University of Trento, May 27, 2027

Lev Pitaevskii: From Moscow to Trento

Sandro Stringari
Pitaevskii Center on Bose-Einstein Condensation

UNIVERSITÀ DI TRENTO

CNR-INO
ISTITUTO NAZIONALE DI OTTICA
CONSIGLIO NAZIONALE DELLE RICERCHE

PROVINCIA AUTONOMA DI TRENTO

Lev Pitaevskii is worldwide known as

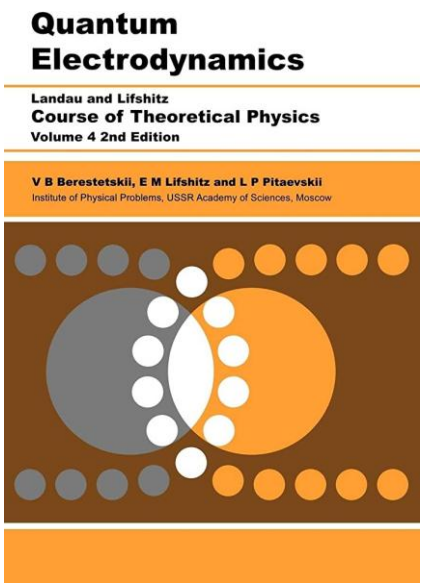
- Outstanding member of the prestigious **Landau's school**

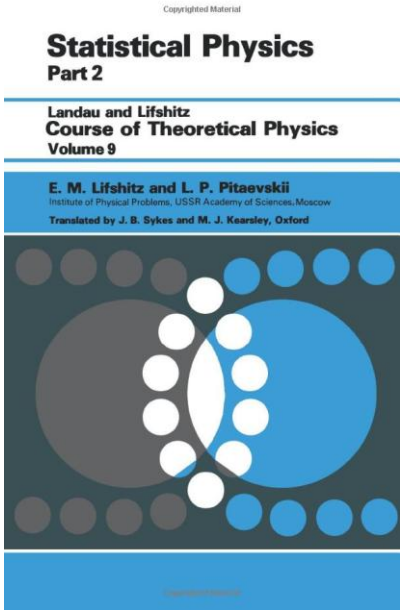
- Coauthor of the last volumes of
  Landau-Lifschitz course on Theoretical Physics

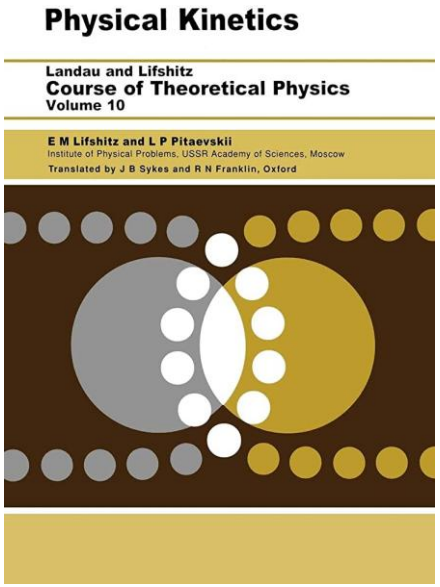
- Author of seminal works on
  - Theory of **van der Waals** and **Casimir forces**
  - Excitation spectrum of **superfluid helium**
  - Theory of **Plasma Physics**
  - Theory of **dilute Bose gases** (Gross-Pitaevskii equation)

