Honey, I Shrunk the Synchrotron, and the result is a STEM!

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Here, I will present several examples demonstrating how the new generation of monochromators, aberration-correctors and cameras in STEM can rival the capabilities of synchrotrons and allow to probe materials behavior at the nanometer and atomic scales. Specifically, I will show how by utilizing the phase of the electron probe one can reveal the anti-ferromagnetic order of complex-oxide materials [1], and explore the ferromagnetic strength at the interfaces of thin-film complex-oxide heterostructures [2] at the atomic level. I will also explain how STEM can be used to detect site-specific isotopic labels in amino acids at the nanometer scale [9], and show our current efforts in obtaining a vibrational spectroscopy atlas of all proteinogenic amino acids via EELS. Additionally, I will show how one can detect the electric field of individual atomic columns of heavy and light elements, at the sub-Angstrom scale, by using an ultra-low noise SCMOS detector in the diffraction plane [10], and how one can detect anti-Fano resonances in plasmonic nanostructures [11].

Lastly, I will discuss potentially relevant new challenges that electron microscopy will need to resolve in the future. Would it be possible to map orbitals and spins with atomic resolution and with single atom sensitivity? Could we detect a superconducting transition? Could we spectroscopically measure cryogenic temperatures with sub Kelvin precision? Could we detect minute concentrations of isotopic elements and perform radiocarbon dating at the nanoscale? These questions will be addressed and further elaborated during the presentation [6].

References:

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