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Neutron transmission imaging with single pixel spectroscopic resolution

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High resolution energy resolved neutron imaging at pulsed neutron sources enables simultaneous measurement
of transmission spectra in a wide range of energies spanning from meV to tens of keV. The key enabling technologies needed for this high resolution spectroscopic imaging are bright spallation neutron sources and novel neutron counting detectors capable of measuring both position and time of each neutron and capable of
operation at very high input rates exceeding 107 n/cm2/s. Analysis of these neutron transmission spectra allows
non-destructive investigation of various sample characteristics such as microstructure (distribution of phase, variation of texture and strain), elemental and isotopic composition (for the elements with relatively high resonance absorption cross section), distribution of temperature, and many others. The recent development of
high resolution neutron counting detectors with Microchannel Plates (MCPs) and Timepix readout provided new opportunities in energy-resolved imaging due to their unique capability to register many nearly simultaneous neutrons with relatively high detection efficiency (˜50% for the thermal neutrons).
In this paper, we demonstrate the unique capabilities of energy-resolved neutron imaging and show results of
our recent studies in fields as diverse as materials science, structural and aerospace engineering, studies of cultural heritage objects, geophysics, and others. The limitations of present detection technology for this applications and possible solutions foreseen in the near future will be discussed

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