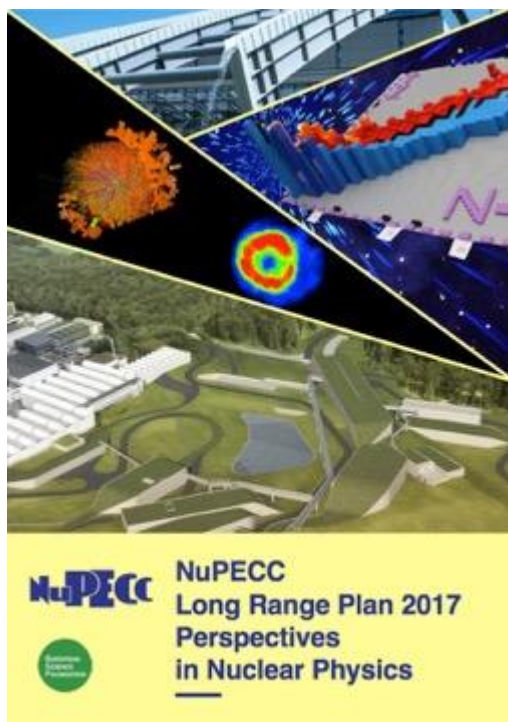


# News from NuPECC



**Marek Lewitowicz**  
*Chair of NuPECC*



**APPEC GA December 9<sup>th</sup> 2020**

The European Expert Board for Nuclear Physics  
hosted by European Science Foundation

**Representing**  
about 6000 scientists

**Composition:**

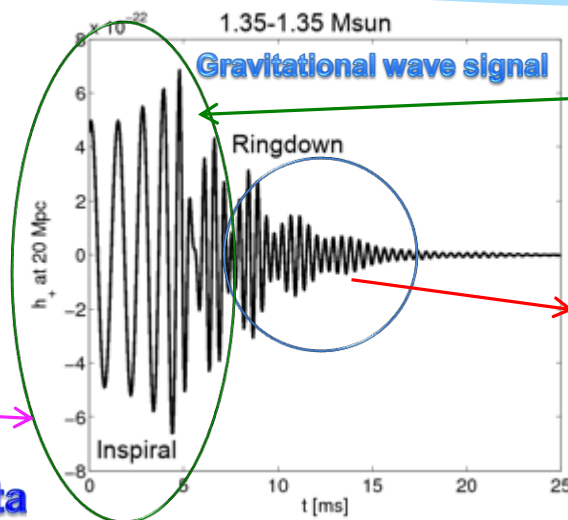
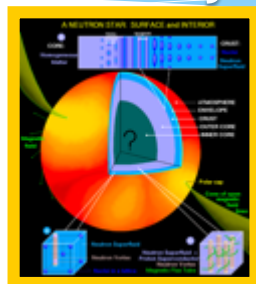
- 34 representatives from 21 countries, 3 ESFRI NP Infrastructures, ECT\* & JINR Dubna
- 3 associated members (Israel, iThemba Labs and Nishina Center)
- 9 observers (ESF, NPD/EPS, ECFA, NSAC, ANPhA, ALAFNA, CINP, IAEA, APPEC)

3 regular Committee meetings/y

32 Years of NuPECC activities





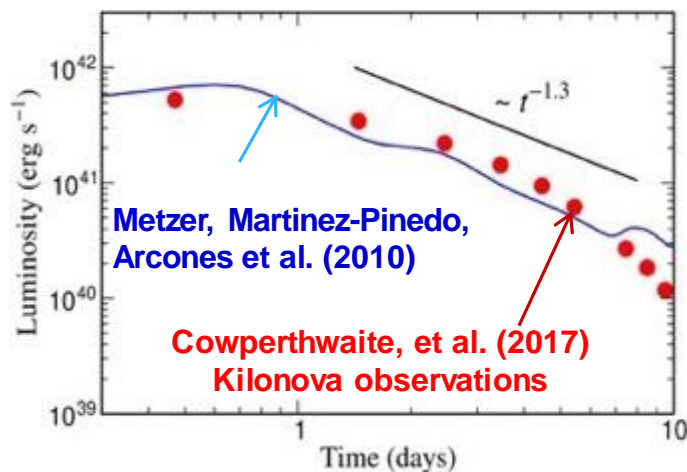


Neutron star mass

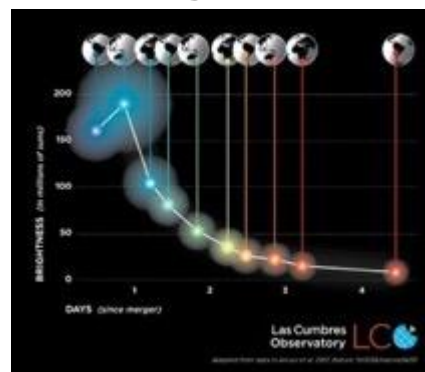
Ringdown depends on the Nuclear Equation of state

