The 7th workshop on nuclear mass table with DRHBc theory
July 1-4, 2024, Gangneung, Korea

Progress report on Z=122

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Outline

- Overall Progress
- Numerical details
- Results of Z=122
- Summary

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➢Overall Progress

Z =122, N =172-336 （A =294-458）

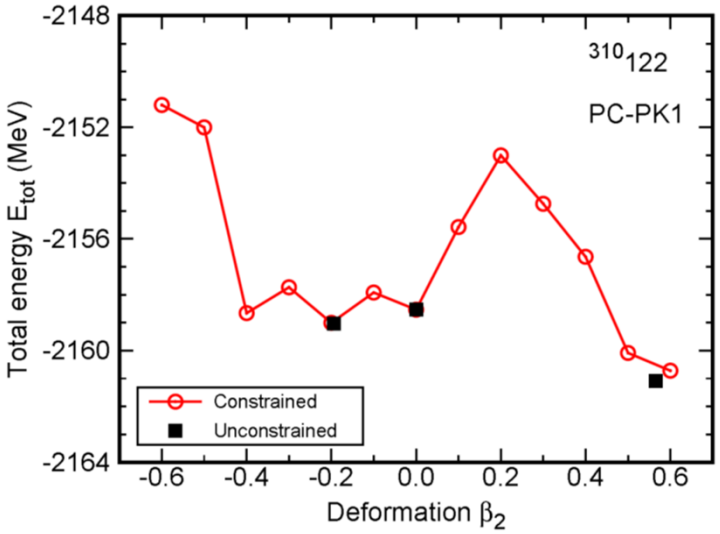
	Unconstrained Cal.	Constrained Cal.	Data summary
even-even nuclei 83	√	√	√
odd-A nuclei 82	X	33%	X

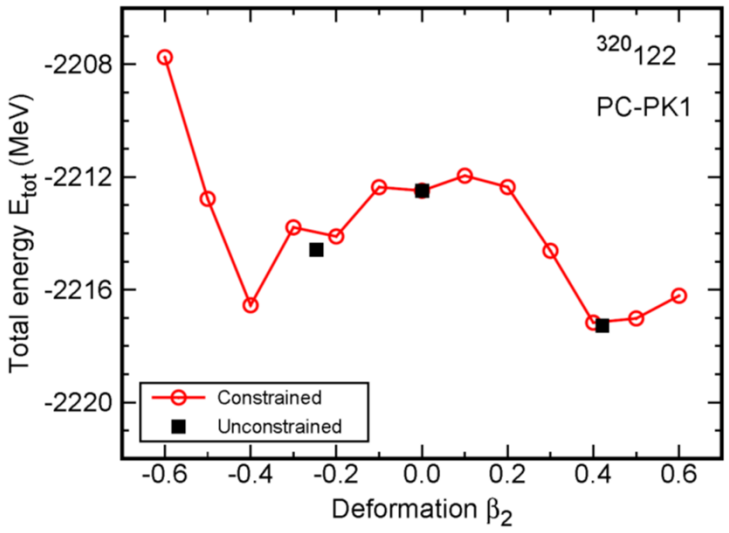
Unconstrained and Constrained Calculations

