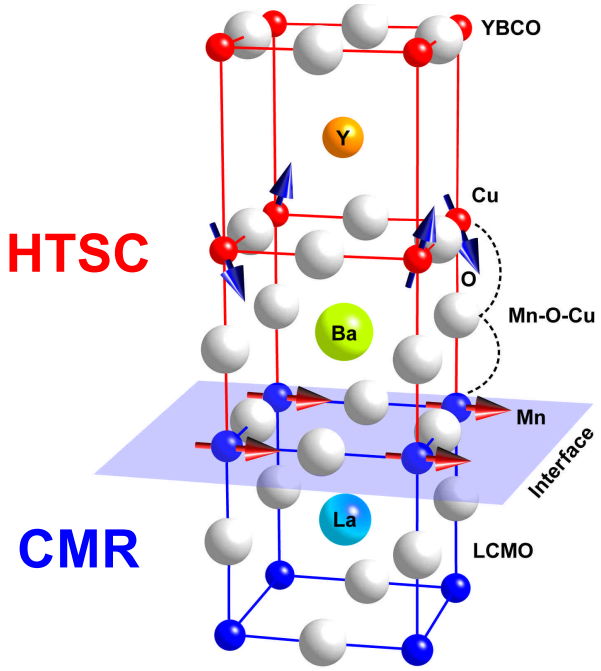
CFI New Initiative Fund Proposal

The Quantum Materials Spectroscopy Center at the Canadian Light Source

Novel Complex Materials and Functionalities

Tune the physical properties

Chakhalian et al., Nature Physics 2006



- Modern synthesis methods

  Single crystals, multilayers, nanostructures

- Sophisticated structural tools

  Physical, chemical, and magnetic structures

- Novel probes of intrinsic susceptibilities

  Lattice, magnetic, and electronic excitations

$$\varepsilon(q,q',\omega) \quad \chi(q,q',\omega)$$
$$N(\vec{r},E) \quad A(\vec{k},E)$$

Interface-tuned magnetism in oxide multilayers

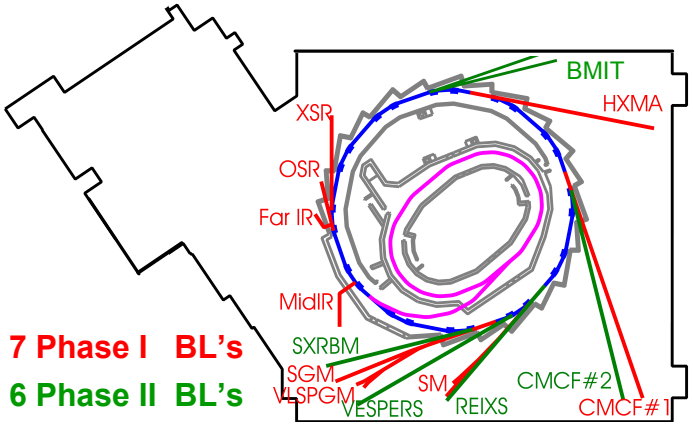
Understand interplay of **lattice**, **spin**, **charge**, **orbital** degrees of freedom

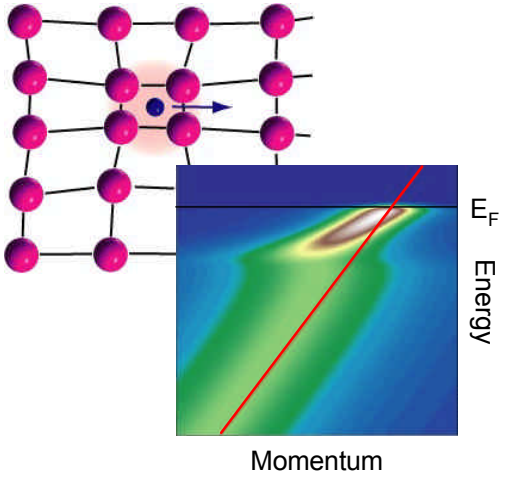
Strong Material Science Community in Canada

CLS provides a prime opportunity to establish a world-class program

- **Unique portfolio of tools at the CLS:** Chemical and physical structure of materials

$$N(\vec{r},E) \qquad \varepsilon(q,q',\omega) \qquad \chi(q,q',\omega)$$





- **Outstanding questions:** Which electrons are free to move and how? $A(\vec{k},E,\sigma)$

