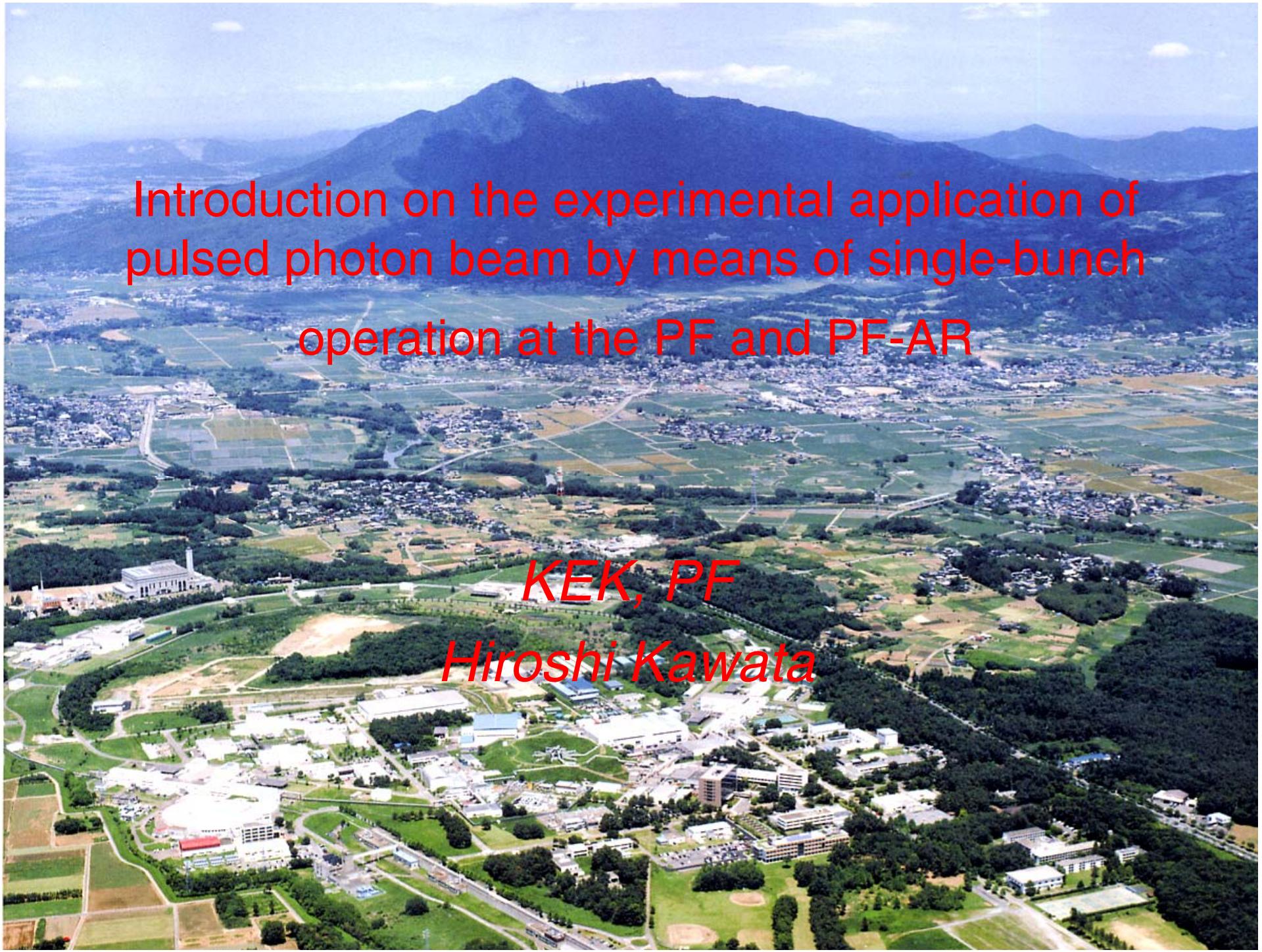