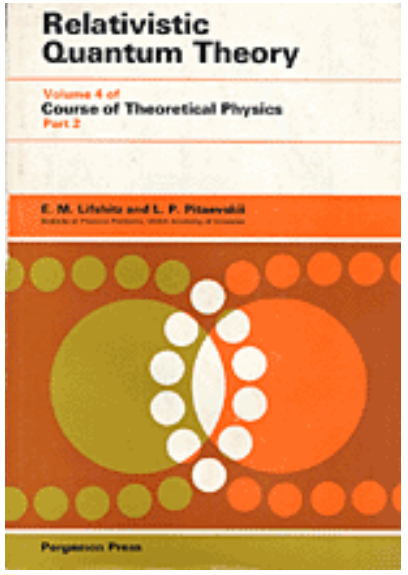
Landau's group in Moscow, 1956. Are sitting: L. Prozorova, A. Abrikosov, I. Khalatnikov, L. Landau, E. Lifshitz. Are standing: S. Gershtein, Lev, L. Vainshtein, R. Arkhipov, I. Dzyaloshinskii

Books of the Landau-Lfshitz series written by Pitaevskii and Lifshitz









SOVIET PHYSICS JETP VOLUME 13, NUMBER 2 AUGUST, 1961

VORTEX LINES IN AN IMPERFECT BOSE GAS

L. P. PITAEVSKII

Institute of Earth Magnetism, Ionosphere and Radio Wave Propagation,
Academy of Sciences, U.S.S.R.

Submitted to JETP editor September 14, 1960

J. Exptl. Theoret. Phys. (U.S.S.R.) **40**, 646-651 (February, 1961)

It is shown that the vortex lines possessing a thickness which is inversely proportional to the square root of the gas density and of the intensity of the interaction may exist in Bose gases with weak repulsion between the atoms. The energy of a vortex line is computed. It is also shown that in the presence of a vortex line a branch appears in the energy spectrum of the gas which corresponds to oscillations of the vortex.

- The theory of interacting Bose-Einstein condensates was first introduced in the seminal papers by Gross and Pitaevskii (1961)

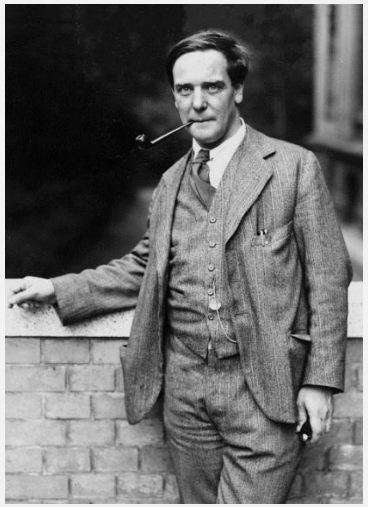
$$i\hbar\partial_t \Psi = \left(-\frac{\hbar^2}{2m}\nabla^2 + V_{ext} + g\,|\Psi|^2 \right)\Psi$$

- Gross-Pitaevskii equation:
  quantum equation for a **classical** field

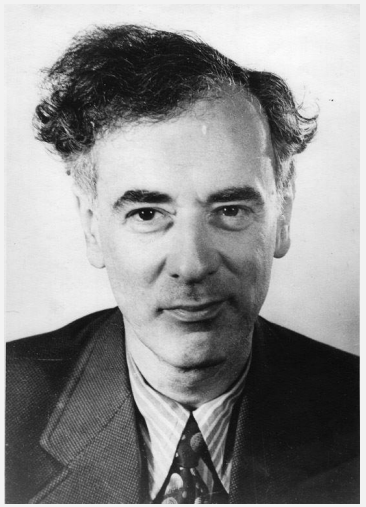
- Crucial role of **non linearity** in the description of the dynamc and superfluid properties

Lev Pitaevski's life has crossed paths with the greatest Russian scientists of the last century, living the dramatic times of the Soviet Union.

