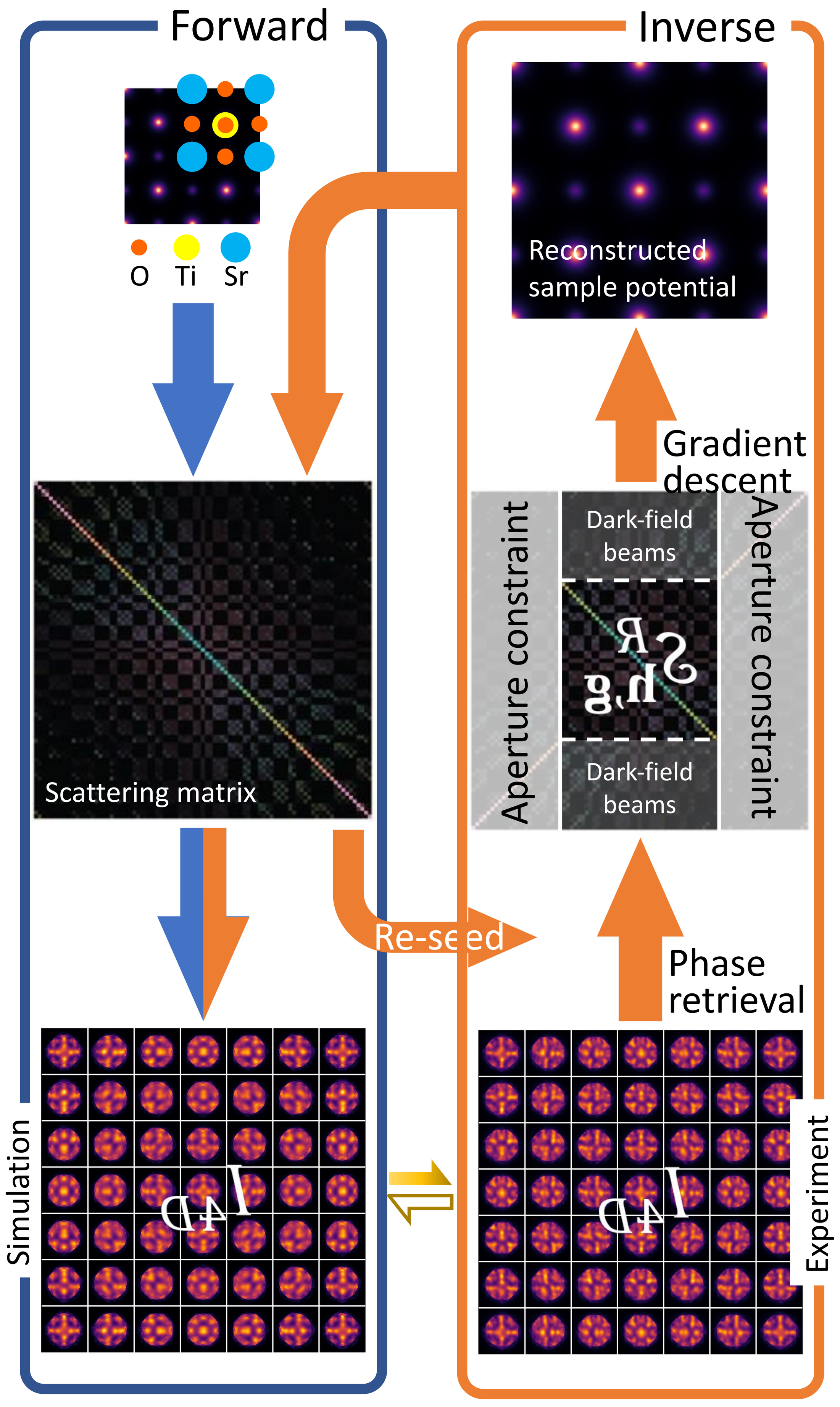
New imaging and analysis methods in electron microscopy of materials

