Magnetism Close to the Metal-Insulator Transition in V_2O_3

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- The Metal-Insulator Transition in V_2O_3
- Metallic $V_{2-y}O_3$
  - Quantum critical heavy fermions
- Insulating $(V_{1-x}Cr_x)_2O_3$
  - Coupled orbital and spin degrees of freedom
- Summary

* Supported by the NSF through NSF DMR-9453362

Alloying and Pressure effects in V_2O_3

- Cr-doping ($3d^3$) → More Insulating
  - Add a site to which 3d electrons cannot hop
- Ti-doping ($3d^1$) → More metallic
  - Add a site to which 3d electrons can hop
- Vacancy doping $V_{2-y}O_3$ → More metallic
  - Add holes to 3d bands
- Hydrostatic Pressure → More metallic
  - Counteract lattice expansion in insulator
  - Increase orbital overlap thus decrease U/W

Collaborators

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Experiments performed at

- NIST Center for Neutron Research
- HFIR, Oak Ridge National Laboratory
- ISIS Facility, Rutherford Appleton Laboratory

The World according to Bill Gates

Mott, Sir Nevill Francis

Mott (m⇩t), Sir **Nevill Francis**
Born 1905
British physicist. He shared a 1977 Nobel Prize
for developments in computer memory.

- from Microsoft Bookshelf Basics circulation >50,000,000?
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Conclusions

- Weakly doped V_2O_3 can lie on either side of an electron correlation induced Metal-Insulator Transition
- Metallic $V_{2-y}O_3$
  - "Heavy" Fermion system ($v_f = 10^4$ m/s).
  - Fermi surface nesting apparent in broad T-range.
  - Weak low T SDW and partially gapped Fermi surface ⟹ almost quantum critical metal.
  - Moriya SCR theory provides Quantitative link between dynamical and thermal properties.
- Insulating $(V_{1-x}Cr_x)_2O_3$
  - Local Structural and Orbital degrees of freedom couple to the spin system and limit correlation length at high T,
  - These degrees of freedom order for T<180 K at which point long range spin order and coherent spin waves develop.