

MULTI CAMERA

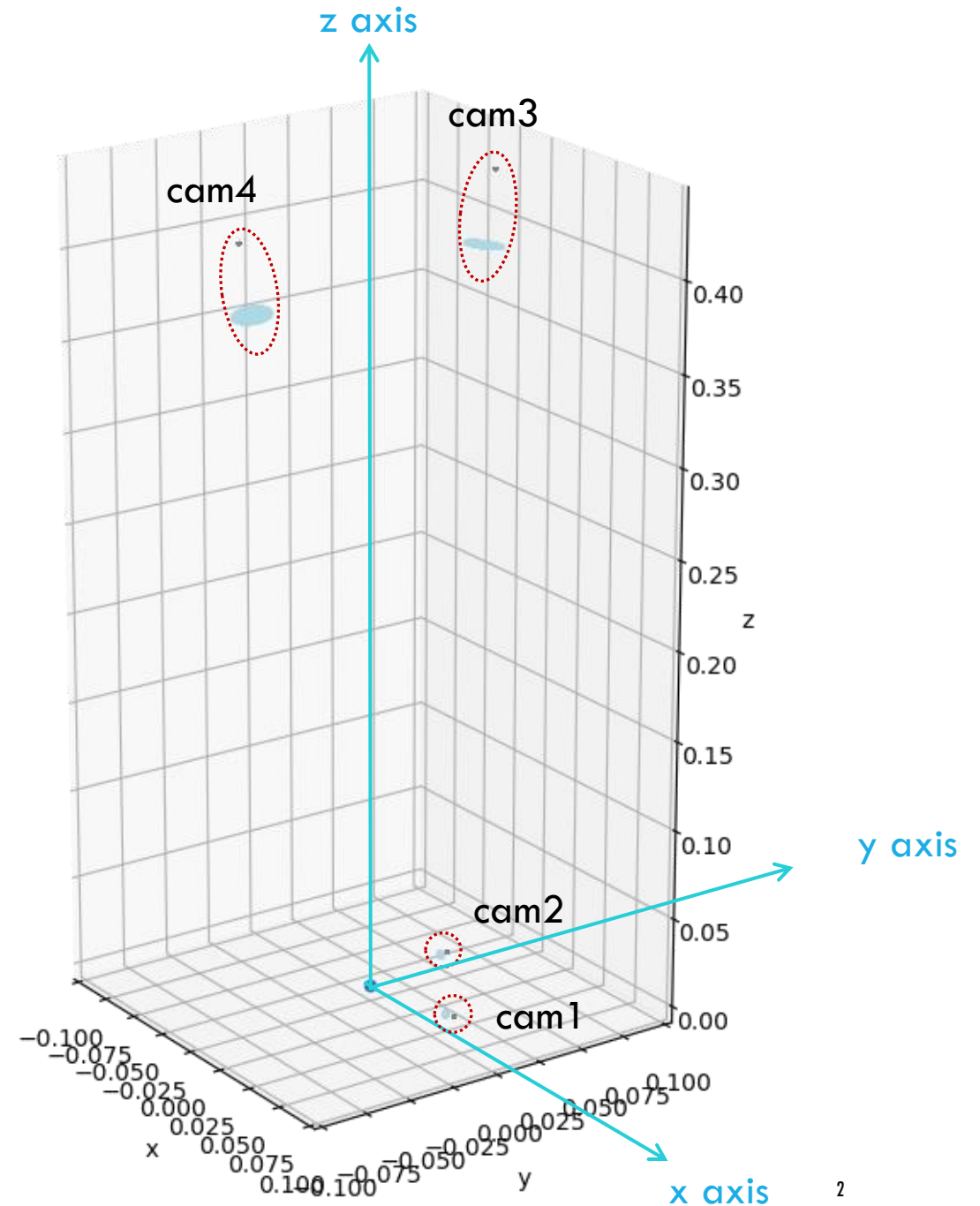
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Korea U./SLAC

INTRODUCTION

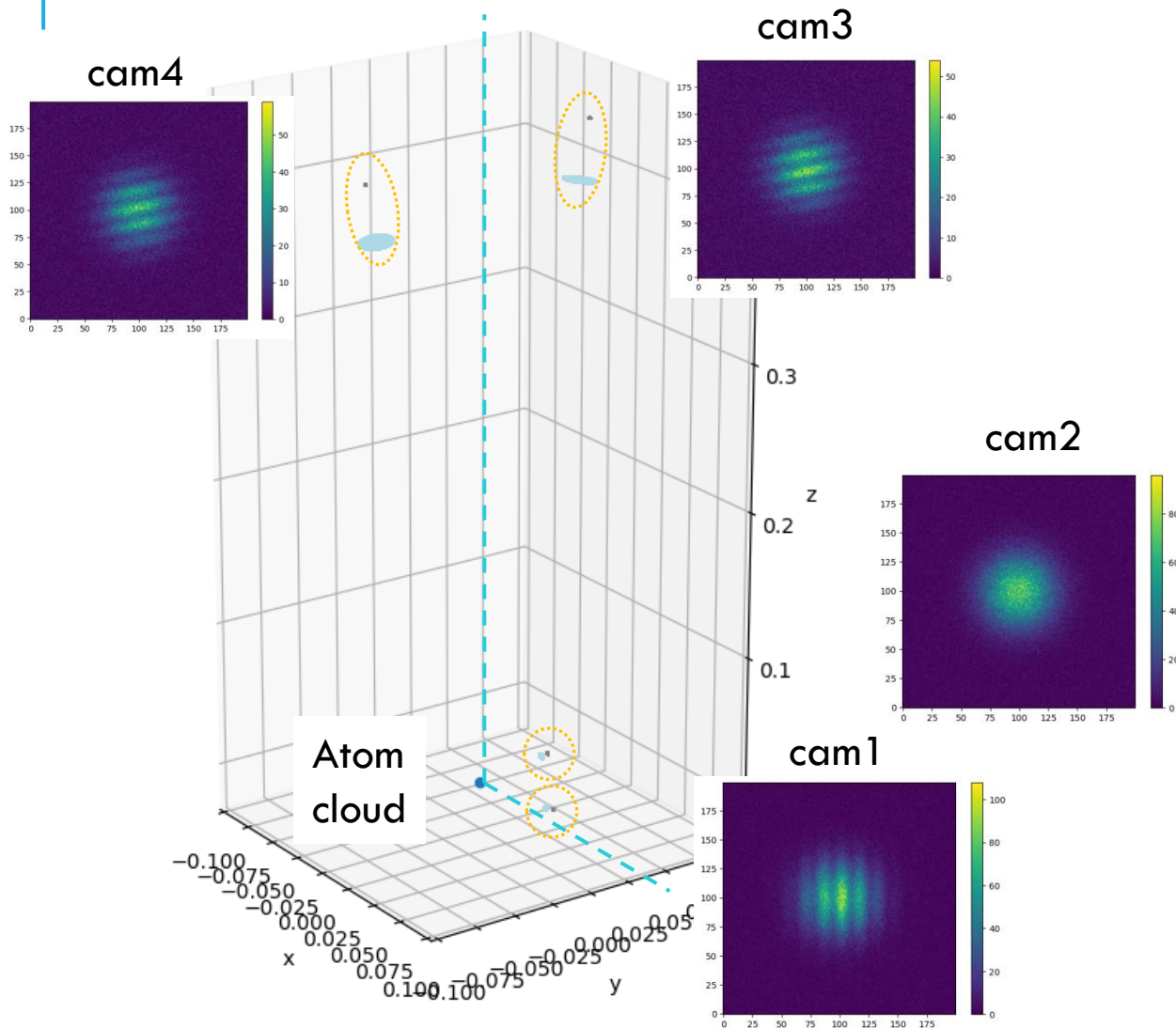
Illustrate potential benefits of additional cameras

