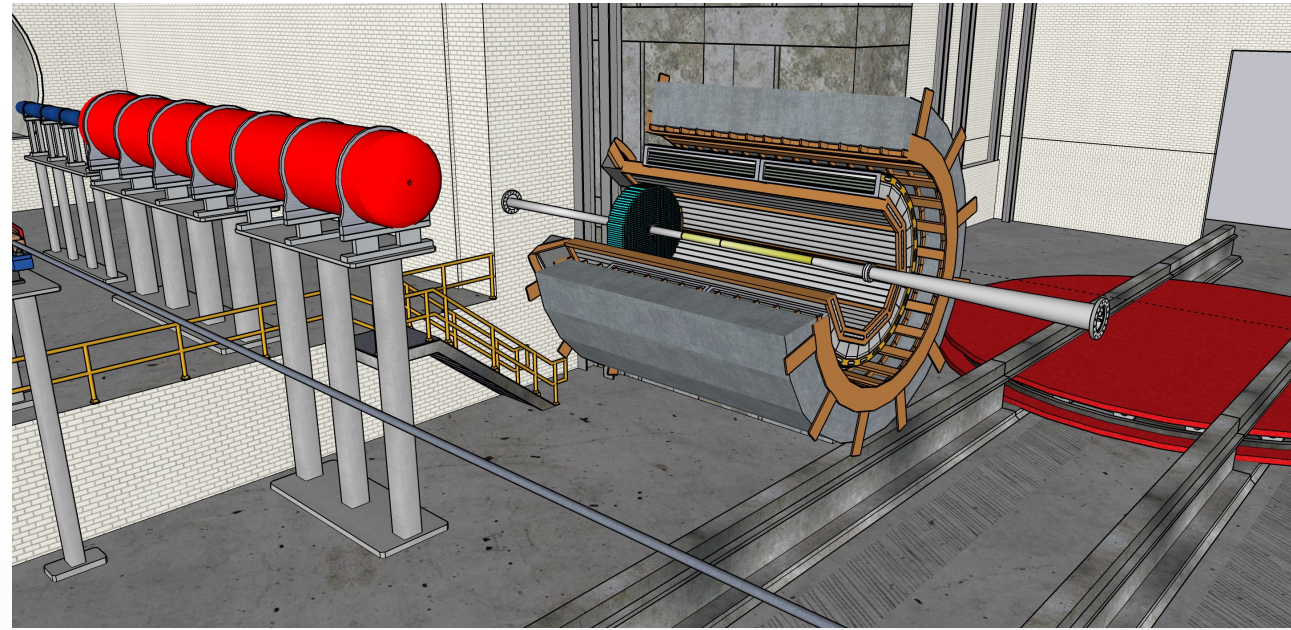


CORE meeting

30 June 2021

<https://indico.jlab.org/event/460/>



CHALLENGES AND SOLUTIONS FOR DEEP EXCLUSIVE SCATTERING ON LIGHT NUCLEI

CHARLES HYDE

OLD DOMINION UNIVERSITY

$$e + {}^A_Z \rightarrow e + {}^A_Z + \gamma, \nu, \pi, \dots$$

$$k + P_A = k' + P_A' + q'$$

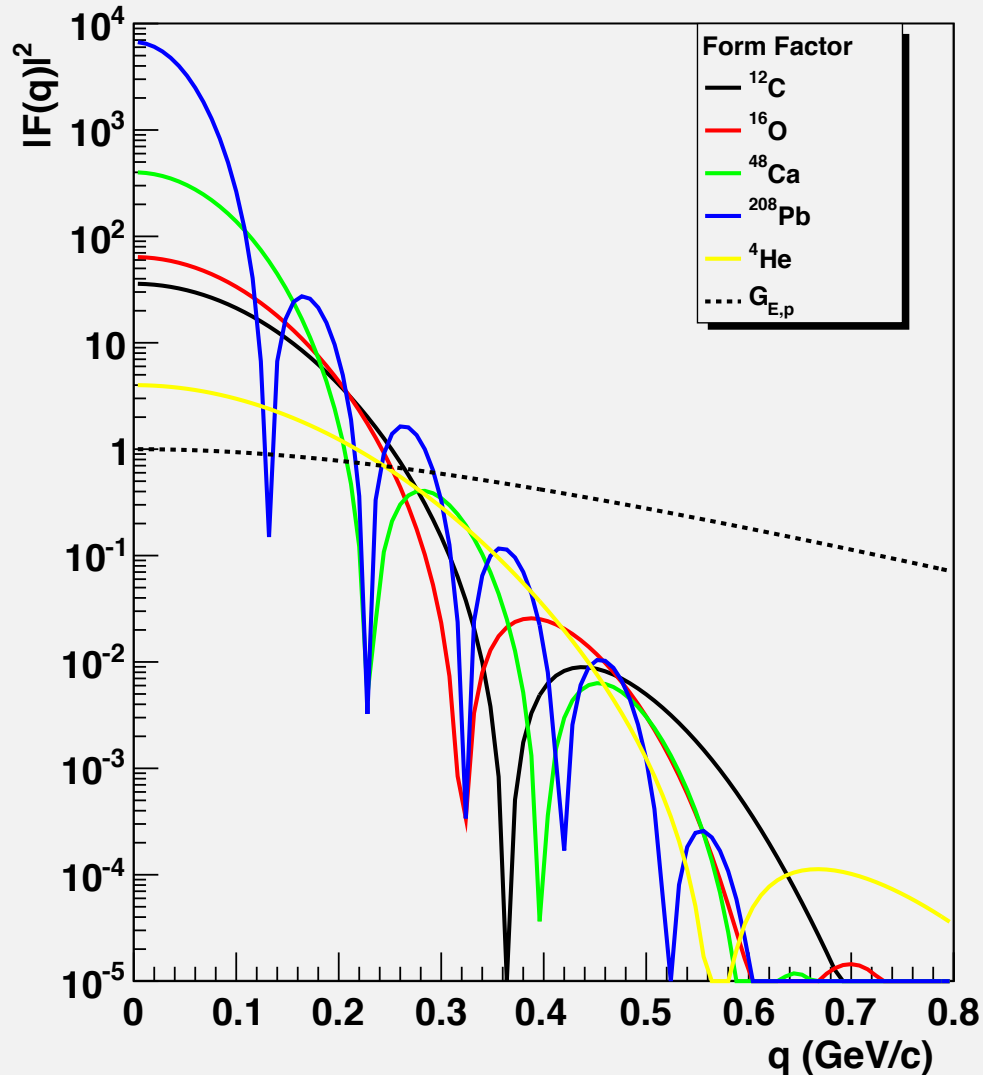
$$P_A = ZP_0$$

- Exclusivity:
 - Tag final state nucleus (must be outside 10σ beam envelope)
 - Veto break-up channels
 - Veto excited bound states by detection of decay photons (boosted in lab)