Among them Pyotr Kapitza and Lev Landau played an important role in the scientific and personal life of Lev



Pyotr Kapitza (1894-1984)
Nobel Prize 1972



Lev Landau (1908-1968)
Nobel Prize 1962

Lev Pitaevski's life has crossed paths with the greatest Russian scientists of the last ce… the dramatic times of the Soviet U…

See Michail Liberman's talk after the coffee break

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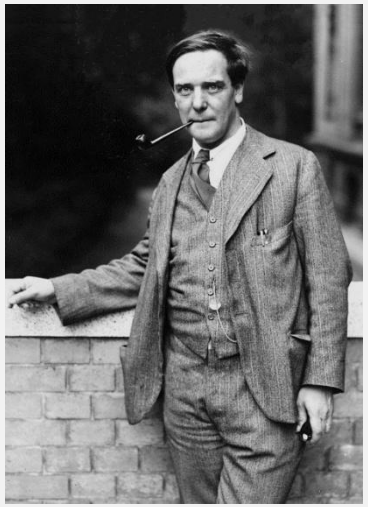

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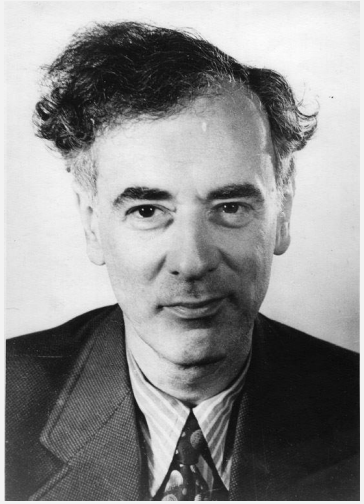

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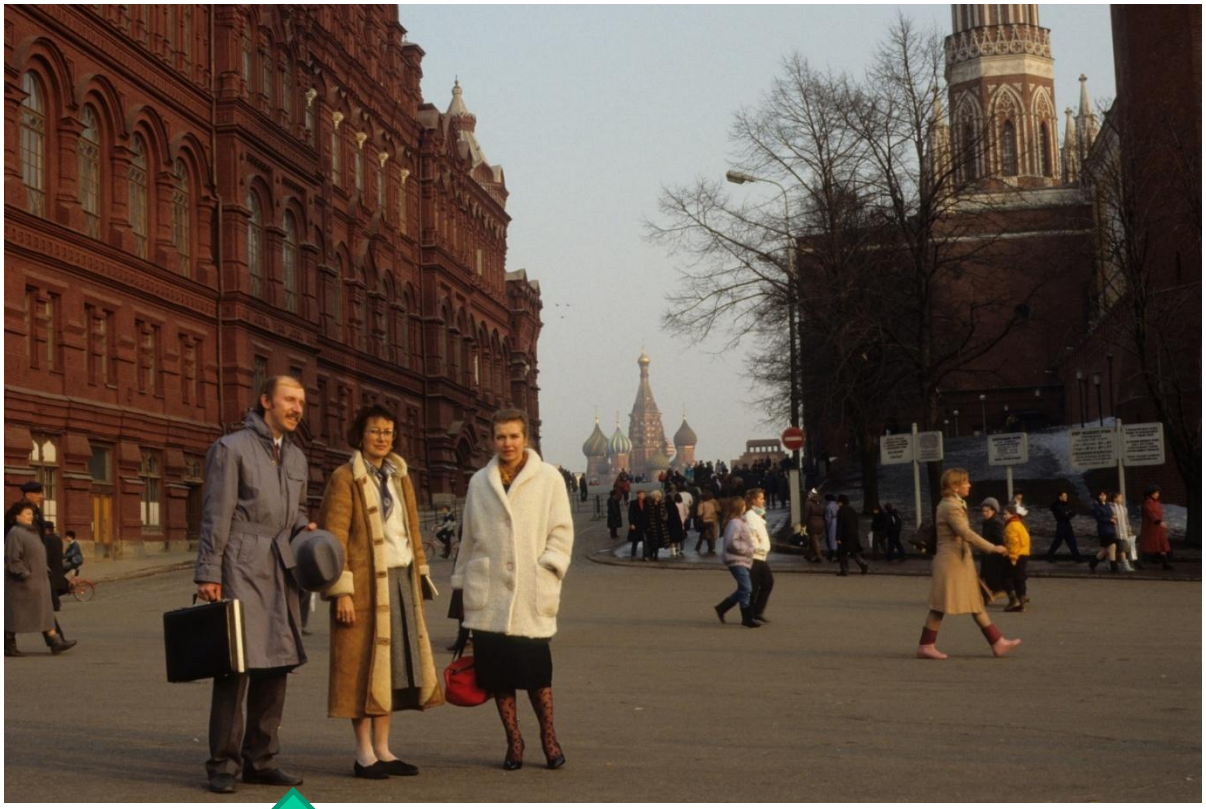
From Moscow to Trento

