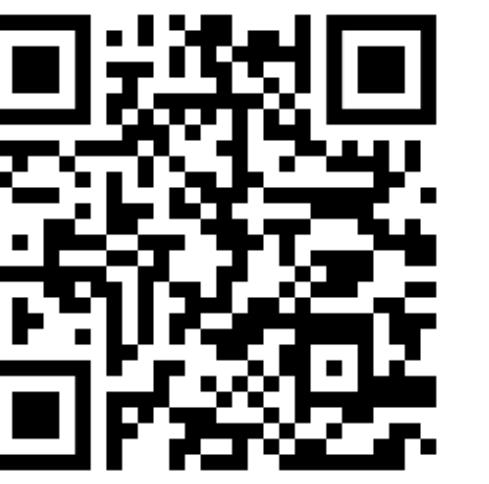




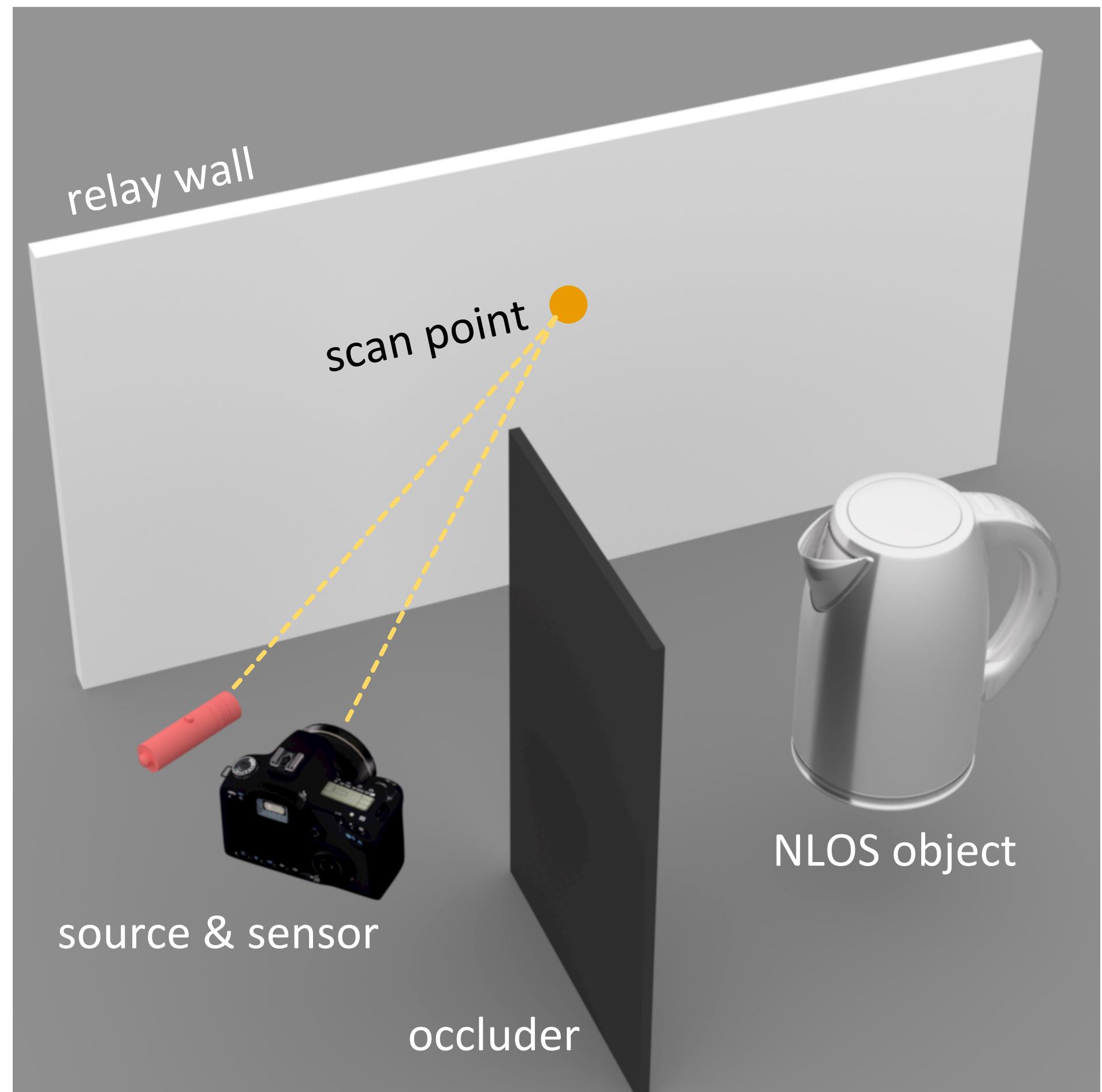
A Theory of Fermat Paths for Non-Line-of-Sight Shape Reconstruction

