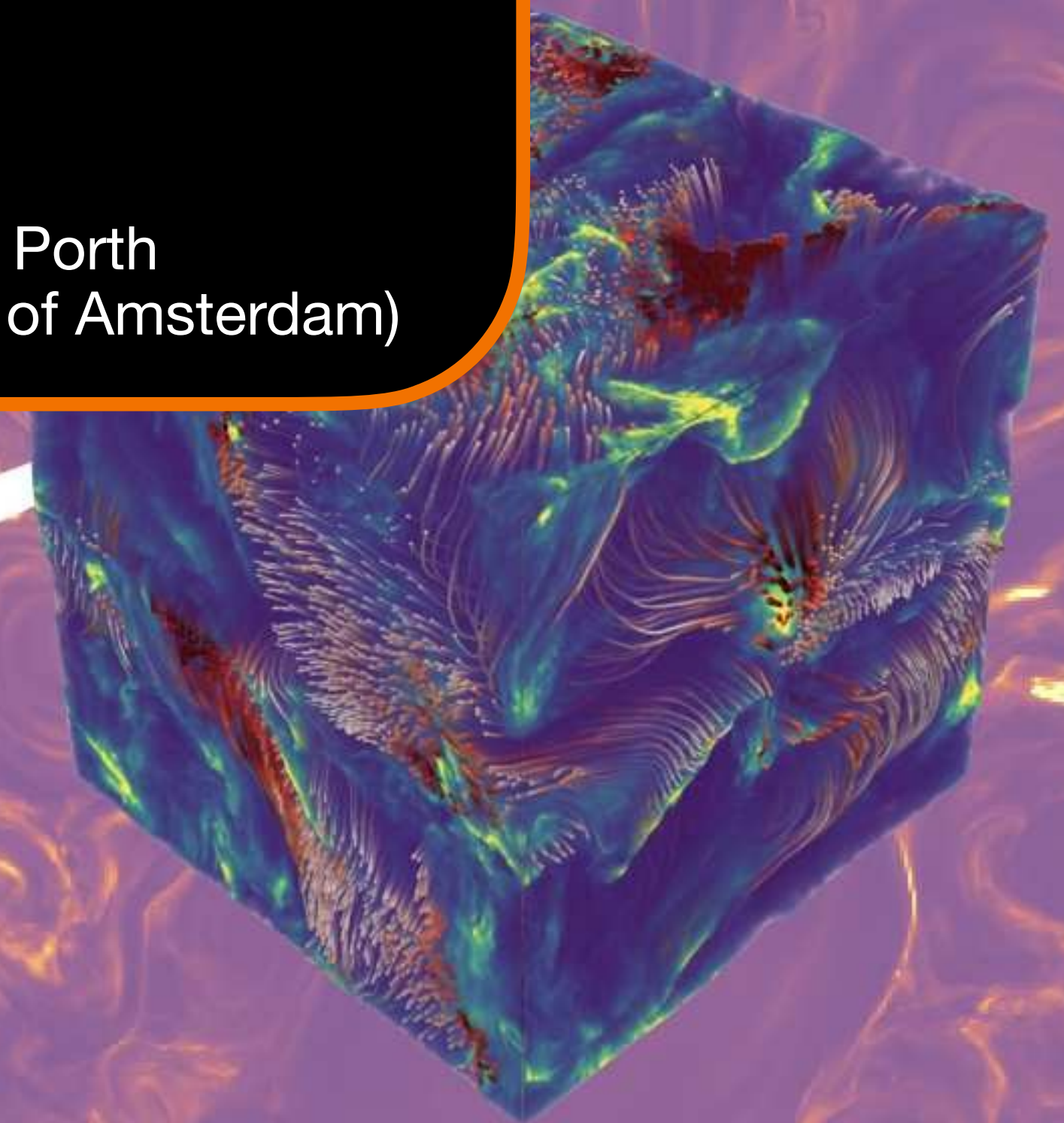
