Answer on question #62269, Physics / Atomic and Nuclear Physics

Explain double diffraction.

Answer:

Double diffraction (DD) is the process in which two colliding hadrons dissociate into clusters of particles producing events with a central pseudorapidity gap (devoid of particles), as shown in Fig. 1. This process is similar to single diffraction (SD) dissociation, in which one of the incident hadrons dissociates while the other escapes as a leading (highest momentum) particle.

The physical reason for causing such phenomena are inelastic processes. In the collision of high-energy hadron, it made possible the birth of many new particles. The presence of these inelastic channels leads to a partial absorption and the associated change in the wave function of the initial hadron in an area where there is an interaction, having dimensions of the order of the size of the field R of strong interactions, i.e. the order of the hadron size ~ 1 fm.

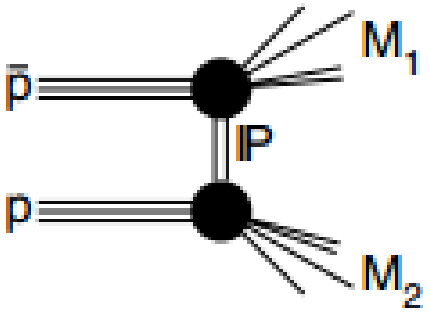

Fig. 1.

The process of diffraction is closely related to elastic scattering. Single diffraction dissociation may be regarded as a two-body reaction

$$p + p \to p + X$$

where one of the colliding protons is excited to a system *X* which then decays in a number of stable particles. To be diffractively produced, the system *X* must have the same intrinsic quantum numbers as the incoming proton while spin and parity may be different because some orbital angular momentum can be transferred to *X* in the collision.

In a high-energy collision, the mass *M* of the system *X* may take quite large values with a limitation which is imposed by the coherence condition. If p_0 is the beam momentum and *p* the momentum of the final state proton, the mass *M* is given by $M^2 = (1 - x)\, s$ where $x = p/p_0$. The coherence condition implies M^2/s £ 0.1 High-energy data indeed provide clear evidence for diffractive production up to M^2/s ~ 0.05.