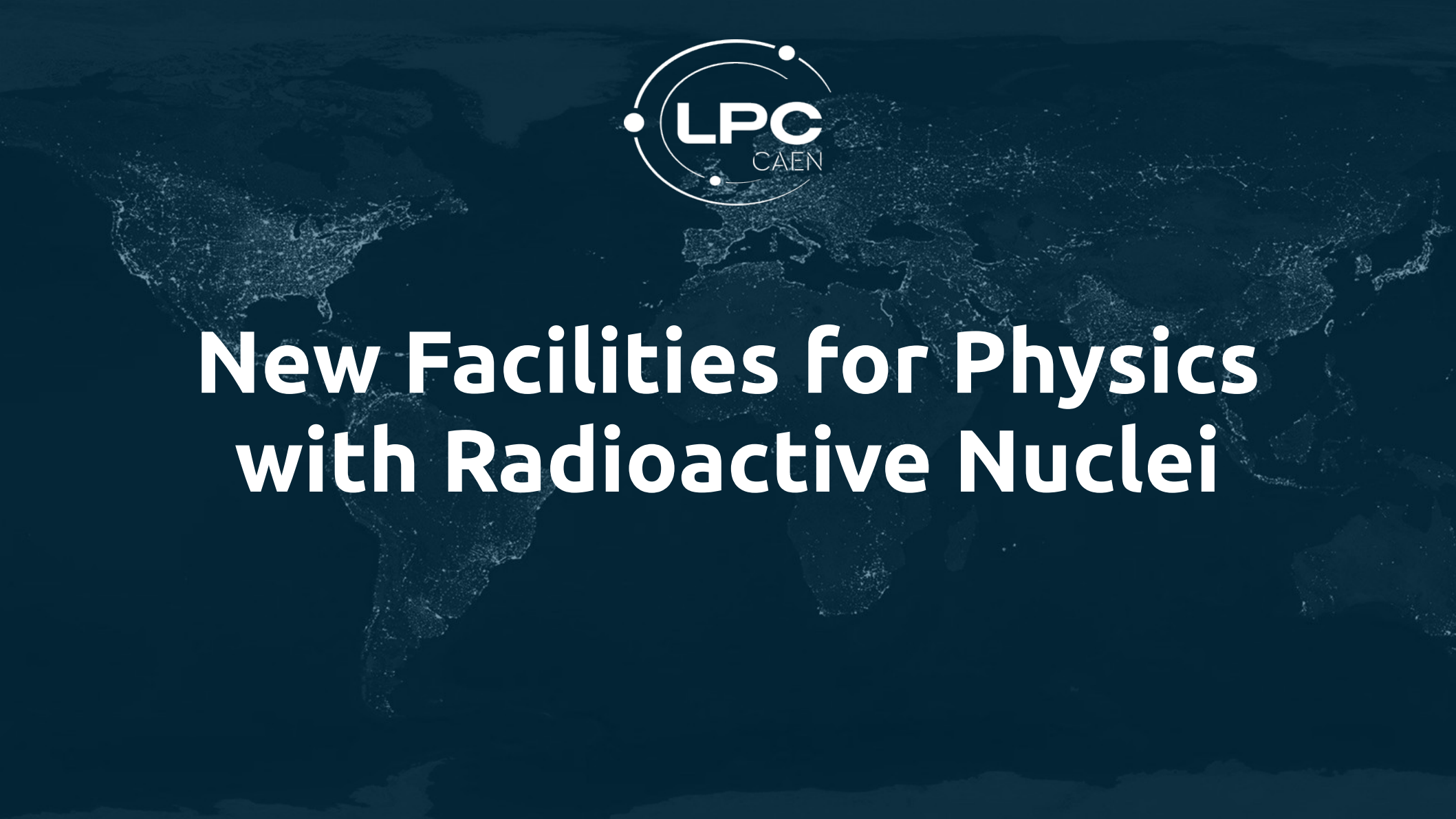