- X', y' cameras at 5.2 cm with numerical aperture of 1/1.4 (mag=0.1)
- Two near z views at 40 cm with NA=1/4
 - Ideal lens diameter 1 cm
- Gradoptics framework for simulation and reconstruction

Cameras rotated by 0.2 radians in azimuth



SETUP



Highest contrast when viewed from x or z axis

- Reduced contrast due to rotation

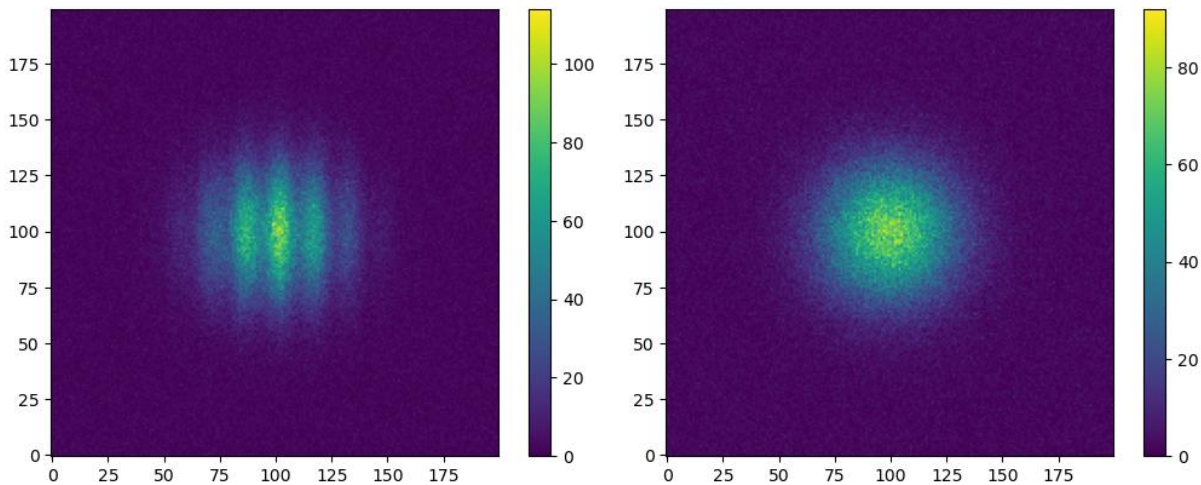
Phase -1.0 input into the cloud

4 sensor images simulated with gradoptics

- 2 p.e. mean noise per pixel added

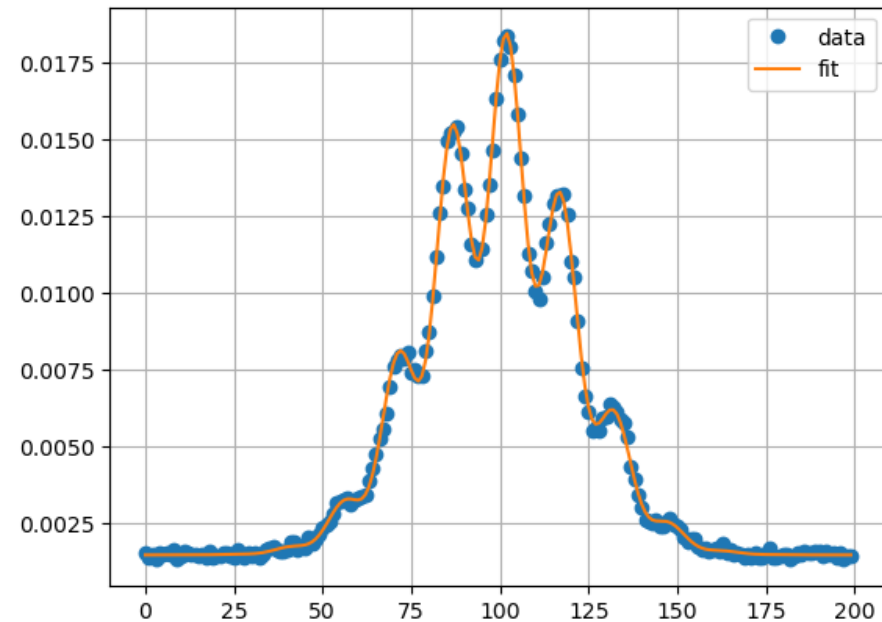
USING TWO CAMERAS IN $Z=0$ PLANE

Sensor images



To make full use of the information in the image, try to infer the cloud model fringe parameters

