# TT 28 Superconductivity - Applications I : Cryodetectors

Zeit: Dienstag 14:00–16:00 Raum: TU H104

## Hauptvortrag

TT 28.1 Di 14:00 TU H104

**Cryogenic Detectors for X-ray Astronomy** — •Piet de Korte — Sorbonnelaan 2, 3584CA Utrecht, The Netherlands

The future of X-ray astronomy will be directed towards the study of very high redshift sources, that are therefore extremely weak. Some observational cases will be presented.

In addition to extremely large area collection optics this requires detectors with a high detection efficiency in combination with very good spectral resolution and imaging. Such a mission is conceptualized by the European Space Agency under the name XEUS.

The only type of sensors fulfilling those requirements are cryogenic sensors with single photon detection capability and an intrinsic energy resolution of a few eV at photon energies of a few keV. Microcalorimeters making use of the phase-transition between the normal-to-superconducting state for thermometry are at presently the most promising devices.

This paper will describe the characteristics of these so-called transition-edge-sensors (TES), there present performance and the means to make large imaging pixel arrays. Also the characteristics of SQUID-based readout electronics will be presented.

TT 28.2 Di 14:30 TU H104

**EDS- material analysis with Microcalorimeters** — •Christian Hollerith[1], Matthias Bühler[2], Franz v. Feilitzsch[1], Jens Höhne[2], Christian Isaila[1,3], Michael Huber[1], Josef Jochum[1], Kevin Phelan[2], Birgit Simmnacher[3], Rainer Weiland[3], and Doreen Wernicke[2,1] — [1]Physik-Department E15, TU München, James-Franck-Straße, 85747 Garching — [2]VeriCold Technologies GmbH, Bahnhofstr. 21, 85757 Ismaning — [3]Infineon Technologies AG, Otto-Hahn-Ring 6, 81739 München

Energy dispersive X-ray spectroscopy (EDS) of samples mounted in scanning electron microscopes (SEM) is a standard technique for elemental material analysis. Today Si(Li)-detectors are used in this field with a maximum energy resolution of about 130eV at a X-ray energy of 6keV. This energy resolution is unsatisfactory for the separation of the low energetic lines like M-lines of heavy elements, L-lines of medium heavy elements and K-lines of light elements. But for excitation of small volumes like particles in samples with the electron beam in the SEM only low acceleration voltages may be used and therefore only low energetic lines are excited. A high resolution spectrometer with a microcalorimeter detector cooled by a pulse tube refrigerator with an ADR unit has been installed on a SEM for this purpose. It shows an average energy resolution of better than 10eV @ 1.5keV. The low countrate in comparison to Si(Li) detectors due to the small area of the microcalorimeter has been increased by the application of a polycapillary X-ray optics. This way the microcalorimeter is a promising tool for material analysis of thin layers and small samples.

TT 28.3 Di 14:45 TU H104

**Development of metallic magnetic calorimeters for high-resolution X-ray spectroscopy** — •M. Linck, A. Burck, T. Daniyarov, H. Rotzinger, T. Scarbrough, A. Fleischmann, and C. Enss — Kirchhoff-Institut für Physik, Heidelberg, Germany

X-ray detectors based on the concept of magnetic calorimetry are well suited for high-resolution spectroscopy. Metallic magnetic calorimeters (MMC) make use of a metallic paramagnetic temperature sensor, which is in tight thermal contact with a metallic X-ray absorber. The paramagnetic sensor is placed in a weak magnetic field; its magnetization is used to monitor the temperature. High-energy resolution can be obtained by using a low-noise, high-bandwidth DC SQUID system to measure the small change in magnetization upon the absorption of a X-ray.

We present the state of development of the current prototype detectors. We discuss noise contributions and the energy resolution observed in MMCs. Applications in material analysis and in metrology, such as absolute activity measurements of low-energy emitting radionuclides, will also be shown.

TT 28.4 Di 15:00 TU H104

**Development of Detectors for High Count Rate Calibration Measurements in CRESST** — •Wolfgang Westphal, Franz von Feilitzsch, Chiara Coppi, Thomas Jagemann, Jan König, Walter Potzel, Wolfgang Rau, Michael Stark, and Hesti Wulandari — Technische Universität München, Physik Department E15, James-Franck-Straße, 85748 Garching

CRESST is an experiment for the direct search of dark matter particles (WIMPs) using cryogenic detectors. The detectors are designed as "double detectors"for the simultaneous measurements of the phonon signal and the scintillation light from a recoil event in a $CaWO_4$ crystal. The phonon signal is read out via a tungsten transition edge sensor (TES) evaporated directly onto the crystal. For the measurement of the light signal there is a silicon light detector, also read out by a TES, mounted together with the $CaWO_4$ inside a reflective housing. This design allows for discriminating the relevant nuclear recoils from the background electron recoils due a different light output.