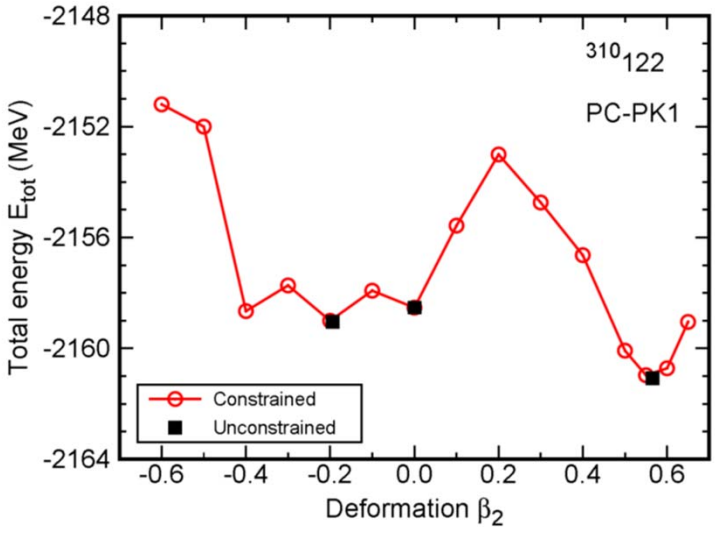
- ✓For the even-even nuclei, the unconstrained calculations are performed from initial deformations $\beta = -0.4, -0.2, 0.0, 0.2, 0.4, 0.6$.

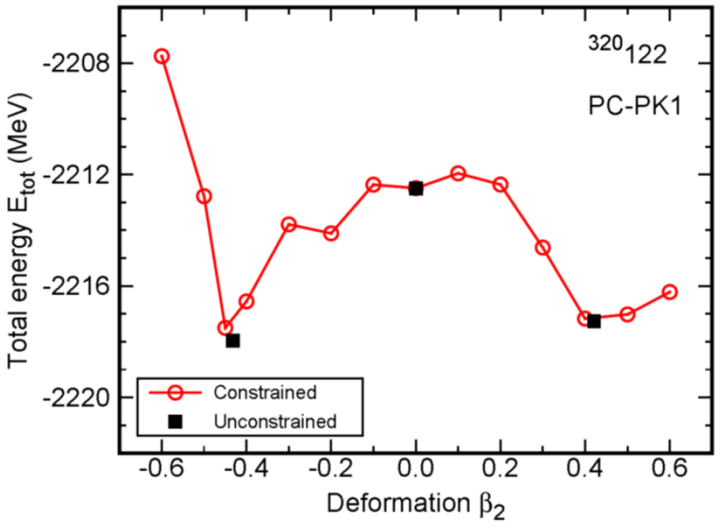
- ✓For all the nuclei, the constrained calculations are performed with $\beta = -0.6, -0.5, -0.4, -0.3, -0.2, -0.1, 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6$.

- ✓If necessary, additional unconstrained and constrained calculations are performed.


^{310}122
PC-PK1
Total energy E_{tot} (MeV)
Deformation β_2
Constrained
Unconstrained


^{320}122
PC-PK1
Total energy E_{tot} (MeV)
Deformation β_2
Constrained
Unconstrained


^{310}122
PC-PK1
Total energy E_{tot} (MeV)
Deformation β_2
Constrained
Unconstrained


^{320}122
PC-PK1
Total energy E_{tot} (MeV)
Deformation β_2
Constrained
Unconstrained

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➢ Numerical details

- Box size: $R_{\mathrm{box}} = 20\ \mathrm{fm}$
- Mesh size: $\Delta r = 0.1\ \mathrm{fm}$
- Energy cutoff: $E_{\mathrm{cut}} = 300\ \mathrm{MeV}$
- Angular momentum cutoff: $J_{\mathrm{max}} = 23/2\ \hbar$
- Legendre expansion order: $\lambda_{\mathrm{max}} = 10\ (121 \leq Z \leq 136)$
- Relativistic density functional: PC-PK1
- Pairing strength: $-325.0\ \mathrm{MeV\ fm^3}$

Zhang, et al. (DRHBc Mass Table Collaboration), PRC 102, 024314 (2020)
58th Skype meeting of DRHBc mass table

