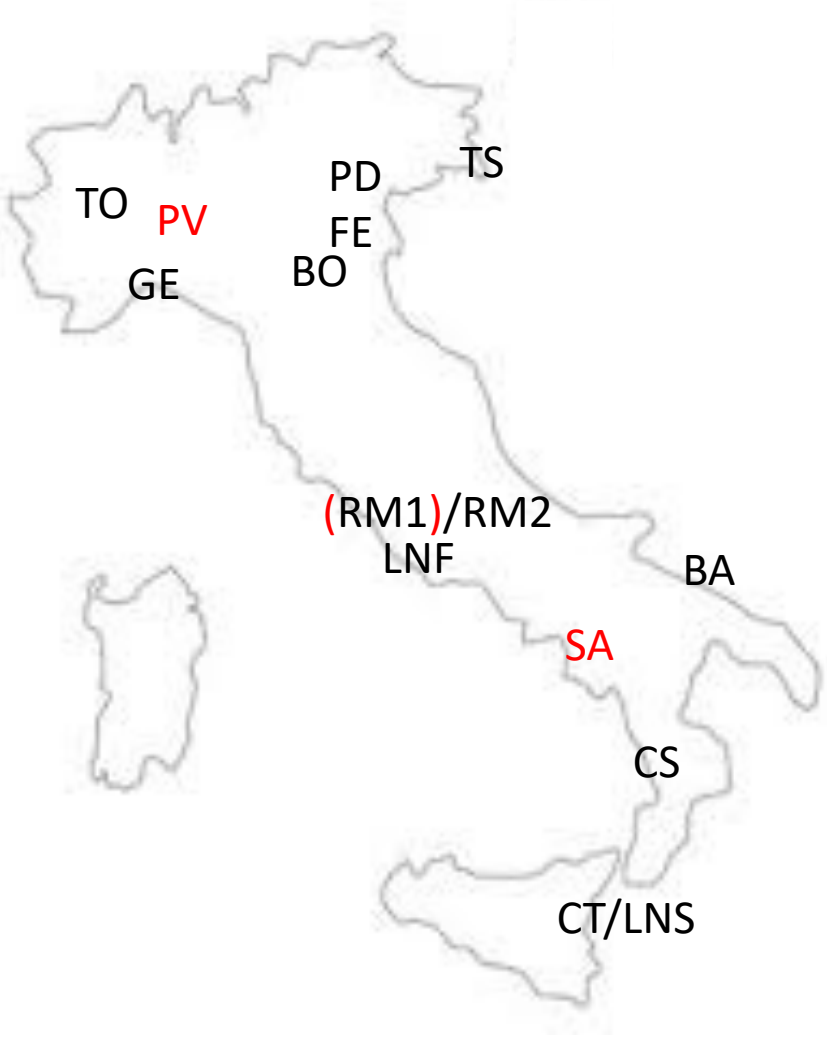
Status of EIC project and EIC_NET initiative

P. Antonioli

INFN-Bologna

Outline (1)

- Status of EIC project: the last 6 months
- EIC_NET initiative & our (growing) community
- Our contribution to "Detector-1"
- Introduction to our agenda



last EIC_NET general meeting: **20-21 December 2021 Turin:** https://agenda.infn.it/event/30932/

A special welcome to **Salerno** and **Pavia** groups and an "arrivederci" to **RM1**

A growing community with different background:
COMPASS, JLAB/CLAS12, ALICE, ATLAS, CMS, STAR,...

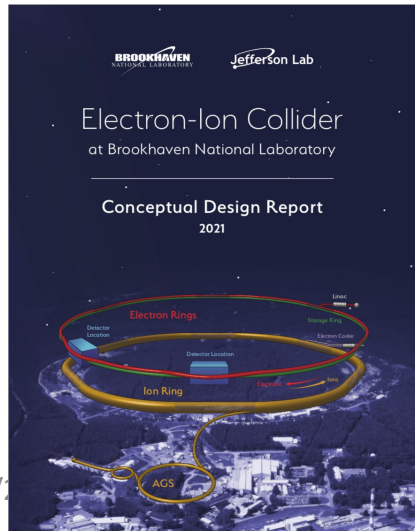
Outline (2)

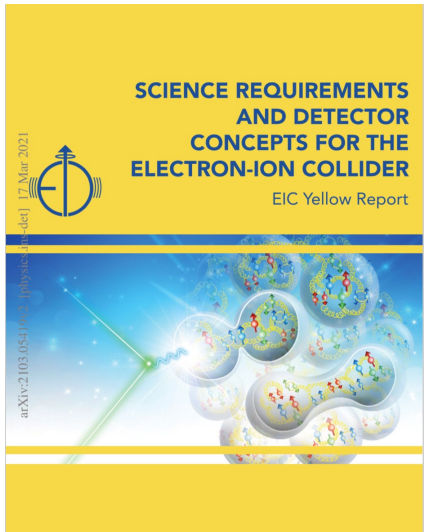
Fils rouges with respect to our Turin meeting (December 2021) are unchanged

- From generic R&D to "experiment mode"
- 2022/2023 a time of choices!
- Grow an EIC generation

A very long journey through the pandemic (last 2.5 years)

CD-0 approved + BNL site selected (Dec2019/Jan2020)
All 2020: 4 online workshops to prepare Yellow Report + 1 EICUG meeting online
February 2021: EIC Conceptual Design Report: https://doi.org/10.2172/1765663
8 March 2021 Yellow Report released: https://arxiv.org/abs/2103.05419
March 2021: Call for detector proposals: https://www.bnl.gov/eic/CFC.php
March: First meetings of protocollaborations
28 June 2021: CD-1 passed "completion of the project Definition Phase and the conceptual design."
2-7 August 2021 EICUG (online) meeting: https://indico.bnl.gov/event/11463/
10 August 2021 call EIC Detector R&D FY22: https://indico.bnl.gov/event/10974/contributions/53172/attachments/36485/59965/Detector_RD_Plan_Aug10.2021.pdf
1st December 2021: **experiment proposals sent to DoE (ATHENA, ECCE, CORE)**
13-15 December 2021: first meeting of Detector Proposal Advisory Panel vis à vis proto-collaborations
https://indico.bnl.gov/event/13614/

