The interesting feature with this method would be that the velocity is measured more directly than in the usual procedure where a combination of electric and magnetic fields is used. The method could probably also be applied to other particles than electron at high energies.

Preliminary measurements with electrons show promising results.

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E3. Remarks on "meta" relativity. (T. Alväger, J. Blomqvist and P. Erman)

Some of the consequences within the domain of the special theory of relativity of the existence of meta particles, i.e. a class of particles created with a velocity $v > c$, have been discussed by Bilaniuk, Deshpande and Sudershan[1]. They showed that by a suitable interpretation of fundamental concepts, the positive definiteness of the energy carried by a meta particle is preserved, and that these particles cannot serve as infinite sources of energy. However, they did not examine the causality aspects of the theory. As pointed out first by Einstein[2], the time ordering of cause and effect cannot be maintained in every situation if we allow some actions to propagate with a velocity c. This can be visualized in the following way. Assume that some device which transmits meta particles moves with respect to an observer such that from his point of view the world lines of the meta particles point backwards in time. If a pulse of this kind is reflected back towards the observer he will be able to receive the signal at a time preceding the transmission time. In this process energy is transferred from the receiver to the transmitter, but still information has been brought backwards in time, and this certainly has very queer consequences.

In spite of the causality difficulties which the existence of meta particles would create, it may be of value to look for possible occurrence

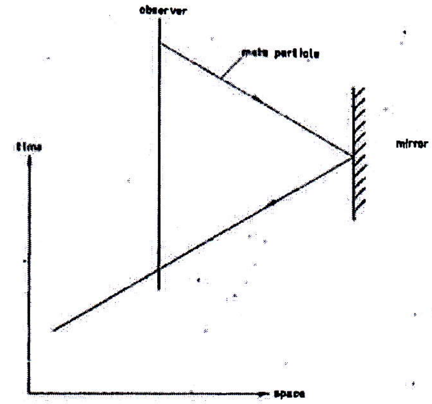

Fig. 1

of such particles. It is naturally quite difficult to make predictions of where meta particles should appear, but if they exist and interact with ordinary particles they may, for example, be created in pairs simultaneously with electromagnetic production of electron pairs. However, it is probably safe to state that the production cross section for meta particles in this process is less than 10^{-2} of the production cross section of electron pairs in the region which have been studied experimentally.

To distinguish between an ordinary particle and a meta particle, the most straight forward method is to measure the velocity of the particle. However, a simplier but not so sensitive test is to measure simultaneously energy and momentum of the created particles. For the same momentum p, a meta particle and an ordinary particle would generally have different energies if the absolute value of the masses are equal. If we restrict ourselves to masses of the order of less than the electron mass, a combination of a beta-spectrometer selecting p and an energy sensitive detector can discriminate between the two classes of particles. If the meta particles give up all their available energy in the detector, the signal from this due to a meta particle (S_i) and an ordinary one S satisfy the following relation.

$$S_i^{\,2} = (S + m)^2 - m_i^{\,2} - m^2$$

where m_i and m are the masses of the two classes of particles. In the limiting case that $m_i = m$ we get the ratio R between the signals S_i and S

$$R = \frac{\sqrt{p^2 c^2 - m^2 c^4}}{\sqrt{p^2 c^2 + m^2 c^4} - mc^2}$$

R is zero at $p = mc$ and has a maximum $R = \sqrt{2}$ at $p = \sqrt{3}\, mc$, and will asymptotically approach unity when $p \longrightarrow \infty$. That means if we focus a beta spectrometer at $p = \sqrt{3}\, mc$ (511 keV electrons) two different signals with about 40 % energy difference would appear in a detector if meta particles with $m_i = m$ are present. This energy differnce could easily be established in an anthracene or plastic scintillator. In general it seems possible to observe meta particles experimentally if $m_i \lesssim 1.2\, m$ and if the creation cross-section is larger than about 10^{-4} of the electron production cross-section. Experiments to establish a limit for the production cross-section of meta particles are in progress at the Nobel Institute.

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E4. On the law of conservation of nucleons. (T. Alväger, I. Martinson and H. Ryde)

The law of conservation of nucleons, or in a generalized form, the law of conservation of baryons, is usually most accurately tested in investigations of possible instabilities of the free proton or the bound nucleon. The degree to which this law is valid is then expressed as a limit of the life-time of nucleons. The most sensitive experimental test performed so far seems to be that reported by Giamati and Reines[1]. They have found lower limits for the half-lives of nucleons ranging from 10^{26} to $7 \cdot 10^{27}$ years, depending on the decay mode assumed. The non-conservation of the baryon number requires, in considering the possible modes of decay, the violation of at least one more conservation law. Giamati and Reines therefore assumed also the breakdown of the lepton conservation law. Typical decay modes would then be

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