



Séminaire du Centre Quantum Saclay

# NONLINEAR SCHRÖDINGER EQUATIONS: HOW CAN MATHEMATICIANS BE USEFUL FOR PHYSICISTS ?!

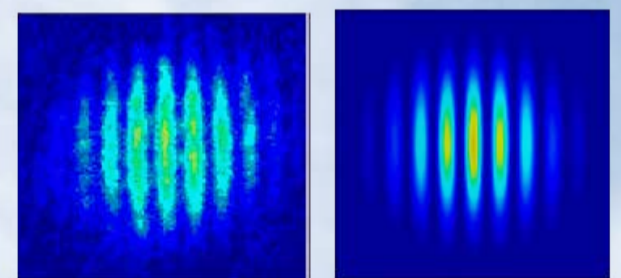


Photo ID Norbert J Mauser

**Norbert J Mauser**

WPI & Inst CNRS Pauli, Vienna

Nonlinear Schrödinger equations (NLS) are a large class of partial differential equations, including Gross Pitaevskii equations as simple mean-field models of Bose Einstein Condensates. There is a large amount of work by «pure» mathematicians on increasingly refined analysis of NLS (e.g. studies of «blow up», «semi-classical analysis» etc), but few mathematicians tackle things where (experimental) physicists could need their help most: mathematical modeling - numerical methods - computer simulations. We present selected topics in our 15 years of cooperation of mathematicians with the experimental groups at AtomInstitut Wien (Jörg Schmiedmayer, Thorsten Schumm) in the frame of the Wolfgang Pauli Institute, like efficient numerics for the «time of flight» or «Generalized HydroDynamics». We conclude with general remarks on the increasing separation of mathematics from physics at (most) universities.



experiment  
BEC on atomchip

vs  
numerical model  
simple GPE

- [1] J.-F. Mennemann, S. Erne, I. Mazets and N.J. Mauser, « The discrete Green's function method for wave packet expansion via the free Schrödinger equation », J. Comp. Phys. 511 (2024) 113131
- [2] H.P. Stimming, X. Wen and N.J. Mauser, « Adaptive absorbing boundary layer for the nonlinear Schrödinger equation », Comp. Methods in Appl. Math. 24, 3 (2024) 797-812
- [3] F. Møller, N. Besse, I. Mazets, H.P. Stimming and N.J. Mauser « The dissipative Generalized Hydrodynamic equations and their numerical solution », J. Comp. Phys. 493 (2023) 112431
- [4] J.-F. Mennemann, I. Mazets, M. Pigneur, H.P. Stimming, N.J. Mauser, J. Schmiedmayer and S. Erne, « Relaxation in an extended bosonic Josephson junction », Physical Review Research, 3(2) (2021) 023197
- [5] « Mean field dynamics of fermions and the time-dependent Hartree-Fock equation », C. Bardos C., F. Golse, A. Gottlieb and N.J. Mauser, J. Math. Pures Appl. (9) 82 (6) (2003) 665-683
- [6] « Semiclassical limit for the Schrödinger equation in a crystal with Coulomb interaction », P. Bechouche, N.J. Mauser and F. Poupaud, Comm. Pure and Appl. Math. 54 (2001) 851-890

WEDNESDAY  
DECEMBER 11,  
2024

**5 PM - 6:30 PM**

**D'ALEMBERT LECTURE HALL  
ROOM 1Z18**

**ATTENTION !  
UNUSUAL PLACE AND TIME !**

**ENS PARIS-SACLAY,  
4, avenue des Sciences  
91190 GIF-SUR-YVETTE**