Phase of -0.94 extracted from simple fit from 1D projection of image



A CLOUD MODEL

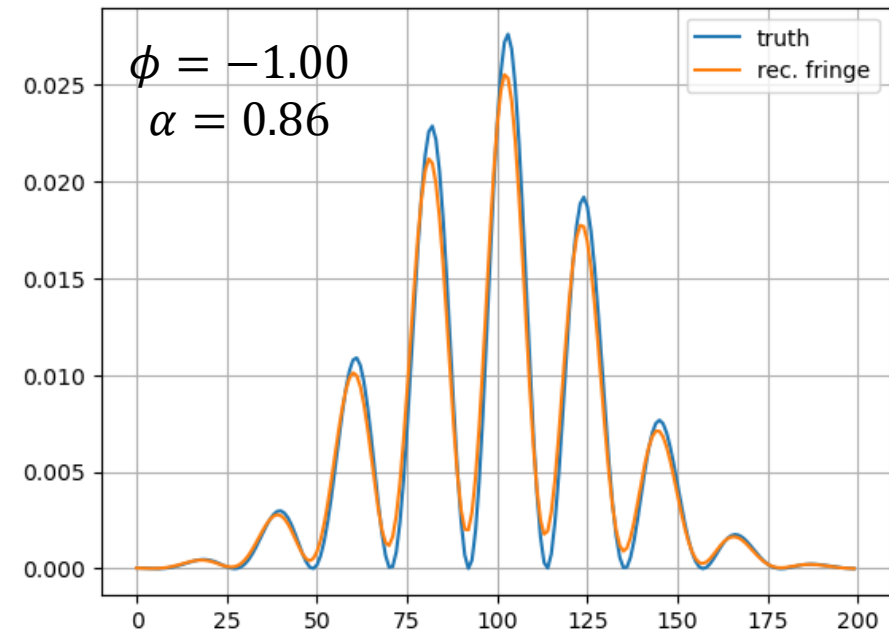
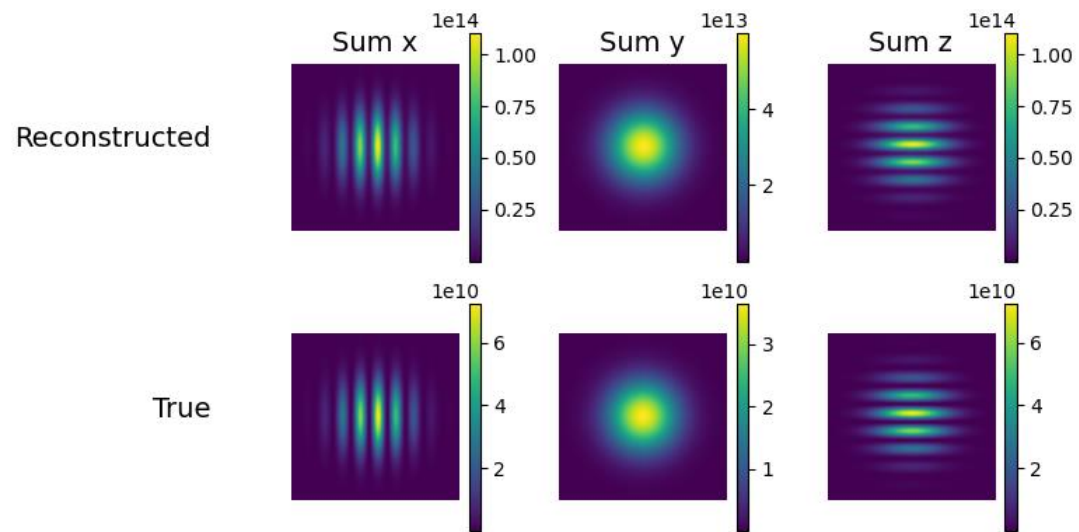
Following model as a light source in gradoptics to determine parameters

$$p(\vec{x}|I_0, \vec{o}, \mathbb{C}, \mathbb{R}, \alpha, k, \phi) = I_0 \exp\left[-(\vec{x} - \vec{o})_{\mathbb{R}}^T \mathbb{C}^{-1} (\vec{x} - \vec{o})_{\mathbb{R}}\right] \left\{1 + \alpha \cos\left[k(y - o_y)_{\mathbb{R}} + \phi\right]\right\}$$

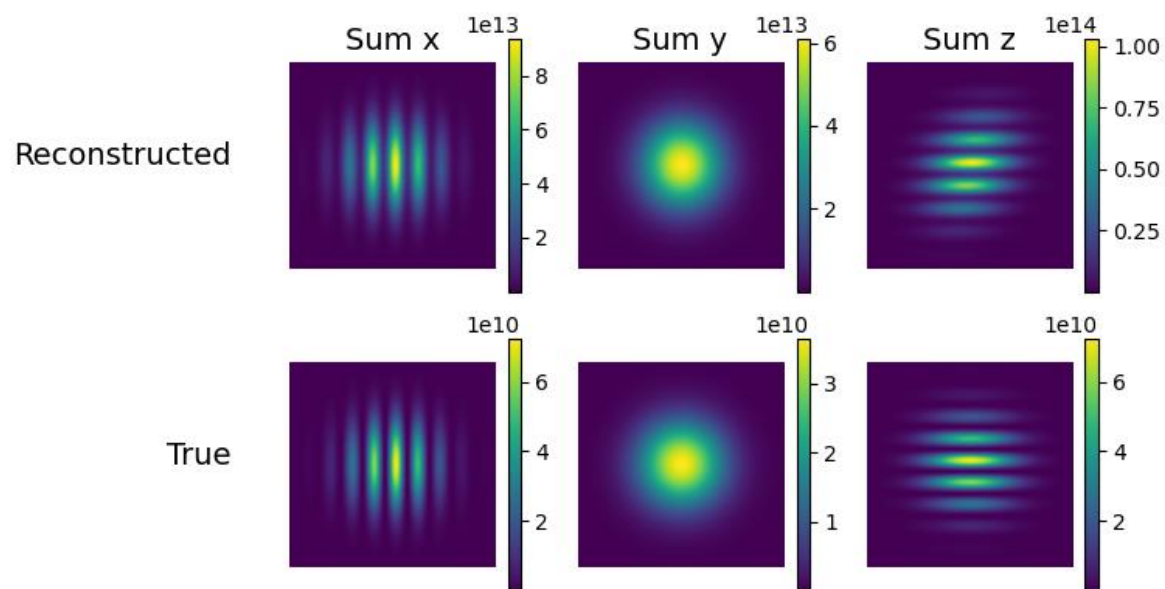
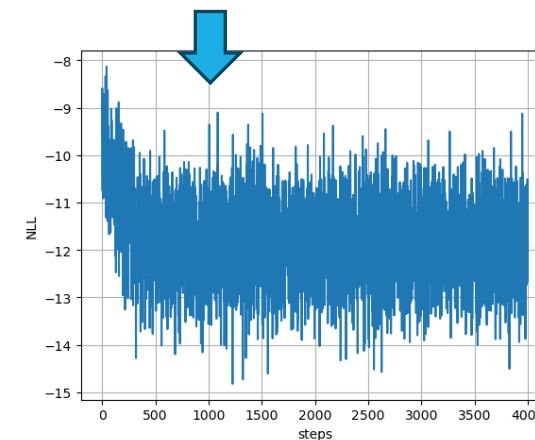
- \vec{o} : center of the cloud
- \mathbb{C} : covariance (3x3 positive definite symmetric)
- \mathbb{R} : rotation (3x3 orthogonal)
- α : contrast ($0 \leq \alpha \leq 1$)
- k : wave number
- ϕ : phase
- Model parameters determined by minimizing NLL

Compared to the cloud model that created the images, general covariance, rotation, contrast allowed

