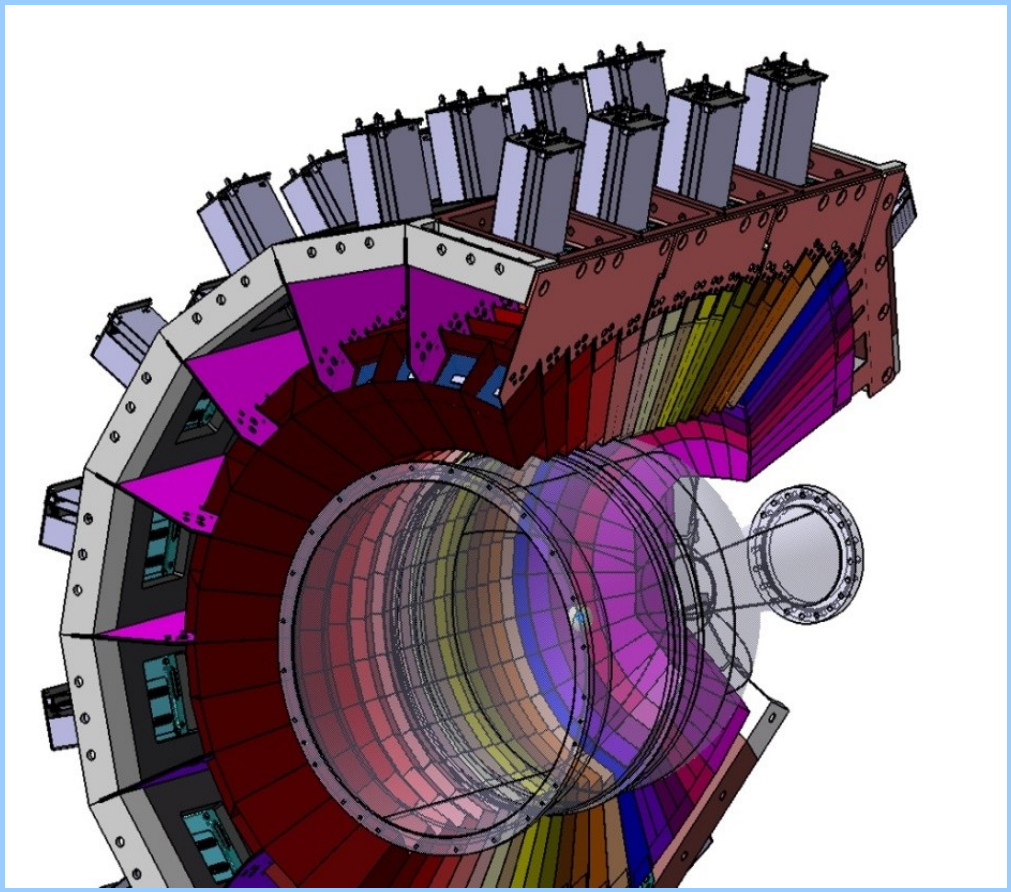

CALIFA: The R3B Calorimeter, and the CALIFA commissioning

Pablo Cabanelas, on behalf of the CALIFA working group of R3B

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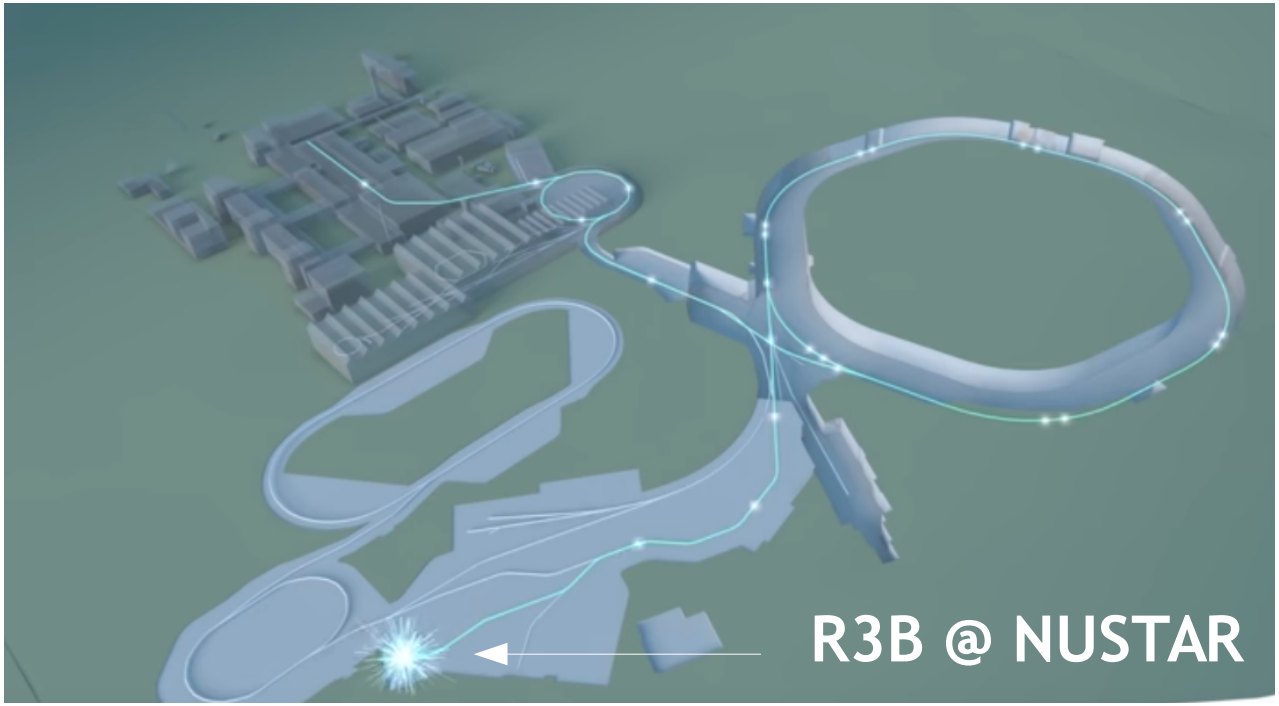
The R3B Experiment

Reactions with Relativistic Radioactive Beams



Relativistic beams

- → in-flight production and detection of secondary beams
- → nuclear fragments are forward focussed
- → simplified description of the reaction mechanism

Reactions with Relativistic Radioactive Beams

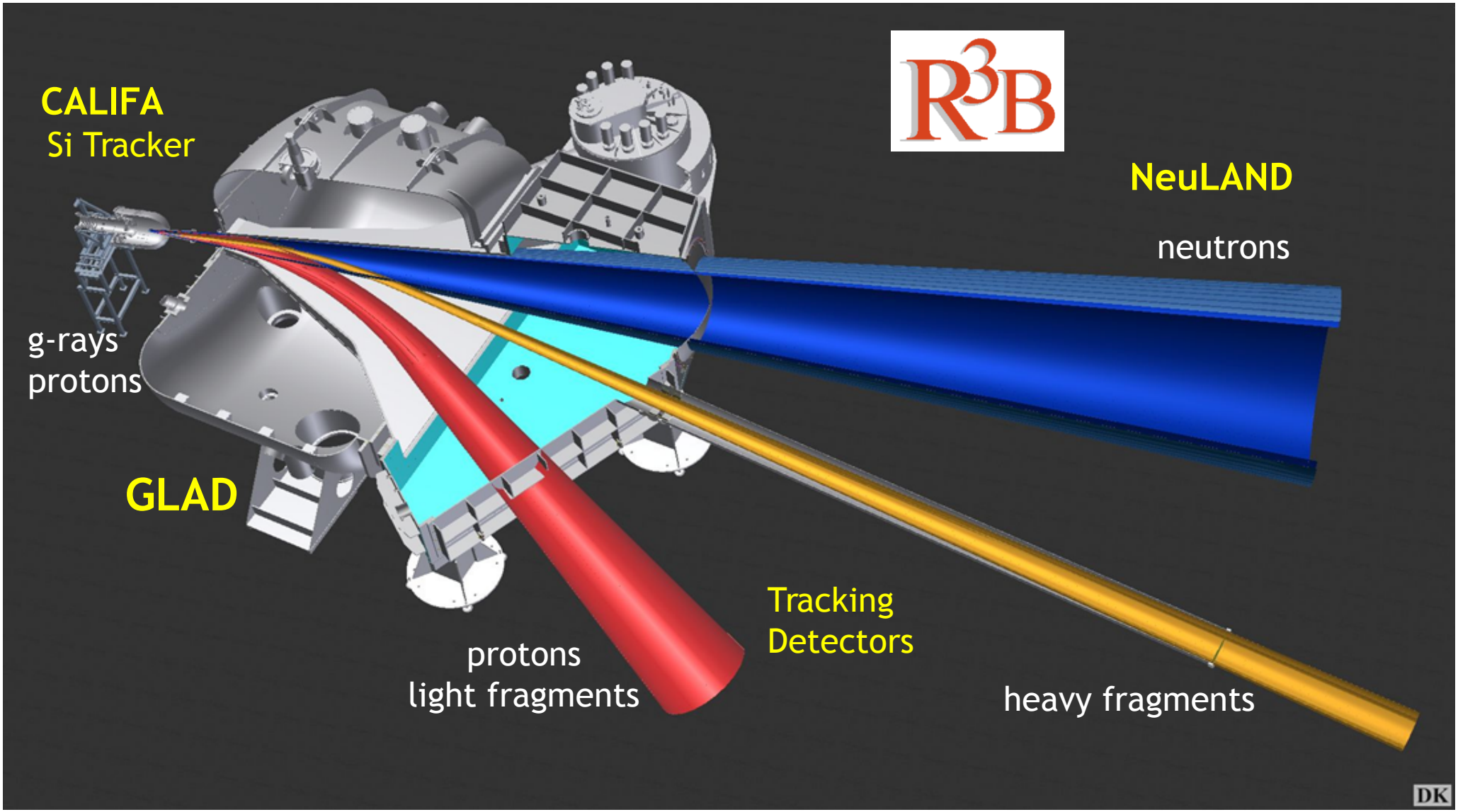
- →Secondary beams at 700 A.MeV
- →Fixed target reactions
- →Large Acceptance Dipole Magnet
- →Powerful detector system: beam, fragment, gamma, Light charge particles and neutrons

