

Status of EIC project e preview preventivi

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Introduzione

Main reference: briefing del 19/07 su stato progetto EIC e programmazione (*non ripetuto qui*) ma citato

Disclaimer:

- **no stato update generale EIC_NET** → Annual Report + altri talk + comunicazioni 19/7 + CSN3 20/9
-

Contenuti:

- Outcome EICUG meeting 26-30 luglio 2022
- Preventivi 2022
- Richieste straordinarie Settembre 2022
- Introduzione all'agenda



The next big step → next week



- First face-to-face meeting of the community since 3 years and first meeting of the new Collaboration
- The Collaboration will get a name! D1, EPIC or
- We need to "convene" on dRICH and set our role in tracker, computing and DAQ
- Key role of Silvia, Roberto, Andrea and Marco in SC or conveners (PID, computing, SIDIS) + Silvia/MarcoR in EICUG SC
- 13 from INFN attending

| | Sunday 24 | Monday 25 | Tuesday 26 | Wednesday 27 | Thursday 28 | Friday 29 | Saturday 30 |
|------------|-----------|-----------|---------------------|--------------|-------------------------|----------------------------|-------------|
| MORNING I | EARLY | EARLY | Project+DOE Updates | Detector I | Detector II + IR8 | Long Range Plan Discussion | Open |
| MORNING II | | | Detector I | Detector I | IB Meeting | RHIC TOUR | Open |
| AFTERNOON | CAREER | CAREER | Detector I | Detector I | EICUG Committee Updates | TAVERN on the GREEN | X |

Project + DOE Updates

- Update from the project
- Status of Detector I
- Status of Accelerator Design
- News from DOE

19/07/2022

Meeting con collegio referale

11

EICUG and Detector-1 meeting

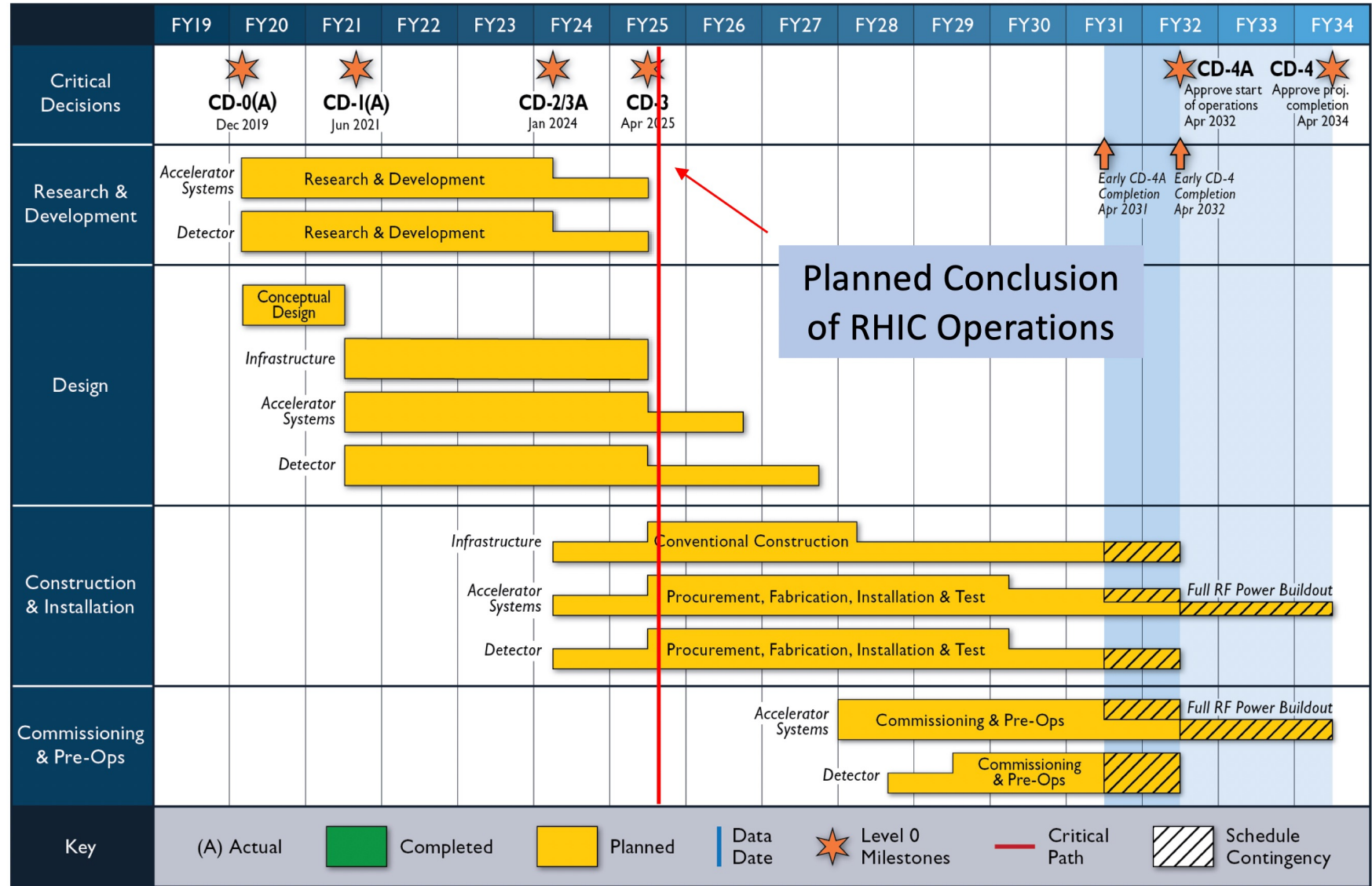
- 300 participants (> 100 in presence)
 - Large (and noted!) INFN participation: 16 (including two members from CNS5)
 - Very useful in-person contacts (“the power of the corridors”)
 - Updates from the EIC project: schedule, funding, governance, accelerator
 - Detector-1 meeting incapsulated in larger community EICUG meeting
 - Detector-1 -→ **EPIC Collaboration** is born!
 - ✓ Charter Committee at work
 - ✓ Bylaws adoption and possibly leadership election by October 2022
 - ✓ Advances in “merging” (ATHENA/ECCE) and steps toward detector definition
 - ✓
- "Electron Proton/Ion Collider" experiment

