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STATUS REPORT OF THE n_TOF FACILITY AFTER THE 2nd CERN LONG SHUTDOWN PERIOD

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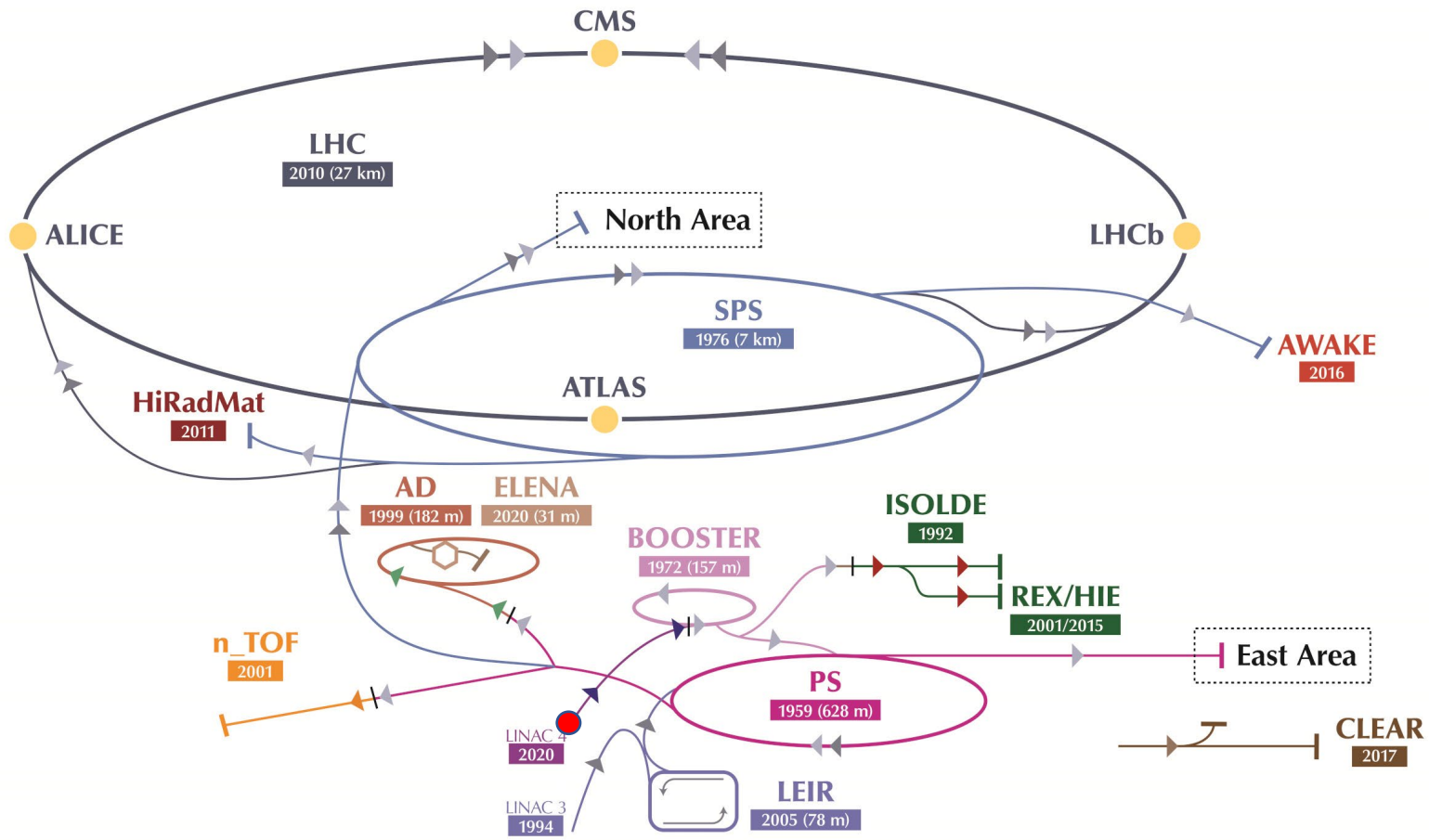
The n_TOF facility

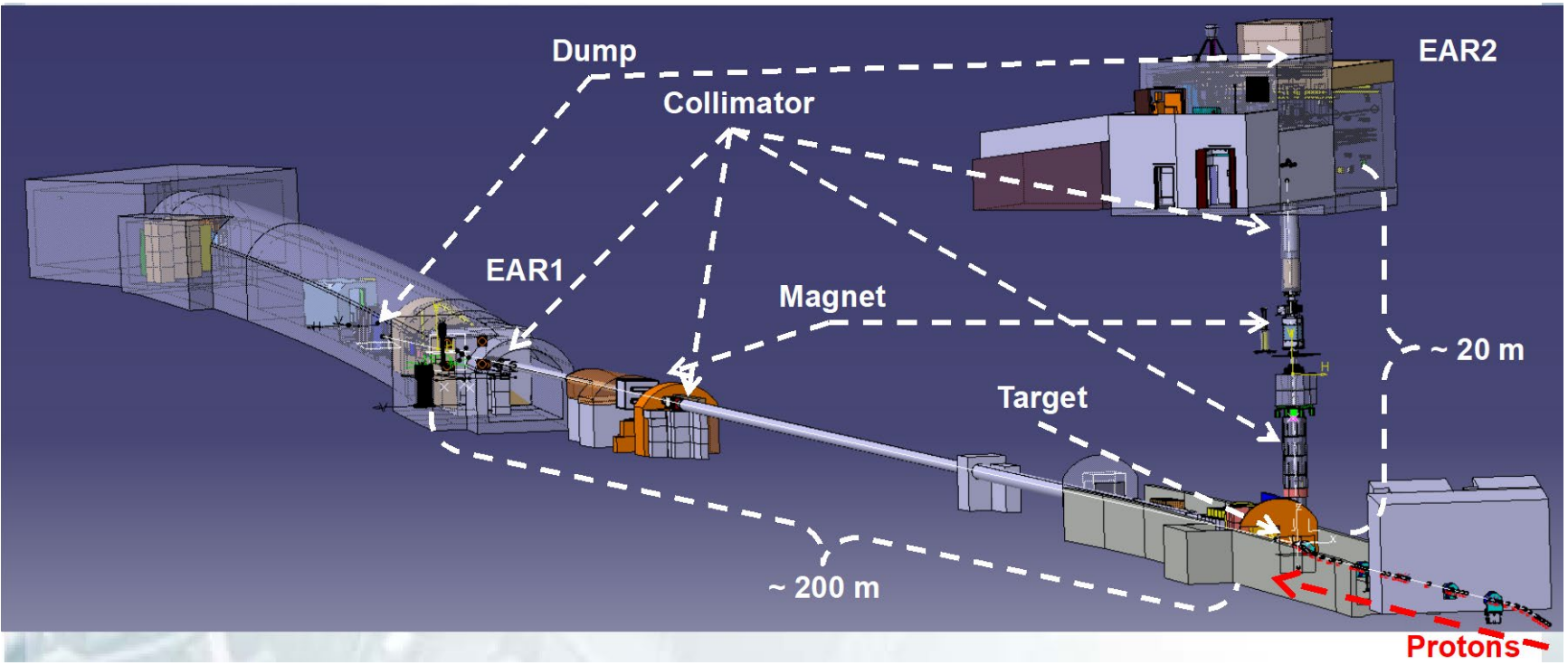
Motivation:
High precision neutron induced cross section measurements for:

a) Nuclear astrophysics
b) ADS systems and G4 Fast neutron reactors
c) Medical physics
d) Basic research
e) …