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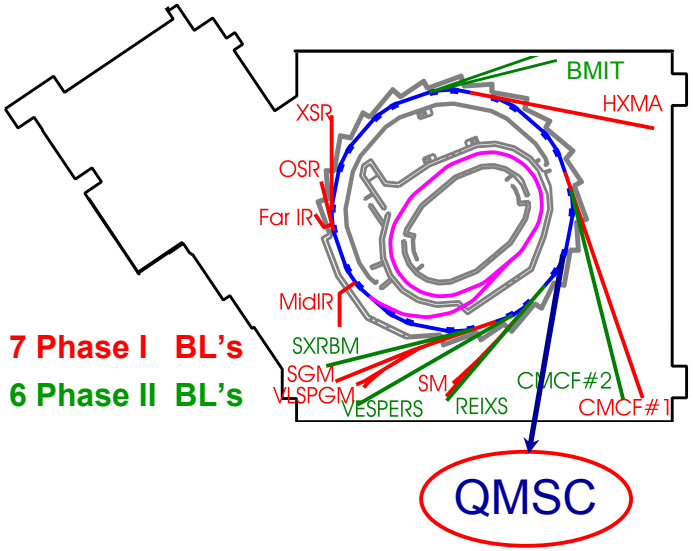
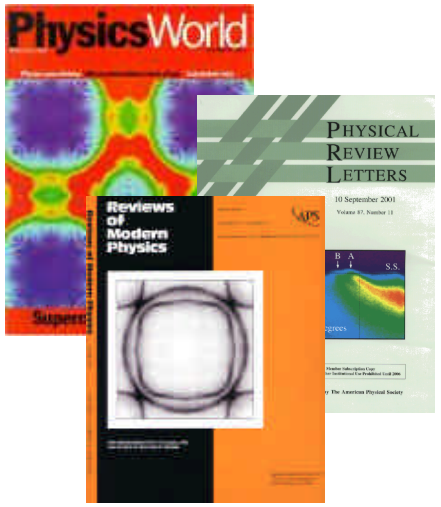


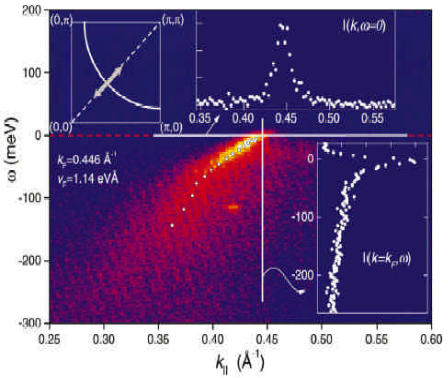


- **Outstanding questions:** Which electrons are free to move and how? $A(\vec{k},E,\sigma)$

The **Quantum Materials Spectroscopy Center** will answer these questions

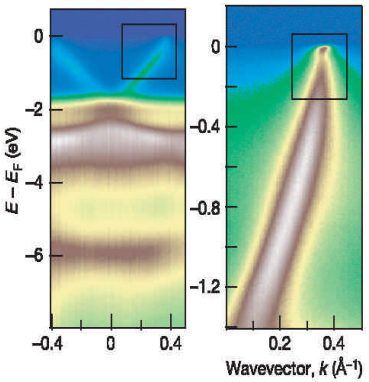
ARPES: Widespread Impact in Complex Materials

