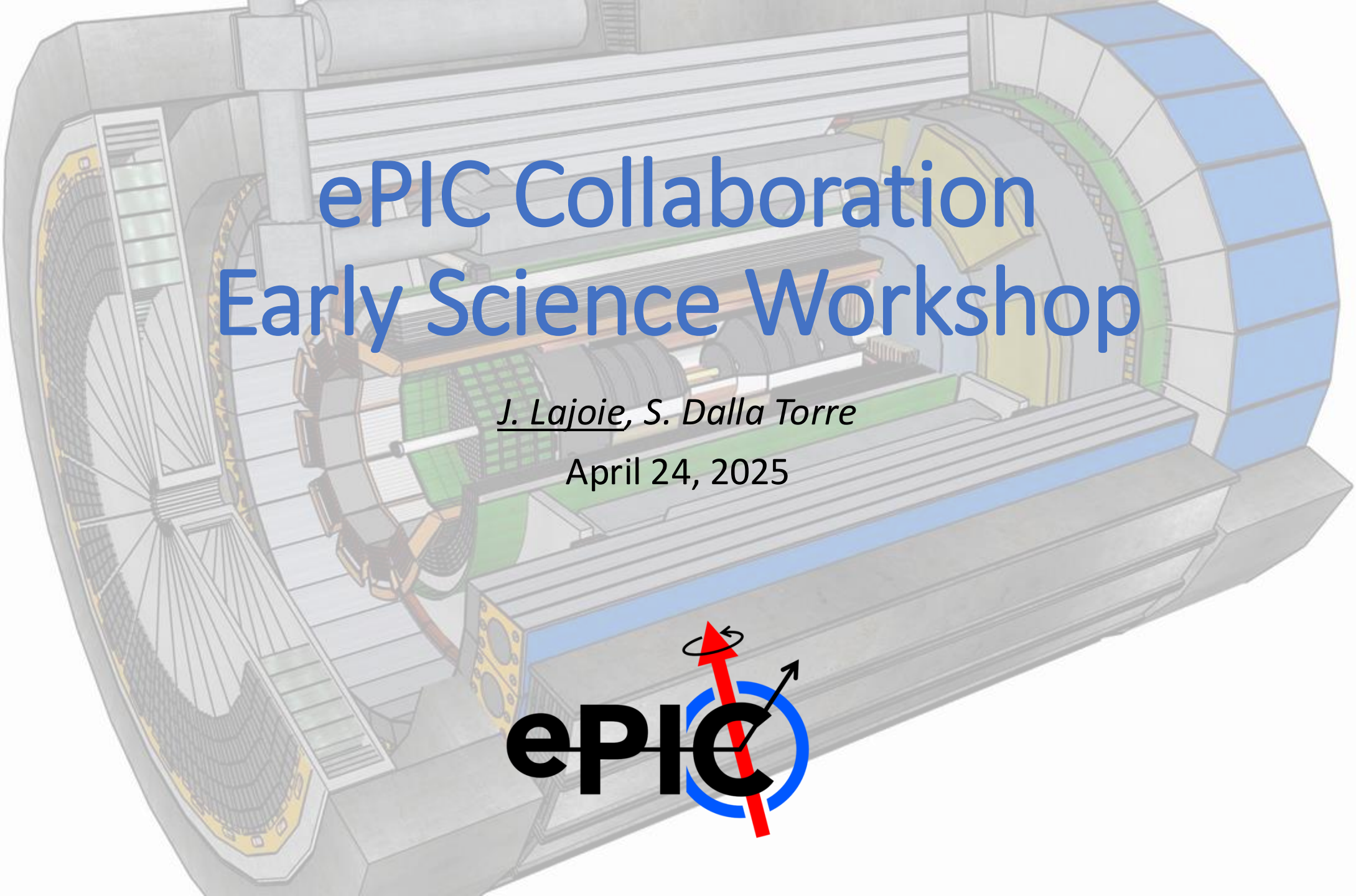

ePIC Collaboration Early Science Workshop

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April 24, 2025

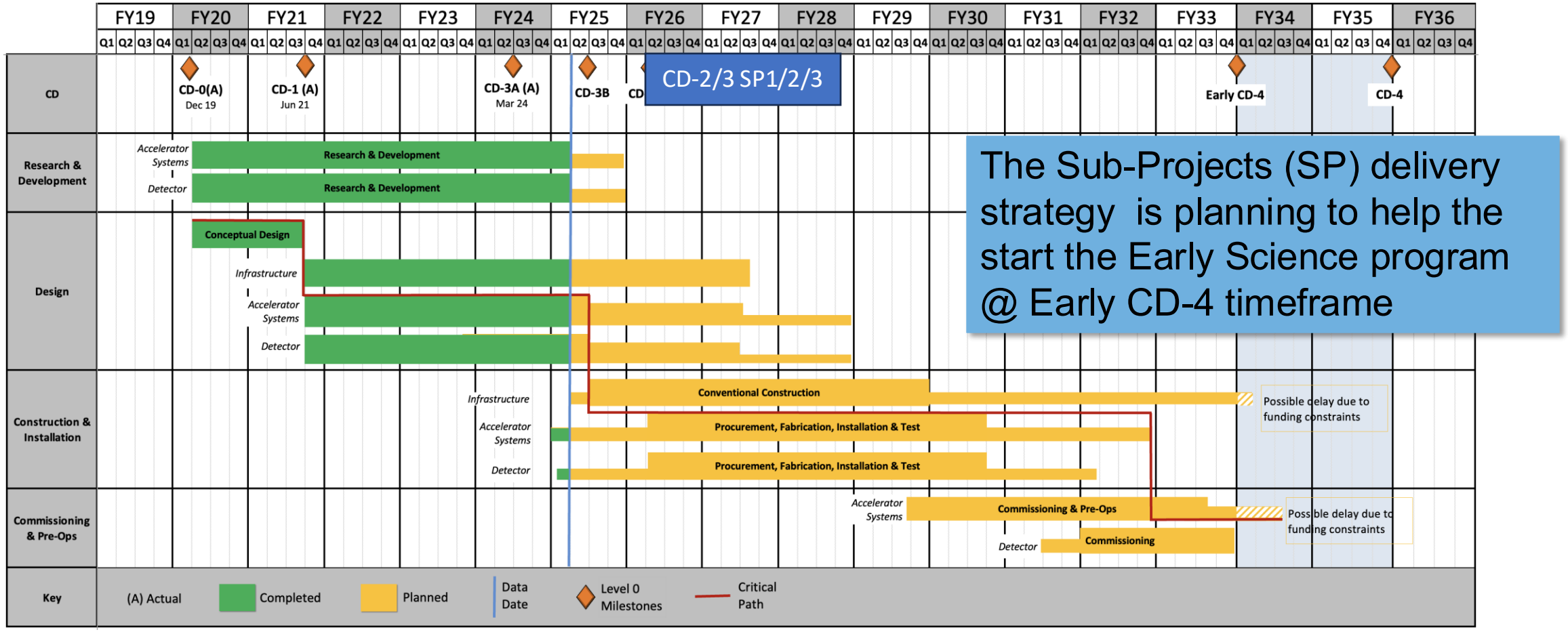
Why an Early Science Workshop?

- The EIC Project is developing a plan based on subprojects. This plan will allow an earlier start of the EIC Science program before the full capabilities of the collider are realized.
  - Important to maintain the community, AND important for DOE to show stakeholders that the investment will yield results
  - Early science will be one component of the evaluation of the EIC phased project plan

- The Early Science Program should *start* the process of addressing the *full* EIC science mission (white paper, NAS report, YR)
  - Early science should have *impact*
  - The early science program should be embraced by the community
  - It should emphasize the flexibility of the EIC (spin, species, energy)
  - Sets the foundation for the facility for 20-30 years of operation

Current EIC Schedule

Schedule Update Underway - Mostly Technically Driven after FY2027



The Sub-Projects (SP) delivery strategy is planning to help the start the Early Science program @ Early CD-4 timeframe

Since CD-1, the critical path is on the Accelerator systems.

