

**Pauline Yzombard -
Hydrogen/Deuterium 1S-3S
spectroscopy and beyond**

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Hydrogen/Deuterium 1S-3S spectroscopy and beyond

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In this talk, I would like to present our latest results on the 1S-3S 2-photon continuous wave spectroscopy of Deuterium atoms. I will deal with the current situation of our experiment, focusing on the analysis and some of the main systematics, and our ideas to overcome these problems in the future. And in the perspective of opening up the field of hydrogen studies, I would like to conclude my talk by introducing our new project, the observation of the gravitational quantum states (GQS) of hydrogen, within the international collaboration GRASIAN (<https://grasian.eu>). The GQS are formed when a mass-particle is trapped in a potential well formed on one side by the Earth gravitational potential (top confinement) and on the other side, by an atomic mirror (a flat surface placed on the bottom) that reflects the particles upwards. The mechanism behind these specular reflections of the atoms on the mirror is the well-known quantum reflection phenomenon: a very cold mass particle can be seen as a wavepacket that has a high probability of being quantum reflected as it approaches the surface and experiences a rapid and steep change in the potential close to the mirror. These GQS have been observed on ultracold neutrons more than 20 years ago, but never with atoms. Our first goal is to observe such gravitational quantum states on hydrogen, which would open the way to new great studies on ultracold hydrogen atoms.

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