DIRECT RECONSTRUCTION OF THE N-N SCATTERING MATRIX IN THE ISOSPIN STATE T = 1 PLUS T = 0 AT 90° c.m., BETWEEN 310 MeV AND 670 MeV

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For an isospin state T = 0 or T = 1, if one takes into account the invariance with respect to space rotation, space reflection and time reversal, the N-N scattering matrix can be expressed in the following form[1])

$$M = B.S.+C(\sigma_1+\sigma_2)\vec{N}+N(\sigma_1\vec{N}\sigma_2\vec{N})T + \frac{1}{2}\,G(\sigma_1\vec{K}\sigma_2\vec{K}+\sigma_1\vec{P}\sigma_2\vec{P})T + \frac{1}{2}\,H(\sigma_1\vec{K}\sigma_2\vec{K}-\sigma_1\vec{P}\sigma_2\vec{P})$$

where $\vec{N}$, $\vec{K}$, $\vec{P}$ are unit vectors in the directions (p∧p'), (p'-p) and (p'+p), respectively, p' and p are outgoing and incident momenta in the c.m. system, S and T are singlet and triplet projection operators, and σ_1 and σ_2 are Pauli matrices of the incident and target nucleons. This form of the scattering matrix has the advantage to separate at 90° c.m. the amplitudes of the isospin T = 0 and T = 1.

For each isospin state T = 0 or T = 1, B, C, N, G and H are five complex functions of the nucleon energy and scattering angle. The exchange of two nucleons must leave the scattering matrix unchanged, so at 90° c.m. some amplitudes are equivalent to zero and the number of real quantities to be determined is smaller. Thus we have for the isospin state T = 1, N(90° c.m.) = G(90° c.m.) = 0, and for the isospin state T = 0, B(90° c.m.) = C(90° c.m.) = H(90° c.m.) = 0. At this angle, it is enough to determine five real quantities in the isospin state T = 1 (pp system) and nine real quantities in the isospin state T = 1 and T = 0 (np system) with an arbitrary phase.

To have a minimum of nine independent measurements in each case[2)], we occasionally had to do some extrapolations for one or two experimental quantities. Thus, at 310 MeV, the angular distributions of parameters D and R, measured up to 80° c.m., have been continued to 90° c.m. as well as the measurements of the R parameter at 670 MeV have been interpolated to 90° c.m. The measurement of the A parameter have been used at 600 MeV and 635 MeV.

The experimental data have been taken from ref. 3. As the overall phase cannot be determined, the amplitude C is set to be real and positive. For the calculation, the least square method, χ^2 criterion and relativist formulae were used.

The results presented here are only at 90° c.m.,for the isospin state T = 1 and T = 0 at 310, 430, 520 and 600 MeV, and for the isospin state T = 1 at 635 and 670 MeV. In figs. 1 to 5 a comparison with the up-to-date phase shift analysis[4)] is given. To compare the results, the phase C is set equal to the phase C of the phase shift analysis. The different solutions are in good agreement except at 520 MeV for the phase of the amplitude B, but some ambiguities still remain due to the lack of measured quantities.

References

* Centre National de la Recherche Scientifique.

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2) C.R. Schumacher and H.A. Bethe, Phys. Rev. 124 (1961) 1934.
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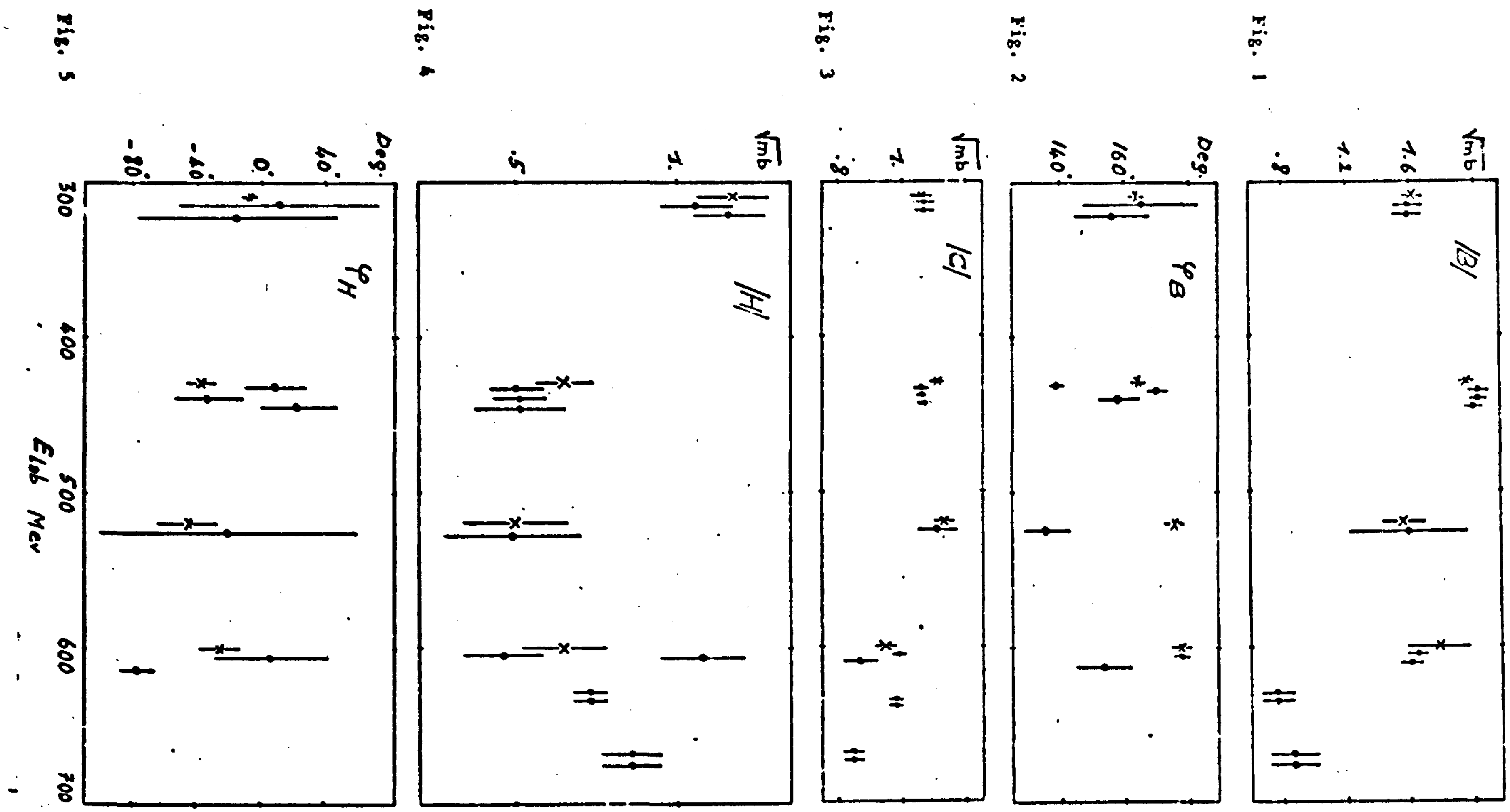

Fig.1-5. The phases φ_B and φ_H are relative to C.
Direct reconstruction ⧫ . Phase shift analysis ✱