

DUNE-SAND

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Requests (no travel funding) to CSN1

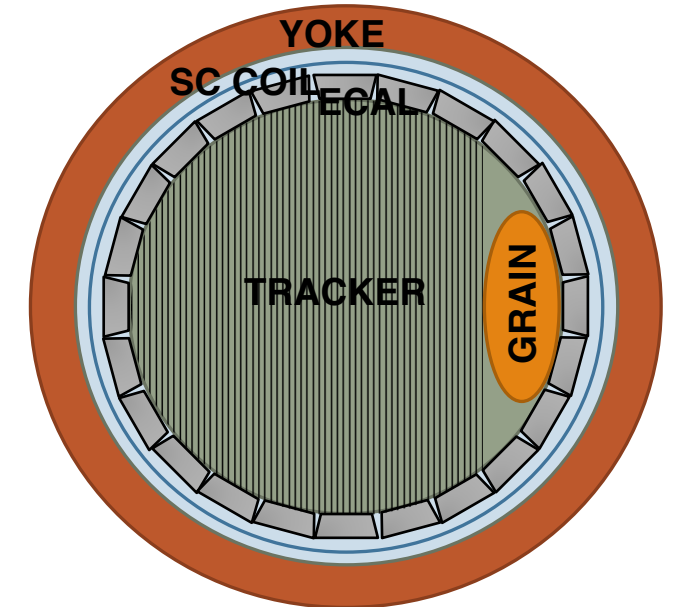
- ECAL
- Magnet
- Tracker
- GRAIN

MAGNET – KLOE 0.6T superconductive coil + Fe Yoke

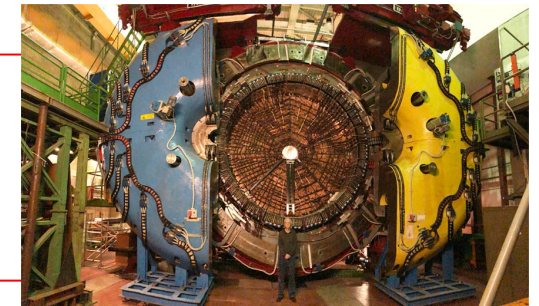
ECAL - KLOE Lead Scintillating Fibers calorimeter (Barrel ~85 t + EndCaps ~40 t)

TRACKER (STT) – 5 ton Straw-Tube tracker with “solid-H” target CH_2 and C interleaved foils (Drift Chamber, DCH, similar)

GRAIN – 1 ton liquid Argon target with VUV imaging system (fully optical read-out)



SAND, a multipurpose detector with a high-performant ECAL, light-targeted tracker, LAr target, all of them in a magnetic field



SAND status in a nutshell

- **Activity in Frascati going on quite smoothly:**
continuing preparation for tools and test operations;
dismounting of calorimeter modules, done for the Barrel ones, ready for the Endcap !
Active involvement of Fermilab engineering group for re-installation planning and preparation
Just underwent to the DUNE PDR, on July 22nd and 23rd.
- **LAr-GRAIN detector:** key issue on ASIC read-out under vibrant studies (defined roadmap towards design and production of 1024 channels ASIC),
first cold test in Genova of coded masks and lenses prototypes almost ready to start;
major advances in cryogenics and preparation of a full-scale test facility in INFN Legnaro Lab
- **Tracker:** advanced prototyping activities at CERN, Pisa and Bologna (plus other sites, installing and testing machines for straws production). Discussion in progress on tracker selection (STT vs DCH).
- **DAQ, Trigger, Timing and Slow Controls:** significant progress on integration with DUNE-DAQ and on timing.
- **Calibrations:** newly formed group; already developed a plan for calibrating ECAL and GRAIN
- **TDR writeup:** writeup progressing; about 240 pages written, for now
- **Physics:** part of the task force for re-evaluation and re-enforcement of the SAND detector
- **All schedules:** already rather detailed

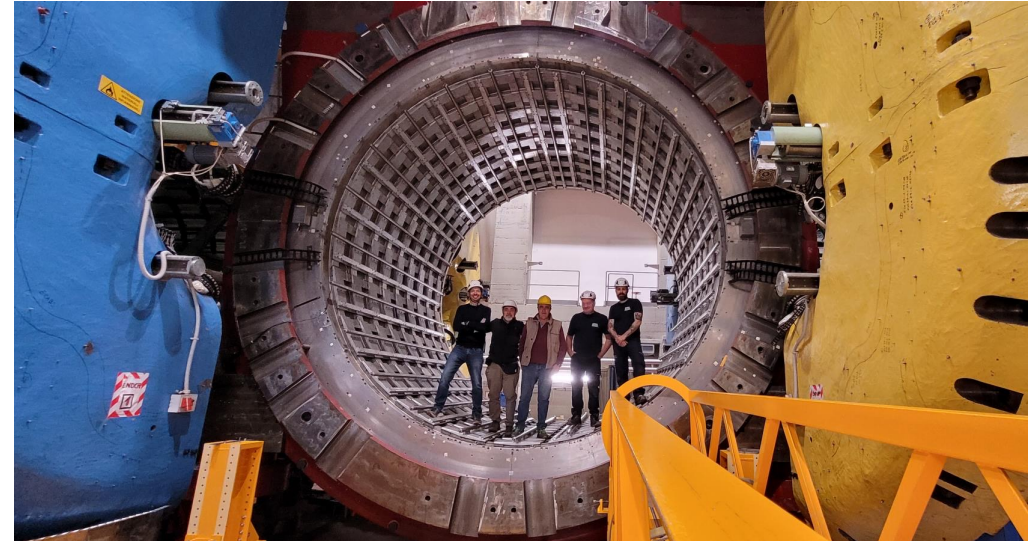
The latest 12 months: very reach of satisfactions !

