

Scaling violations of multiplicity distributions of pn interactions at 400 GeV

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Abstract. Results on charged multiplicity distributions in high energy proton-neutron interactions derived from pd data at 400 GeV are presented. These are compared with other available data on pn distributions at and above 100 GeV. The study reveals that the proton-neutron distribution at 400 GeV do not obey KNO scaling. It has been shown that the negative binomial distribution gives a fair description of the multiplicity distribution and that the early onset of KNO scaling below 400 GeV is approximate.

Keywords. High energy pn interaction; bubble chamber; experimental data; multiplicity distribution; scaling violation.

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1. Introduction

Scaling of charged multiplicity distributions in high energy interactions has attracted recent attention due to its violation reported by UA5 group (Alner *et al* 1984, 1985, 1986) from studies on data from $\bar{p}p$ interactions between 200 and 900 GeV centre of mass energy and due to its consequent effect on the theoretical models (Pancheri 1984; Subramanian 1986; Van Hove 1987; Giovannini and Van Hove 1988). It has also been previously pointed out (Thome *et al* 1977; Guettler *et al* 1976) that Feynman scaling which served as the ingredient of KNO scaling (Koba *et al* 1972) was also violated at ISR energies ($\sqrt{s} = 30\text{--}60$ GeV) (Breakstone *et al* 1984). These results were obtained from studies with data from experiments with doubly charged or neutral initial states, leaving enough scope to analyze data from singly charged initial state.

Consequence of the scaling violations has found expression in the development of theoretical models which favoured non-single diffractive part of the charged multiplicity distribution to be fitted to a negative binomial (NB) distribution (Carruthers and Shih 1987; Van Hove 1987; Lo and Schreiber 1986; Burgers *et al* 1987; Subramanian 1986). It was pointed out sometime ago (Giovannini *et al* 1974; Knox 1974) that the NB distribution should be successful representation of multiplicity distributions for full phase space inelastic data. Data from several experiments on $\bar{p}p$ and pp in the energy range $\sqrt{s} = 200\text{--}900$ GeV (Ansorge *et al* 1989 and 800 GeV (Ammar *et al* 1986) respectively have confirmed this. It is therefore worthwhile to analyze charged multiplicity distributions in proton-neutron interactions at high energy to look into their behaviour.

In this paper we report our experimental data on pn interactions at 400 GeV and