Appendix to: Energy Density Functional Approach to Superfluid Nuclei, nucl-th/0210047

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February 3, 2003

This report is not meant to be submitted for publication at the present time and it is simply a supplement to our work [1]. We have collected together all our results for one–nucleon and two–nucleon separation energies for several isotope and isotone chains and compare them to the values extracted from the 1995 Audi and Wapstra table of recommended masses [5]. Where it was possible we have compared our results to the results of Fayans *et al.* [3] and Goriely *et al.* [4]. We also present results for the charge radii and compare them to experiment and results of Goriely *et al.*

The entire formalism has been described in Ref. [1] and earlier references cited therein. Since the best agreement between our energy density functional for superfluid nuclei and experimental binding energies was obtained when we use for the normal part of this functional Fayans' FaNDF^0 and the bare pairing coupling constant $g = -200\ MeV\ fm^{-3}$, we limit the results presented here to this case only. For the experimental binding energies we have used the recommended values extracted from Ref. [5]. The results of Fayans *et al.* have been obtained by digitizing their published figures and for that reason inaccuracies are likely. The reader has to keep in mind also that Fayans *et al.* [3] did not use a universal pairing energy and have renormalized the strength of their interaction by a factor of 1.05 in case of tin isotopes and by a factor of 1.35 in case of calcium isotopes. Since these authors have also published results for one–nucleon separation energies without this renormalization of the pairing interaction, we have extracted the unrenormalized results in case of S_n for Ca isotopes. Fayans *et al.* [3] have performed calculations only for these three isotope chains. The results of Goriely *et al.* [4] have been extracted from their website. Goriely *et al.* [4] use separate pairing strengths for even proton, odd proton, even neutron and odd neutron systems. In all our calculations we use the same pairing strength for both proton and neutron systems and we did not change its value as a function of the atomic number. We have treated all nuclei as spherical. It is well known that many nickel isotopes are deformed, see e.g. Goriely *et al.* [4], and we suspect that some discrepancies between our predictions and experimental data can be ascribed to deformation. Since it is known that there is a significant amount of pairing among protons in zirconium isotopes [6], pairing has been allowed in both proton and neutron subsystems, but only with the couplings $g = g_0 + g_1 \neq 0$ and $g' = g_0 - g_1 \equiv 0$, see Ref. [1] for details. Note also that the heavier zirconium isotopes are also deformed according to Goriely *et al.*

In the last five figures we present the charge radii for Ca, Ni, Zr, Sn and Pb isotopes. For the proton charge radius we have used $r_p = 0.87\ fm$ according to Ref. [7]. Note that Goriely *et al.* use instead an older value of $r_p = 0.80\ fm$. The experimental values for the nuclear charge radii are from Nadjakov *et al.* [8] and were very kindly provided to us by J. Michael Pearson, to whom we are very thankful. In our self–consistent calculations the protons were treated as point particles when evaluating the nuclear Coulomb energy. Fayans made a strong point in private discussions with us for using the charge distribution with the finite formfactors for both protons and neutrons. A finite proton size leads to a smaller Coulomb energy and a less repulsive Coulomb potential for protons, which thus leads to slightly larger charge radii and very likely to a better overall agreement with experiment in our case. We have also neglected the Coulomb exchange and correlation energies and a possible charge symmetry contribution to the total energy as well, see Refs. [1,3] for additional references and discussions of these terms. Except for the cases when deformation is likely to affect significantly the values of the charge radii, the agreement between our theoretical predictions and experiment is about of the same quality as in case of Goriely *el.* All together we present results for 212 nuclei.

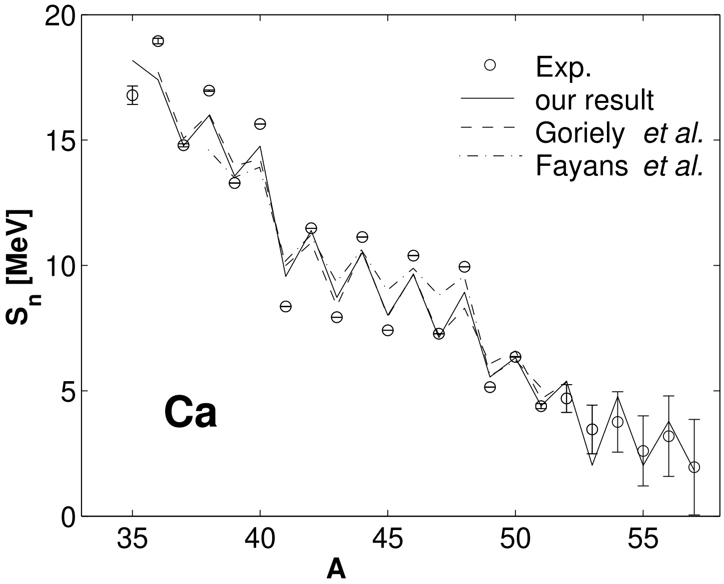

FIG. 1. One–neutron separation energies for calcium isotopes. The results of Fayans *et al.* presented here are for unrenormalized pairing strength.

