Positronium scatters like an electron

November 5 2010, by Lin Edwards

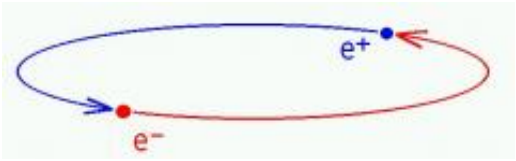

Image credit: Charles Darwin University

(PhysOrg.com) -- Positronium atoms have been found to scatter off gas particles in the same way as lone electrons, a finding which could help astronomers interpret some of their more puzzling observations, and which may have applications in medicine.

Positronium (Ps) atoms are extremely unstable hydrogen-like atoms containing a positron (the electron's positively charged antimatter partner) and an electron. They are formed in large quantities whenever positrons interact with matter, but disintegrate in less than a microsecond to produce gamma rays. An earlier PhysOrg article described the first observations of positronium molecules, which consist of two atoms of positronium.

Scientists have known that when electrons or positrons are fired through a gas, they are scattered off the gas particles at predictable rates. Researchers from the department of Physics and Astronomy at the University College London in the UK, expected positronium atoms to have different scattering rates since they are electrically neutral and

double the mass of electrons or positrons. They were surprised to find their scattering rates were almost identical to those produced by bare electrons moving at the same velocity, as if the influence of the positron was somehow cloaked.

The researchers made their discovery by firing positronium atoms into various gases, including krypton, hydrogen, and water vapor, at speeds of up to 4400 kilometers per second and impact energies of 250 eV.

Leader of the team, Gaetana Laricchia, said knowing how positronium interacts with the surrounding medium, whether it is interstellar gas or human tissue, is important, and the results may be useful for positron emission tomography (PET) scans used in medicine. In PET scanning a radioactive glucose tracer is injected into the human body. The tracer emits positrons and they in turn briefly produce positronium atoms that decay almost instantly to produce gamma rays, which the scanner measures.

Lariccia said knowing more about the positronium scattering rates should make it possible to refine estimates of the distance traveled by positronium, which would allow tumor volumes to be measured with more accuracy. It could also help clarify how positronium atoms deposit their energy as they collide with molecules in the tissue, which may help to limit damage to healthy tissues.

The findings, published in the journal *Science*, may also be useful to astronomers since positronium is known to form in space, and an understanding of how it interacts with interstellar gas clouds could help determine the positions of some mysterious positron sources in our galaxy.

More information: Electron-Like Scattering of Positronium, S. J. Brawley et al, *Science* 5 November 2010: Vol. 330. no. 6005, p. 789.

DOI:10.1126/science.1192322