

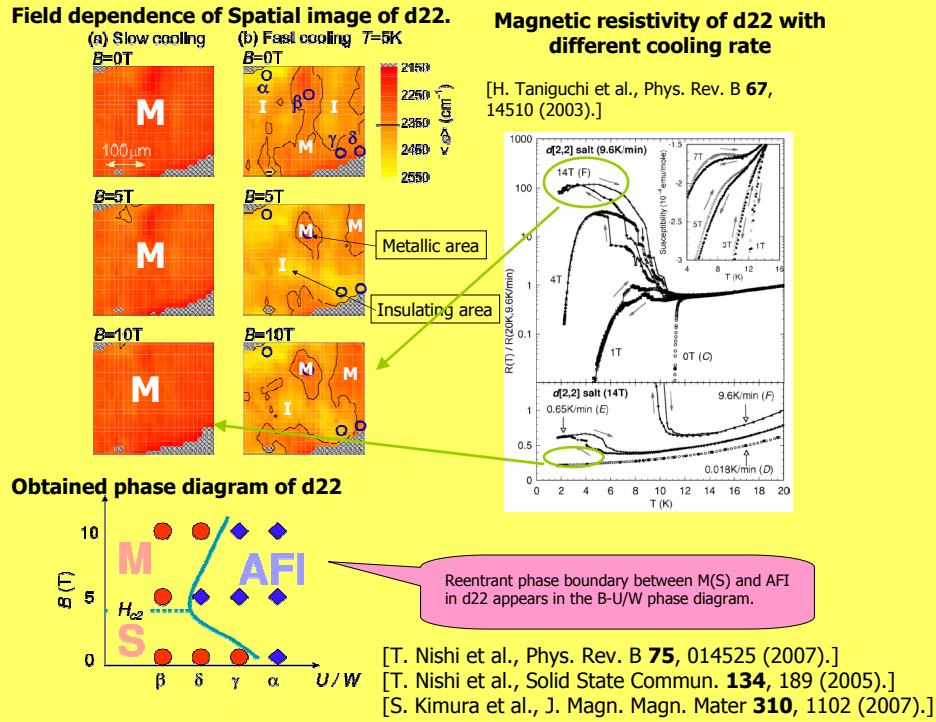
Optical and photoelectrical spectroscopies of solids using synchrotron radiation

Kimura group (S. Kimura, T. Ito, H.J. Im, T. Mizuno, H. Miyazaki, T. Iizuka)



IR magneto-optical imaging on an organic conductor

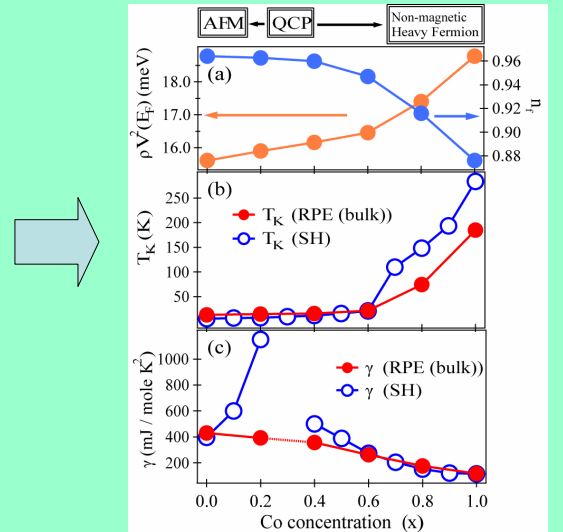
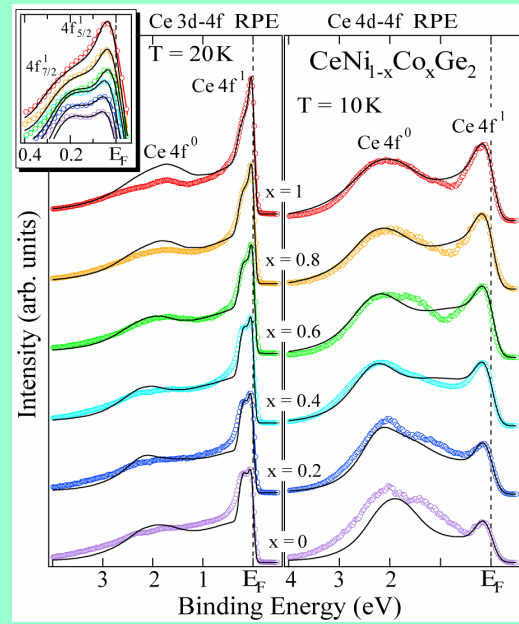
Magnetic-field-induced Superconductor-Insulator-Metal transition in d22



