PRELIMINARY PROGRAM

Monday	Tuesday	Wednesday
10-11 Jacobson(A.Fabbri)	10-10:45 Parentani	10-11 Volovik
	10:45-11:15Macher	
coffee break	coffee break	coffee break
12-13 Cornell	12-13 Garay	12-13 Leonhardt
lunch	lunch	lunch
15-15:45 Balbinot	15-15:45 Josse	15-16 Rousseaux
15:45-16:15 Anderson	15:45-16:30 M.Modugno	
16:15-17 Carusotto	coffee break	coffee break
coffee break	17-17:30 Floreanini	17-17:45 Giovanazzi
17:30 Discussion		

Thursday	Friday	Saturday
10-11 Pitaevski	10-11 Unruh	10- Wrap-up round table: Hawking radiation, future perspectives
coffee break	coffee break	
12-13 G. Modugno	12-13 Westbrook	
lunch	lunch	
15-16 Koehl	15-16 Reznik	
coffee break	coffee break	
17-18 Schutzhold	17-17:45 Gaburro	

ABSTRACTS

Roberto Balbinot and Paul Anderson

Non local density correlations as a signature of Hawking radiation from acoustic black holes in Bose-Einstein Condensates (part 1 and part 2)

Iacopo Carusotto

Non local density correlations as a signature from acoustic black holes in Bose-Einstein Condensates: Numerical experiments

We report numerical evidence of Hawking emission of Bogoliubov phonons from a sonic horizon in a flowing one-dimensional atomic Bose-Einstein condensate. The presence of Hawking radiation is revealed from peculiar long-range patterns in the density-density correlation function of the gas. Quantitative agreement between our fully microscopic calculations and the prediction of analog models is obtained in the hydrodynamic limit. New features are predicted and the robustness of the Hawking signal against a finite temperature discussed.

Eric Cornell

Introduction to Bose-Einstein condensates

Roberto Floreanini

Quantum measuring processes for trapped ultracold atoms

Phase-coherence in ultracold atoms trapped in optical lattices is usually investigated by means of absorption images of the freely expanding atomic cloud after trap release. Quantum mechanically this procedure can be described by a generalized measure, based on fixed- phase, coherent-like states. We discuss this choice in relation to the existing experimental evidences, focusing in particular on density-density correlation profiles.

Zeno Gaburro

Photonic energy lifters and event horizons with time-dependent dielectric structures

Novel photonic devices, based on time-dependent dielectrics, to shift the optical frequency, may be conceived from two complementary principles, Doppler shift and time refraction, and possibly realized as as single cavities or as Coupled Resonator Optical Waveguides (CROWs). Simulations with the finite-difference time-domain method bore out these possibilities and also provided design rules. Preliminary experiments, limited to a pulsed excitation (without any frequency shift) of whispering gallery modes in a LiNbO3 whispering gallery disk resonator in a full fiber-optics setup, the first experiments of an optical whispering-gallery resonator functioning in the steady-pulsed regime, led to a consistent Q-factor measurement between CW and pulsed ringdown characterization. The repetition rate was tuned to an integer submultiple 1/N of the free spectral range of the resonator. The output rate of the resonator was equal to the input rate multiplied by N, thereby showing functionality as a frequency multiplier. The impact of nonlinearity and of dispersion was minimized by the low power level and the limited bandwidth of pulses.

Luis Garay

Sensitivity of Hawking radiation to superluminal dispersion relations

We analyze the Hawking radiation process due to collapsing configurations in the presence of superluminal modifications of the dispersion relation. With such superluminal dispersion relations, the horizon effectively becomes a frequency-dependent concept. In particular, at every moment of the collapse, there is a critical frequency above which no horizon is experienced. We show that, as a consequence, the late-time radiation suffers strong modifications, both quantitative and qualitative, compared to the standard Hawking picture. Concretely, we show that the radiation spectrum becomes dependent on the measuring time, on the surface gravities associated with different frequencies, and on the critical frequency. Even if the critical frequency is well above the Planck scale, important modifications still show up.

Stefano Giovanazzi

Hawking radiation in Bose and Fermi quantum degenerate gases

The perspective of experimentally investigating the hydrodynamic analogue of Hawking radiation in quantum degenerate gases is discussed. The major focus of the talk is the comparison of the Bose and Fermi quantum fluids as candidate for the experimental realization.

Ted Jacobson (A. Fabbri)
Introduction to black holes, Hawking radiation and the gravitational analogy

Vincent Josse
The guided atom laser: a new tool for studying quantum transport phenomena

We develop recently a new kind of atom laser : instead of being accelerated down by gravity, the matterwave propagates horizontally in an optical waveguide. This original configuration enables to a get a quasi "monochromatic" beam with large and constant de Broglie wavelength (around $\Lambda_d B = 1m$) over large distances (typically 1mm). Such well controlled atomic coherent source is therefore well suited to study linear or nonlinear quantum transport over obstacles, like tunneling effect, the atomic blockade through a double barrier or Anderson localization over disorder. In the presentation, I will describe the basic properties of our atom lasers and discuss about our future plans.

Michael Koehl
Supersonic motion of impurities in a Bose gas

Cold atomic gases are systems of unrivalled purity. Many of their extraordinary features have been studied in the past years and exceptional experimental control of quantum many-body states has been achieved. In real materials, however, impurities often play a decisive role. For example, they can destroy macroscopic phase coherence and they affect quantum transport. We discuss our recent experiments with impurities in atomic Bose-Einstein condensates. We have created spin impurities in one-dimensional Bose gases in the strongly interacting regime (Tonks gas). The transport of the impurities through the Bose gas has been studied even at supersonic velocities. Moreover, we will discuss our new approach towards implementing charged impurities in a Bose-Einstein condensate.