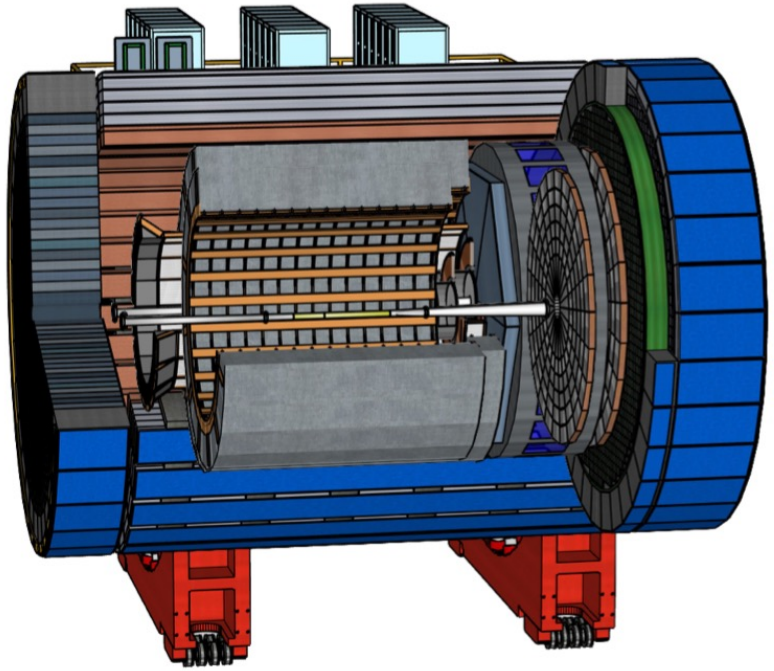


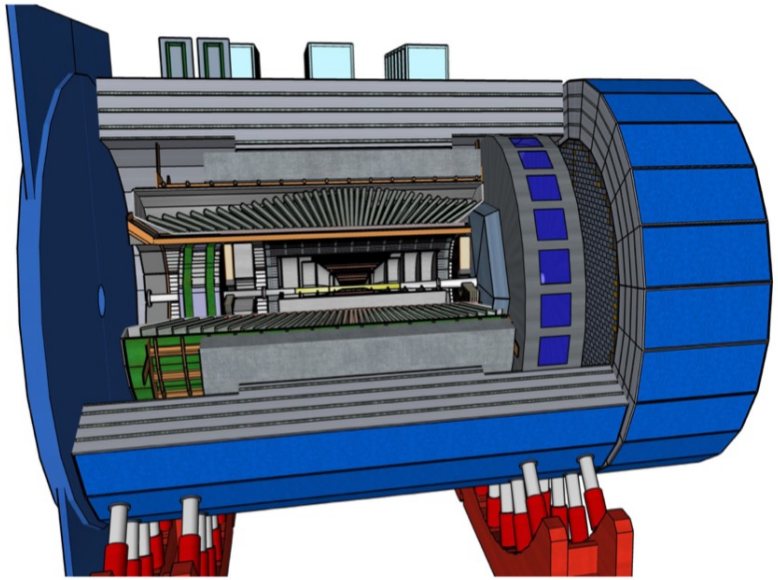


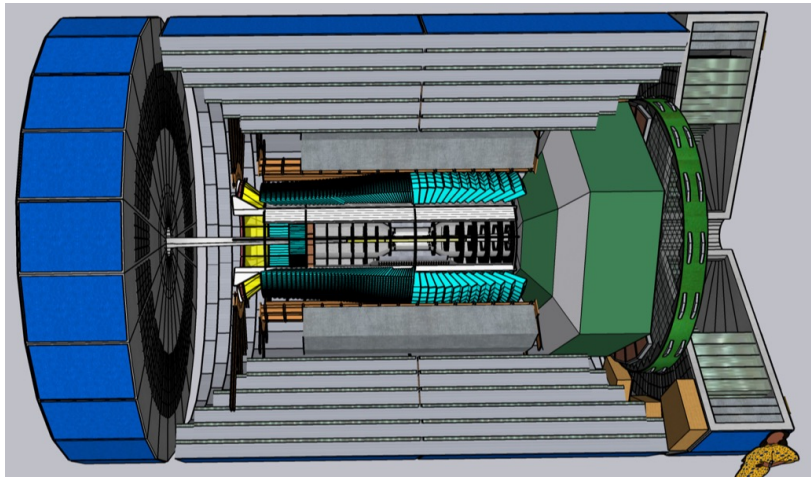
Detector proposals

- ATHENA is general purpose (full EIC science) for IP6 with new 3T solenoidal magnet (and large bore diameter)
- ECCE is general purpose detector for IP6 re-using 1.4 T Babar magnet (bore diameter 2.8)
- CORE is a more "compact" proposal, potentially for IP8 (3T solenoid as well)

Design of all proposal driven by YR requirements, obviously with differences...







Last 6 months: a complicated journey!

January – February: waiting for DPAP report
March:
8th: DPAP report presented orally in a open session **selecting ECCE as reference design**
9th: EIC_NET EB
10th first ATHENA plenary meeting (with INFN "first reaction" presented)
11th first meeting between ATHENA management and EIC project (Jim/Rolf/Elke)
+ DoE (Tim Hallman) ("DPAP closeout followup meeting")
14th meeting responsabili locali EIC_NET
15th briefing to GE/CSN3 chair (Diego/Rosario) // President Biden signs the budget for FY22
17th ATHENA IB (with Rolf/Elke representing EIC project)
22th + 24th: first ECCE-ATHENA meetings (management)
24th ATHENA plenary meeting (again Elke attending)
28th EIC_NET general meeting (online): INFN has no interest for detector 2
31st first briefing to INFN EIC_NET referees (+ follow-up on Zoom 8th April)

more info on next talk
Silvia on "cold fusion"

"re-adjustment", including moving from 5 INFN conveners to 3 (thanks to Salvatore and Domenico!)
and a SC made by 3 (ECCE) + 2 (ATHENA)

April 21: Grant of eRD funds from EIC management
April 29 : First Detector-1 plenary meeting

starting negotiations for the real detector

Some miscellanea comments about the report

Final report now available here: https://www.bnl.gov/dpapanelmeeting/
https://www.bnl.gov/dpapanelmeeting/files/pdf/dpap_report_3-21-2022_final.pdf

- references in the report: ATHENA: 37, ECCE 47, CORE 26
- a surprising umbalanced report towards one specific proposal, not helpful to coalesce the community and attract international support (UK, France, Italy)
- main substantive indication (preference for 1.5 T magnet) seems dominated by cost considerations and a weak case based on risk + (in the panel view) by absence of a convincing physics motivations. However, following a specific question, EIC project management said ECCE is now "reference design" but not "baseline design" (i.e. during coming months there is still space to discuss even the magnet option)
- INFN position is strong being the main driver (and expected in-kind contributor) for the dRICH effort and a key component in the Silicon Consortium (thanks to ALICE/ITS3 synergy + in-kind contribution)

Conclusions for Detector Concept and Feasibility

Based on the careful study by the DAC and the information provided by the three proto-collaborations, the panel finds that ATHENA and ECCE satisfy the requirements to fulfil EIC's "mission need" statement based on the EIC community White Paper and the National Academies of Science (NAS) 2018 report. The more limited range of new technologies and the reuse of the BABAR Magnet and the sPHENIX HCAL make ECCE less expensive and more likely to be ready for data taking on time for Critical Decision 4A (CD-4A), the start of EIC accelerator operations, and therefore suitable as Detector 1. Core has provided a more conceptual, less fully developed design.

28/03/2023

We have some regrets but we are where we are, and we need to work constructively on Detector-1 to make Detector-1 a big success!

me@EIC_NET meeting 28/3

....

R&D needs affecting us (for SIPM, silicon tracker and DAQ) are listed clearly and they should strengthen our position

the fact ATHENA is more structured than ECCE was seen as a disadvantage instead than a parameter that was asked to be evaluated!