4f-derived resonant photoemission on Cerium-compounds

4f-PE spectra of $CeNi_{1-x}Co_xGe_2$ at the 3d and 4d absorption edge

Physical parameters derived by the 4f-PE spectra.

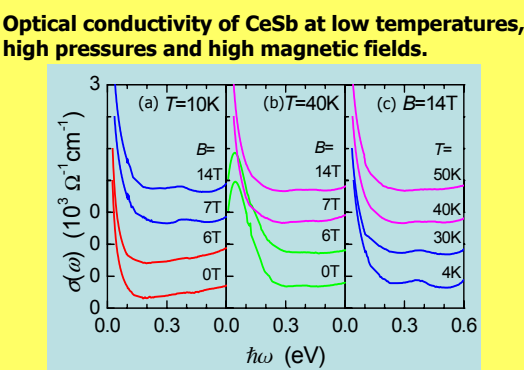


[H.J. Im et al., Phys. Rev. B **72**, 220405(R) (2005).]
 [H.J. Im et al., Physica B **378-380**, 825 (2006).]
 [Y.S. Kwon et al., Physica B **378-380**, 823 (2006).]
 [H.J. Im et al., J. Magn. Magn. Mater. **310**, 411 (2007).]
 [Y.S. Kwon et al., J. Magn. Magn. Mater. **310**, 310 (2007).]

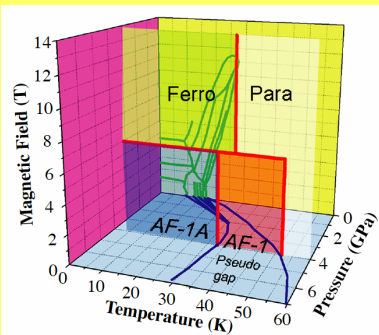
IR under multi-extreme conditions

Setup for IR-MXC at Spring-8
 [S. K. et al., Physica B **329-333**, 1625 (2003).]

- Photon energy: 2 - 0.1 eV
- Magnetic field: 0 - 14 T
- Temperature: 4.0 - 300 K
- Spatial resolution: 12 - 20 μm
- Pressure: 0 - 10 GPa



B-T Phase diagram of CeSb at 4GPa determined by the optical conductivity



[S. Kimura, SPring-8 Research Frontiers 2005, p. 96 (2006).]
 [T. Nishi et al., Phys. Rev. B **71**, 220401(R) (2005).]
 [S. Kimura et al., Physica B **329-333**, 1625 (2003).]
 [S. Kimura et al., J. Phys. Soc. Jpn. **71**, 2200 (2002).]
 [S. Kimura et al., J. Phys. Soc. Jpn. **69**, 647 (2000).]

IR+THz beamline @ UVSOR-II

Reconstructed IR+THz beam line (BL6B) at UVSOR-II (since 2004)

Acceptance angle of SR
 From 80(H) x 60(V) mrad²
 To 215(H) x 80(V) mrad²

THz spectroscopy under pressures

Microscope

- Horizontal optical pass
- Energy range: Laboratory: 50 meV ~ 1.2 eV, UVSOR-II BL6B: 5 meV ~ 50 meV

Diamond anvil pressure cell

- Pressure media: Apiezon grease N
- Pressure is measured by a ruby fluorescence method.

Spatial resolution of microscope in the THz region at BL6B

[S. Kimura + T. Mizuno, AIP Conf. Proc. **902**, 67 (2007).]
 [S. Kimura et al., AIP Conf. Proc. **879**, 595 (2006).]
 [S. Kimura et al., Infrared Phys. Tech. **49**, 147 (2006).]
 [S. Kimura et al., AIP Conf. Proc. **705**, 416 (2004).]