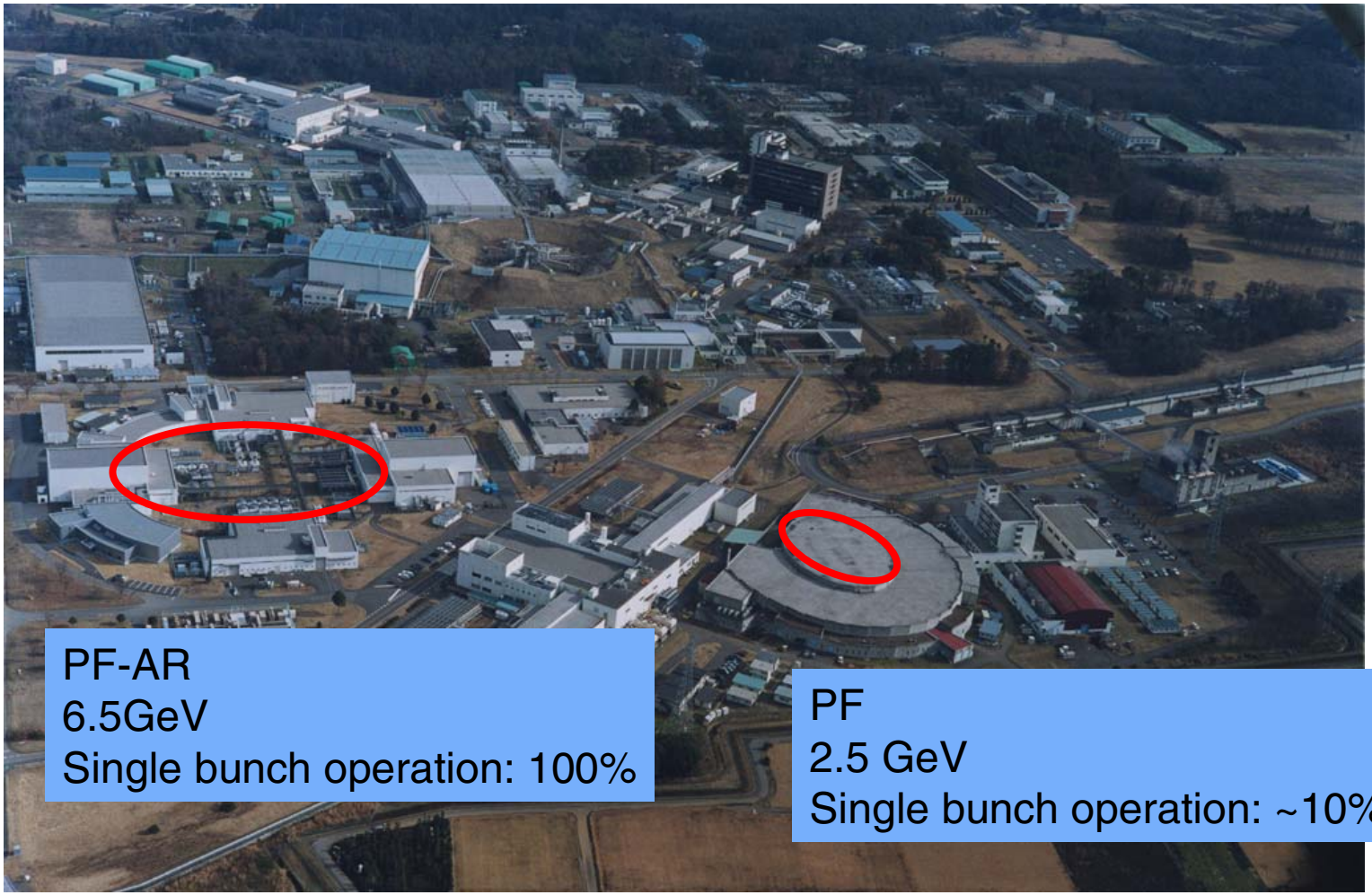