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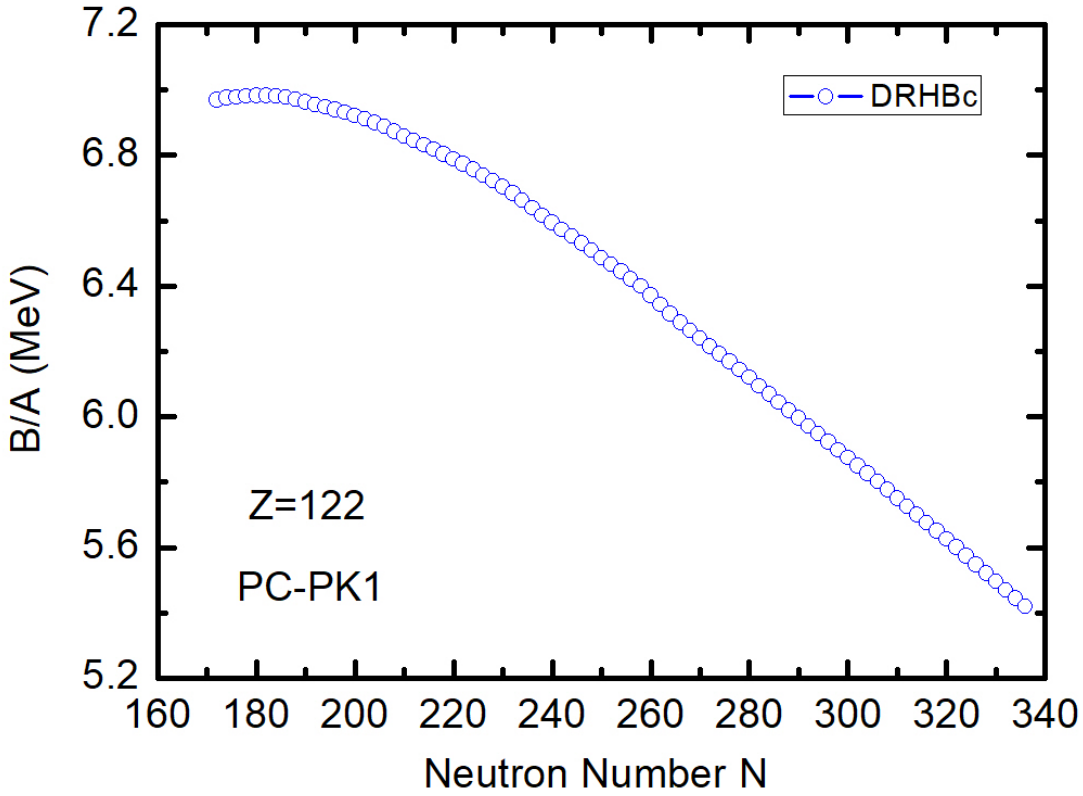
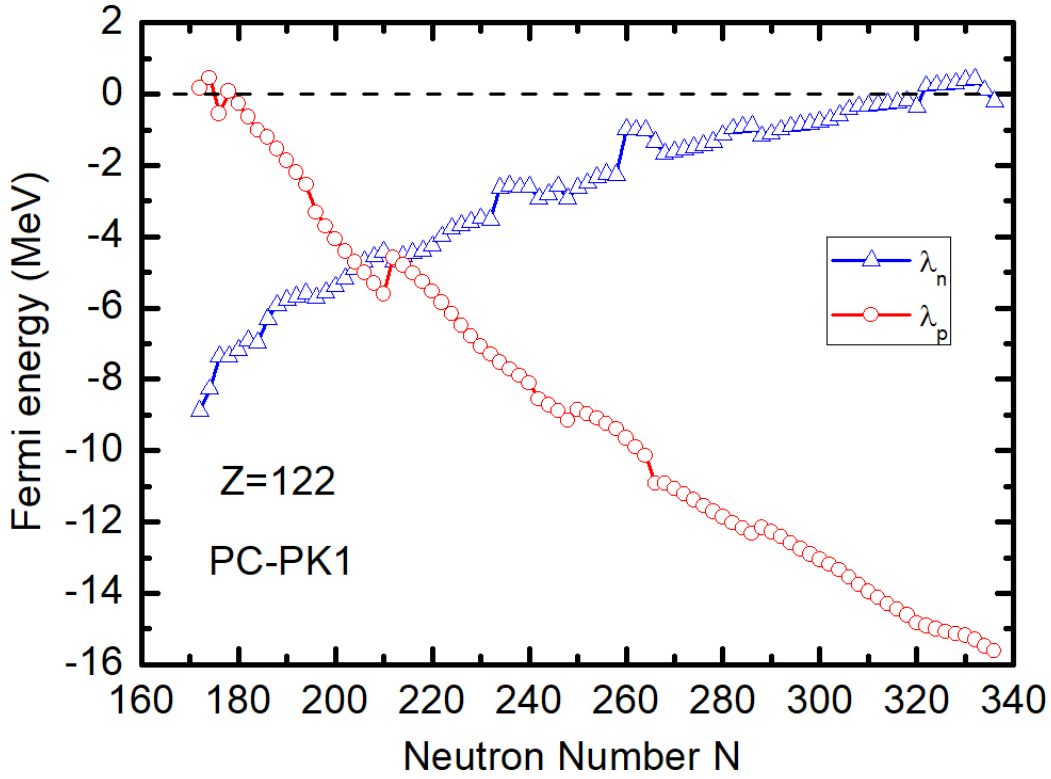
➢ Binding energy per nucleon