EIC Early Science Matrix

What machine capabilities can we expect for Early Science?
See Sergei Nagaitzev's talk in the first Early Science Workshop: https://indico.bnl.gov/event/24432/

	Species	Energy (GeV)	Luminosity/year (fb-1)	Electron polarization	p/A polarization
YEAR 1	e+Ru or e+Cu	10 x 115	0.9	NO (Commissioning)	N/A
YEAR 2	e+D e+p	10 x 130	11.4 4.95 - 5.33	LONG	NO TRANS
YEAR 3	e+p	10 x 130	4.95 - 5.33	LONG	TRANS and/or LONG
YEAR 4	e+Au e+p	10 x 100 10 x 250	0.84 6.19 - 9.18	LONG	N/A TRANS and/or LONG
YEAR 5	e+Au e+3He	10 x 100 10 x 166	0.84 8.65	LONG	N/A TRANS and/or LONG

Note: the eA luminosity is per nucleon

NB: ePIC installation plan calls for the full ePIC to be installed year-1 (exception for roman pots and OMD)

Notional EIC Early Science Program

Year - 1

Start with Phase 1 EIC
New Capability:
Commission electron polarization in parallel
Run:
10 GeV e
heavy ion
Physics:
Add your

Year - 2

Phase 1 EIC
+ electron polarization
New Capability:
Commission proton polarization in parallel
Run:

Year - 3

Phase 1 EIC
+ electron polarization
+ proton polarization
New Capability:
Commission running with hadron

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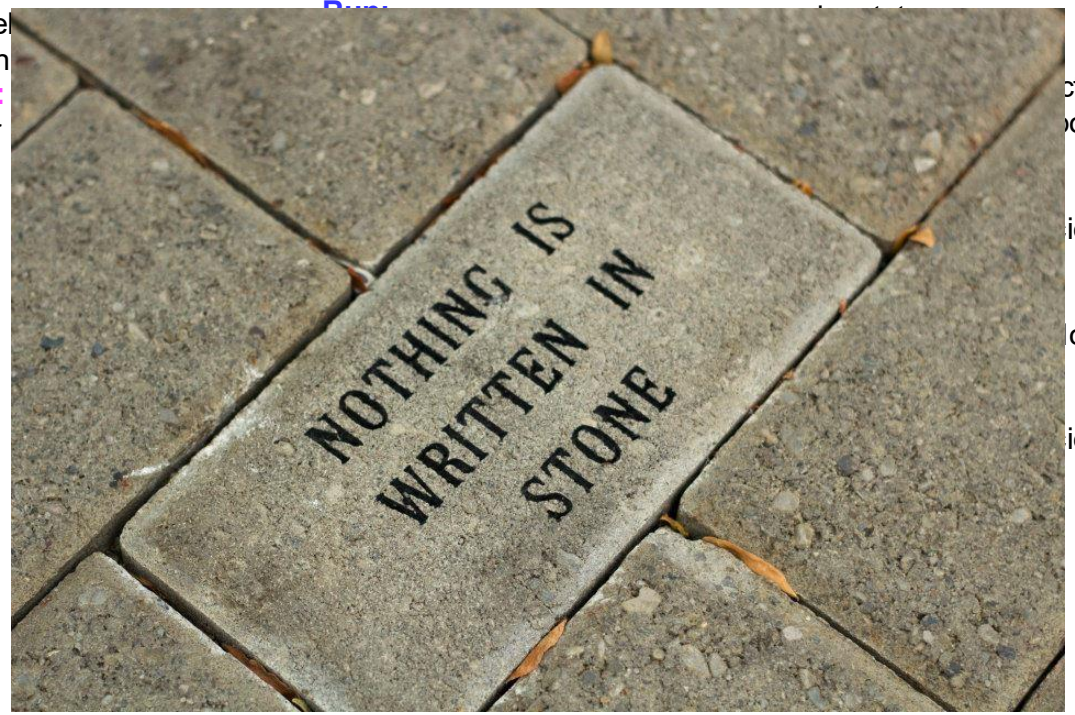


Year - 4

Phase 1 EIC
+ electron polarization
+ proton polarization
+ operation of hadron spin rotators
New Capability:
Commission hadron accelerator to operate with not centered orbits
Run:
10 GeV polarized electrons on 100 GeV Au
Physics:
Add your preferred science topic

Run:
10 GeV electrons on 250 GeV transverse and longitudinal polarized protons
Physics:
Add your preferred science topic

Year - 5

Phase 1 EIC
+ electron polarization
+ proton polarization
+ operation of hadron spin rotators
+ operation of hadron beams with not centered orbits
Run:
10 GeV polarized electrons on 100 GeV Au
Physics:
Add your preferred science topic

Run:
10 GeV electrons on 166 GeV transverse and longitudinal polarized He-3
Physics:
Add your preferred science topic

Time to install additional ESR RF and HSR PS to reach design current and max. energies

Early Science should be *Meaningful* and *Impactful*

- What do I mean by this?