Shumian Xin, Sotiris Nousias, Kiriakos N. Kutulakos, Aswin C. Sankaranarayanan, Srinivasa G. Narasimhan, and Ioannis Gkioulekas

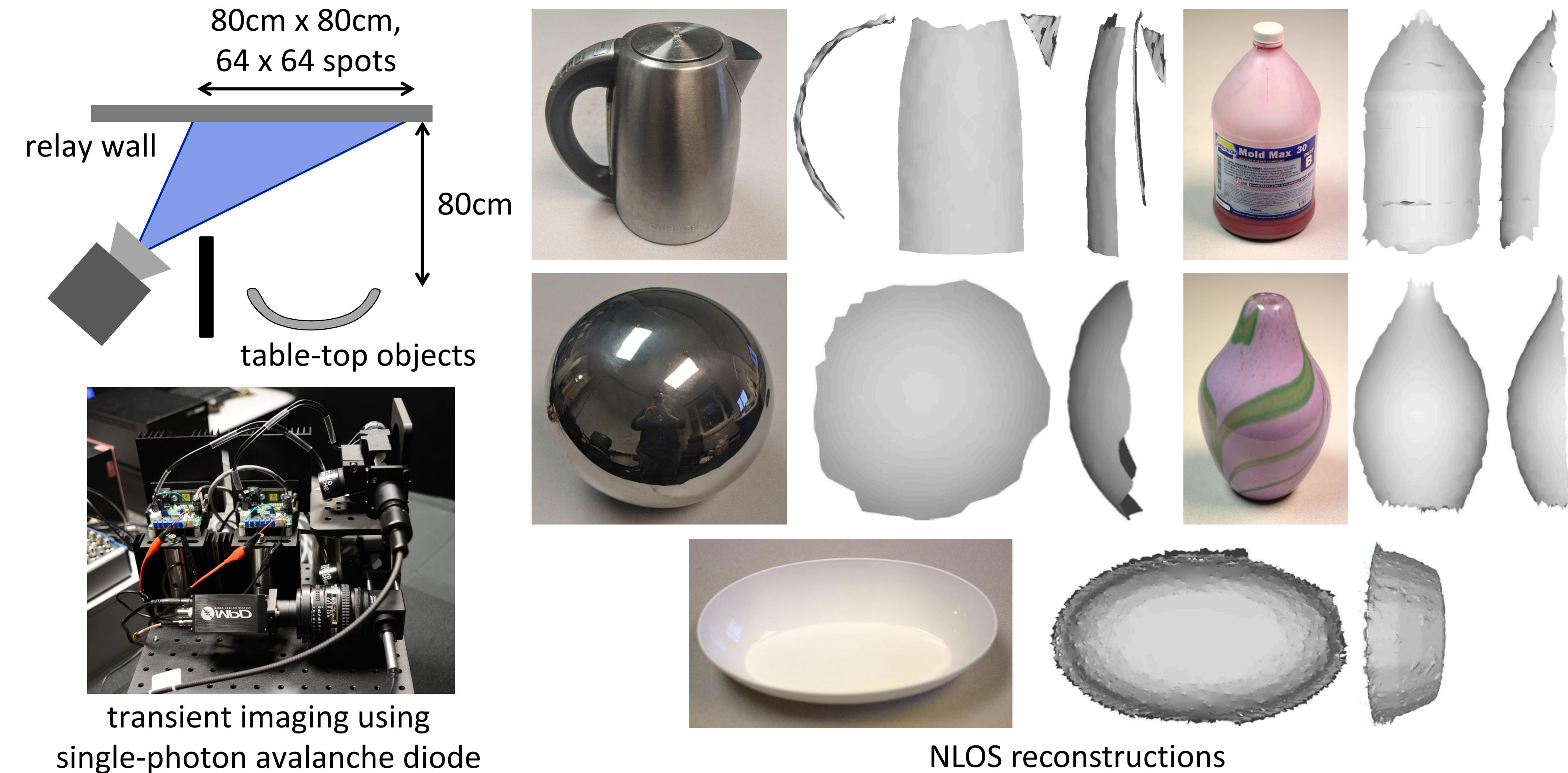