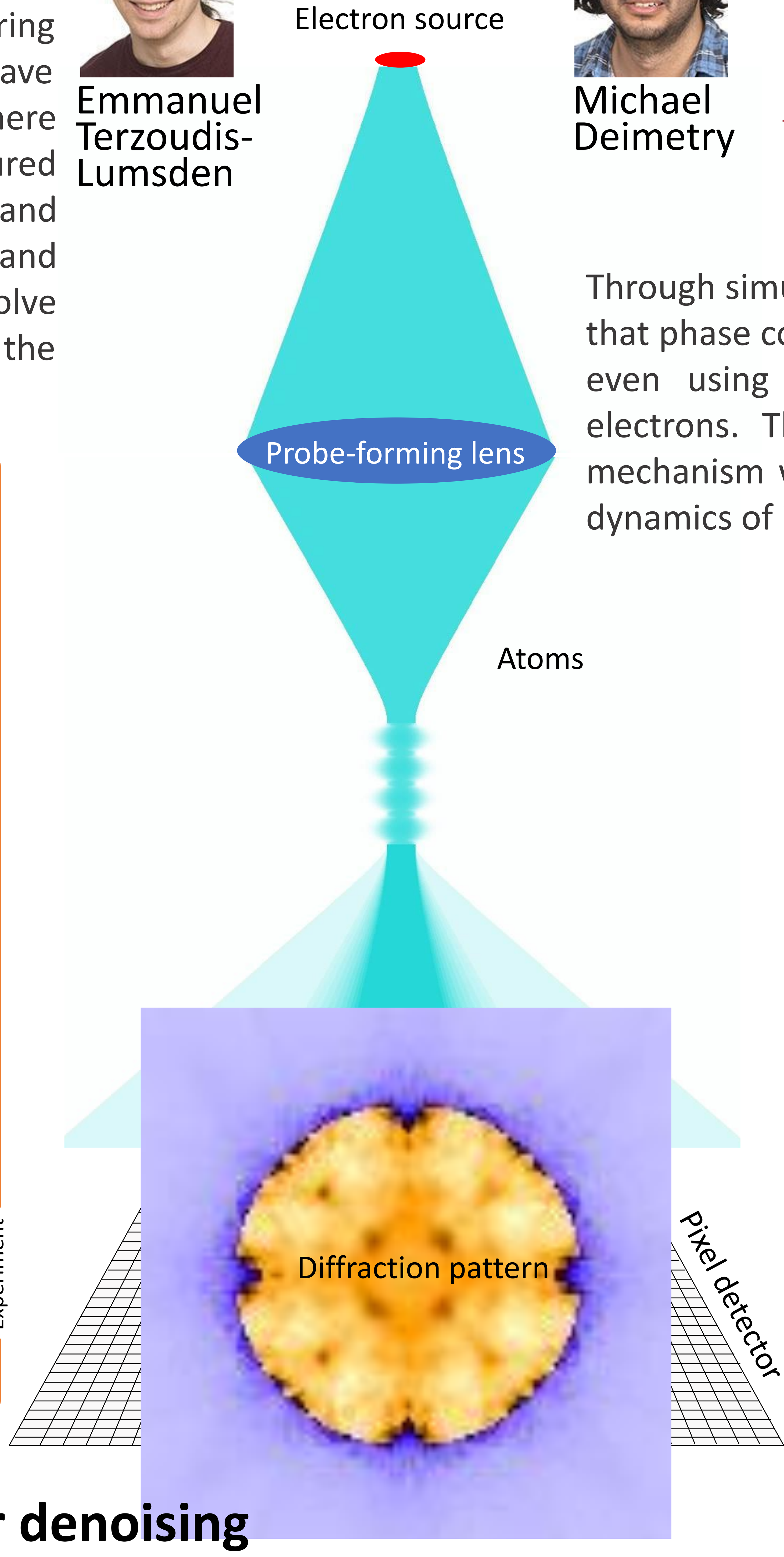
Scott Findlay

Solving the structure from 4D electron microscopy data

Recording 2D diffraction patterns at each probe position in a 2D scan yields much scattering information ("4D data"), but strong electron scattering makes it hard to interpret. We have developed a two-step algorithm where phase retrieval is applied to measured intensities to obtain amplitudes and phases of the scattering matrix and then gradient descent is used to solve for the electrostatic potential of the sample.