ECAL



- Barrel modules extraction
- Tooling for Endcaps
- Modules in good conditions
- DUNE PDR just over
- Test stand at LNF ready (*)
- FEE defined path (*)
- HV/LV defined path (*)

(*) it corresponds to requests for 2025



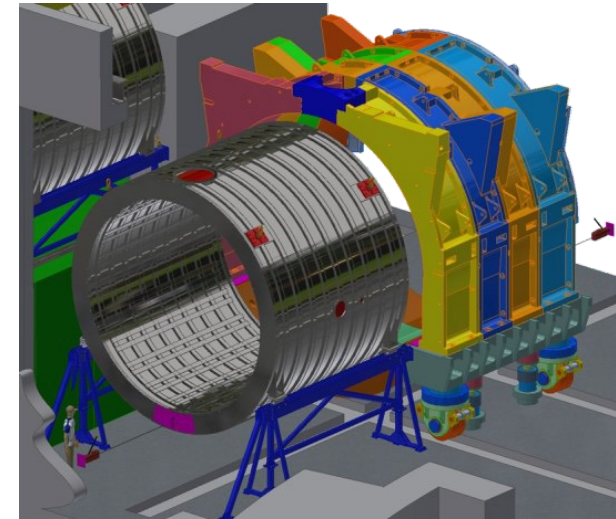
Highlights

Magnet

- Power supply defined path (*)
- Interaction with FNAL people started
- Discussion and documentation on the way on
- Extraction defined (*)
- Magnet test at LNF in 2025 (*)
- Shipping under first evaluation (**)

(*) it corresponds to requests for 2025

(**) it corresponds to requests for 2024/25



Extraction/Insertion Tool

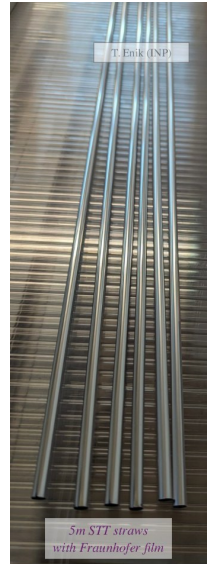
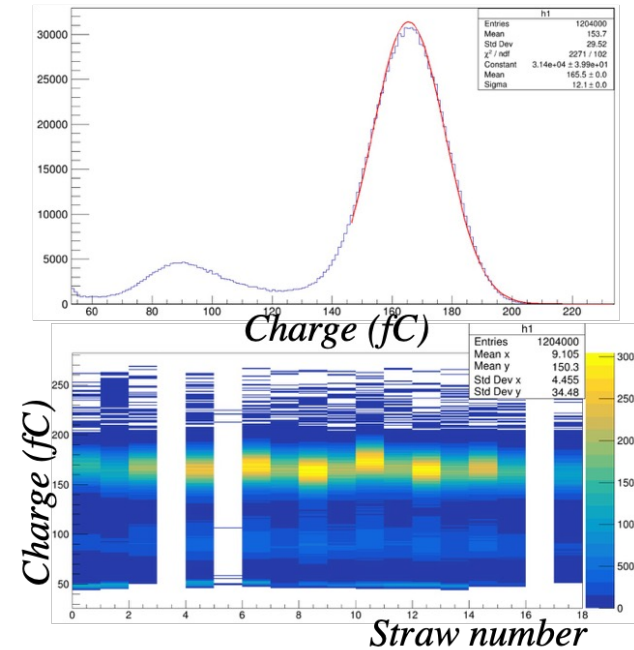


Highlights

Tracker

- First STT prototype on test beam
- New STT prototype under way (*)
- Infrastructure for STT production/assembling
- Option B (DCH) under prototyping (*)
- We should make a choice next year
- We have to start to define tooling (*)

