Electromagnetic response of $^{12}$C: a first-principles calculation

**Objectives**

- Compute the electromagnetic longitudinal and transverse response functions of $^{12}$C for which accurate experimental data are available.
- Investigate the energy dependence of the two-body meson-exchange currents contributions.
- Assess the in-medium modification of the proton electric form factor.

**Impact**

- The calculations of the response function of $^{12}$C can be used to predict the results of the latest electron-$^{12}$C scattering experiment of JLab.
- Accurate calculations of electroweak response functions are crucial to neutrino-nucleus scattering experiments.
- Confirming or ruling out the quenching of the proton electric form factor also impacts the EMC effect and polarization transfer reactions.

**Accomplishments**

- Using DMEM and ADLB libraries we capitalized on the 50 million core hours granted by an INCITE award to reliably invert the Euclidean electromagnetic responses of $^{12}$C.
- Two-body currents significantly enhance the transverse response.
- No quenching of the proton electric form factor is needed to reproduce the Coulomb sum rule when all the transitions to low-lying states of $^{12}$C are accounted for.

**References:** arXiv:1605.00248 (PRL in press)
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Electromagnetic transverse response functions of $^{12}$C for $q = 570$ MeV. Two-body currents increase the one-body response in both the quasielastic and threshold regions, bringing theory in good agreement with experiment.

Coulomb sum rule in $^{12}$C. Good agreement with experiments (with no quenching of the proton electric form factor) if the transitions to, to the 2+, 0+2 (Hoyle), and 4+ states are accounted for.