2S–Decay and Cascade Time of Muonic Hydrogen at 0.6 mbar

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The fast radiative decay of the metastable 2S muonic-hydrogen atoms has been detected for the first time. Its origin are μp(2S) atoms formed with kinetic energies above 0.3 eV that are collisionally excited to the 2P state and decay to the 1S ground state via emission of a 1.9 keV X-ray. This reaction is the main outcome of collisions at kinetic energies significantly above 1 eV whereas near 1 eV or less strong competition from slowing–down to below threshold takes place. As the initial kinetic distribution is known[1], the measured decay allows to check the validity of the calculations of both the quenching and the slowing down cross-sections. In order to do this the diffusion of the μp(2S) ein the target volume has to be taken into account as it spreads the position distribution and changes the X-ray detection efficiency with time. The results are in good agreement with calculations of T. Jensen[2].

Simultaneously, a reliable determination of the atomic cascade time, 37 ± 5 ns at 0.6 mbar, is obtained. It is much too short to be explained with de-excitation processes calculated for a target of hydrogen atoms. Molecular Coulomb de-excitation as calculated by T. Jensen[3] shortens the cascade time but still gives too large values. Possible explanations of the result will be discussed.

[1] R. Pohl, PhD thesis 14096, ETH, Zurich, Switzerland (2001)

[2] T.S. Jensen, V.E. Markushin, Eur. Phys. D **21**, 271 (2002).

[3] T.S. Jensen, V.E. Markushin, Eur. Phys. D **21**, 261 (2002).