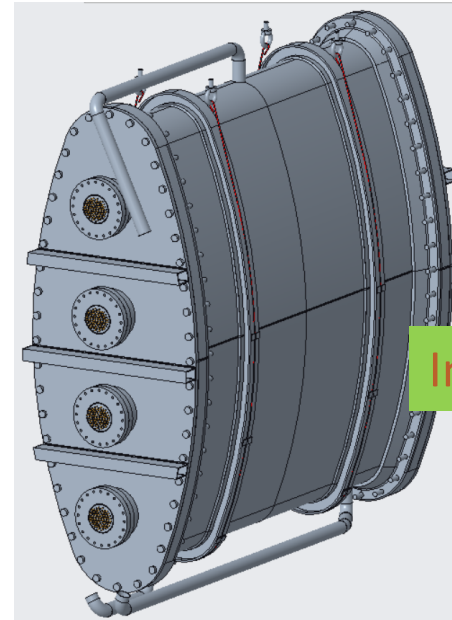
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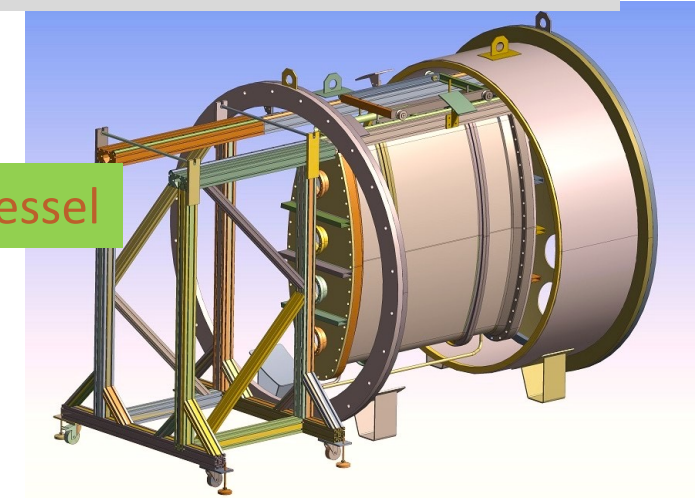
Highlights

GRAIN

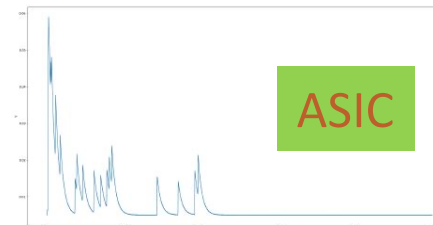
- Lens and Mask under robust R&D
- Internal vessel defined
- ARTIC station at Genova fully activated (*)
- Test station at Legnaro in good progress (*)
- ASIC run and packaging defined path (*)



Vacuum tank for Inner Vessel test at INFN-Legnaro almost ready for tender

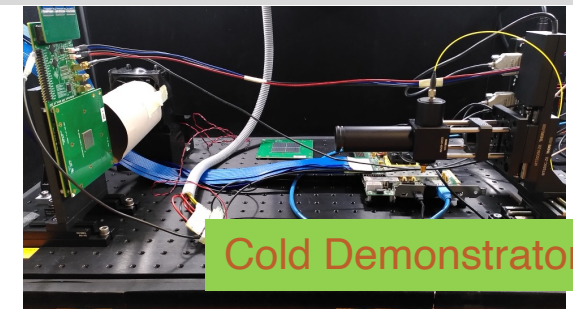


Internal Vessel



Camera with 256 channels ready to be tested in ARTIC facility, Genova (LAr cryostat)

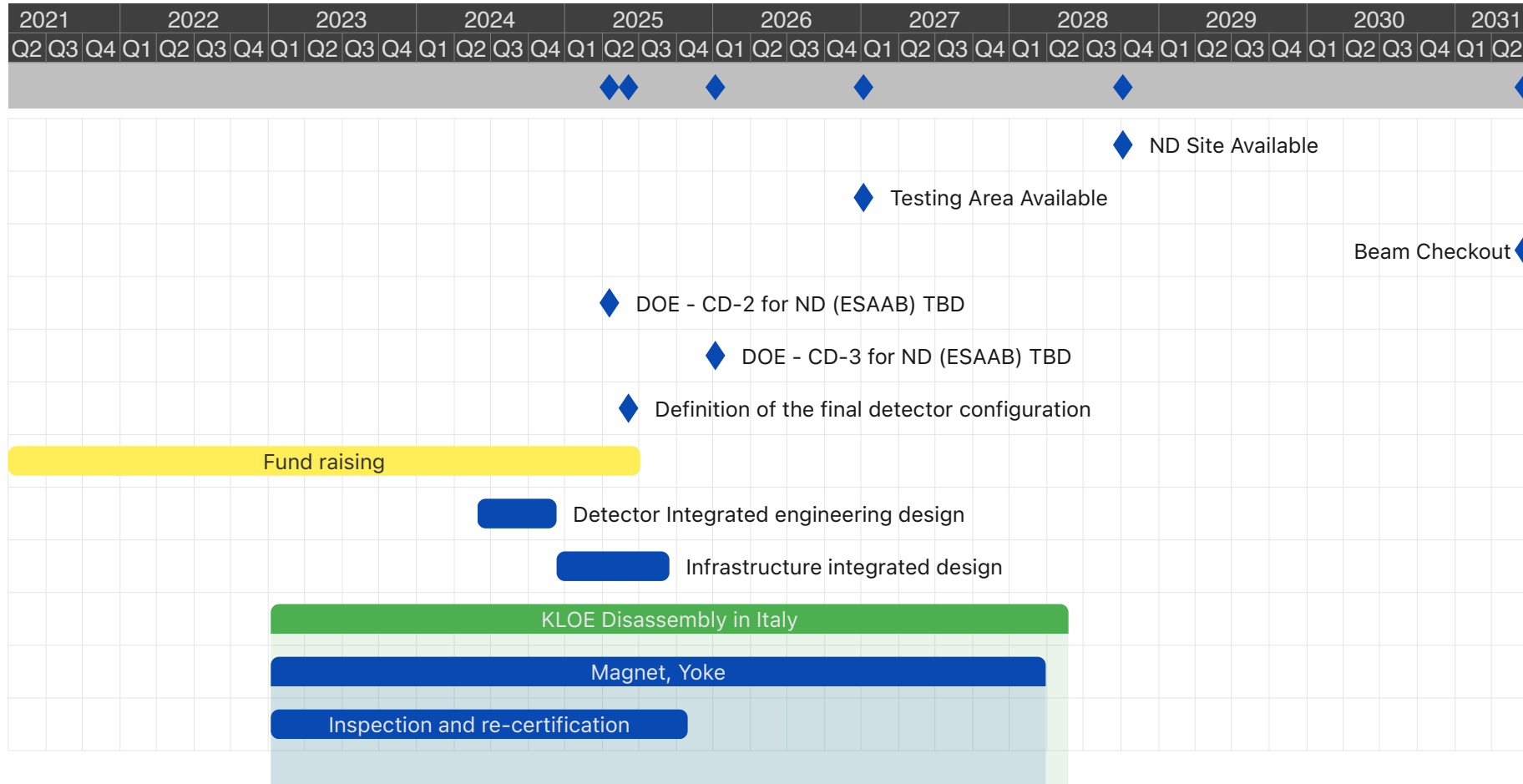
INFN-Torino started the design of a new ASIC 1024 channels. Expected dynamics of photon arrival on SiPMs is used to choose optimized frontend architecture