" **The managements and collaborations of both ATHENA and ECCE are capable of becoming a solid basis for the full development and implementation of a successful Detector 1**. On balance, the Panel finds that the more flexible organizational structure and outlook of ECCE puts it in a better position to become the organizational basis for Detector 1. As noted, the proto-collaborations are not yet at the strength necessary to prepare a detector for Day 1 of the EIC. **Consequently, successful collaboration on Detector 1 by members of all three proto-collaborations will be critical for the EIC**."

some truism about the fact that <u>two experiments are better than one</u>, but the second detector remains uncertain and quite shifted in the future (+ 3 years and half with respect to detector 1 in best case)

ATHENA's effort on offline software will likely stay on the long run

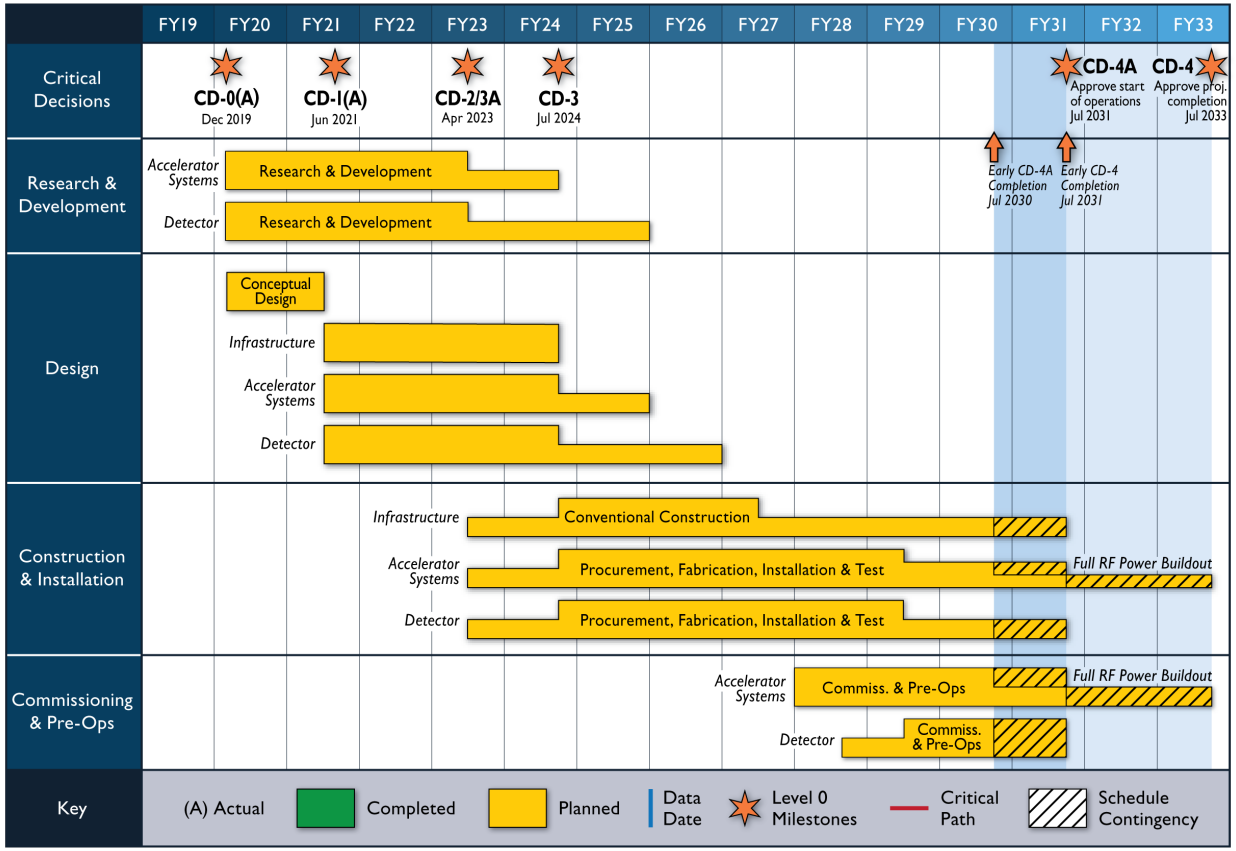
The offline software environment of ATHENA, demonstrated in the detailed simulations, is already quite mature, while ECCE has a well-developed offline computing model. For both ATHENA and ECCE, the development of the DAQ/Offline systems is supported by a substantial team.

the next 18 months towards pre-TDR (CD-2/3a)

[my personal mood after a Yellow Report (12 months), a proposal as a proto-collaboration (8 months),
a tortuous merging of the proto-collaborations (6+ months) that all we knew it would have happened)]

the next 18 months towards pre-TDR (CD-2/3a)

EIC timeline: the new-new schedule



Detector "ready": June 2031
Full-fledged accelerator: 2034

On the "short-term" pre-TDR October 2023

❑ Status Update to Federal Project Director	June 28-30, 2022, @BNL
❑ Cost and Schedule Event(s)	May-June 2022
❑ Technical Subsystem Reviews	January – December 2022
❑ OPA Status Review	January 2023
❑ Preliminary Design Complete & Review	May 2023
❑ Final Design/Maturity Readiness for CD-3A Items	May 2023
❑ CD-2/3A review (expectation), requires pre-TDR	~October 2023
❑ CD-2/3A (expectation)	January 2024
❑ CD-3 review (expectation)	January 2025
❑ CD-3 (expectation), requires TDR	April 2025

The next big step

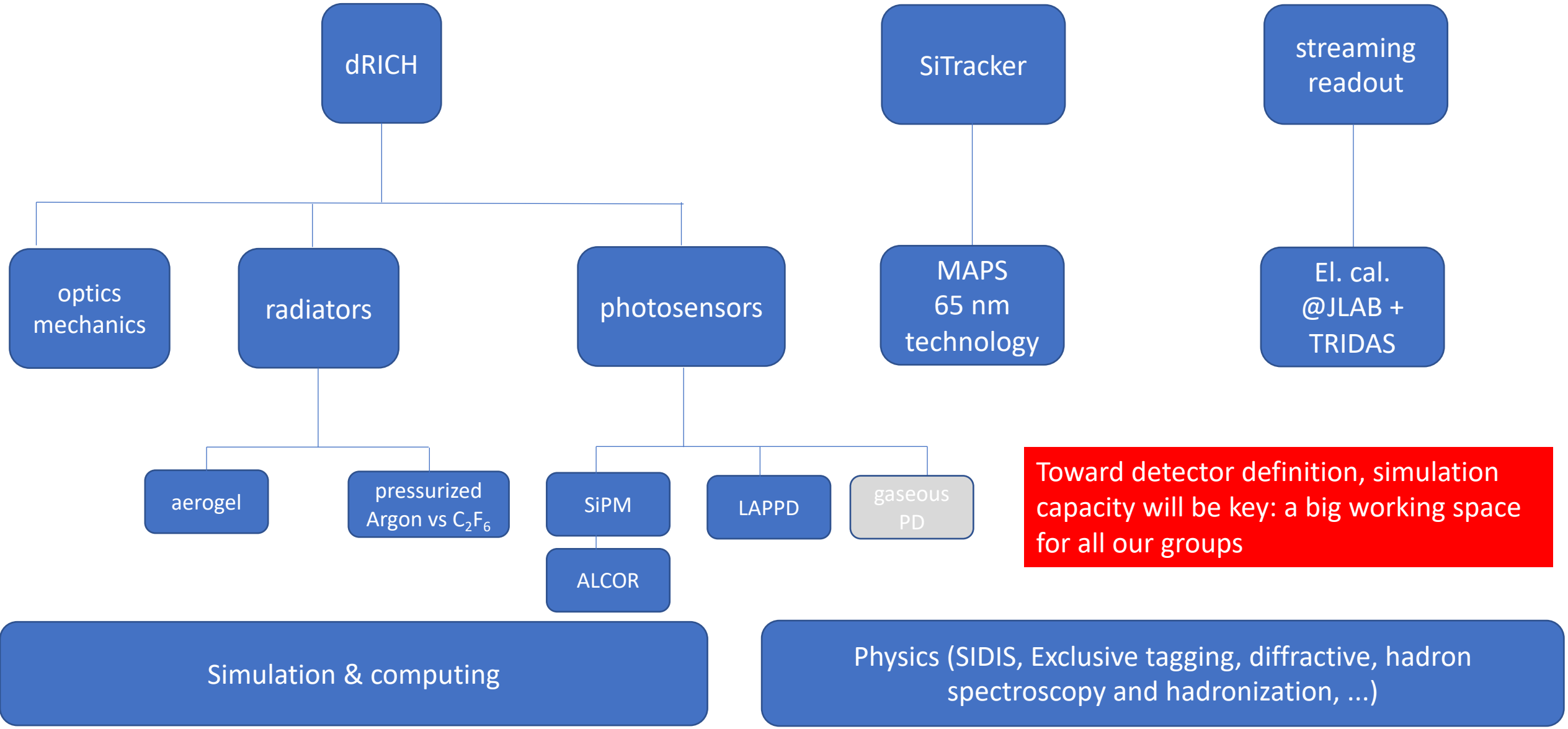
- First face-to-face meeting of the community since 3 years and fisrt meeting of the new Collaboration
- The Collaboration will get a name!
- We need to "convene" on dRICH and set our role in tracker, computing and DAQ
- Key role of Silvia, Roberto, Andrea and Marco in SC or conveners (PID, computing, SIDIS) + Silvia/Marco in EICUG SC
- 11/12 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	