- Proton beam from PS (20GeV)
- 1 pulse / 1.2s
- 300 neutrons /proton
- 7e12 protons/pulse



The n_TOF facility



Two experimental areas (EAR)

- Horizontal flight path
  EAR1 at 200 m
- Vertical flight-path
  EAR2 at 20 m

Both beam lines with

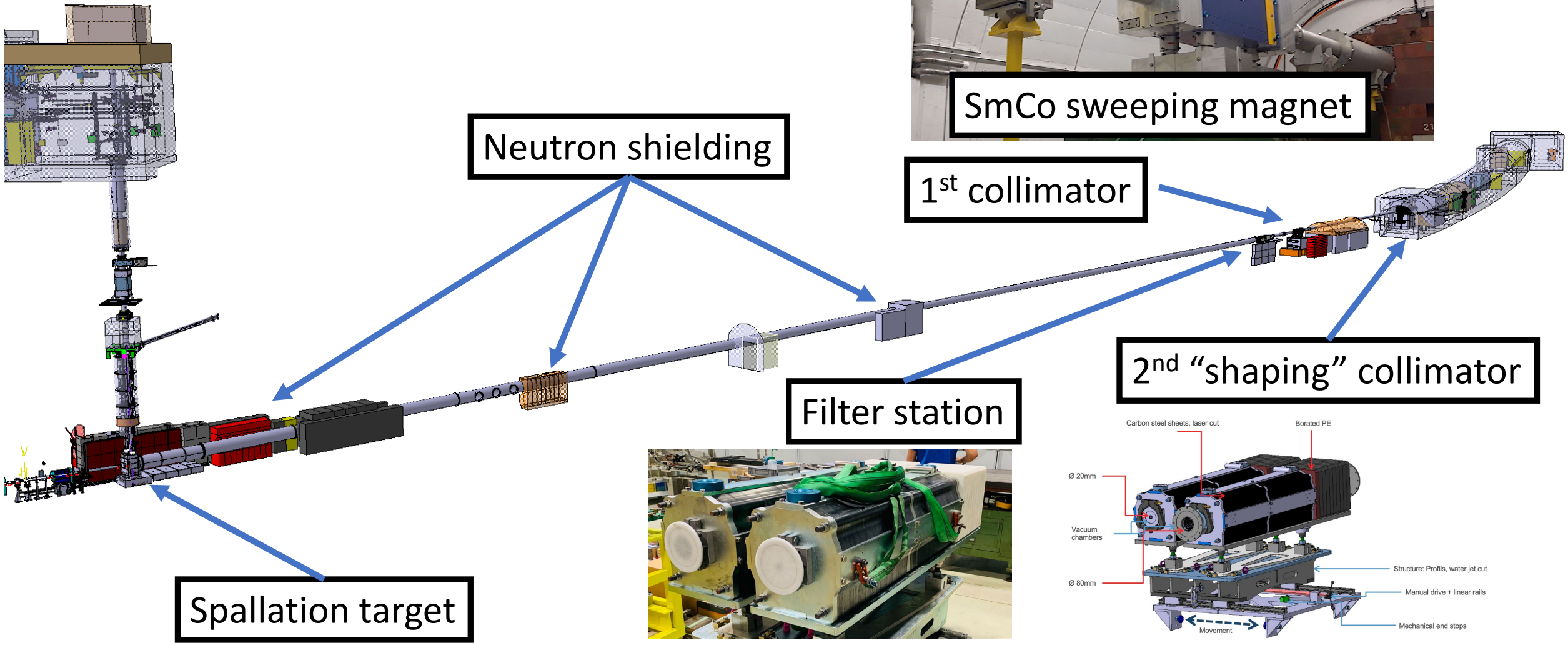
- 1st collimator
  halo cleaning, initial beam shaping
- Filter station
- Sweeping magnet
- 2nd collimator for beam shaping