The largest B/A is the nucleus with N=182 (A=304)

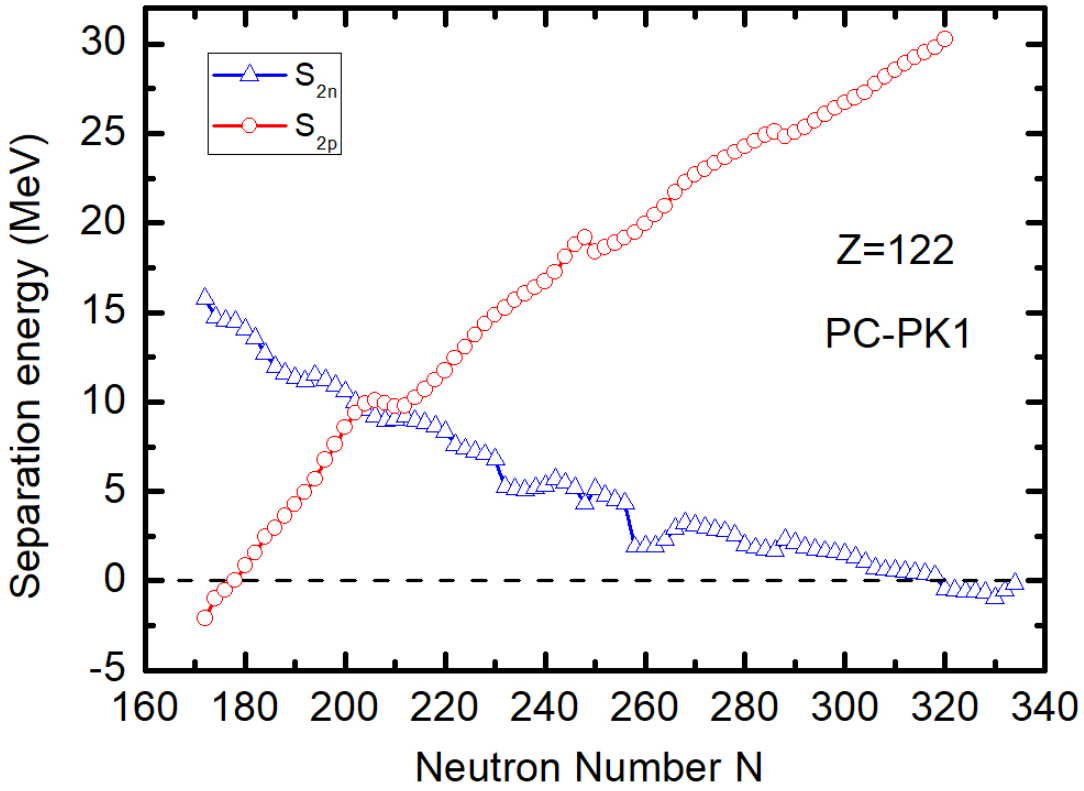
➢ Fermi energy



$\lambda_p > 0$: $N = 178$ $(A = 300)$,
