Q1

On slide 17 of the software talk, you list the priorities for the reconstruction that need to be completed for a successful TDR. You identified the first item as your highest priority. How much FTE effort is presently dedicated to the completion of this task? When do you expect it to be completed?

We limit the scope of the first study to the track reconstruction only. The key is to demonstrate we can correlate hits in a realistic time frame to the various events in the time window of the MAPS.

We need to accomplish the following tasks (15 FTE months):

- **Framework Tests and Development**:
  - **01/24** Integrate Jana2's built-in workflow for supporting frames in and events out in EICrecon.
- **Simulation**:
  - **12/23** Prepare simulation productions, using detailed information on FEEs for tracking detectors, utilizing the full, wide MAPS integration window for tracking purposes.
  - **01/24** Implement and utilize the frame-building infrastructure post-Geant4 and post-digitization.
- **Reconstruction Process**:
  - **02/2024** Adapt the reconstruction process to work with frames, making it frames-aware.
  - **03/2024** Demonstrate tracking from realistic frames
  - **04/2024** Deliver first estimate of reconstruction time from frames.

Q2

We would like to better understand your computing needs as best as you know them today.

- Based on the number of electronic channels in the detector, and the occupancy you expect, how large an event (or frame) size do you expect?
- How many events do you expect to record and simulate per year, respectively?
- How many core-seconds on a typical modern machine does your reconstruction and simulation take today, respectively?
- How much do you think this will change once you added a realistic frame to event reconstruction?

- The frame size (1ms) based on our current detector readout design is 10MB when running at peak luminosity and in standard operating conditions.
- Assuming a 50% up-time for ½ year, we will record 15.5 billion frames in a year.
- The event rate at peak luminosity is 500kHz, which gives roughly 4 x 10^{12} events (60% background, 40% bunch crossing related):
  - This will of course be much lower at start of operations, where the luminosity will be lower (but relatively speaking the background rate is expected to be higher).
  - The actual physics events related to key EIC observables is only a very small fraction of the total physics bunch crossings. The expected number of DIS events / physics event of interest for one year of running at peak luminosity is ~ 10^{10}. This is the number that drives our simulation needs, and we expect to simulate 10x events for each event of interest, yielding O(10^{11}) simulated events. While considerable (~ 60k core years on today's hardware), this should be a realistic target in a decade.
- Our current simulations of background embedded events take ~17s for simulation and ~ 2s for reconstruction, per event.
- We do not currently have an estimate for how event reconstruction time will change once signal events are embedded in realistic frames. For the TDR we expect to have first estimates based on the initial implementation of frames in the reconstruction.

Q3

What is the scope of the production you need to do for the TDR?
- How many events (or frames)?

- For the TDR we need to fully define the technical design of the detector (to the 90% level), and demonstrate the design is capable of delivering on the key physics observables for the EIC Project.
- For this purpose we will mostly do event-based simulations to be supplemented with a few targeted frame-based simulations to demonstrate that the tracker design can deliver the required performance in a realistic environment.
- This means we will mostly generate event-based samples (similar to what we have been doing for the past year), and a few dedicated tracking simulations that the full DAQ frame (but only for the tracking detectors):
    - ~ 50-100M events in general, with a subset of these also produced in tracking frames.

- You mentioned that you expect to be able to do this simulation campaign within a couple of weeks. Did we understand this correctly?

- Correct. Current productions finish running in well under two weeks.
- We have some margin left to support a small factor increase in computation without substantially exceeding this time.
- We expect the biggest increase in time needs to come from realistic photon propagation in the DIRC (which is currently being optimized), and increased tracking combinatorics for track-finding at the MAPS detector's intrinsic timescale (2µs).

Q4

Are there plans to define a mechanism to share the burden of computing operations in the US and internationally?

Yes, we see the need for an operations team to be part of our current operations working groups. This is something the collaboration will manage, and we expect it will be recognized as a valid service task, such as "data production shifts”.

The operations team needs to work closely with the operations teams of Echelon 1 and 2. ePIC is committed to facility integration and robust testing/validation, which includes monitoring and diagnostics.

