Precise luminosity measurement at the EIC
vs. 5 ns bunch spacing

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Luminosity measurement challenge at the EIC

Precise cross-section measurements are the corner stone of the physics program at the EIC, hence very demanding requirements for its luminosity measurement:

- Absolute $\mathcal{L}$ precision (significantly) better than 1%
- Bunch-to-bunch *relative* measurements with very high precision of $\delta\mathcal{L}/\mathcal{L} \approx 10^{-4}$

Are these requirements valid also for IR2? Including (heavy) ions?

- In luminosity detectors **the event pileup scales roughly as Z^2/A** hence for the *eAu* case instead of 10 hard photons every 10 ns more than 100 will hit the detectors, what corresponds to > 10 GHz total event rate!
- (Event pileup will affect strongly also the spectrometer measurement as well as the photoproduction tagging)
- Finely segmented and radiation hard detectors have to be used
- Precise measurements will require developing dedicated detector technologies and specialized electronics – 100 MHz sampling rate and, given > 10 GHz event rates, a near-detector signal processing necessary

5 ns bunch spacing challenge

Pro: Event pileup in a single bunch crossing is halved

Con: But it definitely requires yet faster electronics (200 MHz sampling?), and possibly faster detectors too

Handling the 10 ns bunch spacing seems already very challenging for the luminosity detectors at the EIC – decreasing the spacing to 5 ns might compromise the precision of luminosity determination – it needs proper studies

Larger e-beam angular divergence means a smaller photon acceptance/larger corrections

Conclusion:
Time is needed to properly assess the impact of 5 ns spacing on the luminosity determination at the EIC