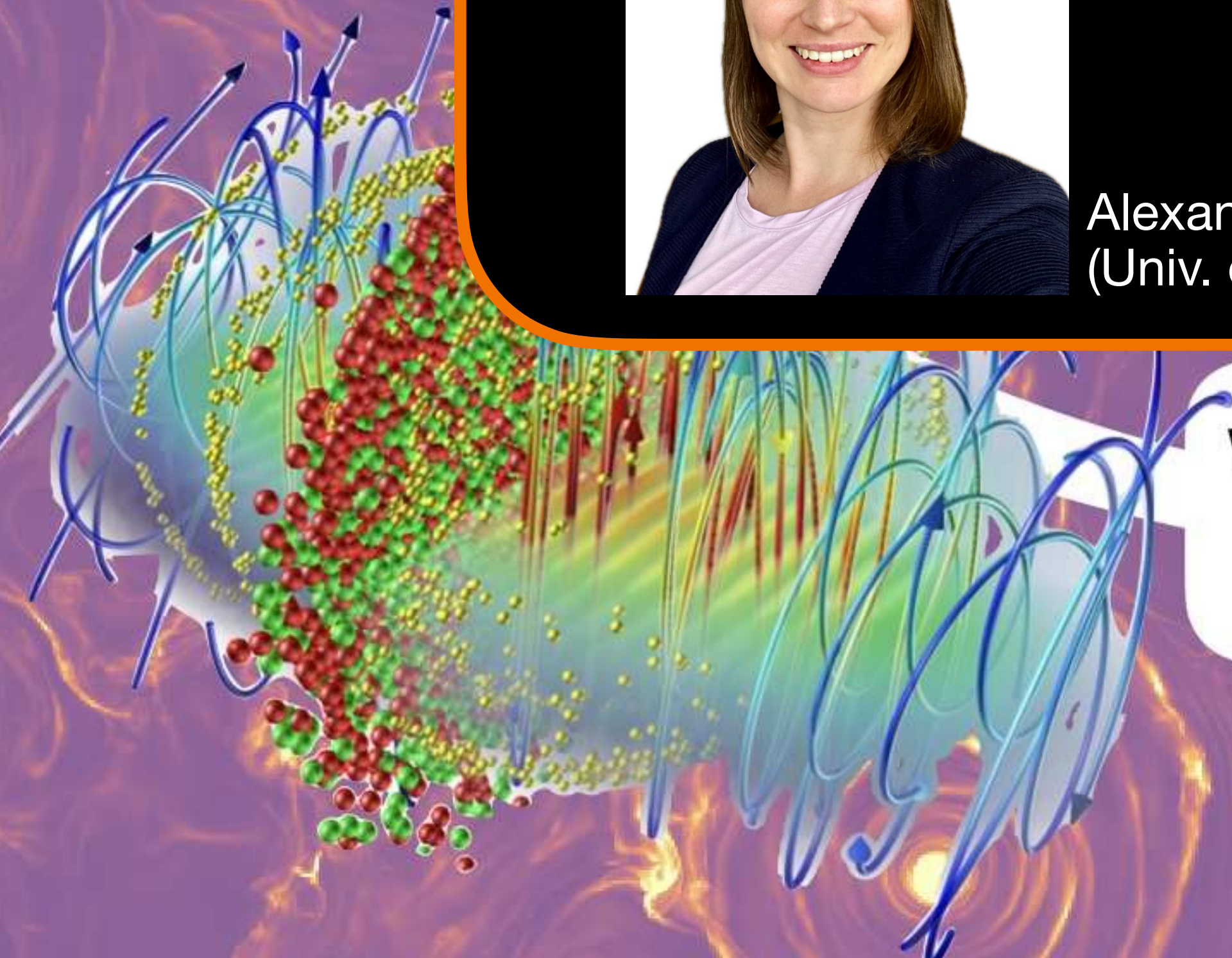


