Zongqi Shen

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Education Background

Department of Physics, Fudan University *Sep.2018-Present*

Bachelor of Science in Physics

- Overall GPA: **3.75**/4
- TOEFL 104 (Reading 28+ Listening 26 + Speaking 23 + Writing 27)

Research Interests

Emergent phenomena in strongly correlated electron systems

- Moiré graphene and transition metal dichalcogenides (TMDC)
- Unconventional superconductors
- Majorana physics in topological superconductors
- Oxide interfaces

Publications

[1] Jiahui Qian, **Zongqi Shen**, Xinyuan Wei, Wei Li, "Z_2 nontrivial topology of rare-earth binary oxide superconductor LaO" *PhysRevB.105.L020508*

[2] Lijie Wang, Huanyi Xue, Guanqun Zhang, **Zongqi Shen**, Gang Mu, Shiwei Wu, Zhenghua An, Yan Chen and Wei Li, "Two-dimensional superconductivity at heterostructure of Mott insulating titanium sesquioxide and polar semiconductor" *arXiv:2106.06948*

Research Experience

Scanning tunneling microscopy(STM) study of moiré graphene and TMDC materials *Aug.2021-Present*

Supervisor: Prof. Michael F. Crommie, UC Berkeley

- Characterized twisted bilayer graphene and transition metal dichalcogenides (TMDC) devices ($TaSe_2$, $NbSe_2$, $TaTe_2$, etc.). Studied the evolution of electronic structures with back gate.
- Imaged the Mott insulating behavior of monolayer 1T-$TaSe_2$ with 'flower pattern' orbital texture.
- Proved the existence of localized spins by observing Kondo resonance peak in the STS spectra of 1T/1H-$TaSe_2$.
- Discovered exotic $\sqrt{19} \times \sqrt{19}$ charge density wave in monolayer 1T-$TaTe_2$.

***Ab-initio* study of rare-earth oxide superconductors with nontrivial topology** *May.2021-Aug.2021*

Supervisor: Prof. Wei Li, Fudan University

- Developed python codes to study the nontrivial topology of rare-earth oxide superconductor LaO and found topologically protected surface states.
- Analyzed the energy splitting of La orbitals in oxygen octahedron crystal fields.

Unconventional superconductivity in oxide heterostructures *Apr.2020-Aug.2021*

Supervisor: Prof. Wei Li, Fudan University

- Grew and optimized single crystal oxide thin films Ti_2O_3/GaN layer-by-layer with pulsed-laser deposition.
- Helped to identify the Bose metallic state in Ti_2O_3/GaN with temperature-independent resistance in a wide range associated with vanishing Hall resistance.
- Analyzed the pairing symmetry in $LiTi_2O_4$ with group theory and helped to explain the coexistence of ferromagnetism and superconductivity.
- Fitted STS data of $LiTi_2O_4$ with the calculated LDOS spectrum of triplet-pairing superconductors using Green's function method.

Theoretical study of Majorana zero modes in topological superconductors *May.2019-Apr.2020*

Supervisor: Prof. Wei Li, Fudan University

- Constructed a lattice model of metal-superconductor junctions and developed python codes to simulate Andreev reflection spectrum.
- Studied the finite-size effects of the zero-bias conductance peak in topological superconductors.

CVD growth of 2D materials and device fabrication *Nov.2018-May.2019*

Supervisor: Prof. Faxian Xiu, Fudan University

- Synthesized high quality Bi_2SeO_2 sample using chemical vapor deposition (CVD) method.
- Peeled off single-layered graphene for heterostructure fabrication.

Honors & Awards

- Excellent Student Award from Fudan University *Sept.2021*
- Selected for National Top Talent Undergraduate Training Program *May.2021*
- National Scholarship (1/115 in the Department of Physics) *Dec.2020*
- Xiyuan Scholar (UROP funding at Fudan) *May.2020*
- First Prize in Chinese College Physics Competition (ranked No.1 in First Prize winners) *Oct.2019*

Skills

Laboratory:

- Material Growth: PLD and CVD growth of thin films
- Micro- and Nano-fabrication skills: Electron Beam Lithography, Wire Bonding
- Characterization skills: STM/STS, AFM, Cryogenic Transport Measurements, MPMS, X-Ray Diffraction, Raman Spectroscopy

Theory:

- Programming: Python, C, Mathematica
- Simulation: *ab-initio*(VASP), transport properties(Kwant), STS spectrum