Schedule and implications

Approval of CD 2/3A by Jan 2024 means documents submitted by October 2023

Key challenge:
Deliver pre-TDR by October 2023
"preliminary design"

Starting operations in 2031, design operations of the machine reached in 2034



Preparing for pre-TDR "Preliminary design"

Plans for Design Maturity

| System | Estimated Design % Complete | Estimated Design % Complete | Estimated Date for Final Design Complete | Comments |
|-------------------------------------|-----------------------------|-----------------------------|--|------------------------------------|
| | Now | CD-2 / 3A | | |
| 6.10.02 Detector R&D/Physics Design | 0% | 60% | 06/30/2026 | Project R&D just started |
| 6.10.03 Tracking | 10% | 50% | 12/31/2026 | Need only late |
| 6.10.04 PID | 15% | 50% | 03/31/2026 | hpDIRC well underway |
| 6.10.05 EmCal | 20% | 85% | 12/31/2024 | eEMCAL far ahead |
| 6.10.06 HCal | 15% | 70% | 06/30/2025 | Barrel Hcal reuse, rest delayed |
| 6.10.07 Magnets | 30% | 100% | 12/31/2023 | LLP, completed 30% design |
| 6.10.08 Electronics | 10% | 50% | 03/31/2027 | ASICs/electronics can come in late |