Versatile program

- → NN correlations and the nuclear force
- → nuclear structure far from stability
- → nuclear dynamics: fission
- → EoS for high-density neutron-rich matter
- → in-medium excitation of baryon resonances
- → origin of the heavy elements in Universe

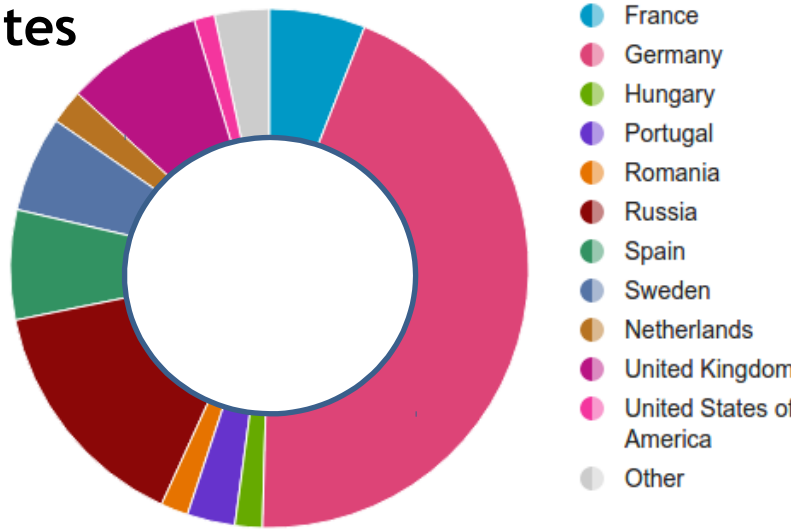
The R3B Experiment

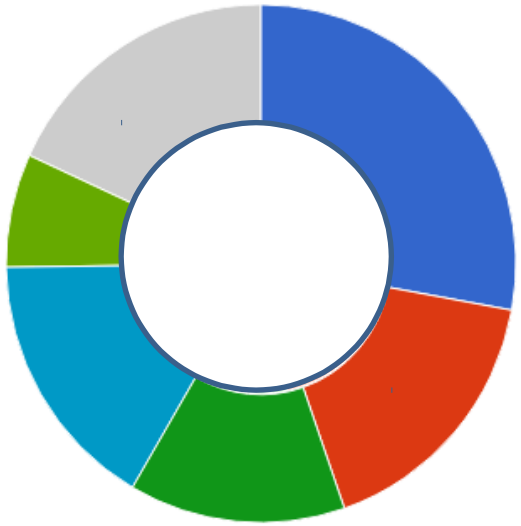
Reactions with Relativistic Radioactive Beams



R3B in numbers

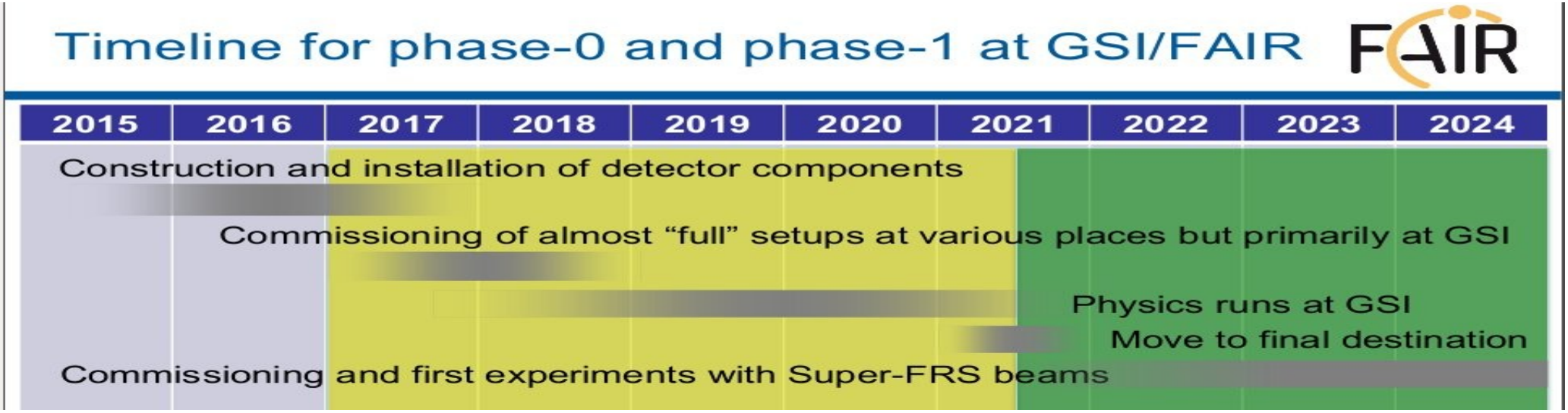
- ~ 250 collaborators
- ~ 15 countries
- ~ 50 Institutes





+ Si Tracker
+ DAQ
+ GLAD
+ Infrastrucure

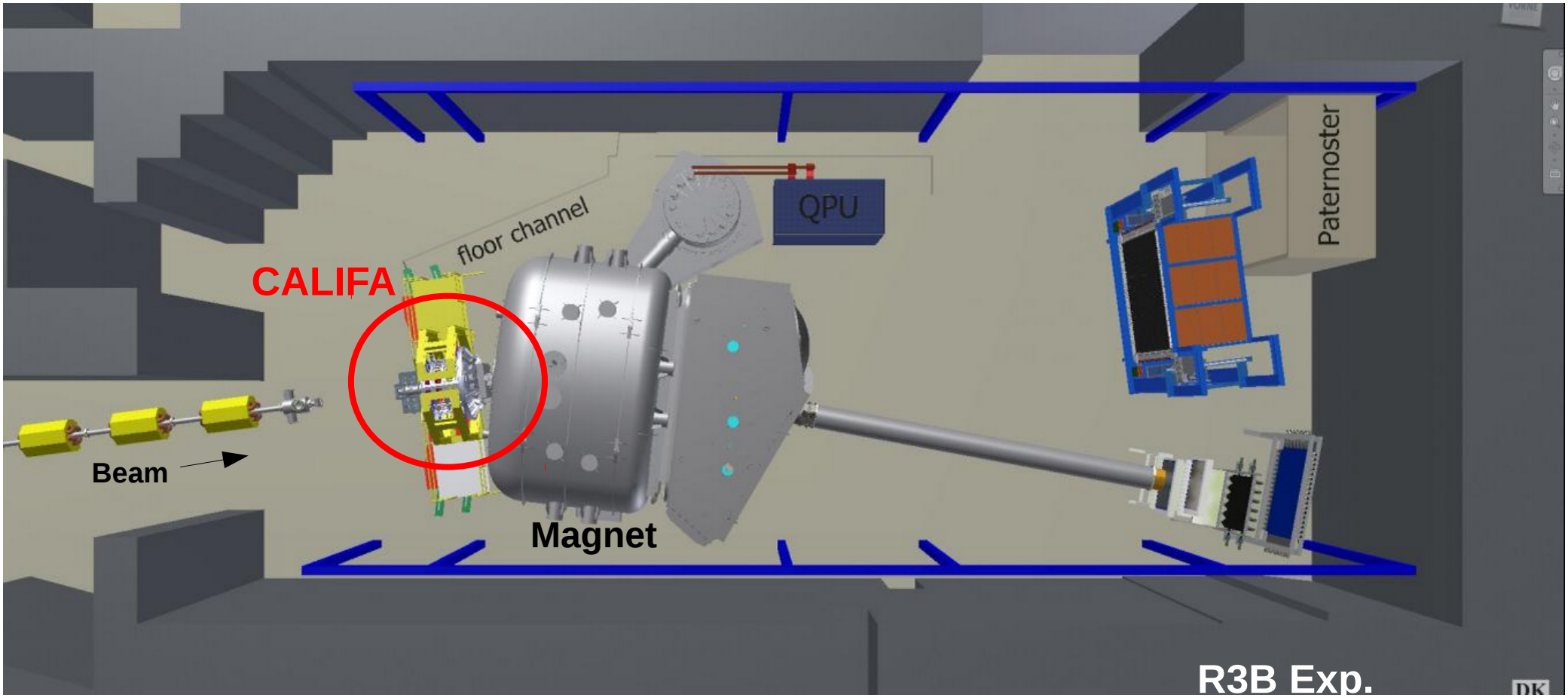
Timeline for phase-0 and phase-1 at GSI/FAIR



The CALIFA Calorimeter

CALorimeter for **I**n **F**light detection of γ and charged p**A**rticles

Calorimeter for the R3B Experiment at FAIR



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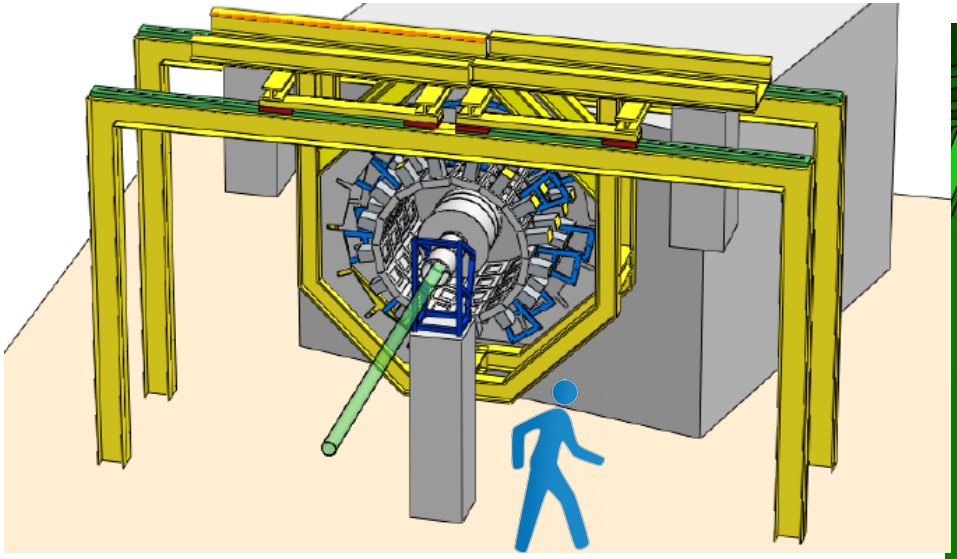

