

Bhavesh Kharbanda

Eidgenössische Technische Hochschule Zürich

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Education

Program	Institution	%/CGPA	Graduation
○ Doctorate in <i>Physics</i>	○ Eidgenössische Technische Hochschule Zürich	○	○ 2027
○ Master of Science in <i>Optics and Photonics</i>	○ Karlsruhe Institute of Technology, Germany	○ 1.2	○ 2022
○ Bachelor of Technology in <i>Engineering Physics</i>	○ Indian Institute of Technology Madras, Chennai	○ 8.31/10.00	○ 2019
○ XII Standard (C.B.S.E.)	○ Durga Public School, Solan, Himachal Pradesh	○ 95.2%	○ 2015

Research Interests

- Optomechanics
- Bio-Inspired Optics
- Quantum Sensing

References

Supervisor/Professor	Institution	Role	Email Address
○ Dr A Eichler, Prof C Degen	○ ETH Zürich	○ Doctorate Thesis Supervisor	○ eichlera@phys.ethz.ch , degenc@ethz.ch
○ Dr T Segawa, Prof C Degen	○ ETH Zürich	○ Master's Thesis Supervisor	○ takuya.segawa@phys.chem.ethz.ch , degenc@ethz.ch
○ Prof D Hunger	○ KIT, Karlsruhe	○ Project and Course Supervisor	○ david.hunger@kit.edu
○ MSc T Sägger, Prof J Home	○ ETH Zürich	○ Internship Supervisor	○ tobiass@phys.ethz.ch , jhome@ethz.ch
○ Asso. Prof B Roy	○ IIT Madras	○ Bachelor's Thesis Supervisor	○ basudev@iitm.ac.in

Scholastic Achievements

- Awarded **Spin Lab's Scholarship** (under special provision) for Master's Thesis at ETH Zürich. 2021
- Awarded **KSOP Bosch® Scholarship** for student excellence at KIT Germany during Master studies. 2019-21
- **All India Rank 14** (99.82 percentile) in the Joint Entrance Screening Test (JEST) for Physics PhD admissions. 2019
- **Merit-cum-Means Scholarship** awardee during Bachelor studies at IIT Madras. 2015-19
- **National top 190** amongst Physics undergraduates for Summer Research Fellowship by IAS, Bengaluru. 2017
- Secured a **national rank of 1863** among 152 thousand students in IIT Joint Entrance Examination Advanced. 2015
- **1st place** in Physics and Maths Exams at **INSPIRE State Science Camp** by Ministry of Science & Technology. 2014

Publications

- Amrendra Kumar, Gunaseelan M., Bhavesh Kharbanda, Rahul Vaippully and Basudev Roy
"Study of absorption and emission dipoles of upconverting nanoparticles optically trapped at absorption resonance"
SPIE Photonics Conference (Europe) April 2020 [11345-35 Plasmonics and Nanoantennae \(2020\)](#)
- Dhanush Bhatt, Rahul Vaippully, Bhavesh Kharbanda, Anand Dev Ranjan and Basudev Roy, et al.
"Detection of self-generated nano-waves on the interface of an evaporating sessile water droplet"
Optics Express (OSA) October 2019 [Vol. 27, Issue 22, pp. 31900-31912 \(2019\)](#)

Research Experience

- Probing T_1 relaxometry using ensembles of NV centres in bulk- and nano-diamonds** **July 2021 - Jan 2022**
Guide: [Dr Takuya Segawa](#), [Prof Dr Christian Degen](#), Spin Physics Group, ETH Zürich *Master's Thesis Project*
 - Characterising piezo stage effects on microwave (MW) frequency and power dependent defocusing on a wide-field setup.
 - Performing continuous-wave ODMR, T_1 and chirped MW measurements on NV centres in bulk and nanodiamonds.
 - Introducing a double-pass AOM configuration and optimising experiment parameters for system improvement.
 - Obtaining MW-induced partial-spin inversion for probing 'true' T_1 relaxometry by difference method.
- Laser phase locking of diode lasers for Raman transitions in a Penning ion trap** **October - December 2020**
Guide: [M.Sc. Tobias Sägger](#), [Prof Dr Jonathan Home](#), Trapped Ion Quantum Info. Group ETH Zürich, Switzerland
 - Setting up a sum frequency stage to use 1550 nm and 1050 nm IR beams lines for producing 626 nm light.
 - Assembling a frequency doubling cavity to produce 313 nm UV light.

- Performing a phase lock (OPLL) at the IR stage and study linewidths of the output UV, Visible and IR lines.