imaging.cs.cmu.edu



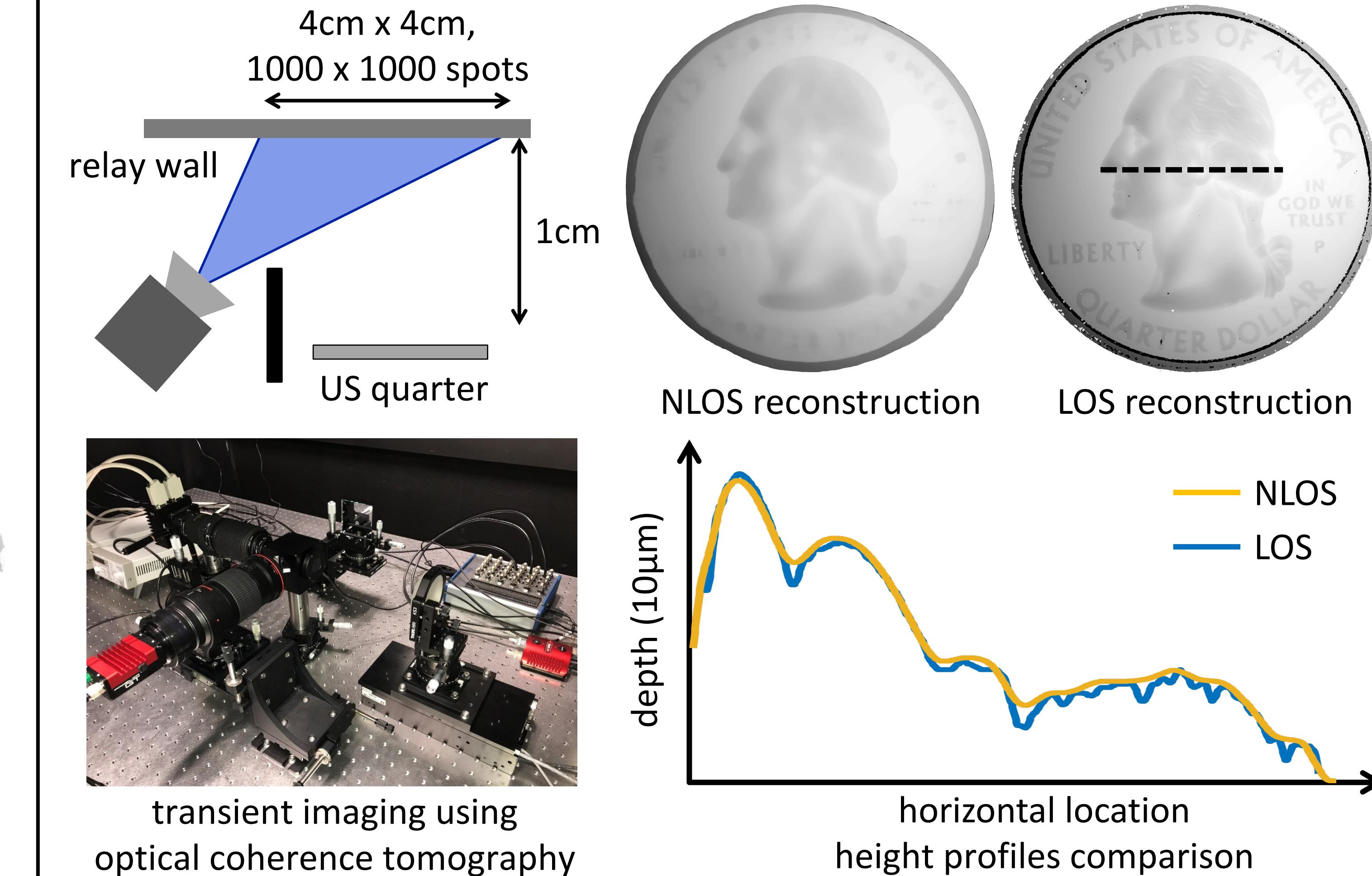
Non-line-of-sight (NLOS) Imaging



Picosecond-scale Reconstructions (1.2mm resolution)

