## Comment on "Neutron-Proton Spin-Correlation Parameter $A_{zz}$ at 68 MeV"

In a recent Letter [1], a group at the University of Basel reported a measurement of the spin correlation parameter $A_{zz}$ in neutron-proton scattering at 67.5 MeV. They also presented results from a phase shift analysis in which these new data play a crucial role, particularly for the ${}^3S_1$-${}^3D_1$ mixing parameter $\epsilon_1$, for which they obtain the (rather large) value of 2.9° ± 0.3° at 50 MeV. It is the purpose of this Comment to point out that this large value for $\epsilon_1$ at 50 MeV may be incorrect. We present essentially two arguments.

*First, there are nucleon-nucleon (NN) potentials which predict $\epsilon_1$ at 50 MeV substantially below the Basel value and reproduce the Basel $A_{zz}$ data accurately.* In Fig. 1 we compare the Basel $A_{zz}$ data with the predictions by the Reid [2] (2.36°), Nijmegen [3] (2.27°), Paris [4] (1.89°), and Bonn A [5] (1.55°) potential (with the predictions for $\epsilon_1$ at 50 MeV in parentheses), which fit the data with a $\chi^2$/datum of 116.7, 47.7, 1.55, and 1.72, respectively. In contrast to the Basel claim, *the models with a small $\epsilon_1$, namely, Paris and Bonn A, fit the $A_{zz}$ data best.* $A_{zz}$ is also sensitive to the ${}^1P_1$ phase shift which at 50 MeV is predicted to be −10.95° and −11.05° by Paris and Bonn A, respectively; the Basel group uses −9.4°. The ${}^1P_1$ phase shift is essentially determined by *np* differential cross section data at backward angles. The most recent and very accurate *np* $d\sigma/d\Omega$ backward angle data at 50 MeV taken by the Karlsruhe group [6] are reproduced with a $\chi^2$/datum of 0.2 and 0.8 by Paris and Bonn A, respectively (Nijmegen: 1.2; Reid: 8.7). Finally, $A_{yy}$ must be considered, since for $A_{yy}$ the correlation between $\epsilon_1$ and ${}^1P_1$ is of opposite sign as compared to $A_{zz}$. Paris and Bonn A fit the world data on $A_{yy}$ at 50 MeV quite satisfatorily with a $\chi^2$/datum of 1.37 and 1.27, respectively. The world data on all *np* observables at 50 MeV are reproduced with a $\chi^2$/datum of 1.6 by Paris and 1.4 by Bonn A. This is of the same quality as the VPI phase shift analysis [7].

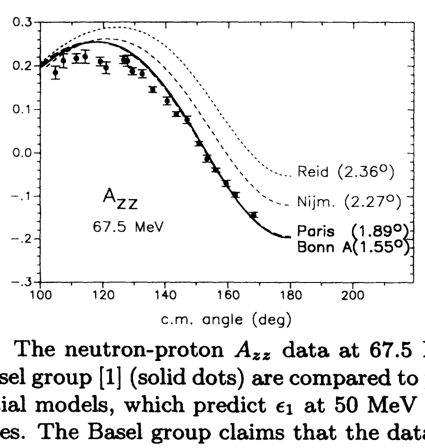


FIG. 1. The neutron-proton $A_{zz}$ data at 67.5 MeV taken by the Basel group [1] (solid dots) are compared to predictions by potential models, which predict $\epsilon_1$ at 50 MeV as given in parentheses. The Basel group claims that the data displayed in this figure imply 2.9° ± 0.3° for $\epsilon_1$ at 50 MeV. [Bonn A: solid line; Paris: long dashes.]

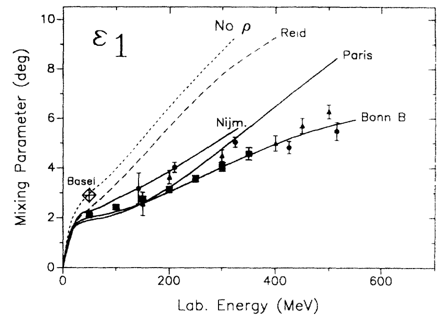


FIG. 2. Phase shift analysis results (triangles, Ref. [7]; dots, Ref. [8]; squares, Ref. [9]) and potential model predictions for the $\epsilon_1$ mixing parameter as discussed in the text. The crossed diamond denotes the value claimed by the Basel group.

*Second*, we have investigated the question whether there is any theoretical model that can explain the large value for $\epsilon_1$ at 50 MeV proposed by the Basel group. Our result is that only a meson-exchange model which contains no $\rho$ meson and uses an essentially pointlike $\pi NN$ vertex (cutoff mass 10 GeV) can reproduce the Basel value. Note, however, that the predictions by such a model for the deuteron and for most phase parameters (particularly, ${}^1P_1$ and ${}^3P_J$) are totally wrong; thus, it is a very unrealistic model. Moreover, even the $\epsilon_1$, in the energy range where it is well determined (150–500 MeV), is overpredicted by a factor of 2 by this model (see Fig. 2, dotted line "No $\rho$"). In contrast to the situation below 100 MeV, recent phase shift analyses [7–9] agree very well in their determinations of the $\epsilon_1$ in the energy range 150–500 MeV (cf. Fig. 2). Realistic $NN$ potentials which reproduce this well-determined part of $\epsilon_1$ correctly (solid lines in Fig. 2) predict $\epsilon_1$ at 50 MeV substantially below the Basel point.

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