Progress report on odd-even nuclei : $Z = 131$

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Jul.3, 2024

Outline

- Numerical details
- Current Progress
- Results
- Summary

Numerical details

- **Nuclei : Odd-even nuclei with Z =131**

  Unconstrained calculation (in the works):

  - ✓ **Run 6 deformations with a step size of 0.20 from -0.40 to 0.60 .**

  Constrained calculation (in the plan):

  - ✓ **Run 27 deformations with a step size of 0.05 from -0.60 to 0.70 .**

- **Version : Code_DRHBc_202401**
- **Box size : R_{box} = 20 fm**
- **Mesh size : Δr = 0.1 fm**
- **Energy cutoff : E_{cut} = 300 MeV**
- **Angular momentum cutoff : J_{max} = 23/2 ħ**
- **Legendre expansion order : λ_{max} = 10**
- **Density functional : PC-PK1**
- **Pairing strength : -325.0 MeV fm^3**

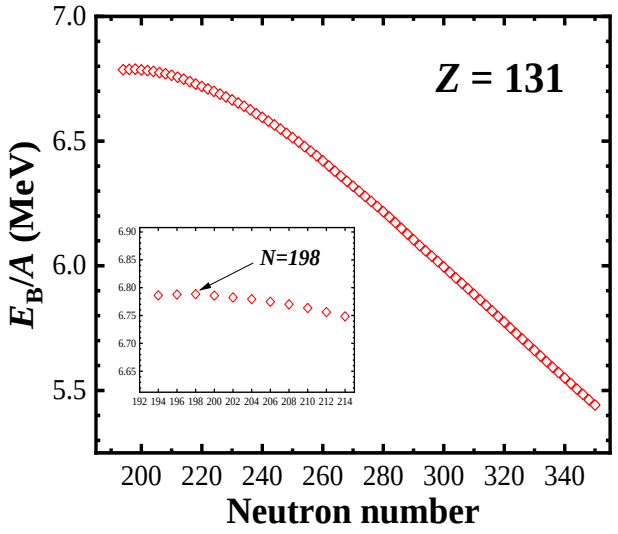
Current Progress

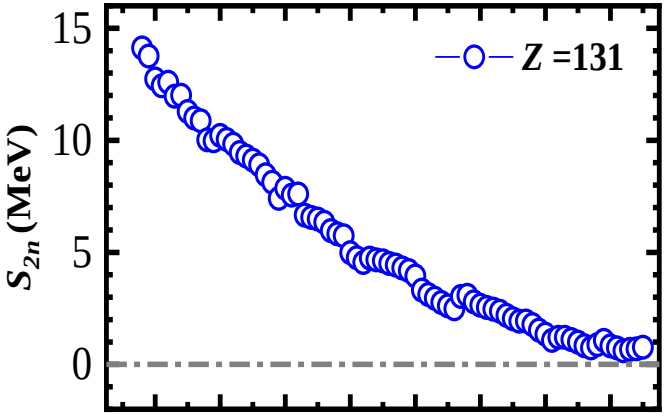
- RCHB is used to perform preliminary calculations. Based on the RCHB results, for the nuclei with Z =131, the proton drip line is approximately around A = 327 (N = 196), and the neutron drip line is approximately around A = 481 (N = 350).
- DRHBc calculations start from A = 325 and currently extend to A =479 (80 nuclei).

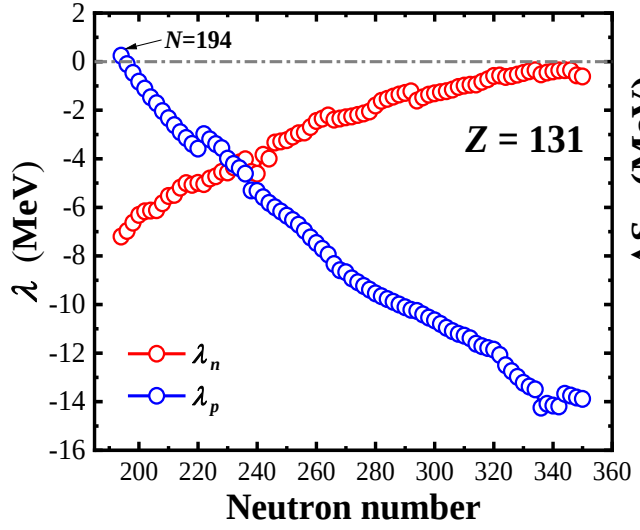
Calculated quantity	odd-even
Total	480
Converged in auto. blocking	340 (71%)
Converged in orbit-fixed blocking	111 (23%)
No convergence	29 (6%)