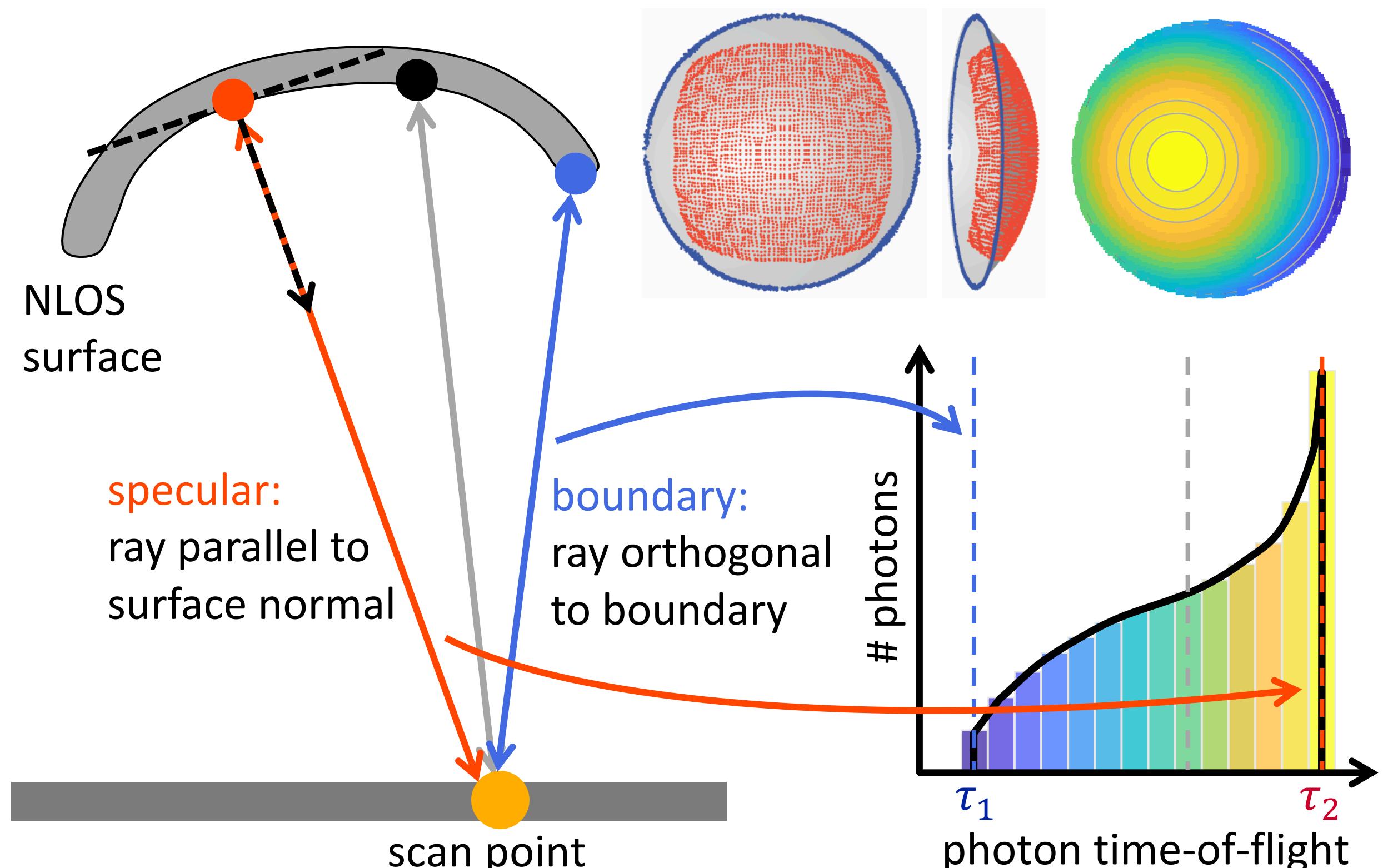


Femtosecond-scale Reconstructions (10μm resolution)



