## **REARRANGEMENT CROSS-SECTION FOR HYDROGEN-ANTIHYDROGEN SCATTERING**

## Puspitapallab Chaudhuri<sup>1</sup>, Sumana Chakraborty<sup>2</sup>, P K Sinha<sup>3</sup> and A S Ghosh<sup>2</sup>

<sup>1</sup>Departamento de Física, Universidade Federal do Amazonas (UFAM), 69077-000, Manaus-AM-Brasil <sup>2</sup>Department of Theoretical Physics, IACS, Jadavpur, Kolkata-700032, India <sup>3</sup>Department of Physics, Bangabasi College, Kolkata-700009, India

Observations of the first antimatter atom, the antihydrogen  $(\overline{H})$  has created a renewed interest in the investigation of matter-antimatter systems. Recently cold  $\overline{H}$  atom has been obtained in large numbers by the experimentalists at CERN [1]. Theoretical studies have been performed to understand the mechanism that permits trapping and cooling of antihydrogen  $(\overline{H})$ . The knowledge of the rates of elastic and inelastic atom-antiatom collision is of key importance. The elastic cross section is responsible for cooling and the inelastic one, particularly the rearrangement cross section (H+ $\overline{H}$  = Ps + Pn ), is the measure of the loss of antihydrogen via annihilation.

The H-H collision system has been investigated by different groups [2-5]. Froelich *et al* [2] and Jonshell *et al* [3] have investigated the problem in the framework of Born-Oppenheimer (B-O) separation model. They have predicted s wave elastic and cross section. Armour and his coworkers [4] have investigated H- $\overline{H}$  scattering using Kohn variational principle in the framework of B-O separation. They have also predicted s-wave elastic and rearrangement cross-section. Results of rearrangement cross-sections obtained by theses two groups differ from each other. Both the groups have employed adiabatic model to investigate the problem in the Kelvin region. Ghosh and his collaborators [5] have investigated the problem using close coupling model. Their model is *ab initio* and non adiabatic in nature. Their elastic results are found to be reliable.

Here we investigate H-H collision system with the inclusion of rearrangement channel using close coupling model. In the calculation Ps atom is held fixed in the ground state and three protonium excited atomic states (22s to 24s) are retained. In the direct channel we have employed an elaborate basis sets. Convergence of results has been found. We report the results of direct and rearrangement cross-section and scattering length up to the incident energy  $10^{-2}$  a.u. in the conference.

## **References:**

[1] CERN press release for Sep. 18, 2002 (info.web.cern.ch/Press/PressReleases/Releases2002/List.html)

- [2] P. Froelich, S. Jonshell, A. Saenz, B. Zygelman and A. Dalgarno, Phys Rev Lett. 84 (2000) 4577.
- [3] S. Jonshell, A. Saenz, P. Froelich, B. Zygelman and A. Dalgarno, Phys Rev A 64 (2001) 052712.
- [4] E. A. G. Armour and C. W. Chamberlain, J. Phys. B: At. Mol. Opt. Phys. 35 (2002) L489.
- [5] P. K Sinha, P. Chaudhuri and A. S. Ghosh, Phys Rev A 67 (2003) 052509.