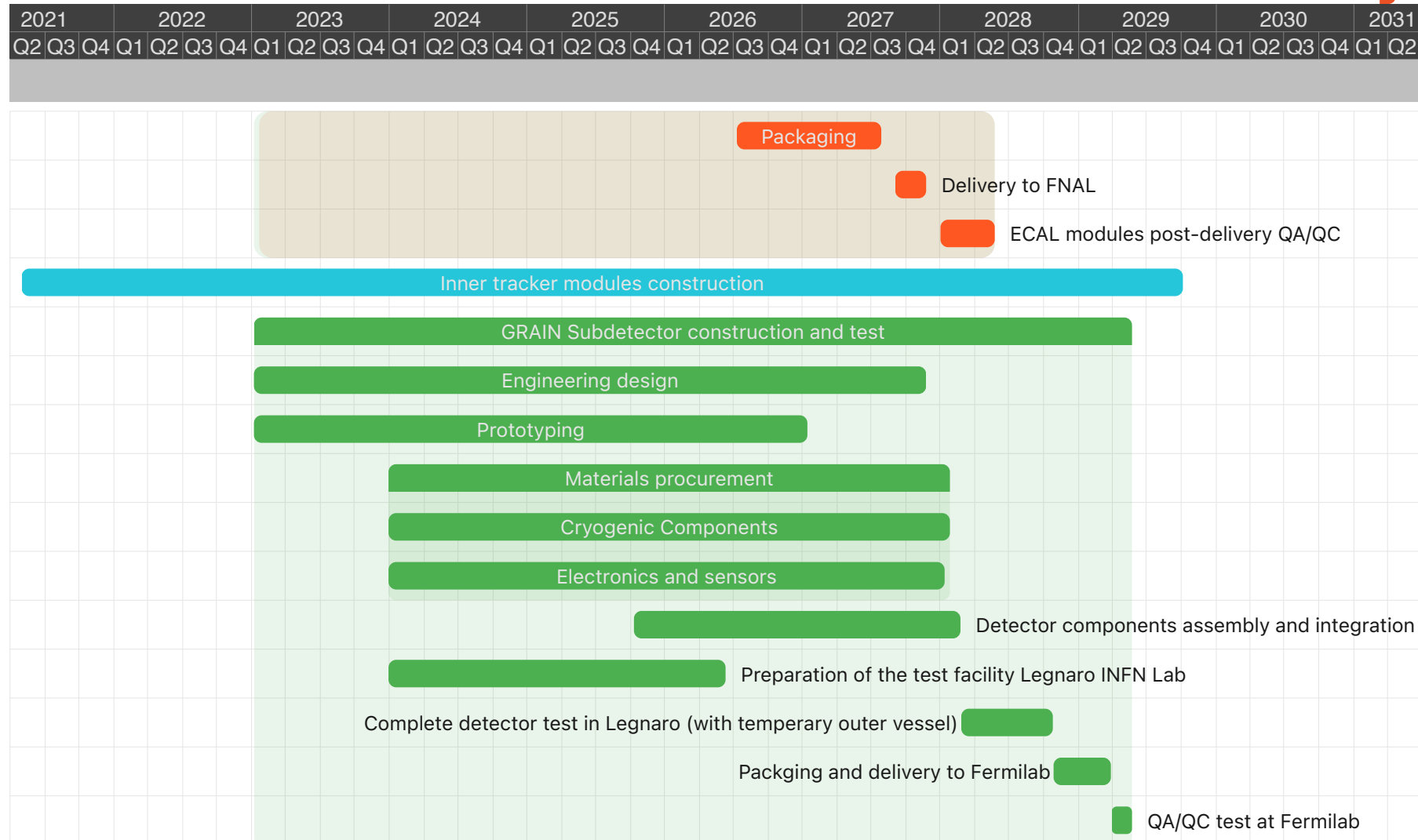
Cold Demonstrator

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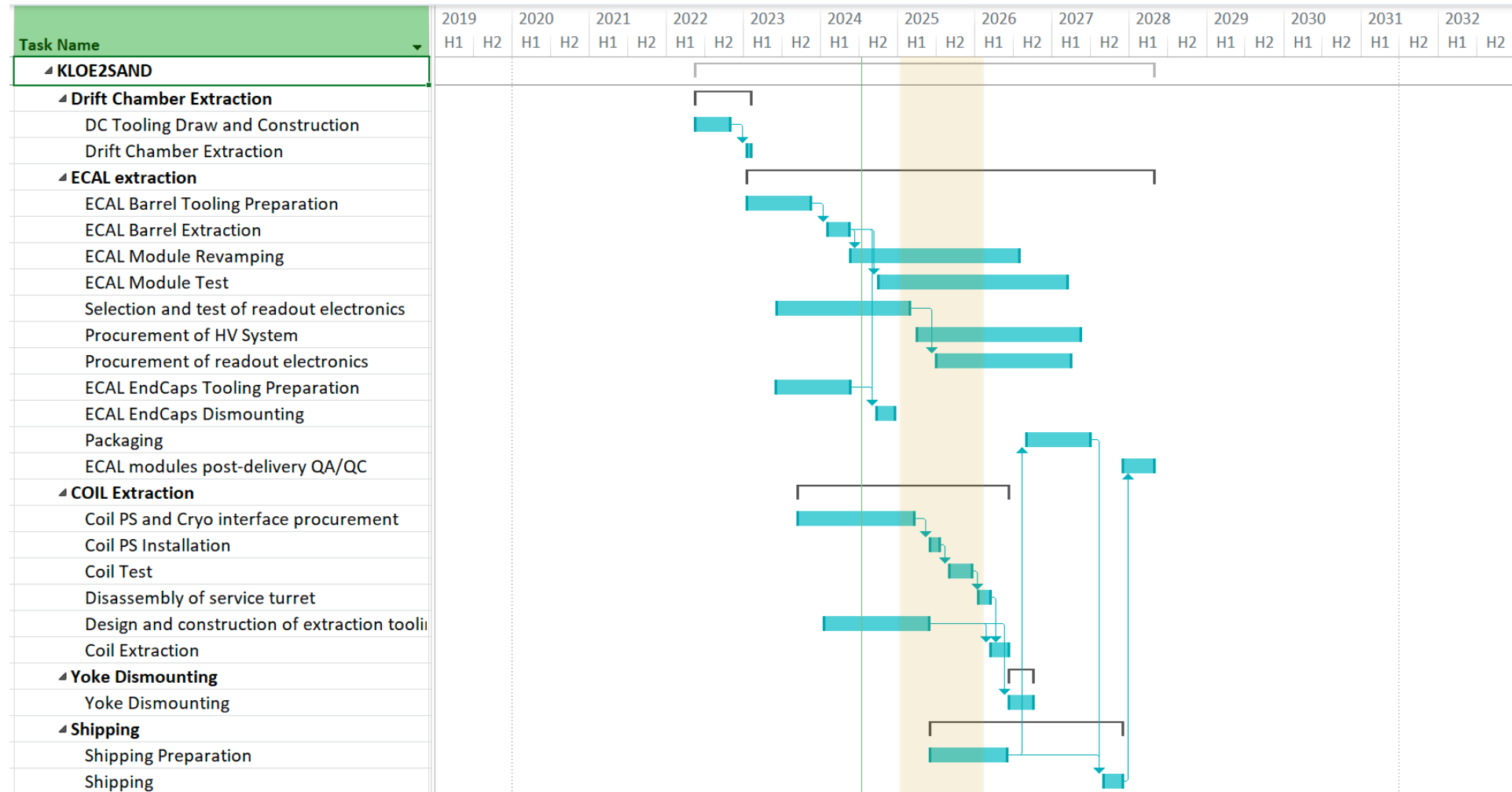
SAND timeline – construction and delivery - I