What Does a Preliminary Design mean

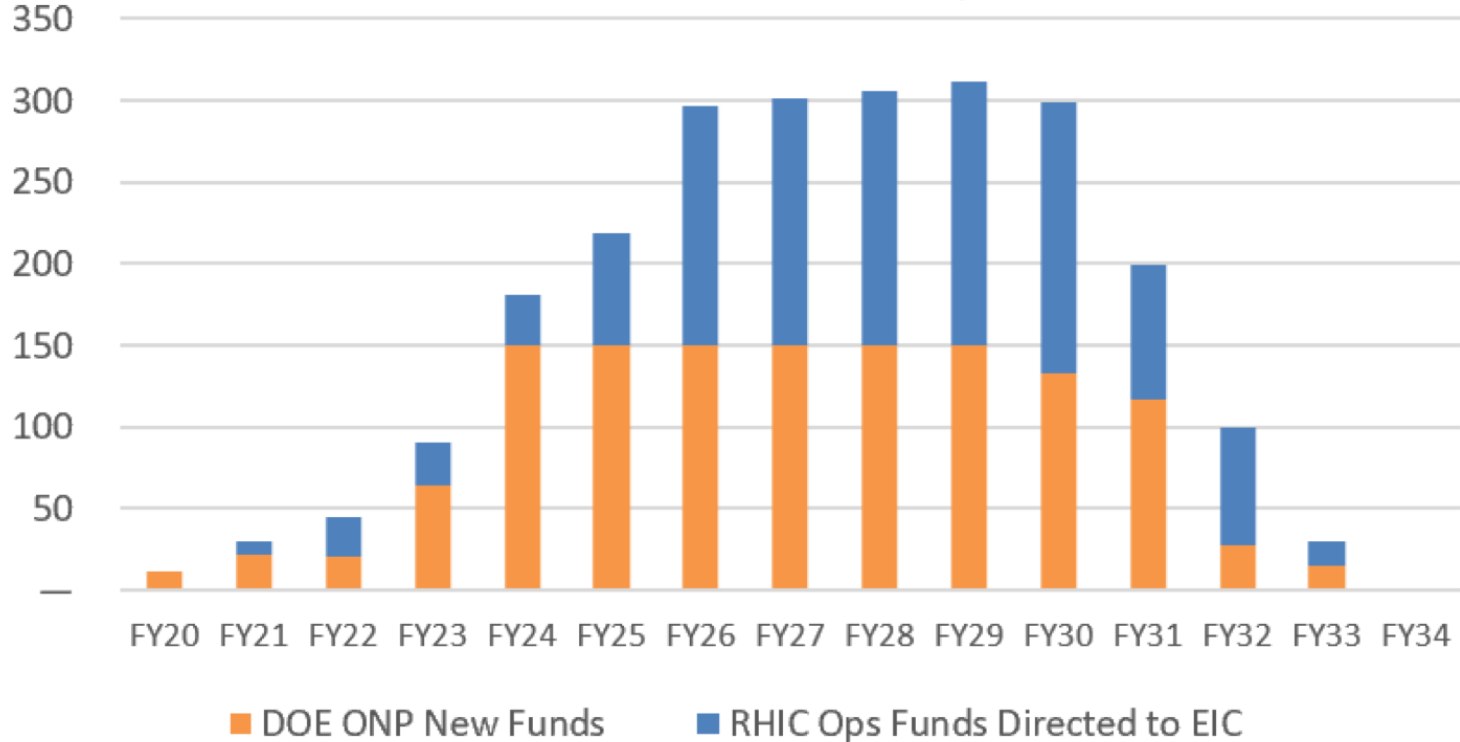
Example: dRICH

- need to define the sub-detector technology to a level of detail that we can baseline cost, schedule and workforce and functional requirements needs
- what do we build: a CF-gas + Aerogel RICH or is the CF-gas replaced with a pressurized or cooled Argon
 - vessel design needs to be well advanced
- geometry of the subsystem and how it is integrated in the overall detector
- photon-sensor technology and # of readout – channels
- what is the front-end electronics, what ASIC will be used
- define mirror - system
- what needs to be cooled and how
- 3d-CAD of the detector with details how the detector will be assembled, drawings of the different components but not on fabrication quality
- design of gas system
- slow control and monitoring of hardware systems are needed, how do we realize it
- A worked-out concept (but no detailed plan) of assembly and service needs

There can still be some open questions (but not affecting costs and schedule in major way), further engineering design to be done, detailed drawings to be done, etc.

Funding plan

EIC Possible Reference Profile Option #1 - Cap at \$150M/yr
 \$2.419B with CD-4 at April 2034



dopo ritardo nel 2022 per approvazione budget federale e taglio nella "Infrastructure bill" assunzione di 90 M\$ in FY23

dopo approvazione Inflation Reduction Act (IRA) news positive ("funding to get CD 2/3A in Jan 2024" seems now secured)

25/08 EPIC General Meeting:

“Our short-term objective is to secure CD-2/3a at the earliest possible date and we are fortunate that DOE will provide the funds we require through both IRA funding and the traditional annual appropriations process. We will work with DOE and our partners to secure CD-2/3a approval in early calendar 2024.”

