Atomic Spectroscopy And Collisions Using Slow Antiprotons (ASACUSA)

Contribution to SPSC Villars meeting, April 5, 2004
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<table>
<tr><th>Physics Goals</th><th colspan="2">Measurements</th><th>Method</th><th colspan="2">Status & Outlook</th></tr>
<tr><td rowspan="5">CPT tests:

high-precision determination of antiproton mass, charge, magnetic moment and magnetic structure using various spectroscopic methods</td><td>3-body system</td><td>Antiprotonic helium atom laser spectroscopy</td><td>RFQD+low-density target</td><td>New high-precision laser system being developed.
Two-photon spectroscopy will enable ultimate accuracy.</td><td rowspan="2">Proton mass is known with a precision of 0.46 ppb.

The goal of these measurements is to measure antiproton mass to similar precision.</td></tr>
<tr><td rowspan="3">2-body systems</td><td>Antiprotonic helium ion laser spectroscopy</td><td>RFQD+low-density target</td><td>Free from theoretical ambiguities (unlike the 3-body case).</td></tr>
<tr><td rowspan="2">Antihydrogen ground-state HFS microwave spectroscopy</td><td>RFQD + Paul trap + Two-tone Paul trap (point source of cold antihydrogen)</td><td>Superconducting Paul traps being developed first Hbar production test in 2006.</td><td rowspan="2">The magnetic properties of antiproton are poorly known. The goal is to measure the magnetic moment of antiproton to < ppm and to compare the magnetic structure of proton and antiproton.

Depending on the outcome of the present R&D, technology choice will be made.</td></tr>
<tr><td>RFQD + Penning trap + cusp trap (possible source of polarized antiydrogen beam)</td><td>Cusp trap being developed. Proton + electron test to be done in Japan in 2004-2005.</td></tr>
<tr><td>Auxiliary measurements</td><td>Understanding the collisional behavior of very low energy antiprotons</td><td>RFQD + gas/solid targets</td><td colspan="2">Ready to start measurements in 2006.</td></tr>
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***) Aarhus - Belfast - Budapest - CERN - Copenhagen - Debrecen - Frankfurt - Heidelberg - RIKEN - Swansea - Tokyo**