15. 7. 64 EEC A

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

NOT TO BE CIRCULATED

15 July, 1964

ONLY FOR EEC

PROPOSAL FOR AN EXTENSION OF THE S26 EXPERIMENT:

"STUDY OF THE CONJECTURED 2800 MeV NUCLEON ISOBAR THROUGH THE REACTIONS $\pi^- p \to \pi^0 n$ and $\pi^- p \to \eta n$"

Falk-Vairant Group

Saclay

* * *

This is a modification of the low-energy experiment contained in our proposal of 25 March, 1963.

There are some indications of a new $T = \frac{1}{2}$ nucleon isobar of mass 2700 or 2800 MeV.

1. In a photoproduction experiment R. Alvarez et al.[1] have found, at 3.5 GeV, a bump in the reaction

$$\gamma + p \to \eta + p$$

and some much smaller structure in

$$\gamma + p \to \begin{cases} \pi^+ n \\ \pi^0 p \end{cases}$$

(Fig.1). From the measured $\eta : \pi^+ : \pi^0$ branching ratio they conclude that this bump could be due to the production of a member of a (27) representation of SU_3, with $T = \frac{1}{2}$. In the same experiment they find an indication of a $T = \frac{3}{2}$ isobar of mass 2500 MeV.

2. Independently G. Höhler et al.[2] have pointed out that the difference of the total $\pi^{\pm} p$ cross-sections measured by A.N. Diddens et al.[3] shows a $T = \frac{1}{2}$ bump at the corresponding energy (Fig.2).

3. A bump also shows up in the study of forward $\pi^- p$ charge exchange by M. Wahlig et al.[4], at a slightly different energy, due presumably to interference of the resonant amplitude with the non-resonant background, and with the lower lying resonances (Fig. 3). The geometry of this experiment did not allow a measurement of the ηn final state.

PURPOSE

We propose to study the reactions $\pi^- p \to \eta n$ ($\eta \to 2\gamma$) and $\pi^- p \to \pi^0 n$ in the region 2.5 GeV/c $\leq P_{\pi^-} \leq$ 4 GeV/c in steps of 200 MeV/c and with statistics of the order of 4000 $\pi^0 n$ events and 1000 ηn events at each momentum. The purpose is to look for a bump in the ηn cross-section integrated over a given solid angle, and for rapid changes in the shape of the π^0 and η angular distribution in the same region.

Furthermore, we propose to extend this study to the region from 4 to 6 GeV/c where the variation with energy of the cross-sections has not yet been studied. The analysis might include the $\pi^- p \to \omega n$ ($\omega \to \pi^0 \gamma$) reaction.

EXPERIMENTAL METHOD

The experimental apparatus will be the same as the one which is working satisfactorily in the d_{16} beam in a study of high-energy $\pi^- p$ charge exchange. The H_2 target will be 7.5 cm long, at a distance of 60 cm from the γ-detecting spark chamber.

ηn and $\pi^0 n$ events can be clearly distinguished by using the $\gamma\gamma$ opening angle and the γ-energy information.

The angular distribution of both $\pi^0 n$ and ηn can be measured up to 60° c.m. angle $[\Delta^2 \simeq 1\ (\text{GeV/c})^2]$. The c.m. angular resolution is ± 2° for π^0 and ± 8° for η.

The pictures will contain events involving more than two γ's and might allow a study of other neutral reactions (e.g., $\pi^- p \to \omega n$, $\pi^- p \to f^0 n$).

BEAM AND MACHINE TIME

After discussions with Drs. Munday and Geibel, it is felt that the most sensible solution is to use the actual d_{16} beam in its "6 GeV/c" version. The PS maximum field will then have to vary proportionally to the desired beam momentum, between 8 and 15 GeV/c. The tests can be performed at any PS energy.

With one burst per second, and at a rate of three pictures per burst, the measurements should take five hours per momentum:

1 hour for changing the PS energy and beam tuning;

3 hours for taking pictures;

1 hour either for target empty pictures and study of the beam contamination (3 points in 10) or as reserve time.

Therefore, we request 48 hours with control of the PS energy, for the experiment up to 4 GeV/c (8 to 10 different momenta). Another 36 hours would be required to extend the experiment up to 6 GeV/c (7 momenta). No extra testing time is needed if the experiment can be done before the end of August 1964.

