

PERSONAL INFORMATION

Ritsch Helmut:

Theoretical Physics, University of Innsbruck

Researcher unique identifier(s): [ID: L-4704-2016](#), see also: [google scholar](#), [research gate](#)

Date of birth: 12.03.1962

Nationality: Austria

URL for web site: <https://www.uibk.ac.at/th-physik/cqed/research.htm>

EDUCATION

1993 Habilitation (venia docendi) in Theoretical Physics
1989 Ph.D. in Physics, Theoretical Physics Institute, University of Innsbruck, Austria

CAREER POSITIONS

2016 – pres. Head of Theoretical Physics Institute at University of Innsbruck
2011 – Professor, Theoretical Physics Institute, University of Innsbruck
1998 - 2011 Associate Professor
1996 – 1997 Marie Curie scholarship at university of Milano
1993 – 1996 Universitätsdozent (Assistant Professor)
1989 – 1993 various Postdoc, research assistant positions and scholarships
 in Innsbruck, Konstanz, Milano, Boulder, Munich

FELLOWSHIPS AND AWARDS

2019 Erwin Schrödinger Award of the Austrian Academy of Sciences
2008 SUPA distinguished visitor award, Glasgow
2004 Dr. Otto Seibert Wissenschaftspreis
1993 Ludwig-Boltzmann-Award of the Austrian Physical Society
1992 Research Award of the City of Innsbruck

SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS

28 Ph.-D.-students supervised in Innsbruck (3 current)
17 Postdoctoral fellows from peer reviewed research grants (3 current)

TEACHING ACTIVITIES

1993 – more than **38** main lecture courses for students in physics in Innsbruck
2003 & 2009 Guest professor for photonics + optoelectronics, TU Vienna
2004 Advanced school on field-atom surface interactions, Les Houches, France
2011 From C-QED with quantum gases to opto-mechanics, TaCoNa-Photonics
2023 Ultracold Atoms and Molecules, Bad Honnef School, Aug. 2023

ORGANISATION OF SCIENTIFIC MEETINGS

2002 - 2024 International Quantum Optics Conference in Obergurgl, 10x times chair / vice chair
 2013 Cavity Optomechanics workshop: from micro- to macro scale, Innsbruck
 2009 Cavity Cooling of atoms, molecules and ions, CCQED-meeting, Obergurgl

COMMISSIONS OF TRUST

2023- advisory board of Carl Zeiss Stiftung
 2021-23 ERC Panel
 2015 - DAE Board: Physical Review Letters
 2014 –21 Editorial Board, Journal of Physics B/ IOP/ GB
 2003 - Reviewing for national funding agencies:
 DFG Germany, ANR France, NSF USA, EPSRC GB, MIUR Italy, Marsden Fund,
 Fondecyt, Rustaveli, Foundation for Polish Science, Hungary, ESF Estonia
 2002 – Review panel member EU: ITN, FET, EURYI, QIPC, ERC,
 ----- Referee for IOP, EPS, APS, OSA, NPG, Science EPJD

INTERNATIONAL COLLABORATIONS

- Peter Domokos, Ultracold atom cavity QED Wigner Institute, Budapest
- Tilmann Esslinger and Tobias Donner, Ultracold Gas Quantum Optics, ETH, Zürich
- Jean Philippe Brantut, Ultracold Fermion Quantum Optics, EPFL, Lausanne
- Giovanna Morigi +Jürgen Eschner, Selfordering in Optical Resonators, Universität Saarbrücken
- Jun Ye & Murray Holland, Atomic clocks, super-radiant lasers, JILA, Boulder
- Ticijana Ban, Zagreb, Frequency comb self-ordering and collective cooling
- Maria Moreno-Cardoner, Dipolar nanophotonics, Universitat Autònoma de Barcelona
- Claudiu Genes, Molecular quantum optics, MPL Erlangen
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RECENT GRANTS

<i>Title</i>	<i>Funding source</i>	<i>Amount</i>	<i>Period</i>	<i>Role</i>	
QuantA	FWF-Excellence	€ 240.000.-	2023 - 2027	KR	Collective quantum dynamics
IQCLOCK	EU-Flagship	\$ 385.000.-	2018 - 2021	PI	super-radiant laser clock shifts induced by BBR
DK-ALM	FWF-Austria	€ 235.000.-	2016 - 2023	PI	Atoms Light and Molecules:
MOSAIC	EU ITN	€ 264.207.-	2020 - 2024	PI	Superradiant lasers
CRYST3	EU-FETOPEN	€ 324.875.-	2021-2025	PI	Hollow core fibers

Research track-record ([Researcher ID: L-4704-2016](#))

My Innsbruck theoretical physics group works in AMO physics with emphasis on quantum optics, fundamental quantum physics, ultracold quantum gases and quantum simulation. In the past decade we put forward foundational contributions of cavity cooling, ranging from ultra-cold gases, large molecules, nano-particles to opto-mechanics. Merging traditional quantum optics with ultra-cold gas physics we predicted and analysed new atom-field self-ordering phenomena and emerging exotic quantum phases as super solids, edge states and spin spiral phases.