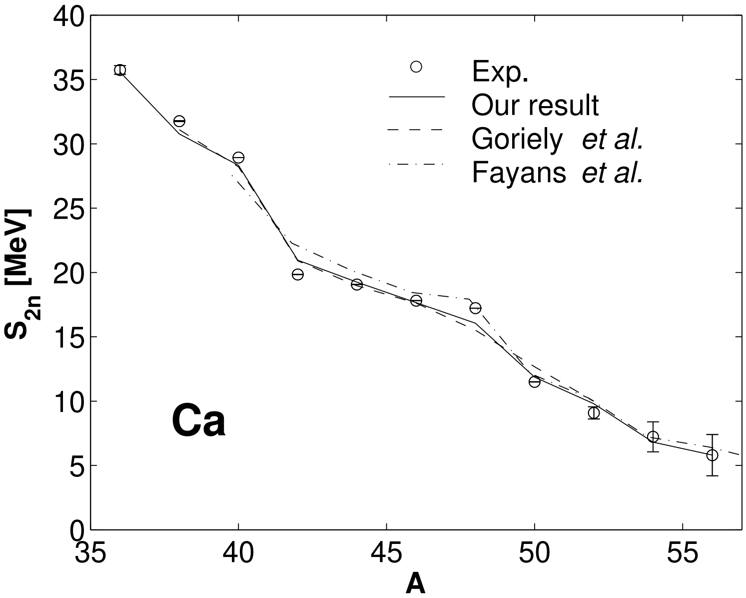

FIG. 2. Two–neutron separation energies for calcium isotopes. The results of Fayans *et al.* presented here are for a renormalized pairing strength with a factor of 1.35.

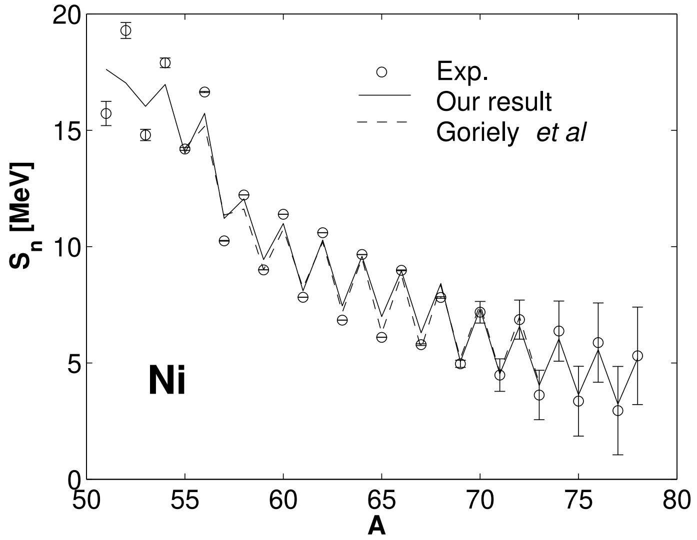

FIG. 3. One–neutron separation energies for nickel isotopes. Note that many nickel isotopes are deformed and we have treated them as spherical.

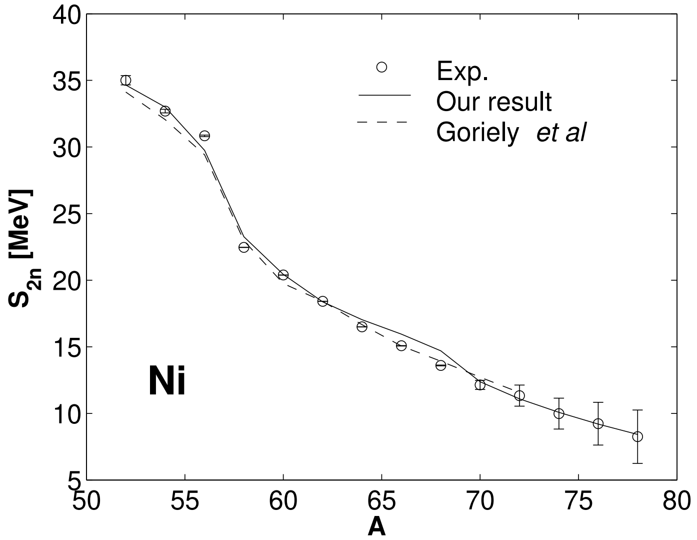

FIG. 4. Two–neutron separation energies for nickel isotopes. Note that many nickel isotopes are deformed and we have treated them as spherical.