Oliver Porth
(Univ. of Amsterdam)

WG1: Radiativ
Interplay of rad
processes with

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WG4: Plasmas in Strong Gravity
Plasma dyna
and
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WG5: Computing Core
Coordination of high-performance computing efforts; development and sharing of novel modeling tools

WG4: Plasmas in
Plasma dynamic twisted s

Working Group 5: Computing Core

This group underpins all scientific activities by developing advanced numerical tools to model extreme plasmas across scales and physical regimes.



Fabio Bacchini
(Univ. of Leuven)



Philipp Moesta
(Univ. of Amsterdam)

EXPAND: Extreme Plasma Network for Advanced Discovery

Working Group 6: Training, Dissemination and Communication

This group ensures effective knowledge exchange, training, and outreach within and beyond the network.



Brian Reville
(Max Planck, Heidelberg)



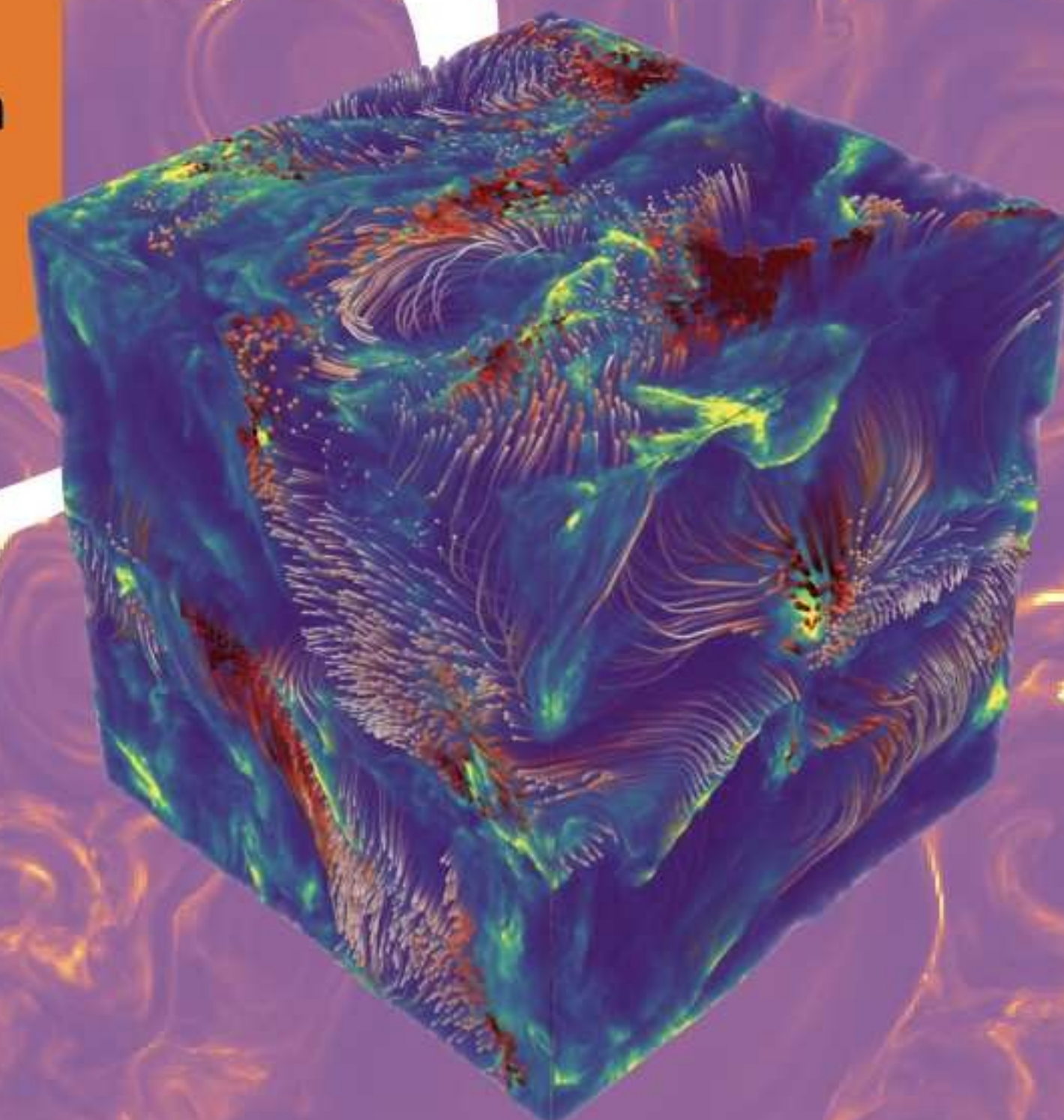
Daniel Grosej
(Univ. of Leuven)

World QED Plasmas
-strong (above-
magnetic fields

WG3: Relativistic Plasmas
Dynamics of relativistic plasma flows

WG6: Networking Core
Coordination of the
network's education,
training, and information
dissemination efforts

Strong Gravity
in curved and
spacetime



EXPAND: Extreme Plasma Network for Advanced Discovery

WG1: Radiative QED Plasmas
Interplay of radiative and QED processes with plasma physics

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Plasma dynamics in curved and twisted spacetime

www.expand-plasma.eu

www.cost.eu/actions/CA24149/

CONFERENCE

EXPAND Kickoff Conference

📅 June 1—3, 2026

📍 Lisbon Academy of Sciences, Lisbon, Portugal

Our flagship conference brings together researchers from across the network and beyond. Features keynote talks, presentations, and networking events.