$N \leq 174$ $(A \leq 296)$

$\lambda_n > 0$: $322 \leq N \leq 334$
$(444 \leq A \leq 456)$

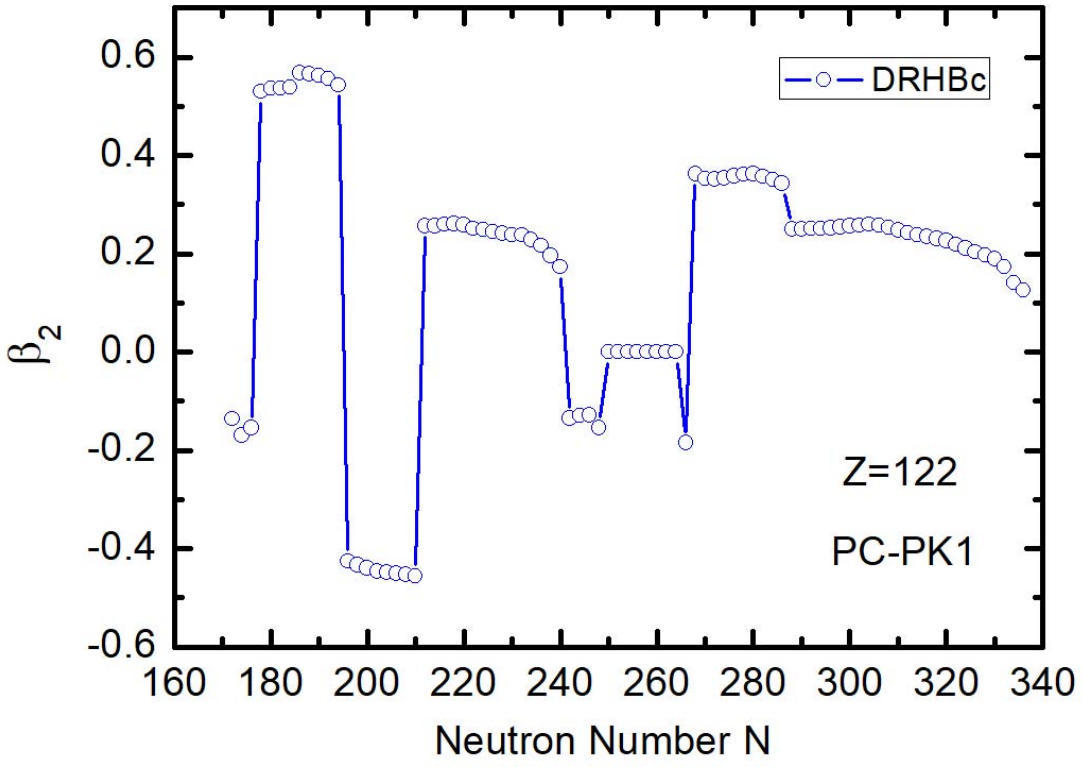
➢ Separation energy



