HiSOR 低エネルギービームラインの現状

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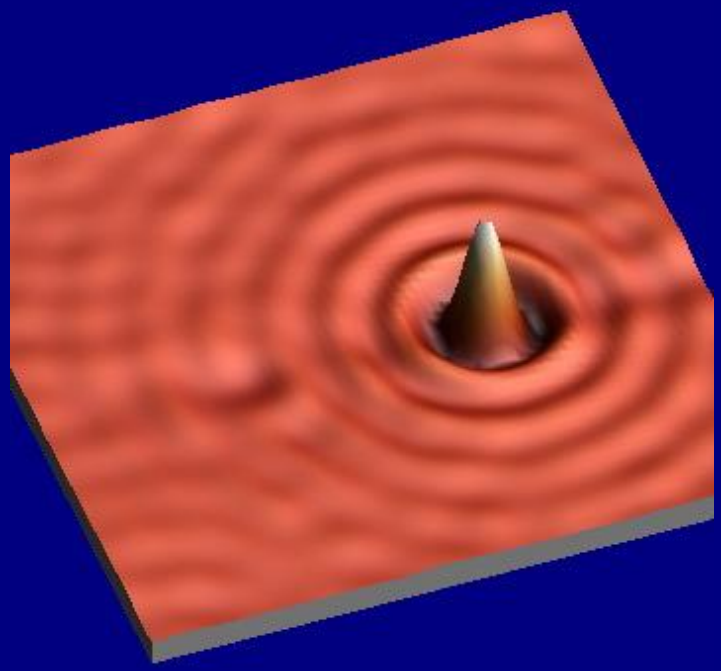

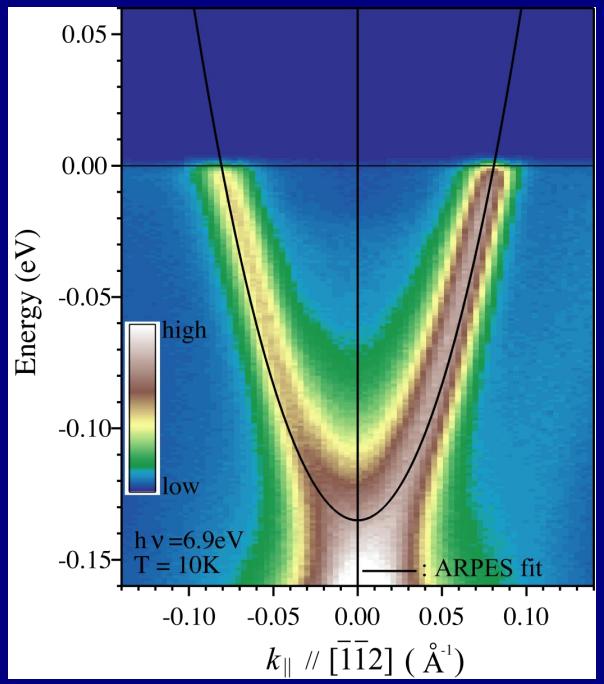

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Hiroshima Synchrotron Radiation Center

BL-1

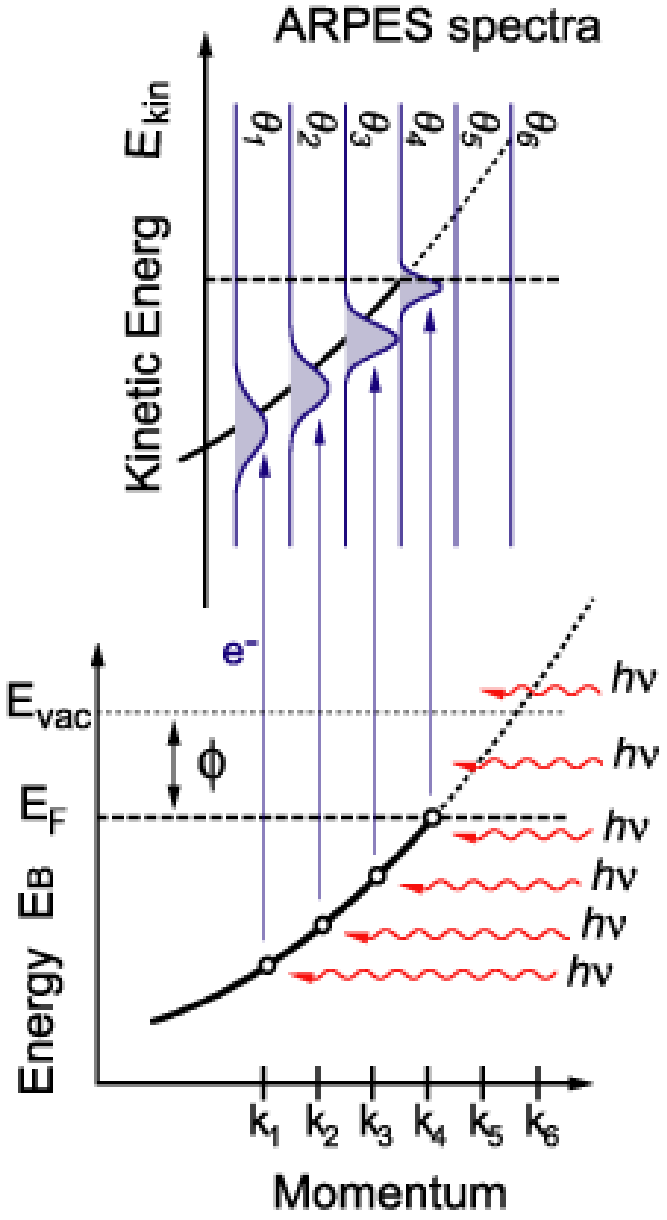
- リニアアンジュレータ
- $h\nu$ = 26-300eV
- VG-Scienta R4000
- 偏光依存測定

