Tanmay Singal: Curriculum Vitae

CONTACT INFORMATION	Institute for Theoretical Physics, University of Cologne 50937, Cologne, Germany	*E-mail:*	tanmaysingal(at)gmail(dot)com
		Google Scholar:	https://tinyurl.com/yc6u8jur

PERSONAL
INFORMATION

Age: 37 years.
Gender: Male.
Nationality: Indian.
Languages spoken: fluent in English, Hindi.

WORK EXPERIENCE

*Employed remotely from India due to COVID.

February 2023 - present

Postdoctoral Researcher
Research group lead by David Gross
Link: https://qi.uni-koeln.de/
Institute for Theoretical Physics,
University of Cologne, Germany

October 2021 - January 2023

Postdoctoral Researcher
Research group lead by Dariusz Chruścinski
Link: https://tinyurl.com/wmmyu247
Institute of Physics,
Nicolaus Copernicus University
Toruń, Poland

July 2021 - October 2021*

Postdoctoral Researcher
Research group of Hsi-Sheng Goan
Link: https://web.phys.ntu.edu.tw/goan/
Physics Division, National Center for Theoretical Sciences
National Taiwan University
Taipei, Taiwan

March 2021 - July 2021*

Visitor
Quantum Information Theory Research group,
Lead by Milan Mosonyi
Link: https://qi.nemzetilabor.hu/people/milan-mosonyi
Budapest University of Technology and Economics
Budapest, Hungary

October 2020 - January 2021*

Postdoctoral Researcher
Research group led by MichałOszmaniec
Link: https://quantin.pl/team/
Center for Theoretical Physics, Polish Academy of Sciences
Warsaw, Poland

	Independent postdoctoral researcher
September 2019 - September 2020	Research group lead by Huangjun Zhu
	Link: https://phys.fudan.edu.cn/13/75/c7605a136053/page.htm
	Department of Physics
	Fudan University Shanghai, China

	Postdoctoral researcher
	Lead by Cedric Bény and Joonwoo Bae (earlier)
November 2016 - May 2019	Link: https://www.qimlr.org/
	Department of Applied Mathematics
	Hanyang University (ERICA)
	Ansan, Republic of (South) Korea

	Project Assistant
April 2016 - October 2016	The Institute of Mathematical Sciences, Chennai, India

EDUCATION

	PhD.
	Thesis: Some problems in Quantum state discrimination
	Link: https://www.imsc.res.in/xmlui/handle/123456789/384
August 2011 - March 2016	Advisor: Sibasish Ghosh
	The Institute of Mathematical Sciences
	Chennai, India

	Masters in Theoretical Physics.
	Master's Thesis: Study of Gaussian Channels
	Link: https://www.imsc.res.in/xmlui/handle/123456789/327
August 2009 - July 2011	Advisor: Sibasish Ghosh
	The Institute of Mathematical Sciences
	Chennai, India

	Bachelor in Physics
July 2006 to June 2009	St. Xaviers College,
	Ahmedabad, India

RESEARCH
INTERESTS

Mathematical aspects of quantum computing and information theory, physics and theoretical computer science. All things math.

- Application and structure of the theory of t-designs, quantum error correction: stabilizer formalism and the Clifford group, QECC with non-prime dimensional qudits.
- Quantum information theory: quantum state discrimination.
- Application and mathematical aspects of concentration of measures: the methods of concentration of measure, random matrix theory, various ensembles, free probability.
- Applications of group theory: the hidden subgroup problem, random walks on Cayley graphs, volume growth.

- Applications of representation theory: the symmetry group, the Clifford group, $SL(2, \mathbb{F}_{2^m})$-subgroup of the Clifford group.