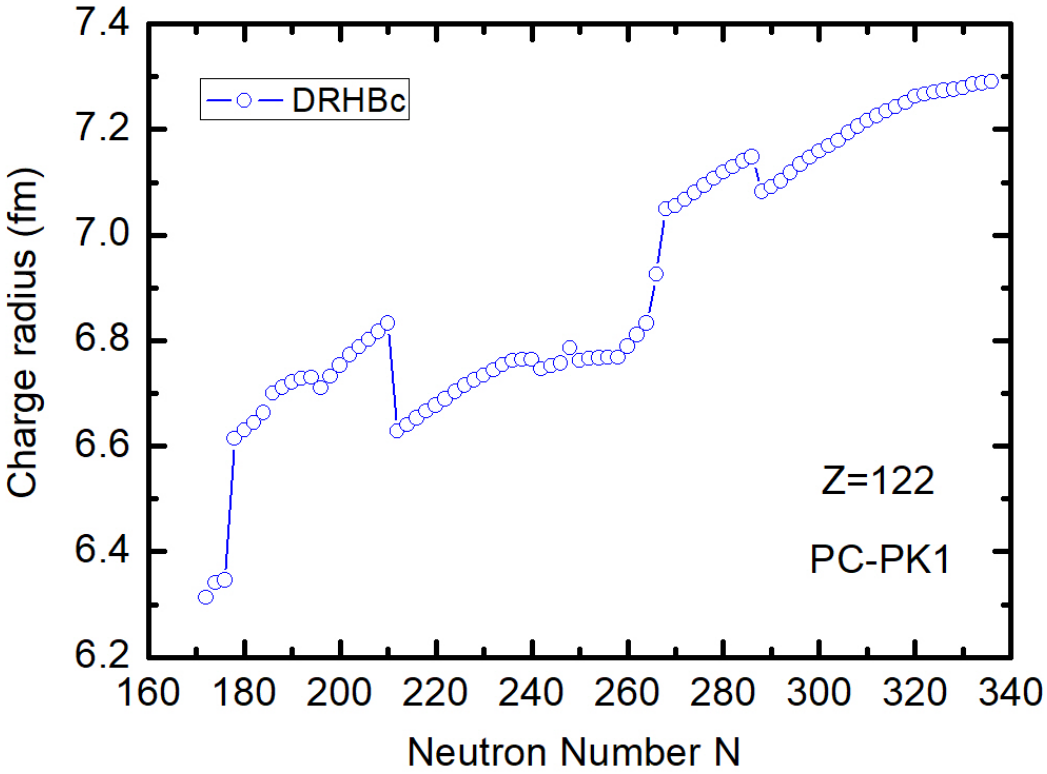
$S_{2p} < 0$: $N \leq 176$ $(A \leq 298)$

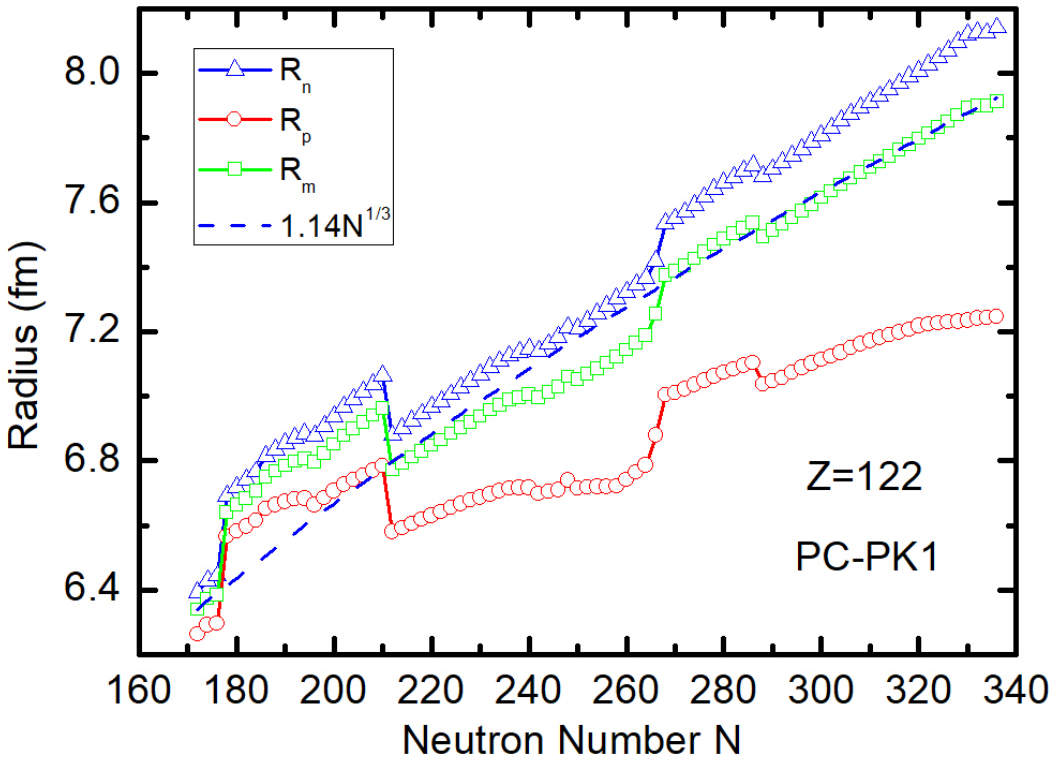
$S_{2n} < 0$: $N \geq 320$ $(A \geq 442)$

