Scanning tunneling microscopy has evolved into one of the most versatile experimental tools to probe the electronic structure on an atomic scale. 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 $11.4 \pm 0.3 \mu$eV. In this presentation, I will give an overview of recent results. I will show first measurements on the AC Josephson effect in the nanoscale tunnel junction of the STM and how we intend to employ it as an atomic scale light source. Further, I will show how we enhance the critical magnetic field in a superconducting STM tip to exploit the Zeeman splitting as a new probe for spin-polarization on the absolute scale.

Figure: A New Spin-Polarized Scanning Tunneling Microscopy: (Left Panel) On a spin-unpolarized sample, the Zeeman splitting in a superconducting STM tip leads to a symmetric splitting of the spin-up and spin-down excitations. If the tunneling current is spin-polarized, the asymmetry of the spectrum can...