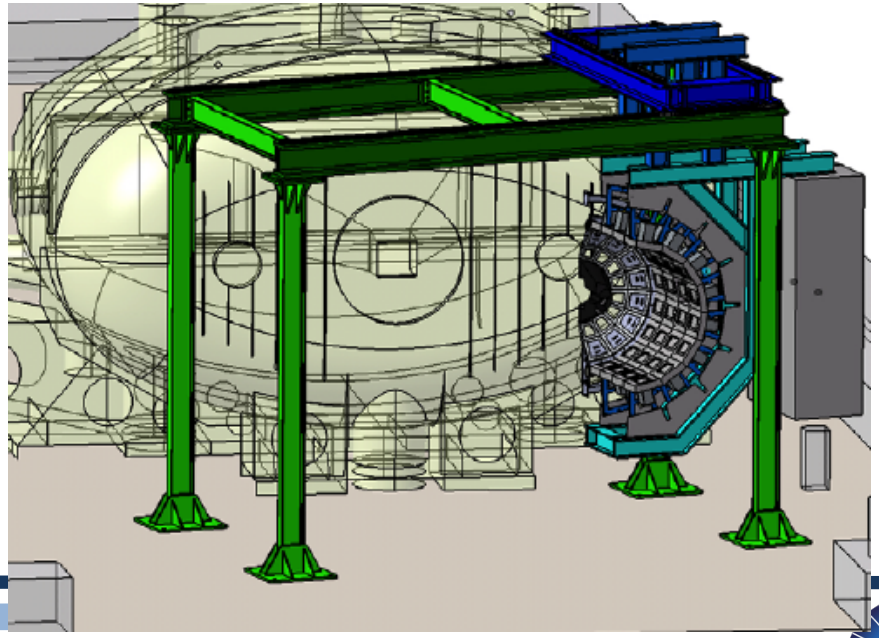

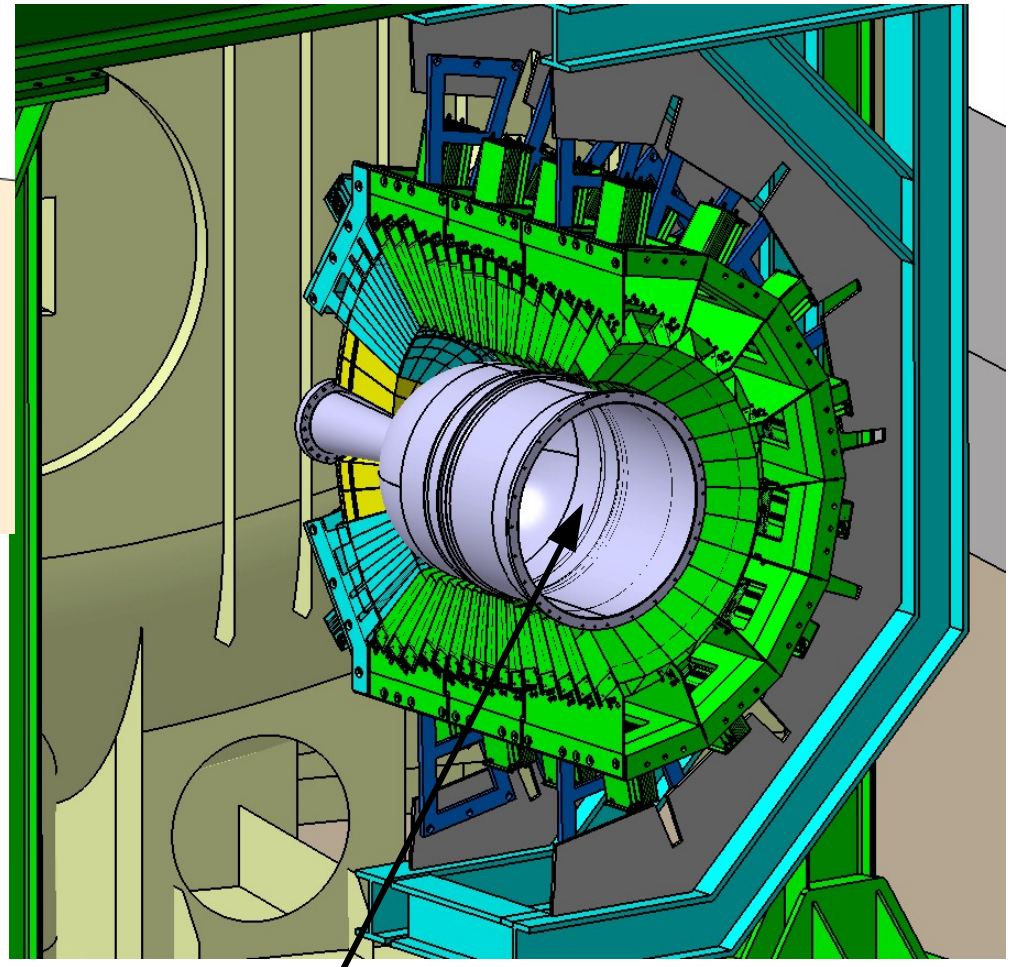

Interaction area

Scientific Requirements for CALIFA

The required functionality of CALIFA will vary greatly from one case to another

- Spectroscopic properties
- Calorimetric properties
- Hybrid mode
- Other features: fast response

Calorimetrer	Intrinsic photopeak efficiency	40% (up to Eg=15 MeV projectile frame)
	Gamma sum energy resolution $D(E_g sum)/<(E_g sum)>$	< 10% for 5 g rays of 3 MeV
	Calorimeter for high energy Light charged particles	200-700 MeV in lab system
Spectrometer	Gamma energy resolution	~ 6% (FWHM at Eg=1 MeV) ~ 3% for very forward angles
	Light charged particles resolution	~2% (stopped particles) ~ 5% (punch through particles)
	Proton-g ray separation	For 1 to 30 MeV

Calorimetrer Spectrometer

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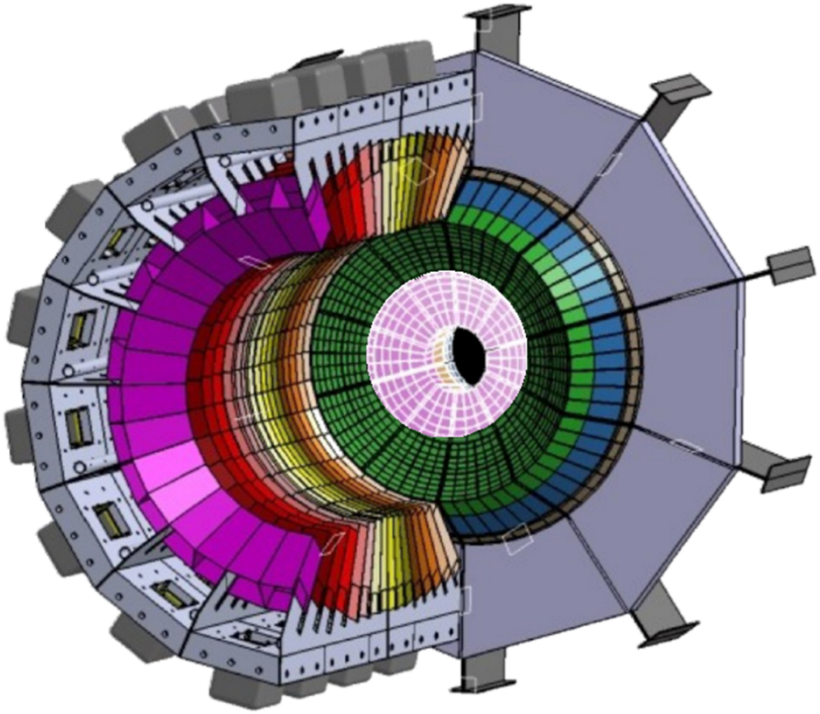
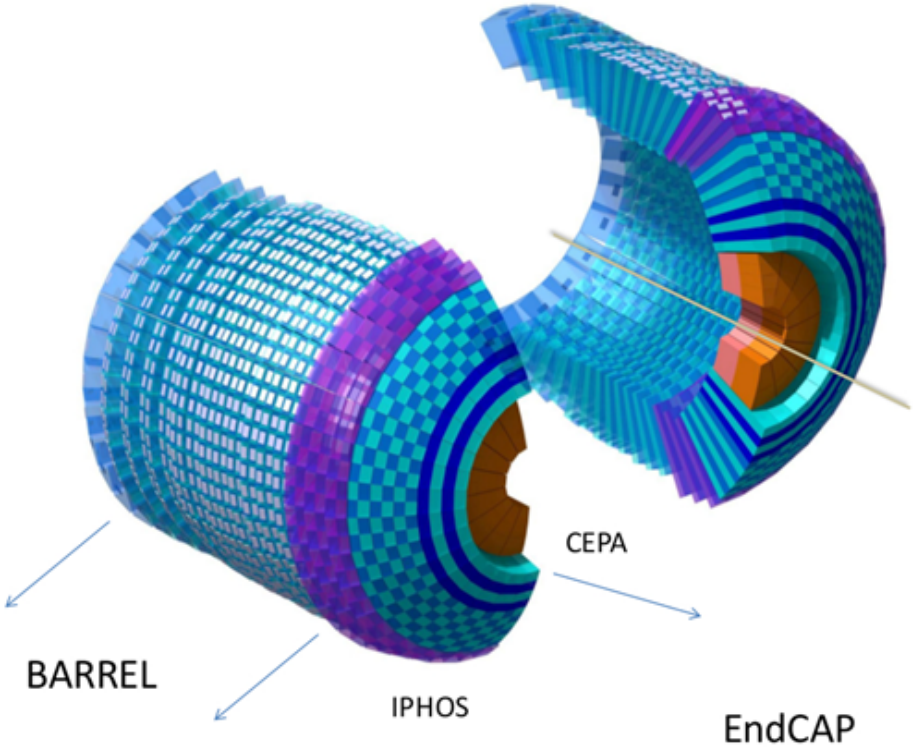
The CALIFA Design:

- Design dominated by the kinematics of particles emitted by relativistic sources
- The detection of low energy g-rays together with high energy charged-particles
  → huge dynamic range

Detector splits in two sections : BARREL and ENDCAP





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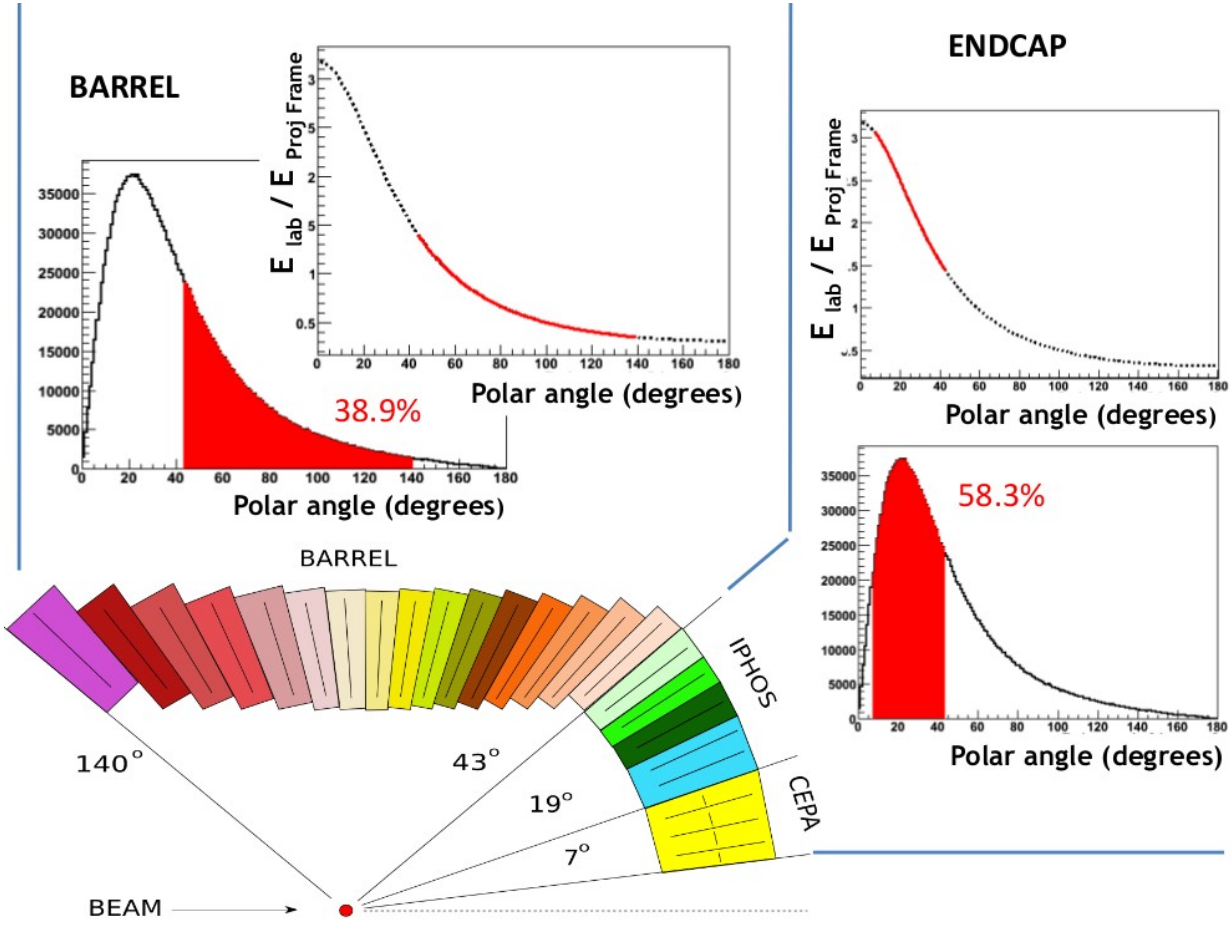
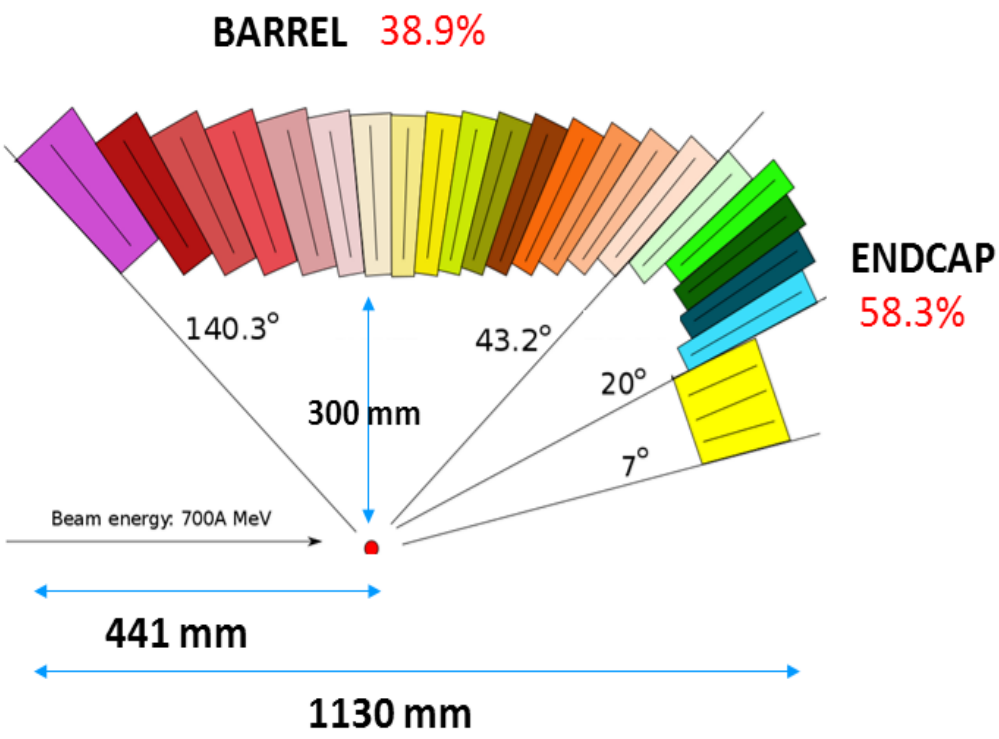


Technical choices

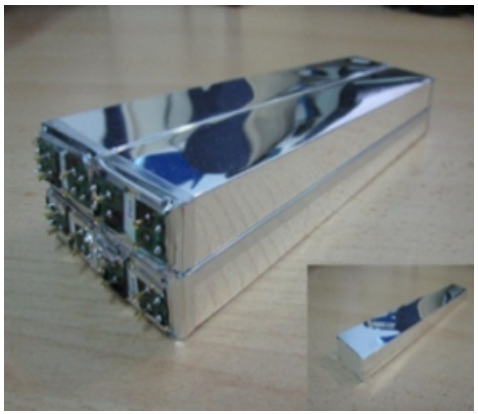
- Performant scintillator materials and photosensors adapted to the different needs over the angular range
- Granular detector: Thousands of finger-like crystals (~2100)
- Minimum dead volume: compact arrangement + carbon fiber alveoli support

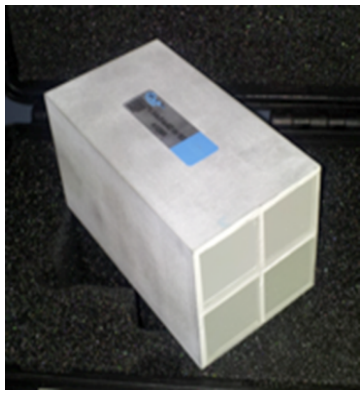
The CALIFA Design:



- External structure 3.5 x 4 m
- Detector volume ~ 1.3 m^3
- Detector weight ~ 2.5 Tm
- ~2500 detection units (~1500 double FEE)
- ~4000 channels

	Barrel	Endcap	
		iPhos	CEPA
Scintillator	CsI(Tl)	CsI(Tl)	LaBr/LaCl
Geom.	11	16	6
Crys. Len (cm)	15-22	22	4/7
Polar cov.	7-20º	20-43º	43-140º
Read-out	LAAPD	LAAPD	PM/SiPM
Dete.chan.	1952	480	96
Elec. chan.	1952	960	96
Weight (Kg)	~ 1500	~ 550	~ 50
Volume (cm^3)	285.000	90.000	11.000