➢ Deformation

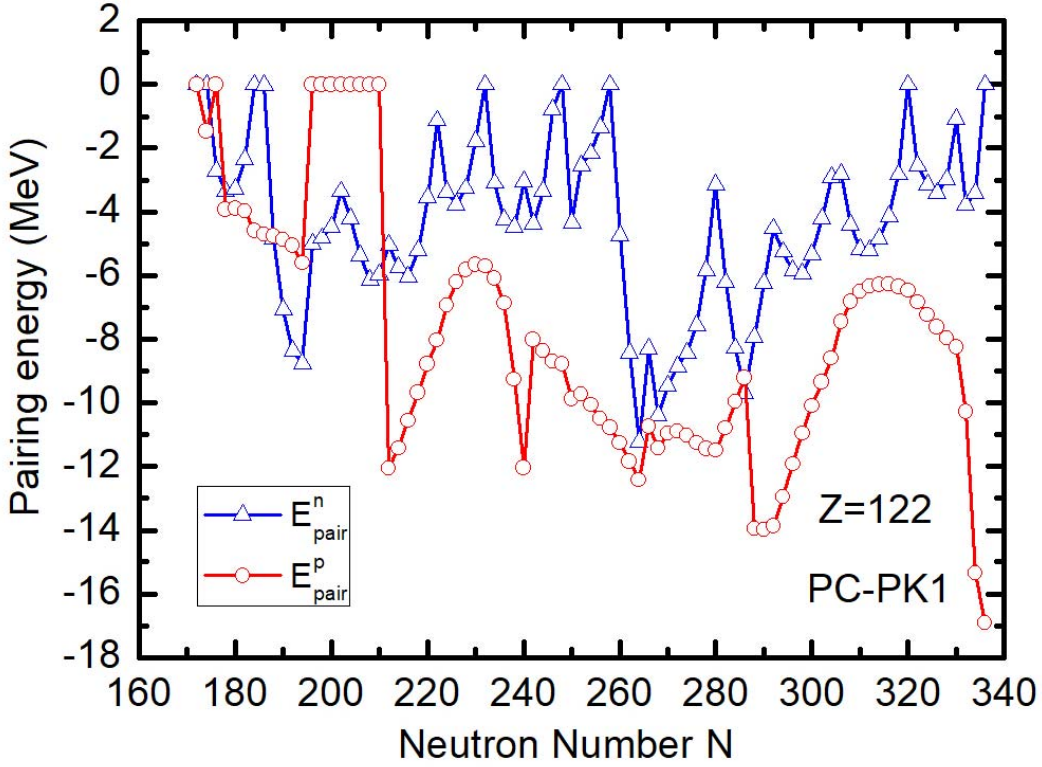


➢ Radius


DRHBc
Z=122
PC-PK1
Charge radius (fm)
Neutron Number N
7.4
7.2
7.0
6.8
6.6
6.4
6.2
160
180
200
220
240
260
280
300
320
340