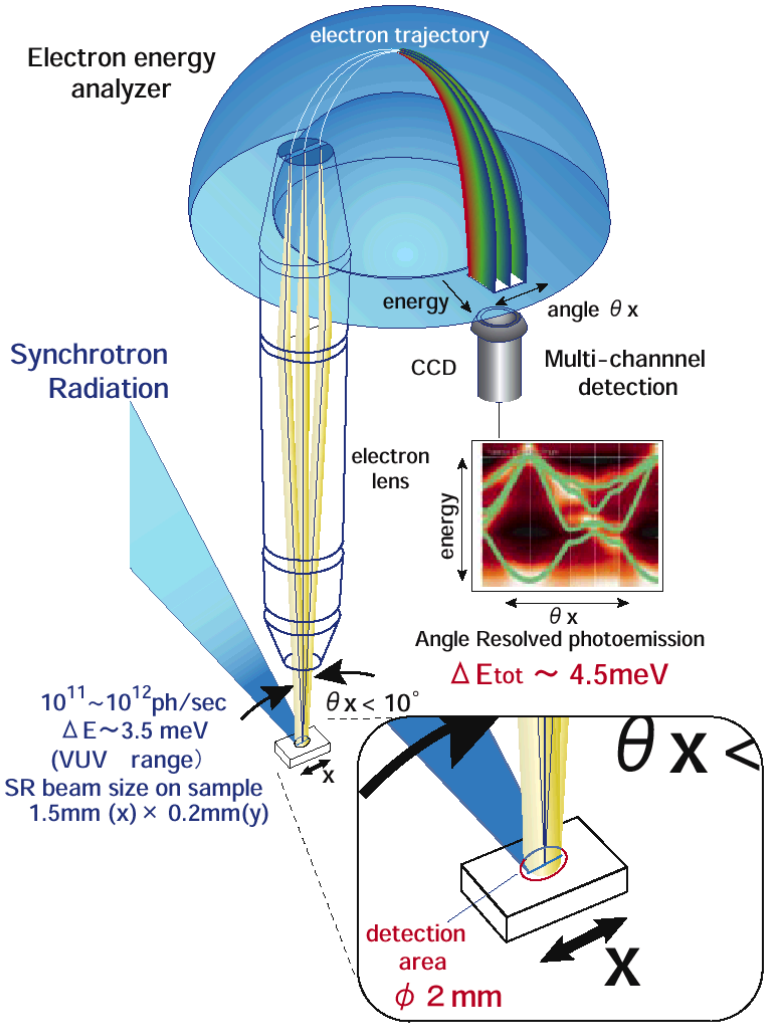
ΔE=4-6meV,
Δθ=0.2゜ -0.3゜

BL-9A

- ヘリカルアンジュレーター
- イーグル型直入射分光器
- $h\nu$ = 4-30eV
- VG-Scienta R4000

Angle-resolved photoelectron spectroscopy

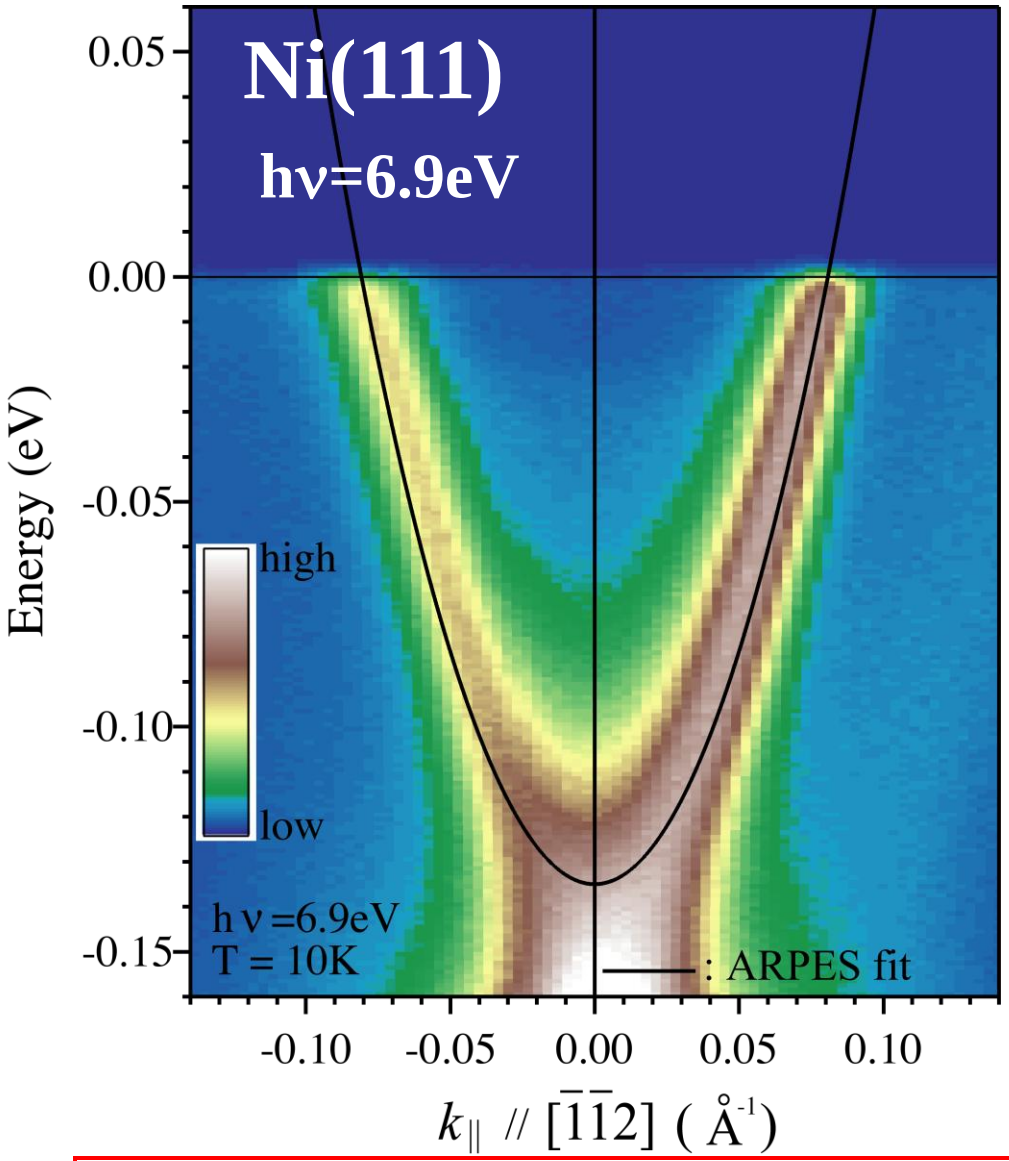


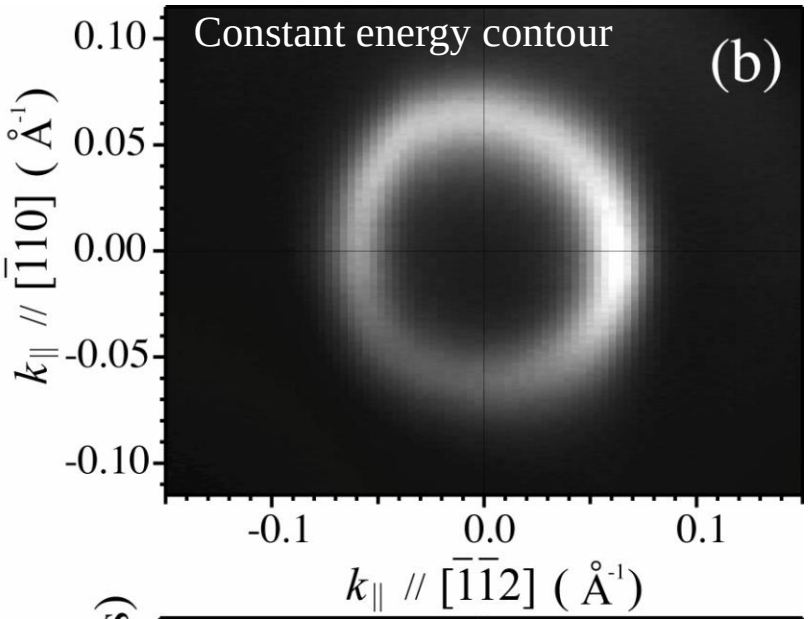


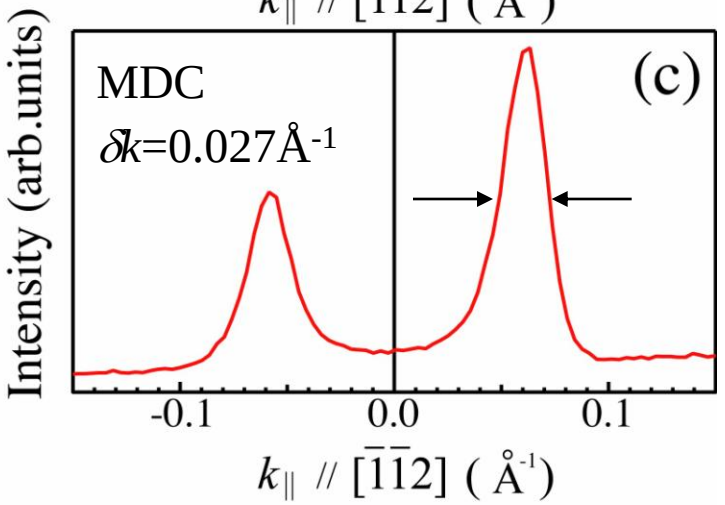
- **Multi-channel detection**
- **High energy and high angular resolution**