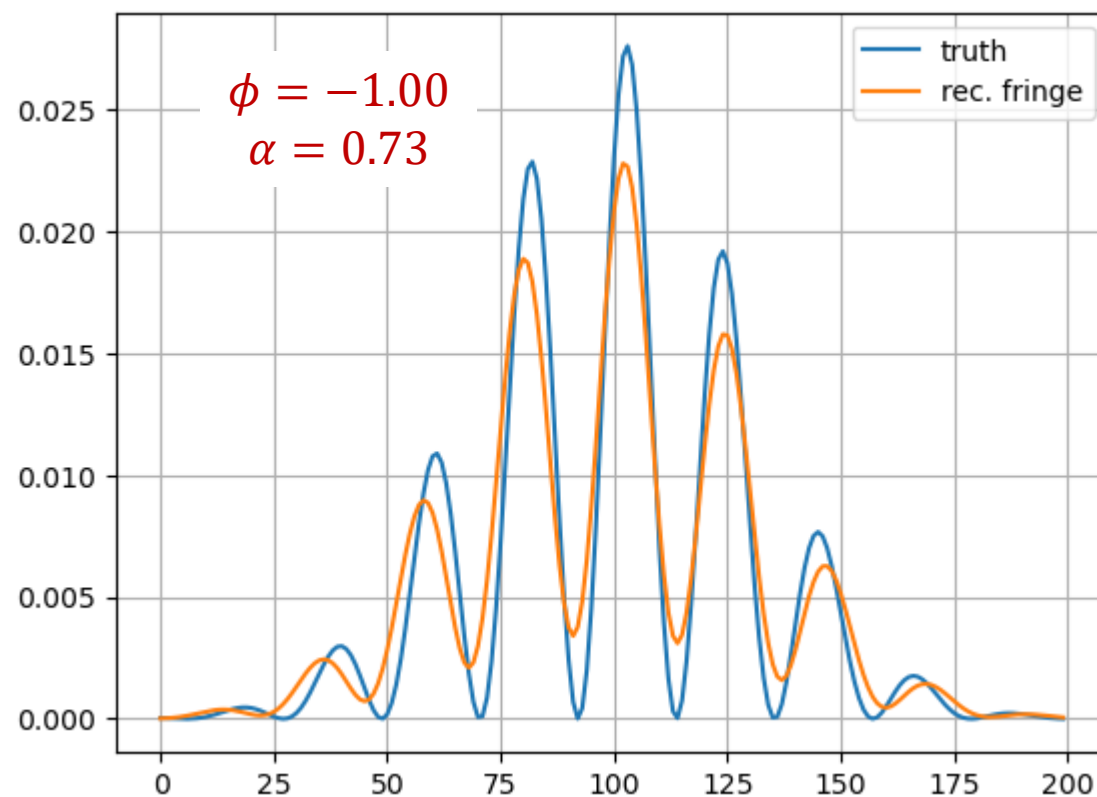
2 CAMS — NO ROTATION & SPHERICAL SHAPE



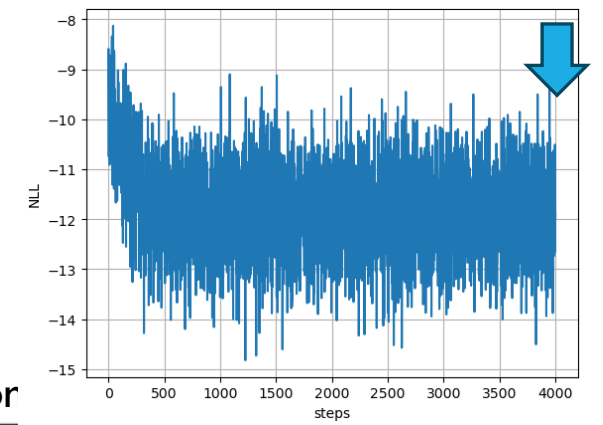
2 CAMS — ROTATION AND GENERAL COVARIANCE