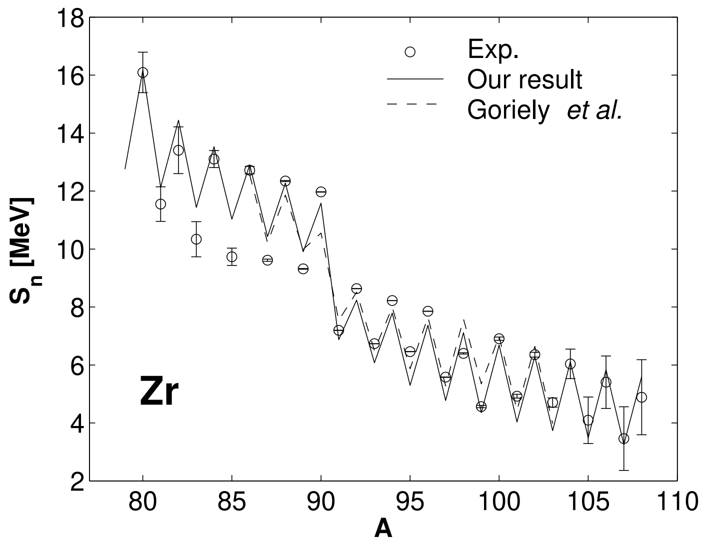

FIG. 5. One–neutron separation energies for zirconium isotopes. Some zirconium isotopes are deformed according to Goriely *et al.*

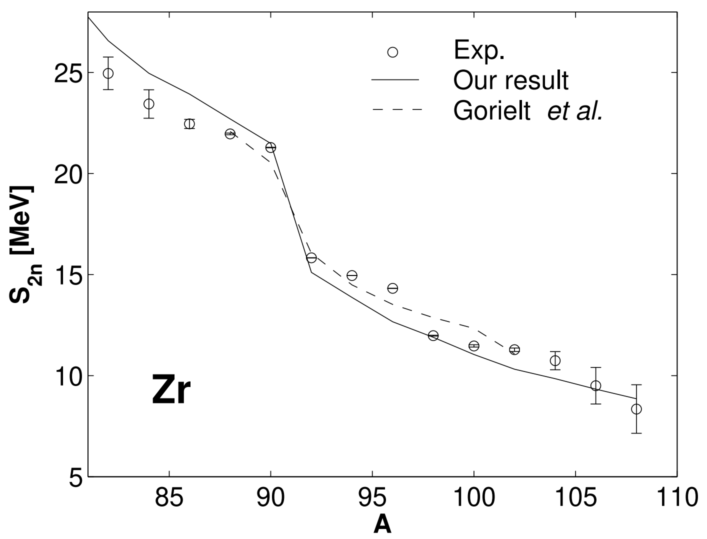

FIG. 6. Two–neutron separation energies for zirconium isotopes. Some zirconium isotopes are deformed according to Goriely *et al.*

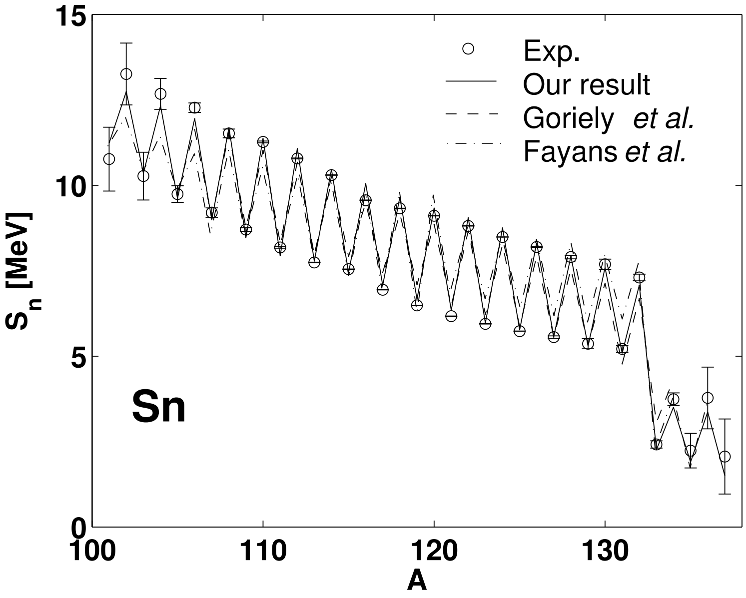

FIG. 7. One–neutron separation energies for tin isotopes.The results of Fayans *et al.* presented here are for a renormalized pairing strength with a factor of 1.05.