E-k relation

HiSOR BL9







E_B =135meV m^*=0.19 m_e k_F= ± 0.08Å^{-1}

Electron MFP $l = \delta k^{-1} \sim 37$Å

Line width analysis

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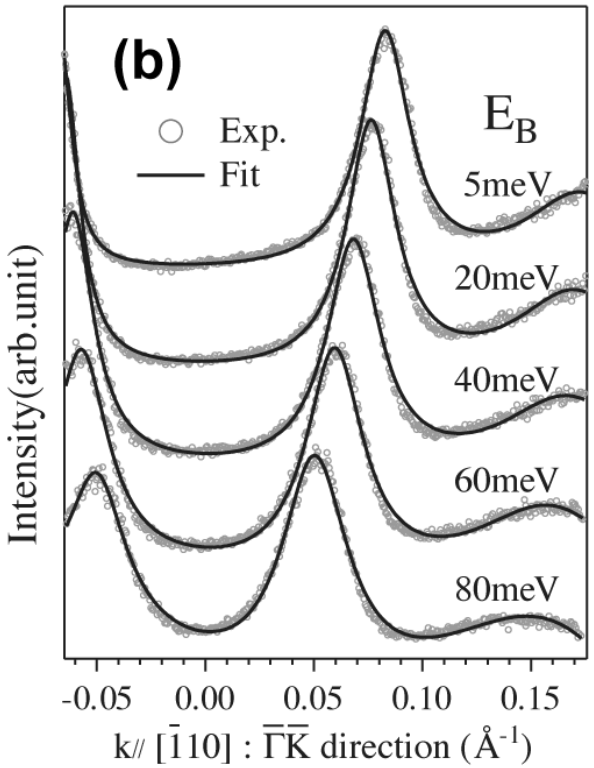
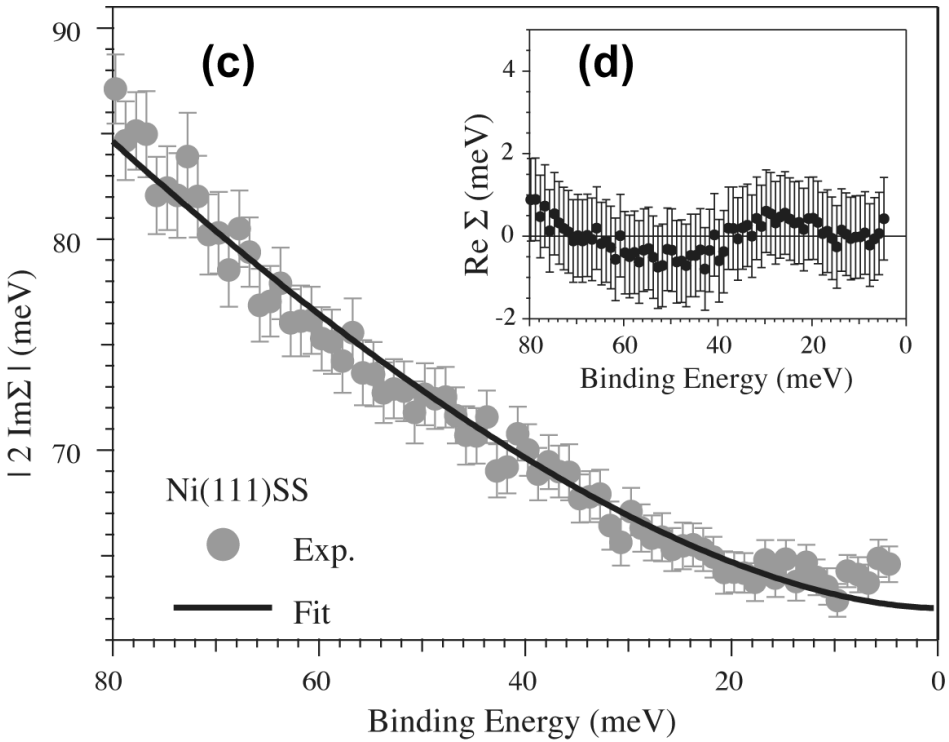
2D electrons $\Gamma^{el-el}(\omega) = 2\left|\mathrm{Im}\Sigma^{el-el}(\omega)\right| = C + 2\beta\omega^2\left[1/4 + \ln 2 + \ln\left|\omega/\mu\right|\right]$