PUBLICATIONS AND
PREPRINTS

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(14) [Wigner's theorem for stabilizer states and quantum designs](),
J. Math. Phys. 65, 112202 (2024). DOI: https://doi.org/10.1063/5.0222546
Valentin Obst, Arne Heimendahl, **Tanmay Singal**, David Gross

(14) [Counting stabiliser codes for arbitrary dimension](),
Quantum 7, 1048 (2023). DOI: https://doi.org/10.22331/q-2023-07-06-1048
Tanmay Singal, Che Chiang, Eugene Hsu, Eunsang Kim, Hsi-Sheng Goan and Min-Hsiu Hsieh

(13) [Single-Copy Certification of Two-Qubit Gates Without Entanglement]()
Phys. Rev. Applied 18, 044046 **(2022)**
DOI: https://doi.org/10.1103/PhysRevApplied.18.044046
Yujun Choi, **Tanmay Singal**, Young-Wook Cho, Sang-Wook Han, Kyunghwan Oh, Sung Moon, Yong-Su Kim, and Joonwoo Bae

(12) [One parameter generalization of BW inequality and its application to open quantum dynamics]()
Linear Alg. Appl. 656 158 **(2022)**
DOI: https://doi.org/10.48550/arXiv.2208.10005
Dariusz Chruściński, Gen Kimura, Hiromichi Ohno and **Tanmay Singal**

(11) [Implementation of quantum measurements using classical resources and only a single ancillary qubit]()
NPJ Quantum Inf 8, 82 **(2022)**
DOI: https://doi.org/10.1038/s41534-022-00589-1
Tanmay Singal, Filip Maciejewskie and Michał Oszmaniec

(10) [Bounding the Frobenius norm of a q-deformed commutator]()
Linear Alg. Appl. 646 95 **(2022)**
DOI: https://doi.org/10.1016/j.laa.2022.03.021
Dariusz Chruściński, Gen Kimura, Hiromichi Ohno and **Tanmay Singal** (corresponding author)

(9) [Approximate 3-designs and partial decomposition of the Clifford group representation using transvections]()
Preprint available at: arxiv.org/abs/2111.13678v2 [quant-ph] **(2021)**
Tanmay Singal and Min-Hsiu Hsieh

(8) [Structure of Minimum Error Discrimination for Linearly Independent States]()
Phys. Rev. A 99, 052334 **(2019)**

DOI: https://doi.org/10.1103/PhysRevA.99.052334
Tanmay Singal, Eunsang Kim, Sibasish Ghosh

(7) [Preserving Measurements for Optimal State Discrimination over Quantum Channels](#)
Phys. Rev. A 99, 062302 **(2019)**
DOI: https://doi.org/10.1103/PhysRevA.99.062302
Spiros Kechrimparis, **Tanmay Singal**, Chahan Kropf, Joonwoo Bae

(6) [Detecting Noisy Channels by Channel Discrimination : Local versus Entangled Resources](#)
Preprint available at: arxiv.org/abs/1812.02087 [quant-ph] **(2018)**
Joonwoo Bae and **Tanmay Singal**

(5) [Necessary condition for local distinguishability of maximally entangled states: Beyond orthogonality preservation](#),
Phys. Rev. A 96, 042314 **(2017)**
DOI: https://doi.org/10.1103/PhysRevA.96.042314
Tanmay Singal, Ramij Rahman, Sibasish Ghosh and Guruprasad Kar

(4) [Framework for distinguishability of orthogonal bipartite states by one-way local operations and classical communication](#),
Phys. Rev. A 93, 030301, (Rapid Communication) **(2016)**
DOI: http://dx.doi.org/10.1103/PhysRevA.93.030301
Tanmay Singal

(3) [Minimum error discrimination for an ensemble of linearly independent pure states](#),
J. Phys. A: Math. Theor. 49 165304 **(2016)**
DOI: http://dx.doi.org/10.1088/1751-8113/49/16/165304
Tanmay Singal and Sibasish Ghosh

(2) [Algebraic Structure of the Minimum Error Discrimination Problem for Linearly Independent Density Matrices](#)
Preprint available at: arxiv.org/abs/1412.7174 [quant-ph] **(2014)**
Tanmay Singal and Sibasish Ghosh

(1) [Minimum Error Discrimination of Linearly Independent Pure States: Analytic Properties of POVM](#)
Preprint available at: arxiv.org/abs/1402.4553 [quant-ph] **(2014)**
Tanmay Singal and Sibasish Ghosh

Unpublished

(2) **Introduction to concentration of measure (2022)**
Based on lectures given by Sudeep Kamath (available in youtube here).
Presentations given to Chruściński's group from Nov '21 to April '22.
Tanmay Singal

(1) **Finite dimensional inverse function theorem: short proof (2020)**
Tanmay Singal
Remarks: Proof uses only non-singularity of derivative; without fixed point theorem or successive approximations' method.

