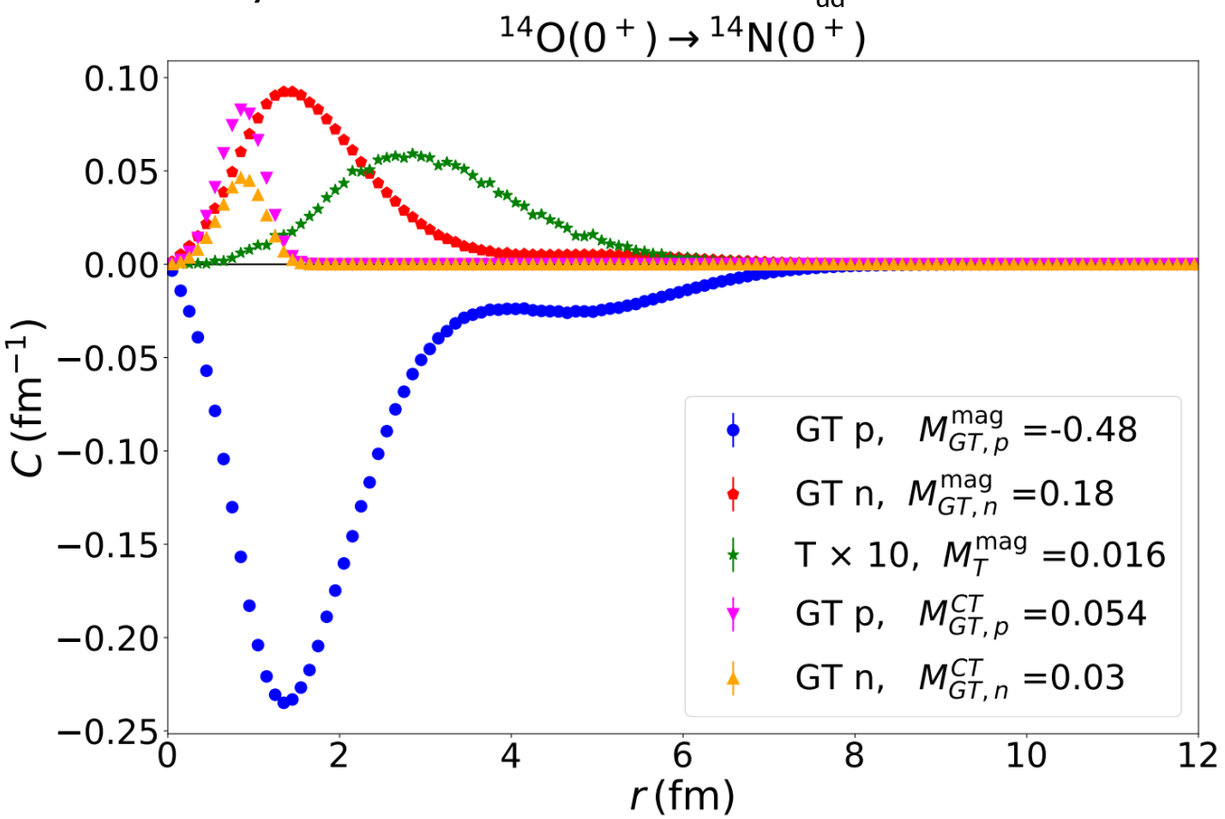
Radiative Corrections to superallowed beta decays in Effective Field Theory

Objectives

The accuracy of V_{ud} determinations from superallowed β decays hinges on control over nuclear structure dependent radiative corrections, parametrized by the quantity δ_{NS}. We laid out a program to evaluate this correction from effective field theory (EFT), highlighting the dominant terms as predicted by the EFT power counting. Our framework paves the way toward ab initio calculations of δ_{NS} and thereby addresses the dominant uncertainty in current extractions of V_{ud}.



Quantum Monte Carlo matrix element densities of the two-body Gamow-Teller (GT) and tensor (T) operators needed to evaluate nuclear structure dependent corrections to the decay of ^{14}O

Impact

We provide a detailed account of the electroweak corrections to superallowed β decays in EFT, deriving a new factorization formula that accounts for contribution of photons in different energy and momentum regions.

We present a first numerical evaluation of the dominant corrections in ^{14}O, based on quantum Monte Carlo methods.

Combined with advances in *ab initio* nuclear-structure calculations, this EFT framework allows one to systematically address the dominant uncertainty in the extraction of the V_{ud} element of the Cabibbo-Kobayashi-Maskawa quark mixing matrix, as illustrated in detail for the 14O→14N transition.

Accomplishments

V. Cirigliano, W. Dekens, J. de Vries, S. Gandolfi, M. Hoferichter, E. Mereghetti, Physical Review Letters and Physical Review C (Editors' suggestion).

See also DOE Office of Science highlight