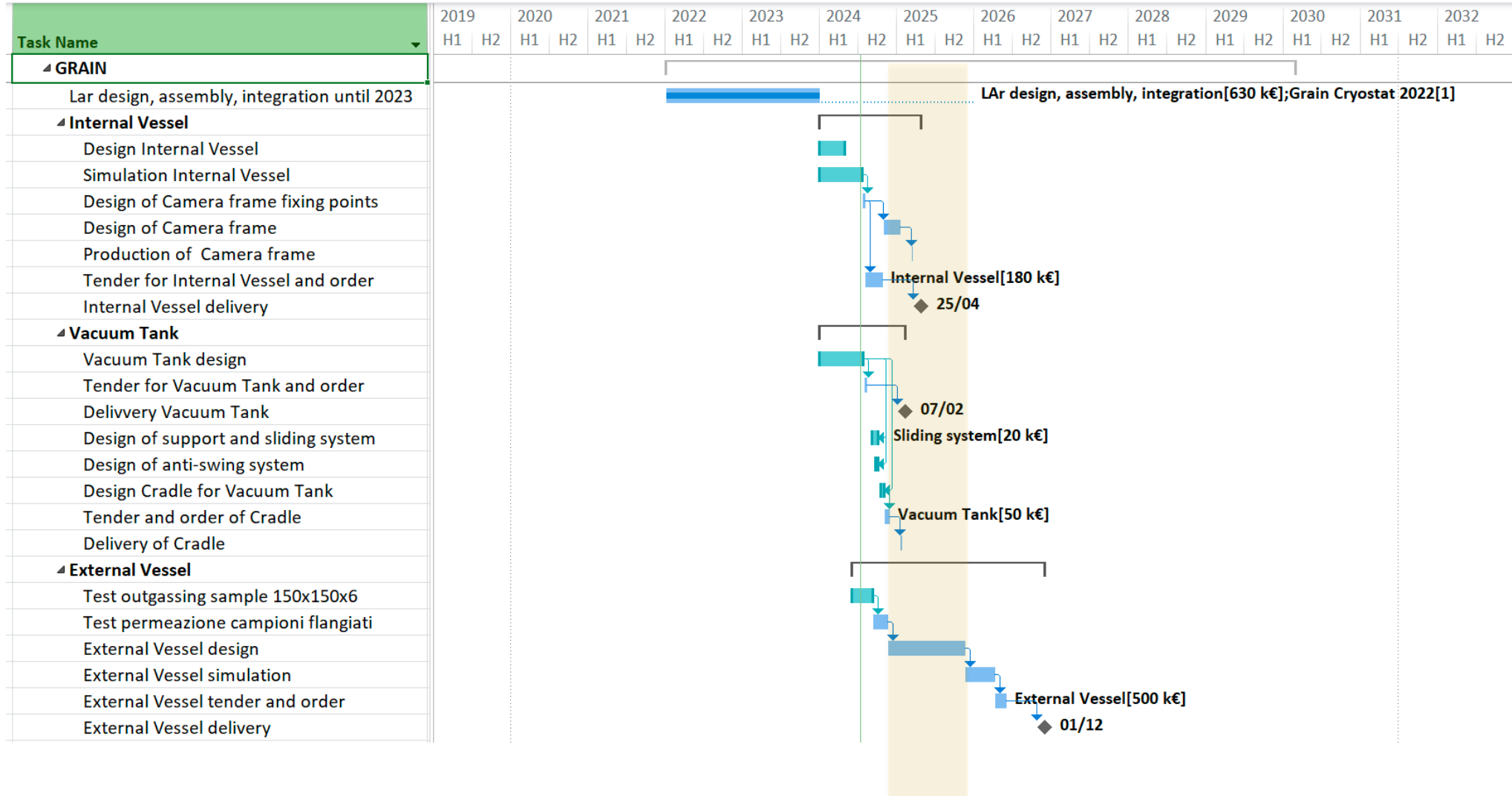
SAND timeline – construction and delivery - III