Besides fundamental theoretical aspects of light-matter interaction I strongly target a wide range of experimental and practical quantum optics applications ranging from laser cooling of solids, heat gradient driven lasing and cooling, self-learning optimal light collection systems, super-radiant optical atomic clocks or cavity enhanced quantum simulation and simulated annealing.

Selected relevant publications : chosen among >200 peer reviewed publications

- **Density-wave ordering in a unitary Fermi gas with photon-mediated interactions**, Helson, V., et. al, *Nature* 2023, 28 May
<https://doi.org/10.1038/s41586-023-06018-3>
- **Cavity qed with quantum gases: New paradigms in many-body physics**. Mivehvar, Farokh, Francesco Piazza, Tobias Donner, and Helmut Ritsch, *Advances in Physics* 70, 1-153 (2021)
<https://doi.org/10.1080/00018732.2021.1969727>
- **Emergent quasicrystalline symmetry in light-induced quantum phase transitions** Mivehvar, Farokh, Helmut Ritsch, and Francesco Piazza, *PRL* 123.21 (2019): 210604.
[doi:10.1103/PhysRevLett.107.060502](https://doi.org/10.1103/PhysRevLett.107.060502)
- **Attractive force on atoms due to blackbody radiation**, Haslinger, P.; Jaffe, M.; Xu, V.; Schwartz, O.; Sonleitner, M.; Ritsch-Marte, M.; Ritsch, H.; Müller, H., *Nature Physics* 14, pp. 257 (2018),
doi.org/10.1038/s41567-017-0004-9
- **Cavity Antiresonance Spectroscopy of Dipole Coupled Subradiant Arrays**. Plankensteiner, D.; Sommer, C.; Ritsch, H.; Genes, C, *PRL* 119/9, 93601 (2017)
doi.org/10.1103/PhysRevLett.119.093601
- **Attractive optical forces from black-body radiation**, Sonleitner, Matthias; Ritsch-Marte, Monika; Ritsch, Helmut; *PRL*, 111, 2, 23601, 2013,
[doi:10.1103/PhysRevLett.111.023601](https://doi.org/10.1103/PhysRevLett.111.023601)
- **Spontaneous crystallization of light and ultracold atoms**, Ostermann, Stefan and Piazza, Francesco and Ritsch, Helmut, *PRX*, 6, 021026, (2016),
[doi:10.1103/PhysRevX.6.021026](https://doi.org/10.1103/PhysRevX.6.021026)
- **Self-ordering and collective dynamics of transversely illuminated point-scatterers in a 1D trap**, D. Holzmann, M. Sonleitner, H. Ritsch, *EPJD*, 68, 352(2014),
[doi:10.1140/epjd/e2014-50692-2](https://doi.org/10.1140/epjd/e2014-50692-2)
- **A superradiant clock laser on a magic wavelength optical lattice**, T. Maier, S. Krämer, L. Ostermann, H. Ritsch, *Optics Express* 22 11, 13269 (2014),
[doi:10.1364/OE.22.013269](https://doi.org/10.1364/OE.22.013269)
- **Cold atoms in cavity-generated dynamical optical potentials**, Ritsch, Helmut; Domokos, Peter; Brennecke, Ferdinand; Esslinger, Tilman; *Reviews of Modern Physics*, 85, 2, 553 (2013)
[doi:10.1103/RevModPhys.85.553](https://doi.org/10.1103/RevModPhys.85.553)

Invited presentations to peer-reviewed, internationally established conferences:

- **Nano photonics with structured quantum emitter arrays**,
[Discussions on Nano & Mesoscopic Optics](#), Svolvaer, Norway, April 2023 & Siglufjörður, Island May 2017
- **Nonlinear nano-optical devices based on coupled quantum emitter arrays**. 53rd Annual Meeting of the APS (DAMOP), Orlando, 02.06.2022
- **Minimalistic nano-optical devices using dipole coupled quantum emitters**. BeyondC, 2022 - Frontiers of Quantum Information Science, Wien, 05.09.2022
- **Subradiance and entanglement in ultrastrong coupling of quantum emitters and light**, [QNO 2018](#), Kuala Lumpur, Feb 2018
- **Selfordering and Adaptive Light Collection by Mobile Scatterers in Resonators**, [Discussions on Nano & Mesoscopic Optics](#), El Chaltén, Patagonia, Argentina, April 2015 & Siglufjörður, Island May 2017
- **Spontaneous crystallization of light and ultracold atoms in free space**, [CoScaLi IV](#): Workshop on Collective Scattering of Light, Ubatuba, 2016-05
- **Cavity QED with ultracold quantum gases**, [22nd International Conference on Atomic Physics](#) (plenary, Cairns, Australia, July 2010)

Patent: European Patent 19154787.6-1002/3690355: *Fibre refrigeration device* (2021)