$$\left|2\,\mathrm{Im}\Sigma\right| = \left(dE/dk\right)\delta k$$

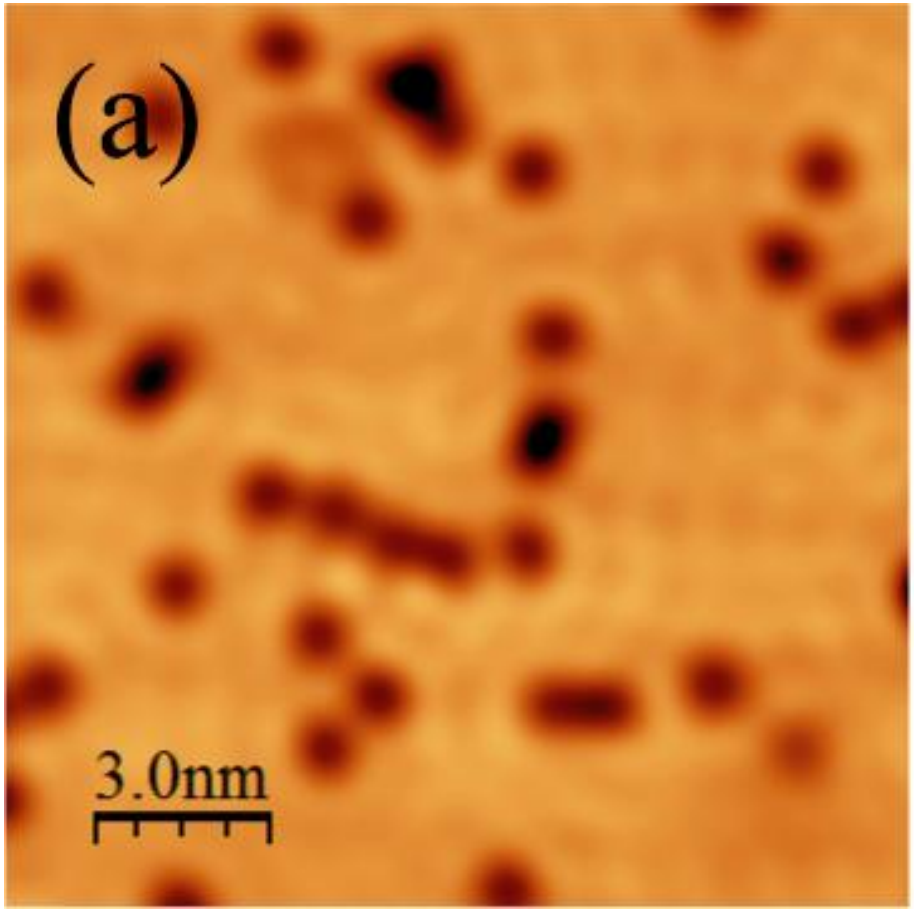
Impurity scattering C **= 62.5meV**

el-el interaction 2β**=1.4±0.3eV^{-1}**

M. Higashiguchi et al., Surf. Sci. **601**, 4005 (2007).

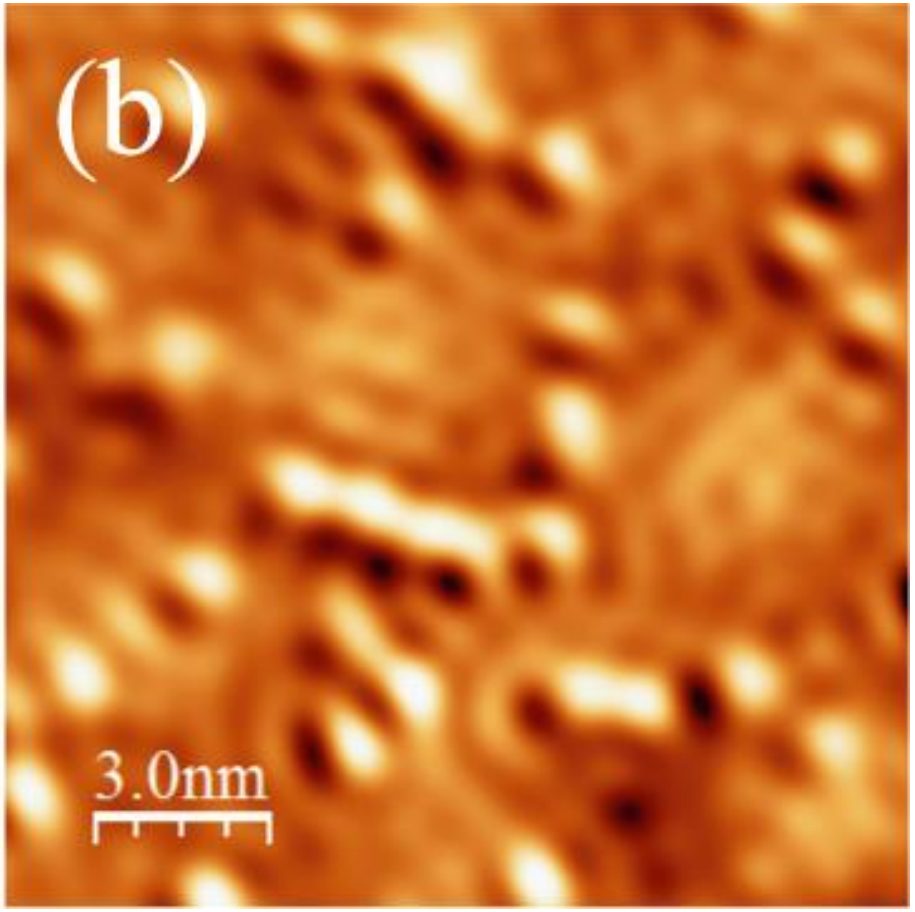
Standing wave of Ni(111) surface

STM image



Vs = -50mV, T=4K

dI/dV image

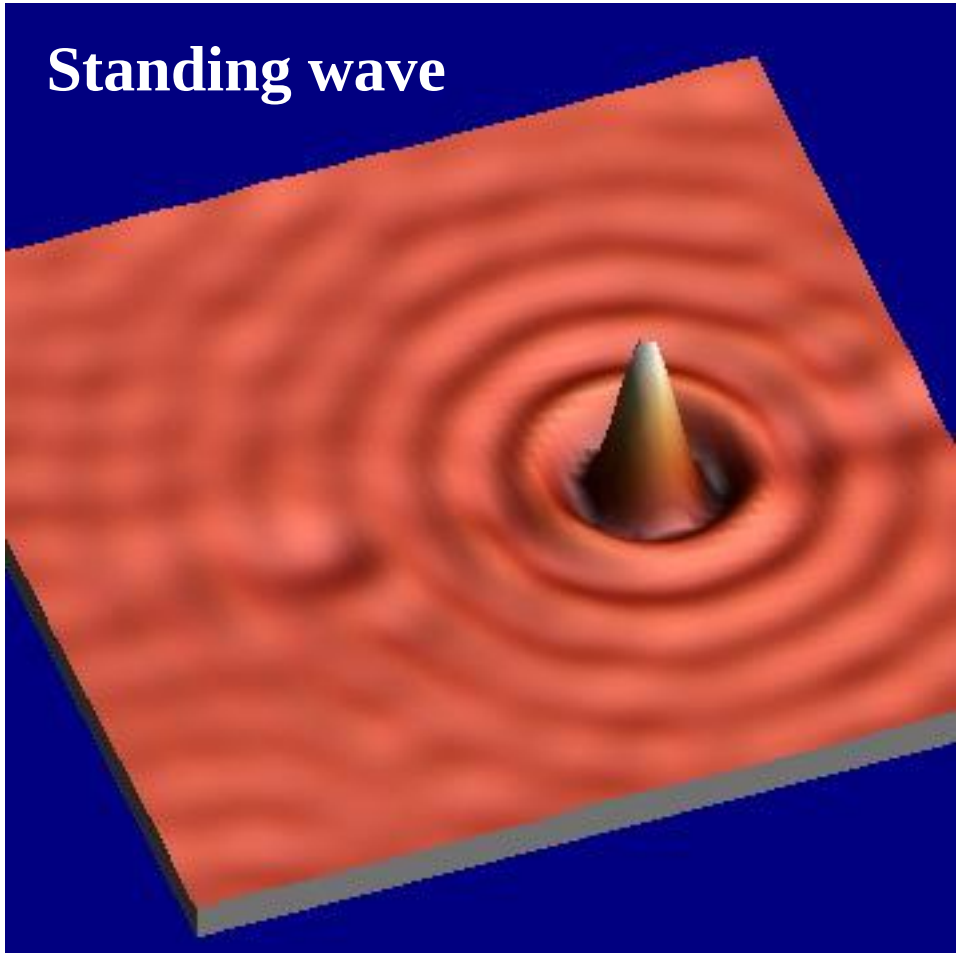


Vs = -50mV, T=4K

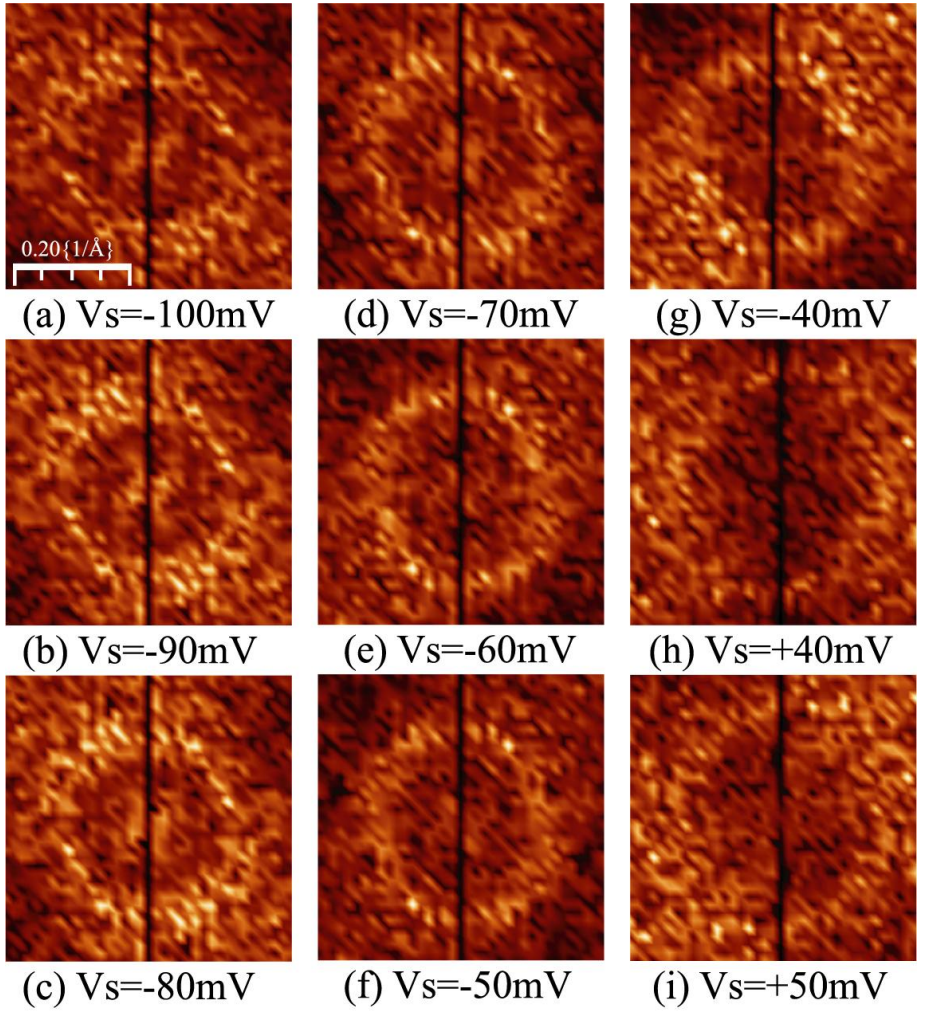
Y. Nishimura et al., Phys Rev. B **79,** 245402 (2009).

