

New experiment for coincidence detection of $H(2l)+H(2l')$ coming from dissociation of H_2 induced by electron impact.

R. F. Nascimento^{*1}, Aline Medina^{†2}, C. R. Carvalho[‡], C. Carvalho[‡], L. O. Santos[‡],
Ginette Jalbert[‡], F. Zappa[§], N. V. de Castro Faria[‡], J. Robert[¶]

^{*}Centro Federal de Educação Tecnológica Celso Suckow da Fonseca, 25620-003, Petrópolis, Brazil

[†]Instituto de Física, Universidade Federal da Bahia, 40210-340 Salvador, BA, Brazil

[‡]Instituto de Física, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 21941-972, RJ, Brazil

[§]Departamento de Física, UFJF, Juiz de Fora, MG 36036-330, Brazil

[¶]Laboratoire Aimé Cotton CNRS, Univ. Paris Sud 11, 91405 Orsay Cedex, France

Synopsis In this work we present a new experimental apparatus being set up in Rio de Janeiro to study coincidence detection of pairs of excited hydrogen atoms coming from the dissociation of a single H_2 molecule by detecting emitted Lyman-alpha radiation.

The production and manipulation of pairs of entangled atoms have direct applications in the fields of quantum information and quantum communication. Moreover, the study of entangled massive particles may provide important insights on basic quantum physics research as, e.g., on the problem of decoherence and the interaction between quantum systems and environments [1]. In addition, the study of the $H(2l) + H(2l')$ dissociation channel allows us to investigate many interesting features on the dissociation dynamics of the H_2 molecule.

This new set-up allows us to investigate all coincidence possibilities in the $H(2l) + H(2l')$ dissociation channel.

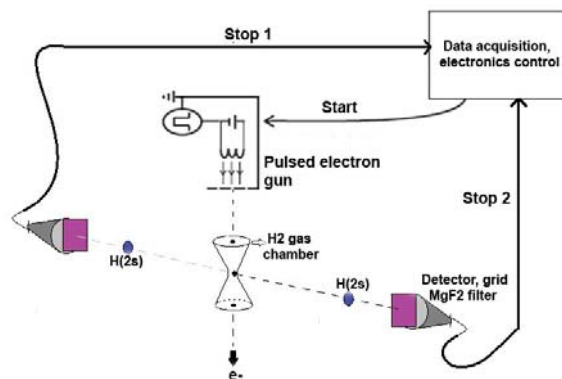


Figure 1. Schematics of our apparatus. The MgF_2 filters are used to ensure Ly- α detection only.

In our set-up, an electron pulse traverses a hydrogen gas chamber inducing dissociation of the H_2 onto its neutral fragments which are analyzed by channel electron multipliers, as displayed in Fig.1, using time-of-flight (TOF) technic. The $H(2p)$ fragments are detected via their direct emission of Ly- α radiation, see Fig.1, while the $H(2s)$ fragments only decay in the vicinity of the detector due to an electrical field that induces their decay by mixing the $2s$ - $2p$ states.

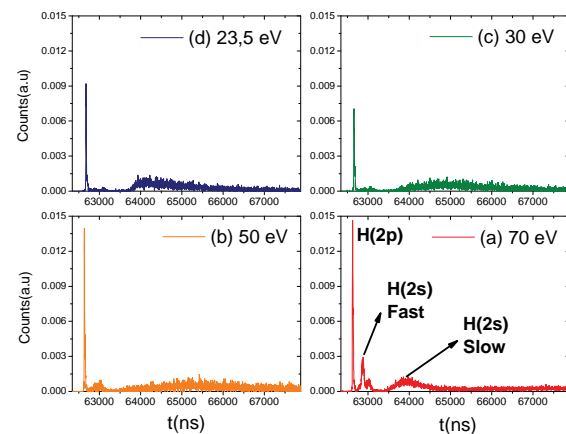


Figure 2. TOF spectra in a single detector. a) electron impact energy of 70 eV; b) 50 eV; c) 30 eV; d) 23,5 eV

One-detector TOF spectra are shown in Fig.2 for different electron impact energies. The first peak (near origin) in each spectrum corresponds to detection of the short-lived $H(2p)$ atoms, the second and third peaks correspond to the fast and slow $H(2s)$ fragments respectively. We note the typical impact energy threshold (~ 30 eV), below which the doubly excited states that give origin to the fast peak can no longer be accessed [2]. Preliminary coincidence results indicate the detection of the $H(2s) + H(2s)$ dissociation channel, not yet seen in the literature.

References

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¹E-mail: rodfer@if.ufrj.br

²E-mail: aline.medina@ufba.br