3. Characterisation of nanoparticles using White Light Interferometry

August - September 2020

Guide: [M.Sc. Sören Bieling](#), [Prof Dr David Hunger](#), Quantum Nano Optics Group, KIT

KIT Karlsruhe, Germany

- Study interferograms for particle scatterers spin-coated on superpolished mirror surfaces.
- Used Python to analyse image-reconstructs for PSF of particles sized 50 nm, 100 nm and 120 nm.

4. Simulating qubit operations by light-atom interaction as Rabi oscillation

June - July 2019

Guide: [Asso. Prof Dr Wen-Te Liao](#), Quantum Optics Group, NCU Taoyuan

[MOST GASE+ Program](#), Taiwan

- Observing density matrix evolution for two-level atoms to implement standard Clifford single qubit gate operations.
- Attempting to generalise qubit operations for an arbitrary unitary gate using phase and area modulated Gaussian pulses.

5. Study of absorption and emission dipoles of up-converting nano-particles (UCNP) trapped in oil-immersion microscopy based optical tweezers

Aug 2018 - Apr 2019

Guide: [Asso. Prof Dr Basudev Roy](#), Bio-Inspired Optical Tweezers Lab, IIT Madras

Bachelor's Thesis Project

- Studying the Brownian power spectra for front-scatter and back-scatter emission of upconverting nanoparticles.
- Ruled out anomalies, differentiating laser mode-hopping from simulated dipoles' interference for label-free imaging.
- Observing hydrothermal waves at the air-water interface using two optical traps along axial and azimuthal orientations.

Skills

- **Languages:** English (excellent skills), Hindi (native language), German (A2), Punjabi (B1 equivalent)
- **Markup Languages:** Comfortable with C
- **Documentation:** Extensively used \LaTeX
- **Software and Packages:** Worked with AutoCAD, LabVIEW and Python

Schools, Seminars and Conferences

1. Nanomechanical Sensing Conference (NMC)

Bangalore, India (hybrid)

Poster, August 2022

<https://www.nmc2022.org/>

2. QSIT Junior Meeting

Flumserberg, Switzerland

Research talk and poster, June 2022

[NCCR-QSIT Junior 2022](#)

3. ASTERISQ Solid-state Spins School

Institut d'Etudes Scientifiques de Cargèse, Corsica, France

Autumn school, November 2021

<https://www.asteriqs.eu/school/>

4. Quantum Optics and Quantum Information Processing using Rare Earth Ions

Guide: [M.Sc. Sören Bieling](#), [Prof Dr David Hunger](#), KIT Germany

Seminar talk, Dec 2020

[\[1\]](#) [\[2\]](#) [\[3\]](#)

Relevant Coursework

1. Quantum Physics and Optics

- Coherent and Quantum Optics
- Atomic and Molecular Physics
- Quantum Mechanics
- Non-linear Optics
- Electrodynamics
- Solid State Optics

2. Mathematical and Computational Physics

- Statistical Physics
- Numerical Methods and Computing for Physicists

3. Electronics and Engineering

- Optoelectronic Components, Fabrication, Characterisation
- Analog & Digital Systems with Laboratories
- Digital Signal Processing
- Engineering Drawing

Volunteering Experience

Scientifica 2021 | Science Exhibition in Zürich, Switzerland

QSIT Ambassador | Quantum Optics Experiments [\[Link to website\]](#) [\[LinkedIn Scientifica 2021\]](#) (September 3-4 '21)

Optics Students Karlsruhe (OSKar) | Karlsruhe Student Chapter

Vice President [\[Link to website\]](#)

(November '20 – November '21)

- Working on-board the Optics chapter based in Karlsruhe for student engagement, lectures, symposium and events.
- Initiated and conducted scientific discussions *Disillusioned* about the 'Why' of optical phenomena.

Avanti Fellows[•] | Puducherry Chapter.....

Team Head (April '17 – May '18) | **Team Strategist** (April '16 – April '17) | **Student Mentor** (Aug '15 – April '16)

- Heading a team of 40 mentors to assist 50 underprivileged higher secondary students in national competitive examinations.
- Micro-planning to promote peer learning and individual mentee mappings in engineering and basic science subjects.
- **22 of 22 students** of XII Std cleared JEE Mains and **10 of them joined prestigious IITs** after clearing JEE Advanced.

[•]Avanti Fellows is a Non-Profit Organization working for education of underprivileged children. <https://www.avantiitm.wordpress.com/>

Hobbies

- Mentoring, teaching and (amateur) philosophy. Literary Interests: creative writing, reading and nano-stories writing.
- Amateur table tennis player, biking, trekking (T2/T3) and mountaineering in the Alpine and Himalayan mountains.

Standardised Test Scores

- **GRE General** (Sept. 20, 2018) : **322/340** (170(Q), 152(V), 4.5/6(A))
- **TOEFL iBT** (Oct 14, 2018) : **115/120** (30(R), 29(L), 27(S), 29(W))