Thermal expansion measurement methods

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Measurement of elastic properties (thermal expansion and magnetostriction) under (multi)extreme conditions is a difficult task. In the vicinity of the room temperature or above it an abundance of methods is available, with decreasing temperature and adding magnetic field and/or hydrostatic pressure their number is limited. Dilatometric cells (either planparaller or tilted plate design) provide superior sensitivity in low temperatures and applied magnetic fields, however, cannot be used in hydrostatic cell. Common choice for the measurement of thermal expansion under hydrostatic pressure are methods based on strain-gauges, with mediocre sensitivity and more importantly a difficult or even impossible usage at very low temperatures (T~<3K).

Our aim was to construct a simple yet sensitive measurement method, which could be used for the measurement of thermal expansion and magnetostriction at very low temperatures (T<2K) and applied hydrostatic pressures. Our design is based on the measurement of the electrical capacitance of the (specifically chosen) capacitor consisting of a base plate (25μm polished copper foil), insulation (7.6μm kapton foil) and polished sample. This allows the measurement of in plane expansion/contraction of rather small sample depending on the field and/or temperature with or without presence of hydrostatic pressure with sensitivity comparable to the use of strain-gauges.

The presentation will discuss the technicalities in detail, as well as test measurements with different samples (HoCo2, UCoAl, UIrGe) under different conditions and theirs comparison with reference measurements.

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