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Abstract. High energy elastic *pp* differential cross section at LHC at the c.m. energy 14 TeV is predicted using the asymptotic behavior of σ_{tot}(s) and ρ(s), and the measured $\bar{p}p$ differential cross section at $\sqrt{s}$ =546 GeV. The phenomenological investigation has progressively led to an effective field theory model that describes the nucleon as a chiral bag embedded in a quark-antiquark condensed ground state. The measurement of *pp* elastic scattering at LHC up to large —t— $\gtrsim$ 10 GeV^2 by the TOTEM group will be crucial to test this structure of the nucleon.

pp Elastic Scattering at LHC and Nucleon Structure (Conference Report)[1]

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High energy *pp* and $\bar{p}p$ elastic scattering have been measured at the CERN ISR[1] and SPS Collider[2-3] over a wide range of energy and momentum transfer: $\sqrt{s}$ = 23-630 GeV and —t— = 0-10 GeV^2. These measurements have been followed by Fermilab Tevatron measurement[4-5] of $\bar{p}p$ at $\sqrt{s}$ = 1.8 TeV and —t— = 0-0.5 GeV^2. Such a large experimental effort naturally presents us with the following questions:
1. What do we learn from these experiments about NN interactions at high energies?
2. What insight do we get from them about the physical structure of the nucleon?

These questions have now assumed greater significance because of the Large Hadron Collider (LHC) currently being built at CERN. One of the first experiments planned at LHC called TOTEM (Total and Elastic Measurement) will measure *pp* elastic $\frac{d\sigma}{dt}$ in the near forward direction at an unprecedented c.m. energy $\sqrt{s}$ = 14 TeV.

My collaborators and I have been studying high energy *pp*, $\bar{p}p$ elastic scattering for some time[6-8]. Our initial phenomenological investigation led us to the following description. The nucleon has an outer cloud and an inner core (Fig. 1). High energy elastic scattering is primarily due to two processes (Fig. 2): 1) a glancing collision where the outer cloud of one nucleon interacts with that of the other giving rise to diffraction scattering; 2) a hard (or large —t—) collision where one nucleon core scatters off the other core via vector meson ω exchange, while their outer clouds overlap and interact independently. In the small —t— region diffraction dominates, but the hard scattering takes over as —t— increases.

Let me present an example from our recent calculations. The solid curve in Fig. 3 is our calculated $\frac{d\sigma}{dt}$ for $\bar{p}p$ scattering at $\sqrt{s}$ =546 GeV. The dotted curve is the differential cross section due to diffraction alone, while the dot-dashed curve is that due to the hard scattering alone. As we can see, diffraction dominates in the small —t— region, but falls off rapidly as —t—

Concluding remarks

1. Our phenomenological investigation has led us to physical aspects of the nucleon which have been proposed and studied by other authors in different contexts.

2. We find that the nucleon is a chiral bag embedded in a quark-antiquark ground state, and this ground state is analogous to a superconducting ground state. We also find that this structure is described by an effective field theory model — a gauged Gell-Mann-Levy linear σ-model.

3. The experimental study of pp elastic scattering at LHC at $\sqrt{s} = 14$ TeV by the TOTEM group up to large $|t|$ will be crucial to test this structure of the nucleon.

Figures 1 - 12: Explanations of the figures are given in the main body of the paper.

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FIGURE 1. **FIGURE 2.**

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FIGURE 3. **FIGURE 4.** **FIGURE 5.**

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FIGURE 6. **FIGURE 7.** **FIGURE 8.**

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FIGURE 9. **FIGURE 10.**

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FIGURE 11. **FIGURE 12.**