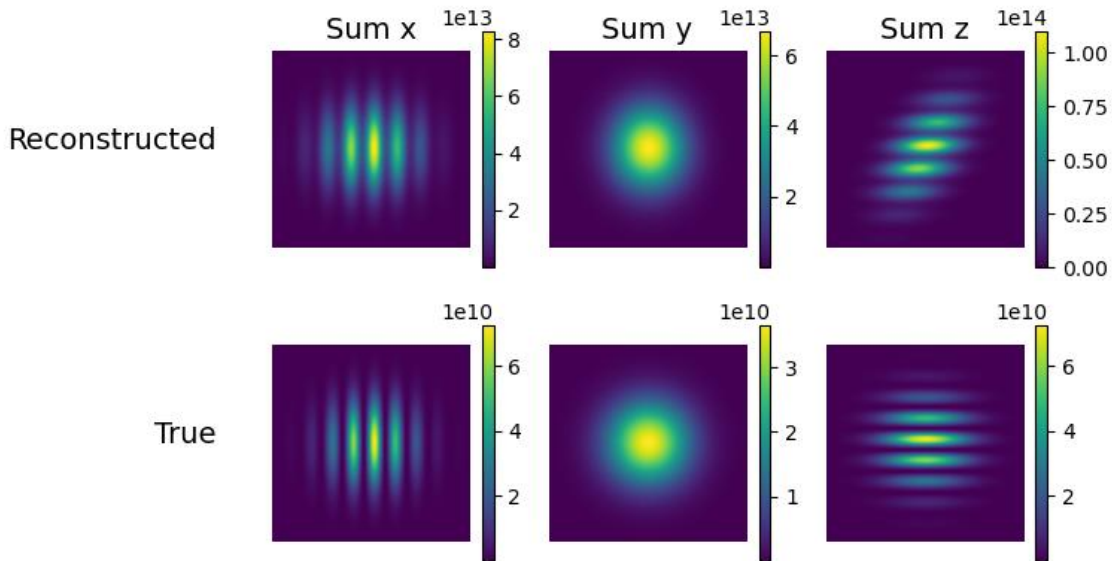
Rotation matrix $\approx I$



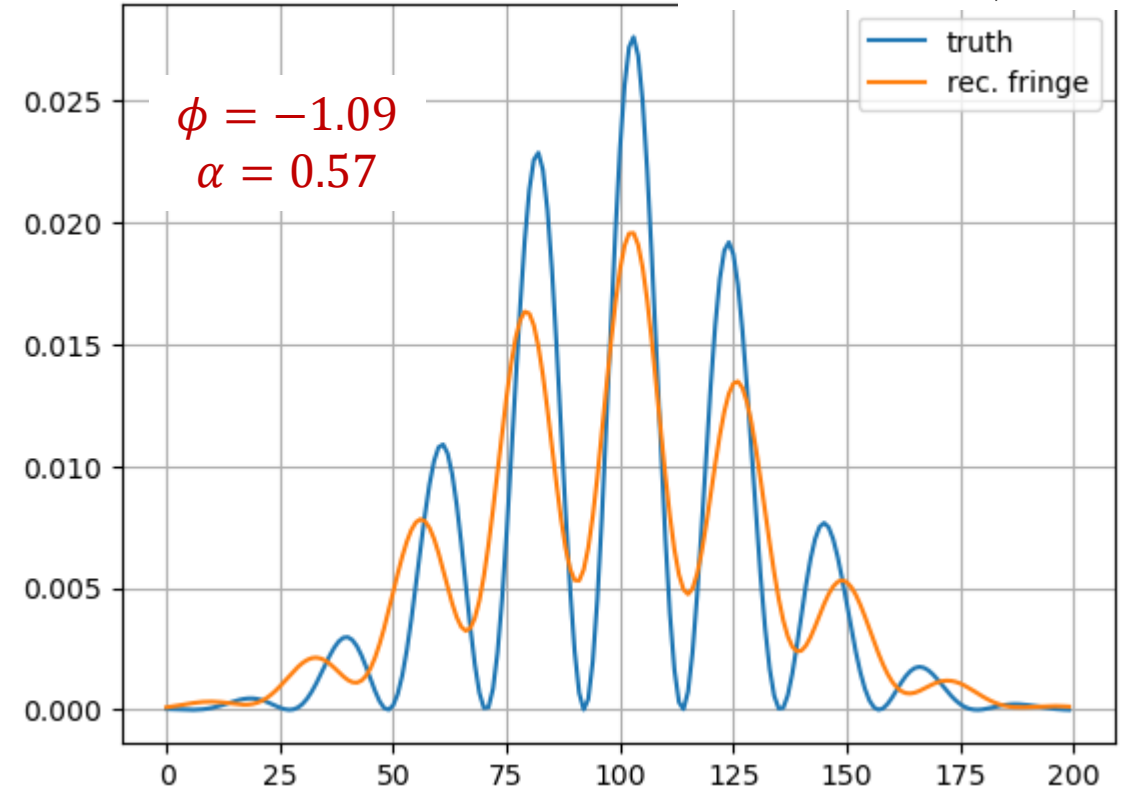
2 CAMS — ROTATION AND GENERAL COVARIANCE



Atom densities with best parameters



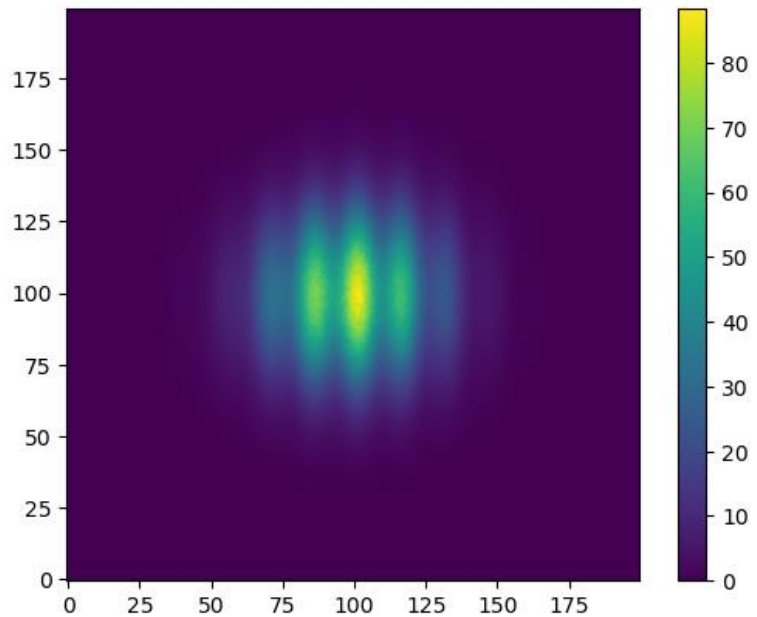
Y projector



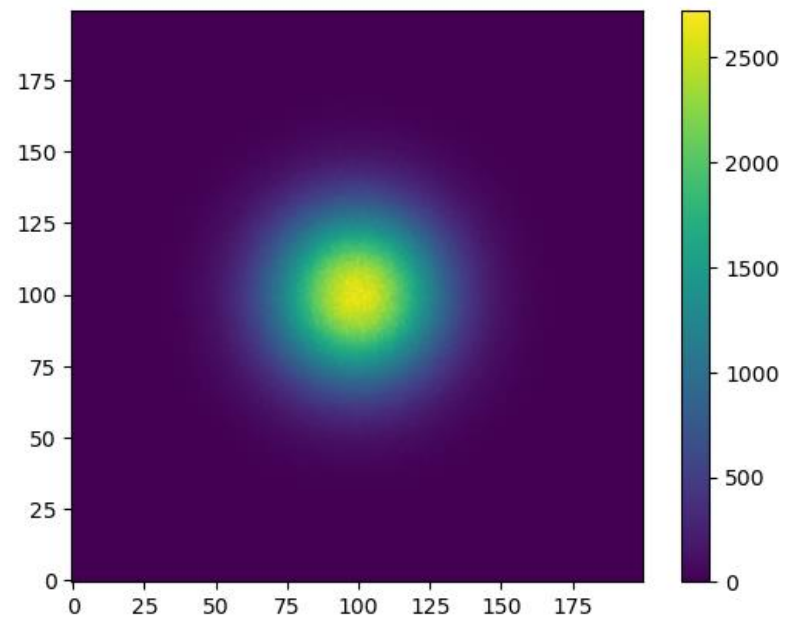
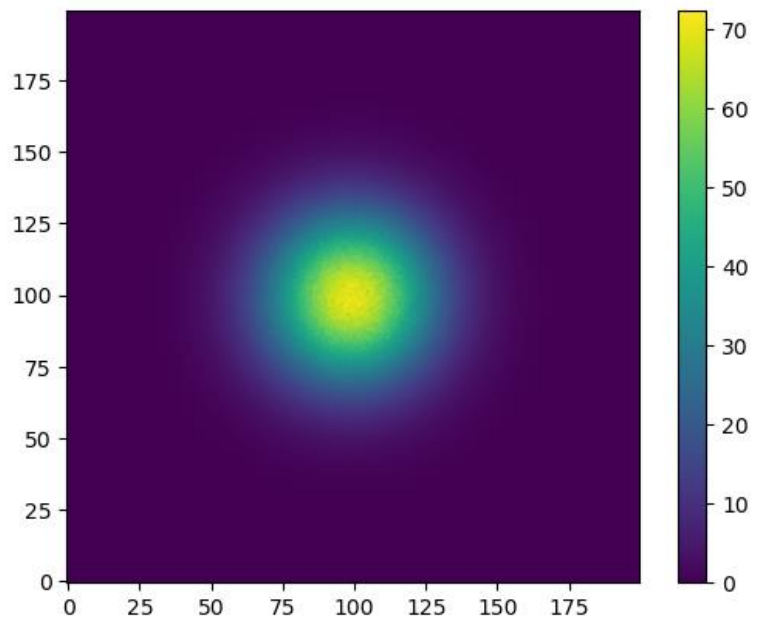
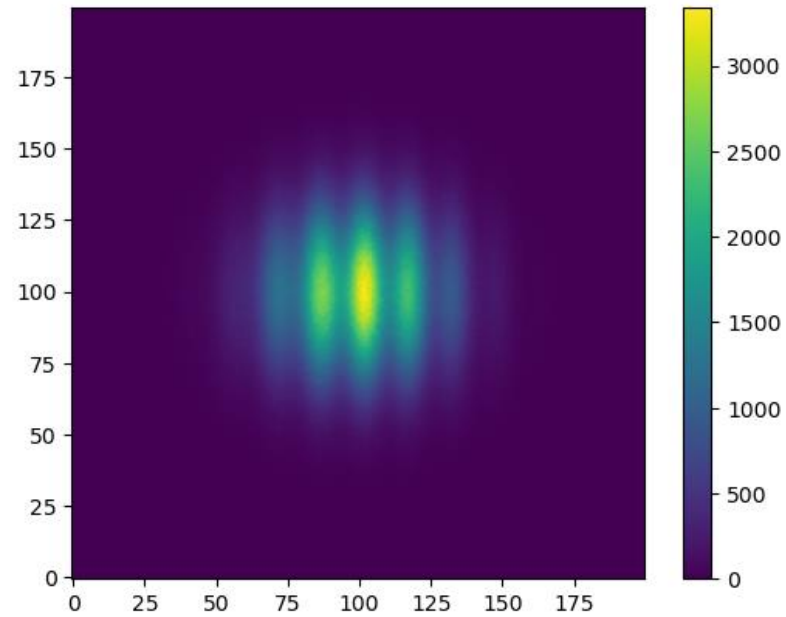
Ambiguity due to using only two images

