Timing in the EIC detector

EIC (1.5 miles)

CEBAF (0.9 mile racetrack)

North Linac

South Linac

Hall D

CEBAF Center

Applied Research Center

Labs

Halls A, B, C

IP1, IP2

Exsisting Buildings

Proposed Buildings
Triggers

**Synchronous**
- Clock driven
- Can have many (LHC) or few (HERA) collisions per bunch crossing
- Yes/No decision every crossing
- Event start time \((t_0)\) is given by the bunch crossing time

**Asynchronous**
- Data driven
- Triggers on detector activity, not clock
- Works with continuous unbunched beams
- Event start time is given by physics (self-timed)
**Time-of-Flight (event by event)**

**Synchronous**
- Time measured with respect to reference signal (RF)
- Since we do not know the position within the bunch, TOF resolution is limited by bunch length (33 ps/cm, with 1-2 cm rms expected)
- Long-term stability of reference signal important

**Asynchronous**
- Time is measured with respect to the trigger, which is sampled at a random time (in CLAS 5 or 15 ns)
- Timing is relative, so the reference time cancels exactly – insensitive to jitter and long term drifts
- Resolution is only limited by TOF detectors and trackers (path length)
- Calibration is done with respect to the speed of light. In CLAS, one electron is sufficient, but one can fit all tracks if needed (PANDA)
Synchronization of cable- and internal module delays is done during an initial setup.

Monitoring of drifts (in detector signals or electronics) can be done using low-resolution signals like the RF (30-70 ps rms jitter with respect to detector signals due to bunch length).

Precise offline synchronization can be done during calibration using high-resolution data or special events.
Central detector overview

Flux return yoke (space for muon chambers)

- EMcal (Sci-Fi)
- DIRC & TOF
- Vertex (Si pixel)
- Central tracker (low-mass DC)
- Endcap tracker (TRD?)

- Modular aerogel RICH
- Hcal (iron)
- PWO₄ EMcal (NPS)

- Flux-return coils
- 3.2 m
- 4.4 m

- 5 m
- 2 m

- Space for additional muon chamber

- Dipole

- e/π Cherenkov (HBD with rTPC?)

- GEMC implementation by Zhiwen Zhao

- Modular aerogel RICH

- Central barrel

- Electron endcap

- Hadron endcap