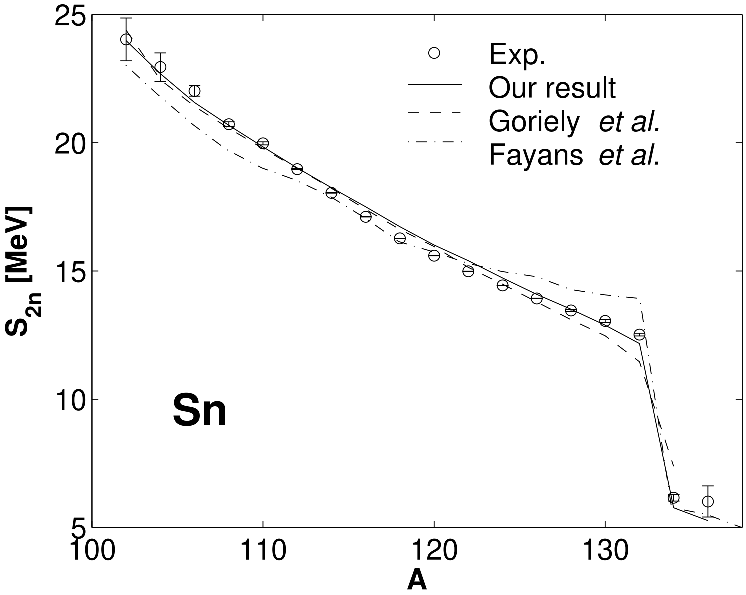

FIG. 8. Two–neutron separation energies for tin isotopes. The results of Fayans *et al.* presented here are for a renormalized pairing strength with a factor of 1.05.

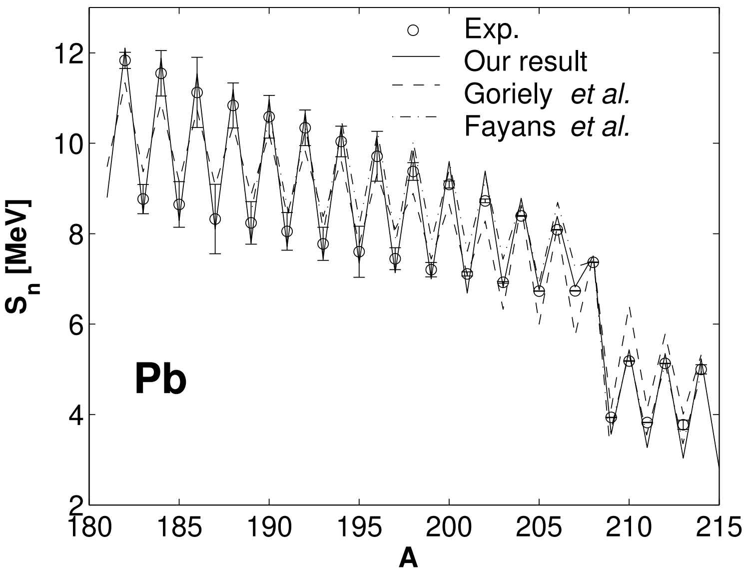

FIG. 9. One–neutron separation energies for lead isotopes.

