Hadron Beams at an EIC

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- This is a far-reaching program that will benefit both the coming JLab EIC complex and the resonance-physics program, which is one of the top priorities at the Jefferson Lab.

- The second piece is a neutron facility that is critical for the US Energy Program, *i.e.*, for Acceleration Driven System (ADS) and upcoming Generation IV Nuclear Reactors.

- So we can longer keep the JLab pre-Booster and Linac busy [to use more then `several minutes” a day], which would be a much more effective use of the MEIC facility, without significant increase of the cost of the JLab pre-Booster and Linac.
285 MeV **protons**, 100 μA
1 MHz, 1 ns

- Secondary **neutrons**, $10^{15}$ 1/s

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3 GeV **protons**, 4 μA
10 Hz, 170 ns

- Secondary **pions**
  - < 3 GeV, $10^7$ 1/s
  - Δ$p/p < 2%$
- Secondary **Kaons**
  - < 2 GeV, $10^5$ 1/s

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**MEIC: Medium Energy EIC**

Three compact rings:
- 3 to 11 GeV electron
- Up to 12 GeV/c proton (warm)
- Up to 60 GeV/c proton (cold)

**Note: conservative assumptions**
- 6T dipole fields
- Synch. Power < 20 kW/m
- $\beta_{\max} < 2.5$ km
Why Intense Pion and Kaon Beams at JLab?

- Physics of collisions at high energies and at low/medium energies are related.

- Theoretical interpretation of DIS experimental results for target fragmentation, as for many other strong processes, may be considered in two manners, in quark-gluon terms of QCD, or in hadronic terms.

- The latter description requires detailed knowledge of the meson-nucleon and NN interactions at lower energies.

- One can consider the pion distribution at small Bjorken $x$ for the process of leading neutron production in DIS.

- Existing data from the H1 and ZEUS experiments at HERA are in good agreement with the predictions using the GW DAC [SAID] $\pi N$ amplitudes as input.
Why Intense Pion and Kaon Beams at JLab?

- Reliable theoretical and phenomenological analyses need hadron induced measurements as, e.g.,
  \[ \pi N \rightarrow \pi N, \eta N, K \Lambda, K \Sigma, \omega N, \phi N, \text{and} \]
  \[ K N \rightarrow K N, \pi \Lambda, \pi \Sigma, \eta \Lambda, \eta \Sigma, \text{and also multi-meson} \]
  final states.
These measurements would complement current studies using EM probes.

- Polarized measurements would also be an important part of the hadron program at Jefferson Lab.

- The inverse pion electroproduction \[ \pi^- p \rightarrow e^+ e^- n \]
  measurements will significantly complement the current JLab pion electroproduction study for
  the evolution of baryon properties with increasing momentum transfer by investigation
  of the case for the time-like virtual photon.

- Application:
  Knowledge of hadron-nucleon amplitudes is also necessary for MC simulations of
  detectors for high-energy facilities.

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Why Intense Neutron Beam at JLab?

- The information about the **neutron-nucleus** interaction is important in many applications, for example:
  - **Acceleration Driven System (ADS),**
  - The conceptual design of an innovative **nuclear reactor** being carried out in the course of the **Generation IV** initiative.

**Neutron-proton** scattering is used as the **Primary Standard** in measurements involving neutron-induced nuclear reactions. Its cross section is used in determining the flux of incoming neutrons.

In **2007**, the International Atomic Energy Agency (**IAEA**) within the **International Evaluation of Neutron Cross Section Standards** highly rated the GW DAC [**SAID**] group work:

**Industrial request** for the accuracy of the fission Xsections of main actinides is **1 %** for energy range of **0.1 – 20 MeV**

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  The Arndt evaluation was accepted by the NEANDC/INDC as a primary standard for cross section measurements in the 20–350 MeV range.