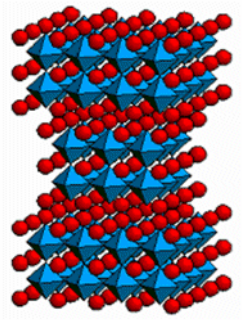
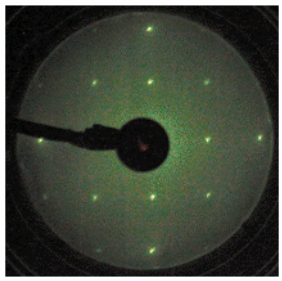
Quantum electron matter at the nanoscale: scanning tunneling microscopy and spectroscopy of CMR manganites

The manganites and related perovskite-like oxides took the solid state science world by storm in the early 1990's when they exhibited changes in electrical resistance of several orders of magnitude upon application of a magnetic field - colossal magnetoresistance (CMR) was born. Like their cousins, the high Tc superconducting cuprates, the CMR manganites are late transition metal oxides whose electronic properties go way beyond the framework of the 'standard model' for metals - Fermi liquid theory. Many of their key physical parameters (think of bandwidths, exchange integrals, on-site Coulomb repulsion, charge transfer energies, phonon energies) are of similar magnitude, resulting in a highly rich and complex physical landscape, involving interplay and competition between phenomena such as charge and orbital ordering, double-exchange ferromagnetism, Mott-Hubbard physics, strong electron-phonon coupling and phase separation.

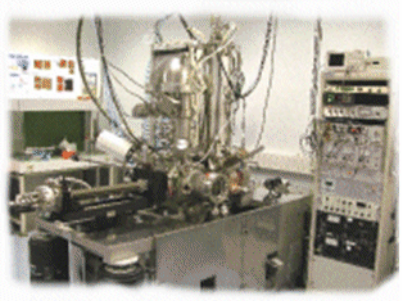
In this M.Sc. project you'll join the joint research effort of the Quantum Electron Matter (Golden) and Spin Science (Goedkoop) groups to investigate the electronic states of layered managanites on the nanoscale. The weapon of choice is our new low temperature UHV scanning tunneling microscope. After successful commissioning and investigation of HTSC superconductors within an M.Sc. project last year (Jesse van Vollenhoven), we now turn our attention to the layered manganites. To date there is a single group with STS data on these systems, which are currently of great interest worldwide, and so the scene is set for Amsterdam to make a big impact.



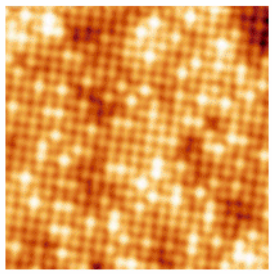
Crystal structure.



LEED image.



The new LT, UHV-STM.



STM of a HTSC.

STM and STS of such complex systems is not a Sunday afternoon stroll, and use will be made of the expertise in the growth and characterisation of high quality single crystals of these systems within the QEM group, so that the project student can concentrate on the core business of tunneling spectroscopy. This project involves real research, running real-time on the group's front-line research equipment, thus you should be a resourceful and motivated student with a good feeling for experimental work. In return for your serious commitment to the project, you get a real taste of research in a globally competitive and fast-moving field.

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Yingkai Huang Staff member. Crystal growth wizard.
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? M.Sc. students (2006/2007)