(1) **Lecture notes on error correction (2018)**
Tanmay Singal, Cedric Bény, Eunsang Kim, and Joonwoo Bae

TEACHING EXPERIENCE

April 2025 to July 2025	Tutor for UG course for classical mechanics (Johannes Berg)
October 2024 to January 2025	Tutor for an UG quantum mechanics course (David Gross)
April 2024 to July 2024	Tutor for mathematical methods for physics II (David Gross)
October 2023 to January 2024	Tutor for undergraduate statistical mechanics by Simon Trebst
April - Jul 2023	Quantum algorithms seminar
July 2022 - September 2022	Representation theory of finite groups Study group with interns at Foxconn
July 2021 - November 2021	Unitary 2-designs, Clifford group, Galois fields, $\mathrm{SL}\left(2, \mathbb{F}_{2^m}\right)$ Group meeting presentations with Hsi-Sheng Goan's group

EXPERIENCE AS A SUPERVISOR TO STUDENTS

December 2021 - June 2022	Students: (1.) Che-Chiang (2.) Eugene Hsu Affiliation: Department of Physics National Taiwan University Project: **Counting stabilizer codes for arbitrary dimensions**

PROFESSIONAL ACTIVITIES

Reviewer for Quantum Information Processing Conference, 2021

Reviewer for IEEE Transactions on Information Theory, since 2019.

Reviewer for Quantum Information Processing, since 2018.

CONFERENCES

Oral Presentations

    Wigner's theorem for stabiliser states and quantum desings,
Young Quantum Information Scientists (YQIS24) ,
Paris, France, November 6, 2022- November 8, 2022.

    Approximate 3-designs and partial decomposition of the Clifford group representation using transvections,
International Conference on Quantum Information and Foundations 2022,
Kolkata, India, February 14, 2022- February 24, 2022.

    Random transvections approximate unitary 2 and 3 designs,
Beyond IID 2021, Taipei, Taiwan, September 27- October 1, 2021.

    Implementation of quantum measurements using classical resources and only a single ancillary qubit,
APS March Meeting 2021, Washington DC, Maryland, March 15-19, 2021.

    Implementation of quantum measurements using classical resources and only a single ancillary qubit,
24th Annual Conference on Quantum Information Processing, Munich Center for Quantum Science and Technology, Munich, February 1-5, 2021.

    Implementation of arbitrary quantum measurements using classical resources and only single ancilla,
Quantum Speedup 2020, International Center for Theory of Quantum Technologies, Gdańsk, 16-18 December, 2020.

    Implementation of arbitrary quantum measurements using classical resources and only single ancilla,
Asian Quantum Information Science, 2020, University of Technology Sydney, Sydney, 07-09 December, 2020

    Minimum Error Discrimination for an Ensemble of Linearly Independent Pure States,
International Program on Quantum Information 2014, Institute of Physics, Bhubaneswar, 17-28, February 2014

Poster

Wigner's theorem for stabiliser states and quantum designs,

6th Seefeld Workshop on Quantum Information

Minimum Error Discrimination for an ensemble of linearly independent pure states,
Asian Quantum Information Science, 2014, Kyoto, 20-24 August 2014

WORKSHOPS

Quantum Information Workshop,
Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain, from 16th of June 2025, to 28th of June, 2025.

Framework for Distinguishability of Orthogonal Bipartite states by Local Operations and One-Round of Classical Communication,
Korean Institute of Advanced Study Workshop on Quantum Information Theory, Busan, ROK, November 2016.

Quantum Information Workshop,
Centro de Ciencias de Benasque Pedro Pascual, Benasque, Spain, from 24th of June 2017, to 14th of July, 2017.

Mathematical Aspects in Current Quantum Information Theory, 2019
Seoul National University, Seoul, Republic of (South) Korea, 20-24 June 2019