Introduction on the experimental application of pulsed photon beam by means of single-bunch operation at the PF and PF-AR
KEK, PF
Hiroshi Kawata

PF(2.5GeV) and PF-AR(6.5GeV)



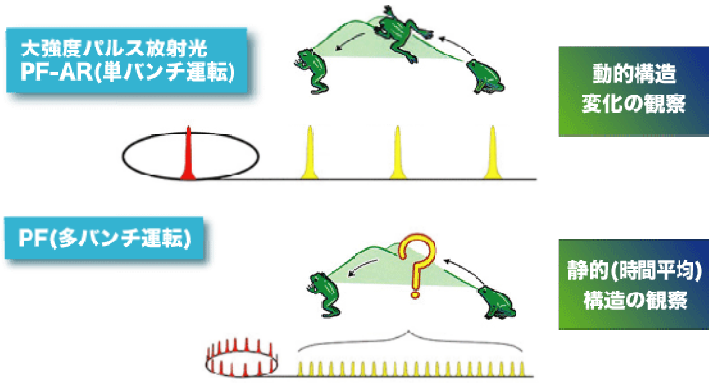
Experimental application of pulsed photon beam (1)

Time-resolved experiments at 100 pico second time resolution

#)Non-equibrium state

#)Reaction process

#) Dynamics



1) Time-resolved crystallography
2) Time-resolved XAFS
3) Time-resolved Photo-electron spectroscopy
4) ,,,,,,,,etc.

Experimental application of pulsed photon beam (2)

Experimental applications based on the time-domained experimental techniques

#)Time-gated technique

#)Time of flight technique

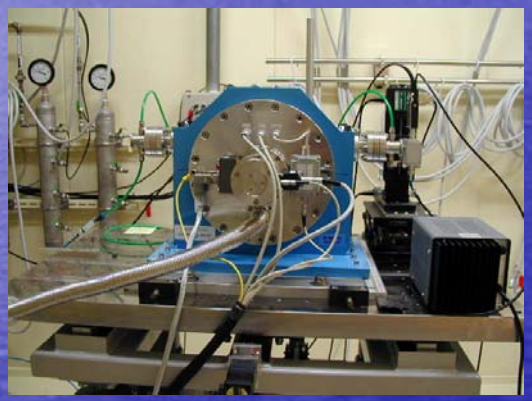
#) ,,,etc.

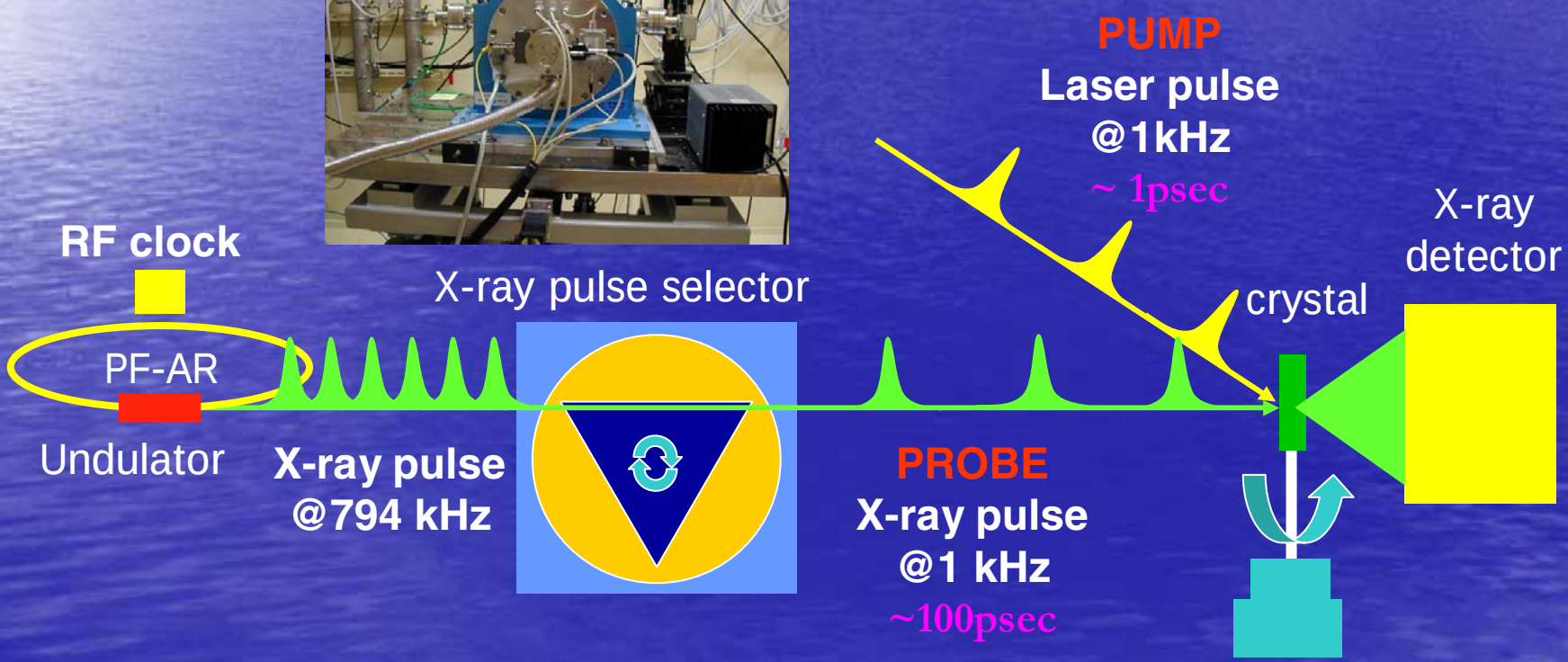
→ Development of the time resolved detection system

