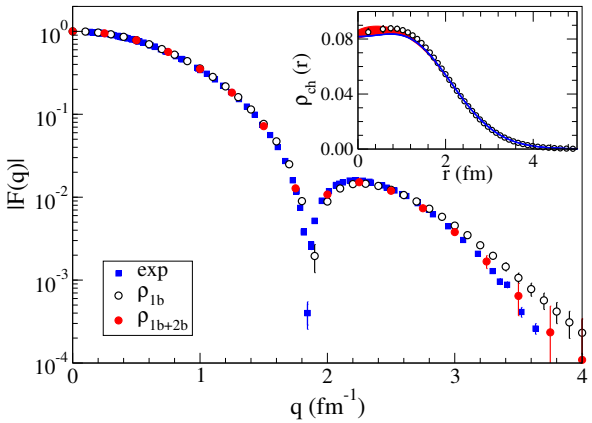
Electromagnetic Form Factor and Sum Rules in ^{12}C

Objectives

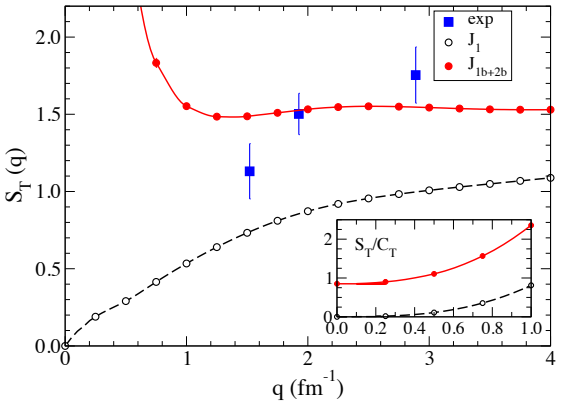
- Compute electroweak response in 12-Carbon. This is a fundamental ingredient in describing the neutrino – ^{12}C scattering.
- As a first step compute the sum rules for the electromagnetic response of ^{12}C including two-body meson exchange currents.

Impact

- This calculation can be used to predict the results of a recent experiment at Jlab, which are not yet released!
- It sets the stage for neutrino scattering calculations relevant to neutrino-nucleus scattering detector calibration (MiniBooNE) and supernovae explosions.



Longitudinal form factor: Two body terms in the density operator bring theoretical prediction closer to experimental data in the high-momentum transfer tail (q).



Transverse sum rule:
- *Two-body contribution is large for all momentum transfers.*
- *Satisfactory agreement with the experimental values.*

Accomplishments

We ported GFMC, our Green's Function Monte Carlo code, together with the ADLB load-balancing library, to the 10-petaflop Mira computer at Argonne and demonstrated scaling to more than 250,000 MPI ranks with over 2 million threads.

We conducted experiments to determine the best configuration of MPI processes per node and OpenMP threads per process for the sum rule calculations (4 ranks/node, 16 threads/rank).

We computed the longitudinal form factor and the sum rules for the electromagnetic response of ^{12}C including two-body meson exchange currents. This is the first step towards our overall objective.

The two-body currents are important for agreement with existing data; the Jlab results soon to be available should provide a more stringent test.

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NUCLEI Nuclear Computational Low-Energy Initiative

Reference: http://arxiv.org/abs/1305.6959

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