At TU München we are performing calibration measurements for the better understanding of the detector response on various event types (e.g. neutrons scattering on different nuclei). For this purpose we are developing a special version of the CRESST detector optimized for higher count rates. In our design we are using a TES based on Ir/Au multilayers instead of tungsten.

TT 28.5 Di 15:15 TU H104

**Untergrundarmer $4\pi$-Kryodetektor zur Messung des $^{71}$Ge-Zerfalls bei GNO** — •Walter Potzel, Tobias Lachenmaier, Jean-Côme Lanfranchi und Franz von Feilitzsch — Physik-Department E15, James-Franck-Str, 85748 Garching

Tieftemperaturdetektoren könnten aufgrund ihrer hohen Energieauflösung, niedrigen Energieschwelle und hohen Nachweiseffizienz den bisher bei GNO (Gallium Neutrino Observatory) eingesetzten miniaturisierten, radioaktivitätsarmen Proportionalzählrohren deutlich überlegen sein. Nach der erfolgreichen Entwicklung eines hocheffizienten $4\pi$-Detektors und der Optimierung der thermischen Ge-Deposition auf das Detektorsubstrat, konzentriert sich unsere derzeitige Aktivität auf die Unterdrückung des Untergrundes. Neben dem Aufbau eines Myon-Vetos und einer externen Bleiabschirmung wurde auch, nach eingehender Materialanalyse, eine interne, den besonderen Ansprüchen von GNO genügende Abschirmung und Detektorhalterung entworfen. Desweiteren soll über erste langzeit-stabile Messungen im Untergrundlabor (15m.w.e.) in Garching berichtet werden.

TT 28.6 Di 15:30 TU H104

**Low Temperature Calorimeters for Precise Lamb shift Measurements on Hydrogen-Like Heavy Ions** — •Alexander Bleile[1], V. Andrianov[1], P. Egelhof[1], S. Kraft[1], D. McCammon[2], H.J. Meier[1], J.P. Meier[1] und C. Stahle[3] — [1]GSI, Darmstadt / Univ. Mainz — [2]Univ. of Wisconsin, Madison, USA — [3]Goddard Space Flight Center, Greenbelt, USA

The precise determination of the Lamb shift in hydrogen-like heavy ions provides a sensitive test of quantum electrodynamics in very strong Coulomb fields, not accessible otherwise. To increase the accuracy of the Lamb shift measurement on stored $^{238}U^{91+}$ ions at the ESR storage ring at GSI, a calorimetric low temperature detector for hard X-rays was developed. The experimental requirements for the detector are the high absorption efficiency and the relative energy resolution of the order of $10^{-3}$ for 50-100 keV X-rays. The detector consists of arrays of silicon thermistors and X-ray absorbers made of high Z material. A test array consisting of 8 pixels was recently set up and tested, the achieved energy resolution $\Delta$E=75-140 eV @ 60 keV is close to fulfill the demands of the experiment. The status of the experiment will be presented and results of first test measurements at the ESR will be discussed.

TT 28.7 Di 15:45 TU H104

**Untersuchung und Optimierung extrem dünner NbN-Filme für die Herstellung phonon-gekühlter Hot-Electron-Bolometer (HEB)** — •T. A. Scherer, M. Schicke und K. Schuster — IRAM, Domaine Universitaire, St-Martin-dHères, France

Supraleitende HEBs für radioastronomische Anwendungen im THz-Bereich bestehen aus extrem dünnen Mikrobrücken. Diese Bauele-

mente arbeiten im Gegensatz zu konventionellen SIS-Mischern auch oberhalb der Bandlückenfrequenz. Zum Verständnis des Phonon-Kühlmechanismus in HEBs auf der Basis von NbN-Mikrobrücken werden zunächst ultradünne NbN-Filme auf Quartz-Substrat reaktiv aufgesputtert. Die Deposition erfolgt mittels eines Nb-bestückten RF-Magnetrons in einer Mischgasatmosphäre bestehend aus Argon, Stickstoff und Methan. Mit Hilfe ellipsometrischer und profilometrischer Messungen wird die Schichtdicke der NbN-Filme kalibriert. Vorgestellt werden das Verhalten der kritischen Temperatur in Abhängigkeit von der Schichtdicke sowie korrespondierende Raman-Messungen und daraus resultierende Interpretationen der Phononenableitgeschwindigkeit zur Kühlung der Mikrobrücke. Der Einfluss von Film-Stress und Wachstum auf die Eigenschaften des Bolometers werden diskutiert.