

Matthias Raphael Stock

PhD student, TUM

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Research Interests

Liquid scintillator development and characterization, neutrino physics, neutrino astronomy, active galactic nuclei, optical interferometry

Education

- 05/2019 – present **PhD student in Physics**
Technische Universität München (TUM), Germany
Thesis: “*Development and Characterization of Novel Liquid Scintillators for the Detection of Neutrinos in Future Large-Scale Detectors*,” Research Advisor: Lothar Oberauer
- 10/2015 – 05/2018 **Master of Science in Physics**
Technische Universität München, Germany
Specialization in Nuclear, Particle and Astrophysics,
Thesis: “*Spectro-Interferometric Signatures of the Broad Line Regions in Active Galactic Nuclei*,” Research Advisor: Jason Dexter
Grade: 1.5 (passed with distinction)
- 09/2016 – 02/2017 **ERASMUS+ exchange student**
Sorbonne Université, France
Nuclei, Particles, Astroparticles and Cosmology (NPAC, Master 2 level)
- 10/2012 – 09/2015 **Bachelor of Science in Physics**
Technische Universität München, Germany
Grade: 2.6 (passed)
- 09/2004 – 06/2012 **Abitur** (General Higher Education Entrance Qualification)
Gymnasium Vilshofen, Germany
Grade: 2.5 (passed with merit)

Employment

- 11/2018 – present **Research and teaching assistant**
Chair for Experimental Physics and Astroparticle Physics (E15)
Physik-Department, Technische Universität München (TUM), Germany
- 06/2018 – 09/2018 **Research assistant**
Infrared/Submillimeter Group
Max Planck Institute for Extraterrestrial Physics (MPE), Germany

Professional Activities

07/2022 – present	Laser protection officer of E15, TUM
09/2020 – present	Chemistry laboratory manager of E15, TUM
05/2019 – present	PhD Thesis I develop organic and water-based liquid scintillators using different solvents such as LAB or DIN, and different fluors such as PPO or Bis-MSB. Using light sources, radioactive sources and particle accelerators I characterize liquid scintillators, e.g. for the JUNO collaboration, concerning the emission spectra, the fluorescence time profiles, the relative light yields, and the proton quenching factors with dedicated experiments at room and cold temperatures. I analyze the large amounts of data with statistical analysis, model fitting and numerical convolutions, TUM.
04/2022 – 02/2023	JUNO Deputy Young Researcher Representative
03/08/2022 – 08/07/2022	Active participation in pumping out the far detector of the Double Chooz experiment, Centrale nucléaire de Chooz, France
22/04/2022 – 12/05/2022	Co-leading beam times at the CN accelerator and at the Tandem-XTU accelerator, INFN LNL, Legnaro, Italy
14/12/2021 – 24/12/2021	Co-leading a beam time at the CN accelerator, INFN LNL, Legnaro, Italy
02/06/2021 – 22/06/2021	Co-leading a beam time at the CN accelerator, INFN LNL, Legnaro, Italy
12/04/2021 – 23/04/2021	Active participation in pumping out the near detector of the Double Chooz experiment, Centrale nucléaire de Chooz, France
18/01/2021 – 30/01/2021	Active participation in pumping out the near detector of the Double Chooz experiment, Centrale nucléaire de Chooz, France
09/10/2019 – 11/10/2019	Co-organizer of the “ <i>JUNO DFG Meeting 2019</i> ,” TUM, Germany
16/09/2019 – 27/09/2019	Co-leading a beam time at the MLL accelerator, Garching, Germany
27/07/2019 – 29/08/2019	Expert shifter at the “ <i>PMT Characterization and Instrumentation Station for JUNO</i> ,” Pan-Asia, Zhongshan, China
28/04/2019 – 06/05/2019	Co-leading a beam time at the MLL accelerator, Garching, Germany
12/08/2018 – 16/08/2018	Assistance in an observing program with ESO VLTI GRAVITY/AT, 24 hours, Paranal Observatory, Chile
05/2017 – 05/2018	Master’s Thesis I developed models of the broad line region (BLR) as a collection of optically thin, orbiting clouds. Comparing model predictions for spectral lines and differential phases with interferometric VLTI/GRAVITY data of quasars, e.g. 3C 273, or other AGN provide constraints on their orientation, structure and dynamics, such as black hole masses, BLR sizes or inclinations. MCMC methods were used for model fitting, MPE.

