ePIC Workshop on Streaming Reconstruction: Scope and Goals

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What the ePIC Streaming Computing Model Enables

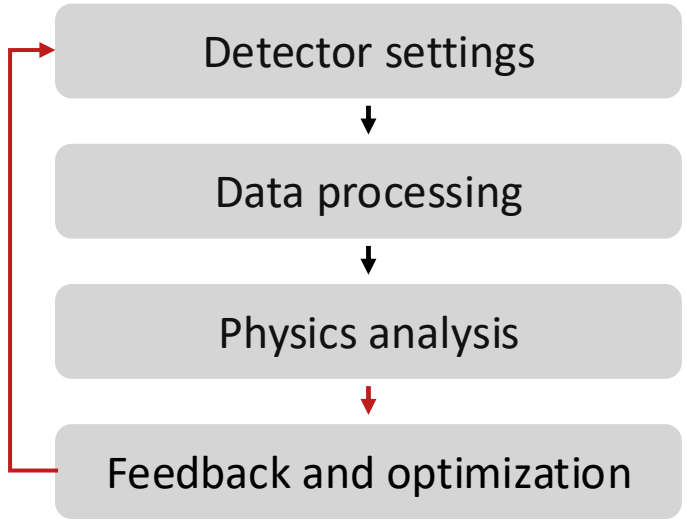
The ePIC Streaming Computing Model integrates streaming readout, AI, and distributed computing.

1. **Streaming Readout**
   Maximizes scientific reach through unbiased event selection and continuous measurement of backgrounds and detector noise.

2. **AI**
   Accelerates science through automated alignment, calibration, and validation, shortening the path to physics results and publications.

3. **Distributed Computing**
   Enables flexible access to dedicated and opportunistic computing resources where they are needed.

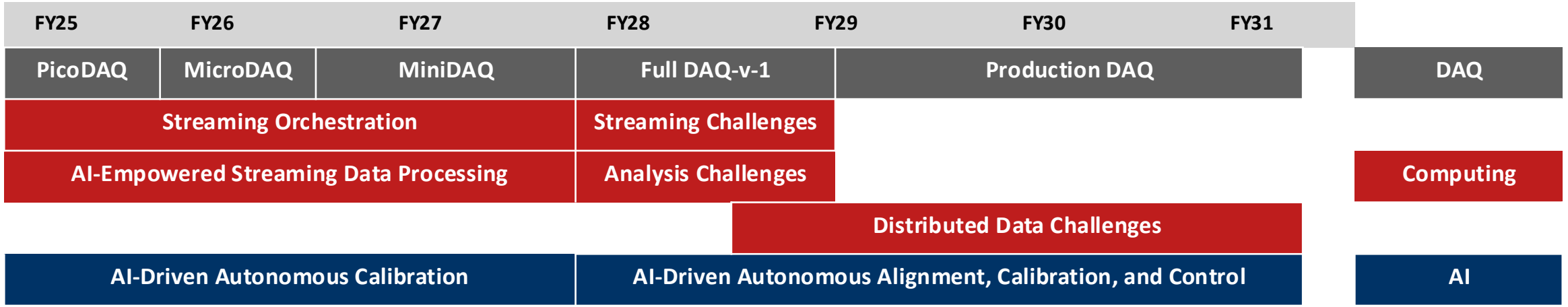
Closed-loop experimental control



Investing now in the ePIC Streaming Computing Model ensures that the collaboration will have the infrastructure, resources, and workflows needed to **commission and operate the experiment**.

