



## Seminars of Condensed-Matter Physics

Monday, 29<sup>th</sup> of October 2012 – CH B3 31 – 12h30

### Sub-100 mK SQUID Magnetometer and Characterisation of the Spin Glass Series $\text{LiHo}_x\text{Er}_{1-x}\text{F}_4$

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The first part of this talk is dedicated to the design and implementation of a piezomotor driven SQUID magnetometer capable of running at temperatures below 100 mK. The overall design is presented with key components explained in detail.

The second part describes a comprehensive experimental study of a new model spin-glass series  $\text{LiHo}_x\text{Er}_{1-x}\text{F}_4$ , which combines the Ising anisotropy of ferromagnetic  $\text{LiHoF}_4$  with the XY anisotropy of antiferromagnetic  $\text{LiErF}_4$ . The temperature-doping phase diagram has been studied using AC susceptibility, and three key regions investigated in detail using additional neutron scattering experiments and mean-field calculations. The first region,  $x \geq 0.6$ , corresponds to an Ising ferromagnet, where  $T_C(x)$  decreases linearly and faster than mean-field predictions, unlike in the related series  $\text{LiHo}_x\text{Y}_{1-x}\text{F}_4$ . At  $T < T_C$ , a so-called embedded spin-glass state is observed. The second region,  $0.6 \leq x \leq 0.3$ , undergoes a spin-glass transition, where needle-like spin clusters form along the Ising axis below  $T_g$ . The final region,  $x \leq 0.3$ , corresponds to a spin-glass with antiferromagnetic spin-spin correlations and shows archetypal spin-glass behaviour. The non-mean field decrease in  $T_C$  is examined theoretically using a combination of inhomogeneous mean-field and direct diagonalisation of small clusters of spins. In the  $x = 0.5$  sample, a thermal runaway occurs at a field of 250 Oe, when the field is applied along the Ising direction. The onset of the thermal runaway is discussed in terms of hyperfine level crossings.