

## FERROMAGNETISM IN BARE GOLD NANOCCLUSERS

A. Venalainen<sup>1\*</sup>, V. Tuboltsev<sup>1</sup>, A. Savin<sup>2</sup> and J. Raisanen<sup>1</sup>

<sup>1</sup> Division of Materials Physics, Department of Physics, University of Helsinki, P.O. Box 43, FIN-00014 University of Helsinki, Finland

<sup>2</sup> Low Temperature Laboratory, Department of Applied Physics, Aalto University School of Science, P.O. Box 15100, FI-00076 Aalto, Finland

\*email: annika.venalainen@helsinki.fi

Bulk gold is well known to be diamagnetic. Recently however there have been both experimental and theoretical work showing that magnetic properties arise, while going down to nanoscale gold systems. These effects have mostly been exhibited by gold nanocrystalline films as well as functionalized gold nanoparticles. We demonstrate a size dependent ferromagnetic behavior in bare gold nanoclusters. This is demonstrated by the temperature dependent saturation magnetization, remanence and coercivity of gold nanocluster aggregates. Characteristic superparamagnetic behaviour was detected in dispersions of small clusters. Magnetic measurements were conducted using an ultra-high-sensitive magnetometer based on a superconducting quantum interference device (SQUID) and the morphology of the samples was analyzed by scanning tunnelling microscopy (STM) as well as transmission electron microscopy (TEM).