

## Title

**Tunable Many-body Interactions and Induced Superconductivity in a Helical Luttinger Liquid**

## Speaker

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## Date & Time

Friday, 16<sup>th</sup> December, 2022  
at 2.30PM (IST)

## Meeting Link

[Click here to join the webinar](#)

## Venue

Physics Department  
Auditorium, IISc

**Abstract:** The interplay of topology, superconductivity, and strong correlations has become a subject of intense research for the pursuit of non-trivial superconducting pairing [1]. In one-dimensional (1D) systems, electronic interactions lead to a breakdown of Fermi liquid theory and the formation of a Tomonaga-Luttinger Liquid (TLL) [1,2]. The strength of its many-body correlations can be quantified by a single dimensionless parameter, the Luttinger parameter  $K$ , characterising the competition between the electrons' kinetic and electrostatic energies. Recently, signatures of a TLL have been reported for the topological edge states of quantum spin Hall (QSH) insulators, strictly 1D electronic structures with linear (Dirac) dispersion and spin-momentum locking. Here we show [2] that the many-body interactions in such helical Luttinger Liquid can be effectively controlled by the edge state's dielectric environment. This is reflected in a tunability of the Luttinger parameter  $K$ , distinct on different edges of the crystal, and extracted to high accuracy from the statistics of tunnelling spectra at tens of tunnelling points. The interplay of topology and many-body correlations in 1D helical systems in the superconducting state [3] has been suggested as a potential avenue towards realising non-Abelian parafermions.

## References :

- 1.M.S. Lodge, S.A. Yang, S. Mukherjee, and Bent Weber\*, Atomically Thin Quantum Spin Hall Insulators. *Advanced Materials* 33, 2008029 (2021).
- 2.J. Jia, E. Marcellina, A. Das, M. S. Lodge, B.K. Wang, D.-Q. Ho, R. Biswas, T.-A. Pham, W. Tao, C.-Y. Huang, H. Lin, A. Bansil, S. Mukherjee, and Bent Weber\*, Tuning the Many-body Interactions in a Helical Luttinger Liquid (under review)
- 3.W. Tao, Z.J. Tong, A. Das, D.-Q. Ho, Y. Sato, M. Haze, J. Jia, Y. Que, F. Bussolotti, K.E.J. Goh, B. Wang, H. Lin, A. Bansil, S. Mukherjee, Y. Hasegawa, and Bent Weber\*, Multiband super-conductivity in strongly hybridized 1T'-WTe<sub>2</sub>/ NbSe<sub>2</sub> heterostructures" *Physical Review B* 105, 094512 (2022)

## Biography :

Bent Weber is Singapore National Research Foundation (NRF) Fellow and Nanyang Assistant Professor (NAP) of Physics at Nanyang Technological University (NTU) Singapore. Weber obtained his PhD from the Centre for Quantum Computation and Communication Technology (CQC2T) at The University of New South Wales (UNSW), where he developed atomic-scale silicon quantum devices by scanning tunnelling microscopy. His work on donor-based spin qubits was published in a range of high-impact papers, including *Science*, *Nature Nanotechnology*, *Nano Letters*, and *Physical Review Letters*. Weber has held an Australian Research Council (ARC) DECRA fellowship at Monash University, Australia, and is an Associate Investigator of the ARC Centre of Excellence in Future Low Energy Electronics Technologies (FLEET). Weber's group at NTU Singapore employs complementary local probe and transport spectroscopy to investigate 2D and topological materials for their potential in quantum device applications.