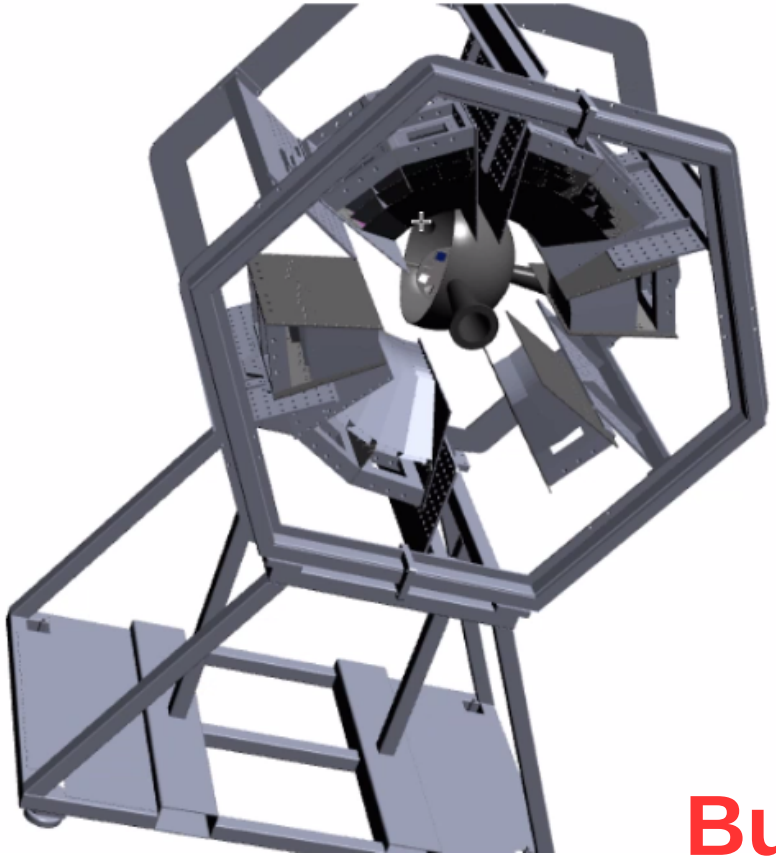


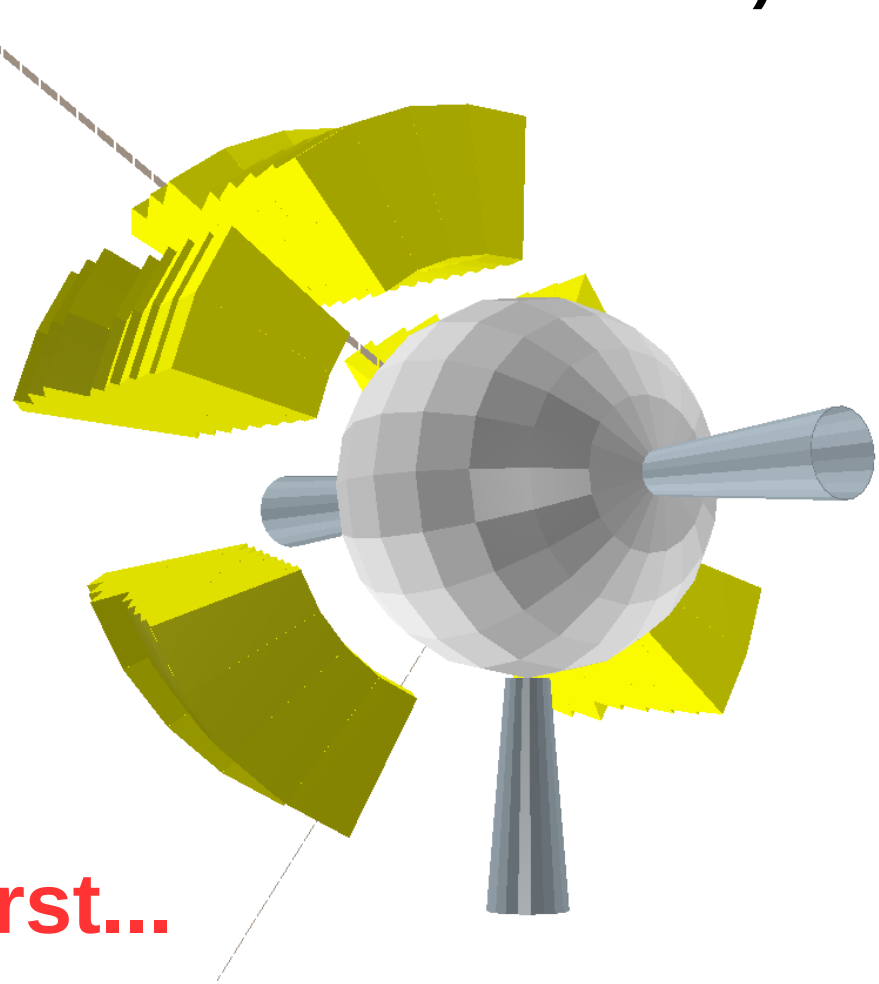


The CALIFA Commissioning plan

February 2019, s444 experiment at Cave C (GSI):

~7 days of 12C and proton beam from sFRS, CH2 target, 7 segments of CALIFA (448 detection units / channels)





But first...

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The CALIFA Commissioning: from lab to GSI

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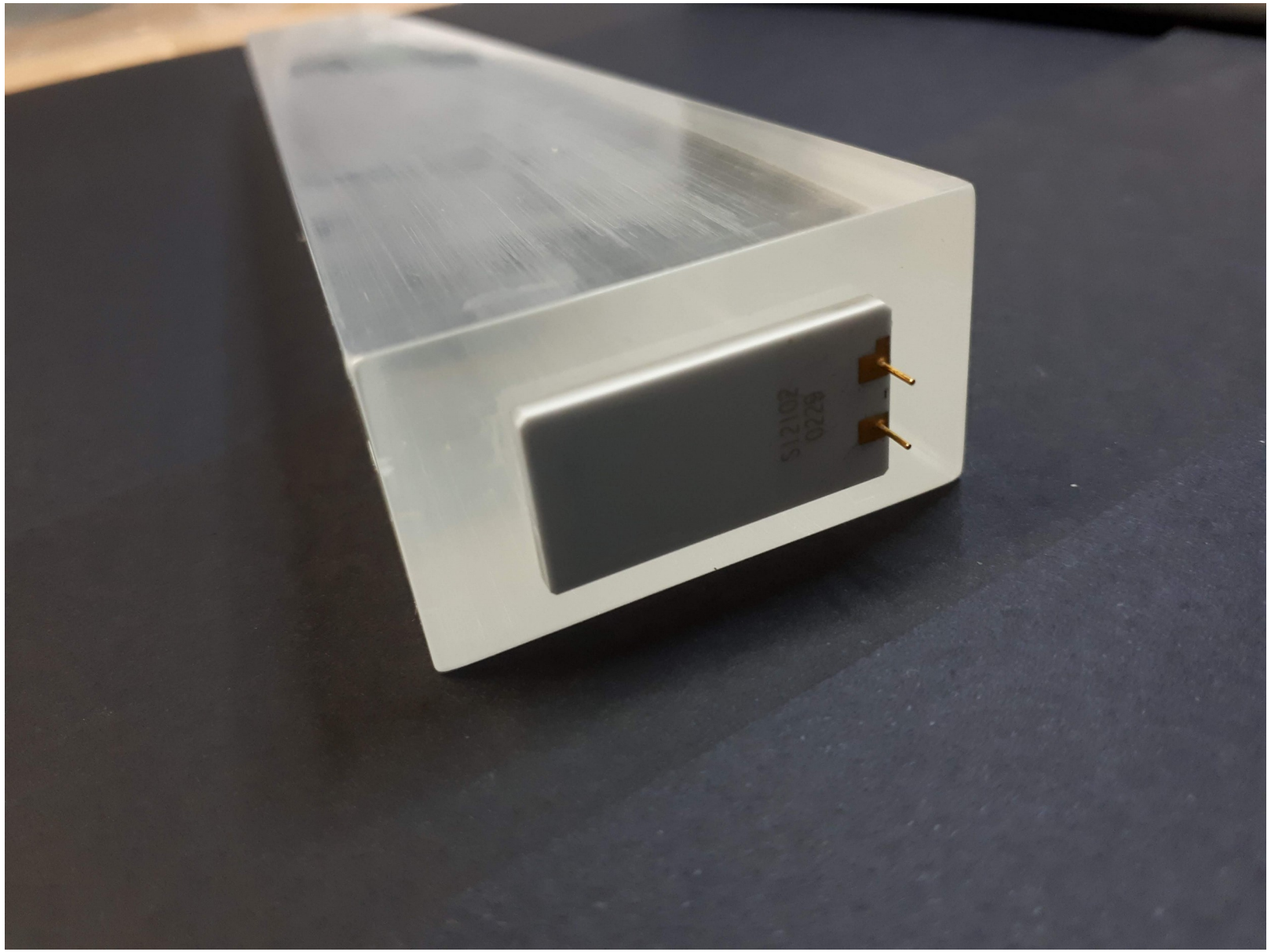

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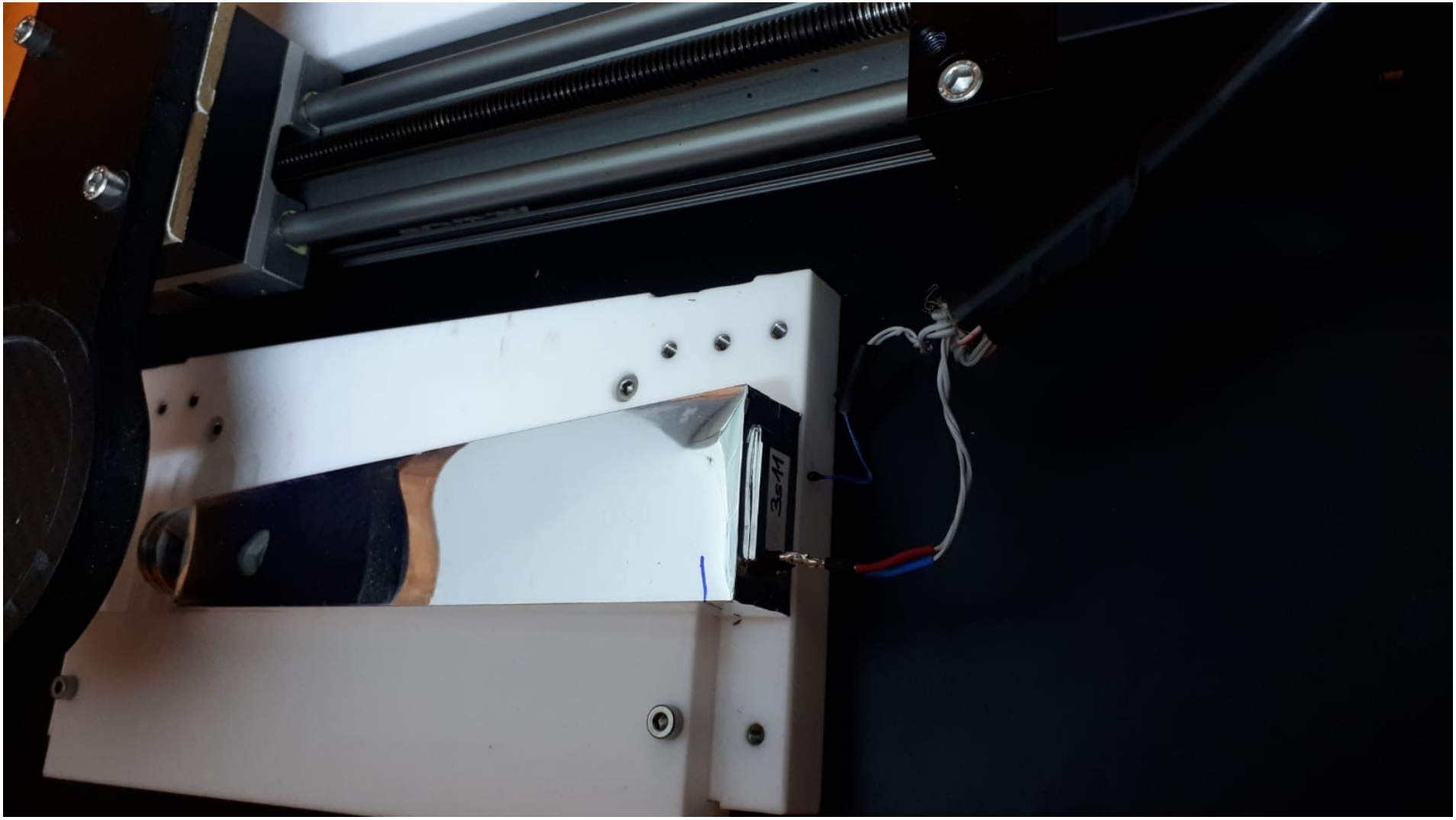