REFERENCES

1) R. Alvarez et al., Phys.Rev.Letters 12, 710 (1964).
2) G. Höhler et al., Preprint, Karlsruhe, June 1964.
3) A.N. Diddens et al., Phys.Rev.Letters 10, 262 (1963).
4) M. Wahlig et al., Preprint, MIT, 1964.

9228/p/ im

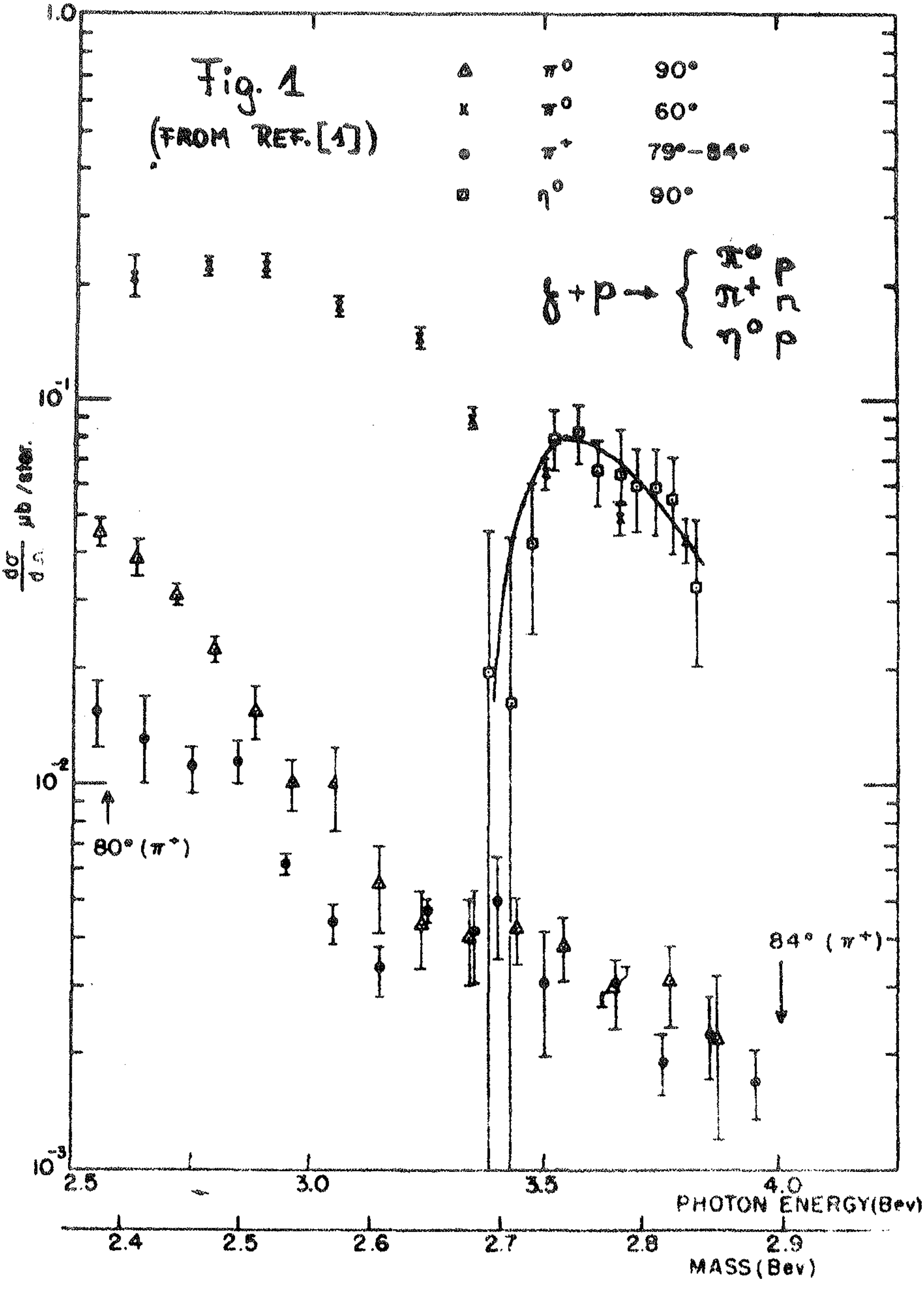

Fig. 1
(FROM REF. [1])
π° 90°
π° 60°
π+ 79°-84°
η° 90°
γ + p → { π° p, π+ n, η° p }
dσ/dΩ μb/ster.
1.0
10-1
10-2
10-3
80° (π+)
84° (π+)
2.5
3.0
3.5
4.0
PHOTON ENERGY(Bev)
2.4
2.5
2.6
2.7
2.8
2.9
MASS(Bev)