- Kinematic Reconstruction:
 - $t_A = (P_A' - P_A)^2 \quad =? \quad t_\gamma = (k - k' - q')^2$
 - Different experimental errors
 - t_A dominated by beam momentum spread, requires detection of final nucleus
 - t_γ dominated by EMCAL resolution for DVCS, Deep π^0

SPATIAL STRUCTURE OF NUCLEI

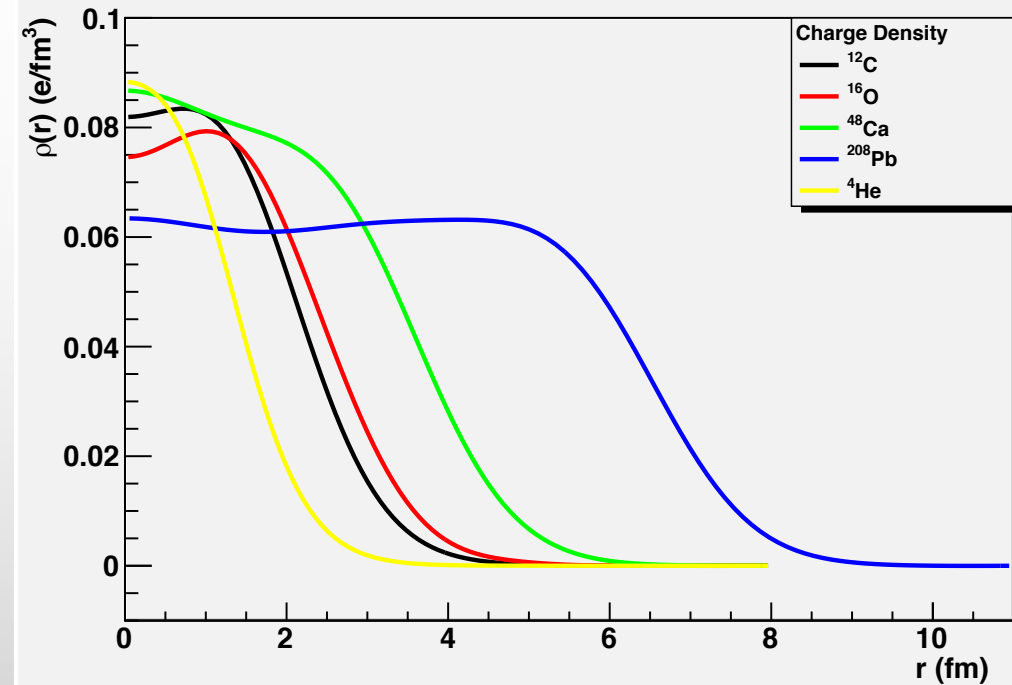
$^A Z(e, e') ^A Z$

Fourier-Bessel Charge Form Factors



- FORM FACTORS & CHARGE DENSITIES: $\frac{2}{3} [u - \bar{u}] - \frac{1}{3} [d - \bar{d}]$
- Separate u, d \rightarrow “neutron skin”

