

Ultra-cold atomic matter and quantum information

My group studies various many-body states of ultra cold atoms and investigates possible applications towards quantum computation. Two subjects particularly interest us.

One is the quantum magnetism in optical lattices. We have carried out extensive studies of nematic Mott states and dimerized valence bond states of spin-one atoms. We also have understood how various many-body states response to external magnetic fields.

The second subject which interests us is lattice Feshbach resonances. We recently have examined many fascinating aspects of this problem and hope to achieve a qualitative understanding of this subject soon.

We look forward to great opportunities to use some of many-body states discussed above to store quantum information. Besides the cold atom research, I would also like to continue the investigations on charge and spin pumping in nano-electronic systems.

What would I do in the context of the center?

- Study the low energy effective theory of valence bond state of spin-one bosons and understand the connection to the Ising gauge fields;
- Explore the possibility for a dimerized valence bond states of sodium atom to be a topological stabilizer code;
- Investigate the properties of Mott states and superfluids near Feshbach resonances;
- Understand spin pumping phenomenon in nano-structures and the role of fermi surface topology.

My vision of the center

- The center will bring together many experts in the field of many-body physics; interactions between my group and these experts will definitely benefit students and postdoctoral working in my group.
- Center will also bring resources in the field of quantum information to UBC. These resources should be valuable to my group given that there are no in-house theorists in this field at the moment.
- The presence of nano-electronic experimental groups in the center could inspire our future activities on quantum pumping.
- I expect center will support members of my group to travel to other universities in the network to establish close collaborations with other groups in the center. And I also think center should have its own building so people can come and work together.