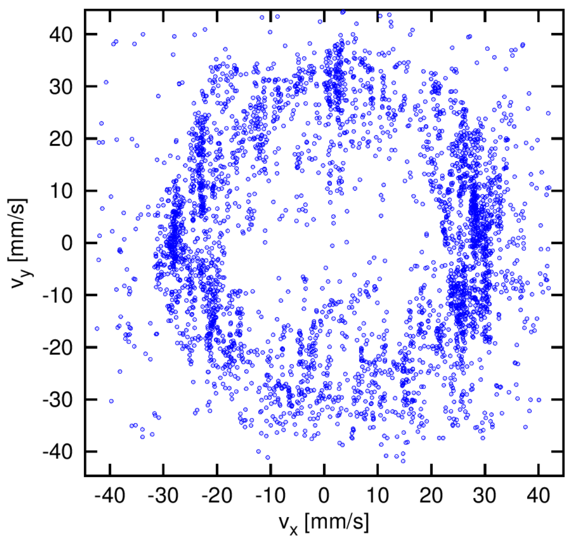
Quantum fluctuations in ultracold gases

Quantum gases are the coldest objects known, even a billion times colder than anything known to occur naturally. They are made nowadays in several tens of labs around the world, and are our best view of the quantum world on a macroscopic scale. Under these extreme conditions, the wavefunction spreads wide and atoms lose their particle nature to such a degree that a gas of thousands or millions of them becomes a collective matter wave. However – not yet completely! This crossover between the wave and particle view of the physics is highly non-trivial and many interesting phenomena await discovery there.

Evolution of phase domains after a rapid cooling of a 1d Bose gas.



Simulation of the detection of entangled atom pairs in the ANU (Canberra) experiment.

Our group at IFPAN has recently developed a number of major enhancements to the widely used “classical field” method which is used to describe the dynamics of quantum gases. Now it is time to use them to learn about phenomena that were previously hard to reach from the theoretical side. The project is to apply these new methods to study superfluid defects, collective excitations, quantum fluctuations, solitons, nonclassical correlations of entangled atom pairs, and we will see what else.

We are collaborating on these topics with several overseas experimental groups (Canberra, Paris, Vienna) and theoretical groups (Newcastle on Tyne, Brisbane, New Zealand).

The project requires a willingness to learn numerical skills – which we will gladly help you with!

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