In 1988 I met Lev at the Kapitza Institute in Moscow



My host in Moscow: Eugene Bashkin

How did I succeed in convincing Lev to move to Trento ?

Thanks to a scientific paper that I had written with Franco Dalfovo a few months before,

VOLUME 63, NUMBER 5 PHYSICAL REVIEW LETTERS 31 JULY 1989

Sum Rules and Spin Multipair Excitations in Liquid ^{3}He

F. Dalfovo and S. Stringari
Dipartimento di Fisica, Università di Trento, 38050 Povo, Italy
and Istituto Nazionale di Fisica Nucleare, Gruppo Collegato di Trento, 38050 Povo, Italy
(Received 11 April 1988)

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Sum rules provide a natural link between **microscopic** and **macroscopic** world !

This was a strong scientifc argument to convince Lev that Trento could become a novel scientific adventure

First Lev's visit to Trento

Please Post

First and Last Announcement

The Dipartimento di Fisica dell'Università di Trento will organize an informal workshop on

CLUSTERS OF QUANTUM LIQUIDS

Villa Madruzzo, Trento - Italy
june 5-6, 1989

- The purpose of the workshop is to bring together experimentalists and theorists working in the area of clusters of quantum liquids (mainly helium clusters).

- Possible topics of discussion are: ground state properties, elementary excitations, statistical properties, superfluidity, scattering of atoms and molecules, interaction with electrons, impurities and spectroscopy.

- The workshop will be organized in the form of oral contributions followed by informal discussions.

- Preliminary list of participants : D. Bassi (Trento), M. Casas (Palma de Mallorca), R. Colle (Pisa), F. Dalfovo (Grenoble), J. Dupont-Roc (Paris), A. Fabrocini (Pisa), S. Fantoni (Lecce), H. Haberland (Freiburg), I. Lagaris (Ioannina), P. Leiderer (Konstanz), J. Northby (Kingston), M. Papoular (Grenoble), L. Pitaevskii (Moscow), S. Pieper (Argonne), F. Pobell (Bayreuth), T. Regge (Torino), G. Scoles (Princeton), P. Toennies (Gottingen), J. Treiner (Orsay), G. Viliani (Trento), B. Whaley (Berkeley).

- People whishing to attend the workshop and present a contribution should return the attached form before **may 7, 1989** to : *S. Stringari, Dipartimento di Fisica, Università di Trento, 38050 Povo, Italy (phone number: 461-881529; electronic address: STRINGAR at ITNCISCA; telefax 461-881696)*