Spin polarized quasi particle interference (QPI)

Ferromagnetic Ni(111) surface



FFT images



Scattering probability

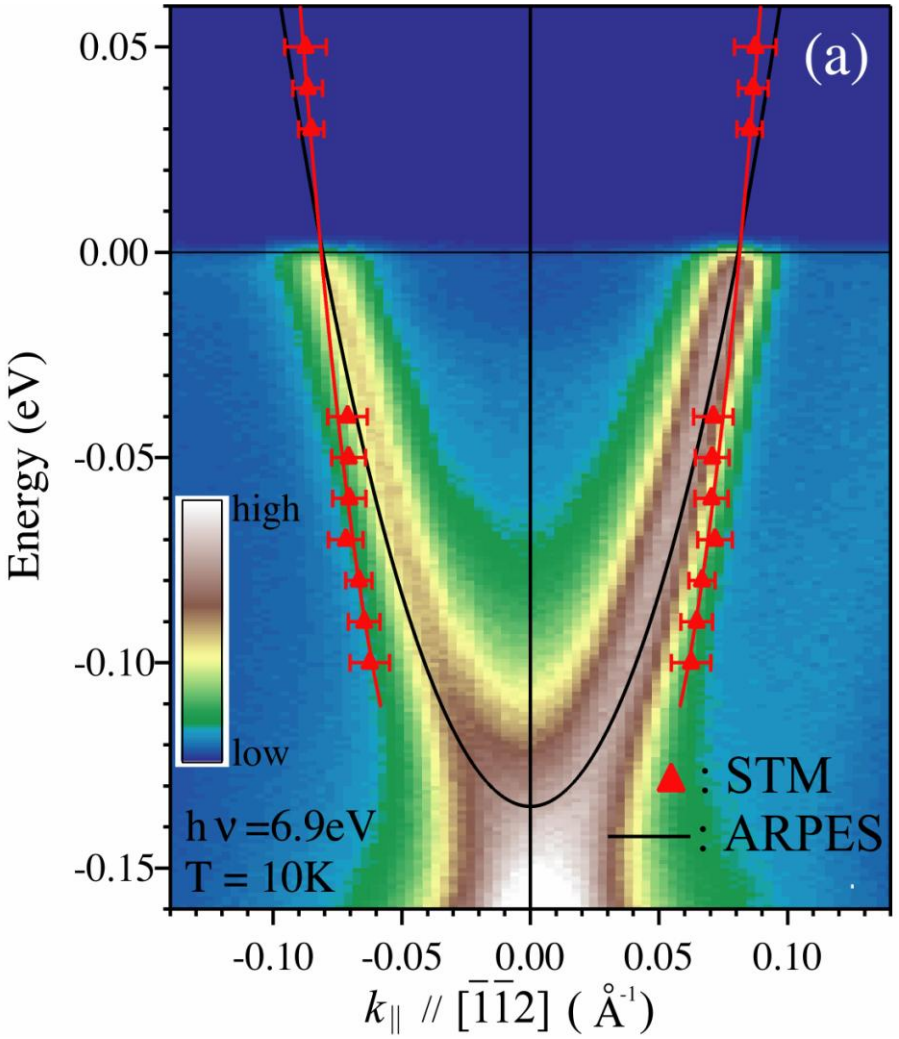
$$\Gamma(\mathbf{q},E)=\sum_{\mathbf{k},\mathbf{k}'}\Gamma_{\mathbf{k}\to\mathbf{k}'}=\frac{2\pi}{\hbar}\sum_{\mathbf{k},\mathbf{k}'}\left|\langle\mathbf{k}'|U|\mathbf{k}\rangle\right|\gamma(\mathbf{q},E)\quad \mathbf{q}=\mathbf{k}-\mathbf{k}'$$

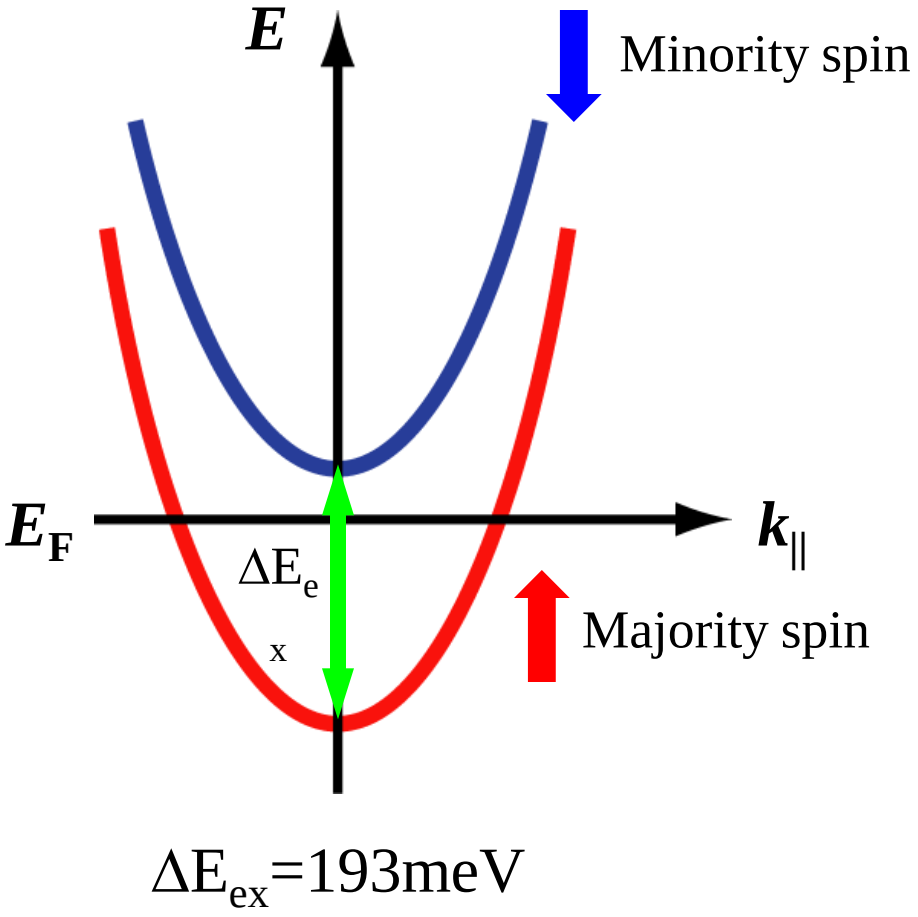
Y. Nishimura et al., PRB (2009).