The n_TOF facility

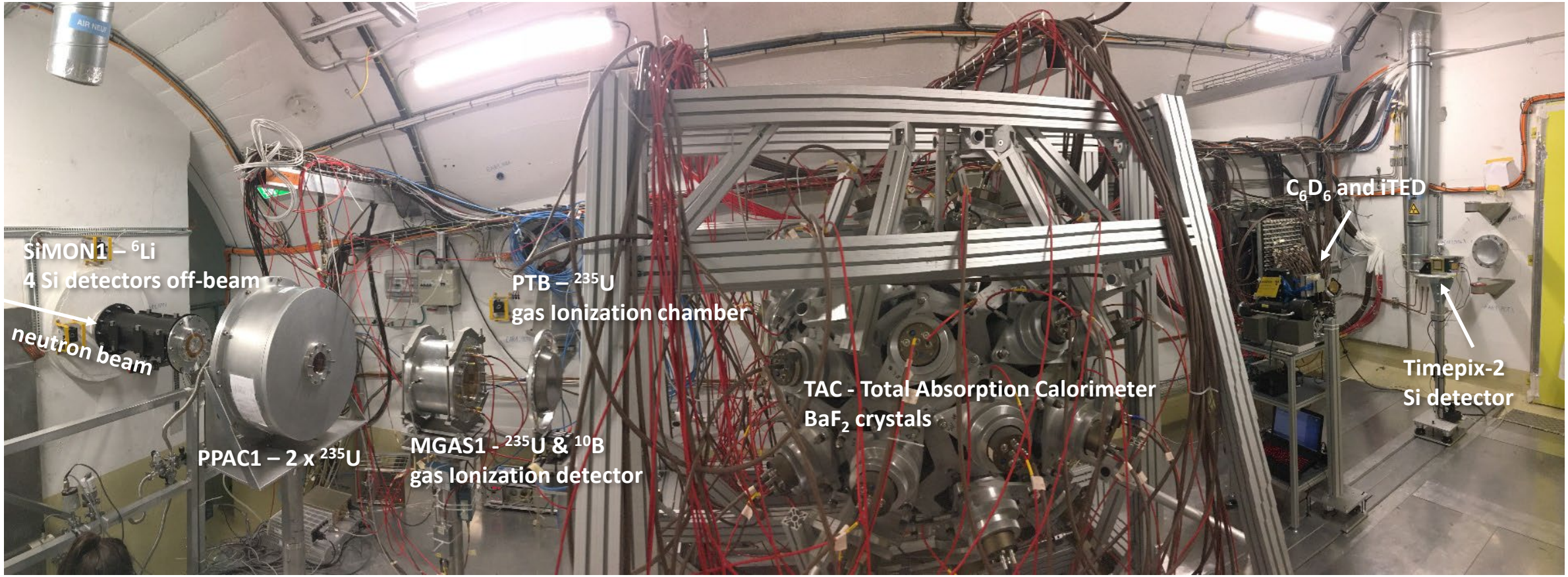
3rd generation target

courtesy of Oliver Aberle and Marco Calviani, CERN

EAR1 beam line



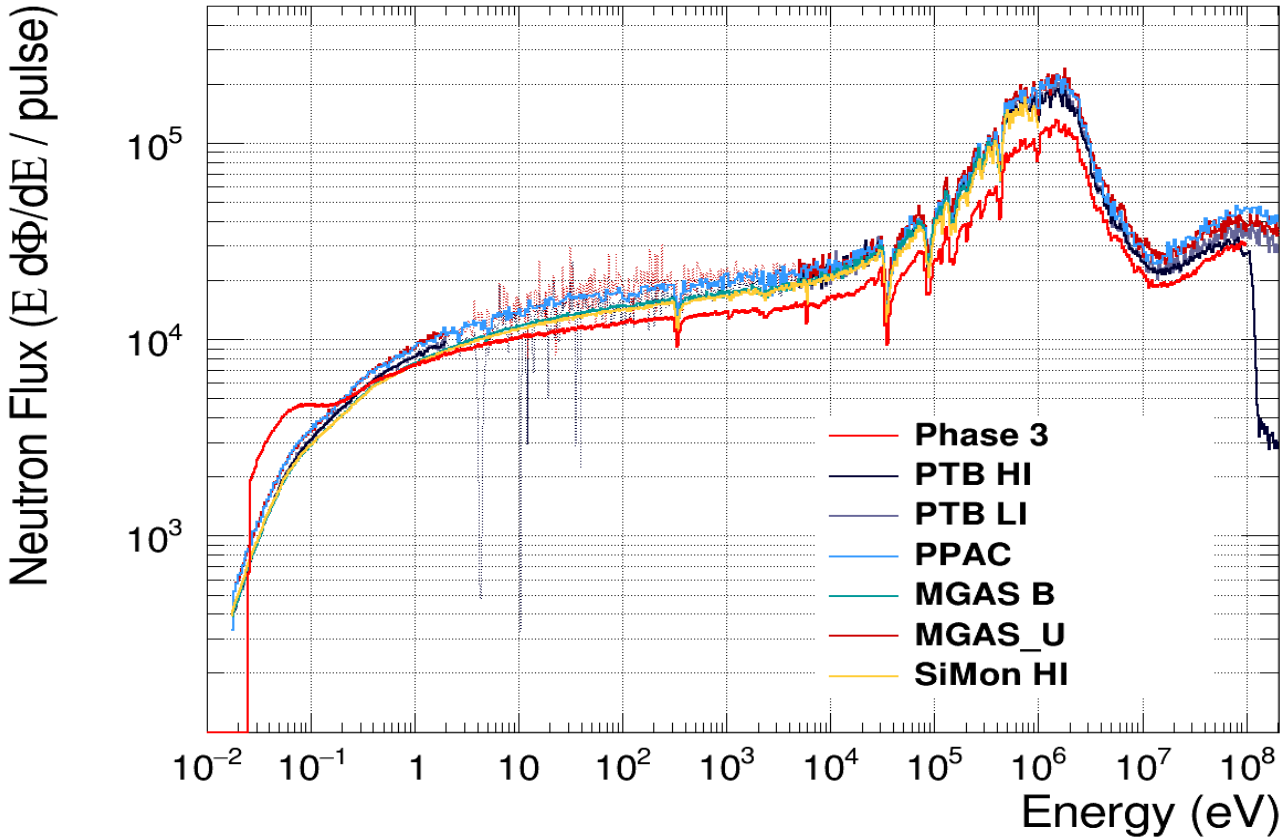
EAR1 beam commissioning



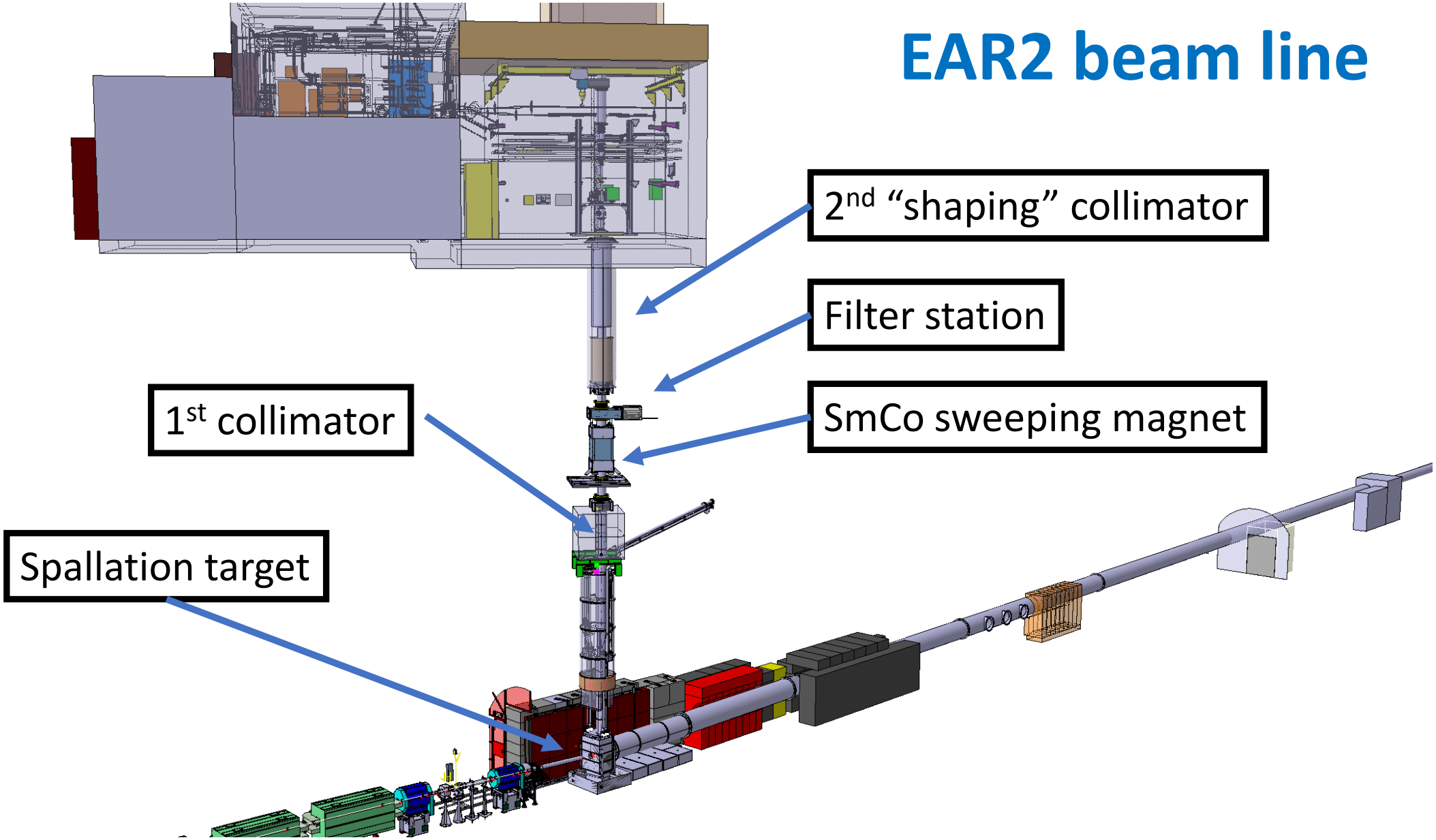
The n_TOF facility

- High instantaneous neutron
- Well collimated neutron beam (two ⌀ options: 8 cm & 2 cm)
- High energy resolution (~10^{-4})
- Large energy range (**meV – GeV**)

