Summary. — A phenomenological model is constructed for low-energy nucleon-nucleon scattering ($\leq 400$ MeV) and high-energy np and $p\bar{p}$ charge-exchange scattering ($\geq 5$ GeV) based on the Veneziano representation. The major advantage of the Veneziano representation vs. the usual OBE models for low-energy phase-shift calculations is that it provides a natural no-cut-off model. It is found that the $S$-waves and the higher partial waves can be reproduced with comparable accuracy using the $\lambda/D$ method with four adjustable parameters. These are the two $\rho$-meson coupling constants, the $\omega$-meson coupling constant and the coupling constant of a pion conspirator. Although the conspirator coupling has little effect on the low-energy phase shifts, its existence is demanded by the self-consistency of the Veneziano representation. At high energies, the conspirator plays an essential role in reproducing the forward peak in charge-exchange scatterings. However, the data indicate that it is necessary to suppress the $\rho$ contribution and introduce a phase factor differing from that of the simple Veneziano model. A two-parameter modification of the $\rho$ trajectory along with the given $\pi$ and $\pi$ conspirator trajectories yields a satisfactory fit to both the np ($5\div 24$ GeV) and the $p\bar{p}$ ($6\div 9$ GeV) data.
I. - Introduction.

Various versions of the one-boson exchange (OBE) model for nucleon-nucleon scattering have met with considerable success in the past decade (1). However, all these models require a cut-off at short distance. It is somewhat dubious, for example, whether S-wave scattering is adequately described by OBE since it is quite sensitive to the cut-off. We present here a no-cut-off OBE model based on the Veneziano representation (2) and show that it does reproduce the S-wave phase shifts along with the higher partial waves reasonably well. Furthermore, a good fit to the near-forward np and \( \bar{p}p \) charge-exchange cross-sections at high energies (above 5 GeV) is obtained based again on the Veneziano model. This lends additional support to the idea that OBE models are useful at high energies (3) as well as low energies. It also shows that Veneziano models can provide a useful starting point for detailed phenomenology.

The Veneziano functions describing nucleon-nucleon scattering amplitudes are pure real in the physical region. They play the role played by a potential in OBE models. These functions must be unitarized by certain procedures. In the low-energy region (\(< 400 \text{ MeV}\)), we impose unitarity by using the \( N/D \) method (4). For high-energy charge-exchange scattering, we find that the asymptotic form of the Veneziano functions will fit the data (5) provided we suppress the \( \gamma \)-exchange term and introduce a phase factor which breaks the exchange degeneracy. These are presumably effects of unitarity but we have no detailed understanding of them. High energy forward elastic scattering is not calculated because the pomeron is not accommodated by our model.

There are four adjustable parameters for fitting the low-energy phase shifts. The high-energy np and \( \bar{p}p \) scattering contains two additional parameters.

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