

## Poster-1-2

**Multifrequency Tunneling Spectroscopy**

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Scanning tunnelling spectroscopy (STS) probes the local density of states (LDOS) via differential conductance measurements. Conventional STS acquires spectra through sequential bias sweeps with a small modulation, making large-area spectroscopic mapping slow.

We introduce Parallel Spectroscopy (PS), previously applied to quasiparticle interference (QPI) measurements [1,2]. PS exploits the nonlinearity of the  $I(V)$  characteristic: a larger modulation drive generates higher harmonics that encode the full spectrum. Simultaneous demodulation of multiple harmonics enables reconstruction of the energy dependence in a single measurement. We further extend this approach to multi-tone waveform drives.

In synergy with compressed sensing [3], PS dramatically reduces acquisition time while preserving spectral fidelity.

[1] Berk Zengin et al., Fast spectroscopic mapping of two-dimensional quantum materials, *Phys. Rev. Research* 3, L042025 (2021).

[2] Ajla Karić et al., High dynamic range scanning tunneling microscopy, *MethodsX* Vol. 13, 102857 (2024).

[3] Jens Oppliger et al., Adaptive sparse sampling for quasiparticle interference imaging, *MethodsX* Vol. 9, 101784 (2022).