HTSC's



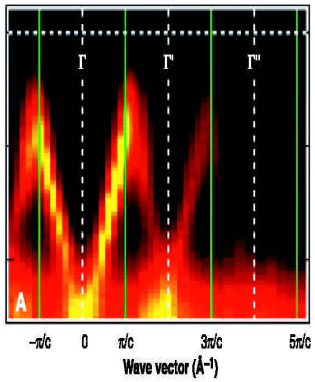
Science 1999

CMR's



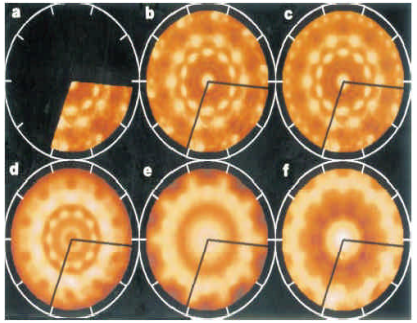
Nature 2005

CDW's



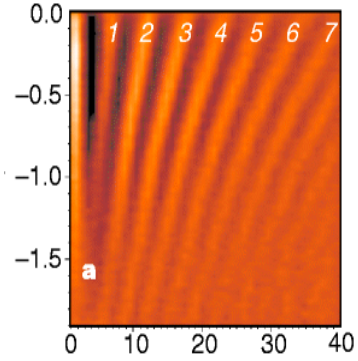
Science 2000

Quasicrystals



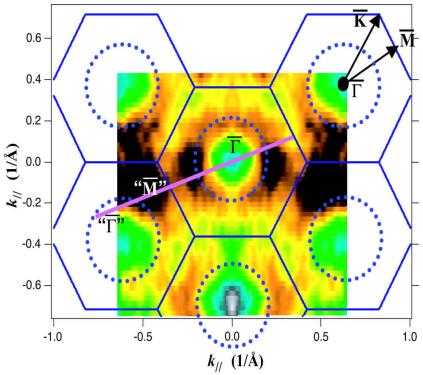
Nature 2000

Quantum Wells



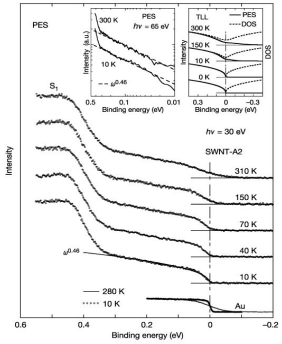
Nature 1999

C_{60}



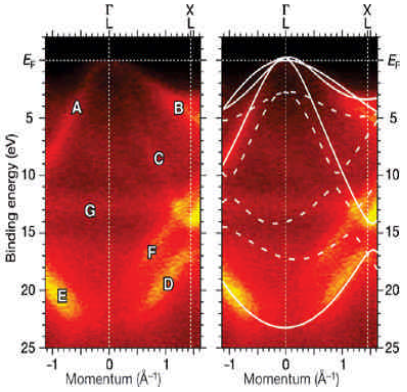
Science 2003

Nanotubes



Nature 2003

Diamond

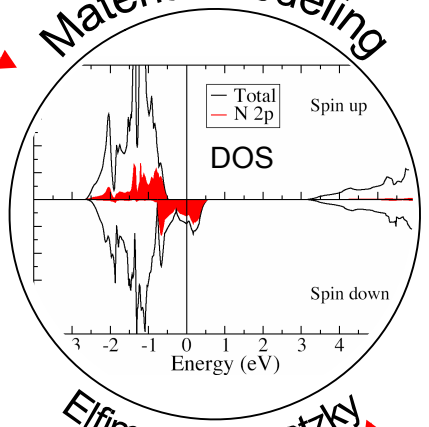


Nature 2005

Novel Complex Materials and Functionalities

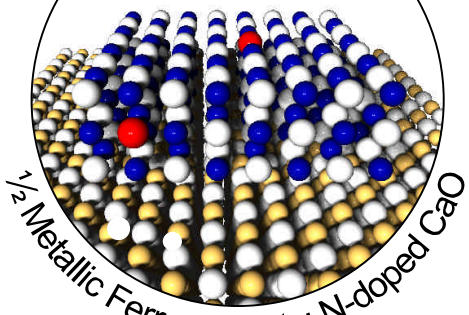
Novel Functionality

Material Modeling