Sensor
plane

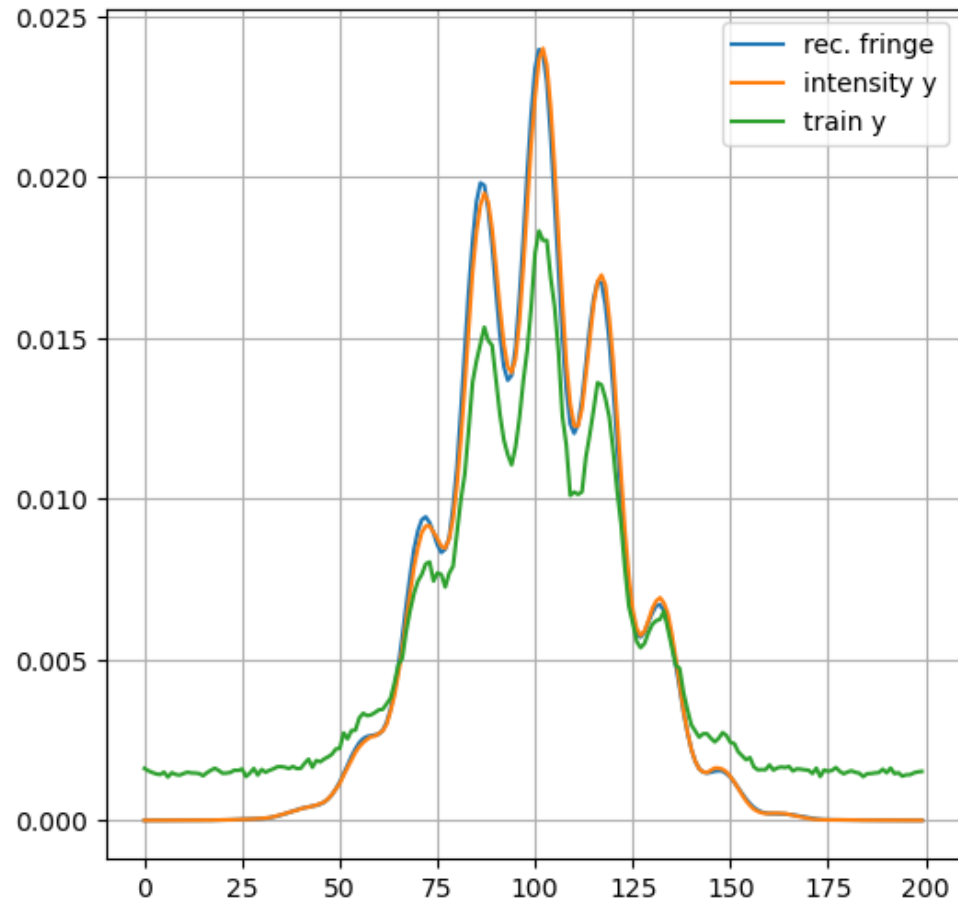
After reconstruction



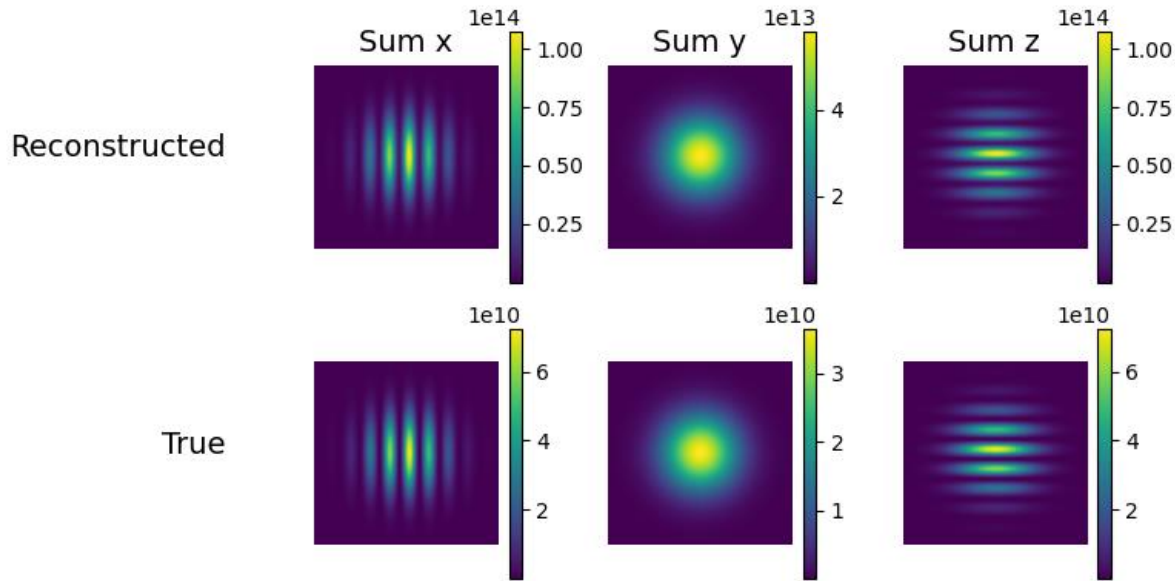
Input intensity



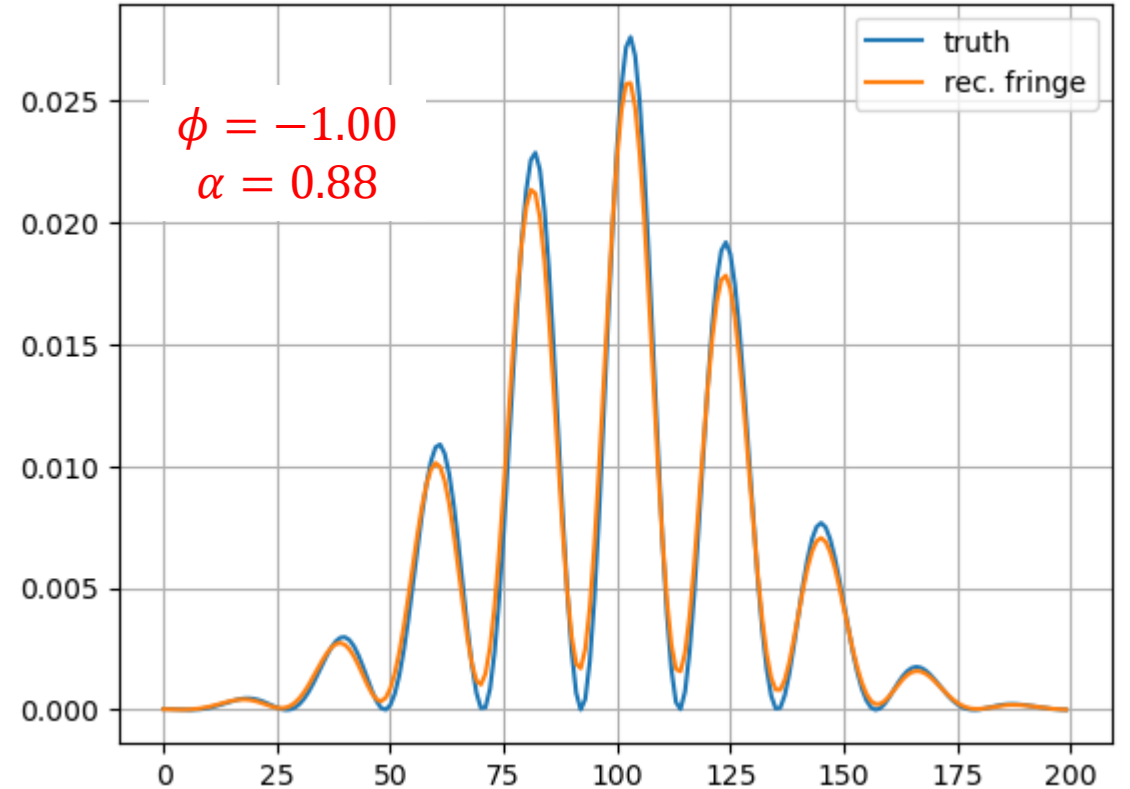