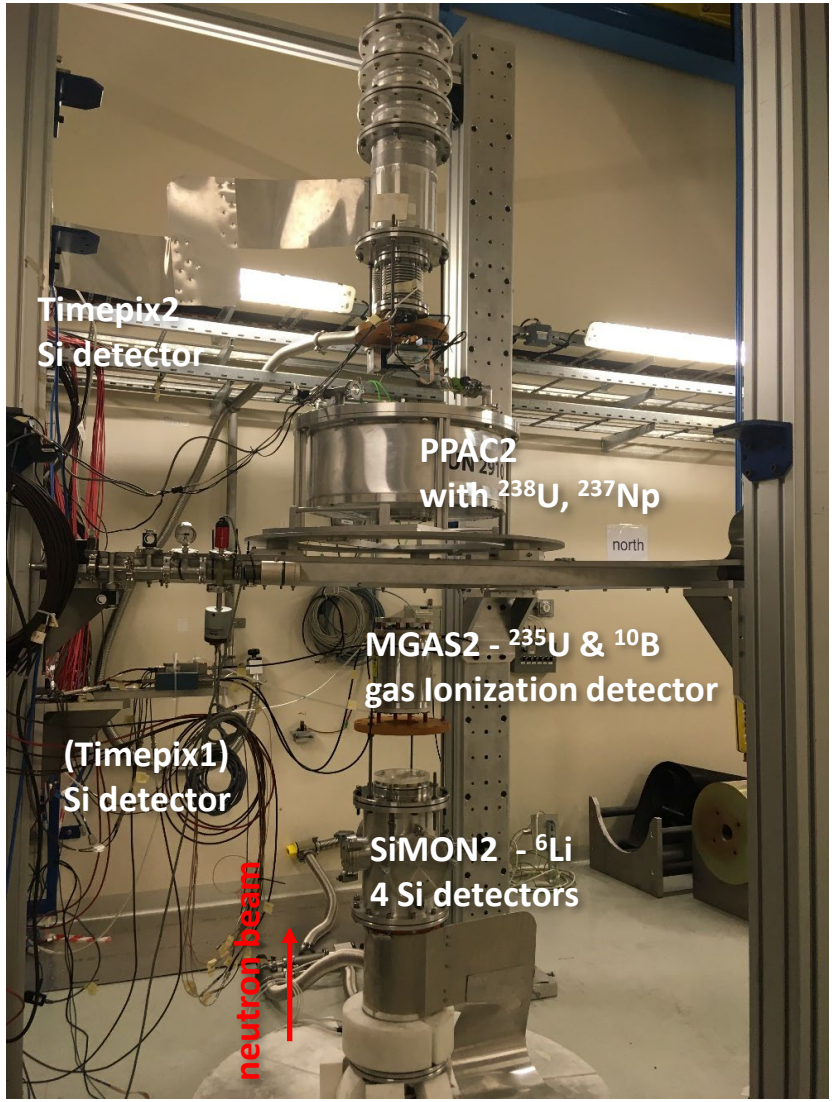
EAR1



EAR2 beam line



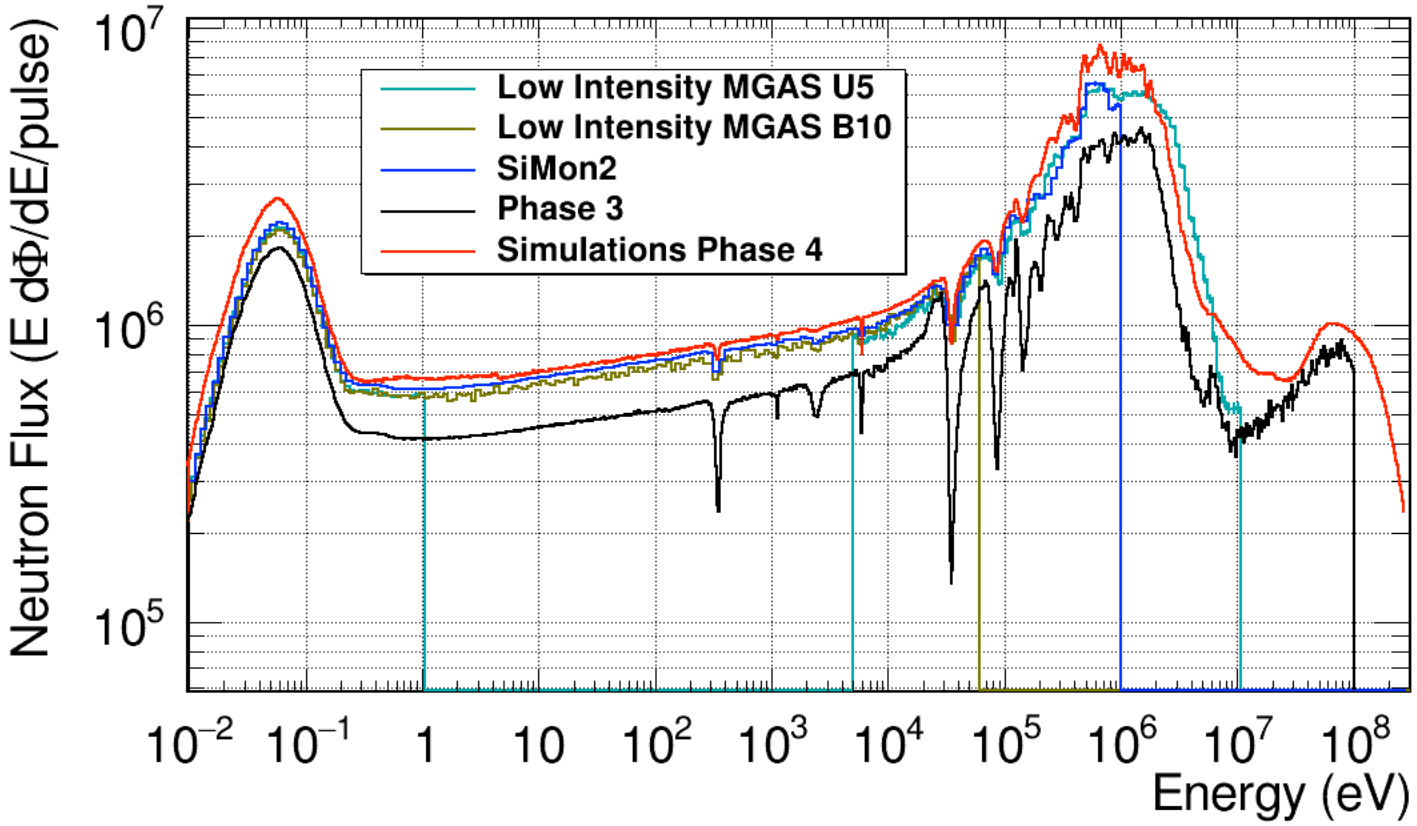
EAR2 beam commissioning



The n_TOF facility

- High instantaneous neutron flux (EAR2: 10^6n/cm^2/10ms)
- Well collimated neutron beam (two ⌀ options: 6 cm & 2 cm)
- High energy resolution
- Large energy range (**meV – MeV**)

EAR2

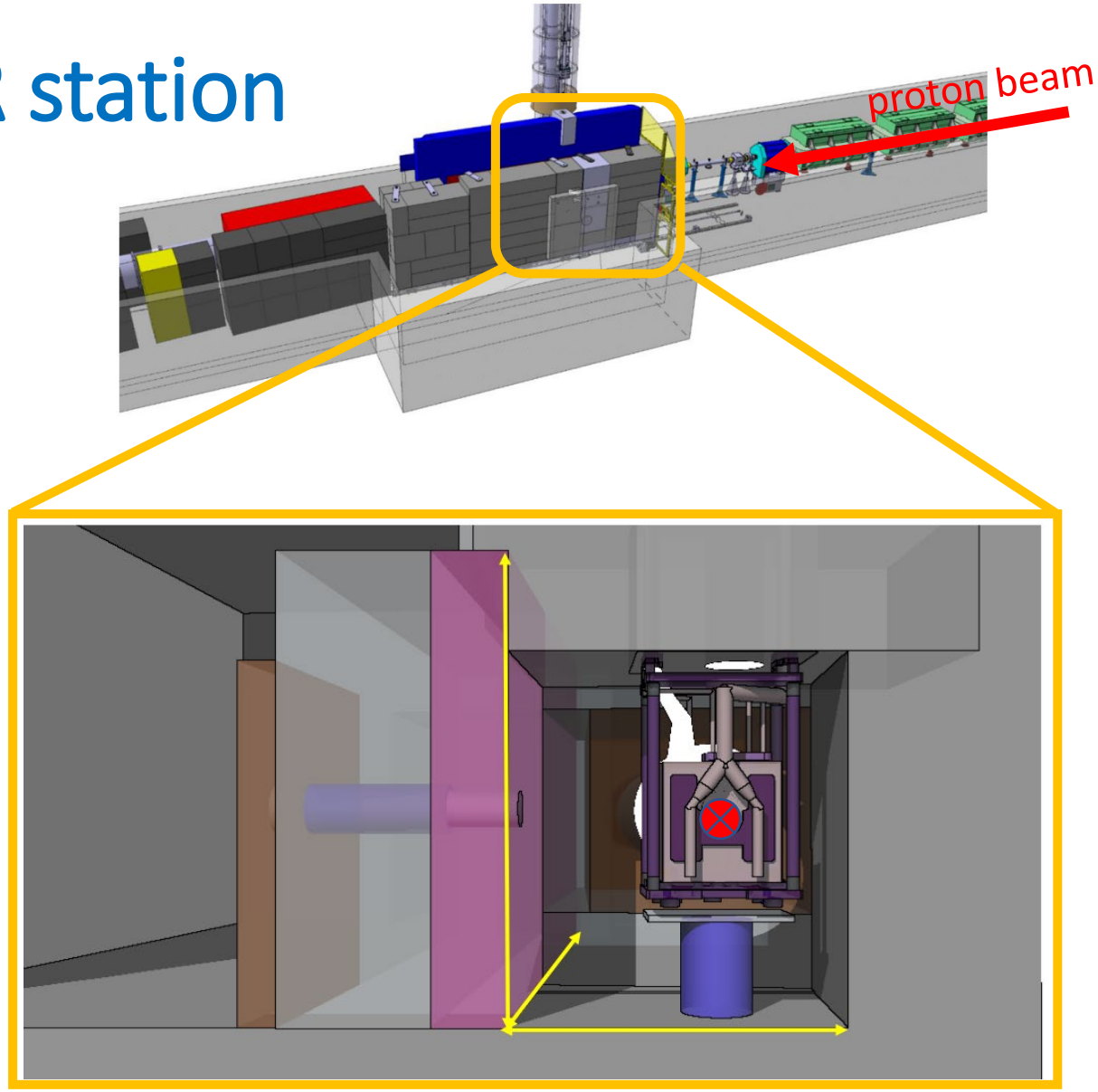


The NEAR station

The NEAR Station is the n_TOF facility's new high-flux irradiation station.

Two regions of activities

1) The irradiation area i-NEAR. Located next to the lead spallation target: high neutron dose material studies
2) The activation area a-NEAR. Located just outside the target bunker shielding, at only 3m distance from the target: nuclear astrophysics studies