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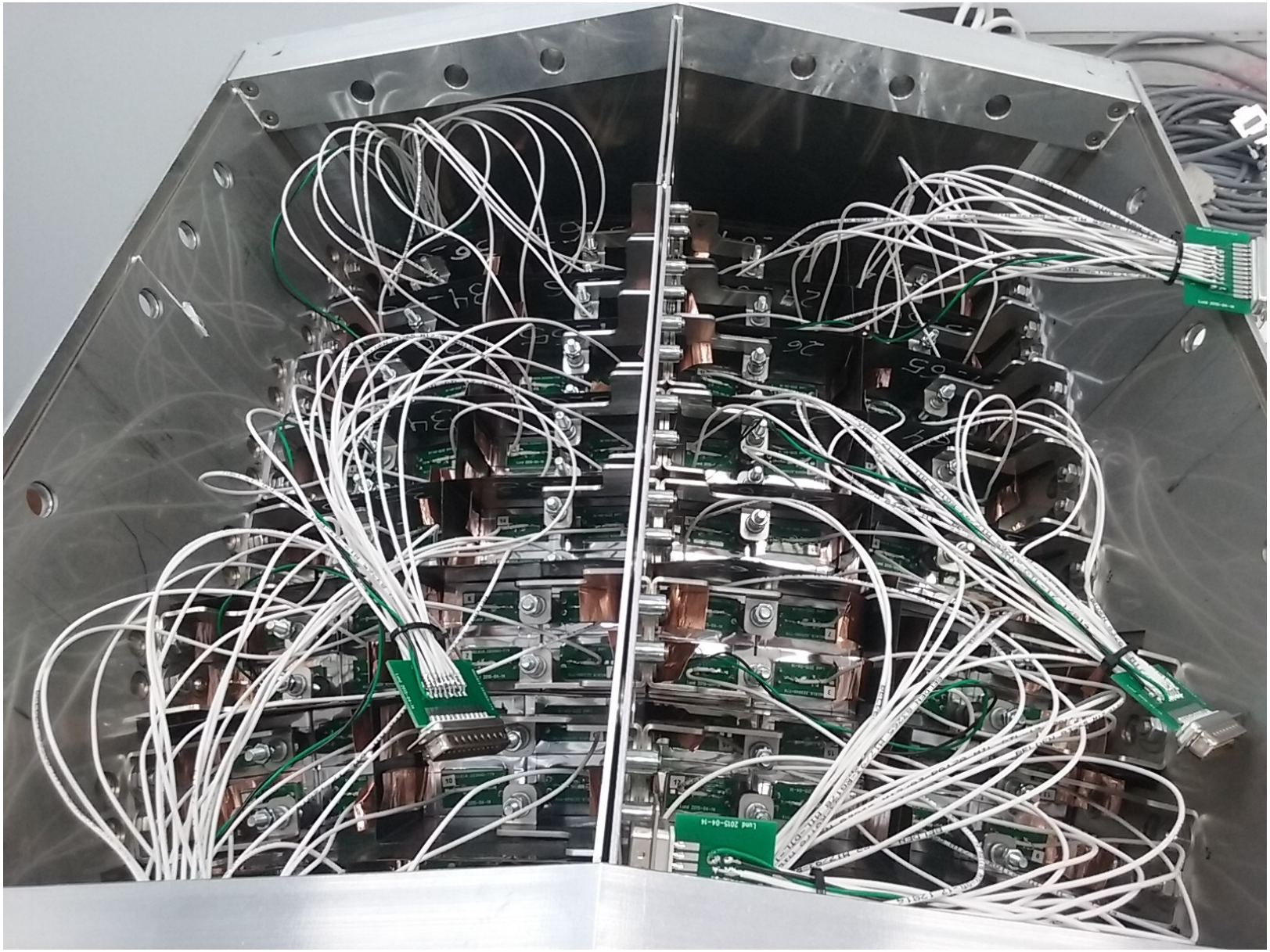

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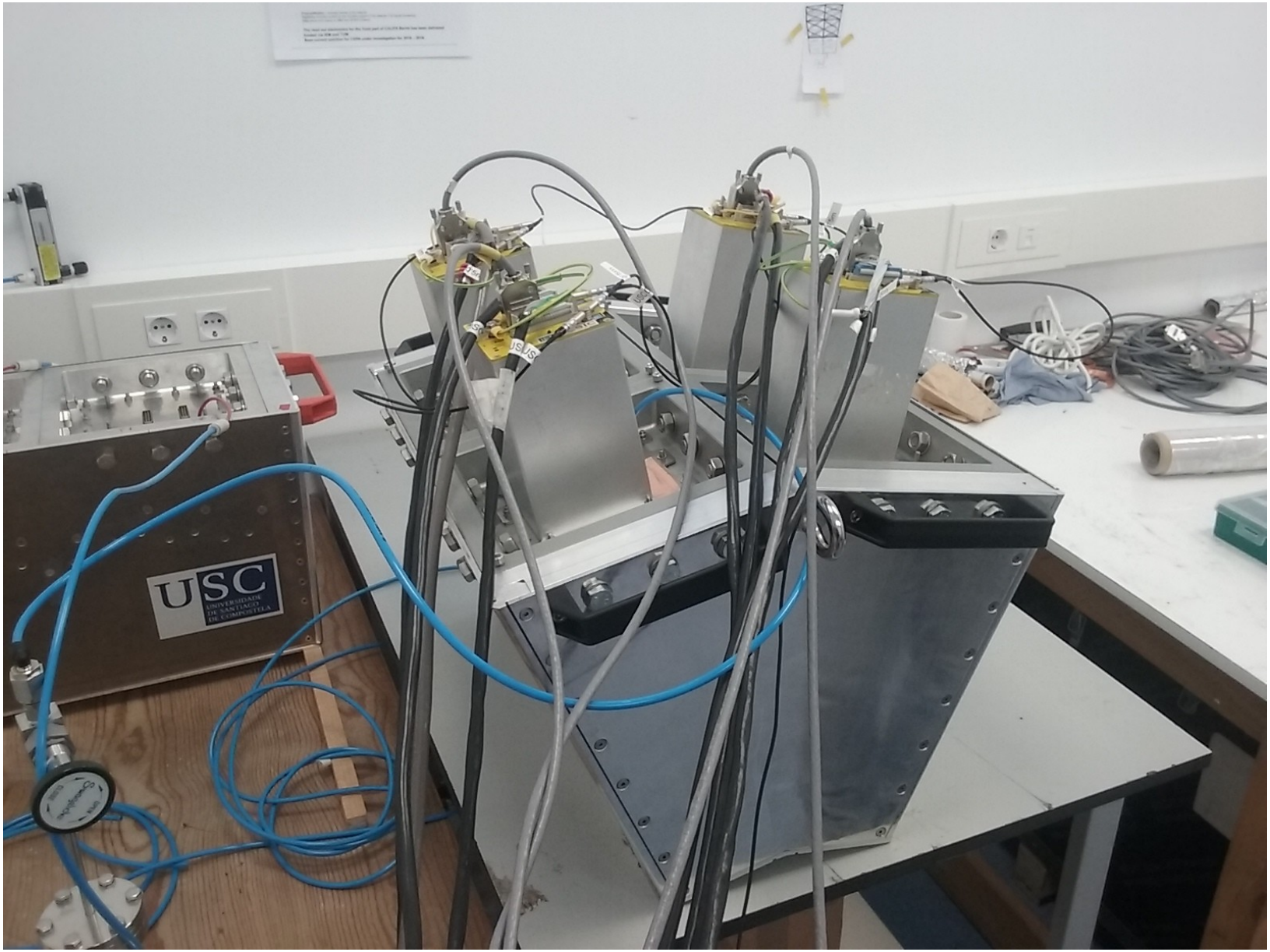