↓

1) Nuclear resonant scattering
2) Lifetime resolved fluorescence spectroscopy
3) Electron spectroscopy at Compton scattering process
4),,,,,,,,etc.

Sub-nano second time-resolved X-ray diffraction experiment at PF-AR (Photo-induced phase transition)

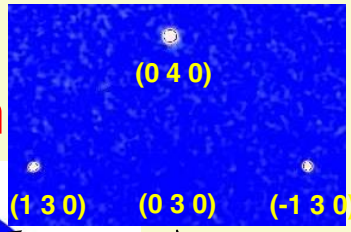


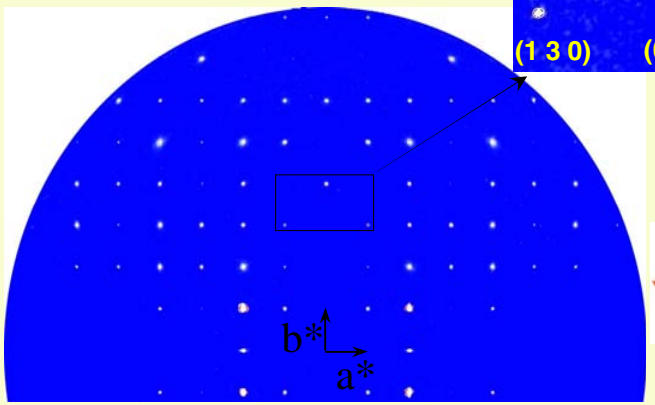


Neutral-to-Ionic Transition in TTF-CA

(Collet et al. Science 300, 612, 2003)

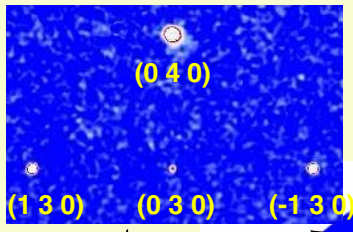
2 ns before laser irradiation



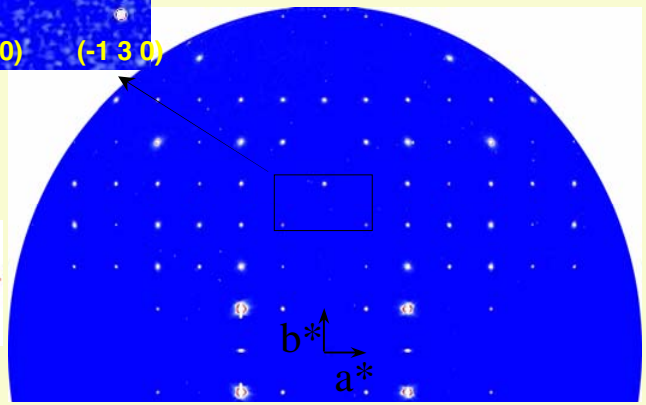


no (030)

1 ns after laser irradiation



(030)



