

# Ultrahigh Resolution X-ray Thomson Scattering Measurements at the European XFEL

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Using an ultrahigh resolution ( $\Delta E \sim 0.1$  eV) setup to measure electronic features in x-ray Thomson scattering (XRTS) experiments at the European XFEL in Germany, we have studied the collective plasmon excitation in aluminum at ambient conditions, which we can measure very accurately even at low momentum transfers. As a result, we can resolve previously reported discrepancies between *ab initio* time-dependent density functional theory simulations and experimental observations. The demonstrated capability for high-resolution XRTS measurements will be a game changer for the diagnosis of experiments with matter under extreme densities, temperatures, and pressures, and unlock the full potential of state-of-the-art x-ray free electron laser (XFEL) facilities to study planetary interior conditions, to understand inertial confinement fusion applications, and for material science and discovery.

## References

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