The messengers from neutron star mergers :

- Gravitational waves
- Electromagnetic signals characterizing the nuclei in the ejecta
- neutrinos



Gravitational wave emission seen together with electromagnetic signals



Time evolution determined by the radioactive decay of r-process nuclei (science drive of facilities with RIB)

Joint ECFA-NuPECC-APPEC EoI: Gravitational Waves for fundamental physics

<http://www.nupecc.org/jenaa/?display=eois>

**LRP Recommendations: Strong support for a large effort involving small scale accelerators ..... & large infrastructures**



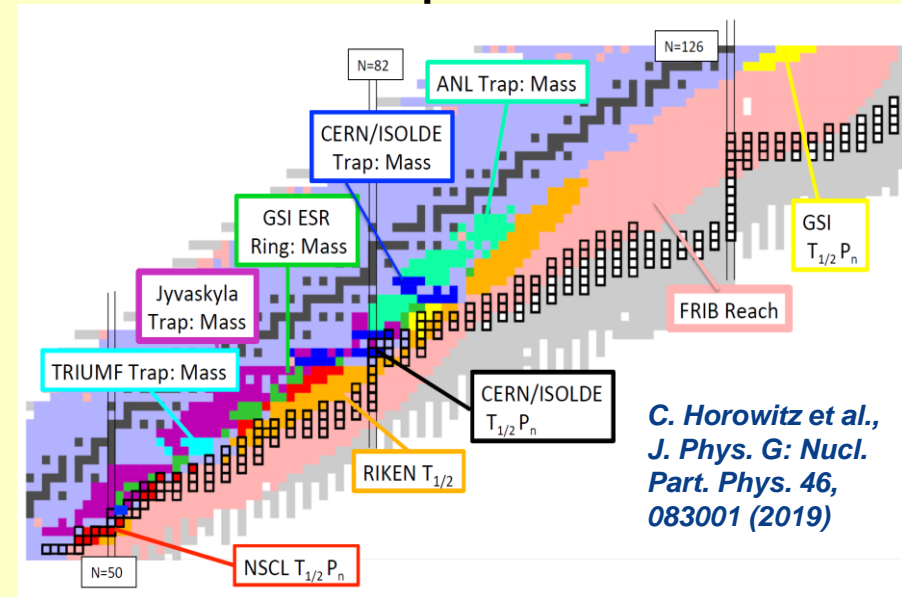
**In particular at smaller scale accelerators :**

- BBN and fusion reaction in stars for light nuclei nucleosynthesis
- reactions for energy generation