Accelerator

Many developments in critical R&D for accelerator design

<https://indico.bnl.gov/event/15342/contributions/64650/attachments/42380/70993/2022-07-26-EICUG-Satogata-AcceleratorDesign.pdf>

International Engagement - Accelerator

- Active engagement ramped up last summer through meetings with DOE and funding agency reps, Accelerator Workshops, and dialogue with potential partners
- Collaborations contributing to both design and hardware that cover a broad range of WBS items are in development
- Bi-lateral meetings now expand from EIC L1 management to L2 & L3 EIC experts for detailed technical discussion of possible in-kind scope
 - Examples: **Crab Cavity** system information exchange meeting w/UK and Canada, meetings w/INFN-Accelerator collaboration on **HSR vac. system**, w/CERN on **ESR vac. sys.**, etc.

| | Armenia | Australia | Austria | Belgium | Brazil | Canada | Czechia | France | Germany | India | Italy | Japan | Korea, Republic of | Mexico | Netherlands | New Zealand | Poland | Senegal | South Africa | Spain | Sweden | Switzerland | Thailand | Ukraine | United Kingdom |
|---|---------|-----------|---------|---------|--------|--------|---------|--------|---------|-------|-------|-------|--------------------|--------|-------------|-------------|--------|---------|--------------|-------|--------|-------------|----------|---------|----------------|
| Contact / Attend EIC Accelerator Partnership Workshop 2020 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Presentation at EIC Accelerator Partnership Workshop 2020 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bi-lateral meetings with L1 management to explore interests | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bi-lateral meetings with L2 & L3 experts on concrete scope | | | | | | | | | | | | | | | | | | | | | | | | | |
| Scope proposal ready for DOE & funding agencies | | | | | | | | | | | | | | | | | | | | | | | | | |

24 Electron-Ion Collider

Potential Accelerator Contributions

- Italy, INFN
 - HSR vacuum chamber inserts
- Canada, TRIUMF
 - SC Crab Cavity system
 - Pulsed systems
- UK, ASTEC & Cockcroft Inst.
 - ERL components
- France, IJCLab
 - SHC ERL diagnostics
- France, CEA Saclay
 - IR SC magnets
 - SC spin rotators
- CERN, Switzerland
 - ESR SC cryomodules joint design
 - ESR high current elements joint design
- Japan, KEK
 - ESR collimation system

High level readiness of technical status
Possibly, first case for use of seed funds

High level readiness of technical status

Project is developing possibility of "Seed" funds for EIC international collaboration that can enable early start of EIC accelerator design efforts in partner countries

- Recent & tentative:
- Israel, SARAF
 - RF power amplifiers, collimators, controls
- Sweden, Uppsala Uni.
 - SSPA

T. Satogata@EICUG meeting

EPIC on-going discussions towards detector definition

Hot items in consolidation/optimization

An introductory list (much more during the DETECTOR-1 meeting)

- ❑ Optimization of barrel tracking
 - Achieve a realistic, low-mass design with good performance
 - MPGD selection (μ RWell / MM)
- ❑ Reference design did not include backward HCAL
 - Is there a strong physics justification?
- ❑ The two barrel EMCAL solution imply a different physics emphasis
- ❑ AC-LGADs are new, unproven technology
 - Potential for risk-reduction
- ❑ PID in backward region (two competing technologies)

- ***This process must be driven by the physics performance based on a holistic approach***
- ***Integration aspects also to be considered***
- ***Iterative process toward optimization***

+ (from INFN-perspective):

"space" optimization for dRICH remains critical. ECCE community was clearly less dRICH oriented in design

TOF AC-LGAD layer seems more a complication can something helpful for dRICH (instead of a tracker behind dRICH)

potential synergies between dRICH and PID backward depend on the choice of technology

EPIC: software model

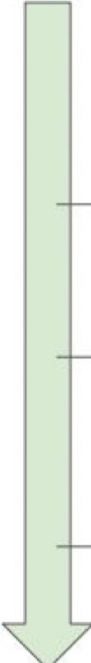
Intense (and complex) review by the WG (confirmed then by an independent expert panel later in August)

Slide shown by on May 13, 2022



A Critical Path for EIC Software

Towards a unified software approach for the EIC

- 
- A large, light green downward-pointing arrow is positioned to the left of the list, indicating a sequential or descending order of steps.
1. Assessment on the software solutions (pro & con list) together with the SimQA and DAQ working groups, guided by the EIC Software Statement of Principles.
 2. Propose conclusion and recommendation to collaboration management and Project **by the Summer EICUG meeting.**
 3. Software choice treated as any other technology choice? Optional independent review in the Summer.
 4. Once decision is made, all new development should go in the official framework.
 5. **Aim to have fully transitioned to the official software by October.**

