

***ab-initio* calculations of nuclear structure**

Current nuclear structure calculations are largely model dependent.

***ab-initio* calculations starting from the first principles provide advanced theoretical tools:**

- **for understanding the nature of nuclear force;**
- **for developing nuclear models themselves towards the universal description of nuclear problems;**
- **for reliable predictions;**
- **.....**

Present status:

ab-initio calculation:

realistic nuclear force + good approach to solve the many-body Hamiltonian

Realistic nuclear forces:

For example: Chiral EFT (N^2 LO, N^3 LO), AV18, CD Bonn, JISP16 ...

Renormalization methods

OLS, SRG, $V_{\text{low-k}}$, UCOM, G-Matrix ...

ab-initio methods

Greens Function Monte Carlo (GFMC)

No Core Shell Model (NCSM)

No Core Full Configurations (NCFC)

Coupled Cluster (CC)

Many-Body Perturbation Theory (MBPT)

Lattice Nuclear Chiral EFT ...

However, current *ab-initio* calculations are limited to light mass regions or some special regions (e.g., around shell closures).

Prospects:

Realistic nuclear force:

- uncertainties and calibrations of potential parameters;
- high-order components, e.g., $3NF$, $4NF$...
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ab-initio methods:

- fast convergence and well quantitative;
- extend to heavier mass regions;
- extend to exotic nuclei;
- develop large-scale computing algorithms
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Provide rich and reliable predictions!