BAGGE'S INTERPRETATION OF DARMSTADT EXPERIMENTS

Low-energy Positrons in Pair Creation

by Erich H. Bagge

Dr. Erich Bagge (1912-1996), a student of Werner Heisenberg and Arnold Sommerfeld, was a pioneer of the nuclear energy industry in West Germany and the designer of the world's first nuclear-powered commercial vessel, the Otto Hahn. *He was director of the Institute for Pure and Applied Nuclear Physics at the University of Kiel and a member of the West German Atomic Energy Commission. Bagge's ideas on pair production contributed to the Moon model.*

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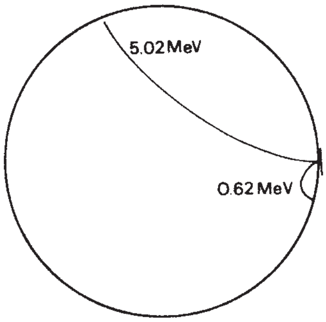

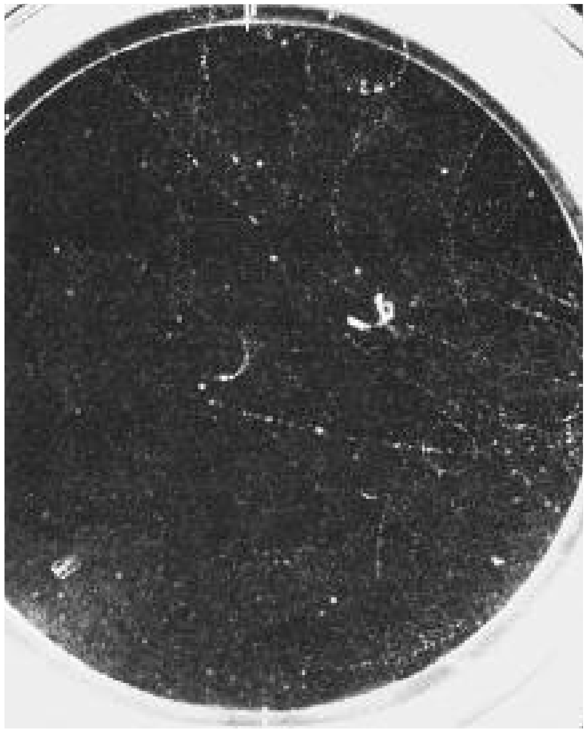

TRAJECTORIES OF AN ELECTRON-POSITRON PAIR

In this photograph of one of Bagge's experiments in a Wilson cloud chamber, the electron exits upward, with energy of 5.02 MeV, while the positron exits downward with energy of 0.62 MeV. According to the Bethe-Heitler theory, the two energies were supposed to be nearly equal.

In the November 1985 issue of *Physics Today,*[1] Bertram Schwarzschild reports on "puzzling positron peaks appearing in heavy ion collisions at the Society for Heavy Ion Research at Darmstadt in West Germany (GSI)." There is also a discussion of experiments to explain the intensity peaks of positron energies between 300 and 400 keV.

Erich R. Bagge, Ahmed Abu El-Ela, and Soad Hassan have reported in several places,[2] on measurements of pair creation of positrons and electrons that were triggered by gamma quanta of 6.14 MeV, at their passage at nuclei of gold atoms (atomic number or Z = 79). It was also established that the positrons predominantly receive low kinetic energies, generally around 270 keV.

There is a great probability that both the GSI measurements and those done by our group at the University of Kiel are based on the same effect. If one conceives of the impact of a uranium nucleus (atomic number = 92) of 6 MeV energy per nucleon on another uranium nucleus of the same type at rest as being a pair-producing process, as if the Fourier-analyzed Coulomb fields of the 92 impacting protons would be fields of light quanta, then these trigger electron-positron pairs in the Coulomb field of the nucleus at rest. In these pairs—in accordance with our observations and their consequent interpretations—mainly positrons are created, densely compacted at the surface of the Dirac Sea; that is, with practically zero energy. These positrons are then discharged through the Coulomb field of the uranium nucleus at rest.

Since the positrons must be looked at as wave packets of minimal extension *h/mc,* they can, by means of this discharge process, gain the energy:

$$E^{+}_{kin} = (Ze^2/\hbar c)mc^2 = 92/137\ mc^2 = 343.2 \text{ keV}.$$

This is just about the energy found at GSI in the maximum intensity peaks, during six experiments using various actinic impact partners. The results of the experiments our group conducted at Kiel show the same interpretation in the case of the gold nucleus, with somewhat smaller average energies:

$$E^{+}_{kin}\ (Kiel) = E^{+}_{kin}\ (GSI) \cdot 79/92 = 294.7 \text{ keV}.$$

Notes

1. "Puzzling Positron Peaks Appear in Heavy Ion Collisions at GSI," by Bertram Schwarzschild, *Physics Today,* Nov. 1985, p. 17.
2. Erich R. Bagge, *Fusion* (German-language edition), Dec. 1985, p. 11; and *International Journal of Fusion Energy,* Jan. 1985, p. 53; Ahmed Abu El-Ela, Soad Hassan, Erich R. Bagge, *Atomkernenergie/Kerntechnik,* Vol. 47, No. 109, 1985; Vol. 45, No. 208, 1984; *Fusion,* Nov.-Dec. 1985, p. 29.