Project + DOE Updates

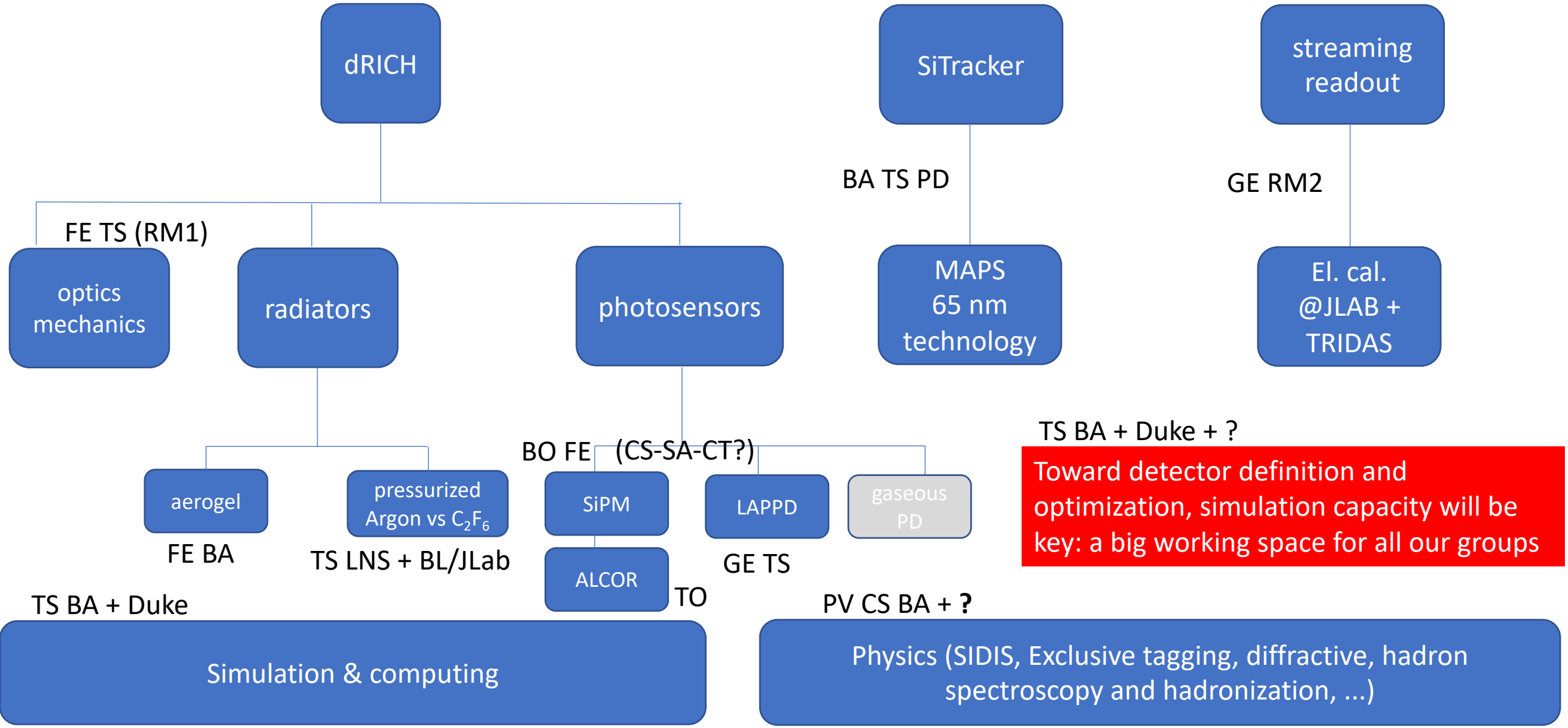
- Update from the project
- Status of Detector I
- Status of Accelerator Design
- News from DOE

EIC_NET "map": refining our committments



Toward detector definition, simulation capacity will be key: a big working space for all our groups

EIC_NET "map": refining our committments



Toward detector definition and optimization, simulation capacity will be key: a big working space for all our groups

EIC & INFN (high-level governance)

Shown by Rolf & Elke, last 9th June Det-1 Gen. Meeting

Recent and near future Project Meetings

- Meetings with BNL & JLab lab directors, DOE/NP and a few international funding agency partners to further EIC Governance
  - EIC Advisory Board Meeting (formerly the EIC Council)
    - Provides advise on the construction of the facility
    - Membership: Senior leaders of institutions making significant contributions to the facility including national labs
  - Contrasted by Resource Review Board (RRB)
    - Provide coordination among funding partners and oversight of the experiment
    - Membership: One representative from each funding agency that sponsors the project detector and/or computing resources
    - First “RRB-like” kick-off meeting in early autumn – will likely require some detector-1 leadership involvement also

→ Next step is further develop draft plan for these and collect input from EICUG and other stake holders

- Preparations for FPD Status Meeting in full swing
  - will discuss the nice progress since the DPAP report
  - cost and schedule update and status of in-kind

2 Electron-Ion Collider

DoE meeting with "main" funding agencies about EIC governance
8 April (D. Bettoni for INFN)

16 June INFN in-camera meeting with DoE (Washington)

→ good working relationship INFN-DoE
→ GE/CSN3 supporting EIC_NET initiative
→ next months we will need to see how it is practically shaped this "dual" bodies governance and actual role ("CERN-like but...")
→ agreement toward "sigla" in 2024

INFN contribution (accelerators)

high-level (GE vs DoE) and accelerator level (LNF-BNL) contacts on-going between DoE and INFN acceleratori

Alessandro Gallo's talk at Milan workshop "INFN-Acceleratori"

https://agenda.infn.it/event/29704/timetable/#20220407

In-kind contribution from INFN?

