Thermal Kinetic Inductance Detectors: Highly Multiplexible Micro-Calorimetric Detectors Not Only for X-ray Imaging Spectroscopy

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To detect X-rays, a **T**hermal **K**inetic **I**nductance **D**etector (TKID) modifies the principle of Microwave Kinetic Inductance Detectors (MKIDs), a novel detector technology for visible to far-IR photons. TKIDs are superconducting low temperature detectors that are simultaneously capable of single photon detection, single pixel energy resolution and µS time resolution. To allow a flexible choice of photon absorbers, TKIDs use freestanding membranes and operate as micro-calorimeters. They have the potential to achieve time and energy resolutions that can compete with Transition Edge Sensors (TESs). What makes them unique among low temperature detectors is their built-in frequency domain multiplexing, offering a feasible way to kilo- or even mega-pixel detector arrays for applications in fields ranging from X-ray analysis to observational astronomy.

I will explain in detail how TKIDs work, discus their advantages and disadvantages and present results from our first working TKID prototypes. These used superconducting, sub-stoichiometric TiN_x and Ta or Au to absorb X-ray photons. Even without optimized sensitivities and heat capacities we have been able to achieve a TKID energy resolution of 75 eV at 5.9 keV. As particularly their thermal design has been far from optimal, our TKID prototypes still show clear saturation effects. Eliminating this saturation should in principle allow us to reach an energy resolution of less than 10 eV at 5.9 keV. Further changes to the readout technique could allow to improve the energy resolution even further and thus enable TKIDs to catch up to TESs while still being much easier to multiplex.