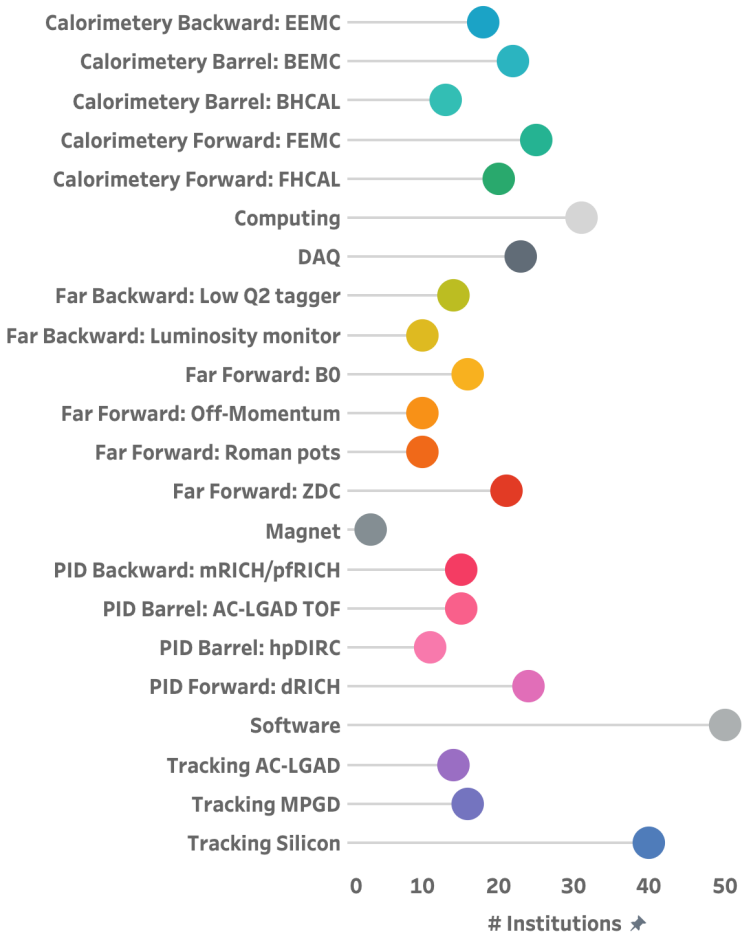
Q5

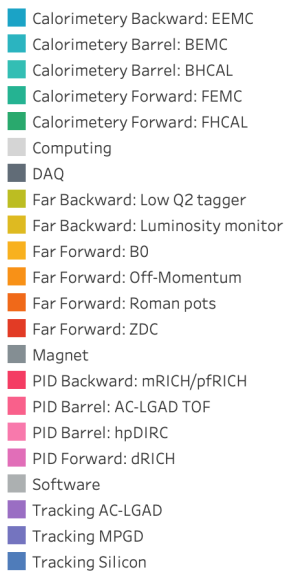
Are there already ongoing discussions with the international collaborators about what kind of areas in software or computing infrastructure different countries are willing to commit to long term? If not yet, when do you expect to start this kind of discussion? Similarly, when do you expect to start this kind of discussion with JLab and BNL?