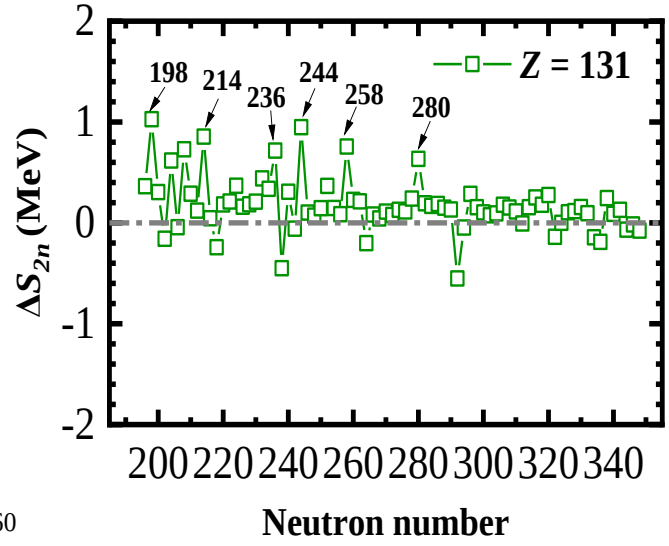
- The constrained calculations are in progress.

Results： Binding energy and two-neutron separation energy



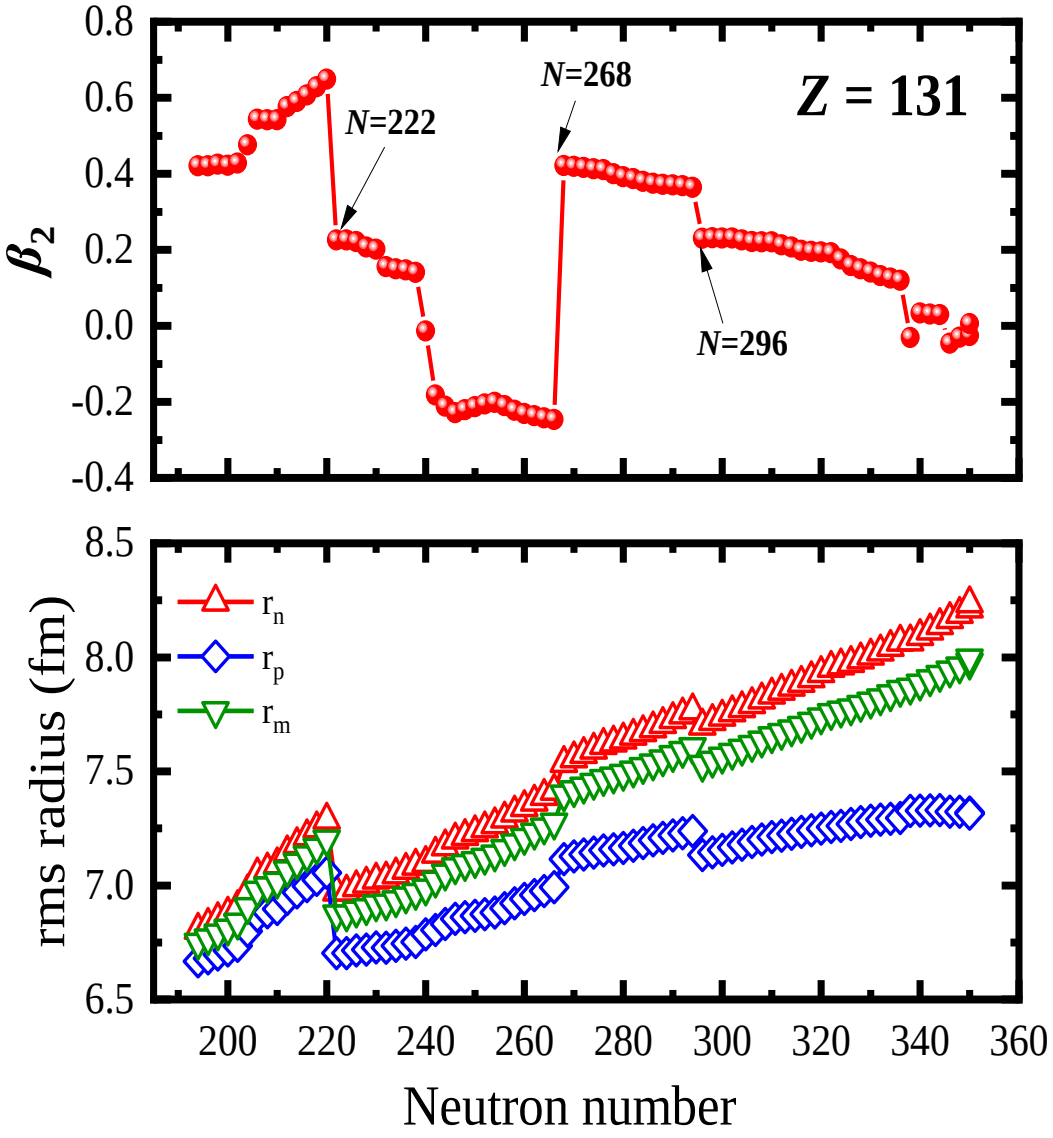






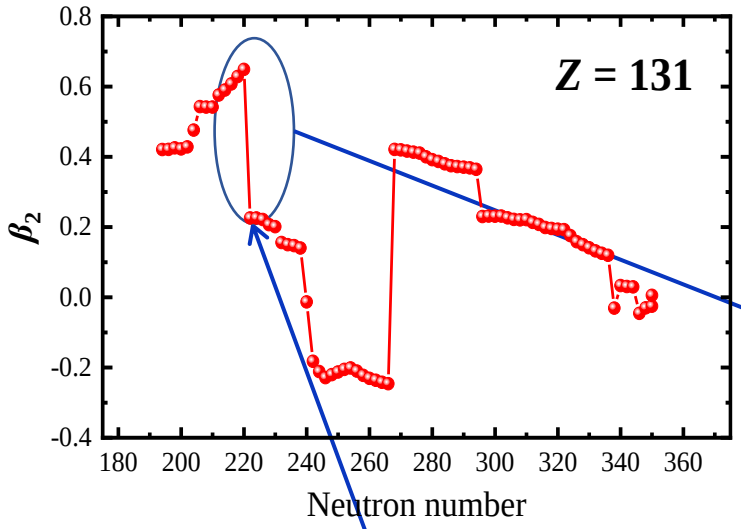
- More calculations are needed to determine the neutron drip line
- The neutron shell structure is no longer obvious. The neutron magic number seems to disappear. It is necessary to examine the single-particle levels for further discussion.