Key decisions

Code repository:

- github + gitlab/EIC

Geometry description & detector interface:

- dd4HEP

Data model:

- PODIO for management
- EDM4hep

Reconstruction framework

- JANA2

JANA2

Multi-threaded HEP Event Reconstruction

Existing code under Gaudi/Juggler or Fun4all under adaptation re-use for JANA2 @ JLAB

EPIC: magnet

at EICUG meeting

- confirmed ECCE proposal tracking performance overevaluated due to lack of materail budget for support structures
 - concerns about re-use of BABAR/sPHENIX magnet
- towards new magnet (Jlab/CEA project) from backup solution to "plan-A"

in the meantime (**update at EPIC meeting 18/08**)

- BaBar magnet re-use officially rated "high risk"
- conductor choice (Al) for ATHENA design not feasible!
- to make a robust (>1.5 T) magnet a solution is possible increasing conductor layers from 4 to 6
- magnet might operate at 2T, certainly safe 1.5-1.7 T

- 😊 no big impact in geometry and material budget
- 😊 performance within YR requirements
- 😬 + 5 M\$ in costs
- 😬 "ECCE was wrong, ATHENA not feasible"

New Magnet Design – Nuclear Interaction Lengths

| Thickness/Nuclear interaction length | | | | |
|--------------------------------------|-------|----------------|-------|-----------|
| BaBAR | New | ATHENA/SOCRATE | Marco | 2T magnet |
| 0.344 | 0.000 | 0.650 | 0.000 | 0.000 |
| 0.011 | 0.167 | 0.170 | 0.115 | 0.173 |
| 0.000 | 0.239 | 0.417 | 0.239 | 0.239 |
| 0.007 | 0.014 | 0.020 | 0.003 | 0.004 |
| | | | | |
| 0.362 | 0.420 | 1.258 | 0.356 | 0.415 |

What we asked you earlier to bless

achievable only with Al-conductor

Where we ended after conductor choice

With 6 layers of conductor



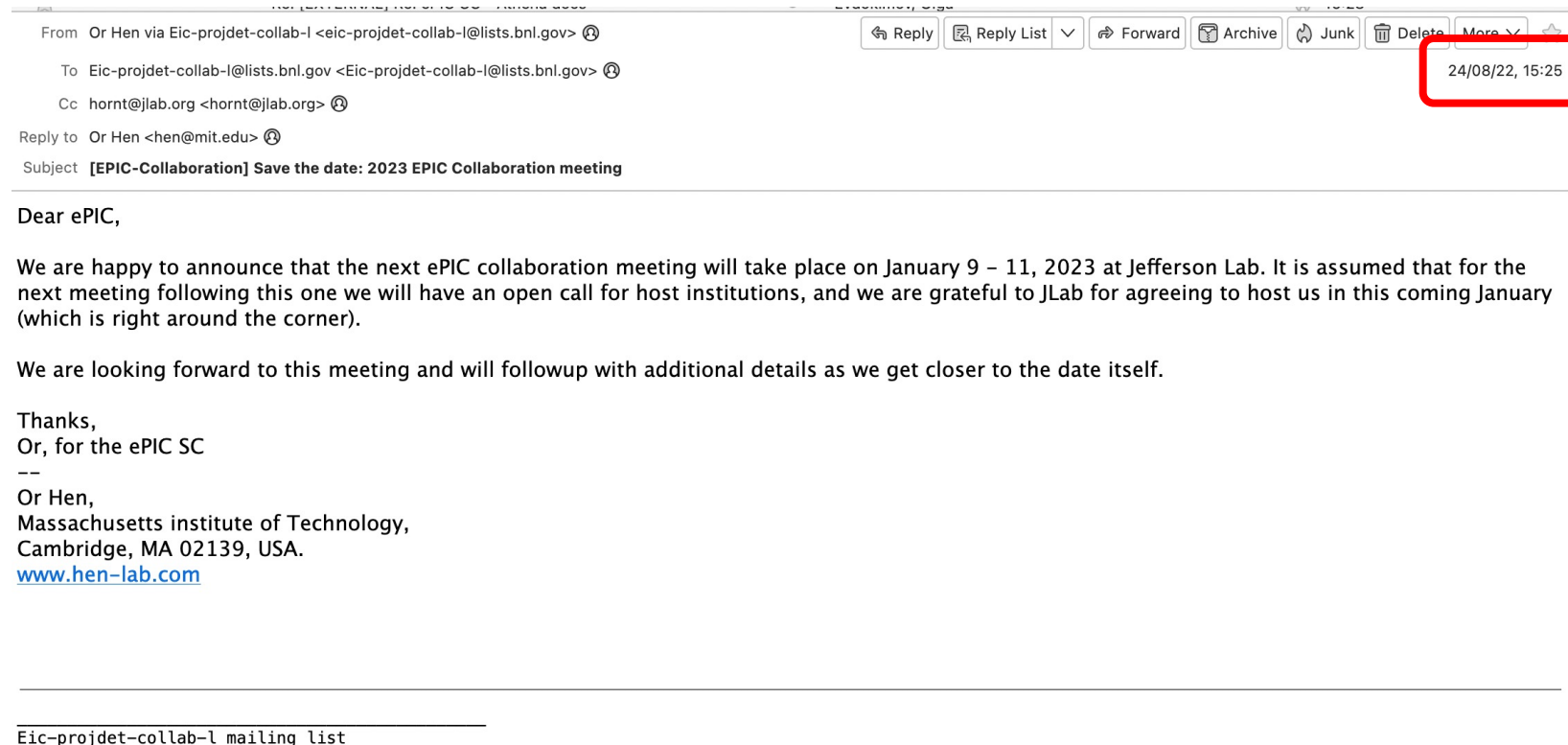
thickness of magnet critical for barrel HCal performance
→ if too thick HCal becomes a MuID