Ulf Leonhardt
Fibre-optical analogue of the event horizon

The physics at the event horizon resembles the behavior of waves in moving media. Horizons are formed where the local speed of the medium exceeds the wave velocity. We use ultrashort pulses in microstructured optical fibers to demonstrate the formation of an artificial event horizon in optics. We observed a classical optical effect, the blue-shifting of light at a white-hole horizon. We also show by theoretical calculations that such a system is capable of probing the quantum effects of horizons, in particular Hawking radiation.

Giovanni Modugno
A Bose gas with widely tunable interaction

We explore the properties of a Bose-Einstein condensate of potassium-39 atoms, where the contact interaction can be tuned over a large range of values at a broad Feshbach resonance. A Bloch oscillation interferometer allows us to evidence a weak dipole-dipole interaction in a region of vanishing contact interaction. The study of three-body losses across the resonance reveals us the presence of multiple Efimov states. Finally, we exploit the possibility of dynamically adjusting the contact interaction to study disorder-related physics.

Michele Modugno
Dynamical instability, dispersion management and parametric instability of a Bose-Einstein condensate

I will review the behavior of a BEC moving in the presence of a 1D optical lattice by discussing the instability regimes of the superfluid flow and the possibility to manage the dispersion by tuning the lattice velocity and the nature of interactions. I will also discuss the occurrence of parametric instabilities for a BEC in a cylindrical wave guide under modulation of the transverse confinement, and how this feature can be used for spectroscopic applications.

Renaud Parentani and Jean Macher
Spectral properties of black hole radiation in BEC (part 1 and part 2)

We first explain why Black Hole radiation in BEC is governed by an enlarged Bogoliubov transformation which encodes three different processes. The enlargement arises from the dispersive properties of the Bogoliubov-de Gennes equation. We then numerically compute the coefficients of this transformation, and interpret the results.

Lev Pitaevski
TBA

Benni Reznik
Hawking radiation in an acoustic black holes on a ion ring

I will present results on the simulation of acoustic black holes and Hawking radiation on an ion ring. Ion rings, which have already been realized experimentally, represent ion chains with periodic boundary conditions. If the ions are rotating with a stationary and inhomogeneous velocity profile, regions can appear, where the ion velocity exceeds the group velocity of the phonons. In these regions phonons are trapped like photons in black holes.

Exploiting this analogy known for hydrodynamic systems, we give evidence for the prediction of the thermal distribution of Hawking radiation and present a realistic experimental scenario to measure Hawking radiation. Thus, we propose for the first time an experiment to detect Hawking radiation in a discrete analogue of space-time with a nonlinear dispersion relation.

Germain Rousseaux
What classical fluid mechanics can teach us on Hawking radiation

I will present a review on the interaction between water waves and a current with its possible application to the observation of a stimulated-like Hawking radiation. Then, our recent water-channel experiments in Nice will be discussed : I will show a movie displaying negative energy waves. If time permits, I will speak of the application of Thom's catastrophe theory to the understanding of wave propagation in the vicinity of fluid and gravitational horizons with the help of an analogy with the optical rainbow. Some of our current experimental work will be addressed.

Ralf Schuetzhold
Observability of a Hawking radiation in BEC: problems and open questions

Bill Unruh
Where are particles created?

Black hole evaporation is still a mystery after 33 years. What is it that creates the particles near a black hole horizon? Using the behaviour of dumb holes– analogs of black holes in which a similar process creates particles– I will stengthen the argument that they are created at low frequencies/long wavelengths (of order the black hole horizon length) rather than being an ultr high frequency phenomenon.

Grisha Volvik
Problems of horizon in effective gravity

We discuss effects of event horizons and ergoregions in effective gravity emerging in condensed matter systems: sonic gravity in superfluid 4He and BEC; gravity emerging in fermionic systems near the Fermi points; and gravity for ripplons on the surface of liquid or at the interface between two superfluids. Hawking radiation is discussed for the analog of the black-hole horizons and for de Sitter expansion. While the semiclassical tunneling approach gives the similar results for Hawking radiation from the black hole and from de Sitter cosmological horizons, the radiation from the de Sitter horizon still remains the problem. Tunneling approach to the radiation from ergoregion (analog of Zeldovich-Starobinsky effect) and from objects rotating in superfluid vacuum (rotational Unruh effect) is also discussed. The condensed matter systems (especially experiments with liquids and superfluids, which demonstrate the instability of the vacuum in ergoregion) teach us that the behavior

of the quantum vacuum in the presence of a horizon and an ergoregion may have more serious consequences than the Hawking radiation. Vacuum typically resists to formation of a horizon, or if the horizon is formed, the instability may develop inside the horizon destroying the black hole. Finally we suggest the theory of the self-sustained Lorentz invariant vacuum, which is based on the condensed matter experience and which may be used to handle the problems of event horizons and ergoregions in general relativity.

Chris Westbrook

Producing and detecting correlations in quantum degenerate gases

In our laboratory, we have been developing measurement methods to extract at two-particle correlations functions in degenerate gases. Simple examples include the observation of correlated atom pairs in a four wave mixing geometry, and Hanbury Brown-Twiss type interferometry. In these experiments we observe the correlations in momentum space. We have also been able to observe density fluctuations in position space by using in situ imaging on an atom chip. I will attempt to review some of the possibilities open to us and discuss some of our plans for the immediate future.