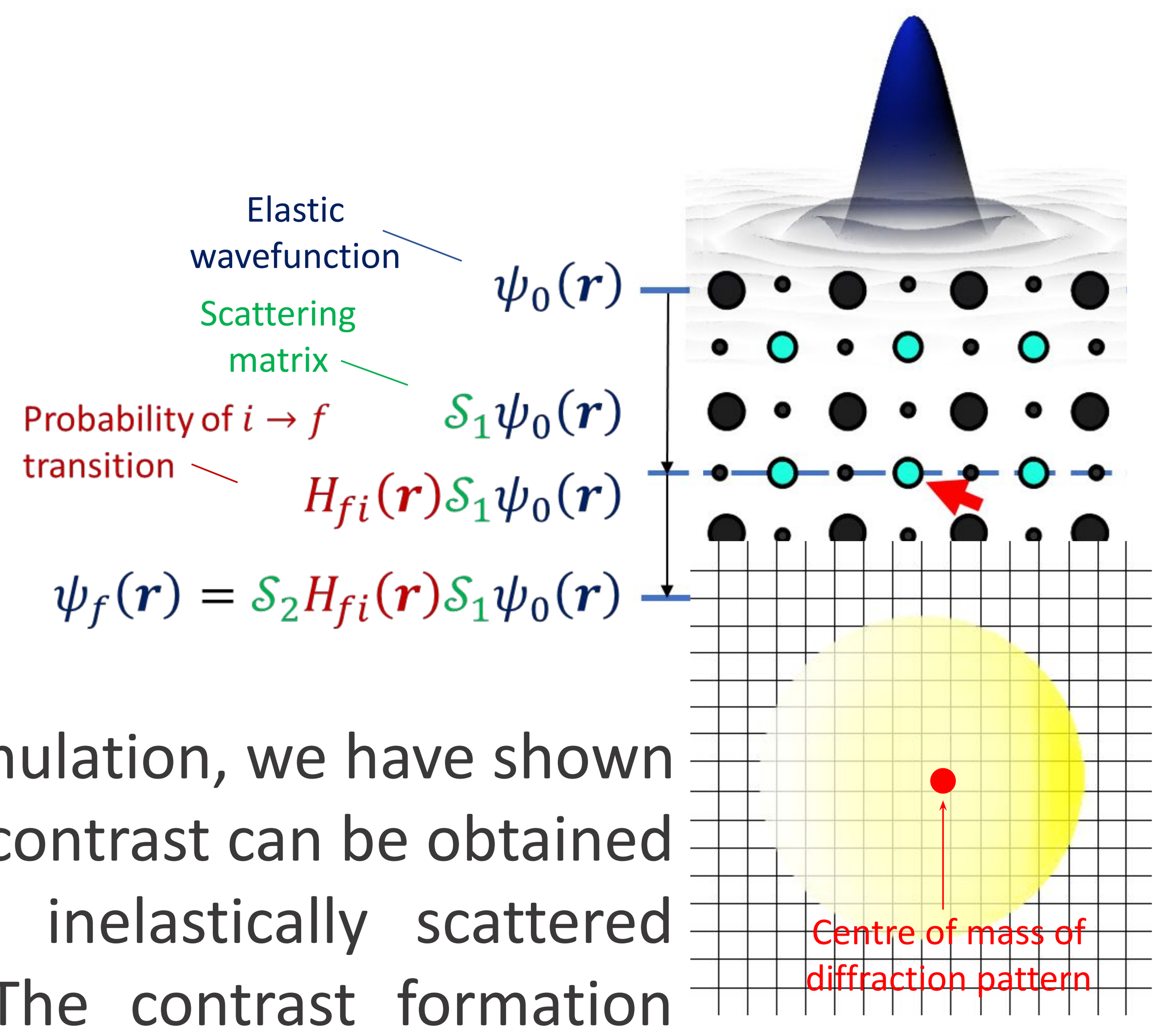
Emmanuel Terzoudis-Lumsden



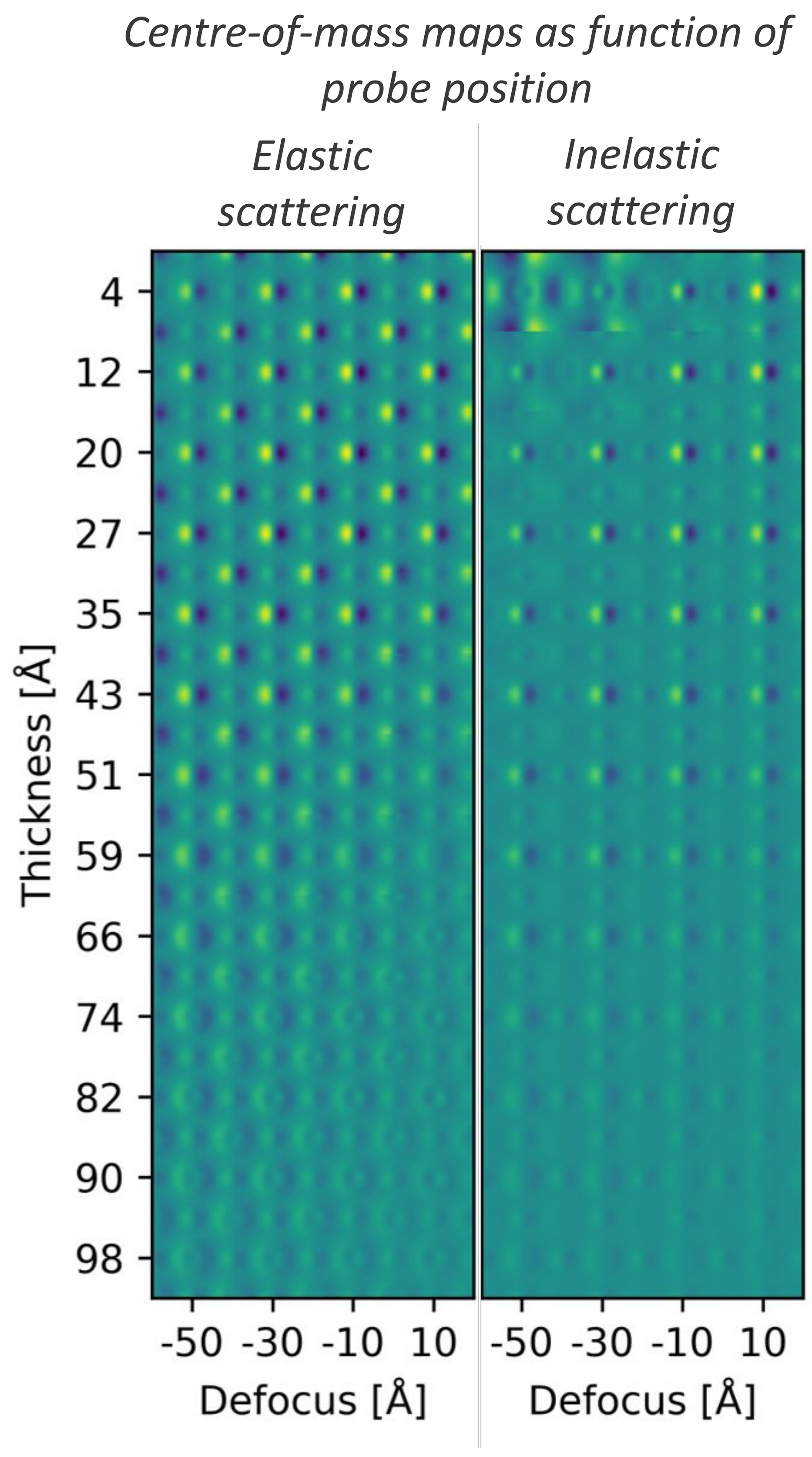


Phase contrast from inelastically scattered electrons

Michael Deimetry



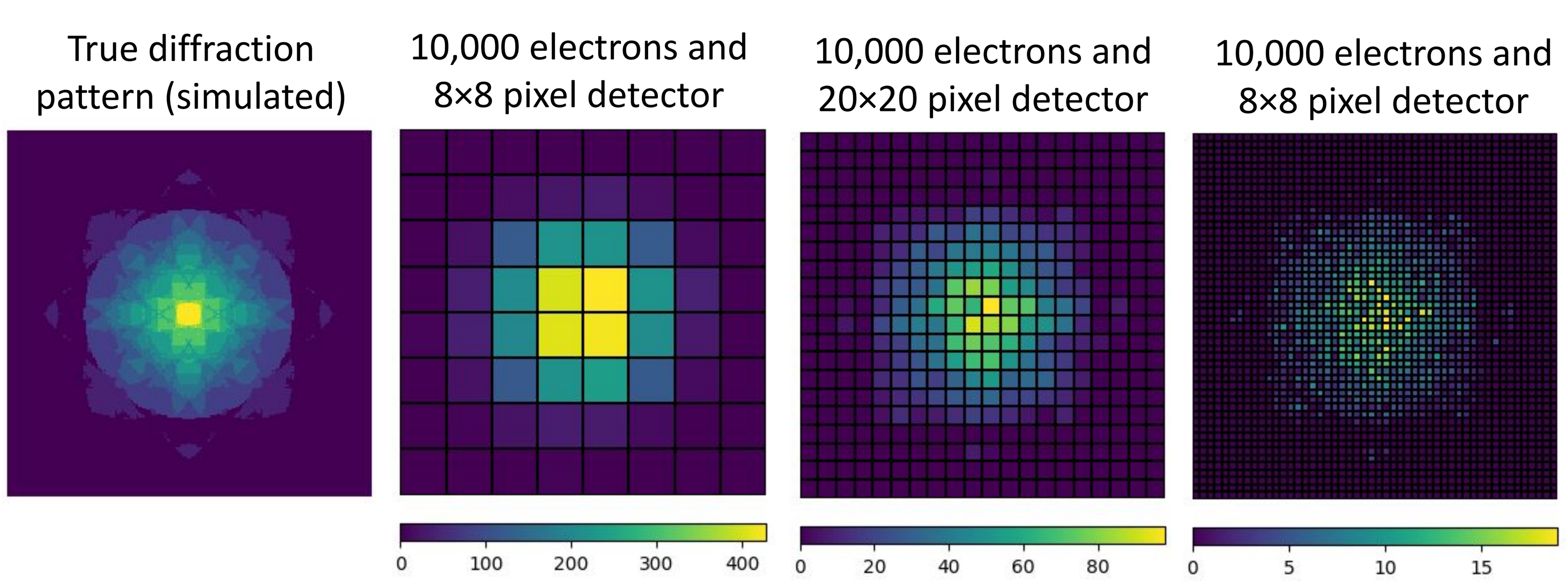
Through simulation, we have shown that phase contrast can be obtained even using inelastically scattered electrons. The contrast formation mechanism was explained, and the dynamics of imaging explored.



Deep learning model for denoising

Distributing the electron dose over many pixels gives us better (scattering angle) resolution in the diffraction pattern, but reduces the signal-to-noise in each pixel.

Alireza Sadri



We trained an unsupervised network denoiser that treats the diffraction patterns as a "2D language", using the surrounding "words" (patterns) to improve our prediction of each "word" (pattern).