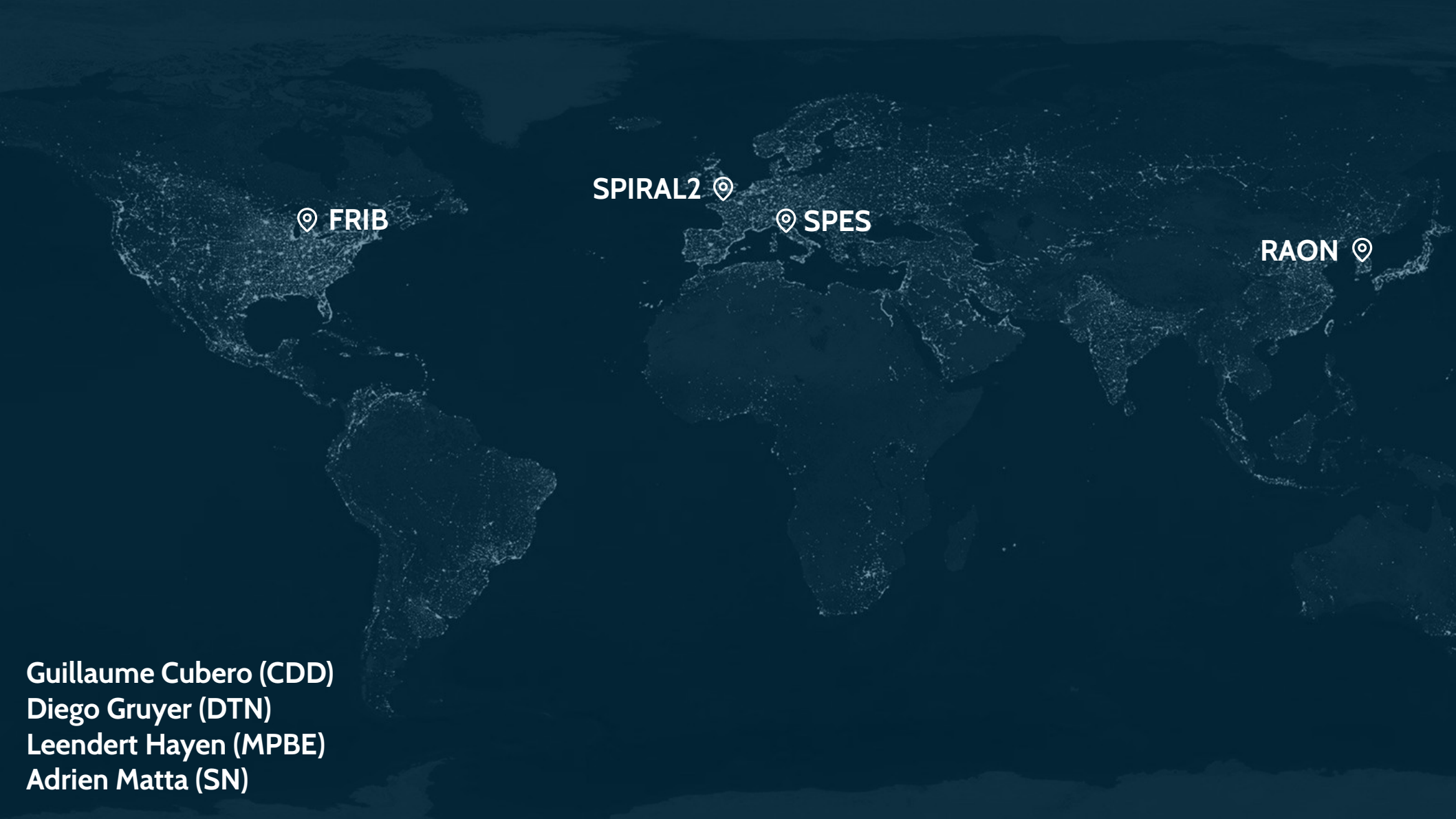