Spin polarized 2D electron gas

Ni(111) surface

Y. Nishimura et al., Phys Rev. B **79,** 245402 (2009).





Half-metallic 2D free electron gas !

Low-energy ARPES of Bi2212

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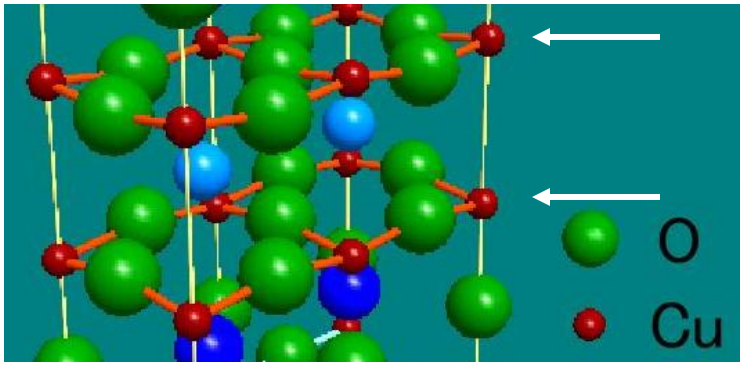

CuO_2 bilayer

Bilayer splitting

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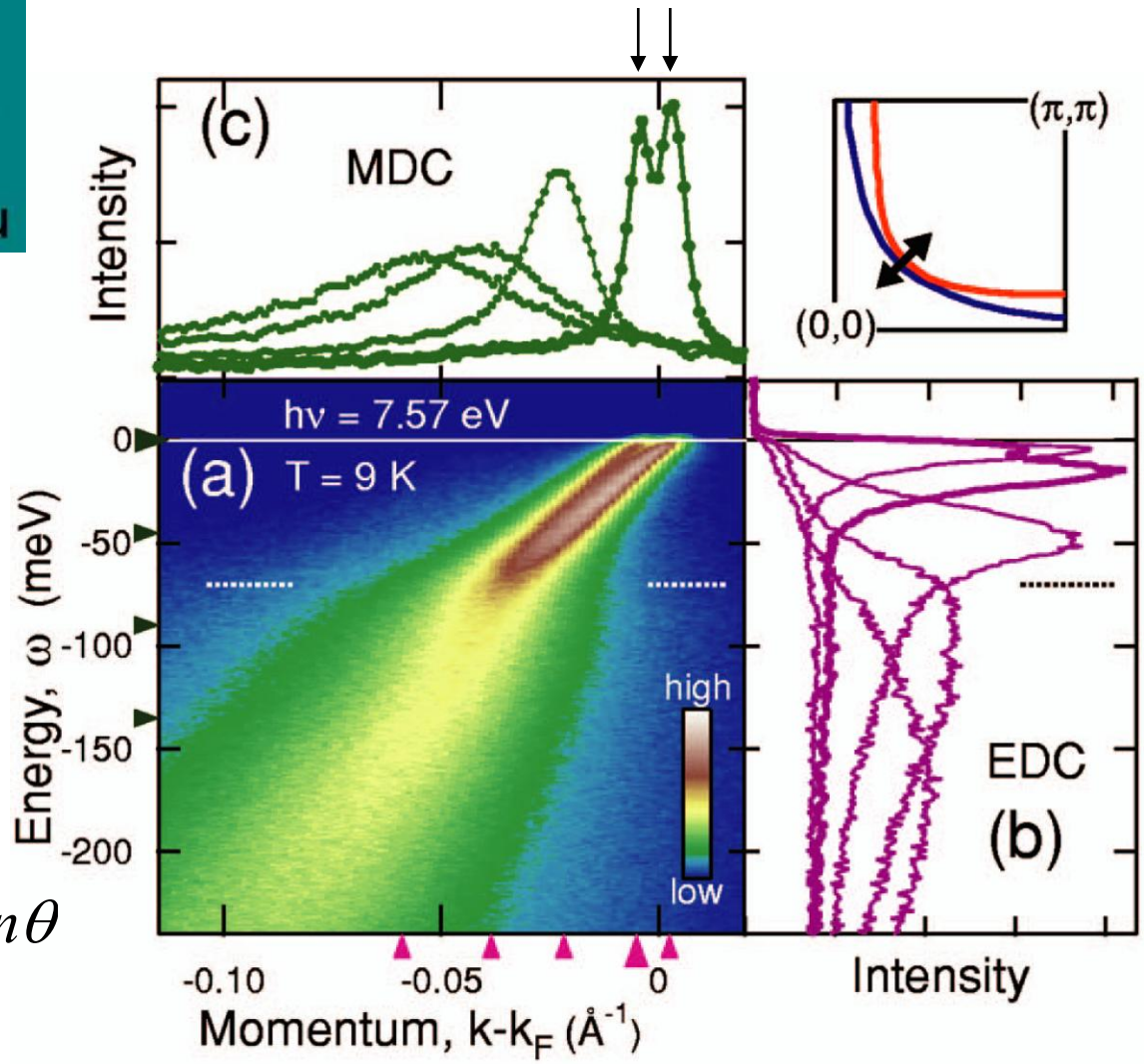
hν = 7.57 eV