The CALIFA Commissioning: from lab to GSI

FAIR

GSI

LABS

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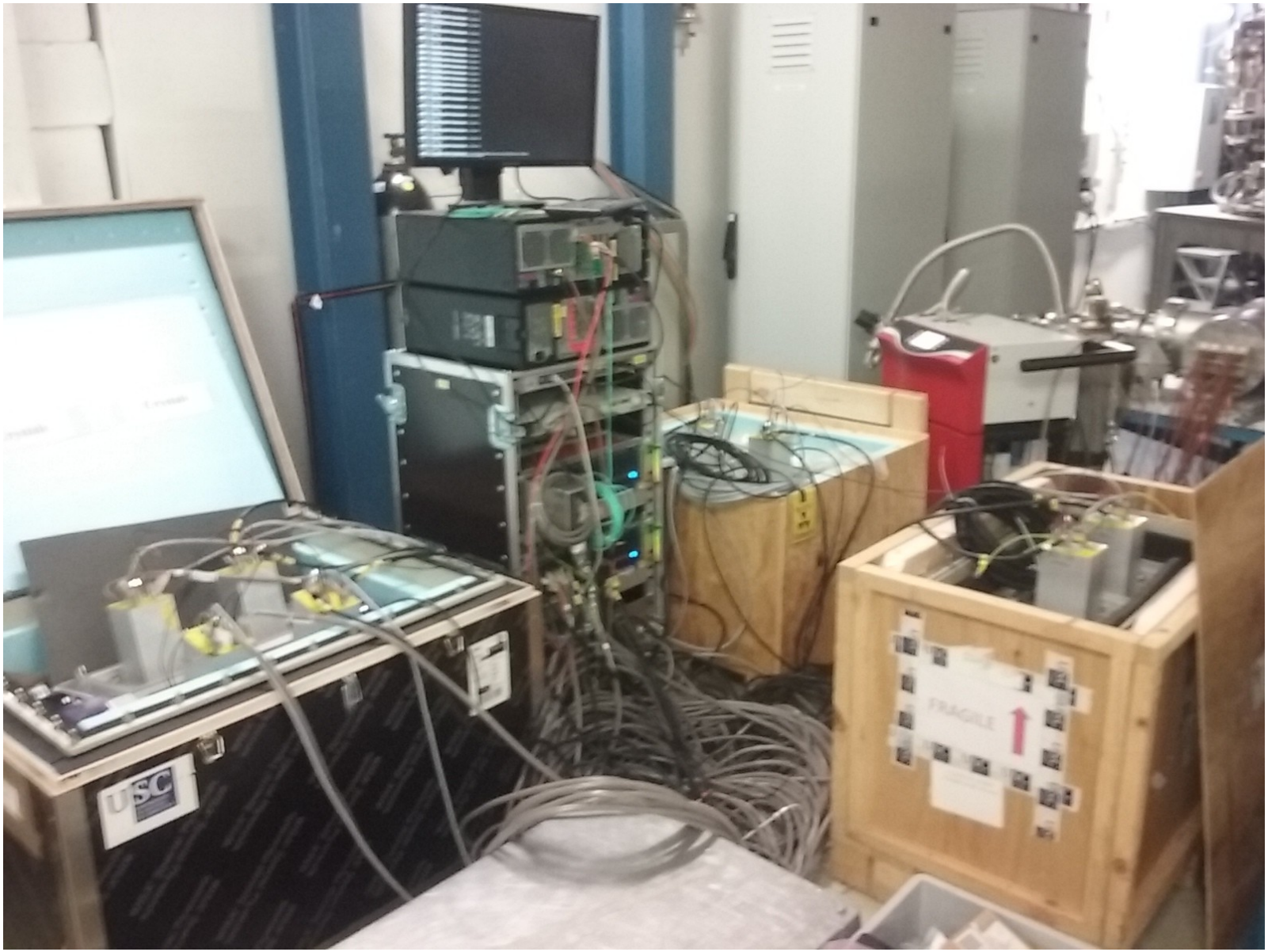

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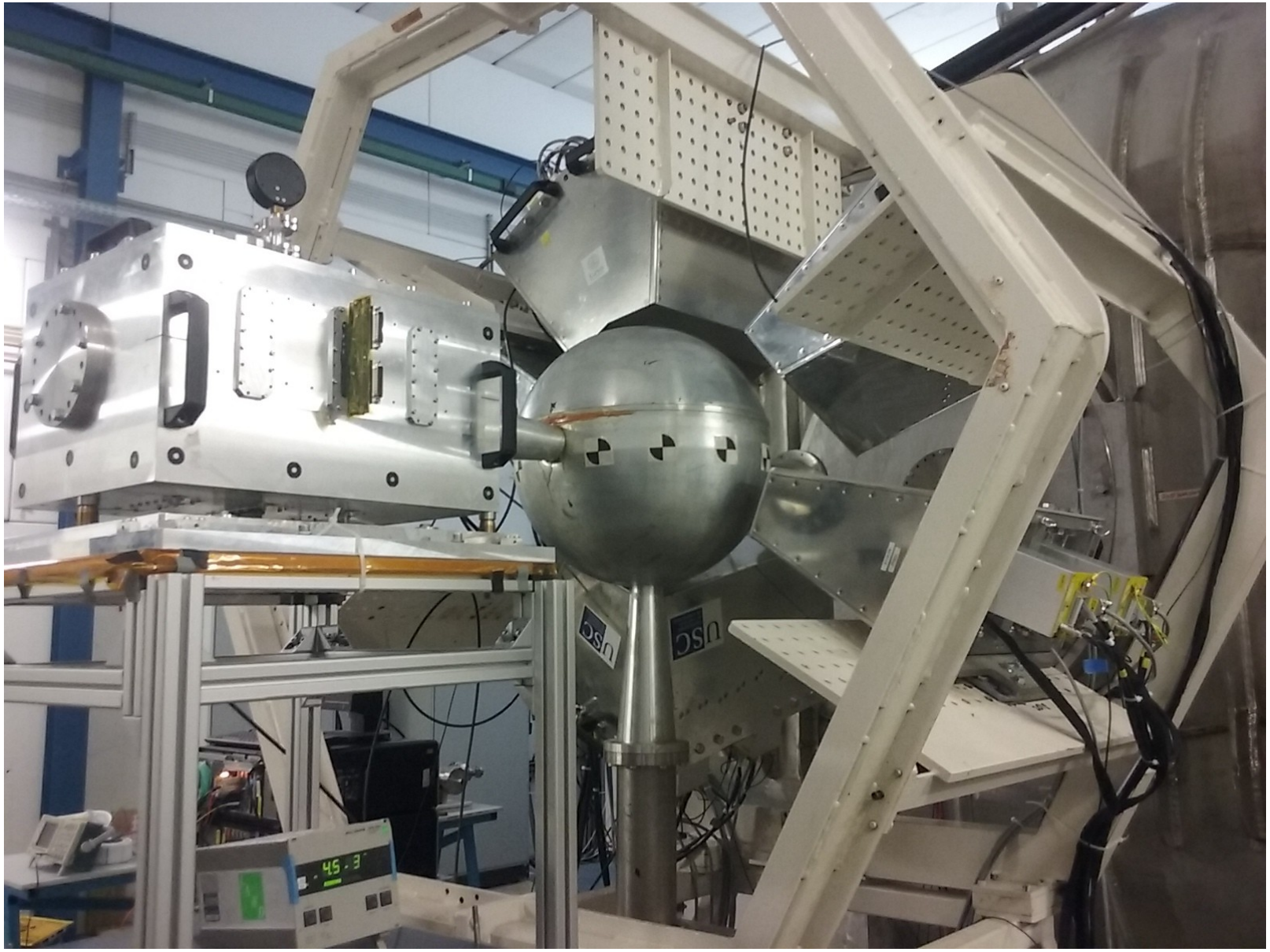

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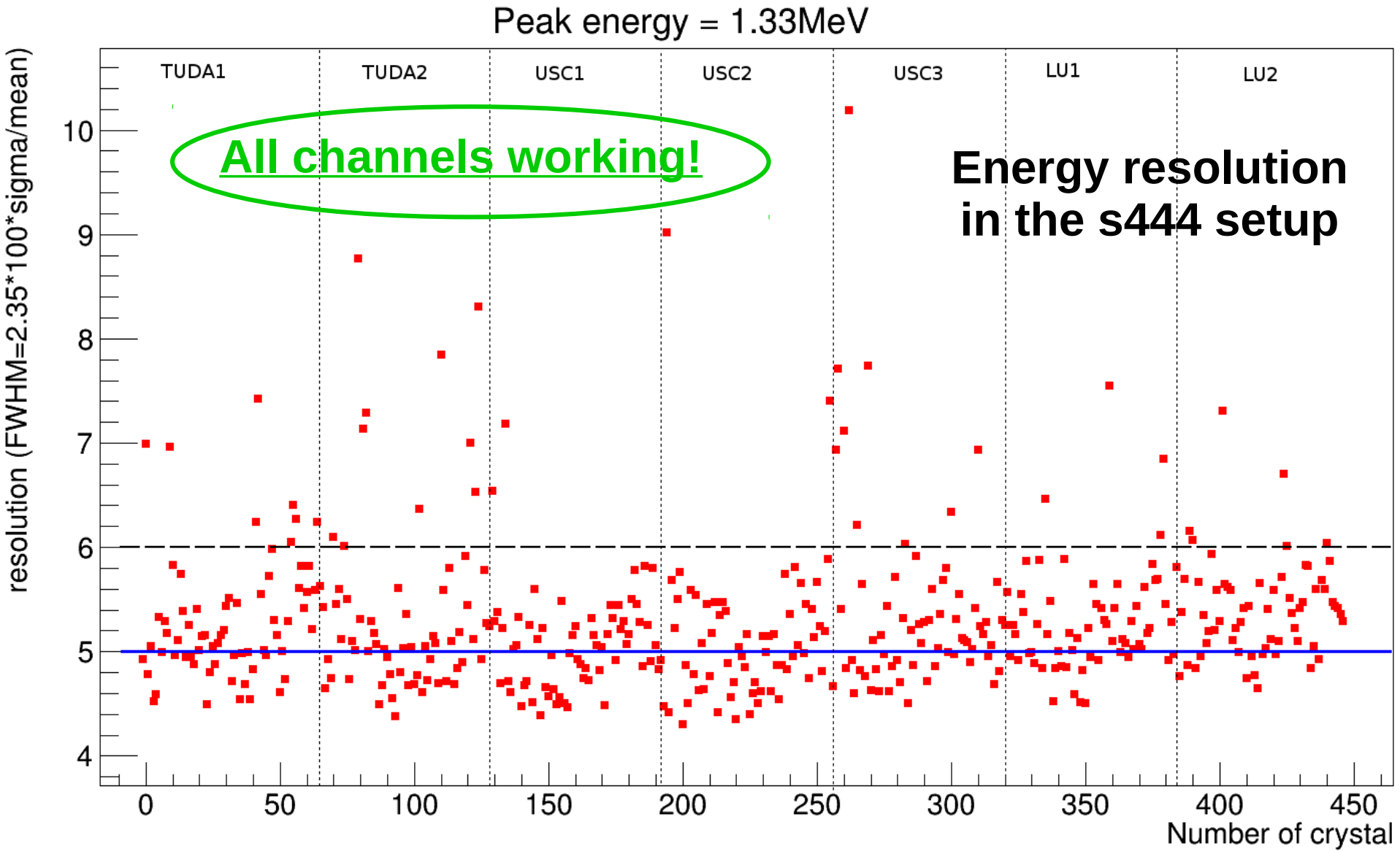