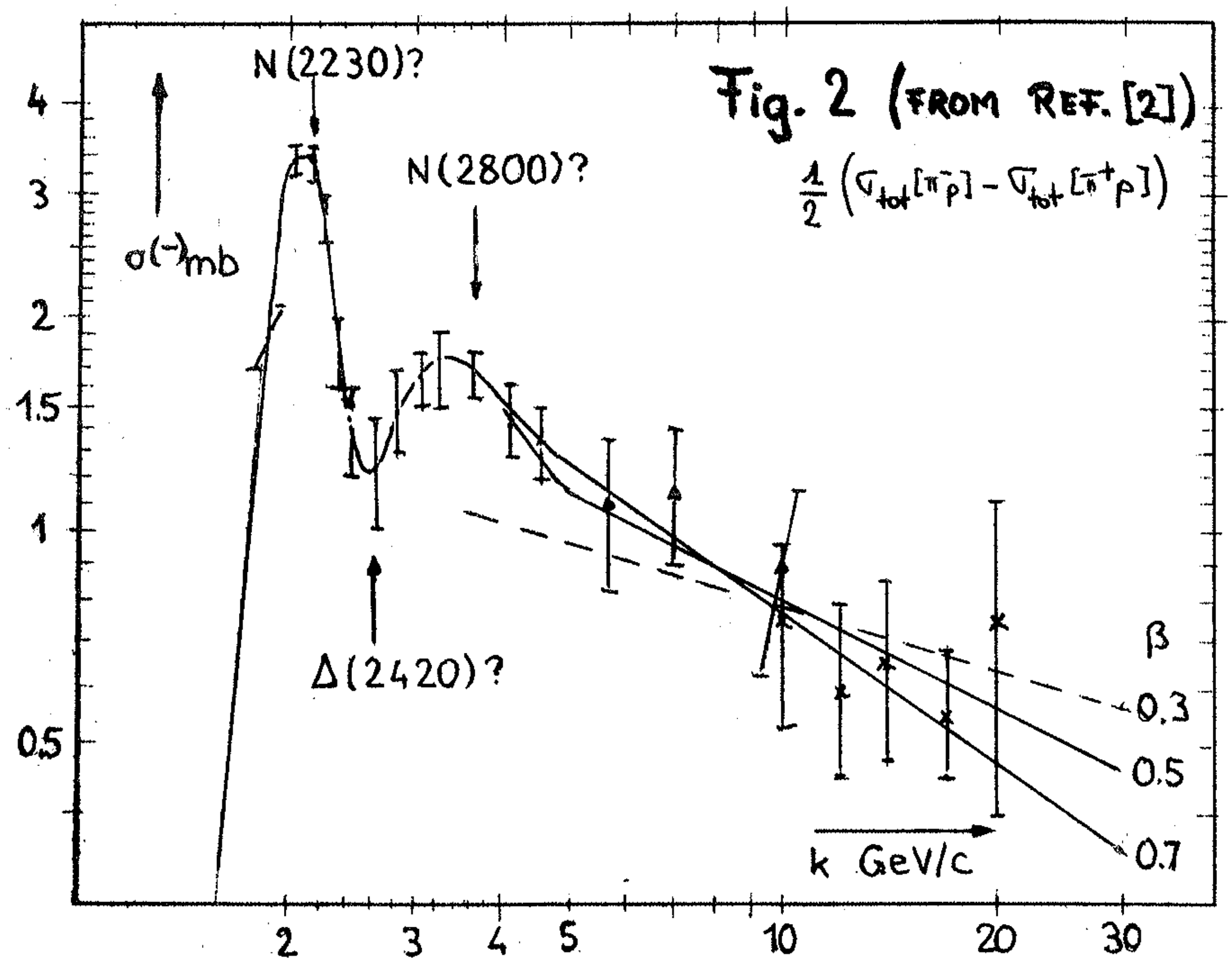

Fig. 2 (FROM REF. [2])
$\frac{1}{2}\left(\sigma_{tot}[\pi^- p] - \sigma_{tot}[\pi^+ p]\right)$
N(2230)?
N(2800)?
Δ(2420)?
σ(−) mb
k GeV/c
β
0.3
0.5
0.7
4
3
2
1.5
1
0.5
2
3
4
5
10
20
30