EPIC Collaboration meetings

- Due per anno
- Rispetto a luglio abbiamo ora date del "secondo meeting" → **9-11 gennaio 2023 al JLab**
- Inoltre: meeting estivo "dentro" EICUG meeting (in Europa)

Una parte delle richieste sj per missioni/networking ("meeting collaborazione in USA") andranno impegnate subito!

(o chiederemo poi supporto per meeting estivo?)



Annual Report 2022

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1. Introduction

- 1.1 The Electron Ion Collider and the CSN3 EIC_NET initiative
- 1.2 The international project
- 1.3 The EIC_NET contribution to the international project
- 1.4 EIC_NET Collaboration: status and responsibilities
- 1.5 EIC governance / relevant contacts within INFN

2. EIC_NET R&D activities (Jan 2021 - June 2022)

- 2.1 Physics and software/computing coordination
 - 2.1.1 Spectroscopy programme at the EIC (GE, RM2)
 - 2.1.2 Exclusive processes: partonic imaging in coordinate space (CS)
 - 2.1.3 Radiative correction effects at the EIC (TS)
 - 2.1.4 Software and computing coordination (BA, TS)
- 2.2 Detector simulation (BA, BO, RM1, TS)
- 2.3 Detector R&D: dual RICH activities (BA, BO, CT, FE, LNF, LNS, RM1, TO TS)
 - 2.3.1 dRICH prototype (CT, FE, LNF, LNS, RM1)
 - 2.3.2 SiPM studies and readout electronics (BO, FE, TO)
 - 2.3.3 LAPPD studies (GE, TS)
 - 2.3.4 High pressure Argon as gaseous radiator (LNS, TS)
 - 2.3.5 Aerogel studies (BA, FE, RM1)
 - 2.3.6 Gaseous single photon detectors for Cherenkov application (BA, TS)
- 2.4 Detector R&D: Si-Vertex (BA, TS)
- 2.5 Detector R&D: streaming readout (GE, RM2, BO)

3. 2023 Activity planning

- 3.1 EIC_NET requests for 2023
- 3.2 Networking activities
- 3.3 Physics, software and simulation studies
 - 3.3.1 Semi-inclusive DIS (PV)
 - 3.3.2 Diffractive physics - Partonic imaging in coordinate space (TO, CS)
 - 3.3.3 EIC software coordination and computing (TS, BA, CT, CS)
 - 3.3.4 Detector simulation (BA, TS, LNS, SA)
- 3.4 Detector R&D: dRICH
 - 3.4.1 dRICH prototype (BA, CT, FE, LNF, LNS, RM1, TS)
 - 3.4.2 SiPM and electronics (BO, FE, CT, CS, SA, TO)
 - 3.4.3 LAPPD (GE, TS)
 - 3.4.4 Streaming readout (GE, RM2)
- 3.5 Detector R&D: Si-vertex (BA, PD, TS)