Luba and Lev in Milano

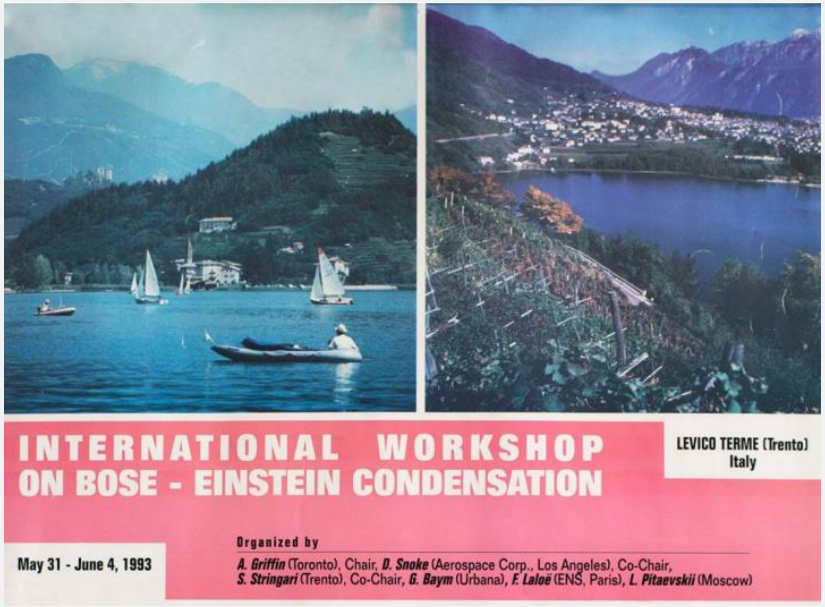
- In the decade 1989 – 1998 Lev visited Trento in a regular way as visiting researcher, also during his 4 year stay in Haifa (Israel)

- In 1998 he became full professor of the University of Trento. He then moved to Trento in a permanent way

First Lev's collaborations (before 1995) with Trento concerned

- Superfluidity of Helium clusters
- Quantum Evaporation in superfluid Helium
- Generalization of Hohenberg-Mermin-Wagner theorem to T=0
- Effects of disorder in dilute Bose gases

- Scientific organization of the Levico BEC workshop in 1993



- The BEC workshop is now organized every 2 years involving the best scientists working in the field .

After the experimental realization of BEC in atomic gases in 1995

Lev started collaborating with the Trento team in the new field of ultracold gases where the **Gross-Pitaevskii equation** soon emerged as the basic theoretical tool to attack the large variety of theoretical and experimental issues (about 1000 scientific papers refer to the Gross-Pitaevskii equation in their title !)

Lev's scientific presence in Trento has accompanied the growth of the weight of the Trento team in the international community.

BEC group in Trento, 2002.
F. Dalfovo, M. Cozzini, G. Astrakharchick, S. Stringari,
P. Pedri, Lev, C. Menotti, M. Kraemer, S. Giorgini

Many collaborations with the **Trento team** as well as with **other labs around the world** (Florence, Innsbruck, ENS Paris, Jila-Colorado, MIT, Barcelona, Institut d'Optique …) (about 100 papers)

- Thermodynamics and critical temperature of BEC gases
- Casimir-Polder Force
- Momentum distribution and Bragg scattering
- Landau damping in dilute Bose gases
- First and second sound in dilute Bose gases
- Second sound in superfluid Fermi gases
- Propagation of sound in 2D Bose gases
- Interference in momentum space
- Motion of heavy impurities
- Magnetic vortices and vortex pairs
- Propagation of solitons
- Spin Orbit Coupled gases and supersolidity

Two examples of
successful international collaborations

Mauro Antezza PhD Defense, Trento, 13 Oct 2006

Thermal dependence of the Casimir-Polder-Lifshitz force and its effect on ultracold gases

Obrecht, Wild, Antezza, Pitaevskii, Stringari, Cornell, PRL 98, 063201 (2007)