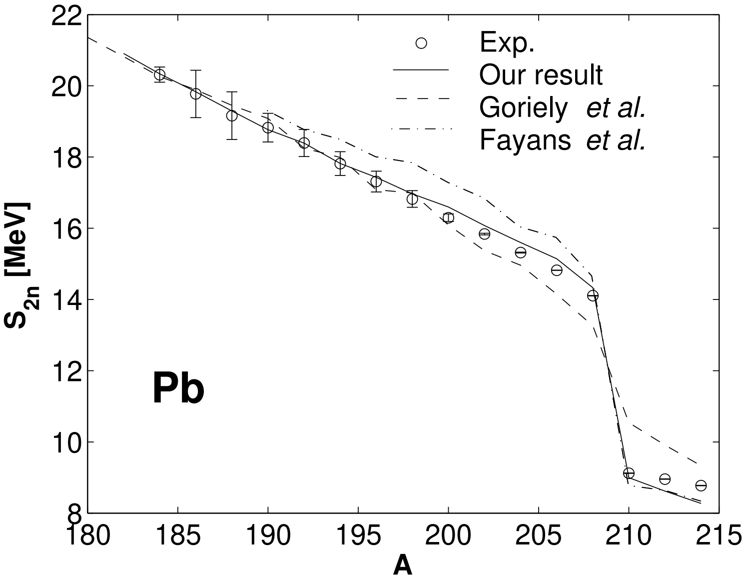

FIG. 10. Two–neutron separation energies for lead isotopes.

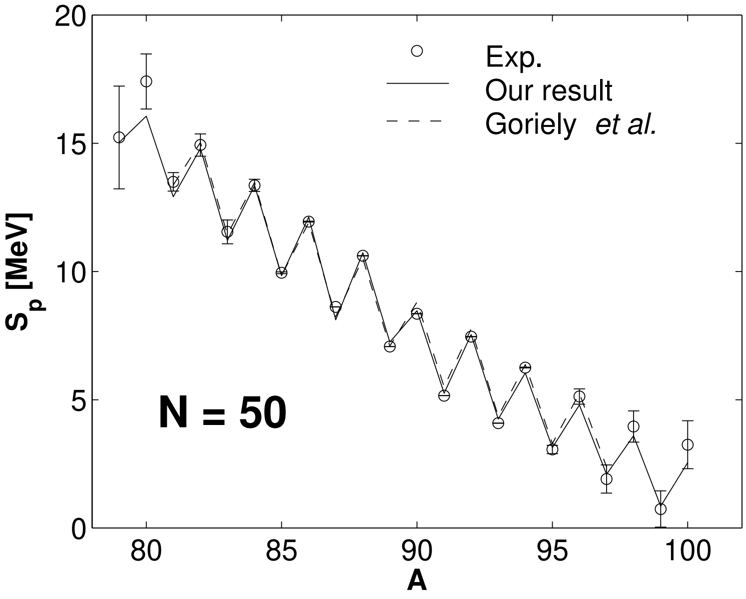

FIG. 11. One–protron separation energies for $N = 50$ isotones.

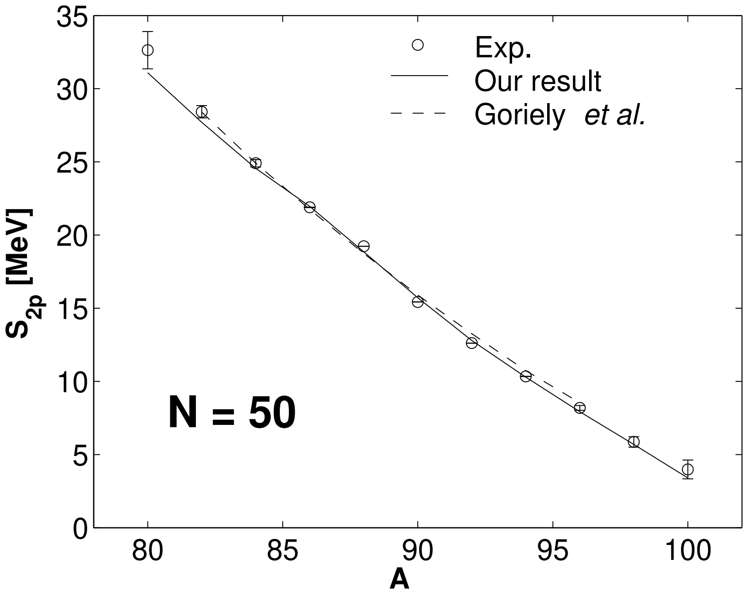

FIG. 12. Two–protron separation energies for $N = 50$ isotones.

