Nanofabrication of Altermagnet-Superconductor Quantum Devices

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Altermagnets are a newly discovered type of magnetic material that break time-reversal symmetry, even though they have no net magnetization [1, 2]. This sets them apart from conventional ferromagnets and antiferromagnets. Thanks to their unusual spin structure, they can split electron spins without disturbing the crystal symmetry. This makes them very promising for new types of electronic devices, especially in the field of spintronics, which aims to use the spin of electrons in addition to their charge. The theory behind altermagnets and their first experimental realizations were developed in the group of Tomáš Jungwirth at the Institute of Physics of the Czech Academy of Sciences, where this project will take place.

You will be involved in developing and optimizing lithographic processes for devices combining altermagnets with superconductors. These devices will allow us to study how the unique spin properties of altermagnets interact with superconductivity. You will get hands-on experience in a cleanroom environment, working with techniques such as optical and electron beam lithography, plasma etching, and thin-film deposition. The project can be expanded to the subsequent electrical measurements of these devices. Throughout the project, you will work closely with our experimental team and gain skills in nanofabrication, characterization, and device development in a modern research lab.

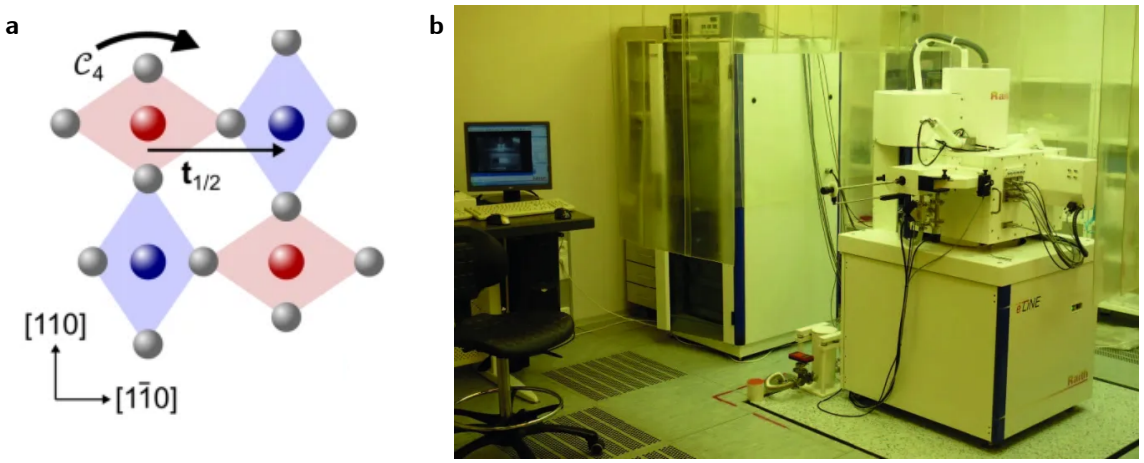

Figure 1: **a** Crystal symmetries of a prototypical altermagnet [3]. **b** Electron-beam lithography machine.

References

[1] Šmejkal, Libor, Jairo Sinova, and Tomas Jungwirth. *Physical Review X* **12**, 040501 (2024).

[2] Gonzalez Betancourt, R. D., et al. *Physical Review Letters* **130**, 036702 (2023).

[3] Dal Din, A., et al. *npj Spintronics* **2**, 25 (2024).