Comparison of calculated average gaps to BCS

G.F. Bertsch

There has recently been published a global study of pairing gaps with calculations based on mean field theory and with the pairing treated with a contact interaction in the HFB (or BCS) approximation [1] The calculation were performed for several interaction strengths to make a rough fit of the empirical gaps. The calculated average gaps are shown by squares and circles in Fig. 1. For reference, the empirical gaps are 1.04 MeV and 0.96 MeV for neutrons and protons, respectively.

Here I want to compare to the simple BCS formula for the gap, as given for example by Ref. [2],

$$\Delta_{BCS} = (E_{max} - E_{min}) e^{-1/g} \tag{1}$$

In this formula, the prefactor gives the energy window within which the pairing interaction is nonzero. The parameter g is the product of average pairing matrix element and single-particle density of states. For my purposes here, the important point is that g depends linearly on the strength of the interaction. In ref. [1], the cutoffs for the HFB calculation were taken to be $E_{max} \approx 60$ MeV and $E_{min} \approx -40$ MeV. Fitting the formula to the average gap at $V_0^{\rm std}$, ones find $g \approx 0.19$ at that point. The variation of gap with g values scaled by the point at $V_0^{\rm std}$ is shown by the dashed curve in Fig. 1. One sees that the gap is a very strong function of the pairing strength and that BCS formula describes the variation rather well.

[1] G.F. Bertsch, C.A. Bertulani, W. Nazarewicz, N. Schunck, and M.V. Stoitsov, Phys. Rev. C 79 034306 (2009).

[2] A. Bohr, B.R. Mottelson, and D. Pines, Phys. Rev. **110**, 936, (1958).

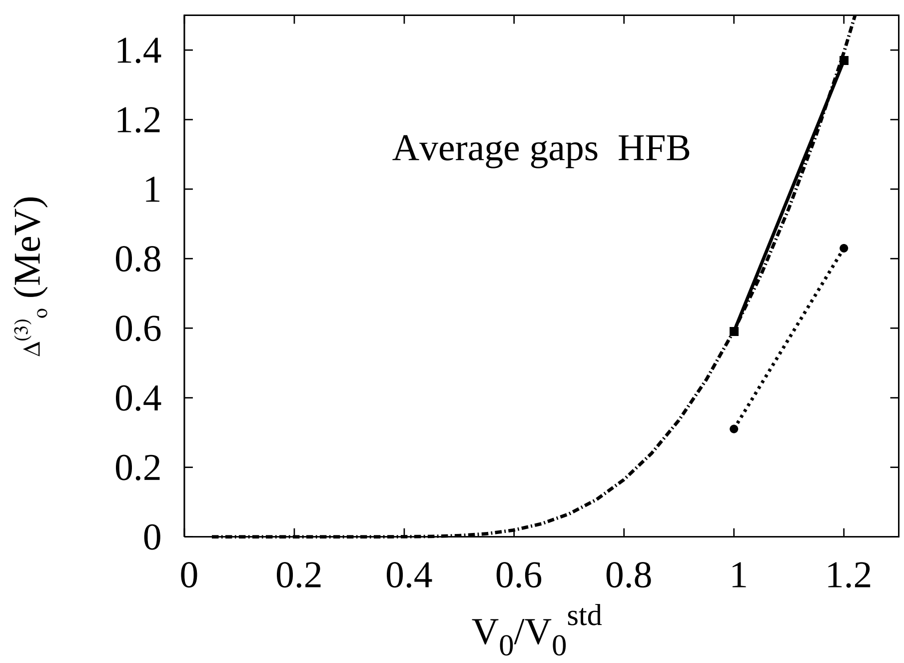

FIG. 1: Calculated average gaps for the present data sets. Squares: neutron gap; circles: proton gap. Dot-dashed curve shows the dependence on strength according to eq. 1.