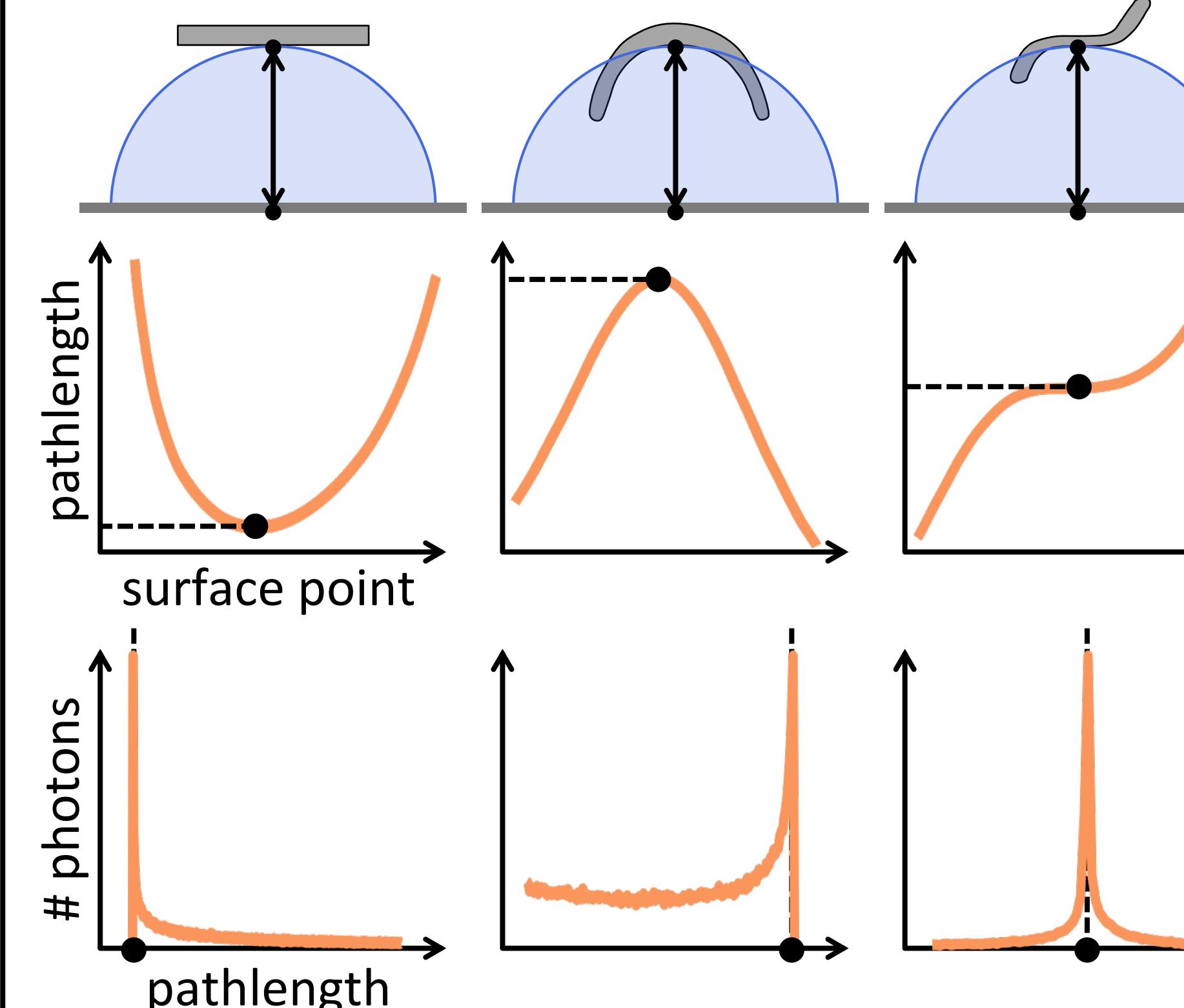
Fermat paths = Transient discontinuities

Fermat paths: **specular** or **boundary**



Why Fermat?