**LUNA, LNS, ALTO, n-TOF,...**

## Nucleosynthesis of medium to heavy nuclei

**Example: Mass measurements & r-process**



*C. Horowitz et al.,  
J. Phys. G: Nucl. Part. Phys. 46,  
083001 (2019)*

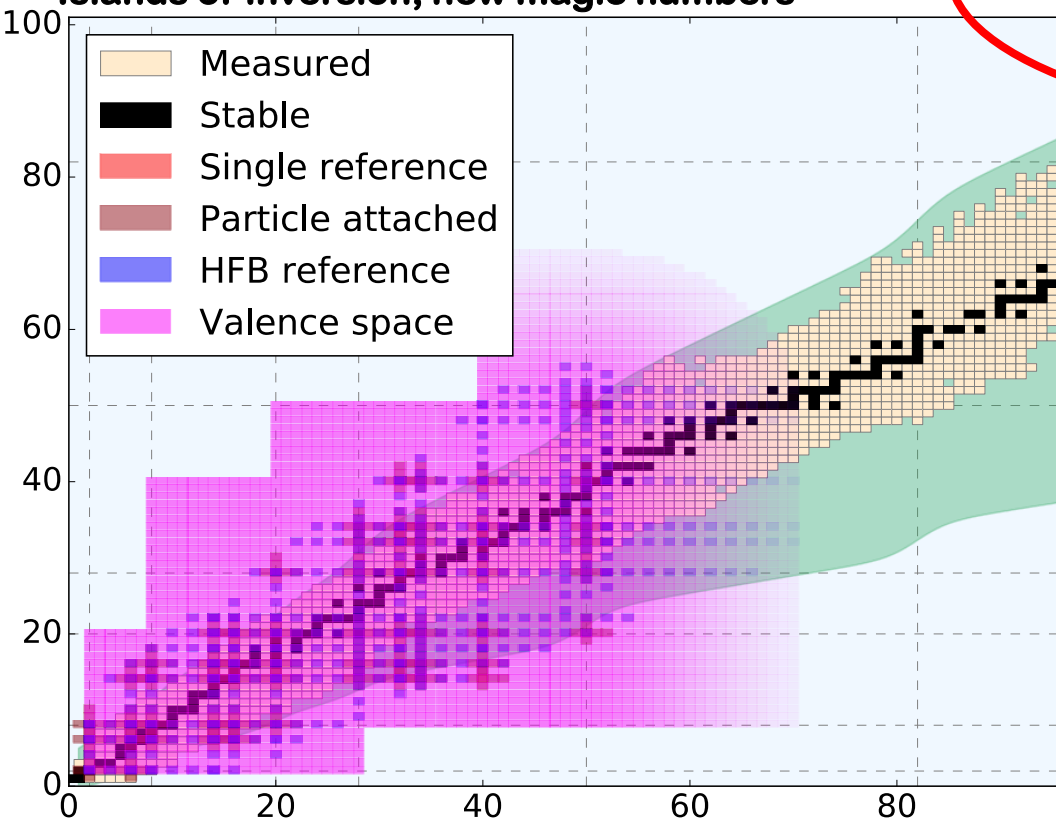
**Scientific programs at :**

- FAIR
- ISOLDE-SPES-JYFL
- GANIL

### Theory for Next-Generation Nuclear Physics Facilities

#### Ab initio valence-shell Hamiltonians

Ab initio prediction of nuclear driplines/*r*-process  
Islands of inversion, new magic numbers



#### Fundamental physics

Effective electroweak operators: M1, GT, ...  
Effective  $0\nu\beta\beta$  decay operator  
WIMP-Nucleus scattering  
Superaligned transitions

#### Outstanding issues

Controlled many-body approximation  
E2 operators problematic  
Continuum essential beyond stability  
Quantify uncertainties

#### Experimental overlap

Best data for constraining nuclear forces  
New measurements of driplines  
Data on magic numbers in exotic nuclei  
Precision data on GT transitions

