TOTAL CROSS SECTIONS, ELASTIC SCATTERING
OBSERVABLES AND DIRECT RECONSTRUCTION OF
SCATTERING MATRIX IN np INTERACTIONS
BETWEEN 0.8 AND 1.1 GEV AT SATURNE II

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Neutron-proton total cross section differences with the beam and target polarizations
orientated either transversally or longitudinally with respect to the beam direction, as

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well as 11 spin dependent elastic scattering observables measured at SATURNE II as a function of energy and angle are presented. A major part of results was measured using the quasimonoenergetic polarized neutron beam and/or the polarized proton target. A small part of data was obtained using a polarized deuteron beam considered as a beam of quasifree neutrons and protons. The present paper represents a review of measured observables. Several sets of present data are compared with results obtained in other laboratories below 0.8 GeV. Imaginary parts of spin dependent forward amplitudes for np scattering and for the isospin state $I = 0$ were determined. First direct reconstruction of the np scattering matrix at 0.84 GeV is shown.

1 Introduction

A review of the nucleon-nucleon scattering situation in the intermediate energy region below 30 GeV was presented in ref. [1]. A large amount of new results for np elastic scattering and transmission experiments at intermediate energies appeared recently. A considerable part of them was measured at SATURNE II using the intense polarized beam of free neutrons obtained by a break-up of accelerated polarized deuterons. The total cross section differences $\Delta \sigma_T$ and $\Delta \sigma_L$ were measured in a large energy region [2-4]. Below 0.8 GeV differential cross sections at medium and large scattering angles have been accurately measured for many years now in different laboratories. Measurements at small angles, however, have been scarce. At SATURNE II, the small angle elastic np differential cross section at 378, 481, 532, 582, 633, 683, 708, 784, 834, 884, 934, 985, 1085 and 1135 MeV was measured by Saclay and Gatchina groups [5], resulting in 585 experimental points. In this experiment, neutrons were scattered at small angles inside a high-pressure drift chamber IKAR which measured the slow recoil proton angle and path length in the gas. The same experimental set-up completed by two large neutron counters was used to determine the np analyzing power at 0.633, 0.784, 0.834, 0.934 and 0.985 GeV [5,6]. Most of spin dependent observables were measured by the "NUCLEON-NUCLEON GROUP" (NN), either in quasielastic [7,8,9], or in elastic [10-15] np scattering (90 and 1646 data points, respectively). For these measurements the polarized deuteron or neutron beams and the Saclay polarized proton target (PPT) were used. The aim of SATURNE II experimental program is a reconstruction of scattering matrix either via the phase shift analysis (PSA), or by a direct determination of scattering amplitudes.

In the present review, the spin-dependent total cross section differences and np $\Rightarrow$ np scattering results of the NN group are reported. The notation of observables and the scattering amplitude representation as in ref. [16] are used.

2 Polarized beam and polarized target

A small part of np data was measured with a polarized deuteron beam considered as a beam of quasifree proton and neutrons. For such a beam the polarizations of protons and neutrons in accelerated deuterons are equal and the ratio of the quasielastic pp to np asymmetries is independent on the deuteron beam polarization.