Δ*k* = 0.0065 Å^{-1}

$$\hbar k_{//} = \sqrt{2m\left(E_B + h\nu - \phi\right)} \cdot \sin\theta$$



T. Yamasaki et al., Phys. Rev B **75**, 140513(R) (2007).

$Bi_2Sr_2CaCu_2O_8$

Temperature dependence of QP

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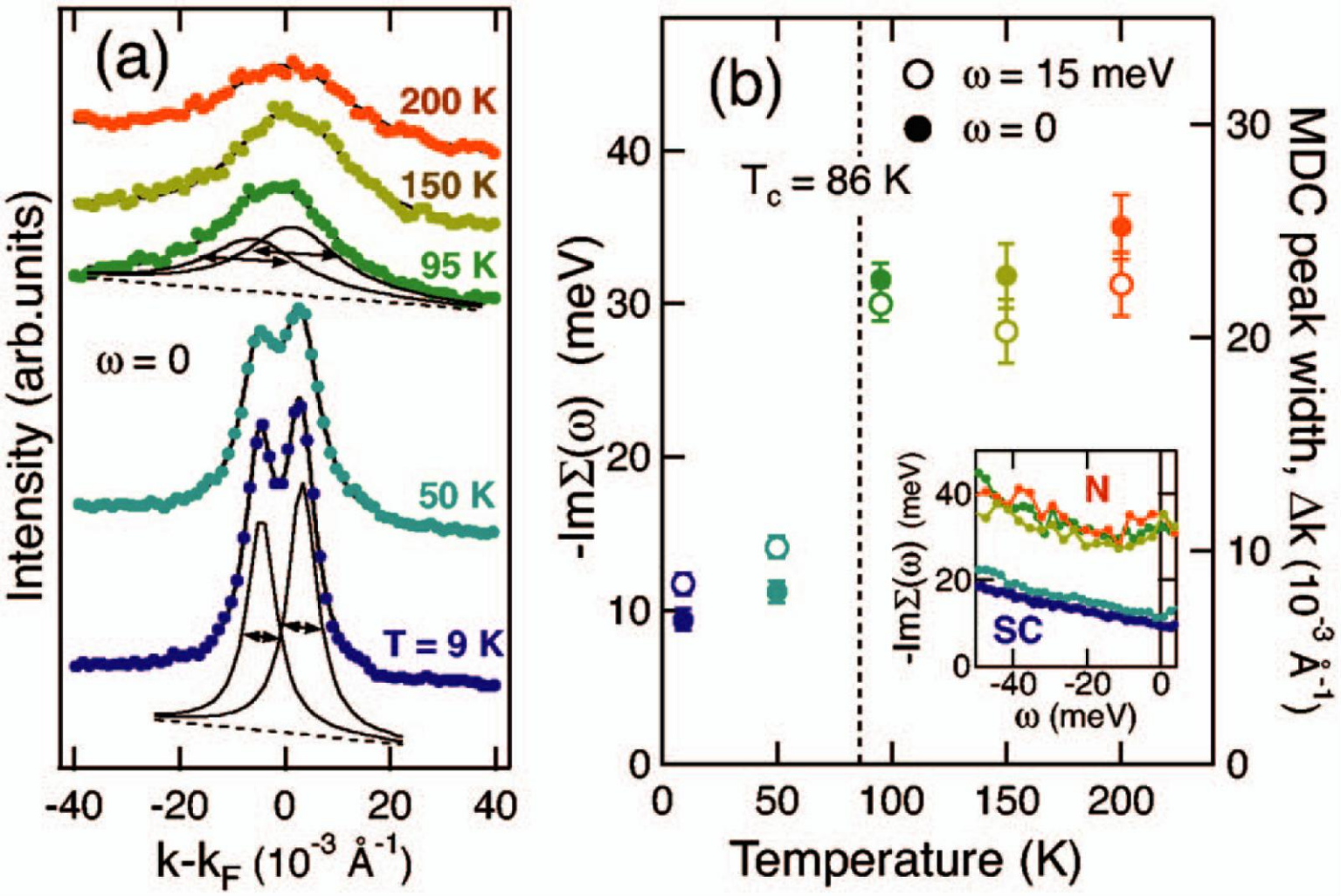
T. Yamasaki et al., Phys. Rev B **75**, 140513(R) (2007).



Scattering is abruptly suppressed below T_c.

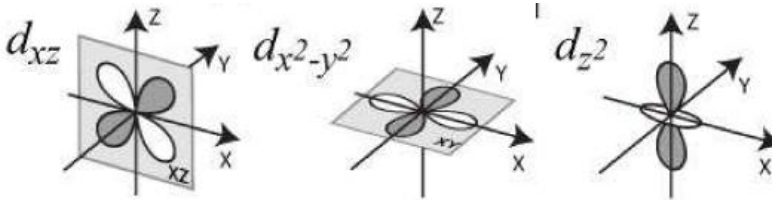
Resolving the orbital symmetries

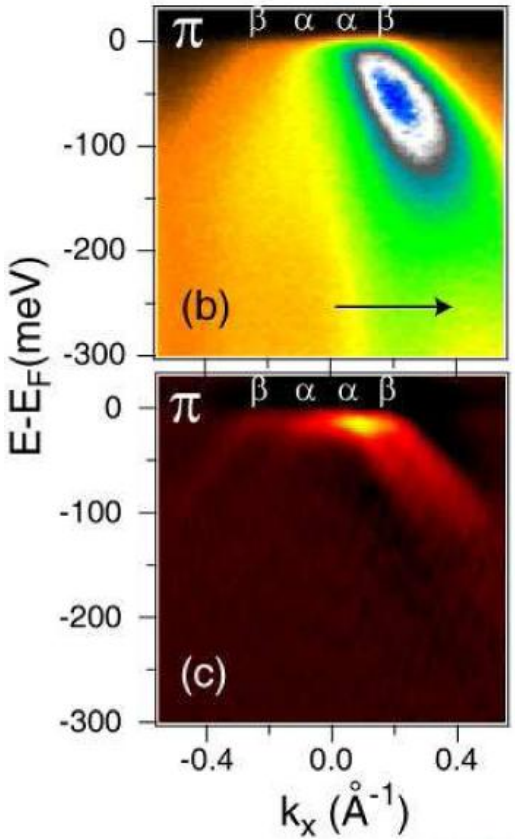
HiSOR BL1

$BaFe_{1.85}Co_{0.15}As_2$

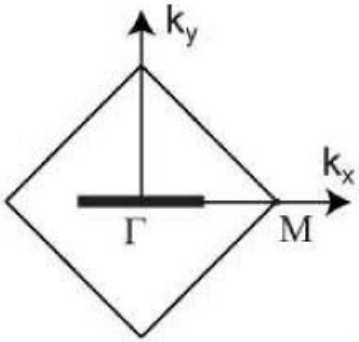
Y. Zhang et al., arXiv:0904 [cond-mat.supr-con].

***p* 偏光配置**





hν=40eV
ΔE=15meV
T=10K



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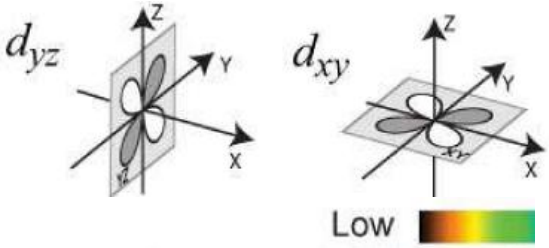
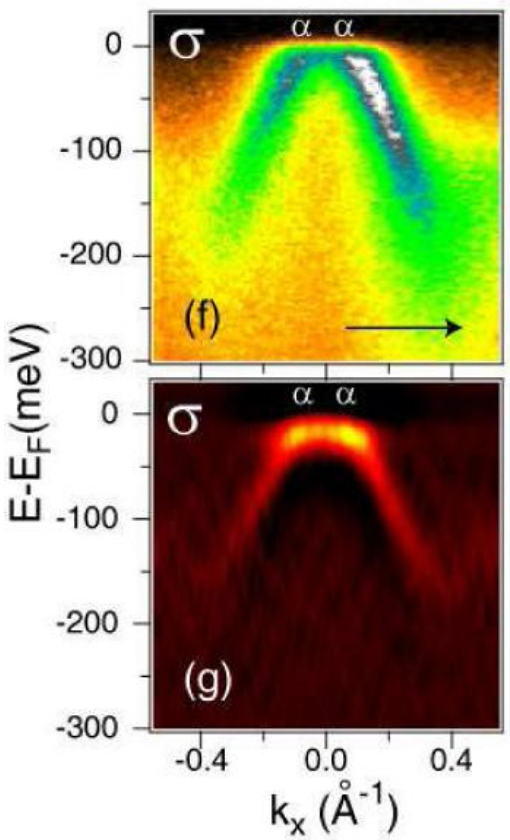