- frequent contacts between me and Alessandro
- Diego Bettoni (GE) very explicit (even at INFN2022 post meeting with DoE) about in-kind contribution from INFN
- BNL tasked LNF (R. Cimino) lab for analysis of materials to curb secondary electron yields
- On-going discussion with INFN PD (mechanical workshop + engineers involvement) for shields for hadronic ring
  - could be a procurement for 3 km of metal shields at high technology
  - the LNF work would need 100 kEU/year valued as in-kind at 250 kEU/y vs DoE
  - not yet there... I hope to report good news by September

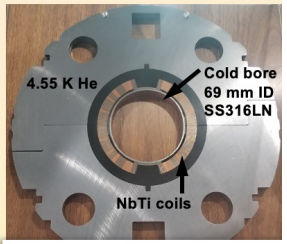
EIC HSR Vacuum Chamber Upgrade

MOTIVATION

- **Reusing RHIC** for the EIC Hadron Ring **will save costs**, but its vacuum chamber is **not designed for EIC beams**
  (higher intensity, shorter bunches than RHIC beams, circulating with large beam offsets at certain beam energies)
- Two main concerns: – *Resistive-wall impedance*
  – *Electron-cloud buildup*

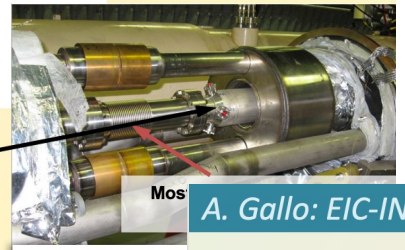
SCOPE

- Vacuum **chamber with reduced impedance, SEY**, for:
  – *SC magnets* ~ 3.4 km
  – *Cold mass interconnects* (bellows, BPMs) ~ 532 units



RHIC arc dipole cross section


Stripline BPMs


Cold mas

Silvia Verdú-Andrés, INFN-EIC meeting February 9, 2022

A. Gallo, Milan workshop April 2022

Collaboration status and perspectives

- The collaboration proposal, based on e-cloud mitigation and beam dynamics simulation and experimental studies, has been released in **early 2021** but a decision on who and how would cover the **additional costs** is still **pending**.
- The **interest of EIC** accelerator team on these studies has been **confirmed**, especially on the LNF WP related to e-cloud mitigation studies and **material SEY characterization**. Very recently, EIC team contacted LNF group to have an evaluation of the *"cost to measure the SEY of 25 samples over the next 12 months"*, indicating that part of the WP activity (the most urgent) could be **covered by EIC project directly** (outside an INFN-EIC specific agreement).
- Possible in-kind contributions have been identified by EIC team in the sector of design and **realization of hadron ring inserts** (shields, screens, bellows …) to **mitigate electron cloud and wakefield instabilities**. This would properly complement the beam dynamics study activity. However, availability of an **INFN mechanical engineering team** taking care of it is **not granted**. Contacts with the INFN-PD group (A . Pepato) are ongoing.
- The activity on e-cloud/SEY characterization will likely proceed in some forms, it is relevant and strategic but it would represent a limited INFN contribution to the project. Design, engineering and construction of the **hadron ring inserts** (3.8 km ring!) would surely represent a different scale contribution and an **opportunity for national industry**.
- A **clear mandate**, with granted funds for manpower and hardware in the framework of a collaboration agreement, is **necessary** to consolidate the **expressions of interest** of INFN teams potentially interested to exploit this opportunity.
- Contributions on **other accelerator fields** are **always possible**, if any will in the INFN community would appear.

EIC_NET is improving its "footprint"

INFN2022: bi-annual CSN3 workshop
https://agenda.infn.it/event/22084/
2 talks (Chandra, Simone) + 2 poster (Nicola, Shyam) + two invited talks connected to EIC too (Annalisa)

2+1 CSN3 grants opportunities for graduates/undergraduates (3 months in a lab) LNS, JLAB + CERN (via ALICE/ITS3)
1 INFN PhD (Nicola) attending CNFS School on EIC Physics: https://indico.bnl.gov/event/15003/

Invited talks at:
Otranto School: S. Fazio: https://agenda.infn.it/event/30254/
QCD@Work D. Elia https://agenda.infn.it/event/20170/
HFWINC P. Antonioli https://indico.cern.ch/event/883427/

Abstract approved at NDIP2020 (but it is in 2022): https://www.ndip.fr/
R. Preghenella

Abstracts approved at RICH22: https://indico.cern.ch/event/1094055/
C. Chatterjee (talk)
R. Preghenella (talk)
S. Vallarino (poster)

ATHENA proposal accepted for publication on JINST

EIC_NET is attracting funds: from generic EIC R&D to "targeted" R&D

Project	Topic
eRD101	Modular RICH / aerogel RICH
eRD102	Dual-radiator RICH
eRD103	High-performance DIRC
eRD104	Silicon service reduction
eRD105	SciGlass
eRD106	Forward EMCAL
eRD107	Forward HCAL
eRD108	Cylindrical / planar MPGD
eRD109	ASICs / electronics
eRD110	Photosensors
eRD111	Silicon tracked (excluding electronics)
eRD112	AC-LGAD (including ASIC)

BO-CT-FE-LNF-LNS-RM1-TO-TS: **165 k$**

BA-TS
GE: **20 k$**

BO-FE-TO (**60 k$**) TS-GE (**20 k$**)

BA-TS

Focus on detector R&D common to protocollaboration proposals

More information in Patrizia's talk
Resources finally allocated by EIC project in April 2022 (7 months delay due to US delayed approval of Federal Budget)

- Resources for post-doc and/or PhD positions
- eRD projects as a space to build alliances/consortia for detectors

- Agreed unique SoW for INFN → "sigla" EIC_RD as "external funds"
- Negotiated INFN Statement of Work for the three projects where we got funding → status → aiming for July CD
- Next call for FY23 is key

As usual many other things are happening....

17-19 May 2022 Streaming Readout X (Jlab) https://indico.jlab.org/event/519/overview
(MarcoB's talk + L. Cappelli on Tridas)

7-10 June 2022 AGS/RHIC user meetings: 2 talks from INFN (eRD102 - Marco, eRD110 - Pietro), Giacomo as one of the convener of EIC session https://indico.bnl.gov/event/15479/

8-10 June "HERA 4 EIC" workshop at Stonybrook https://indico.bnl.gov/event/9370/timetable/

20-21 June Synergies between LHC and EIC workshop at CERN https://indico.ph.tum.de/event/7014/
[Silvia talk]

27 June -1st July ECT* Workshop: Saturation and diffraction at LHC and EIC https://indico.cern.ch/event/1134310/

Good EIC visibility at ICHEP Conference in Bologna (6-13 July: not CFNS and BNL as sponsors)