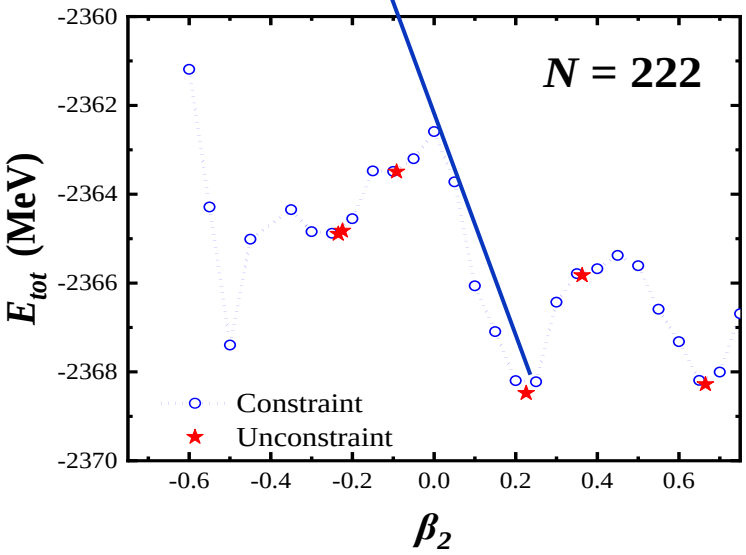
Results : Quadrupole deformation and rms radius

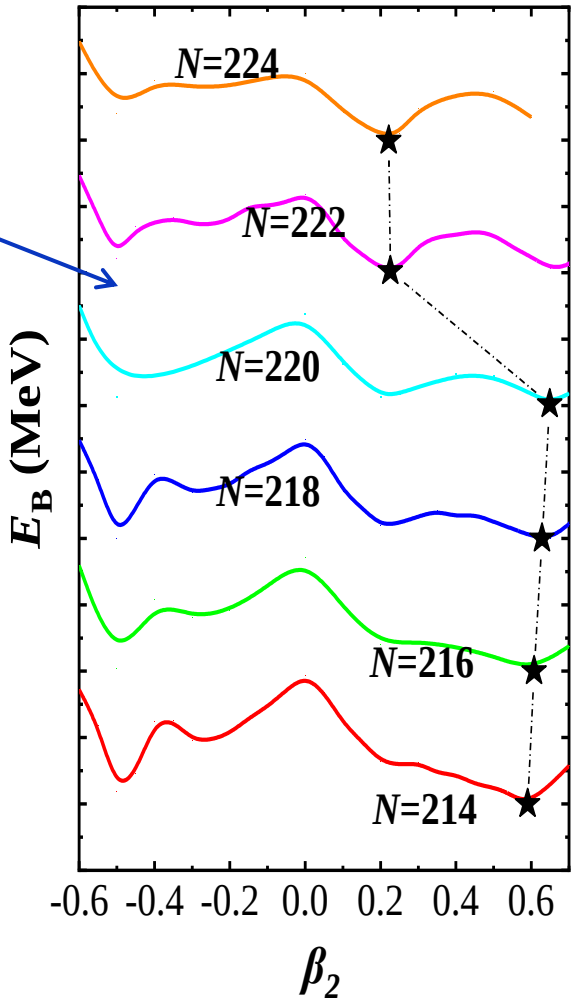


- Several sudden changes in deformation require constrained calculations for verification.The evolution of the ground state deformation can be understood through the potential energy curves.
- The sudden change in rms radius corresponds to a change in deformation.

Results : Potential energy curves



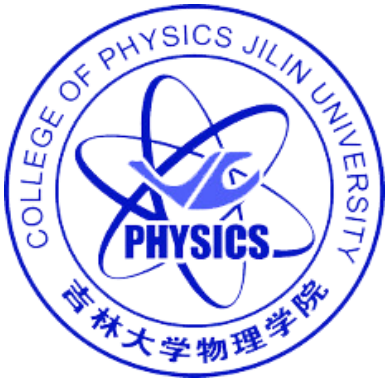




- The competition between two shapes results in a sudden change in ground state deformation at *N*=222.
- Further calculations and data analysis are needed to explain the impact of deformation on shell structure evolution and density distribution,especially with such a large β_2 .

Summary

- **For the nuclei with Z=131, further calculations are still needed to determine the neutron drip line.**
- **Constrained calculations are required to verify previous results, especially in regions where there are sudden changes in deformation.**
- **Follow the suggestions from the discussion yesterday, further numerical tests are needed for superheavy nuclei with large deformation in the future.**
- **Density distribution and the evolution of shell structures for superheavy nuclei are worth studying.**



Thank you for your attention!

Jul.3, 2024