Emerging deep learning based computational microscopy techniques promise novel imaging capabilities beyond traditional techniques. In this talk, I will discuss two microscopy applications. First, I will present a physics-assisted deep learning (DL) framework using multiplexed illumination to achieve large space-bandwidth product (SBP) phase imaging, enabling significant reduction of the required measurements, and opening up real-time applications. We further develop an uncertainty learning framework to provide predictive assessment to the reliability of the DL predictions. Second, I will turn to the pervasive problem of imaging in scattering media. I will discuss a new deep learning-based technique that is highly generalizable and resilient to statistical variations of the scattering media. We develop a statistical 'one-to-all' deep learning technique that encapsulates a wide range of statistical variations for the model to be resilient to speckle decorrelations.