New Facilities for Physics with Radioactive Nuclei



Guillaume Cubero (CDD)
Diego Gruyer (DTN)
Leendert Hayen (MPBE)
Adrien Matta (SN)

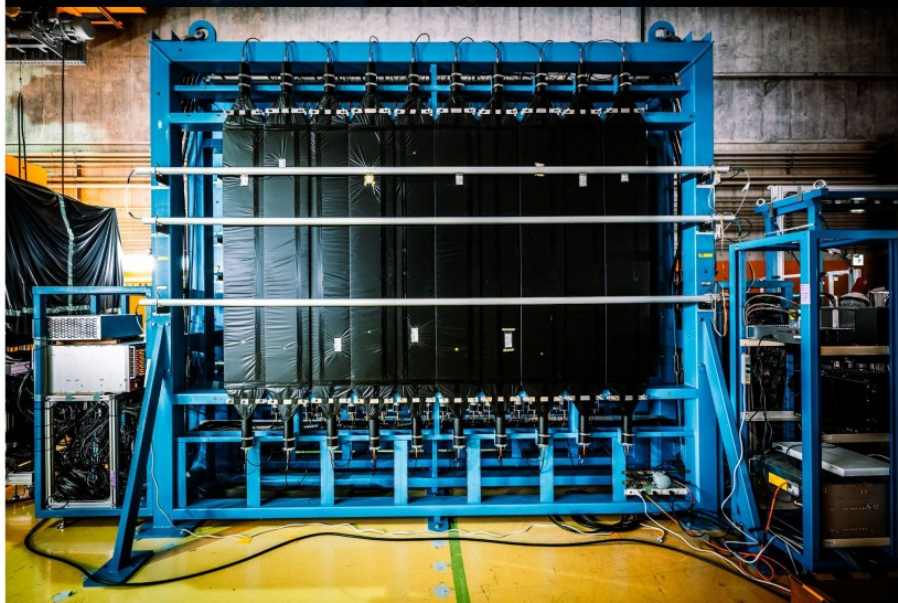
SAMURAI : LIGHT NUCLEI AT THE DRIPLINE

Exotic nuclei structure:

- Neutron rich nuclei at the dripline
  - Advance neutron detection
  - Nebula & **Nebula-Plus**
- Direct reaction
  - Light charged particle detection
  - **Strasse**
- Dependent on **^{48}Ca supply**
  - No more at RIKEN
  - Competition with FRIB

Group contribution

- Detectors: Strasse, Nebula-Plus
- Software: Online/Offline analysis
- Organisation: Steering committee
- Science: Leading proposals



Nuclear Dynamics and Thermo-dynamics (DTN) activities

Rémi Bougault, Ilham Dekhissi, Dominique Durand, Diego Gruyer, Maxime Henry, Nicolas Le Neindre, Olivier Lopez, Antonin Valente, Emmanuel Vient

INDRA and FAZIA collaborations
France, Italy, South Korea, Poland, Spain

Asymmetric nuclear matter Equation of State
Composition of dilute and warm nuclear matter
Nuclear dynamics and reaction mechanisms
Emergence of clustering in nuclei

Heavy-ion collisions around 10-100 MeV/nuc.
Charged particle multidetectors

LNS Catania (2014-2018)
GANIL Caen (since 2019)

Jean-Claude Angelique, Vincent Bosquet, Maylis Brun, Antoine de Roubin, Victor Dumenil, Xavier Fléchard, Daniel Galbinski, Romain Garreau, Driss Guillet, Leendert Hayen, Anjali Kadyan, Mohamad Kanafani, Thomas Lefort, Anthony Lejuez, Etienne Lienard, Skyy Pineda, Antoine Vezon

Fundamental Interactions with RIBs

- Precision studies of electroweak decays
  → Exotic interactions at the TeV scale
  → Quark mixing matrix unitarity
  → CP violation
  → Lepton number violation

- Precise laser spectroscopy
  → Nuclear structure
  → Fundamental constant variation

- nEDM@PSI, bSTILED@GANIL, MORA@JYFL, BeEST@TRIUMF, SALER@FRIB, COMET@JPARK, JYFLTRAP@JYFL,...

Overall Sustainable Development and Social Responsability plan (DD&RS)

No clear policy from the institute

NUCLÉAIRE & PARTICULES

The SDC is working to propose recommendations

Sustainable Development and Social Responsability

Guillaume Cubero for the SDC team

- 162k missions on CNRS credits in 2019
  90% of GHG from missions related related to travel by plane
  300Mkm by plane for the missions in 2019

  → LPC 20% of GHG
  → 1 A/R Paris - Tokyo = 3.5 tCO_2 eq.

- One hour of beam time :
  → CERN ~35 tCO_2 eq. / user
  → GANIL ~30 tCO_2 eq. / user

How to choose the next installations ?

Facility policies consistent with sustainable environmental impact ?