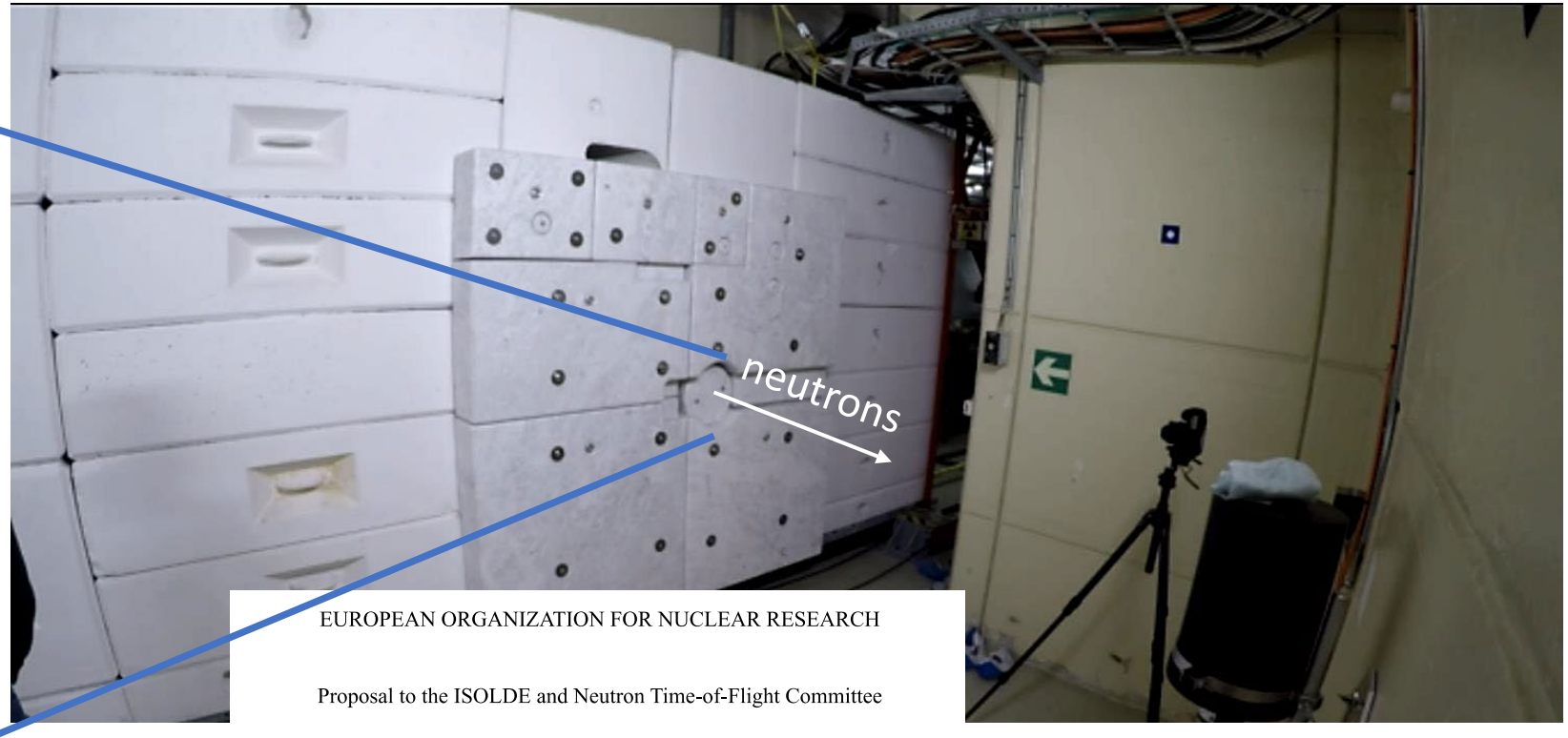


The NEAR station

The NEAR station

n_TOF target area
shielding **CLOSED**

Sample + filter assembly support



EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Proposal to the ISOLDE and Neutron Time-of-Flight Committee

Neutron capture cross section measurements by the activation method
at the n_TOF NEAR Station

[5 January 2022]

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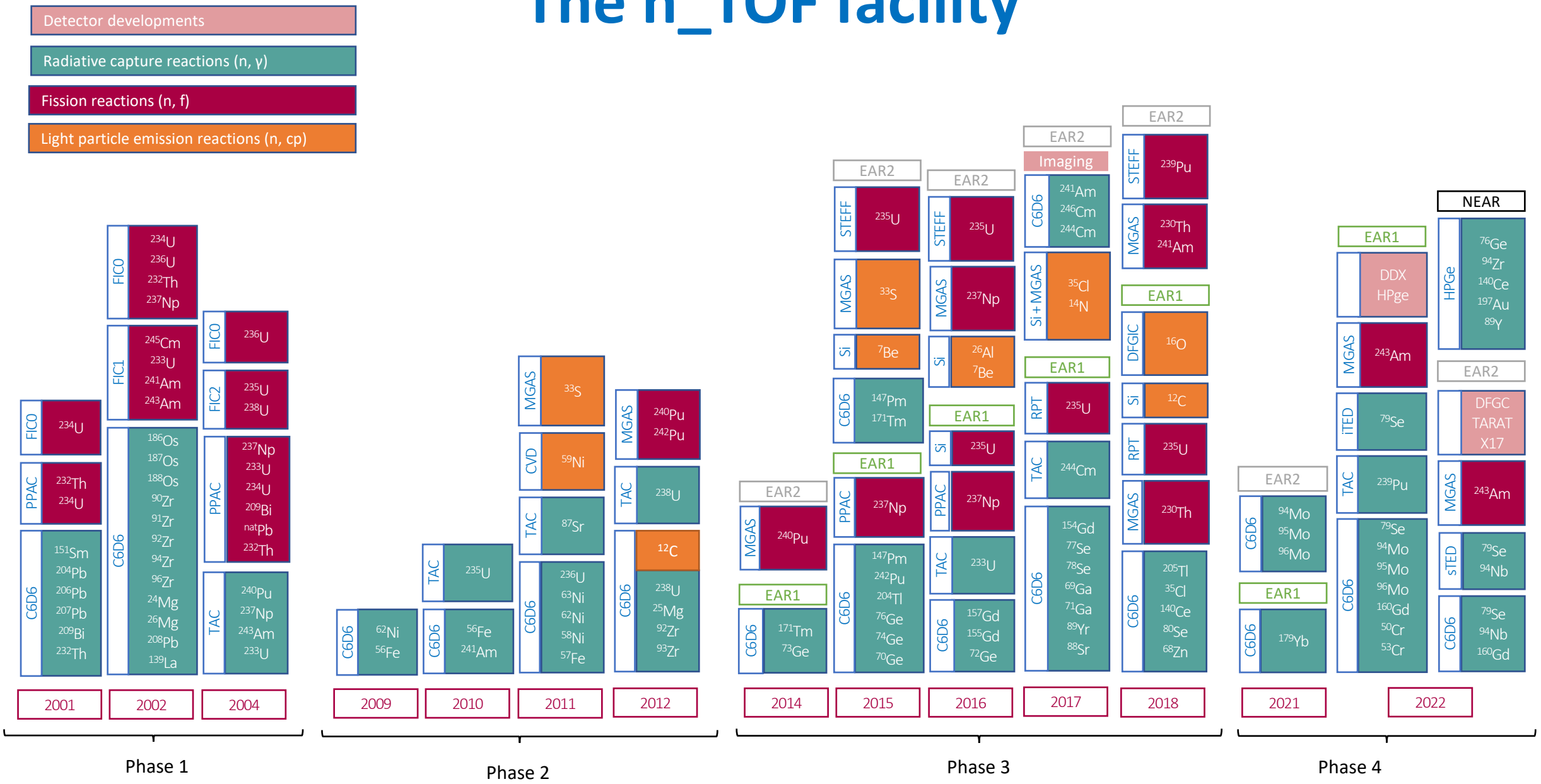
Alberto Mengoni[9,4] , Riccardo Mucciola[10,11], Nikolas Patronis[2,1], Pedro Vaz[12], Rosa Vlastou[8],
and the n_TOF Collaboration[13]

