CALCULATIONS OF CROSS SECTIONS FOR VERY LOW-ENERGY HELIUM-ANTIHYDROGEN SCATTERING

E A G Armour*, S Jonsell†, Y Liu* and A C Todd*

*School of Mathematical Sciences, Nottingham University, Nottingham NG7 2RD, UK
†Department of Physics, Umeå University, SE-90187 Umeå, Sweden

The ATHENA and ATRAP projects are continuing their work on antihydrogen at CERN after their successful preparation of antihydrogen in 2002. See, for example, [1,2]. We have already carried out calculations of cross sections for very low-energy hydrogen antihydrogen ($H\bar{H}$) scattering [3,4].

There is currently considerable interest in the interaction of helium with antihydrogen both as a possible means of cooling $\bar{H}$ and as a way of determining the $\bar{H}$ loss rate due to the presence of He as an impurity. We are in the process of carrying out calculations of very low-energy cross sections for $He\bar{H}$ scattering. We have calculated wave functions and energies for $He\bar{H}$ in the Born–Oppenheimer approximation using basis sets that contain Hylleraas-type functions [5]. These calculations give accurate results for the energy but not as accurate as the values obtained by Strasburger and Chojnacki using a basis set made up of explicitly correlated Gaussian functions [6].

Thus we used Strasburger and Chojnacki's energy values to obtain the potential that we required to calculate elastic scattering cross sections. We have used our wave functions to calculate the delta-function expectation values that determine the positron-electron annihilation rate into gamma rays. We have also used them to calculate cross sections for rearrangement processes using the distorted wave T-matrix approach used by Jonsell et al. in their calculations on $H\bar{H}$ [4].

Results will be presented at the conference for the antiprotonic He + Ps channel. A progress report will be given on calculations on the $He\,\bar{p}+e^+$ channel. In addition, it is hoped to be able to report on preliminary work on the $\alpha\bar{p}+Ps^-$ channel.

References

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