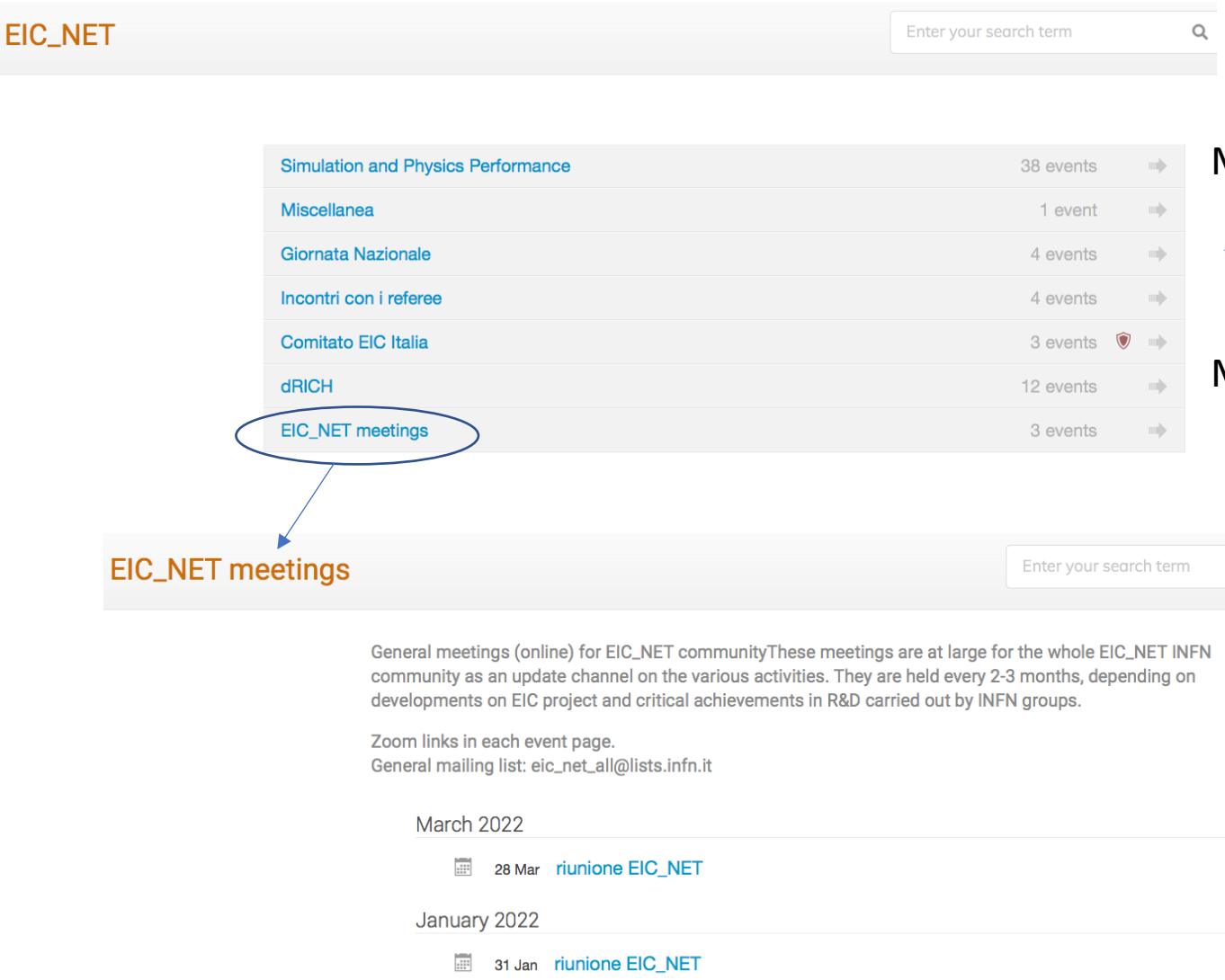
We will get reports on Transversity and DIS conferences see Michela and Marco talks

[....]
24-30 Sep Diffraction and low-x (at Corigliano Calabro) https://indico.cern.ch/event/1148802/

DISCLAIMER: + all things I forgot / I don't know

EIC_NET organization: progresses building a community

https://agenda.infn.it/category/1147/



Monday at 11:30-13:00 bi-monthly

← today and previous editions (since 2019)

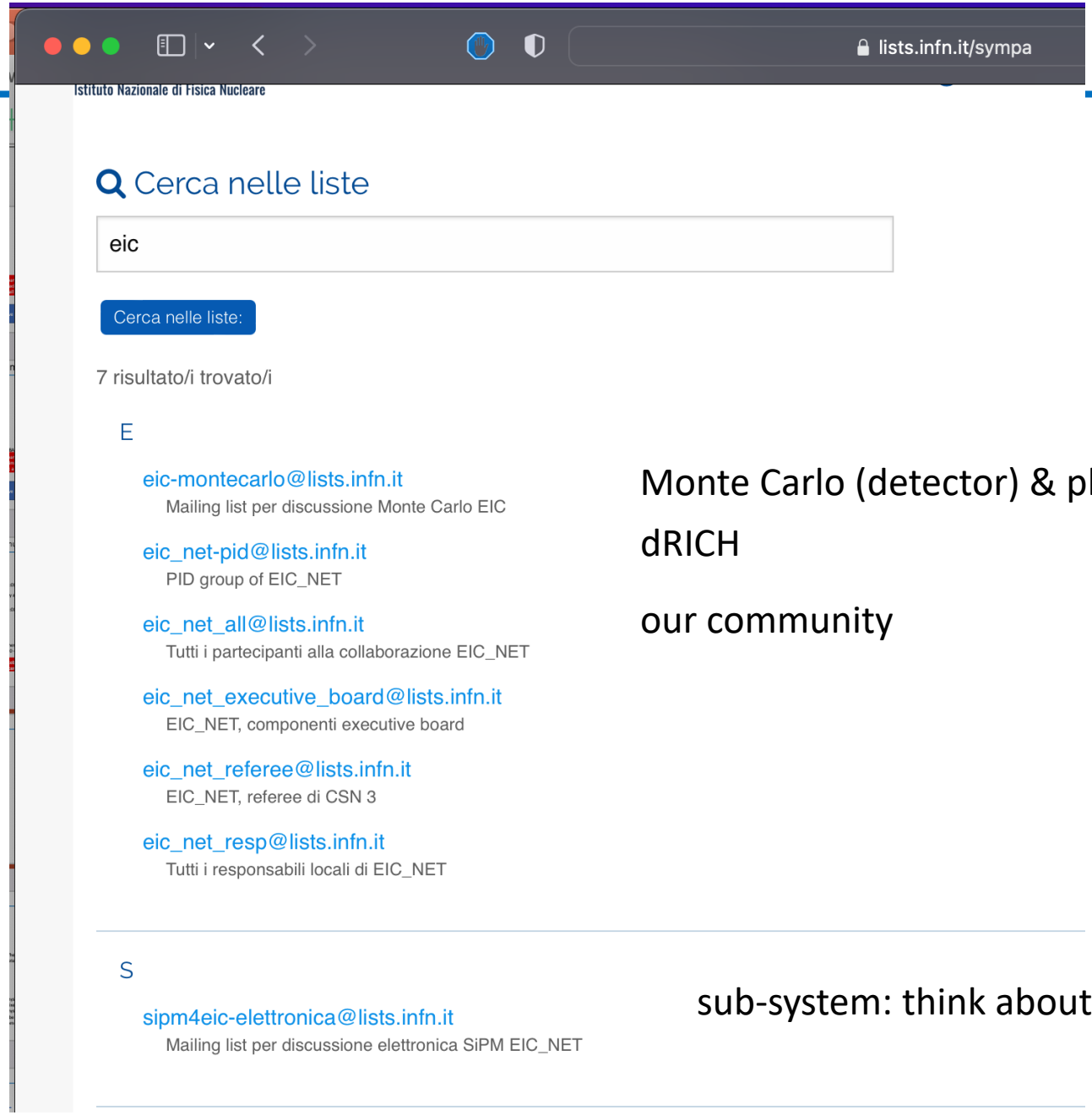
Monday at 11:30-13:00 bi-monthly

Quarterly general meetings (online)
Monday 10:00 – 13:00

next: October 3rd
December 5th

mailing lists

suggestions:
build vertex mailing list



Monte Carlo (detector) & physics

dRICH

our community

sub-system: think about others...