Neutral phase

Space group $P2_1/c$

(0 k 0) : k = 2n+1 absent

(h 0 l) : h+l = 2n+1 absent

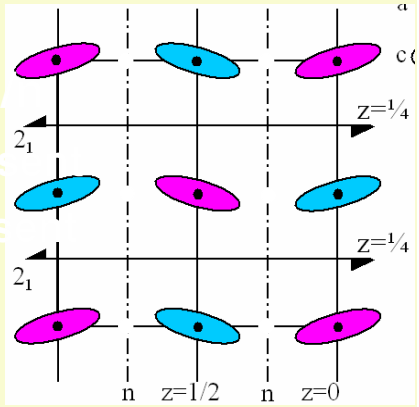
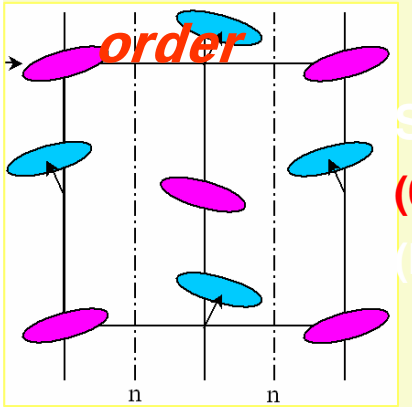