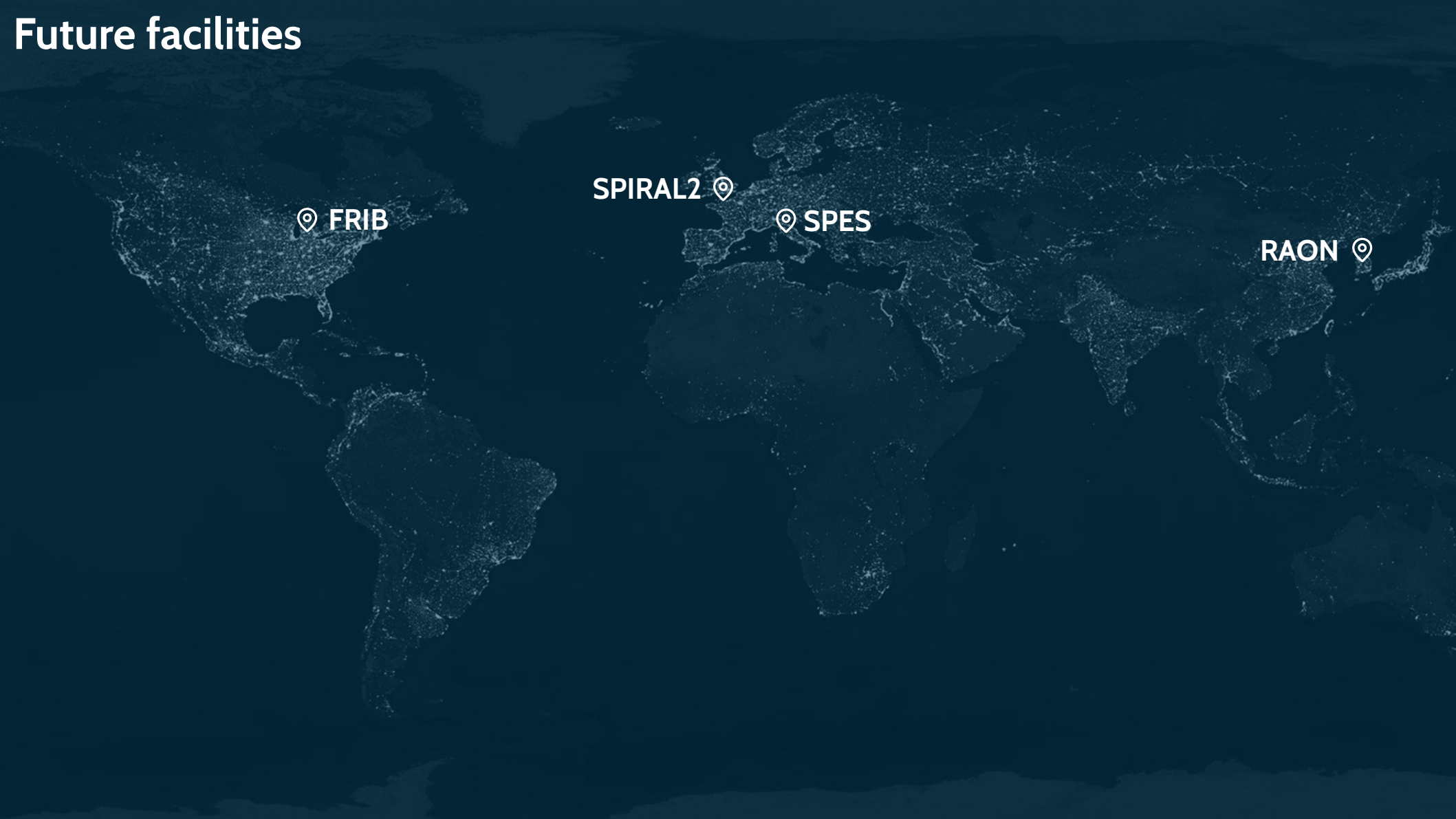
→ Local electricity carbonation (gCO2/kWh) , use of GHG for cooling and detection…

Concerning the missions, what can you do ?

→ Far : Long-term mission ? Mandatory in-person ? Number of people for each mission ?

→ Close : Consistent installations with reduction of environmental impact ?