Our agenda (I)

09:00	**Saluto della direttrice della sezione INFN di Catania e introduzione alle Giornate Nazionali**	*Alessia Rita Tricomi et al.*	*Aula B DFA, Catania* 09:00 - 09:10
	Il Deep Inelastic Scattering: da SLAC-MIT all'Electron Ion Collider	*Enrico Tassi*	*Aula B DFA, Catania* 09:10 - 10:00
10:00	**Status of the EIC project and EIC_NET initiative**	*Pietro Antonioli*	*Aula B DFA, Catania* 10:00 - 10:30
	Toward Detector 1	*Silvia Dalla Torre*	*Aula B DFA, Catania* 10:30 - 11:00
11:00	**Coffee break**		*Terrazza DFA, Catania* 11:00 - 11:30
	DIS 2022: highlights toward EIC	*Michela Chiosso*	*Aula B DFA, Catania* 11:30 - 12:00
12:00	**Transversity 2022 highlights and the physics of SIDIS**	*Marco Radici*	*Aula B DFA, Catania* 12:00 - 12:30
	Toward EIC: an ALICE perspective	*Andrea Rossi*	*Aula B DFA, Catania* 12:30 - 13:00

Where we are on the project and on Detector-1

Physics! With the perspectives of our mixed-community and toward INFN physics contributions
("be prepared to be the leaders on some key analyses")

Our agenda (II)

14:00	*Terrazza DFA, Catania*	13:00 - 14:20
	The dRICH project — Working Group dRICH	*Marco Contalbrigo*
	Catania	14:20 - 14:50
	The Silicon vertex project — The EIC Silicon Consortium	*Domenico Elia et al.*
15:00	*Catania*	14:50 - 15:20
	Monte Carlo studies and Physics Performance — Working Group MC&Physics	*Annalisa Mastroserio et al.*
	Catania	15:20 - 15:50
	Toward streaming readout at EIC	*Mariangela Bondi*
16:00	*Catania*	15:50 - 16:20
	Coffee break	
	Terrazza DFA, Catania	16:30 - 17:00
17:00	**The eRD EIC program**	*Patrizia Rossi*
	Aula B DFA, Catania	17:00 - 17:30
	R&D activity on bending and interconnection with MAPS	*Domenico Colella*
	Aula B DFA, Catania	17:30 - 18:00
18:00	**dRICH: Simulation and reconstruction algorithms**	*Chandradoy Chatterjee*
	Aula B DFA, Catania	18:00 - 18:30

Our detector contribution as INFN

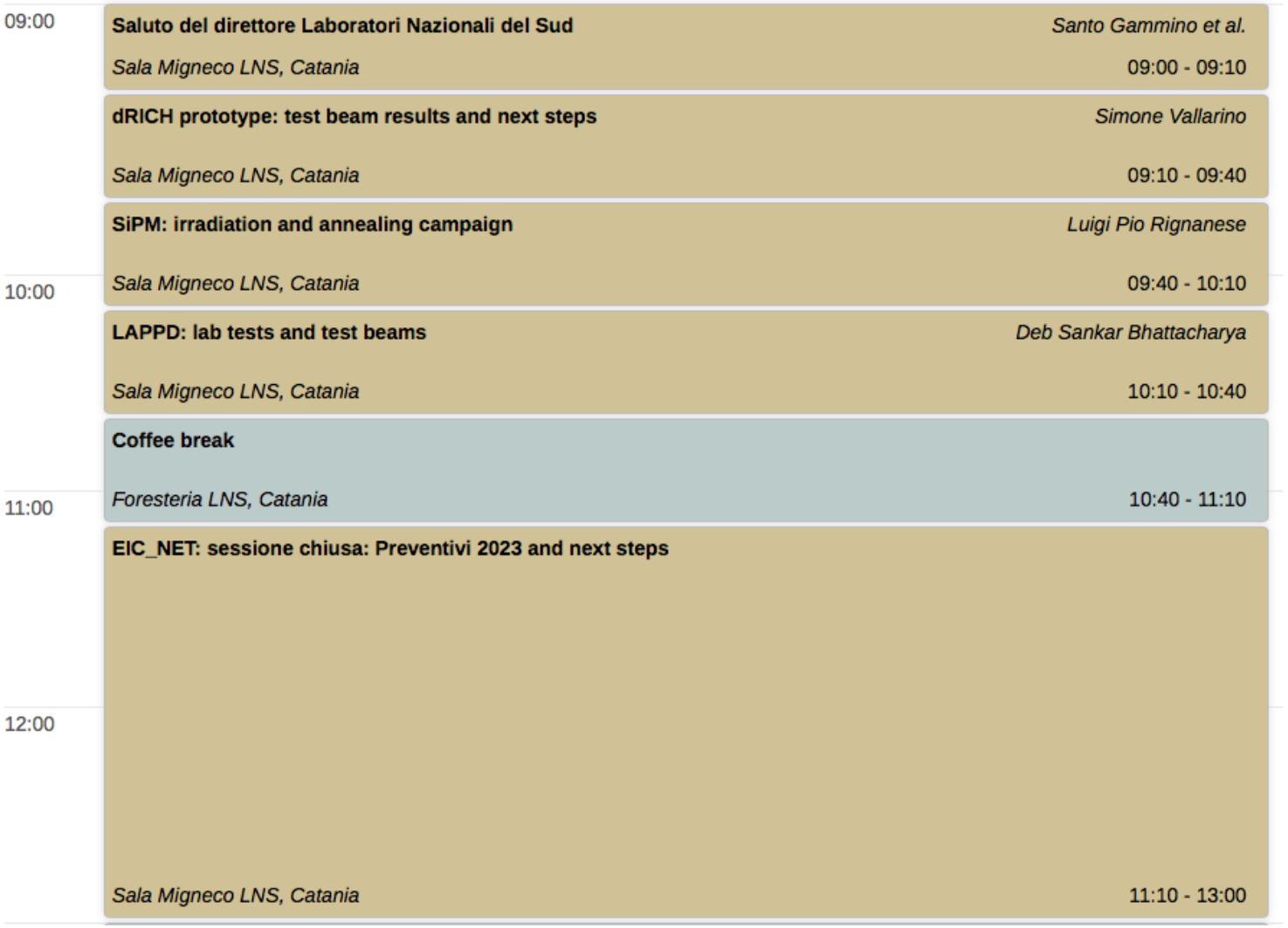
School for PhD and master students

Our expertise (applied specifically to dRICH)

A key resource program: many thanks to Patrizia for being with us!