Kimura group

Advanced Solid State Physics with Synchrotron Radiation

IR&THz spectroscopy
 (UVSOR BL6B, SPring-8 BL43IR)

- Low temperature
- High magnetic field
- High pressure
- Multi-extreme conditions
- Magnetic circular dichroism

Photoemission spectroscopy
 (UVSOR-II BL7U, 5U, SPring-8 BL23SU, PLS BL3A1)

- Bulk sensitive Low energy: $h\nu \sim 10eV$
- High energy: $h\nu \sim 1keV$
- 3D angle-resolved
- Resonant

Strongly correlated electron systems

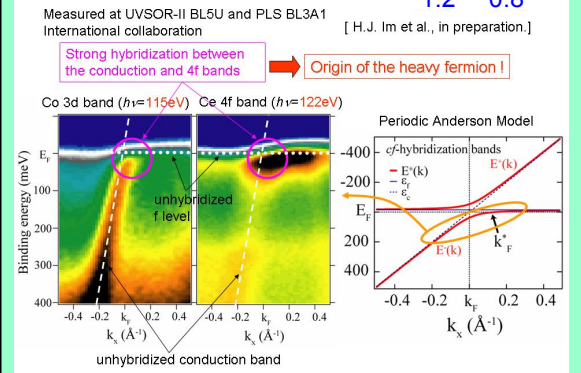
Organic materials, Heavy fermion, Clathrates, Skutterudites, ...

Band calculation

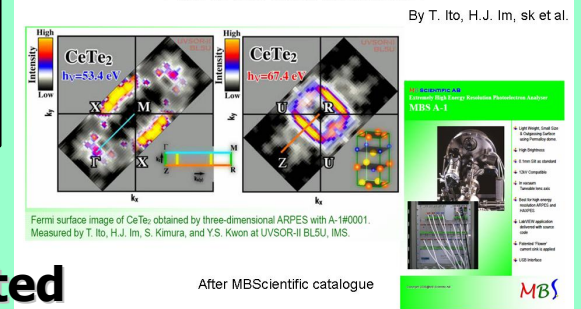
- LSDA, LSDA+U by Wien2k code
- Electronic structure
- Optical property

Origin of the heavy fermion

SR-ARPES on $CeCoGe_{1.2}Si_{0.8}$



An example of 3D-ARPES: Fermi surface detection



[T. Ito et al., Physica B **378-380**, 767 (2006).]
 [T. Ito et al., J. Magn. Magn. Mater. **310**, 431 (2007).]

Fermi surface detected by 3D-ARPES

Photoemission beamlines @ UVSOR-II

Outline of BL7U at UVSOR-II

High resolution and bulk sensitive area $\Delta E \sim 10meV$

Photon energy (eV) vs. Mean free path (nm)

- Tunable excitation energy + high flux + high resolution + variable polarization + ARPES \Rightarrow Determination of three-dimensional electronic structure and Fermi surface \Rightarrow elucidation of transport mechanism.
- (Future) Real space imaging of electronic structure using micro-optics \Rightarrow Direct observation of phase separation of materials.

UVSOR Facility, Institute for Molecular Science

[S. Kimura et al., AIP Conf. Proc. **879**, 527 (2006).]

BL5U@UVSOR-II

MBS-Toyama 'Peter' A-1

$\Delta E \sim 1.2 meV$
 $\Delta \theta \sim 0.1^\circ$

Grating Chamber 'SGM-TRAIN'

Liq-He flow cryostat

SPEC LIST $T = 8-400 K$

Polarization: H PL, L R CL

Photon Energy: 10-250 eV

Energy Resolution: $>10^3$

Photon Flux: $>10^{10}-10^{14}$

[T. Ito et al., AIP Conf. Proc. **879**, 587 (2006).]

Photoemission end station

- 200mm-radius hemispherical analyzer (MB Scientific A-1)
- 6-axes manipulator with cryostat (Rdec/AVC IGONIO-LT)

IGONIO (6-axes manipulator) MBS A-1 photoelectron analyzer

UVSOR-II

UVSOR Facility, Institute for Molecular Science