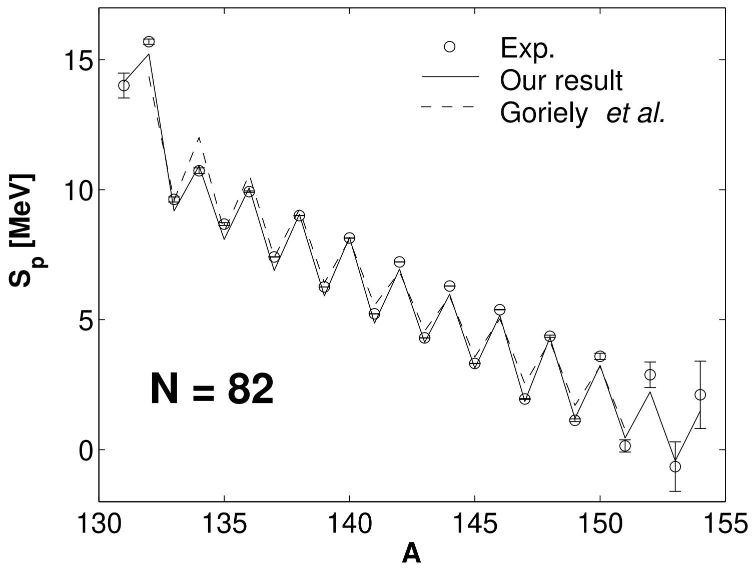

FIG. 13. One–protron separation energies for $N = 82$ isotones.

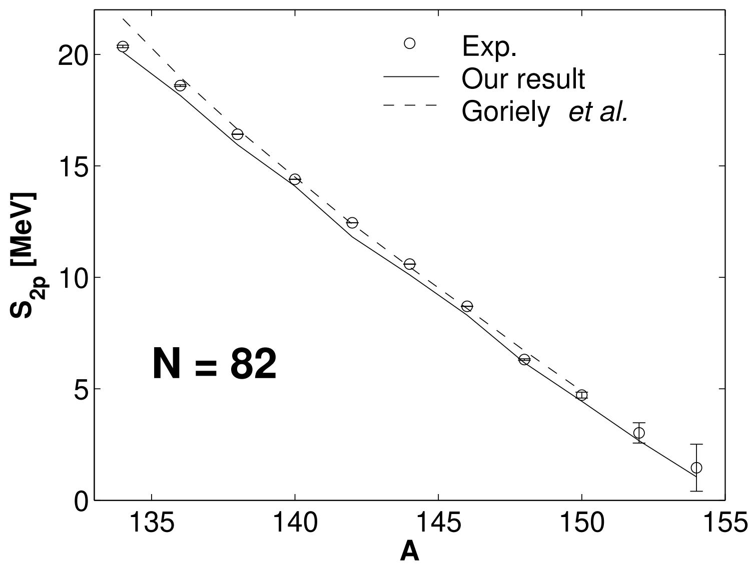

FIG. 14. Two–protron separation energies for $N = 82$ isotones.

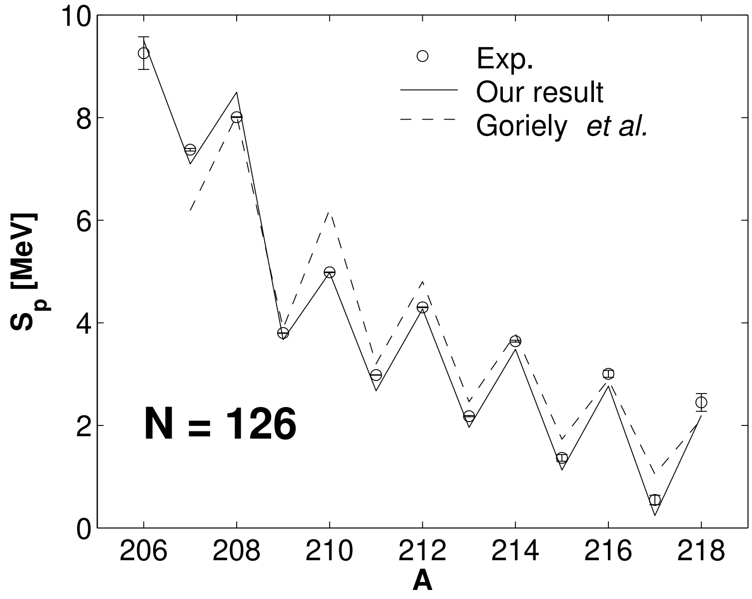

FIG. 15. One–protron separation energies for $N = 126$ isotones.