Appendix A: Synergies with other INFN initiatives

Appendix B: External financial support

Appendix C: Milestones

Appendix D: Note on missions budgeting

updated @ 23 July → "last month update"

Sblocchi s.j. e richieste straordinarie (settembre 2022)

Primo mock-up (test materiali honeycomb+fibre carboni) del vessel per Ar pressurizzato: 7 KEU

→ talk di F. Noto (LNS) + offerta a documentazione

Missioni:

- esigenze ancora sotto valutazione (inseriremo cifra esatta nel database entro 14/9)
- Sbloccato quanto richiesto di rimanente s.j. per test beams che includeva però solo parzialmente costo viaggi
- **MA:**
 - spesa per EICUG meeting sostanzialmente in linea con attese per 13 persone (tasca RN) e su tasca RN ancora viaggi per irraggiamenti a Trento (Novembre/Dicembre)
 - 1 persona (SdT TS) per meeting management EPIC con EIC project + proto-RRB a fine ottobre 2022 → **2.5 KEU**
 - 1 persona (SdT TS) per incontro EPIC con comunità ceca a Praga (**1 KEU**)
 - Ci è stata data 1 settimana in più a settembre per test beam a SPS: 4 persone x 7 gg x 140 EU = **4 KEU**
 - Non riusciamo con le missioni finanziate (13 KEU) a coprire turni di 24 ore al PS, dove ci aspettiamo per la parte dRICH di collezionare dati con elevata statistica. Per stare nei 13 KEU disponibili come s.j. abbiamo presentato richiesta per 4 persone sui 21 giorni, ma avremmo bisogno di sei persone. Questo porterebbe a 2 x 28 x 140 EU = **7 KEU**

Vi daremo richiesta più precisa a breve (consultazione interna!). Ci aspettiamo richiesta per **10-14 KEU**

Preventivi (anagrafica)

| year | researchers | FTE |
|------|-------------|-------|
| 2019 | 45 | 6.20 |
| 2020 | 46 | 6.80 |
| 2021 | 48 | 9.05 |
| 2022 | 62 | 15.50 |
| 2023 | 85 | 20.0 |

| Group | Local Responsible | Researchers | FTE |
|----------------------------------|-------------------|-------------|------|
| BA | D. Elia | 10 | 2.4 |
| BO | R. Preghenella | 11 | 2.75 |
| CS.DTZ | S. Fazio | 3 | 0.8 |
| CT.DTZ | C. Tuvé | 4 | 0.7 |
| FE.DTZ | M. Contalbrigo | 2 | 0.5 |
| GE | M. Osipenko | 7 | 1 |
| LNF.DTZ | M. Mirazita | 2 | 0.1 |
| LNS | F. Noto | 4 | 1.7 |
| PD | R. Turrisi | 6 | 1.35 |
| PV.DTZ | M. Radici | 1 | 0.1 |
| RM2 | A. D'Angelo | 7 | 1.0 |
| SA | D. De Gruttola | 9 | 1.5 |
| TO | M. Ruspa | 7 | 1.1 |
| TS | A. Bressan | 11 | 4.8 |
| Resp. Nazionale: P. Antonioli | Totali: | 85 | 20.0 |

Note that as FTE we are largely exceeding agreed plan (Eol)
20 FTE was target for 2024

TABLE 1 – Labor and investment for R&D and construction in period 2021-2029.

| Years | Labor, scientists | Labor, technical personnel | In-kind investment R&D | In-kind investment constructions | Travelling | Manpower | Investment, TOTAL |
|------------------------------------|-------------------|----------------------------|------------------------|----------------------------------|------------|-------------|-------------------|
| | (FTE) | (FTE) | (USD) | (USD) | (USD) | (USD) | (USD) |
| 2021 | 10 / 45 | | minimal | | minimal | 0.4 M | 0.4 M |
| 2022-2023 | 10 | | 1 M | | 0.3 M | 1.6 M | 2.9 M |
| 2024 | 20 | | | | | | |
| 2025-2029 | 50 / 100 | 10 | | 7-8 M | 0.7 M | 12 M | 19.7 - 20.7 M |
| Investment 2021-2029, TOTAL | | | 1 M | 7-8 M | 1 M | 14 M | 23-24 M |