- *Meaningful*: The EIC early science program must engage the collaboration; it must get the collaboration excited about working hard for the future. It must have a balance of *breadth* and *depth*.

- *Impactful*: The EIC early science program must take the first steps down the path to realizing the EIC science goals.

Objectives for this Workshop

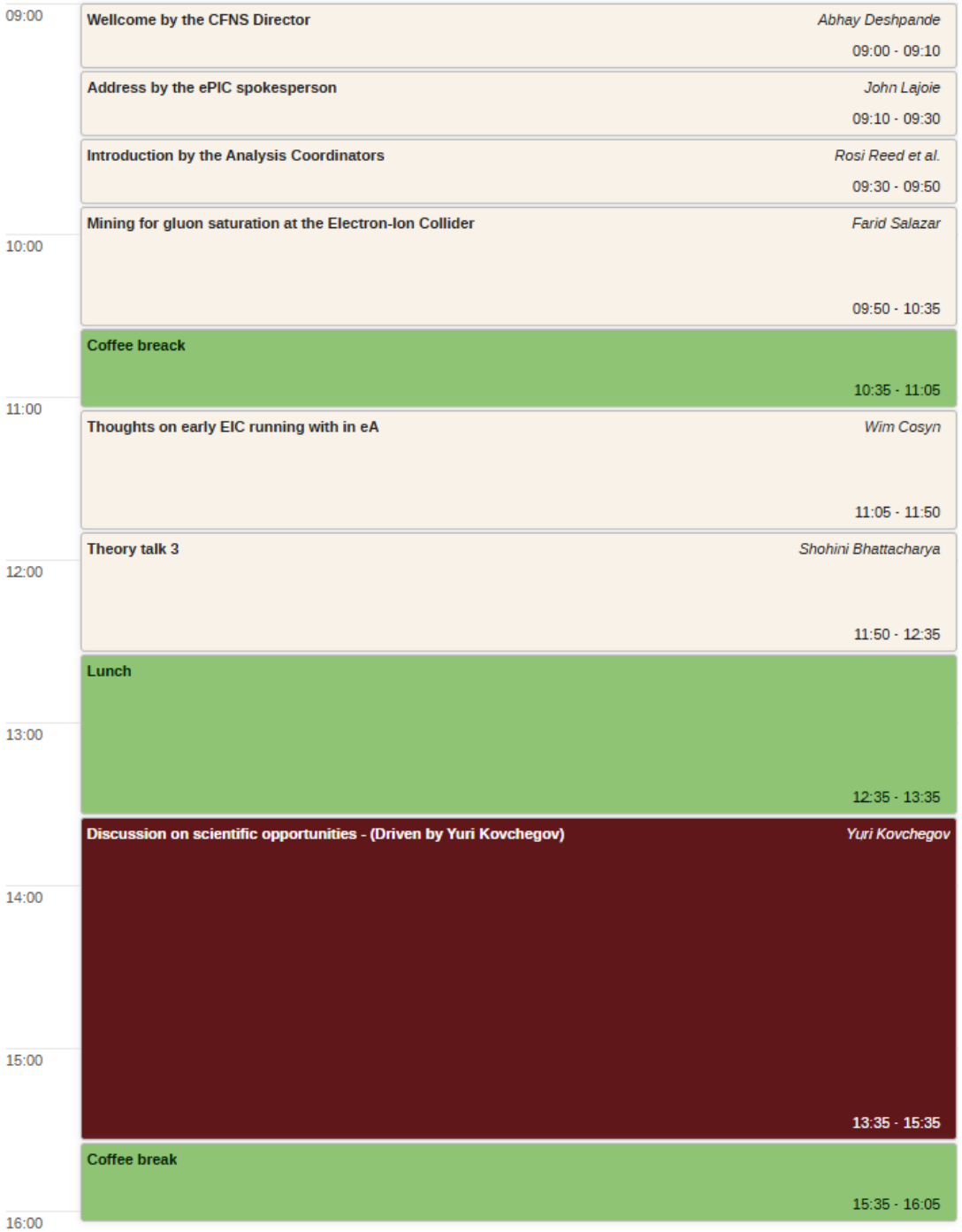
- Discuss processes that are expected to yield an impact given the energy and luminosity configurations of the machine during the first 5 years of running
  - **Challenge:** Don't concentrate on the ultimate statistical precision of a measurement, but how you test the underlying assumptions that go into making that measurement!