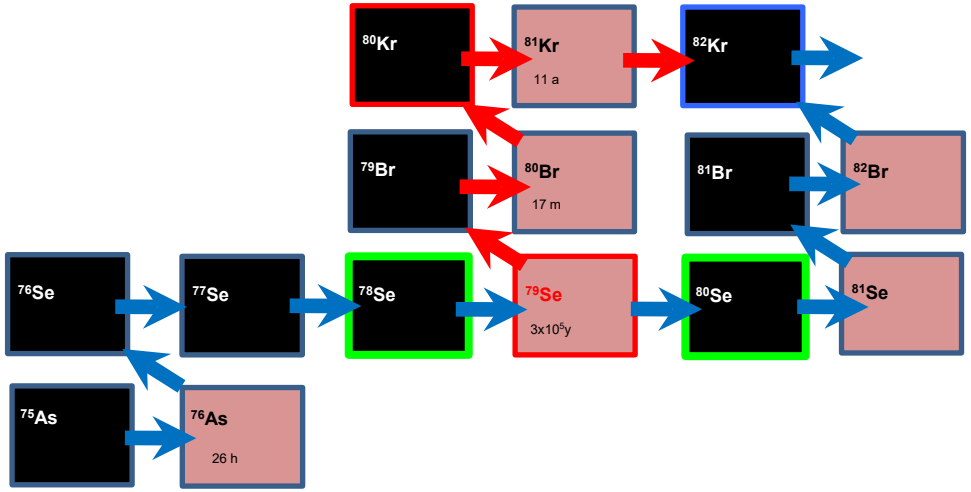
The n_TOF facility

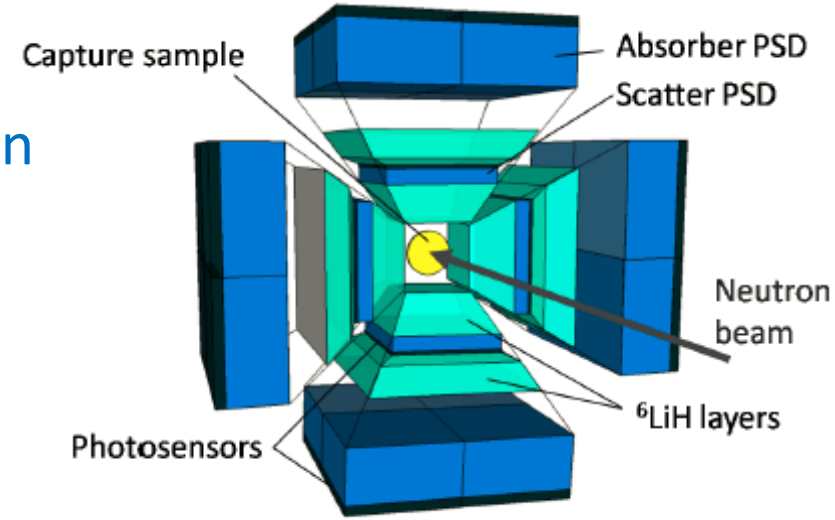


^{79}Se(n,γ) XS @ EAR1

- Physics motivation:
  - s-process nucleosynthesis (A~80)
  - Stellar site thermometer
  - Nuclear waste disposal and transmutation
  - First measurement
- Sample: ^{78}Se irr. @ ILL, PSI preparation & characterization
- i-TED – n_TOF detector development

  *combines compton **i**maging (n-background reduction) with **T**otal **E**nergy **D**eposition technique*
  - Advantageous for isotopes/energies with high **(n,el)**
  - Gain (n,γ)/background wrt standard C_6D_6 detectors ~4-10