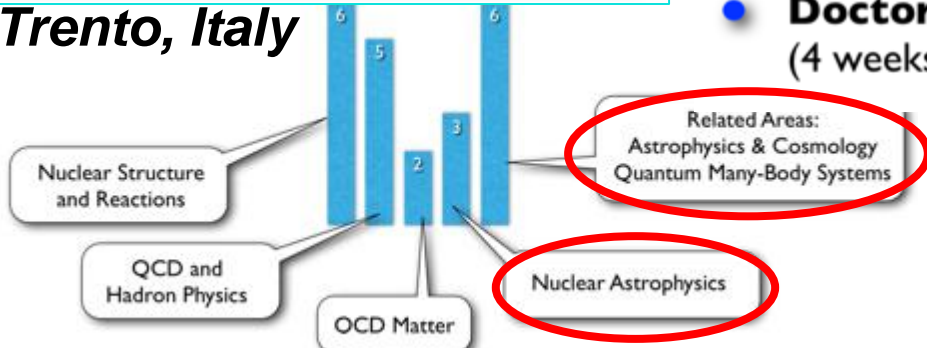
*Courtesy of Jason D. Holt*



Since 27 Years

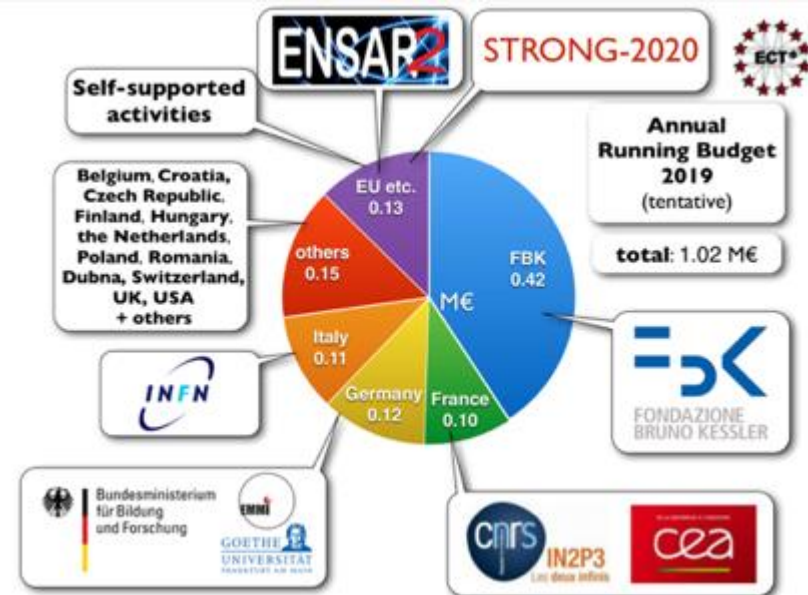
## Scientific activities at ECT\*

Trento, Italy



- International **workshops** and **collaboration meetings** (typically around 20-25 events per year)
- **Doctoral training** programs and **Talent schools** (4 weeks of lectures for advanced PhD students)

## ECT\* budget



ECT\* - EuCAPT collaboration to be developed



Complete urgently the construction of the ESFRI flagship **FAIR** and develop and bring into operation the experimental programme of its four scientific pillars APPA, CBM, NUSTAR and PANDA.

Support for construction, augmentation and exploitation of world leading ISOL facilities in Europe towards EURISOL.

**GANIL/SPIRAL2  
ISOLDE, SPES,  
JYFL**



Support for the full exploitation of existing and emerging facilities.

**ELI-NP  
NICA, SHEF  
MYRRHA  
IFMIF-DONES**

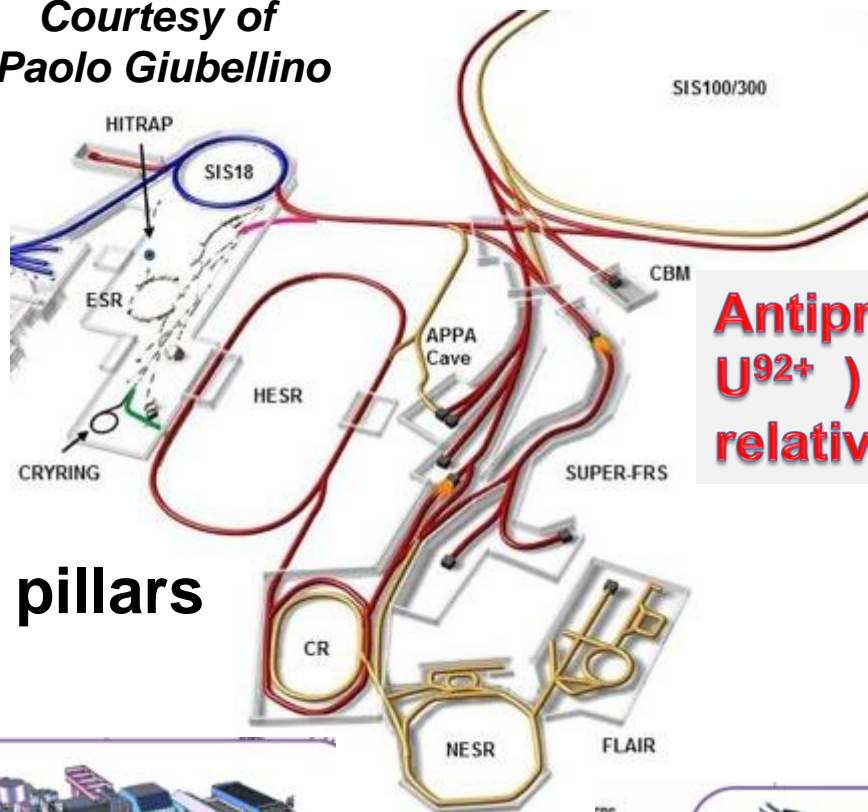
Support for ALICE and the heavy-ion programme at the LHC with the planned experimental upgrades.