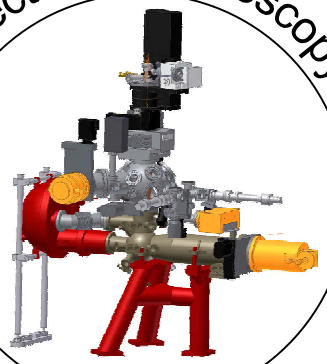
Elfimov - Sawatzky

Material Design



½ Metallic Ferromagnets: N-doped CaO

Electron Spectroscopy



Andrea Damascelli

$A(\vec{k}, E, \sigma)$

Spin polarization of conduction band

Spin-orbit coupling

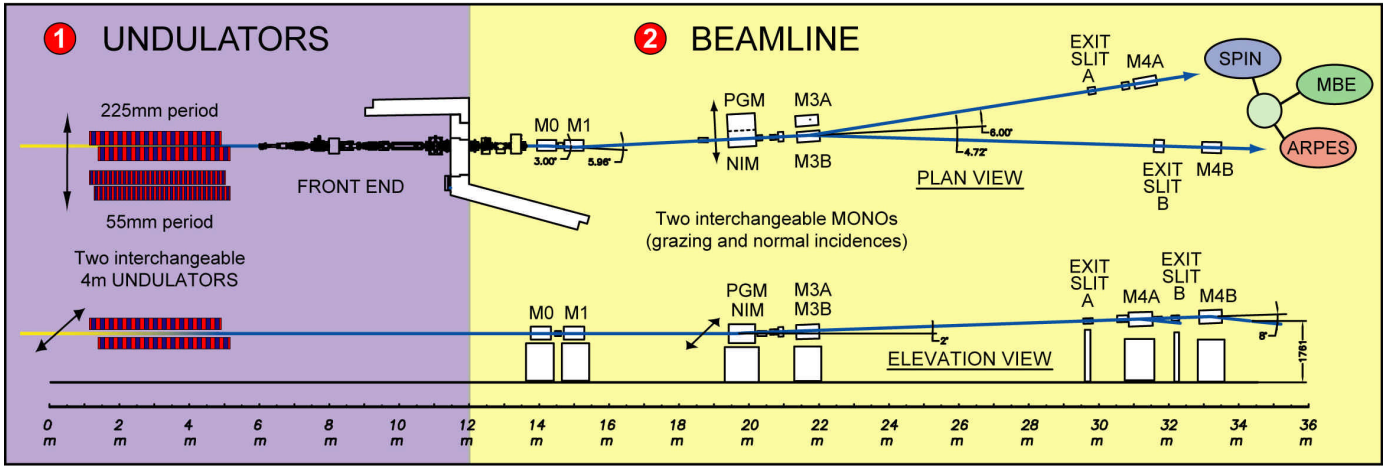
Spin character of FM, AF, PM

Material Synthesis

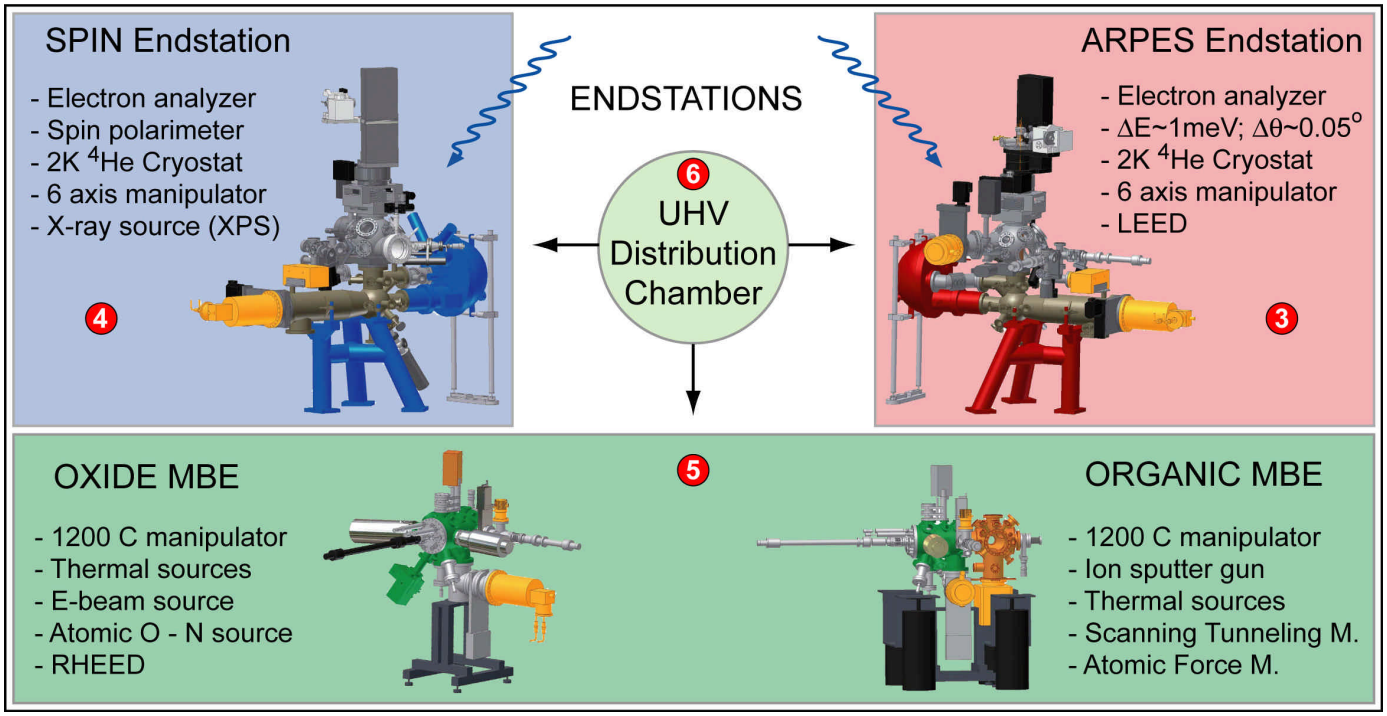
Nicholas Ingle

Quantum Materials Spectroscopy Center: Infrastructure

- Broad energy range
- Polarization control
- Resolving power
- Maximum flux



- High-res. ARPES
- Spin polarimeter
- Motion Accuracy
- Low Temperature



- Oxide MBE
- Organic MBE
- LEED/RHEED
- STM/AFM/XPS