Professional Affiliations

01/2021 – present [Double Chooz collaboration](#)
11/2019 – present [THEIA collaboration](#)
01/2019 – present [JUNO collaboration](#)
11/2017 – present [German Physical Society \(DPG\)](#)

Teaching Experience and Training

Technische Universität München

Summer 2022	Tutor, Particle Oscillations (offline and online)
Summer 2021	Tutor, Particle Oscillations (online)
Winter 2020/2021	Tutor, Introduction to Nuclear, Particle and Astrophysics (online)
Summer 2020	Tutor, Particle Oscillations (online)
Winter 2019/2020	Tutor, Introduction to Nuclear, Particle and Astrophysics Instructor, Physics Lab Course for Food Chemistry Tutor, Pre-study Physics course
Summer 2019	Tutor, Particle Oscillations

Co-supervision of Students

2 Master and 4 Bachelor students, Technische Universität München

Languages

- German (native)
- English (advanced, TOEFL iBT: 104/120)
- French (elementary, A2)
- Latin (Latinum)

Computer Skills

- \LaTeX , Office programmes
- Python, Mathematica, MATLAB, OriginPro, ROOT
- Photoshop, GIMP, RAW converters, Inkscape

Press Coverage

- [*“JUNO Completes Main Supporting Structure for its Gigantic Acrylic Vessel,”*](#) Institute of High Energy Physics, Chinese Academy of Sciences, 7/2022.
- [*“China completes main structure of its neutrino detector,”*](#) CGTN, 6/2022.
- [*“Rotating Gas in a Quasar’s Heart,”*](#) C. M. Carlisle, Sky & Telescope, 1/2019.
- [*“A glimpse into the heart of a quasar,”*](#) E. Kara, Nature News & Views, 11/2018.
- [*“A close-up look at the whirlpool around a gigantic black hole,”*](#) MPE and MPG press release, 11/2018.

Invited Colloquia and Seminars

- February 23, 2023 - [*“Liquid Scintillator Characterization Experiments for Particle Identification in JUNO and THEIA,”*](#) **Deutsches Elektronen-Synchrotron DESY**, Zeuthen, Germany
- July 5, 2021 - [*“On the Road towards THEIA - Development and Characterization of Water-based Liquid Scintillators,”*](#) **TUM**, Garching, Germany
- January 18, 2020 - [*“Fluorescence Decay-Time Spectroscopy of the JUNO Liquid Scintillator using Gamma Radiation and a Pulsed Neutron Beam,”*](#) **INFN Laboratori Nazionali di Legnaro**, Legnaro, Italy

Contributed Conference Presentations and Posters

- March 23, 2023 - [*“Fluorescence Time Profiles of Slow Organic and Water-Based Liquid Scintillators using a Pulsed Neutron Beam,”*](#) **DPG Spring Meeting 2023**, Dresden, Germany
- March 22, 2022 - [*“Fluorescence Time Profiles of the JUNO and TAO Liquid Scintillators using a Pulsed Neutron Beam in the Energy Range from 3.5 to 5.5 MeV,”*](#) **DPG Spring Meeting 2022**, Online
- March 16, 2021 - [*“Measuring the Fluorescence Time Profile of the JUNO Scintillator with Gamma and Neutron Excitation,”*](#) **DPG Spring Meeting 2021**, Online
- June 24, 2020 - Poster: [*“Measuring the Fluorescence Time Profile of the JUNO Liquid Scintillator using Gamma Radiation and a Pulsed Neutron Beam,”*](#) **XXIX International Conference on Neutrino Physics and Astrophysics (Neutrino 2020)**, Online
- July 17, 2019 - [*“Fluorescence Decay Time Measurements of JUNO LS using Gamma Radiation and a Pulsed Neutron Beam,”*](#) **19th JINR-ISU Baikal Summer School on Physics of Elementary Particles and Astrophysics**, Bolshiye Koty, Russia
- December 10, 2018 - [*“Spectro-Interferometric Signatures of the Broad Line Regions in Active Galactic Nuclei,”*](#) **TORUS 2018**, Puerto Varas, Chile (with travel grant)
- July 10, 2018 - [*“Spectro-Interferometric Signatures of the Broad Line Regions in Active Galactic Nuclei,”*](#) **9th VLT Summer School 2018**, Lisbon, Portugal (with travel grant)

Peer-Reviewed Publications

650+ citations, h-index 11 ([Google Scholar](#)), ORCID: [0000-0002-5963-7431](#), ResearchGate link [here](#), ADS link [here](#)