USING TWO CAMERAS IN $Z=0$ PLANE: Y' PROJECTION

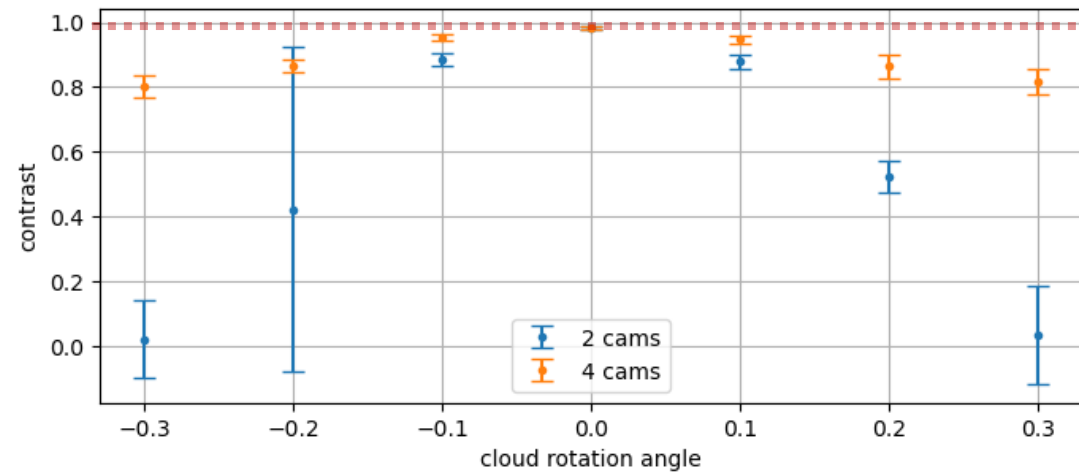
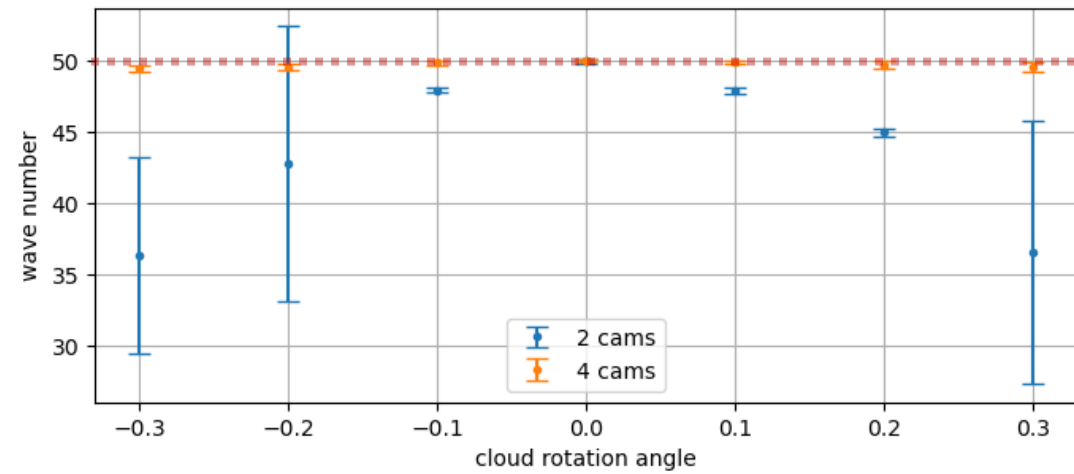
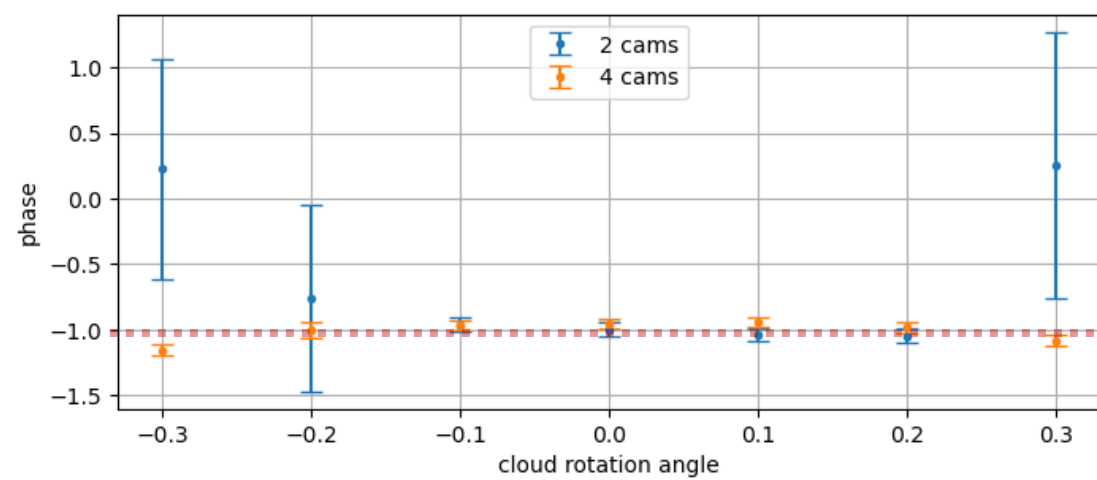