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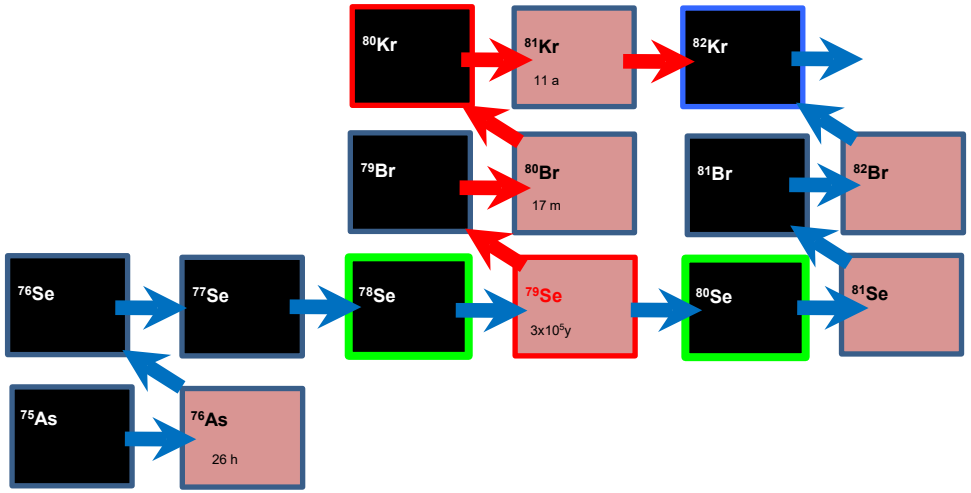
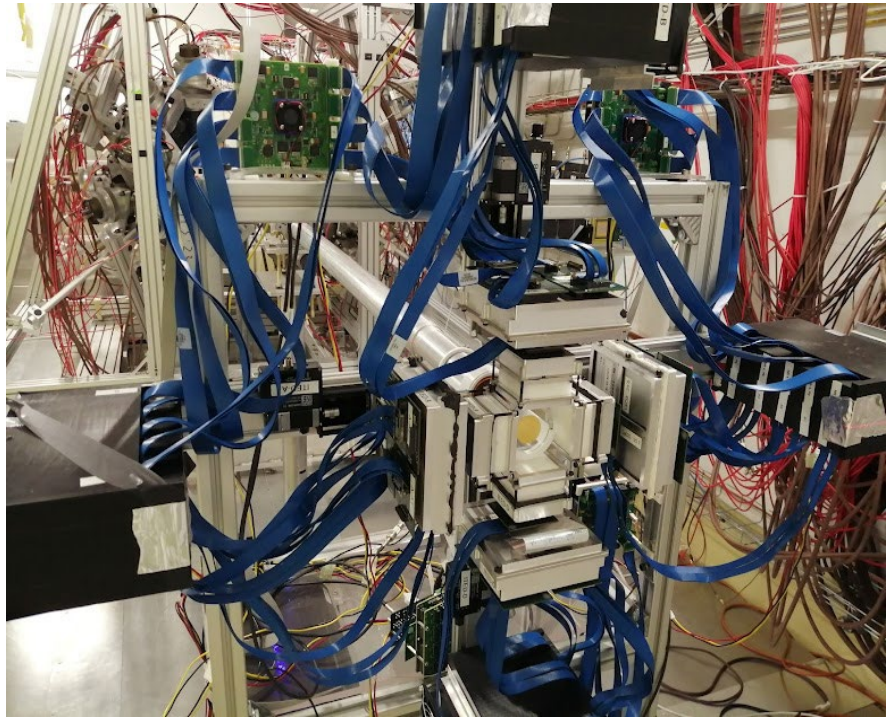
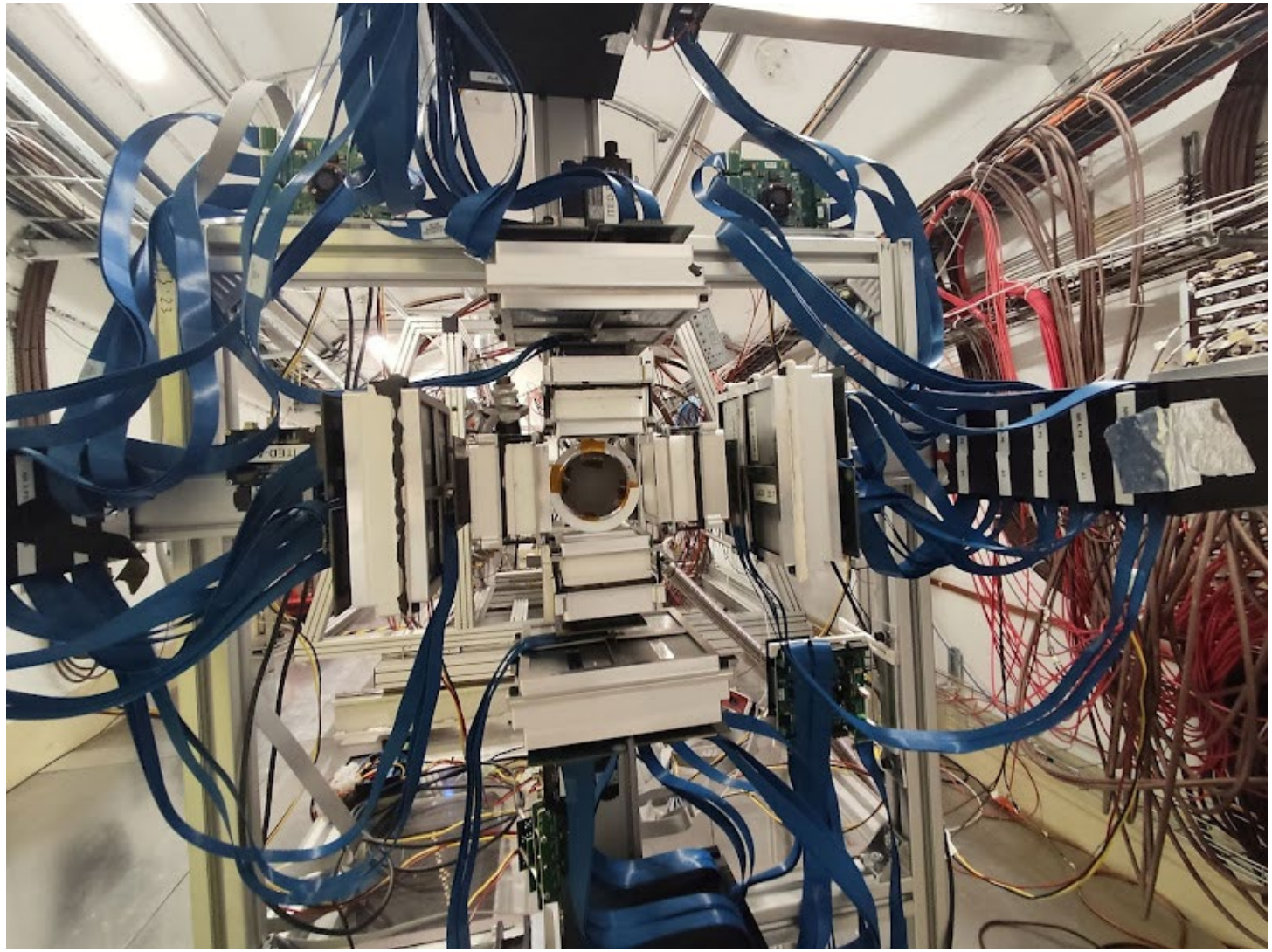
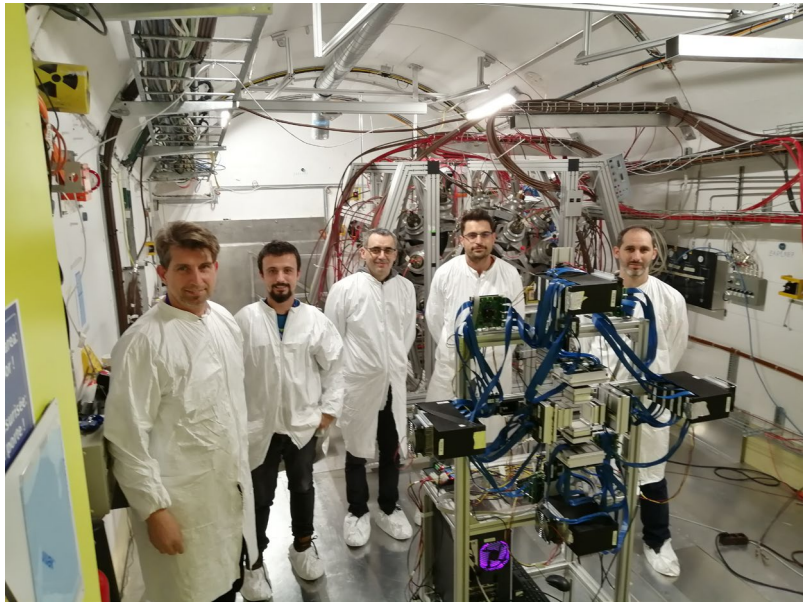




$^{79}Se(n,\gamma)$ XS @ EAR1





Conclusions

- The n_TOF facility is expanding: one more experimental area is already in data-taking mode of operation
- The excellent characteristics of EAR-1 are preserved or even slightly imporved
- The EAR-2 neutron flux is increased by a factor of 2
- The EAR-2 resolution function is hugely improved with respect to phase 3
- New innovative detection setups are already there: new physics is about to come …stay tuned

Thank you

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The n_TOF Collaboration

CERN