Streaming DAQ and Computing Milestones

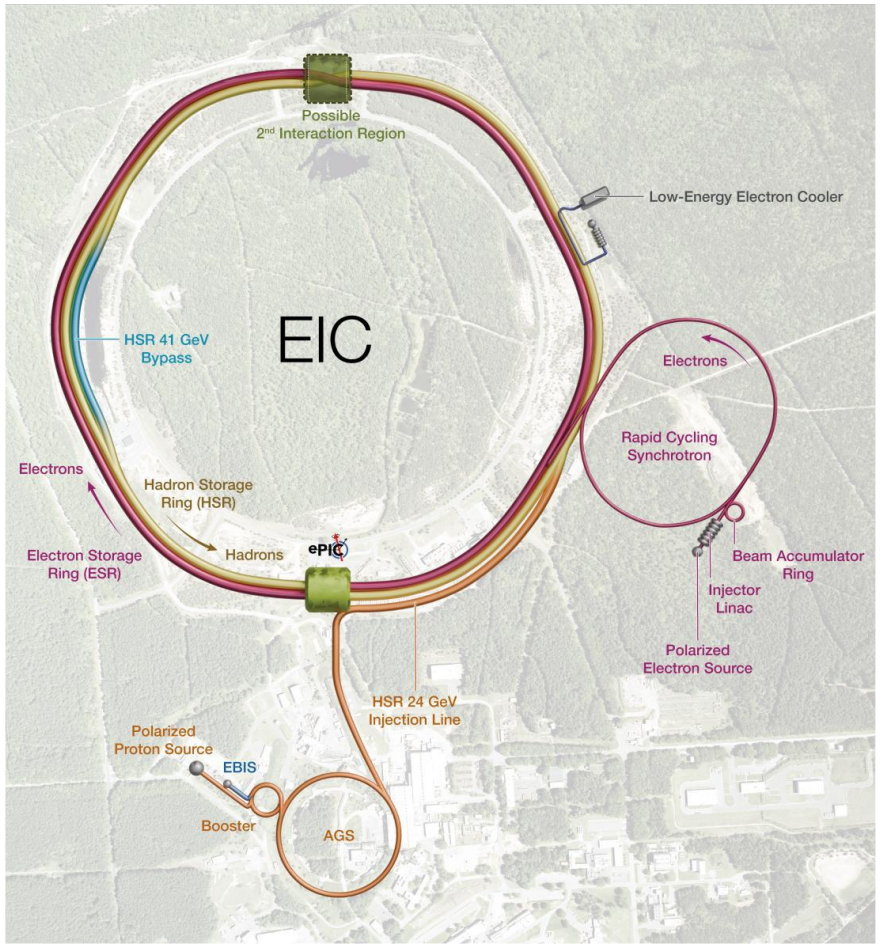
Timeline to be updated following revised EIC project schedule.



- **Compute-Detector Integration**:
  - Joint deliverables between **DAQ** and **computing** to develop an integrated system.
  - Define and test DAQ–computing interfaces early to reduce integration risk and enable system-level testing.

- **Streaming Reconstruction Milestones and Deliverables**:
  - **Streaming reconstruction** is an essential component of **streaming data processing**.
  - For the **pre-TDR**, demonstrate reconstruction of physics events from streaming data.
  - Target publication of a streaming-reconstruction paper in the **NIM-A Special Issue**.

EIC and Event Rates



- **Versatile machine**: versatile range of beam polarizations, beam species, center of mass energies.

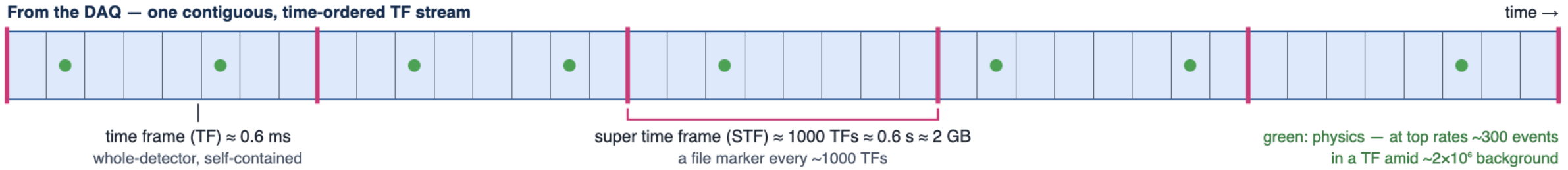
- **High luminosity** up to L = 10^{34} cm^{-2} s^{-1} = 10 kHz/µb.
  - The e-p cross section at peak luminosity is about 50 µb. This corresponds to a signal event rate of about 500 kHZ.

- The **bunch frequency** will be **98.5MHz**, which corresponds to a **bunch spacing** of about **10ns**.
  - For e-p collisions at peak luminosity, there will be in average 200 bunches or about 2µs between collisions (98.5MHz / 500 kHz).

- For our computing resource estimate, we considered a luminosity scenario of L = 10^{33} cm^{-2} s^{-1} = 1 kHz/µb.

Event Identification in Streaming Reconstruction

Streaming readout contains physics collision events, accelerator- and beam-induced backgrounds, and detector noise. In Echelon 0, the data are aggregated into (super)timeframes.



Event identification: As part of streaming reconstruction, we identify the physics collision events within each (super)timeframe.

The streaming readout also provides **background-only events**, which we use to build **data-driven background models** for physics analyses.

ePIC Workshop on Streaming Reconstruction

- **Workshop Goals**
  - Review the status of **streaming reconstruction**.
  - Discuss **requirements and ongoing developments**.
  - Identify the work needed toward a **complete streaming reconstruction workflow**.

- **Program**
  - Reconstruction **algorithms and infrastructure**.
  - **Simulation and visualization** of streaming data.
  - Data sets and procedures for **testing and validation**.
  - Dedicated discussions on **open issues and priorities**.

- **Expected Outcomes**
  - Define **priorities and next steps**.
  - Plan the **Streaming Reconstruction paper** for the **NIM-A Special Issue**.
  - Use **Live Notes** throughout the workshop to capture discussions, action items, and open questions.