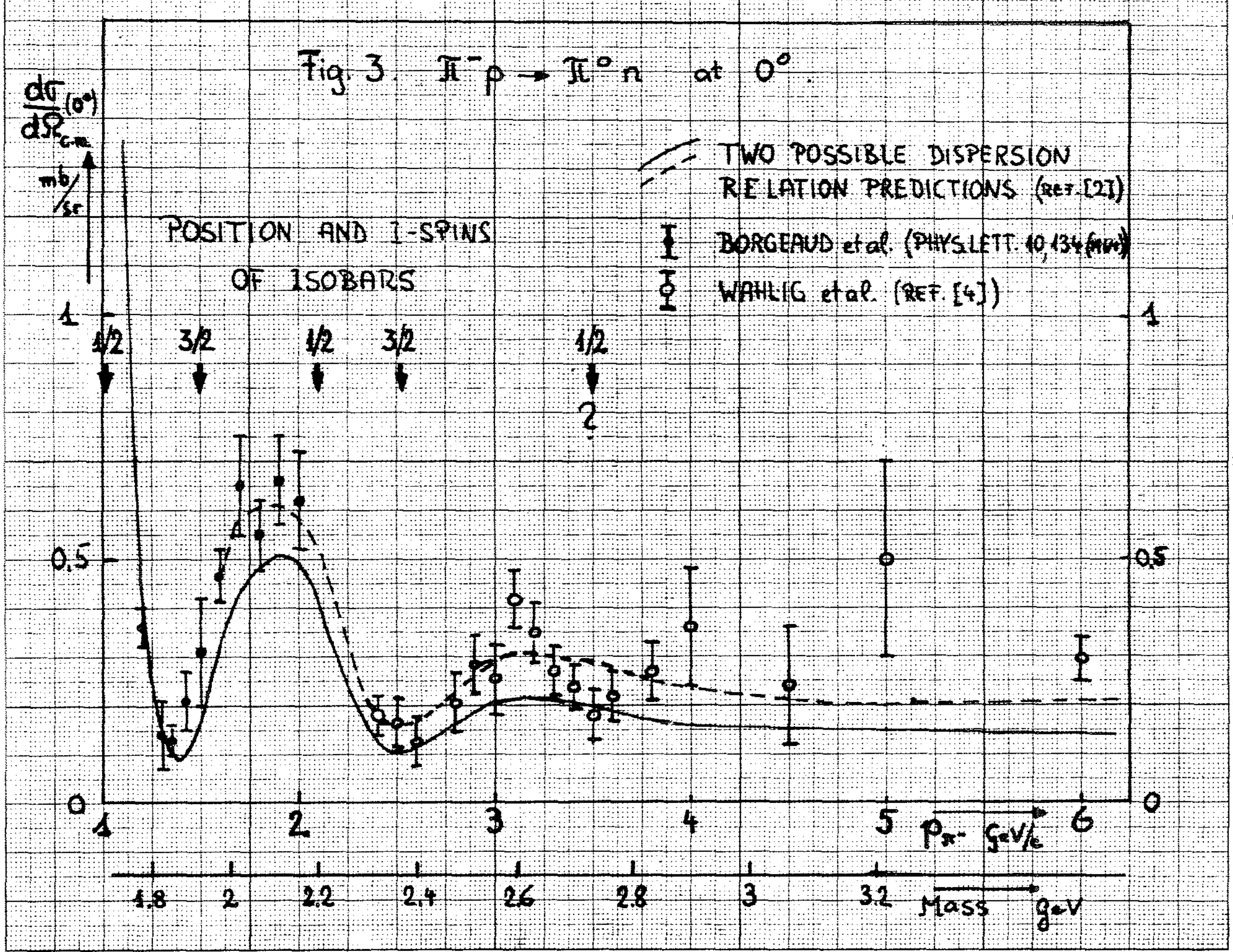

Fig. 3 $\pi^- p \rightarrow \pi^0 n$ at 0°
$\frac{d\sigma}{d\Omega_{c.m.}}(0^\circ)$ mb/sr
TWO POSSIBLE DISPERSION RELATION PREDICTIONS (REF. [2])
BORGEAUD et al. (PHYS. LETT. 10, 134 (1964))
WAHLIG et al. (REF. [4])
POSITION AND I-SPINS OF ISOBARS
1/2
3/2
1/2
3/2
1/2
?
0
0.5
1
1
2
3
4
5
6
p_{π^-} GeV/c
1.8
2
2.2
2.4
2.6
2.8
3
3.2
Mass GeV