Future facilities



New generation technologies at DESIR & FRIB

ASGARD: Recoil spectroscopy at the **eV frontier**

for fundamental physics: *terra incognita*

Unlock **hundreds of isotopes**
for study

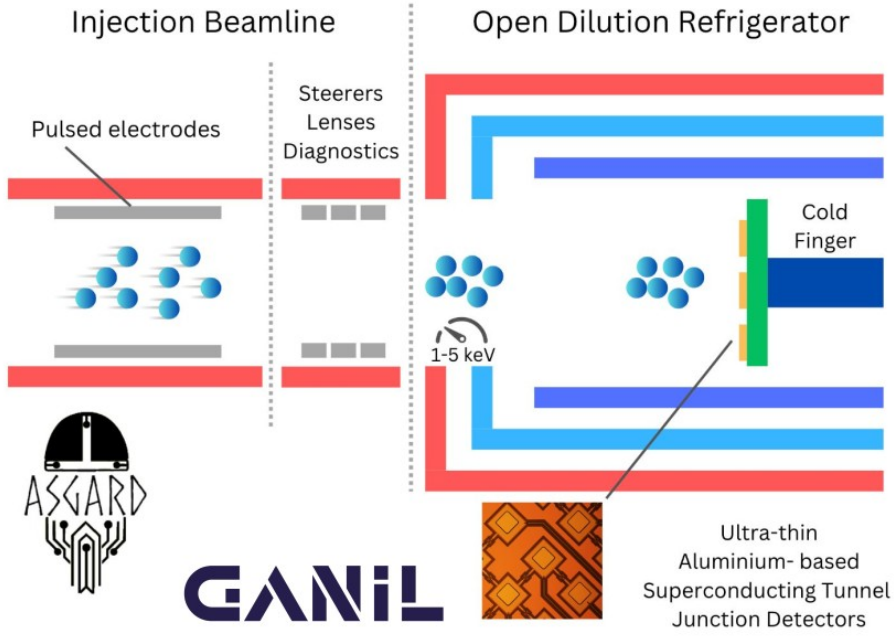
- Nuclear structure
- Auger spectroscopy

S^3(LEB) will **open new windows**

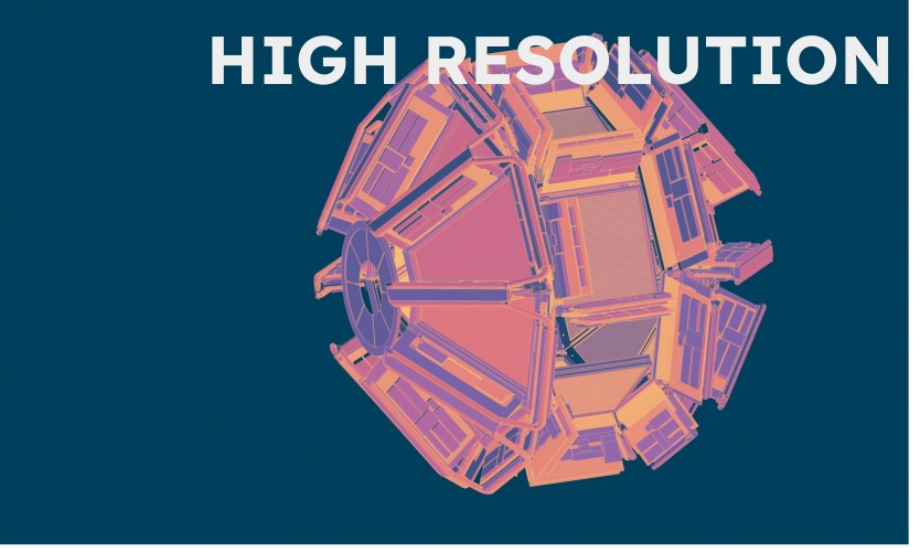
Atomic Beam Unit + Microwave excitation

has potential for several orders of

magnitude improvement



HIGH RESOLUTION SPECTROSCOPY

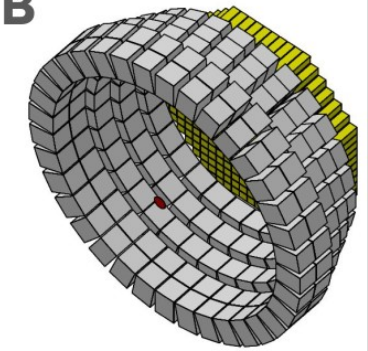


Exotic nuclei structure:

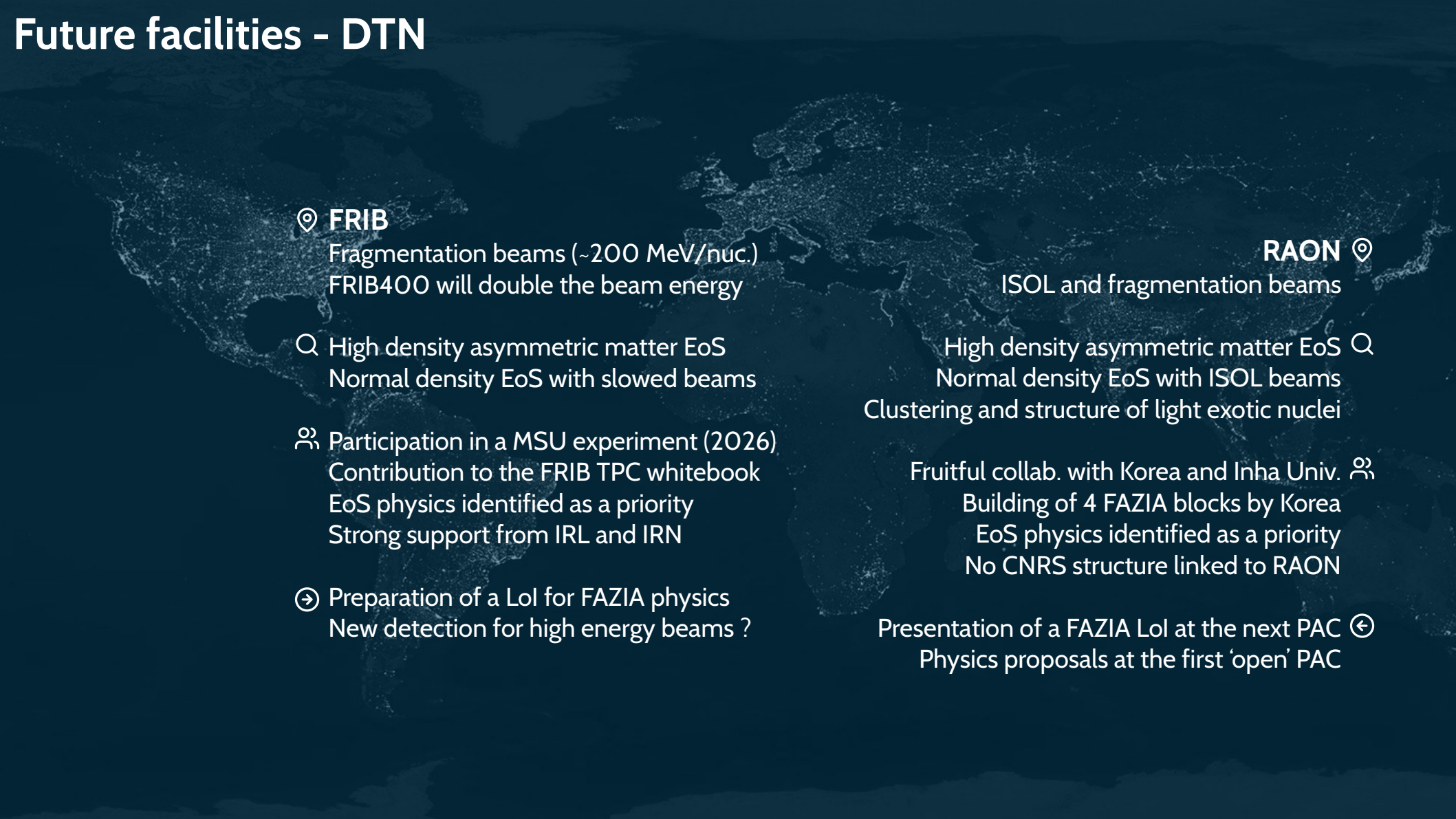
- Neutron rich medium mass nuclei
  - Advance Gamma detection
  - **AGATA or HYPATIA**
- Direct reaction
  - Light charged particle detection
  - **GRIT or STRASSE**
- Adding nucleon **ISOL BEAM**:
  - Limited scope at **GANIL**
  - Strongly delayed at **SPES**
- Removing nucleon **RIKEN upgrade:**
  - Competitive with **FRIB**

Group contribution

- Detectors: **GRIT/STRASSE/**HYPATIA
- Software: **nptool**
- Organisation: GRIT MB/Sunflower SC
- Science: Leading proposals



Future facilities - DTN



FRIB
Fragmentation beams (~200 MeV/nuc.)
FRIB400 will double the beam energy

High density asymmetric matter EoS
Normal density EoS with slowed beams

Participation in a MSU experiment (2026)
Contribution to the FRIB TPC whitebook
EoS physics identified as a priority
Strong support from IRL and IRN

Preparation of a LoI for FAZIA physics
New detection for high energy beams ?

RAON
ISOL and fragmentation beams

High density asymmetric matter EoS
Normal density EoS with ISOL beams
Clustering and structure of light exotic nuclei

Fruitful collab. with Korea and Inha Univ.
Building of 4 FAZIA blocks by Korea
EoS physics identified as a priority
No CNRS structure linked to RAON

Presentation of a FAZIA LoI at the next PAC
Physics proposals at the first 'open' PAC

Discussion