Photo-induced ferroelectric order

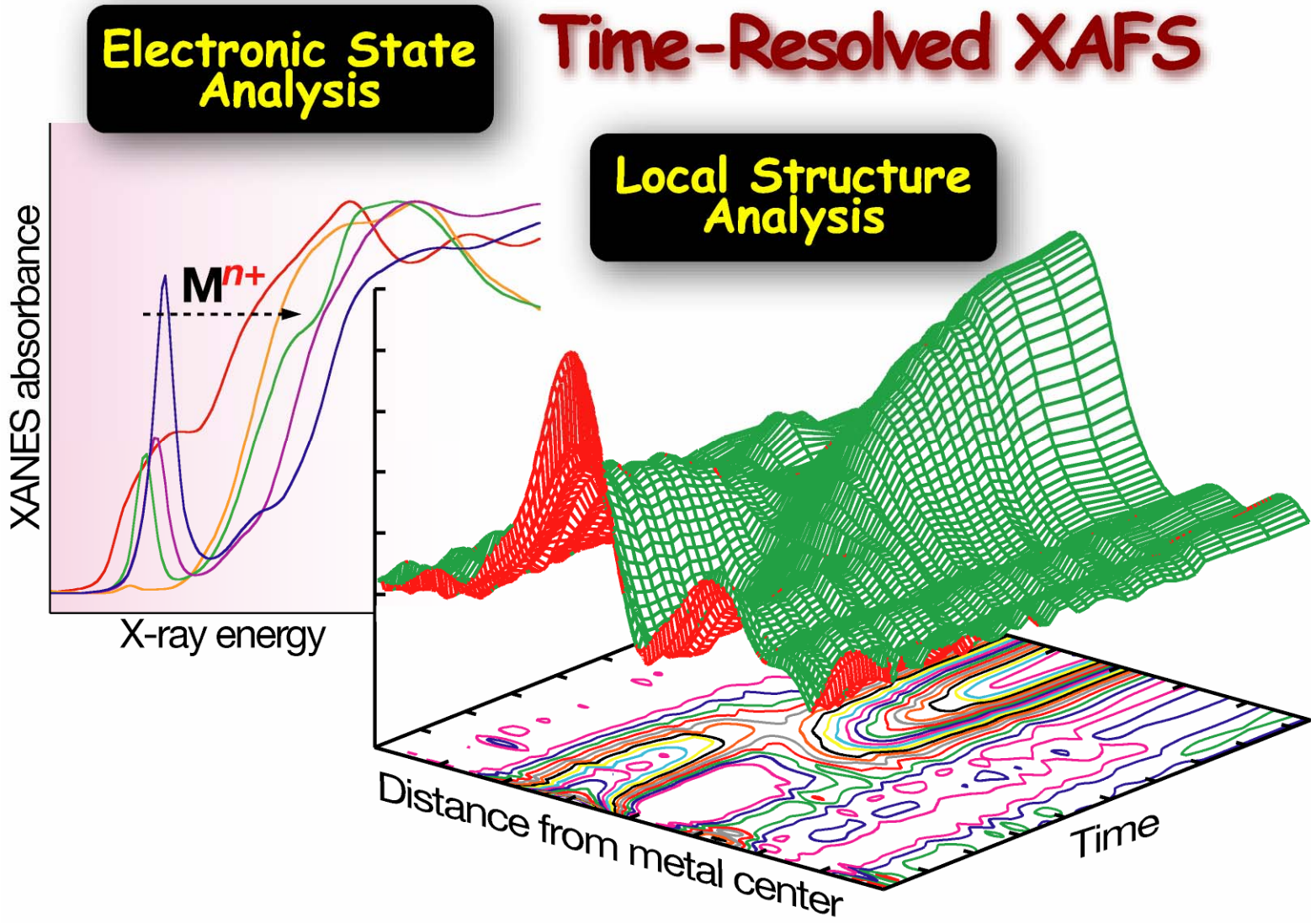


Space group Pn

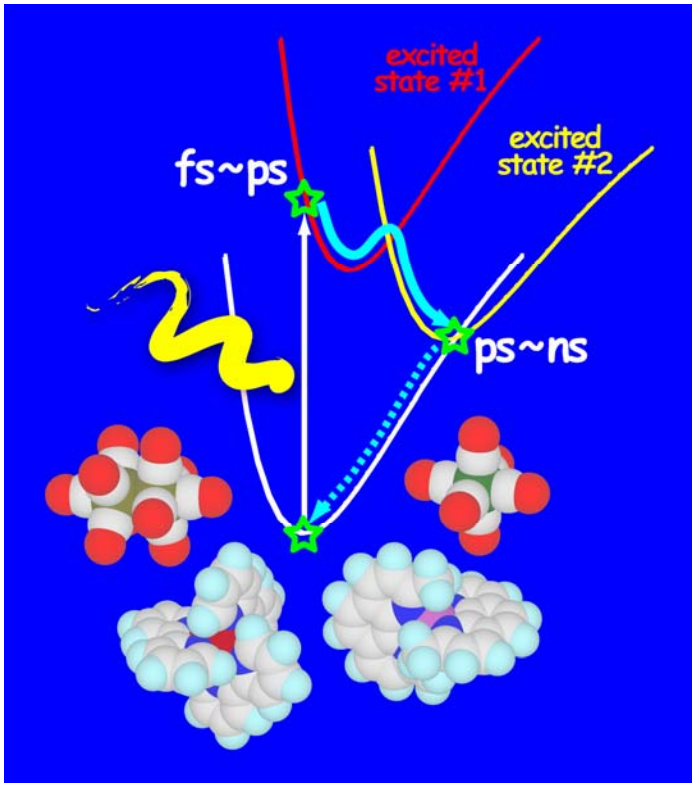
(0 k 0) : k = 2n+1 present

(h 0 l) : h+l = 2n+1 absent

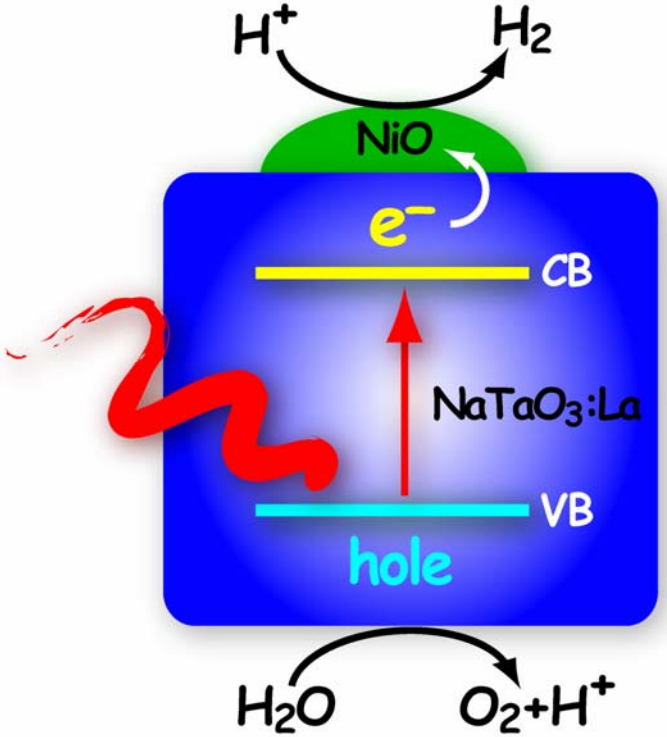
