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Progress towards building a dual species programmable trapped ion quantum simulator[1] CHUNG-YOU SHIH, SAINATH MOTLAKUNTA, NIKHIL KOTIBHASKAR, MANAS SAJJAN, YI-HONG TEOH, FERESHTEH RAJABI, ROLAND HABLUTZEL, RAJIBUL ISLAM, Institute for Quantum Computing and Department of Physics and Astronomy, University of Waterloo — Long coherence times, high fidelity qubit state initialization and detection, and programmable long-range interactions make trapped ions a leading platform for quantum simulation. Here, we report on our progress towards developing a scalable dual species Yb+/Ba+ quantum simulator. Our apparatus includes a novel optical addressing system, based on Fourier holography, that is immune to imaging imperfections. Such a programmable optical addressing system can be used to engineer programmable qubit interaction graphs, that enable the simulation of higher dimensional spin systems with a linear ion chain. Tools from classical optimization methods, such as machine learning techniques, will be used to efficiently program the quantum simulator to solve a range of problems, in areas such as quantum many-body physics, high energy physics, and quantum chemistry.

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Chung-You Shih
Institute for Quantum Computing and Department of Physics and Astronomy, University of Waterloo

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