- Physics performance studies by the ePIC PWGs for the first 5 years of running

- Formulate a plan for simulations to support these ongoing studies

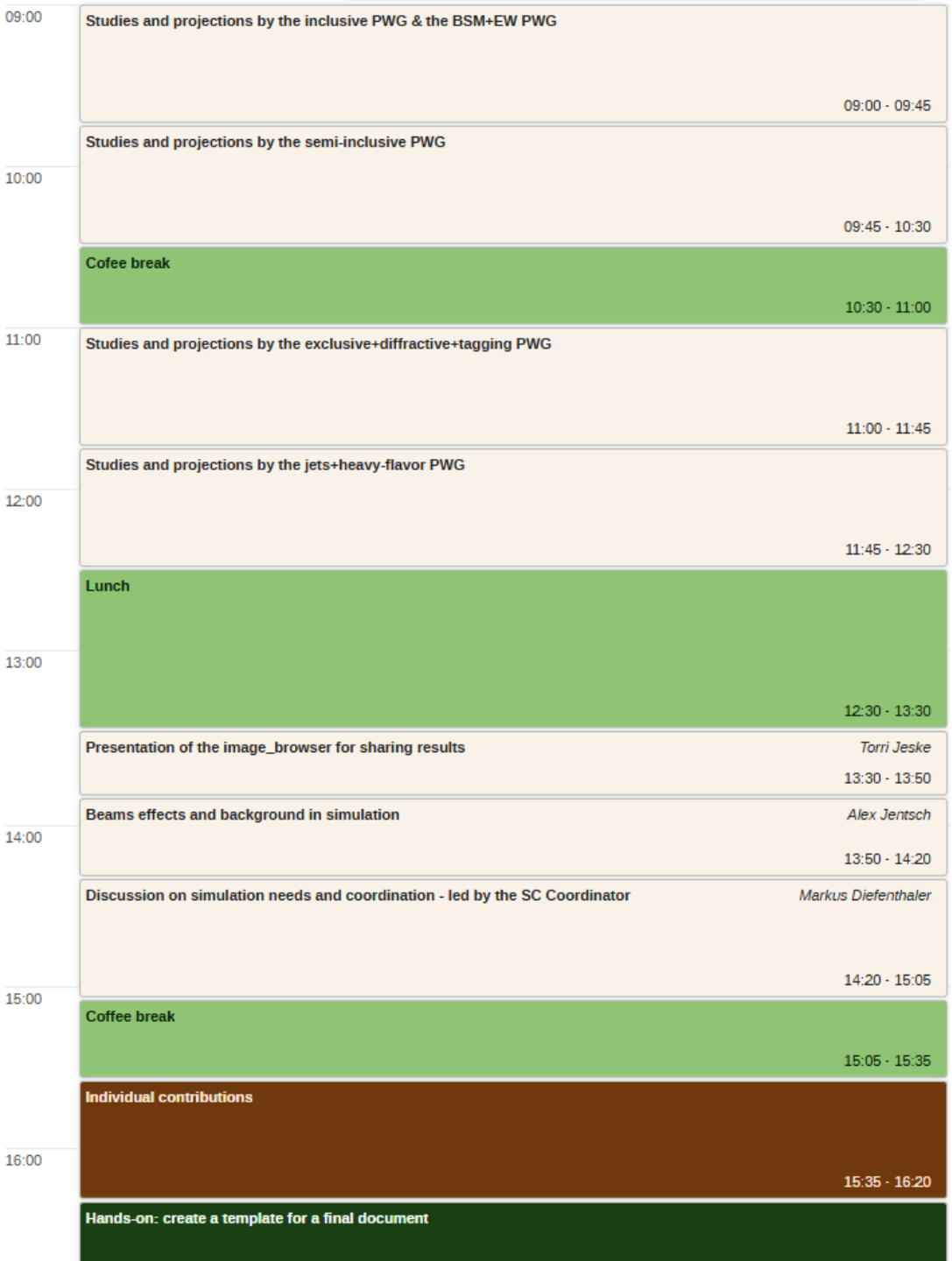
Agenda Day-1

Theory talks to set the stage and start us thinking.



