Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 27 September 2017

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

Code d'identification : — Organisme : CNRS

Site Internet / *web site*: http://www.inln.cnrs.fr/activites/themesrecherche/atomes-froids

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

Lieu du stage / *internship place*: Sophia-Antipolis

Titre du stage / *internship title*: **Polarization of light scattered by atoms**

Résumé / *summary*

Light scattering by atoms gives rise to polarization when coherent superposition of quantum states is taking place, and the Hanle effect results from the partial decoherence caused by an external magnetic field. It is measured in the solar spectrum where it has allowed to show that weak magnetic fields are ubiquitous outside sunspots, in the so-called « quiet Sun » [1,2]. However, some puzzling anomalies have been recorded in the scattering polarization observed in some solar spectral lines, as for example the D1 line of sodium, which shows a polarization peak at its resonance frequency whereas, according to the standard scattering theory it should not be polarizable. Recently a new theoretical framework has been proposed to explain this « D1-enigma » through a quantum interference effect specific to multi-level atoms [3].

We propose to carry out a laboratory experiment to test this extended theory. A Rubidium cell will be illuminated by a monochromatic laser beam which is tuned to scan the absorption line frequencies in the D2 range. The experimental setup will be aimed at measuring with the required accuracy the scattered polarization for various configurations of the exciting laser polarization, while compensating for the Earth magnetic field.

This internship proposal results from a common interest of astrophysicists and physicists in the exploration of matter-radiation interactions in light scattering processes [4]. It is the first step into a wide field exploration, where the next step will be to extend the experiment to the D1 range (the expected polarization rates are much smaller in the D1 range). A similar experiment has been carried out by a Swiss group [3] but with potassium atoms and in slightly different conditions where the polarization may be destroyed by collisions in the atomic cell. The experiment will be carried out at INLN in collaboration with M. Faurobert from the Lagrange Laboratory (University of Nice-Sophia Antipolis and Observatory of the Côte d'Azur) together with the group of Jan Stenflo (Locarno observatory), and the group of Dr. Nagendra (Bangalore Institute for Astrophysics).

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).
[4] **Cold and hot atomic vapors: a testbed for astrophysics?**, Q. Baudouin, W. Guerin, R. Kaiser, in *Annual Review of Cold Atoms and Molecules, vol. 2* (World Scientific, 2014).

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

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

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

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