R&D highlights (I)

Our agenda (III)



R&D highlights (II)

the detector and the photosensors

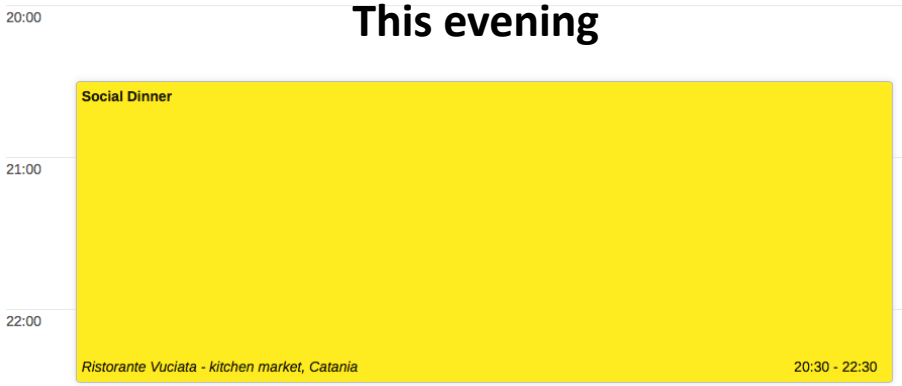
[let's discuss about organizational stuff and the meaning of life ;-)]

Enjoy the meeting!

Enjoy real **networking** for the EIC_**NET** community

All talks 20' **+ 10'**

This evening



Tomorrow afternoon

Backup and useful stuff

A reminder about INFN EoI

S. Dalla Torre @ EIC_NET referee meeting Sep 2021

EIC_NET & INFN Expression of Interest

Expressions of interest

- **Call maggio-novembre 2020 (https://www.bnl.gov/eic/EOI.php)**
- **Prima esplicitazione formale (anche se non binding) dei possibili contributi alla sperimentazione a EIC**

- Authors EIC_NET & some colleagues from ALICE (from TO & TS)
- In close contact with INFN management INFN (Bettoni, Nappi, Nania)
  - Dedicated meetings EIC_NET: 19/5/2020 17/6/2020 20/7/2020 26/8/2020

Preparazione del materiale specifico per le 4 linee di intervento INFN

- PID: S. Dalla Torre, M. Contalbrigo, P. Antonioli, M. Alexeev
- VERTEXING: D. Elia, S. Bufalino, G. Contin
- Streaming R-O: A. Celentano, A. D'Angelo
- SOFTWARE & COMPUTING: A Bressan, D. Elia, R. Preghenella

Redazione EoI: A. Bressan , S. Dalla Torre, A. D'Angelo, D. Elia

Appendici:

- Informazioni generali su INFN: S. Dalla Torre, R. Turrisi
- Interessi di fisica: A Bressan, A. D'Angelo, R. De Vita, R. Preghenella
- Il contributo teorico INFN a EIC: M. Radici

Expression of interest of the INFN community for the Electron Ion Collider

Expression of Interest (EOI) Questionnaire

Please indicate the name of the contact person for this submission:
Silvia DALLA TORRE, INFN- Trieste (Silvia.DallaTorre@ts.infn.it)

Please indicate all institutions collectively involved in this submission of interest:
INFN, the following Units of the Institute:

Sezione di Bari	Laboratorio Nazionale del Sud
Sezione di Bologna	Sezione di Padova
Sezione di Catania	Sezione di Roma 1
Sezione di Ferrara	Sezione di Roma 2
Sezione di Genova	Sezione di Torino
Laboratorio Nazionale di Frascati	Sezione di Trieste

The participating scientists are either employed by INFN or associated to INFN and employed by the following Universities: University of Bari Aldo Moro, Polytechnic University of Bari, University of Bologna, University of Catania, University of Eastern Piedmont Amedeo Avogadro, University of Ferrara, University of Genova, University of Lecce, University of Padova, University of Roma la Sapienza, University of Roma Tor Vergata, University of Torino, Polytechnic University of Torino, University of Trieste.

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)
R&D	2021	10 /45		minimal		minimal	0.4 M	0.4 M
R&D	2022-2023	10		1 M		0.3 M	1.6 M	2.9 M
R&D	2024	20						
construction	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**

EIC_NET FTEs

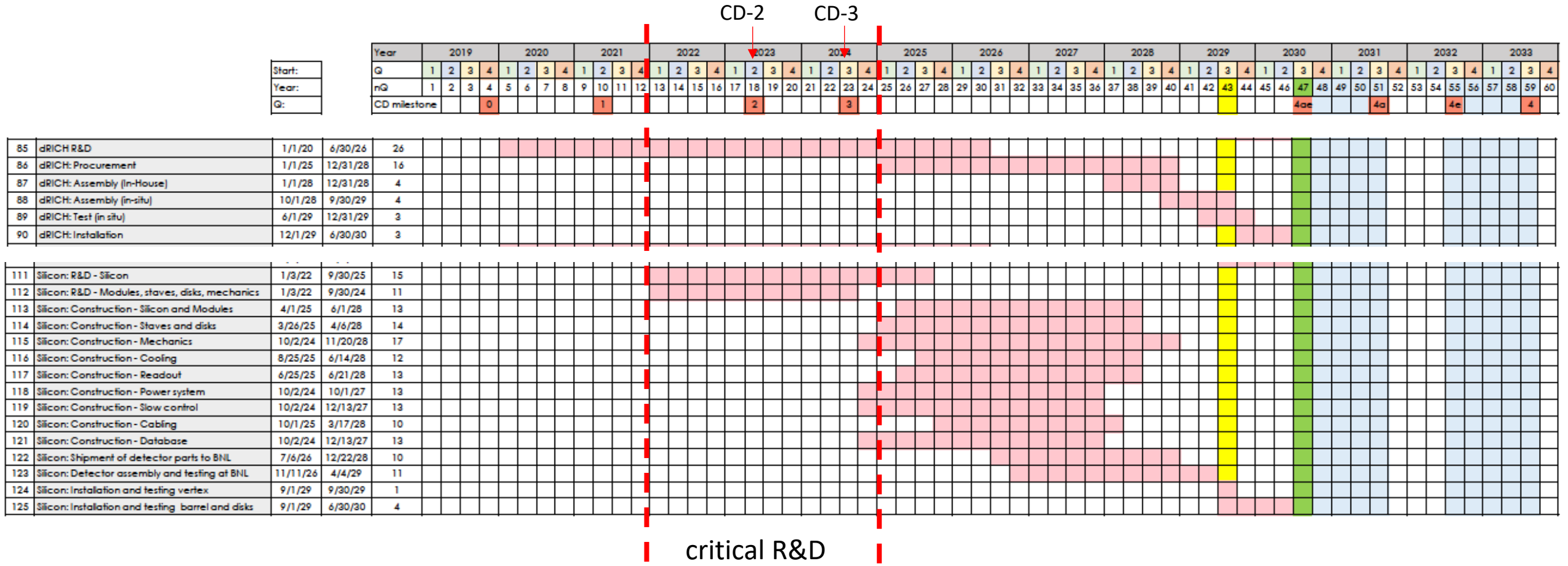
year	researchers	FTE
2019	45	6.20
2020	46	6.80
2021	48	9.05
2022	62	15.50

in ATHENA proposal, INFN "aspirations":

- 1 M Silicon Tracking
- 5.6 M dRICH

2022/2023 is the time to convert aspirations in binding committments

A note on the foreseen schedule



Partially a speculative exercise, but it helps
Aggressive schedule

Growing a new generation of EIC scientists: a PhD starting in 2022 could be key post-doc during construction/commissioning and a future leader @EIC!