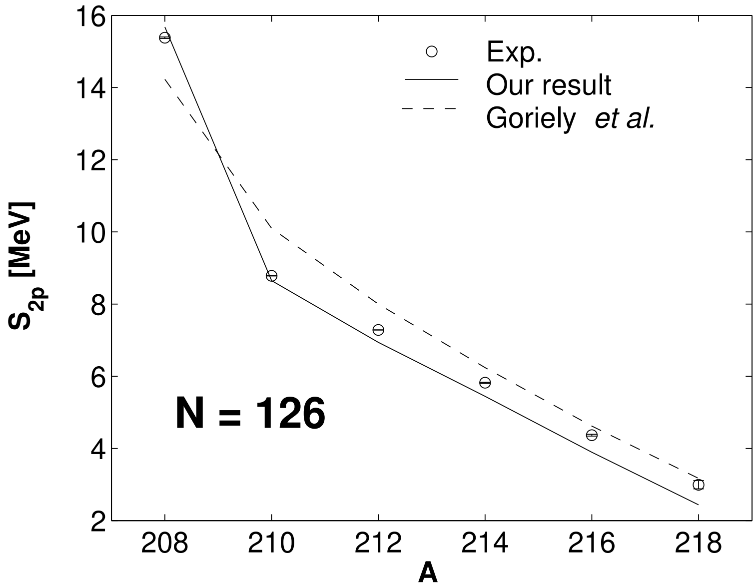

FIG. 16. Two–protron separation energies for $N = 126$ isotones.

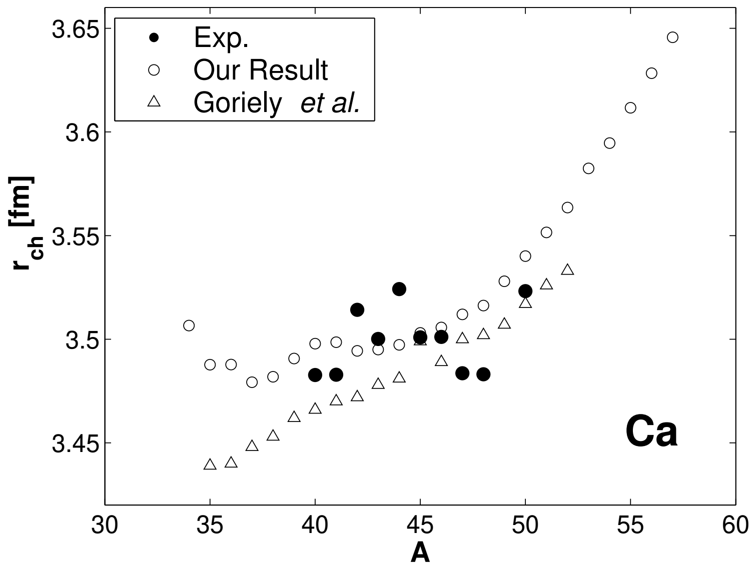

FIG. 17. Charge radii for calcium isotopes, our results (open circles), Goriely *et al.* (open triangles) and experimental values from Nadjakov *al et al.* (bullets).

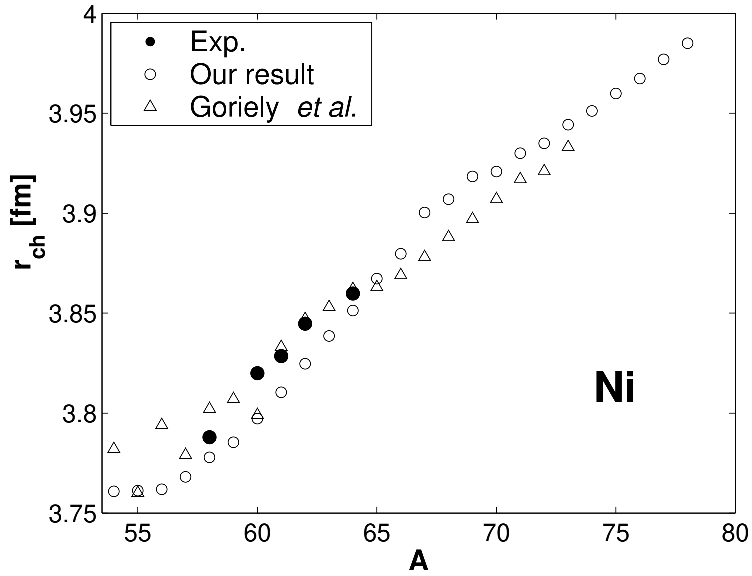

FIG. 18. Charge radii for nickel isotopes, our results (open circles), Goriely *et al.* (open triangles) and experimental values from Nadjakov *al et al.* (bullets).