R&D {
construction {

- TO, PD, Rome2, SA → sigle (≥ 1 FTE)
- PV, SA → new groups
- FE (sotto DTZ) ha un CTER (1 FTE) dedicato a EIC

Richieste 2023 e agenda

| Struttura | Su dot. | missioni | | consumo | |
|---------------|---------|--------------|-----------|--------------|-----------|
| | | | Sj | | Sj |
| BA | | 18.5 | 5 | 5 | |
| BO | | 43 | 5 | 53.5 | 29 |
| CS | sì | 9.5 | | 2 | |
| CT | sì | 6.5 | 5.5 | 2 | |
| FE | sì | 2 | 8.5 | 24 | |
| GE | | 5.5 | 5 | 12 | |
| LNF | sì | 1 | | | |
| LNS | | 9 | 4 | 0.5 | |
| PD | | 7.5 | 2.5 | | |
| PV | | 2.5 | 2.5 | | |
| ROMA2 | | 2.5 | | | |
| SA | | 9.5 | | 2 | |
| TO | | 8.5 | | 3.5 | |
| TS | | 19 | 3 | 10 | |
| Totale | | 144.5 | 41 | 114.5 | 29 |

also cards for **CT-CS-SA**
FBK run

include tasca RN e "EIC school"

dRICH prototype + aerogel (also BA)

Meeting con collegio referale

| | inventario | apparati |
|---------------|--------------|-----------------|
| | Sj | Sj |
| | 30 | laser + chiller |
| | 5 | |
| | 5 | |
| | 8 | |
| | 20 | SRO + LAPPD |
| | | vessel 20 |
| | | SRO |
| | 4.5 | |
| | 6 | |
| | 5 | |
| | 17 | LAPPD |
| Totale | 100.5 | 20 |

| Totali | |
|------------|-----------|
| | Sj |
| 23.5 | 5 |
| 126.5 | 34 |
| 16.5 | 0 |
| 13.5 | 5.5 |
| 36 | 8.5 |
| 37.5 | 5 |
| 1 | 0 |
| 15 | 27 |
| 7.5 | 2.5 |
| 2.5 | 2.5 |
| 7 | 0 |
| 17.5 | 0 |
| 19 | 0 |
| 46 | 3 |
| 369 | 93 |

incontro EIC_NET con i referee INFN

📅 Wednesday 31 Aug 2022, 11:30 → 17:00 Europe/Rome

📍 <https://cern.zoom.us/j/9374314394?pwd=YTFjZjFGcXptMG13cGFQYWwFQWdrZz09>

👤 Pietro Antonioli (Istituto Nazionale di Fisica Nucleare)

| | | | |
|--------------|---------|---|-------|
| 11:30 | → 12:00 | Introduzione e aggiornamento progetto EIC Speaker: Pietro Antonioli (Istituto Nazionale di Fisica Nucleare) | 🕒 30m |
| 12:00 | → 12:30 | status R&D e richieste dRICH Speaker: Marco Contalbrigo (Istituto Nazionale di Fisica Nucleare) | 🕒 30m |
| 12:30 | → 12:50 | dRICH: pressurized-Argon vessel Speaker: Francesco Noto (Istituto Nazionale di Fisica Nucleare) | 🕒 20m |
| 12:50 | → 13:20 | status R&D e richieste SiPM + ALCOR Speaker: Roberto Preghenella (Istituto Nazionale di Fisica Nucleare) | 🕒 30m |
| 13:20 | → 14:00 | lunch break | 🕒 40m |
| 14:00 | → 14:30 | status R&D e richieste LAPPD Speakers: Andrea Bressan (Istituto Nazionale di Fisica Nucleare) , Silvia Dalla Torre (Istituto Nazionale di Fisica Nucleare) | 🕒 30m |
| 14:30 | → 14:50 | status R&D e richieste Streaming Readout Speaker: Marco Battaglieri (Istituto Nazionale di Fisica Nucleare) | 🕒 20m |
| 14:50 | → 15:20 | status R&D e richieste tracking Speaker: Domenico Elia (Istituto Nazionale di Fisica Nucleare) | 🕒 30m |
| 15:20 | → 15:55 | EIC school, simulazione e attività' di fisica Speaker: Salvatore Fazio (Universita' della Calabria ed INFN-Cosenza) | 🕒 35m |
| 15:55 | → 16:35 | Conclusioni e discussione Speaker: Pietro Antonioli (Istituto Nazionale di Fisica Nucleare) | 🕒 40m |