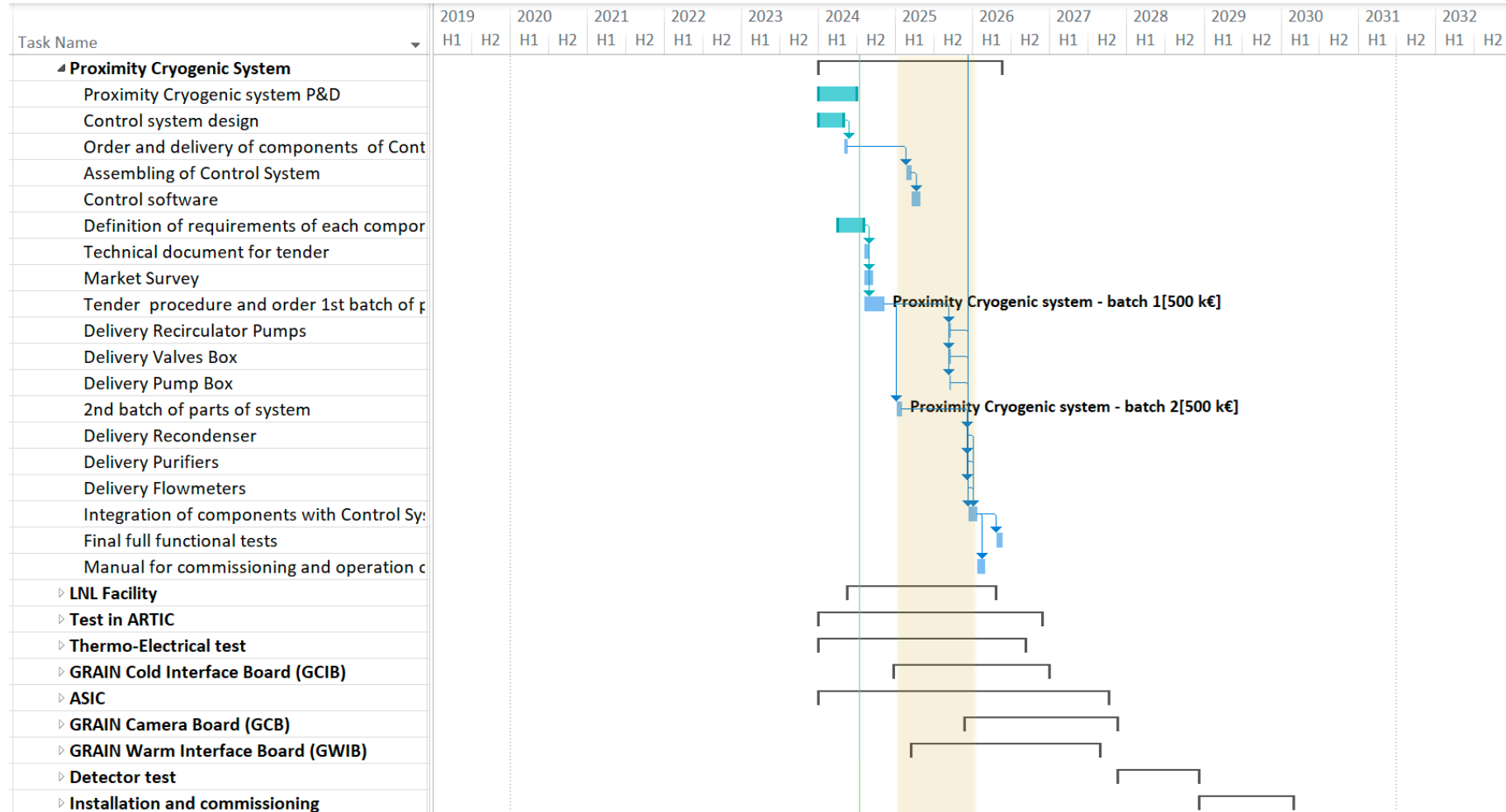
SCHEDULE: KLOE-to-SAND (ECAL+Magnet+Yoke)



