Essay 15 : GENERAL RELATIVITY AND PARTICLE SCATTERING

In the classical and special relativistic theory of particle scattering the masses of one particle scattered from another remain constant. This time honoured and ordered view of things disintegrated in October 2010, when it was found that the theory of particle scattering produced varying masses. The choice is whether to accept this result or abandon the basics of twentieth century physics. The basics of twentieth century physics work very well in certain restricted contexts such as atomic spectra and special relativity considered as independent phenomena. The trouble starts when they are put together. Louis de Broglie was the first to attempt this in about 1922 to 1924 and this attempt produced the de Broglie / Einstein equations as described in previous essays. What can be the meaning of varying mass? The vast amount of data on particle scattering and absorption now indicate the existence of this radically new concept in physics.

To begin to answer this question we must first consider the mass as measured in the standards laboratories to high accuracy. These data are precisely obtained and cannot be abandoned. The rest mass must therefore be the mass of a particle when it is not moving. It is now known that when a particle collides with another its mass varies. Therefore we considered scattering at right angles of a particle of rest mass m10 from another of rest mass m20. This simplifies the algebra and clarifies the underlying physics. The calculation was based on conservation of total energy and momentum and on the de Broglie postulates of 1922 to 1924. So we prefer not to abandon these postulates but to modify them and build on them. The algebra is quite complicated, but nothing that could not be done at a good school. It can also be checked by computer. So there is no room for error or trivially motivated pseudo-criticism. What can not be done at a good school or by trivial pseudo-criticism is to find the exact way forward.

The result was expressed as the ratio of masses m2 / m1 after collision has taken place. This gave a simple formula in terms of the initial and scattered angular frequencies of the incoming particle and the rest frequency or rest mass of the initially static particle. This formula was expressed in terms of the ratio R1 / R2, where the R factors are defined by the ECE wave equation developed in 2003. In the denominator appears the square of the rest frequency. In the numerator appears a generalization of the original Compton effect formula of about 1922, derived independently by Compton and Debye. When the numerator is zero the Compton formula is recovered self consistently for scattering at ninety degrees of a massless particle off a particle such as an electron. The concept of R1 / R2 is therefore the required generalization of all of particle theory from one based incorrectly on special relativity to one based on general relativity. The latter is in turn corrected by ECE theory.

The concept of massless particle is inherently self contradictory, no such thing can exist in nature and it is a mathematical ideal. This is what R1 / R2 is telling us. Let us name it the mass ratio spectrum for want of a better appellation. It is a spectrum because in the general case of scattering at any angle of a particle of any mass from a particle of any other mass, the mass ratio is frequency dependent and it is therefore a spectrum. The mass ratio spectrum reduces to zero if the photon mas sis zero, but as soon as the photon is given a mass, the spectrum is non zero and a property no longer of special relativity where it is asserted to be a constant. It becomes a signature of general relativity, not the failed Einsteinian general relativity but that of the ECE wave equation correctly based on the differential geometry of Cartan. In fact R is the most fundamental expression of differential geometry and so is the most fundamental expression of mass.

Mass is therefore a format of geometry, in particular it is an expression of Cartan=s version of four dimensional spacetime, a spacetime that includes torsion and curvature. The

constant or rest mass is a limit of the more general concept. In general there exists a dynamical mass which reduces to the rest mass when the particle stops moving. In particle scattering one particle is always moving, and this is also true in ordinary absorption theory where a moving photon is captured by a molecule. In this process also, linear momentum must be conserved. Once this is realized the de Broglie postulates can be saved by a slight but profound adjustment, the factor gamma m0 is replaced by m. Here m is the dynamic mass and gamma the Lorentz factor. The case of ninety degree scattering became the first clear insight as to the meaning of the ratio R1 / R2 and the mass ratio spectrum. It means that the whole of particle theory must be developed anew in the context of general relativity, opening up an entirely new era of simplified and more insightful physics free of the complex plethora into which the natural philosophy of the last century fell.

This result means that the mass can be changed by engineering by changing the geometrical characteristics of spacetime. In a sense this is done automatically in particle scattering, so this fact of nature can be captured in principle and used for techniques such as counter gravitation and new energy. This is a prime example of how basic natural philosophy leads to discovery and implementation for the good of humankind.