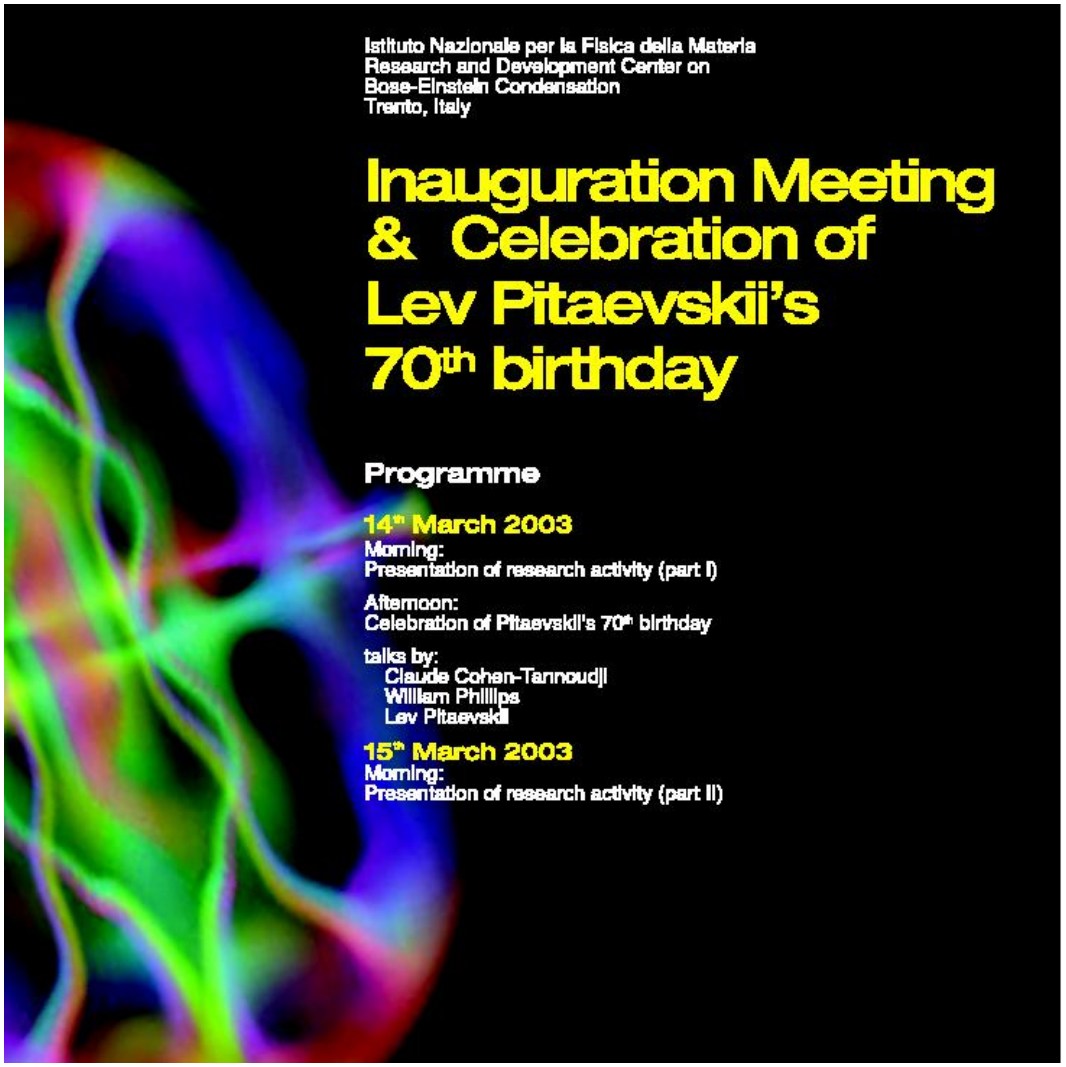
Measurement of **second sound and superfluid density** in a strongly interacting Fermi gas (Innsbruck-Trento collaboration)

On the roof of IBK Institute

Sidorenkov, Tey, Grimm, How, Pitaevskii and Stringari, Nature **498**, 78 (2013)

Rudi Grimm (Innsbruck) was expected to attend the commemoration, but a virus caught him and he could not reach us today. This morning he sent this message:

"One of the greatest experiences of my scientific life was our collaboration on second sound and the superfluid phase transition. Having Lev on the team guided us - the experimentalists from Innsbruck - not only with crucial physical insights, but it also provided a profound source of personal inspiration. Lev represented a direct link to the historic foundations of our field and to the groundbreaking work of Landau's group on the theory of superfluidity. Our joint work remains a wonderful example of a true synergy between theory and experiment, and a definitive highlight of my career. It was a great honor to be a part of it."