Fermat's principle: paths of stationary lengths



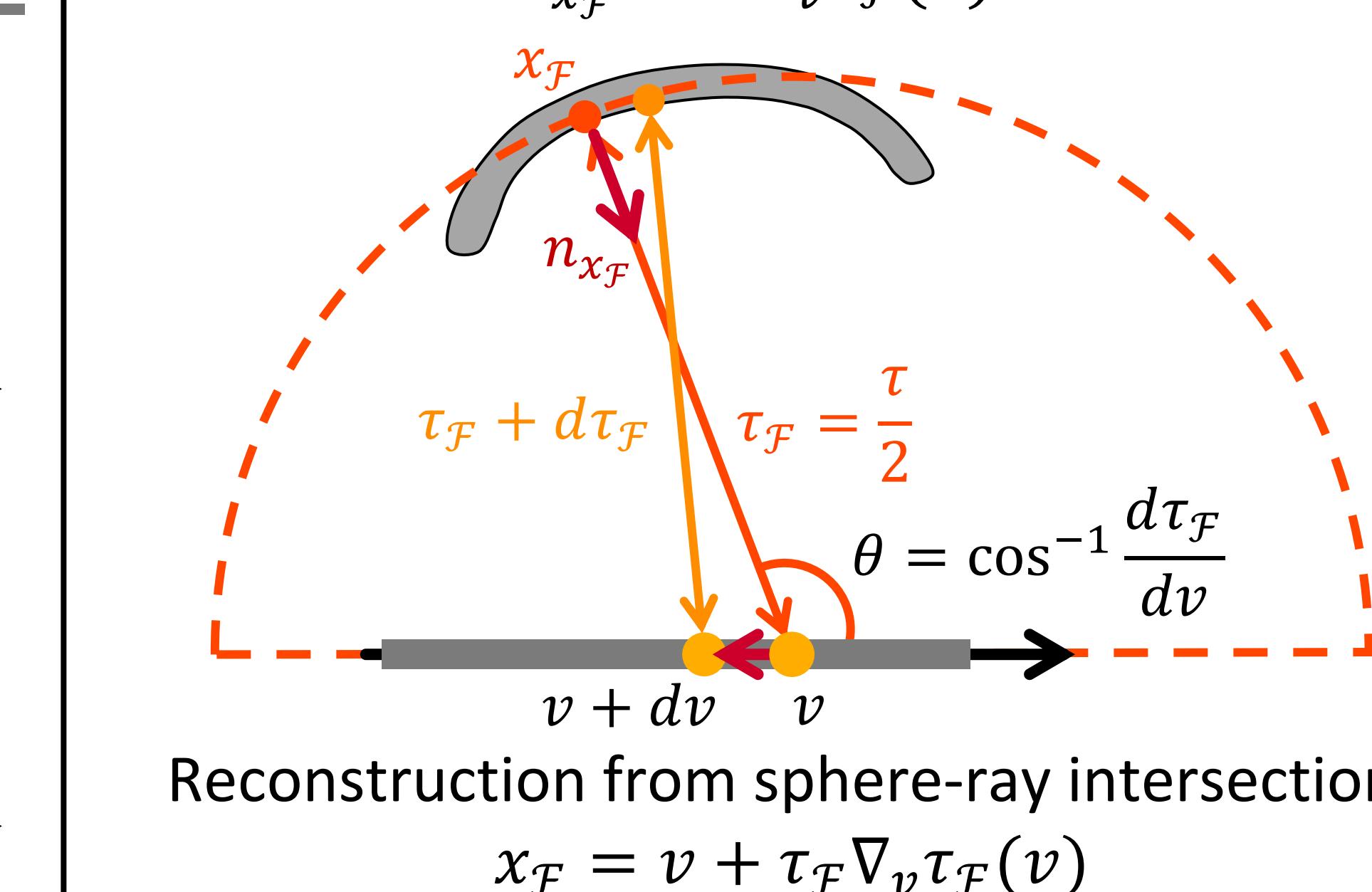
Reconstructing a point and its normal

Fermat pathlength: spherical constraint

$$x_F \in \text{sphere } (\nu, \tau_F)$$

Fermat flow: ray constraint

$$n_{x_F} = -\nabla_\nu \tau_F(\nu)$$



NLOS Reconstruction Pipeline

