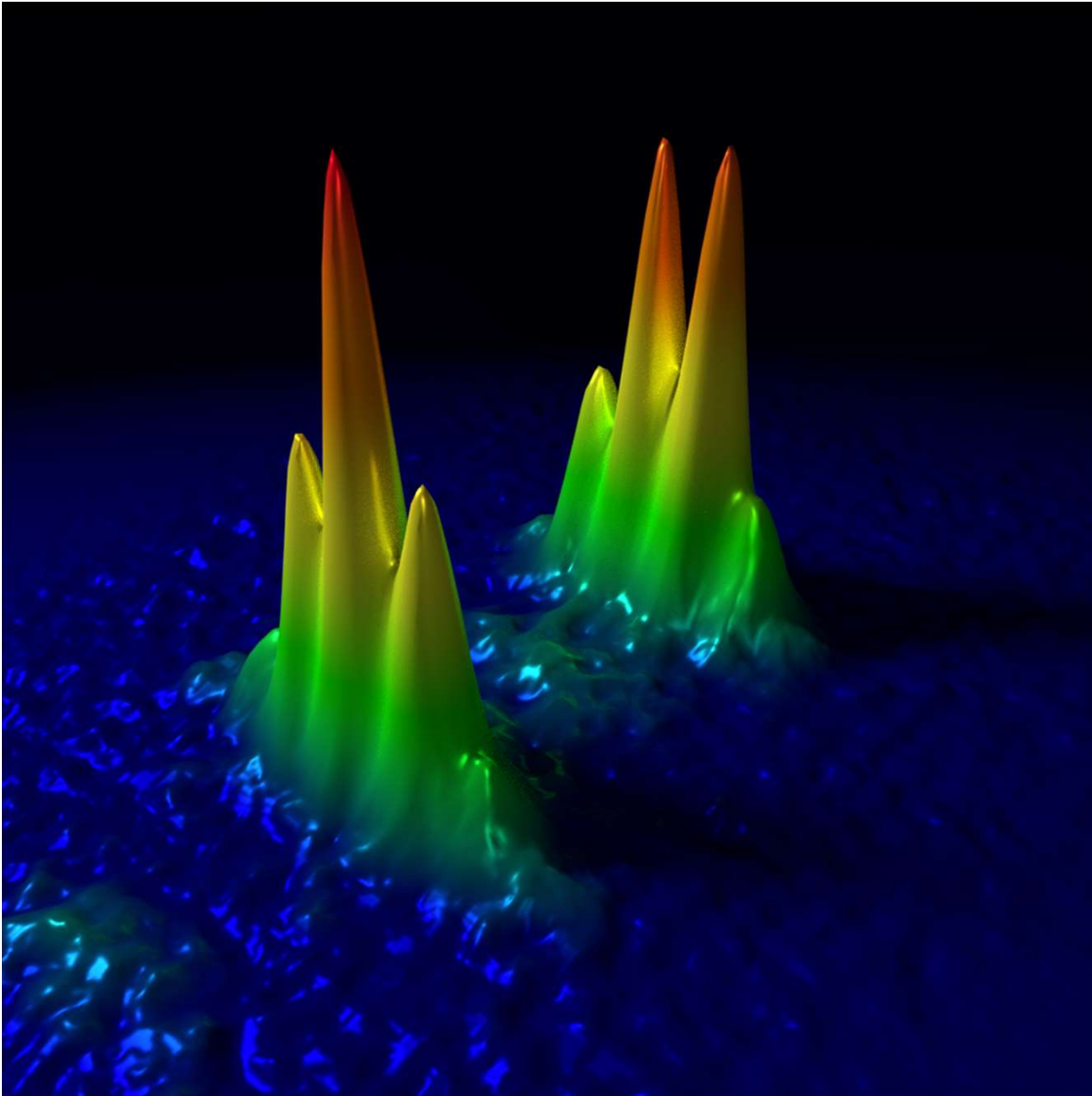# MAGIS-100 Detection R&D

July 27, 2018
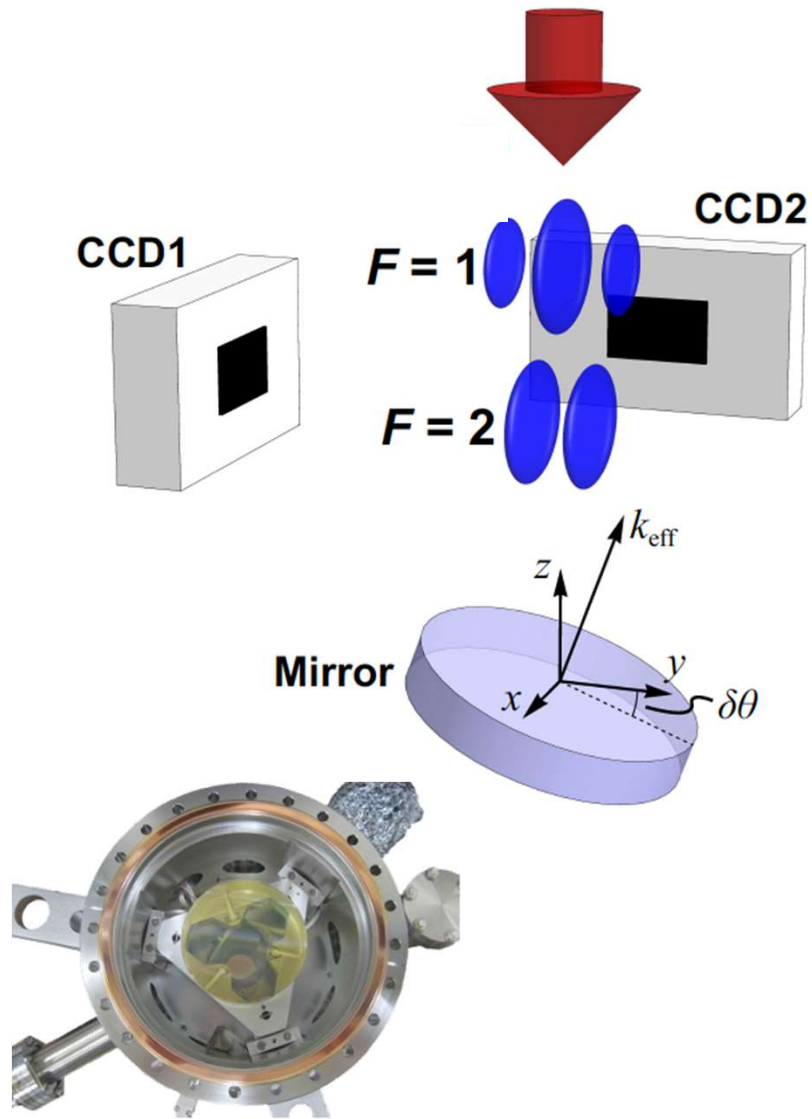
Overview

- ## Phase shear readout
  - Extract interferometer phase by looking at spatial fringes across atom cloud

- ## Are there better data analysis methods to extract the phase from images of the cloud?

- ## Are there detection hardware improvements that could lower the imaging noise?
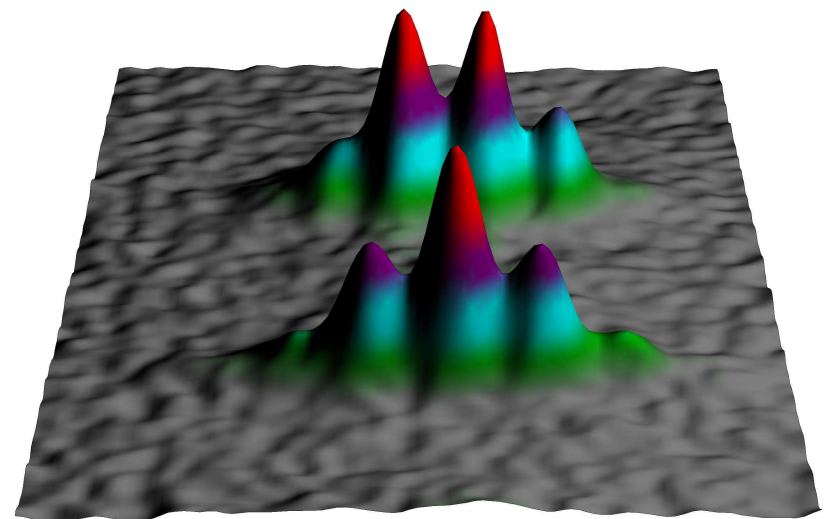
Phase Shear Readout

-Tilt retro-reflection mirror for final pulse to put horizontal fringes on interferometer output ports

-Scans a fringe in one shot: single shot phase readout
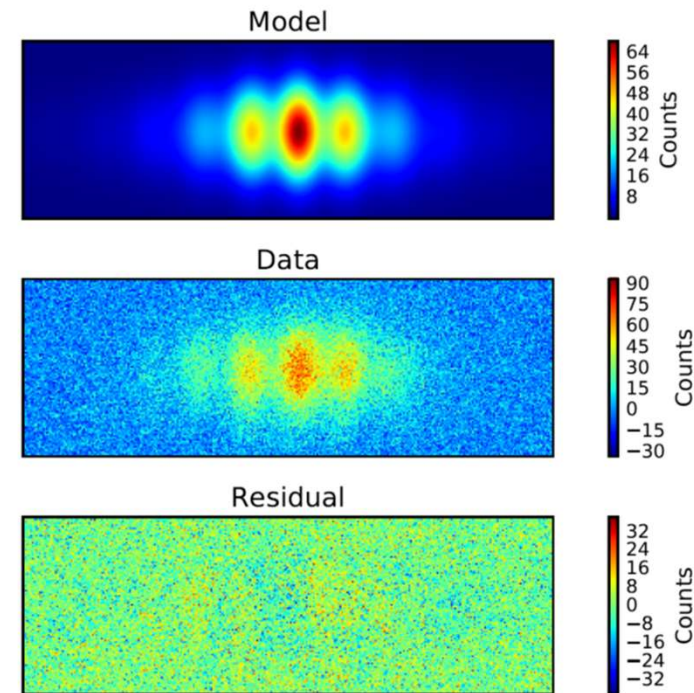
A. Sugarbaker *et al.,* PRL 2013
H. Müntinga *et al.,* PRL 2013

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Phase Extraction

- Fit fringes for phase extraction (have also tried Fourier transform methods with similar performance)
  - A difficulty is fully separating out fringes from cloud envelope effects

$$G_i(x, y)(1 + C_i \cos{(2\pi f x + \Phi_i)})/2$$

- Could more sophisticated fitting or data analysis methods work better? Machine learning?

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Improving Detection Signal to Noise

- **Compromise between imaging duration and contrast**
  - Signal to noise improved for longer imaging time, but fringes start to get blurred out
  - Electronic noise of CCD cameras is a limit

- **Lower noise detection technology could help**
  - Ariel Schwartzman at SLAC had some ideas about this