Istituto Nazionale per la Fisica della Materia
Research and Development Center on
Bose-Einstein Condensation
Trento, Italy

Inauguration Meeting & Celebration of Lev Pitaevskii's 70th birthday

Programme

14th March 2003
Morning:
Presentation of research activity (part I)

Afternoon:
Celebration of Pitaevskii's 70th birthday

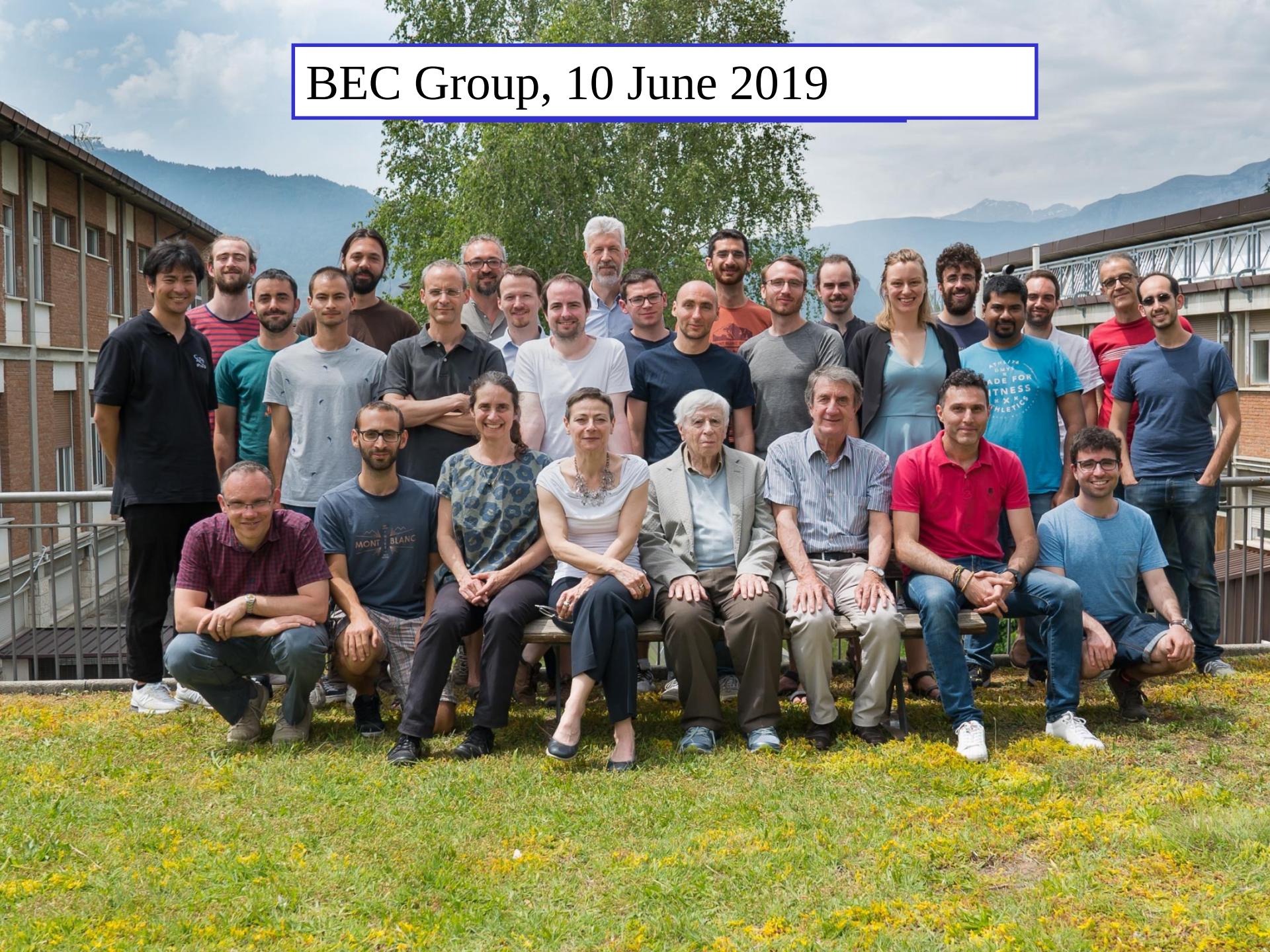
talks by:
- Claude Cohen-Tannoudji
- William Phillips
- Lev Pitaevskii