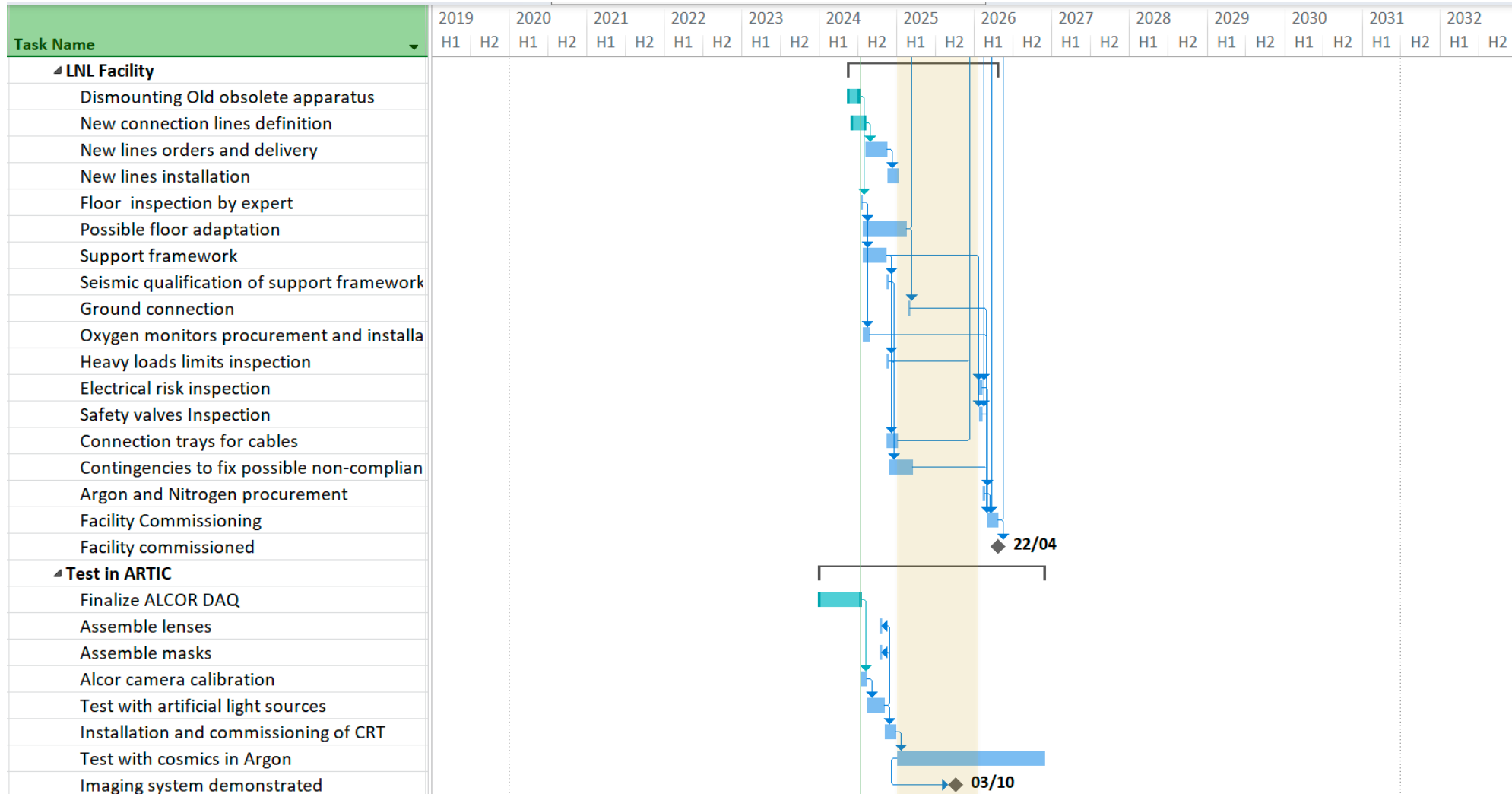
SCHEDULE-I: GRAIN



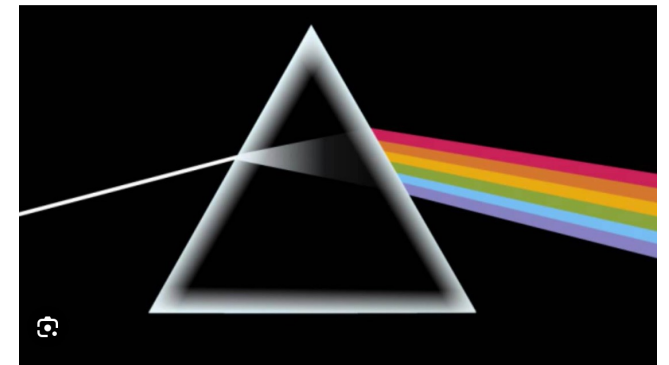
SCHEDULE-II: GRAIN



SCHEDULE-III: GRAIN



MONEY



Caveats for "money" profile reshuffling

- Delay of the DUNE experiment
- Delay of the DOE-INFN MoU signature
- Delay in the identification of the Fermilab sites and definition of the installation procedure

Core costs

To be reshuffled



major shuffling in 2024-25...

INFN Core Cost Spending Profile

		2021	2022	2023	2024	2025	2026	2027	Total
SAND									
MAGNET	Yoke								
	Yoke disassembly, packaging, storage at LNF				300	→	→		300
	Yoke Integration/Installation							200	200
	Superconducting solenoid refurbishment			100	540	→			640
	Transport to FNAL (includes EMC)					1300	→		1300
EMC	EMC test, disassembly, renovation	340	149	300	565	→ 750			2104
GRAIN	LAr design, assembly, integration		40	315	680	1040	→ 980	→	3055
	Spares, small components and transport to FNAL						200	→	200
STT	Design and Prototype			65	150				215
	Contribution to the construction of STT					1700	→ 1700	→ 1700	→ 5100
TRIGGER	Trigger design, realization					200	→	→	200
		340	189	780	2235	4990	2880	1900	year 2028
		340	189	780	1116.5	2444	4573.5	2700	1700
						2620	4393.5		
		340	529	1309	2425.5	4869.5	9443	12143.	13843

SAND INFN sites involvements

with hardware & consumable requests 2025 in ()

- ECAL: Bologna, Ferrara (3 k€), Lecce (20 k€), LNS, LNF (80 k€), Pisa (5 k€), Roma1 (614 k€+553 k€ s.j.+10.5 k€)
- Magnet: LNF (635 k€+120 k€+170 k€ s.j.)
- Tracker: Bologna (35 k€), Pisa (5 k€+200 k€ s.j.)