Nuclear Charge Densities



DVCS ON NUCLEI

$$0 < x_B < A$$

- Expect the cross section to have similar diffraction patterns
- Locations of minima are functions of x_B

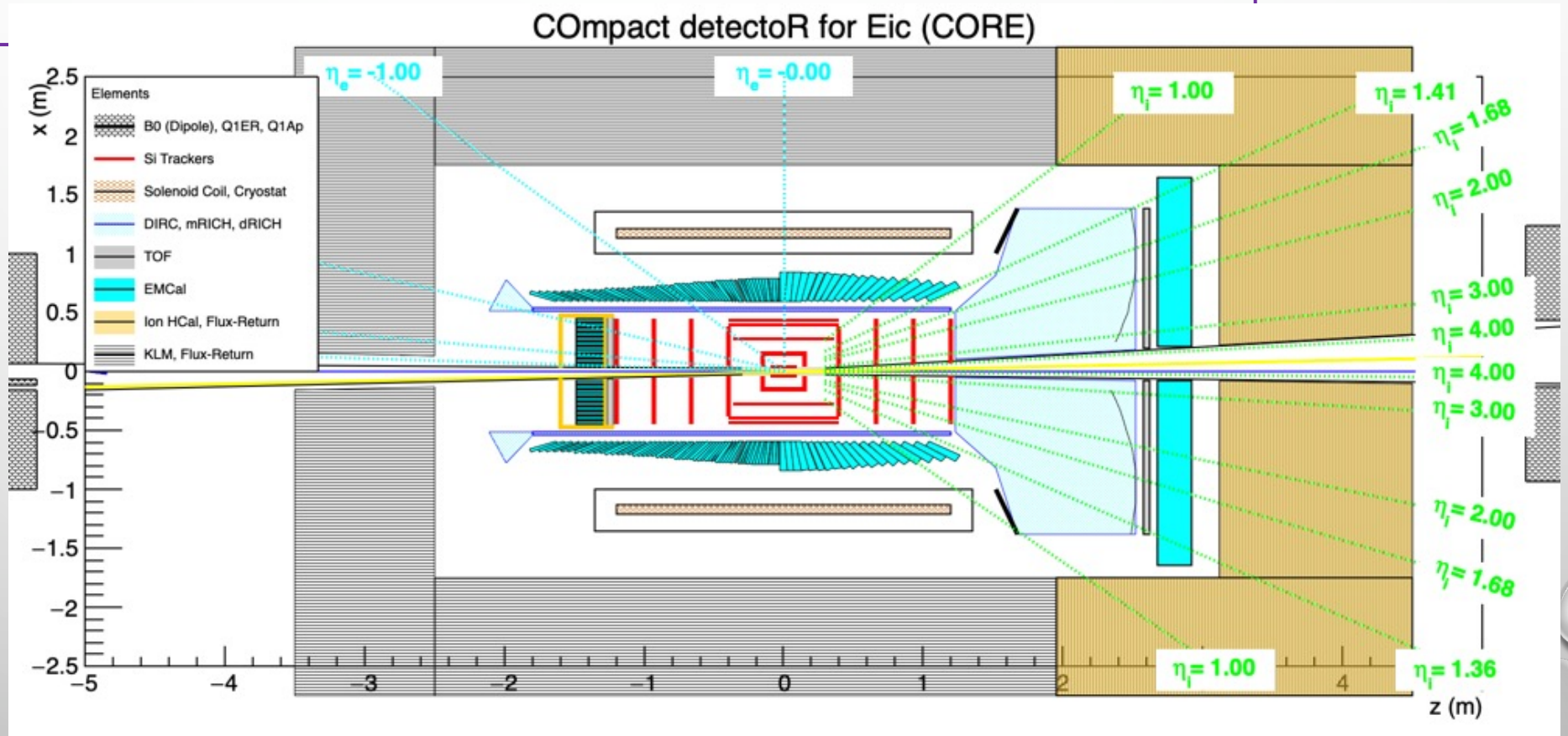
Locations of Charge Form Factor Diffractive Minima		
Nucleus	First Minimum (GeV/c)	Second Minimum (GeV/c)
^4He	0.59	?
^{12}C	0.36	≥ 0.7
^{16}O	0.32	0.64
^{48}Ca	0.20	0.40

KINEMATIC RECONSTRUCTION

- Initial study with of Δ_{\perp} resolution (EMCal contribution only)

- PbWO₄ resolution: $\frac{\sigma(E)}{E} = 1\% \oplus 2\% \sqrt{\frac{1\text{GeV}}{E}} \oplus 1\% \frac{1\text{GeV}}{E}$

$$t_{\gamma} = (k - k' - q')^2 = \Delta^2$$



$^4\text{He:}$
 $10 \text{ GeV } e^-$
 $\otimes 200 \text{ GeV}/c$
 α

