

SLOW-TARGET ACCELERATORS

R. R. Wilson
Cornell University
Ithaca, NY 14853

Usually two regimes of operation of an accelerator are considered: a fixed target mode in which beams of secondary particles such as mesons or neutrinos can be produced and studied; or a collider mode in which two beams are brought into head-on collision. In the latter case only the particles of the accelerated beams can be studied in interaction. Here consideration is given to an intermediate mode in which a collider might be used as a source of a beam of very heavy exotic particles which could not be made in the low c.m. collisions of fixed target operation. In that case we can recognize the low energy beam of the collider as a slow target and still obtain some of the kinematic advantages of a fixed target machine. It will turn out to be of limited application, to say the least.

The asymmetry in the energies of the colliding beams will be made as great as possible, consistent with providing enough energy in the c.m. to provide an adequate production of the desired exotic particle. This clearly enhances the energy and the intensity of the kinematically formed "beam" of exotics.

Thus at threshold of the production of the exotic particle, all of them would go exactly in the direction of the fast beam and with the energy corresponding to the speed of the c.m. system. As the c.m. energy were to increase above threshold, the cone of production in the laboratory would open and would eventually correspond to about 90° in the c.m., namely, to an angle of about E_s/E_f , the ratio of the slow energy to the fast energy of the colliding beams. Hence the intensity would be roughly proportional to $(E_f/E_s)^2$ as the production of exotic particles in the c.m. levelled out. Clearly for an exotic particle of mass smaller than $\sqrt{2m_p E_p}$, the c.m. energy for a proton of energy E_p against a fixed target, the slow target would lose out by a factor of about a million, i.e., the ratio of fixed target luminosity, 10^{38} , to that of a typical collider, 10^{32} . Thus for a 20 TeV accelerator, the slow target regime might be useful for exotic particles heavier than about 100 GeV. Exotic indeed!