- GRAIN: Bologna (54 k€+35 k€), Genova (120 k€ s.j.+19 k€), Lecce (34 k€+10 k€), Padova, Torino (268 k€ s.j.)

- ECAL: 732.5 k€ + 553 k€ s.j.
- Magnet: 755 k€ + 170 k€ s.j.
- Tracker: 40 k€ + 200 k€ s.j.
- GRAIN: 152 k€ + 388 k€ s.j.

2990.5 k€

SAND requests for 2025

(no travel funding and major items, > 10 k€)

- core costs (2444)
- not core costs (528)

Magnet

- Mechanics at LNF (120)
- Yoke at LNF (85)
- Cryogenics at LNF (550)
- Helium at LNF (170 s.j.)

ECAL

- Mechanics at LNF (80)
- FEE + LV at RM1 (553 s.j.)
- HV at RM1 (614)
- Test for LNF at LE (20)

GRAIN

- HV/LV, cables, boards at BO (54+35)
- Test St. for LNL at LE (44)
- ARTIC at GE (19)
- ASIC packaging at GE (120 s.j.)
- ASIC at TO (268 s.j.)

Tracker

- STT at PI (5 + 200 s.j.)
- DCH at BO (35)

Additional SAND requests for 2024/25

- **90 k€** for Magnet PS (190 -> 280)
- **50 k€** for Magnet software
- **40 k€** for Shipping Engineering study

SAND: conclusions

- ✓ The SAND detector is a key element of the ND-complex (and DUNE)
(formally based also on the MoU just signed off)
- ✓ Our plan is compatible with the first day of ND-hall allowance to start installation (Sept. 2028),
(thanks also to FNAL interplay)
- ✓ Disassembly of KLOE in Italy is actively and wonderfully going on
(some delays not relevant for the schedule)
- ✓ Robust R&D program underway for the Tracker and GRAIN
(PDR/TDR will be a disentangling milestone)
- ✓ The physics potentials are huge, for oscillation physics and beyond
(undergoing Task Force mission)