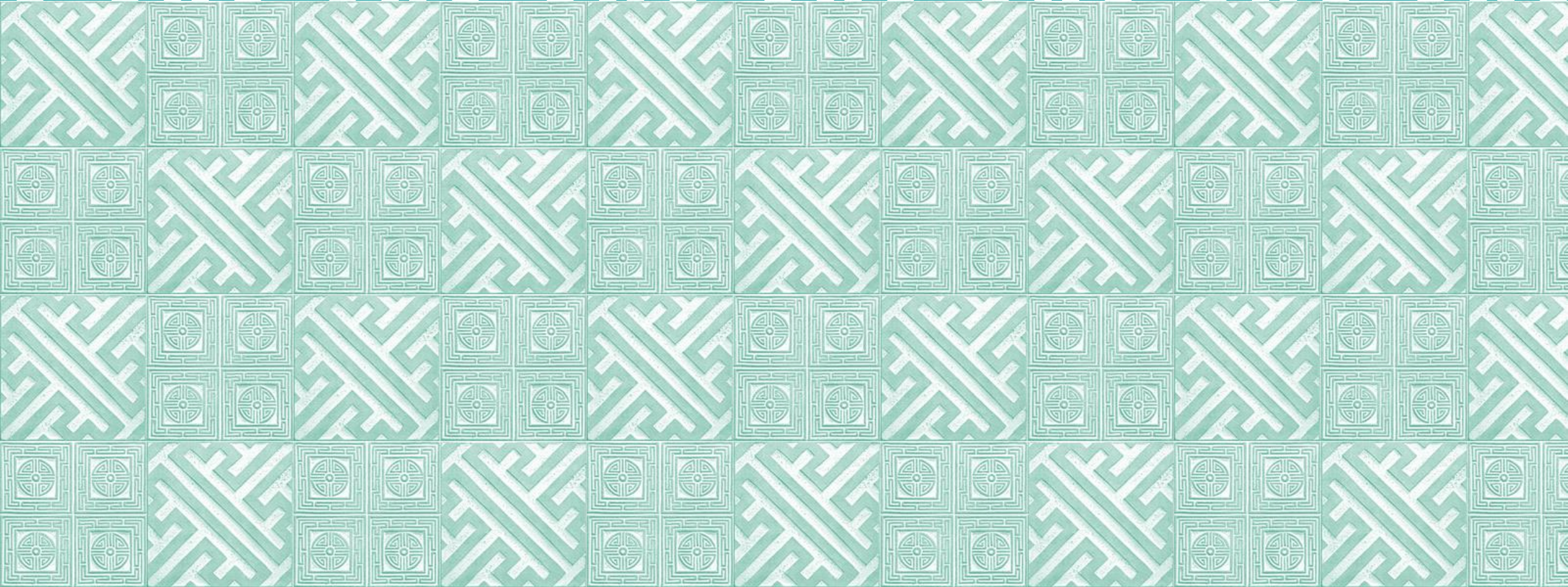
4 CAMS — ROTATION AND GENERAL COVARIANCE



Better contrast

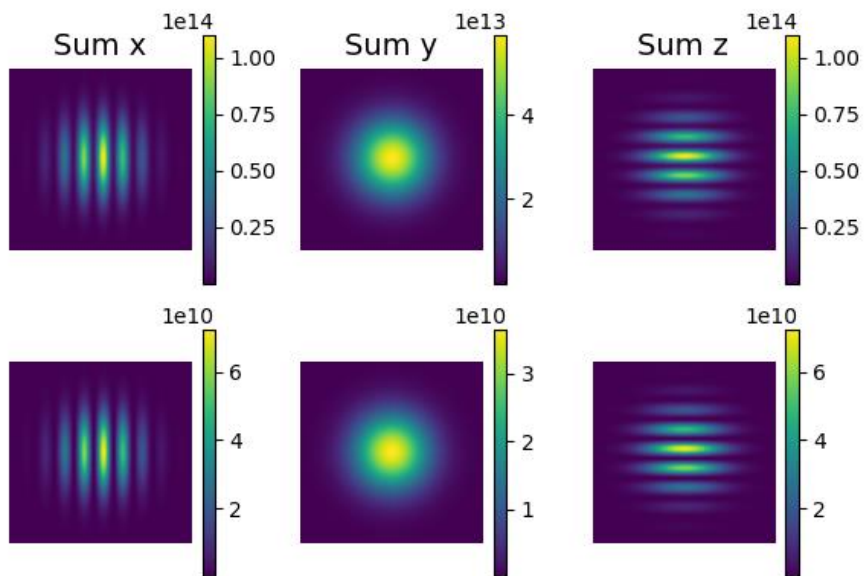






4 CAMS — NO ROTATION & SPHERICAL SHAPE

Reconstructed



True

