

## Fast efficient imaging in scanning transmission electron microscopy via event driven ptychography

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Microsecond dwell time 4D scanning transmission electron microscopy (STEM) enables seamless integration of ptychography into conventional rapid scan annular dark field (ADF) STEM workflows. Single side band (SSB) ptychography is a simple and direct phase retrieval method providing high-quality phase images. After a brief introduction into electron ptychography, I will show how to apply SSB to directly visualize atomic structures and defects in monolayer  $WS_2$  which provides a much stronger signal than the ADF, especially for light atoms neighboring heavy elements such as the S in  $WS_2$ .

The sensitivity of the SSB to charge density allows us to detect the effects of bonding. Furthermore, I show how to combine SSB with ADF to obtain the 3D structure of monolayer CuI at picometer precision at low doses using very few tilts. This is possible because the shift of Cu and I can be reliably tracked when the sample is tilted and the SSB provides far clearer images at low doses, especially for the light elements. Last but not least, the application of SSB to image biological molecules will be investigated by SSB.