Salão Nobre — Lisbon Academy of Sciences

STSM CALL

2nd Call for Short-Term Scientific Missions

📅 Application Deadline: May 15th, 2026

Short-Term Scientific Missions (STSMs) are exchange visits between institutions in COST member countries, allowing researchers to collaborate, learn new techniques, and strengthen the network.

📄 [Application Details](#)

~15 applications funded
for ~33k euros

Extreme Plasma Network for Advanced Discovery is a COST Action dedicated to advancing our understanding of plasmas under the most extreme conditions in the Universe.

It brings together experts from astrophysics, plasma physics, high-energy physics, and computational science to address these challenges through a coordinated and interdisciplinary effort.

Our core goals are to:

- Push the frontiers of extreme plasma physics through collaborative research and shared tools
- Build a cohesive, interdisciplinary community
- Train and empower the next generation of researchers
- Bridge theory, simulations, observations, and laboratory experiments
- Share scientific advances and excitement with both the scientific community and the public



Working Group 1: Radiative QED Plasmas

Key Scientific Questions

- How does radiation and pair production affect the physics of dissipation processes such as shocks, magnetic reconnection, and turbulence?
- What are the observational signatures of radiative QED processes?
- Can laboratory experiments probe these processes and validate underlying models?

Key Objectives / Main Tasks

- Conduct a systematic comparison of numerical methods (e.g. PIC, MHD, Monte Carlo, radiative transfer), establish their domains of validity, and identify current gaps.
- Map the parameter regimes where laboratory experiments can access astrophysically relevant conditions and benchmark simulations.
- Coordinate the use of observational constraints to guide theoretical and numerical development, and use models to inform observational strategies.

Working Group 2: Strong-Field QED Plasmas

Key Scientific Questions

- How can we describe the self-consistent coupling between plasma and nonlinear Maxwell's equations in the non-perturbative QED regime?
- What are the observational signatures of strong-field QED processes, particularly in strongly magnetised objects such as magnetars?
- Can these effects be reproduced in laboratory experiments using ultra-intense lasers and particle beams?

Key Objectives / Main Tasks

- Develop novel numerical capabilities for modelling plasmas in the non-perturbative QED regime, exploring and comparing different approaches.
- Define and prepare testbed experiments relevant to high-energy astrophysical systems in current and future facilities.
- Perform local and global simulations of strongly magnetised magnetospheres, linking microphysics to observable signatures.

Working Group 3: Relativistic Plasmas

Key Scientific Questions

- How can astrophysical jets produce ultra-high-energy cosmic rays and neutrinos?
- How do plasma processes control the dynamics, stability, and emission properties of relativistic jets?
- Can laboratory experiments probe the relevant dissipative processes in relativistic plasmas?

Key Objectives / Main Tasks

- Understand jet propagation by coupling numerical frameworks across scales, from launching to large-scale evolution.
- Develop hybrid modelling approaches combining MHD, force-free electrodynamics, and kinetic descriptions with mesh refinement.
- Establish knowledge exchange between laboratory plasma and astrophysical communities to constrain key dissipative processes.

Working Group 4: Plasmas in Strong Gravity

Key Scientific Questions

- Are kinetic plasma processes significantly modified by strong gravity?
- How are emission properties (multi-wavelength spectra, polarisation, imaging) shaped by strong gravity and radiation fields?
- How can plasmas in curved spacetime be modelled accurately and efficiently?

Key Objectives / Main Tasks

- Advance 3D modelling of accretion flows by linking GRMHD and GRPIC simulations across scales.
- Coordinate global simulations of accretion onto compact objects using GRMHD, GRPIC, and hybrid approaches.
- Connect theoretical models to observations, including constraints from X-ray polarimetry, EHT imaging, and infrared interferometry.

Working Group 5: Computing Core

Key Scientific Questions

- Can we develop shared computational frameworks incorporating new physics (radiation, QED, gravity)?
- When do microphysical processes affect global plasma dynamics, and vice versa?
- Can advanced numerical methods and machine learning enable improved multi-scale modelling?

Key Objectives / Main Tasks

- Identify baseline physics scenarios and critical numerical needs across the network.
- Develop innovative multi-scale computational approaches, including physics-informed machine learning methods.
- Promote the exchange and integration of tools, including through workshops, hackathons, and collaborative development.

Working Group 6: Training, Dissemination and Communication

Key Focus

Training, communication, dissemination, and community building across the Action.

Key Objectives / Main Tasks

- Organise summer and winter schools, including tutorials, hackathons, and career development activities.
- Produce outreach and educational materials, including videos and scientific highlights.
- Manage the Action's website, communication channels, and social media presence.

