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Contribution ID: **520** Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

(G*) Towards a large scale fully programable trapped ion quantum simulator

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A programmable quantum simulator can simulate models of quantum many-body systems that may otherwise be impossible to be modeled with conventional computers. Simulation of such many-body quantum systems may further advance our understanding of exotic quantum materials, fundamental forces of nature, molecules for drug discovery, etc. Laser-cooled and trapped atomic ions serve as an ideal platform for the simulation of interacting quantum spin models. In this talk, we describe the development of a large-scale quantum simulator based on a multi-segmented blade electrode ion trap capable of trapping a large (>50) chain of Ytterbium ions in a near uniformly spaced configuration. A high numerical aperture (NA) holographic optical addressing system will be used for aberration-corrected addressing of the trapped ions with minimal 'crosstalk error' [1]. This would usher the capability to engineer dynamic many-body Hamiltonians with control over the individual ion-spins and the interactions between them. A high NA imaging system would allow us to detect the spin states of individual ions simultaneously with high precision, including the capability to perform partial measurements without necessarily decohering rest of the system. The trap will be housed inside an XHV vacuum system to keep the ions free from background collisions. Optimal vacuum system engineering has allowed us to design a vacuum vessel with simulated pressures of at least one order of magnitude lower than current room temperature trapped ion quantum simulators.
[1] C.-Y. Shih, S. Motlakunta, N. Kotibhaskar, M.Sajjan, R. Hablützel, R. Islam npj Quantum Information (in press, 2021)

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