# Addressing challenges in individual atom EELS

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The latest generation of STEM microscopes based on instrumental developments offers the ability to track in a spectrum-image mode, several signals generated simultaneously by individual atoms and to rekindle the STEM-EELS spectro-microscopy of single atoms.

A $C_s$ corrected Nion UltraSTEM microscope equipped with a new spectroscopic hardware (ProEM camera - Princeton Instruments), has been used to acquire EELS spectrum images with a high acquisition rate resulting in a high noise level. To exploit and analysis such data we usually apply Principal Component Analysis (PCA) as a filtering technique. However, for these high noise levels, a bias is introduced by classical PCA as signal bearing components are discarded with the removal of components considered as noise. That's why we have tested other algorithms based on non-local means methods for denoising.

The first case is the determination of the position of Sm interstitial/substitutional dopants in ceria nanoparticles. The second one addresses the challenge of identifying the characteristic EELS signals from heavy (Tb, Th) atoms in rapid motion on a thin carbon layer, in particular the signal from an individual atom, which imposes a compromise between time acquisition and detection limit.

This contribution emphasizes the possibilities currently offered by a tiny electron probe, a suitable efficient detector strategy and a well chosen signal analysis tool for single atom spectroscopy.