15th March 2003
Morning:
Presentation of research activity (part II)

‘Aquila di San Venceslao’
Trento Award
to Lev Pitaevskii (2003)

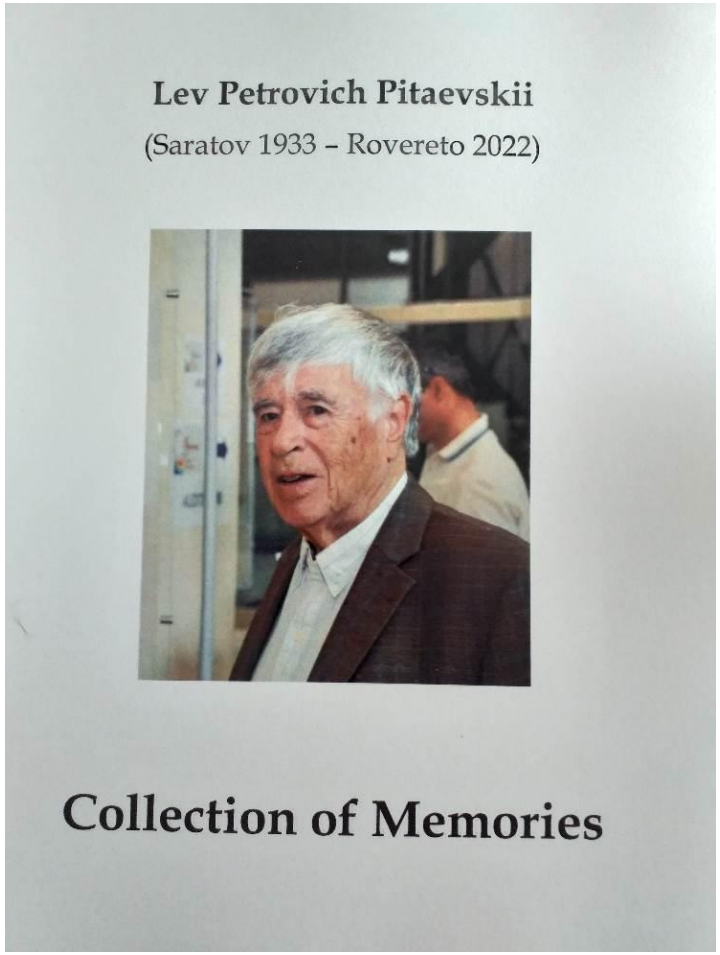
St. Feliu BEC Conference (Sept 2019)
BEC Senior Award: LP and SS
BEC Junior Award: Francesca Ferlaino

BEC Group, 10 June 2019



Due to the profound and longstanding role played by Lev in the scientific life of the Trento BEC Center and the corresponding worldwide recognition, after Lev's death our Center has been renamed

Pitaevskii Center on Bose-Einstein Condensation



(Booklet available at the Pitaevskii BEC Center)

Bill Phillips (NIST and Maryland University),
Nobel Prize in Physics 1997

Lev prepared our community for how to think about quantum degenerate gases **before we even existed as a cold atomic gas community**, and he continued to enrich the Trento and the worldwide community with his intellect.
He was indeed a great physicist, a teacher, and a friend.

Thanks for your attention