Md Nurul Huda

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Research Profile

- I am an experimental condensed matter physicist specialized in quantum nanomaterials processing, sub-Kelvin cryogenics and superconducting circuits measurement, expert in building, installing and testing the quantum measurement systems integrated in Bluefors cryogenic systems, designing, testing and installing the qubit control lines for quantum device measurements, developing cryogenic spectrum analyzer, characterizing bolometers etc. Along with low temperature physics, my emphasis in research has been fabricating designer quantum materials platform which has potential to enable topological quantum computing. The class of materials includes conventional, unconventional, topological superconductors and 2-dimensional ferromagnetic materials and superconductors. I also have significant experience on working in cleanroom facility to fabricate Field Effect Trnasistors and quantum devices using conventional microfabrication technique (it includes wet/dry etching, nanolithogrpahy, metal evaporation etc). I have also been involved in engineering and designing an ultra-high vacuum (UHV) experimental set up for multi-component molecular beam epitaxy (MBE) to synthesize layered materials.

Research / Work Experience

September, 2023 – Present
Postdoctoral Research Associate, Oak Ridge National Laboratory, USA.
- My primary research objective is to advance the field of topological superconductivity within van der Waals quantum materials. This advancement holds the promise of eventually enabling the creation of topological qubits. My research activities encompass various aspects, including the synthesis and fabrication of monolayer magnets and superconductors, defect engineering at atomic level precision etc. I meticulously characterize these materials at the atomic scale using low temperature scanning tunneling microscopy.

April, 2022 – September 2023
Quantum Applications Scientist, Bluefors Oy, Finland.
- My role was to conduct research with superconducting quantum circuits/devices enabling quantum applications aiding achieving quantum supremacy. It also includes developing cryogenic spectrum analyzer using world most sensitive bolometer and designing, calibrating and characterizing qubit control and readout lines in the Bluefors cryogenic systems and full scale product design, prototyping and deploying to the customer end.

February, 2021 – April, 2022
Cryo Engineer, Bluefors Oy, Finland.
- My role was producing, testing and commissioning the dry dilution refrigerator which cools down a system bellow 10 mK temperature primarily used for quantum computation technology. It also includes the calibration of miliKelvin temperature sensor and integrating quantum measurement systems into Bluefors cryogenics system for further quantum devices measurements. Collaborating with teams of technicians, engineers and scientist form diverse background to produce dry dilution refrigerator for the future quantum technology.

January,2017 – February 2021 **Doctoral Researcher, Atomic Scale Physics Group, Aalto University.**

- Worked on experimental realization of the topological quantum matter by using a designer materials approach. The first part of my thesis work involves fabricating artificial lattice structures by atomic manipulation with STM tip (low temperature STM, 300 mK, 11 T magnetic field, see the publication for details). In this study an individual Chlorine vacancies is moved in c(2x2) adsorption layer on Cu(100) crystal to create artificial atomic lattices. This allows us to realize some interesting topological physics experimentally. On the 2nd part, a magnetic/superconductor hybrid vdW heterostructures has been used to realize topological superconductivity. An extensive study has been conducted on epitaxial growth of different magnetic monolayers to achieve topological superconductivity in vdW materials platform. These heterostructures are synthesized by using a MBE set up attached with STM system. A significant effort has been put into the micro-fabrication of a SQUID out of these vdW materials to conduct Josephson-interference experiments for further verification of topological superconductivity.

Education

January, 2017 – February, 2021 **Doctor of Science (Tech.) in Engineering Physics.**
Aalto University, Espoo, Finland.

2014 – 2016 **Master of Science (Tech.) in Engineering Physics.**
Aalto University, Espoo, Finland.

2009 – 2013 **Bachelor of Science in Physics.**
Shahjalal University of Science and Technology, Bangladesh.

2006 – 2008 **Higher Secondary School Certificate.**
Brindaban Govt College, Bangladesh.

List of Publications

Patent

0. R Lake, V Monarkha, **M. Nurul Huda**, S Simbierowicz, V Nuutinen, "Tuneable microwave bandpass filter for cryogen-free dilution refrigerators", submitted, under review

Conference

1. R Lake, **M. Nurul Huda**, V Monarkha, S Simbierowicz, A Vaaranta , "Noise and signal distortions in qubit wiring", ***Bulletin of the American Physical Society***. 2023.

2. S Simbierowicz, V Monarkha, **M. Nurul Huda**, R Lake, , "Quantifying the power radiated to a qubit through its control lines", ***Bulletin of the American Physical Society***. 2023.

Peer-reviewed journals

3. **M. Nurul Huda**, S. Keziliebeke, T. Ojanen, R. Drost and P. Liljeroth "Reply to: "Tuneable topological domain wall states in engineered atomic chains"" ***npj Quantum Mater*** 7 (1), 1-2 (2022)

4. S. Keziliebeke, V. Vano, **M. Nurul Huda**, M. Aapro, S. Ganguli, P. Liljeroth. J. Lado "Moiré-enabled topological superconductivity", ***Nano Letters***. 2022, 22, 1, 328–333.

5. M. Aapro*, **M. Nurul Huda***, S. Keziliebeke, S. Ganguli, J. Karthikeyan, H. G. Herrero, X. Huang, P. Liljeroth, H.-P. Komsa "Synthesis and Properties of Monolayer MnSe with Unusual Atomic Structure and Antiferromagnetic Ordering" ***ACS Nano*** 15.8 (2021): 13794-13802.*contributed equally.

6. S. Keziliebeke *, O. Silveira * **M. Nurul Huda***, V. Vano, M. Aapro, S. Ganguli, J. Lahtinen, R. Mansell, S. van Dijken, A. Foster and P. Liljeroth "Electronic and magnetic characterization of epitaxial $CrBr_3$ monolayers on superconducting substrate" ***Adv. Mater.*** 2021,33,2006850. *contributed equally.

7. S. Keziliebeke, **M. Nurul Huda**, V. Vano, M. Aapro, S. Ganguli, O. Silveira, S. Głodzik, A.F. Foster, T. Ojanen and P. Liljeroth "Topological superconductivity in a van der Waals heterostructure" ***Nature*** 588, 424–428 (2020).

8. **M. Nurul Huda**, S. Keziliebeke and P. Liljeroth "Designer flat bands in quasi-one-dimensional atomic lattices" ***Physical Review Research*** 2, 043426 (2020).

9. S. Keziliebeke, **M. Nurul Huda**, P. Dreher, I. Manninen, Y. Zhou, J. Sainio, R. Mansell, M.M. Ugeda, S. van Dijken, H.-P. Komsa and P. Liljeroth "Electronic and Magnetic Characterization of Epitaxial VSe_2 Monolayers on Superconducting $NbSe_2$" ***Communications Physics*** 3, 116 (2020).

10. **M. Nurul Huda**, S. Keziliebeke, T. Ojanen, R. Drost and P. Liljeroth "Tuneable topological domain wall states in engineered atomic chains" ***npj Quantum Mater*** 5, 17 (2020).

11. **M. Nurul Huda**"Epitaxial growth of lateral graphene/hexagonal boron nitride heterostructures" ***Aalto University*** MS thesis (2016).