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Scanning tunneling microscopy at mK temperatures: Probing the smallest energy scales

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As the energy resolution in a scanning tunneling microscope (STM) is principally connected to the temperature of the system, the smallest energy scales in solid state physics, such as Zeeman splitting or elemental superconductivity, are only observable at lowest temperatures. With our new STM operating at 15 mK, we have access to these small energy scales with an energy resolution of $11.4 \pm 0.3 \mu\text{eV}$. Using examples of recent results, we demonstrate the capabilities of the system, such as resolving the Zeeman-splitting in a nanoscale superconductor or detecting the ac-Josephson effect in the tunneling current. Implications of these results for further research, such as probing the absolute spin-polarization or creating an atomic scale photon source, will be discussed.

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