16. “Mass testing and characterization of 20-inch PMTs for JUNO,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2022, [Eur. Phys. J. C 82](#), 1168
15. “Sub-percent Precision Measurement of Neutrino Oscillation Parameters with JUNO,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2022, [Chinese Phys. C 46](#) 123001
14. “Prospects for Detecting the Diffuse Supernova Neutrino Background with JUNO,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2022, [JCAP 10 \(2022\) 033](#), [arXiv:2205.08830v1](#)
13. “The Double Chooz antineutrino detectors,” Double Chooz Collaboration: H. de Kerret et al., including **M.R. Stock**, 2022, [Eur. Phys. J. C 82](#), 804
12. “Potential for a precision measurement of solar pp neutrinos in the Serappis Experiment,” L. Bieger et al., including **M.R. Stock**, 2022, [Eur. Phys. J. C 82](#), 779
11. “Damping signatures at JUNO, a medium-baseline reactor neutrino oscillation experiment,” JUNO Collaboration: J. Wang et al., including **M.R. Stock**, 2022, [J. High Energ. Phys. 2022](#), 62
10. “Combined sensitivity of JUNO and KM3NeT/ORCA to the neutrino mass ordering,” KM3NeT Collaboration, JUNO Collaboration Members: S. Aiello et al. including **M.R. Stock**, 2022, [J. High Energ. Phys. 2022](#), 55
9. “JUNO physics and detector,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2022, [Progress in Particle and Nuclear Physics](#), 123:103927, [arXiv:2104.02565v2](#)
8. “Radioactivity control strategy for the JUNO detector,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2021, [J. High Energ. Phys. 2021](#), 102
7. “The design and sensitivity of JUNO’s scintillator radiopurity pre-detector OSIRIS,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2021, [Eur. Phys. J. C 81](#), 973
6. “JUNO sensitivity to low energy atmospheric neutrino spectra,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2021, [Eur. Phys. J. C 81](#), 887
5. “Calibration strategy of the JUNO experiment,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2021, [J. High Energ. Phys. 2021](#), 4
4. “Feasibility and physics potential of detecting 8B solar neutrinos at JUNO,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2021, [Chinese Phys. C 45](#) 023004
3. “THEIA: an advanced optical neutrino detector,” M. Askins et al., including **M.R. Stock**, 2020, [Eur. Phys. J. C 80](#), 416
2. “Combined sensitivity to the neutrino mass ordering with JUNO, the IceCube Upgrade, and PINGU,” IceCube-Gen2 Collaboration, JUNO Collaboration Members: M. G. Aartsen et al., including **M.R. Stock**, 2020, [Phys. Rev. D 101](#), 032006

1. “Spatially resolved rotation of the broad-line region of a quasar at sub-parsec scale,” GRAVITY collaboration: E. Sturm, J. Dexter, O. Pfuhl, **M.R. Stock** et al., 2018, [Nature 563, 657–660](#), [arXiv:1811.11195v1](#), **Contribution:** *I developed models and fit them to VLTI/GRAVITY data of the quasar 3C 273 to measure, e.g. BLR size and BH mass. I created all figures.*

Selected Unrefereed Publications

- “The JUNO experiment Top Tracker,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2023, [arXiv:2303.05172](#)
- JUNO sensitivity to 7Be , pep , and CNO solar neutrinos,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2023, [arXiv:2303.03910](#)
- “JUNO Sensitivity on Proton Decay $p \rightarrow \bar{\nu} K^+$ Searches,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2022, [arXiv:2212.08502](#)
- “The Core of the Matter — Spatially Resolving Active Galactic Nuclei with GRAVITY,” GRAVITY collaboration: E. Sturm et al., including **M.R. Stock**, 2022, [ESO The Messenger, 188:20-25](#)
- “Model Independent Approach of the JUNO ^8B Solar Neutrino Program,” JUNO Collaboration: J. Zhao et al., including **M.R. Stock**, 2022, [arXiv:2210.08437v1](#)
- “THEIA: Summary of physics program. Snowmass White Paper Submission,” M. Askins et al., including **M.R. Stock**, 2022, [arXiv:2202.12839v1](#)
- “TAO Conceptual Design Report: A Precision Measurement of the Reactor Antineutrino Spectrum with Sub-percent Energy Resolution,” JUNO Collaboration: A. Abusleme et al., including **M.R. Stock**, 2020, [arXiv:2005.08745v1](#)
- “Spatially Resolving the Quasar Broad Emission Line Region,” GRAVITY collaboration: R. Abuter et al., including **M.R. Stock**, 2019, [ESO The Messenger, 178:20–24](#)