Support to the completion of AGATA in full geometry.



Courtesy of  
Paolo Giubellino



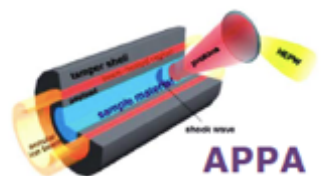
**Top priority for European  
Nuclear Physics Community**

**Antiprotons, highly charged ions (e.g.  $U^{92+}$ ) and exotic Nuclei) from rest to relativistic energies 4.9 GeV/A**

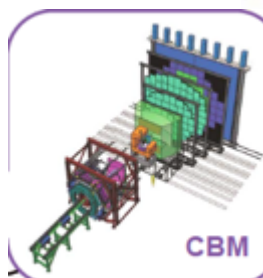
**4 pillars**



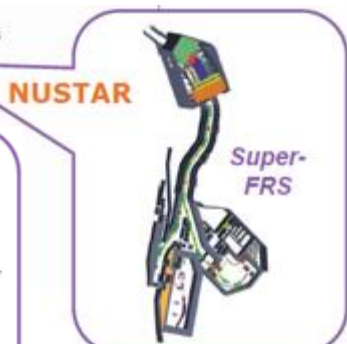
PANDA



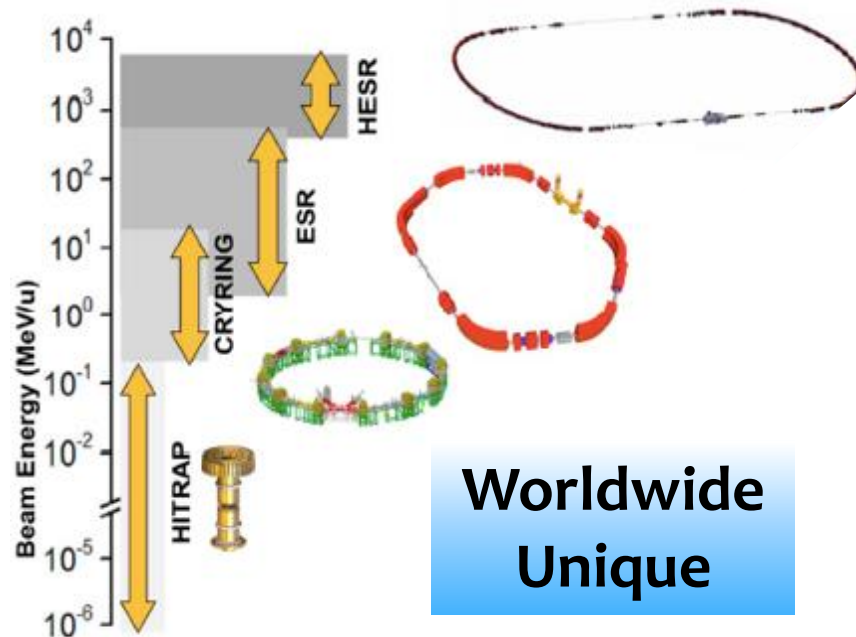
APPA



CBM



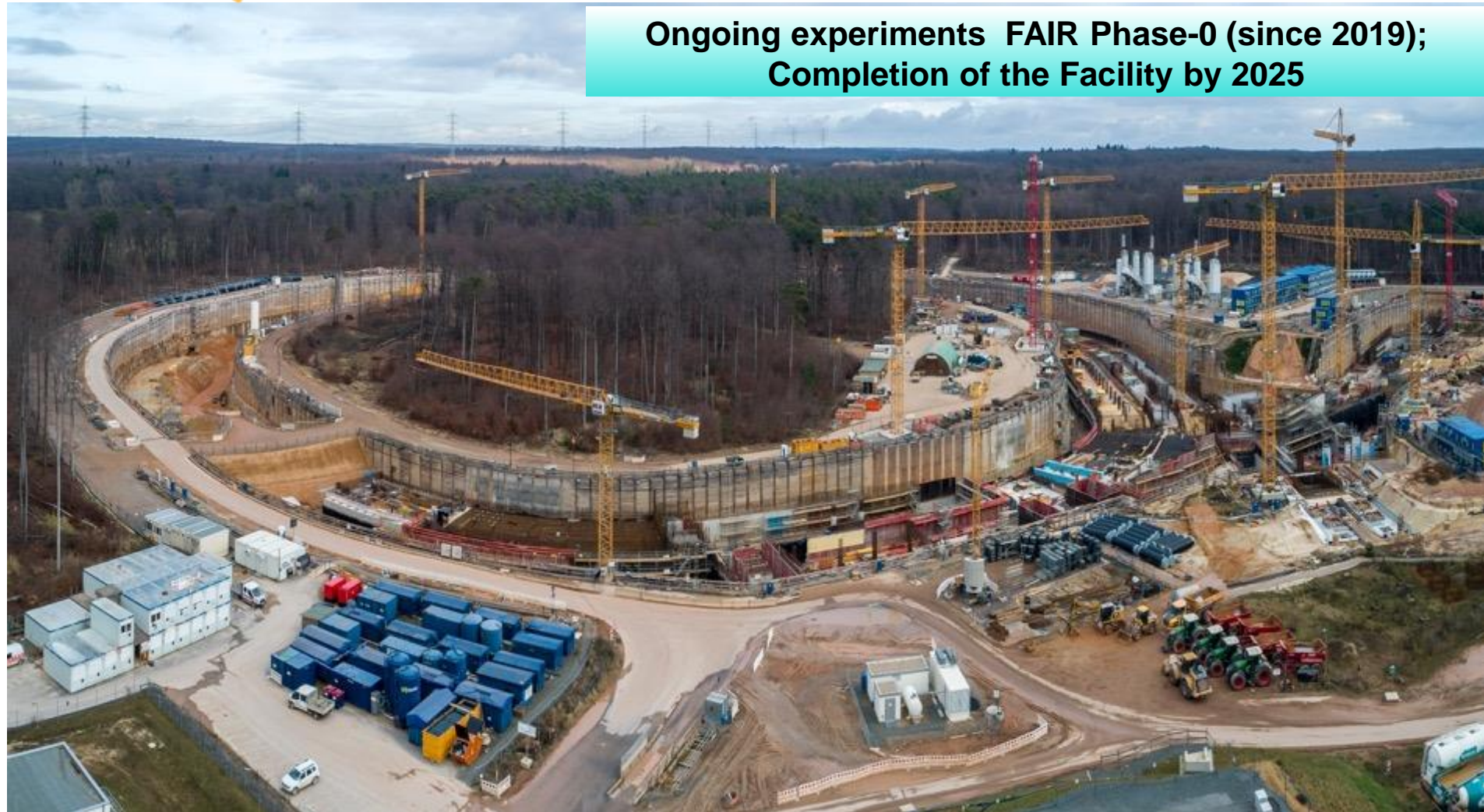