R_n
R_p
R_m
1.14N^1/3
Z=122
PC-PK1
Radius (fm)
Neutron Number N
8.0
7.6
7.2
6.8
6.4
160
180
200
220
240
260
280
300
320
340

➢ Pairing energy



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➢ Summary and Next step

✓For the even-even nuclei of Z=122, both the constrained calculations and the unconstrained calculations have been finished.

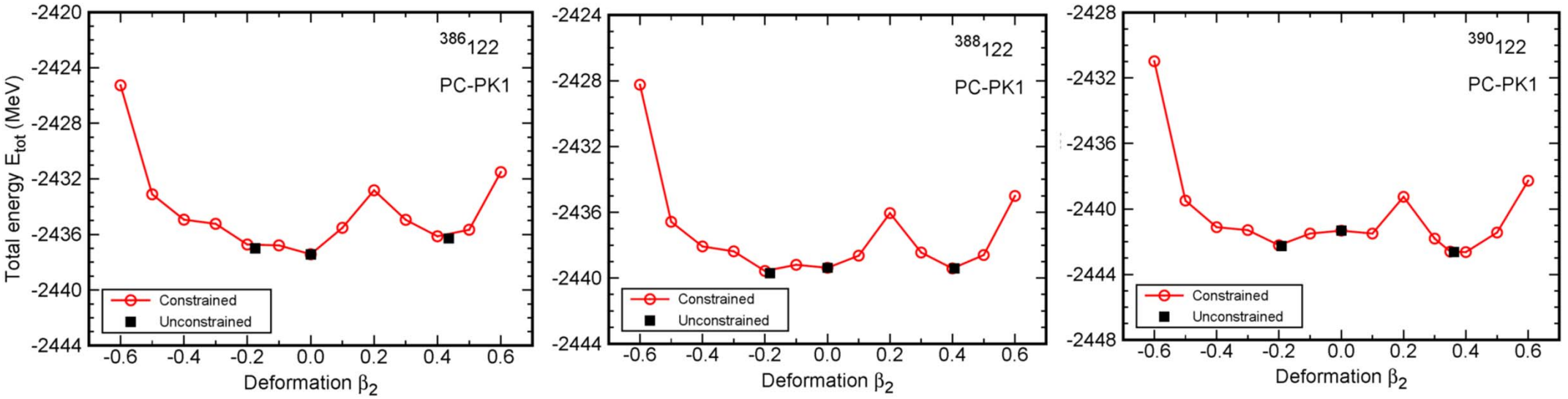
✓For the odd-A nuclei of Z=122, the constrained calculations have been finished about 33% with $N \leq 225$ ($A \leq 347$).

✓Check the results of even-even nuclei.

✓Finish the calculations for all odd-A nuclei by the end of this year.

Thank you !

Appendix



Spherical → oblate → prolate

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Progress report on Z=121

Jing Peng, Wen-Min Deng
Beijing Normal University, Beijing, China

➢Overall Progress

Z =121, N =169-323 （A =290-444）

	Unconstrained Cal.	Constrained Cal.	Data summary
odd-odd nuclei 78	√	12	X
odd-A nuclei 77	√	11	X

Unconstrained and Constrained Calculations

- ✓For all the nuclei, the unconstrained calculations are performed from initial deformations

$\beta = -0.4, -0.3, -0.2, -0.1, 0.0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6$.

- ✓For all the nuclei, the constrained calculations are performed with $\beta = -0.4, -0.35, -0.3, -0.25, -0.2, -0.15, -0.1, -0.05, 0.0, 0.05,$ $0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5, 0.55, 0.6$.

- ✓If necessary, additional unconstrained and constrained calculations are performed.