

NEXT Invited Scientists

Guest name **Tomasz KAWALEC**
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**Host laboratory in
NEXT** LCAR (Laboratoire Collisions Agrégats Réactivité)
**NEXT contact
(name and e-mail)** David Guéry-Odelin (dgo@irsamc.ups-tlse.fr)
Dates of stay From 10 June to 29 July (2017)



Brief Biodata

Tomasz Kawalec is a specialist of atom optics and more specifically on dipole traps close to a surface. He did pioneering contributions on traps made of evanescent waves. He did a post-doc in the group of D. Guéry-Odelin and contributed to the production of the first monomode guided atom laser.

Research project during the visit at NEXT

Descriptive Title Tunneling assisted by chaos

The main goal of the project is the experimental observation of the chaos-assisted tunneling of a Bose-Einstein Condensate (BEC) in a chain of dynamical double wells created in an amplitude modulated optical lattice. Pioneering experiments on this subject have been carried out in the groups of Raizen and Phillips [1,2]. The tunneling effect observed in those experiments was taking place between different momentum states. Our project focusses on the tunneling assisted by chaos between two spatial position separated by 150 nm typically. The experiment will be performed on the Toulouse setup. The implementation of a powerful laser whose phase and amplitude can be control in time is a pre-requisite. The observation of the chaos-assisted tunneling in position space requires four main consecutive steps: **1)** proper preparation of the initial state of the Bose-Einstein condensed cloud with the use of phase space rotation techniques, **2)** the loading of a chain of dynamically stable wells with the observation of the two-well structure generated by the modulation, **3)** the loading of a single island of stability (say left well) in a controlled manner, and **4)** the measurement of loading of the other well by chaos-assisted tunneling.

Bibliography

- [1] Daniel A. Steck, Windell H. Oskay, Mark G. Raizen, *Observation of Chaos-Assisted Tunneling Between Islands of Stability*, *Science* **293**, 274 (2001)
- [2] W.K. Hensinger et al., *Dynamical tunnelling of ultracold atoms*, *Nature* **412**, 52 (2001)