universität innsbruck
Forschungsschwerpunkt Physik

Innsbruck
Physics Colloquium

# Quantum simulation and improved control with large ion crystals in a Penning trap

Colloquium talk
by

## John Bollinger

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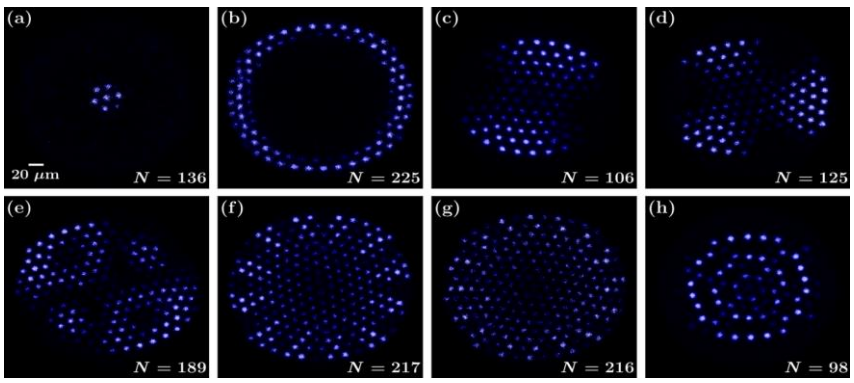
Penning ion traps, which employ static electric and magnetic fields to confine ions, have shown great utility for forming, cooling, and controlling large crystals of hundreds of ions, enabling their use in non-equilibrium quantum dynamics and sensing experiments. Because the ion crystals rotate, most experiments to date have utilized global control of the ion spins and symmetric Dicke states for quantum simulation and sensing. I will discuss one such simulation that documents chaotic and beyond mean field behavior with the Dicke model.

I will also discuss two recent improvements in controlling single-plane ion crystals in Penning traps. First, we demonstrate localized spin control, without the requirement of tightly focused laser beams, by employing an ultraviolet-compatible spatial light modulator (SLM) to imprint programmable AC Stark shift patterns that co-rotate with the ion crystal. Second, we employ a mode coupling technique to significantly reduce the temperature of the so-called ExB modes, which characterize ion motion in the plane of the ion crystal, resulting in improved ion localization and crystal stability.

*Ion fluorescence images of 2D crystal spin states prepared with a spatial light modulator technique*




Tuesday, 29 September, 16:30

HS C, Victor-Franz-Hess-Haus

**Organizers:** Katrin Erath-Dulitz, Hanns-Christoph Nägerl, Francine Marleau