Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage

Date de la proposition : 29/10/2018

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*: Institut de Physique de Nice

Code d'identification : Organisme : CNRS

Site Internet / *web site*: http://inphyni.cnrs.fr/sites/teams/cold-atoms/

Adresse / *address:* 1361 route des Lucioles, 06560 Valbonne, France

Lieu du stage / *internship place*: 1361 route des Lucioles, 06560 Valbonne, France

Titre du stage / *internship title*: **Polarization of light scattered by atoms and application to astrophysics**

Résumé / *summary*

Looking at the polarization of the light emitted by the sun is a way to get information on the radiative transfer mechanisms that take place in the solar photosphere as well as to probe the magnetic fields where light is emitted [1,2]. The link between the measured "polarization spectrum" (i.e. the Stokes components measured as a function of the wavelength, in particular in the vicinity of emission lines) and the physical parameters of interest (such as the magnetic fields) relies on heavy numerical models, which are typically untested in well-controlled environment.

At Institut de Physique de Nice we are starting a collaborative work on this aspect, with Marianne Faurobert from the Observatoire de la Côte d'Azur, Jan Stenflo (Locarno Observatory), the father of the polarization spectroscopy, and the group of Dr. Nagendra (Bangalore Institute for Astrophysics) for numerical simulations. At short term we want to validate the standard models in simple configurations and at longer term we want to check a theory which could explain unexpected observations on the D1 line of sodium: the theory predicts subtle quantum interference effects between the many levels of the atoms [3].

The immediate goal of the internship will be to conduct experiments using a room-temperature or heated cell of rubidium atoms (whose spectrum is similar to the one of sodium) in order to measure the polarization spectrum, i.e. the Stokes parameters near the resonance lines. An involved technique using a photo-elastic modulator and a lock-in detection should allow us to reach high-enough signal-to-noise ratio. We will first use the D2 line, where polarization effects are stronger, no magnetic fields, and a small optical thickness to avoid multiple scattering. Then, if time allows it, we will increase the complexity of the experiment step-by-step: adding a controlled magnetic field, entering the multiple-scattering regime, use the D1 line.

Even limited to the first steps, a successful experiment should give publishable results.

References :

[1] **Investigation of weak solar magnetic fields. New observational results for the SrI 460.7 nm linear polarization and radiative transfer modeling**, M. Faurobert *et al.*, A&A **378**, 627 (2001).
[2] **Solar magnetic fields as revealed by Stokes polarimetry**, J.O. Stenflo, Astron. Astrophys. Rev. **21**, 66 (2013).
[3] **Physics of polarized scattering at multi-level atomic systems**, J.O. Stenflo, ApJ. **801**, 70 (2015).

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Si oui, financement de thèse envisagé/ *financial support for the PhD*:**Ecole Doctorale**

Lumière, Matière, Interactions	**x**	Lasers, Optique, Matière	**x**

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