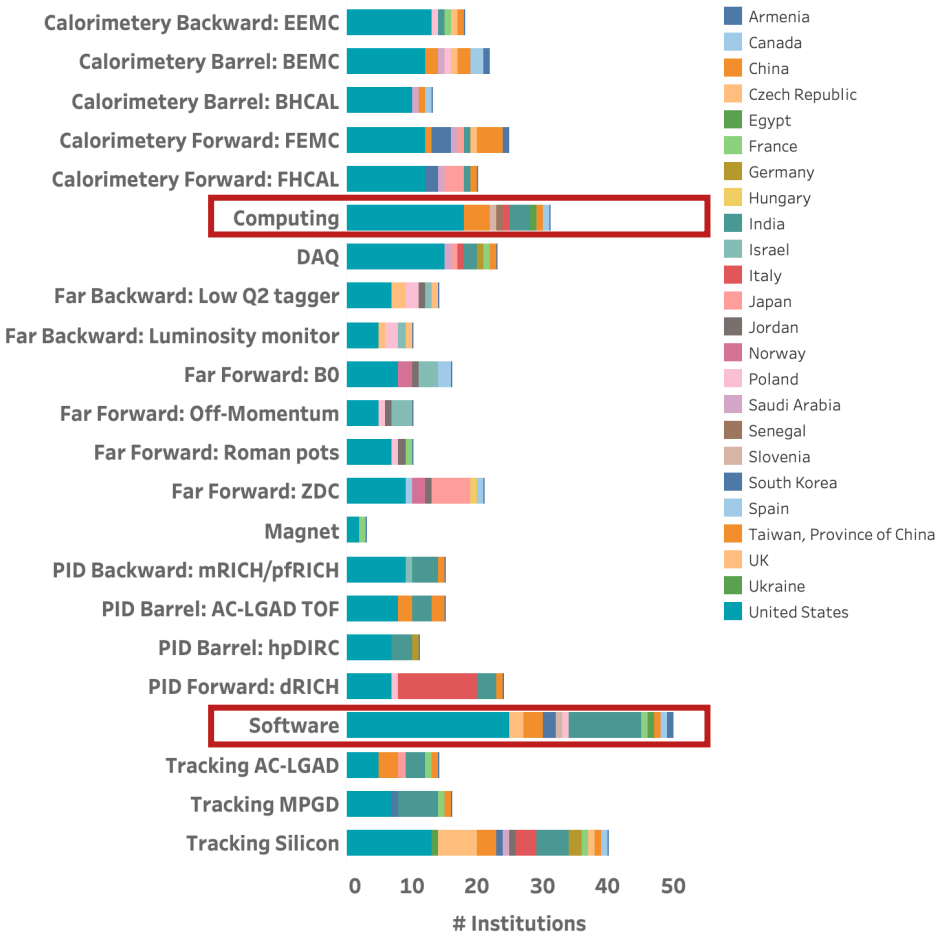
- The software & computing effort is a global effort by the collaboration with contributions from currently North America, Europe, and Asia. A substantial portion of this work originates from the host laboratories, which currently provide two coordinators.
- The survey results shown in the subsequent slide highlight the collaboration's strong interest in software and computing.
- We are currently in the initial stages of more formal discussions concerning computing infrastructure commitments from international partners. These discussions will be a significant focus of the upcoming EIC RRB meeting scheduled for December. Once established, the EICO will assume a critical executive role in this area.
- For software contributions by BNL, ePIC works closely with the Nuclear and Particle Physics Software Group (NPPS) which provides effort, conveners, and coordinators, drawing on other HEP and NP expertise and activities as well. Similarly, the Experimental Physics Software & Computing Infrastructure (EPSCI) group at Jefferson Lab plays a comparable role. This group benefits from the diverse range of experiments conducted at CEBAF 12 and holds a leadership position in streaming readout for Nuclear Physics.
- For computing, we collaborate with the scientific computing teams at the host labs. A notable example of this partnership is the deployment of Rucio. Additionally, we have initiated collaborations with member countries, for example with Digital Research Alliance of Canada.

Q5: Collaboration Interest in Software & Computing

Are there already ongoing discussions with the international collaborators about what kind of areas in software or computing infrastructure different countries are willing to commit to long term? If not yet, when do you expect to start this kind of discussion? Similarly, when do you expect to start this kind of discussion with JLab and BNL?







Q6

We congratulate you for being very well organized, and thoughtful about what organizational structure you need. We noticed that many of the people in these boxes occupy more than one box. What is the typical FTE that actually work in these boxes? Does this lead to overheads in management structure, or are these effectively labels for people who just get the job done?

- Every Working Group (WG) convener is required to commit to at least 0.25 FTE for a two-year term.
- Task forces (TFs) are designed to address high-priority issues in a few months and are used for cross-cutting efforts. There is the hope that they serve as a tool for workforce development at the current stage of ePIC.
- **People occupying more than one box**:
  - **Kolja Kauder**: Serves as the convener for both the Physics and Detector Simulations and User Learing WGs. We benefit from Kolja's being fully paid for EIC software development.
  - **Shujie Li**: Acts as the convener for the Reconstruction WG and leads the TF on vertexing. This TF collaborates with experts on heavy flavor physics and addresses immediate physics studies needs.
  - **Derek Anderson**: Holds the position of convener for the Reconstruction WG and leads the Particle Flow TF. His TF works with jet physics experts on focus on urgent jet reconstruction priorities for ePIC.
- The listed TFs complement the efforts of the Reconstruction WG and have a cross-cutting function, facilitating collaboration between the Reconstruction and Physics WGs, and allows the collaboration to recognize the efforts of early career scientists who facilitate completing key priorities.