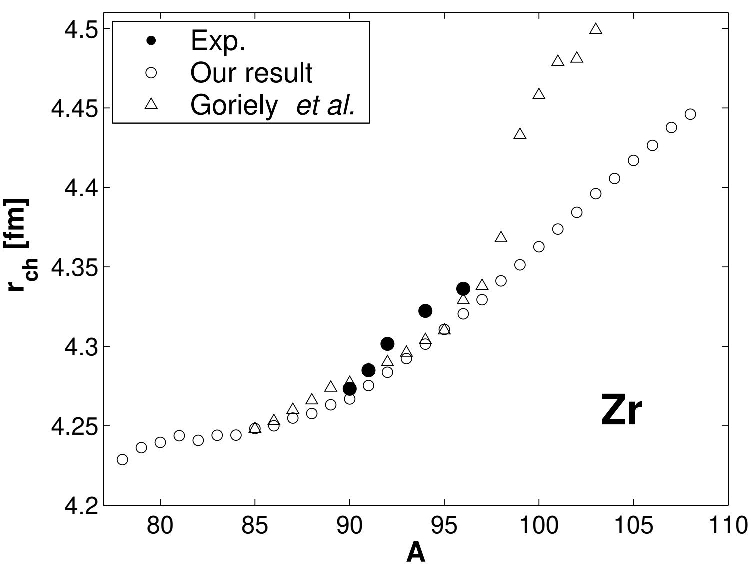

FIG. 19. Charge radii for zirconium isotopes, our results (open circles), Goriely *et al.* (open triangles) and experimental values from Nadjakov *al et al.* (bullets).

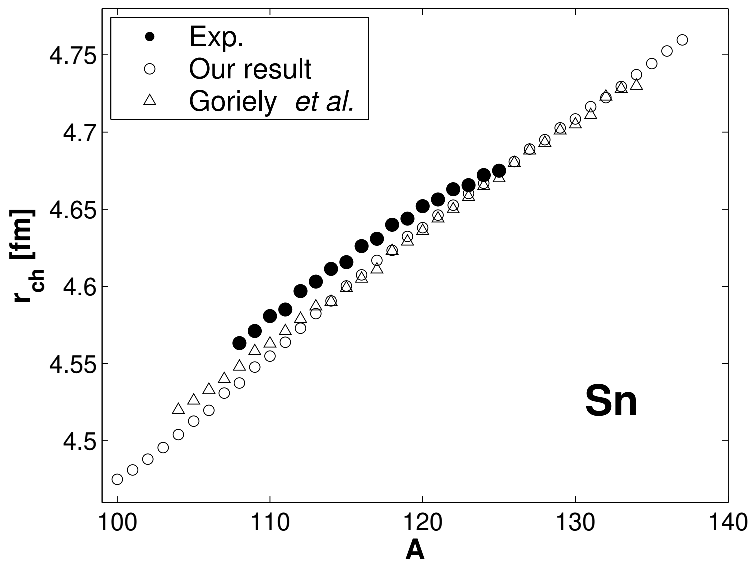

FIG. 20. Charge radii for tin isotopes, our results (open circles), Goriely *et al.* (open triangles) and experimental values from Nadjakov *al et al.* (bullets).

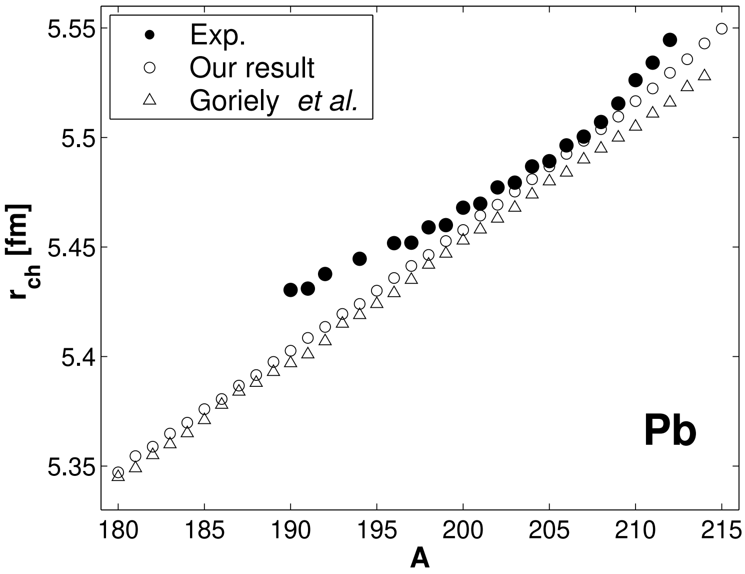

FIG. 21. Charge radii for lead isotopes, our results (open circles), Goriely *et al.* (open triangles) and experimental values from Nadjakov *al et al.* (bullets).

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