Super-FRS



**Worldwide  
Unique**

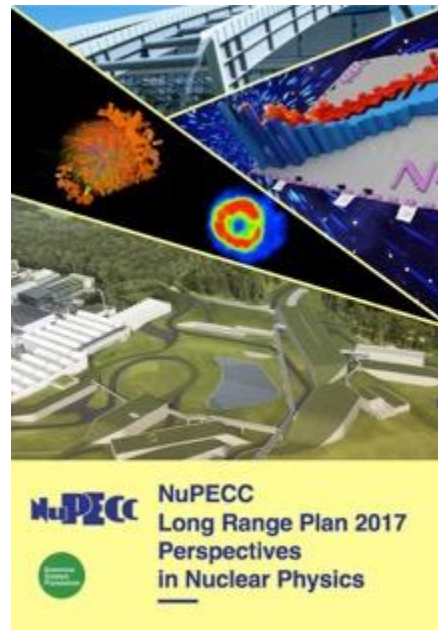


Ongoing experiments FAIR Phase-0 (since 2019);  
Completion of the Facility by 2025



*Curtesy of Paolo Giubellino*





## Nuclear Physics & Astroparticle Physics

- Neutron stars and Neutron star mergers
  - Equation of state of nuclear matter
  - Nucleosynthesis
- BSM
- DM
- Theory
- Data
- Facilities and technologies

**Joint ECFA-NuPECC-APPEC Activities (JENAA) should be further developed**



**Thank you for your attention**