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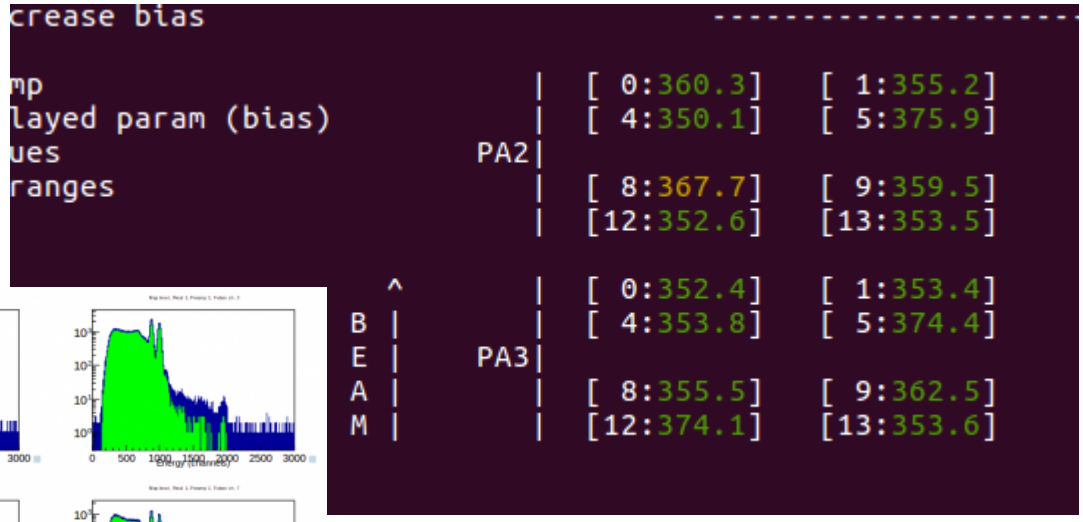
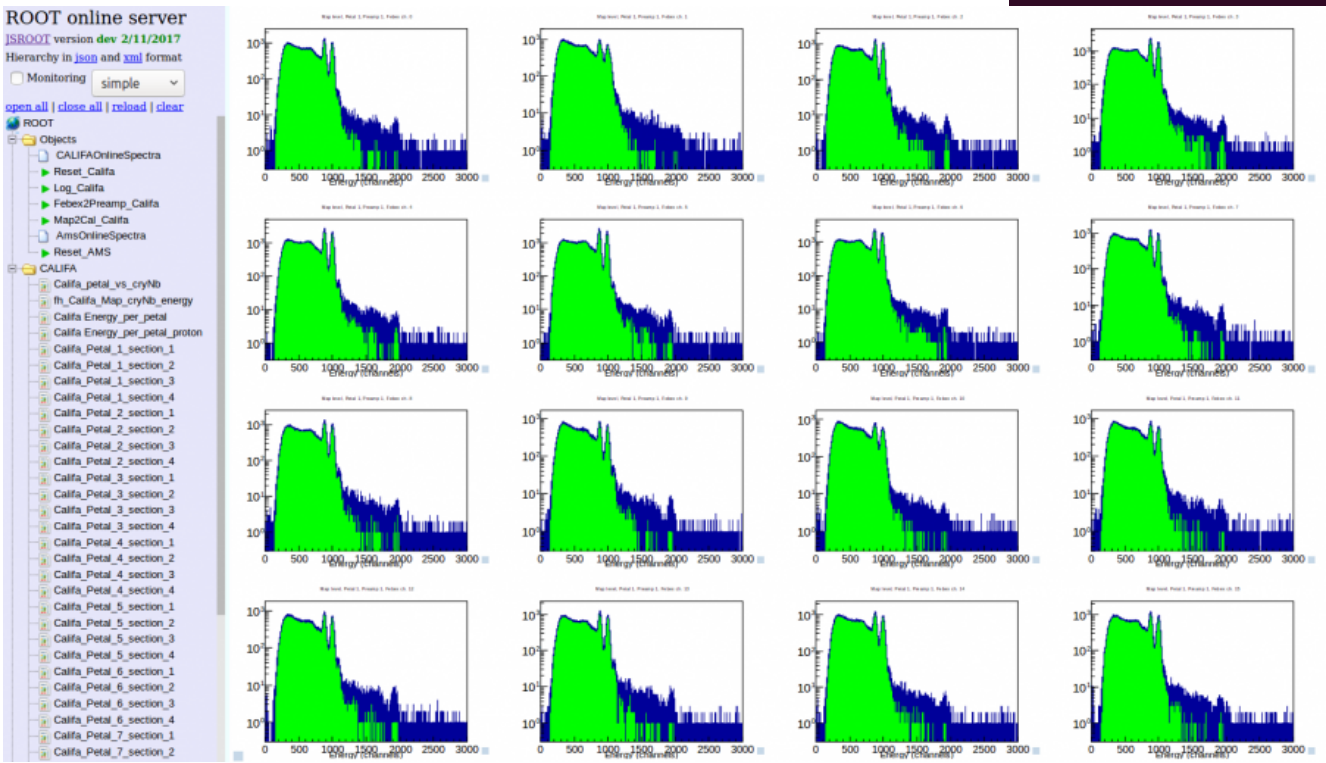
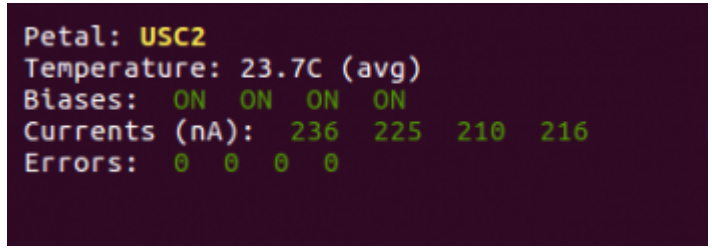
The CALIFA Commissioning

Other Hardware/Software tasks ready:

- DAQ (Febex based)
- Unpacking & Calibration
- Slow control interface
- Online monitoring



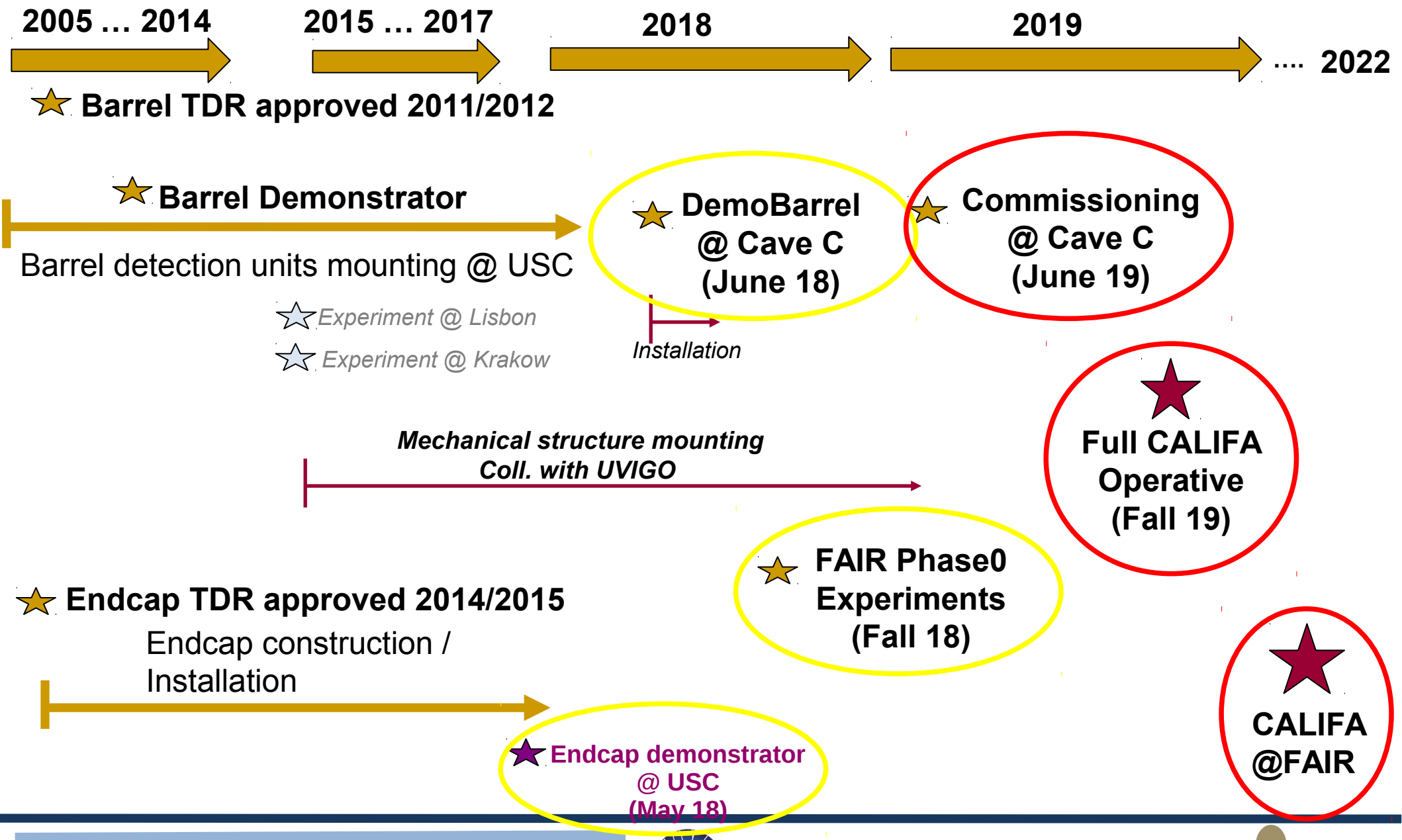




CALIFA Commissioning summary:

- 448 detection units / channels installed and working :-)
- System completely controlled: DAQ, slow control, calibration and online procedures implemented
- Fulfill design requirements: energy resolution ~6% @ 1MeV
- Evaluations under radioactive sources showed good performances
- Data from in-beam reactions under analysis

CALIFA Time Schedule



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