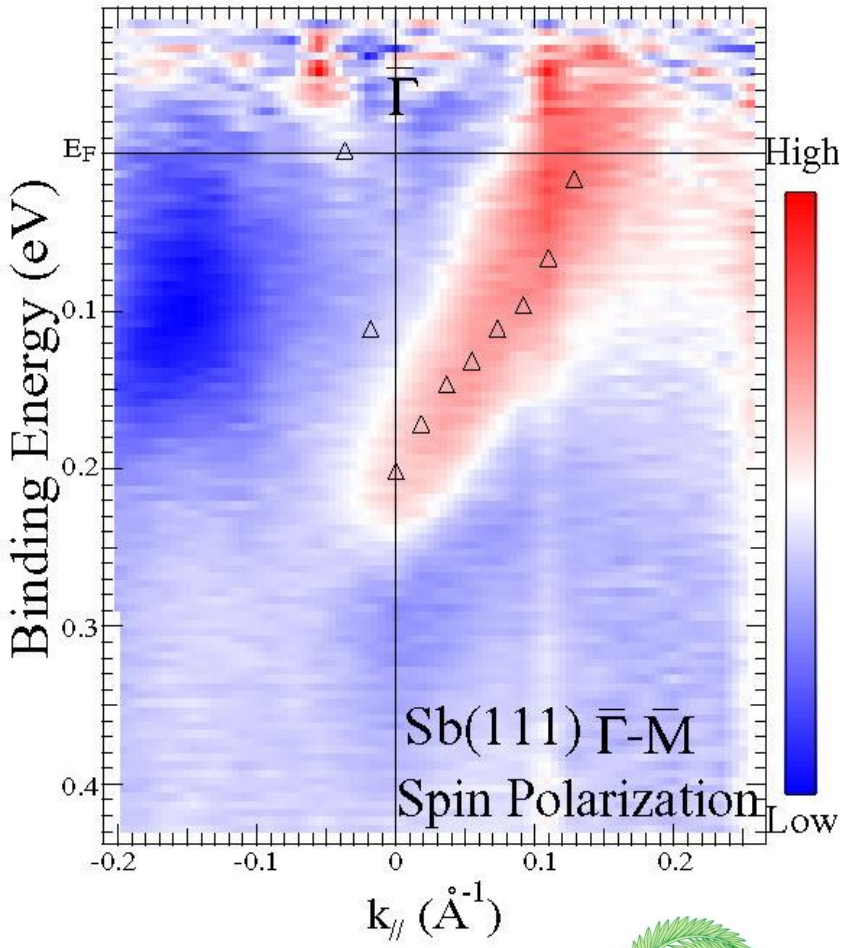


Spin polarized autocorrelation function

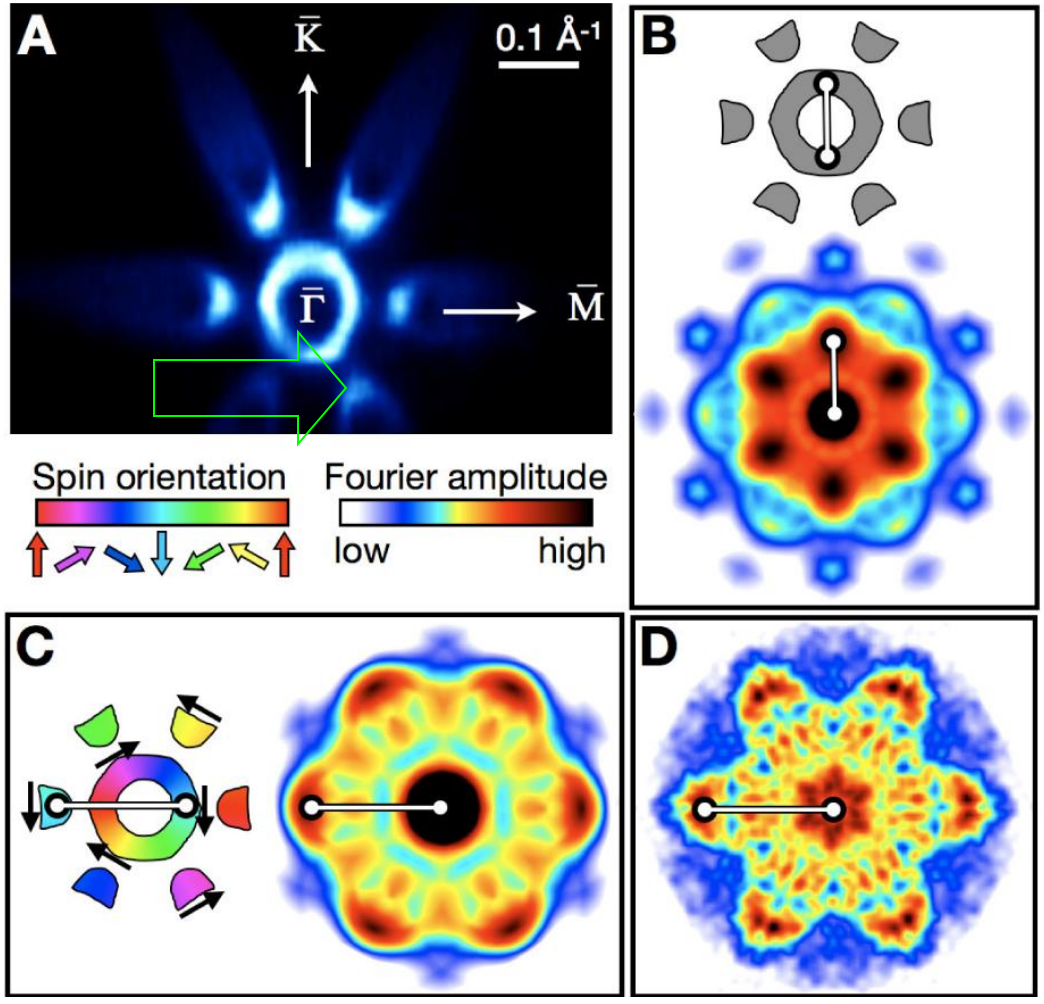
Spin resolved ARPES

$$\gamma_{SP}(\mathbf{q},E)=\int\left|\left\langle \mathbf{s}_{\mathbf{k}+\mathbf{q}}\middle|\mathbf{s}_{\mathbf{k}}\right\rangle\right|^2 A(\mathbf{k}+\mathbf{q},E)A(\mathbf{k},E)d\mathbf{k}$$

K. K. Gomes et al. $\left|\left\langle \mathbf{s}_{\mathbf{k}+\mathbf{q}}\middle|\mathbf{s}_{\mathbf{k}}\right\rangle\right|^2=\cos^2\left[(\theta_{\mathbf{k}'}-\theta_{\mathbf{k}})/2\right]$



T. Kadono et al.,
APL **93**, 252107 (2008).



Acknowledment

Grad. Sch. Sci., Hiroshima University

M. Nagira, M. Higashiguchi, T. Kadono, T. Yamasaki, Y. Nishimura, A. Ino

Hiroshima Synchrotron Radiation Center

K. Miyamoto, M. Arita, M. Sawada,T. Okuda, K. Shimada,
H. Namatame, M. Taniguchi

Summary

Low energy ARPES with tunable photon is required to reveal quasi particle states in strongly correlated electron systems.

Further with spin resolution

Topologically unpaired spin polarized Dirac Fermions