Lots of time for important discussion!

Agenda Day-2



Studies and projections from the PWG's

The nuts and bolts needed for future studies

Time for individual contributions

The Process

- This workshop is a beginning. The discussion surrounding the EIC early science program will need evolve as the project plan evolves.

- Expected Outcomes:
  - Prioritized list of processes to focus on
  - First projections by the PWGs
  - Plan for simulations: production, backgrounds etc.
  - Strategy towards the publication of a final report
    - Early Science could be a section in the NIM-A Special Issue

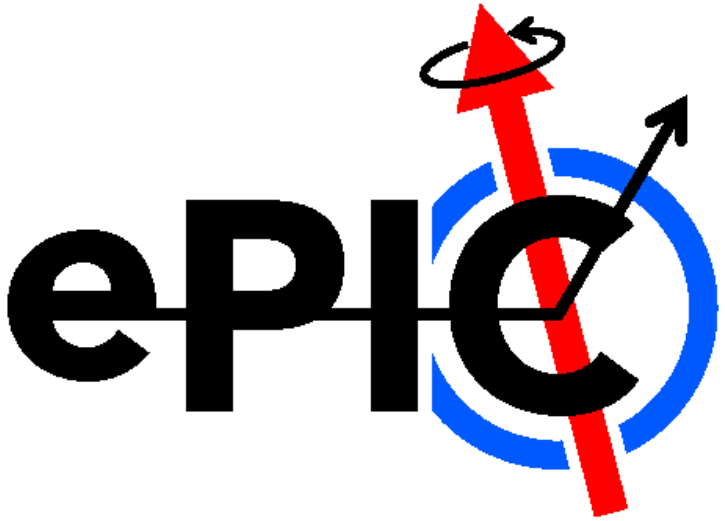
Integration with the ePIC preTDR Effort

- Planning for the EIC early science program and the preTDR effort will need to run in parallel.
  - Will need to evolve as the project plan evolves
  - Necessary to show we can meet DOE goals/constraints
  - The collaboration needs to lead the development of EIC early science

- The preTDR effort is still focused on demonstrating the ability of the ePIC detector to address the full EIC science program as defined by the NAS report.
  - Don’t get distracted – this is still the ultimate goal

Summary

- Defining EIC Early Science is an important component of the EIC project plan as we move towards CD-2/3.
- The collaboration is an essential part of this process.
- It is up to you to define how we will start the full EIC science program.



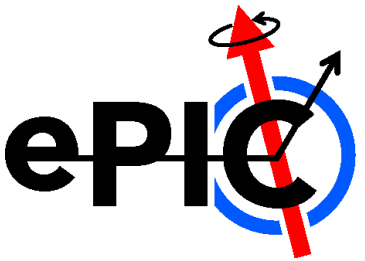
Thank You!

- Thanks to Salvatore, Rosi and Rachel for organizing this workshop
- Thanks for Abhay and the CFNS for hosting us
- Thanks to our invited speakers Farid, Wim, and Shohini, as well as Yuri for leading the discussion period

- But most of all, **THANK YOU** for spending your valuable time thinking and planning to make ePIC and the EIC a success!


BACK UP

ePIC Resources



- Public Website - https://www.bnl.gov/eic/epic.php
- Mailing Lists – https://lists.bnl.gov/mailman/listinfo
- Indico Agenda - https://indico.bnl.gov/category/402/
  - ePIC Software and Computing: https://indico.bnl.gov/category/435/
- Wiki - https://wiki.bnl.gov/EPIC
- ePIC Software Training:
  - Landing Page: https://eic.github.io/documentation/landingpage.html
  - Tutorials: https://eic.github.io/documentation/tutorials.html
- Mattermost: https://chat.epic-eic.org
- ePIC Zenodo Community: https://zenodo.org/communities/epic

EICUG Membership

- The EICUG is a vital organization to promote the interests of the EIC community!
  - Without the EICUG we would never have gotten far enough to form ePIC!

- Please register your institution!
- Check with your EICUG IB representative to get registered as a member

- https://www.eicug.org/content/join.html