XAFS of Short-Lived Species



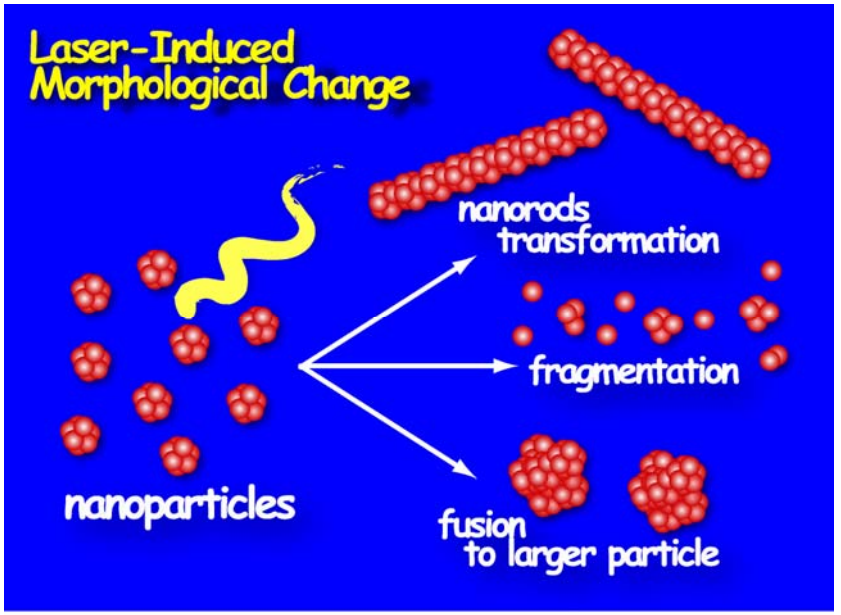
Light-Excited Species



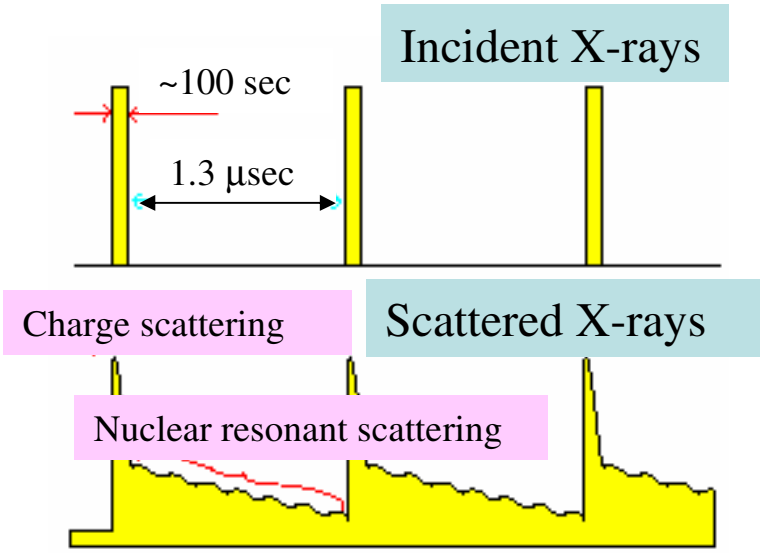
Water-Splitting Catalyst

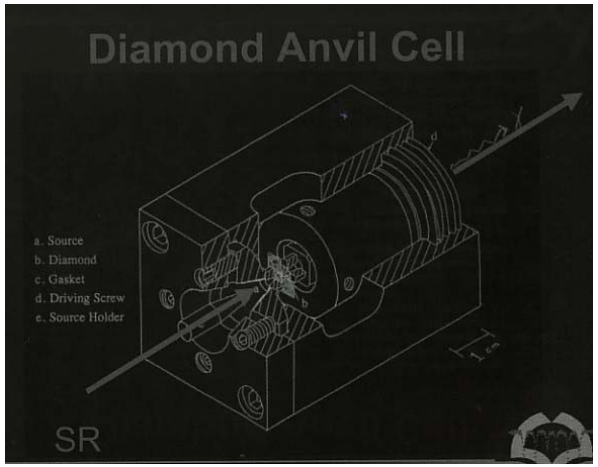


Formation Mechanism of Nanomaterials

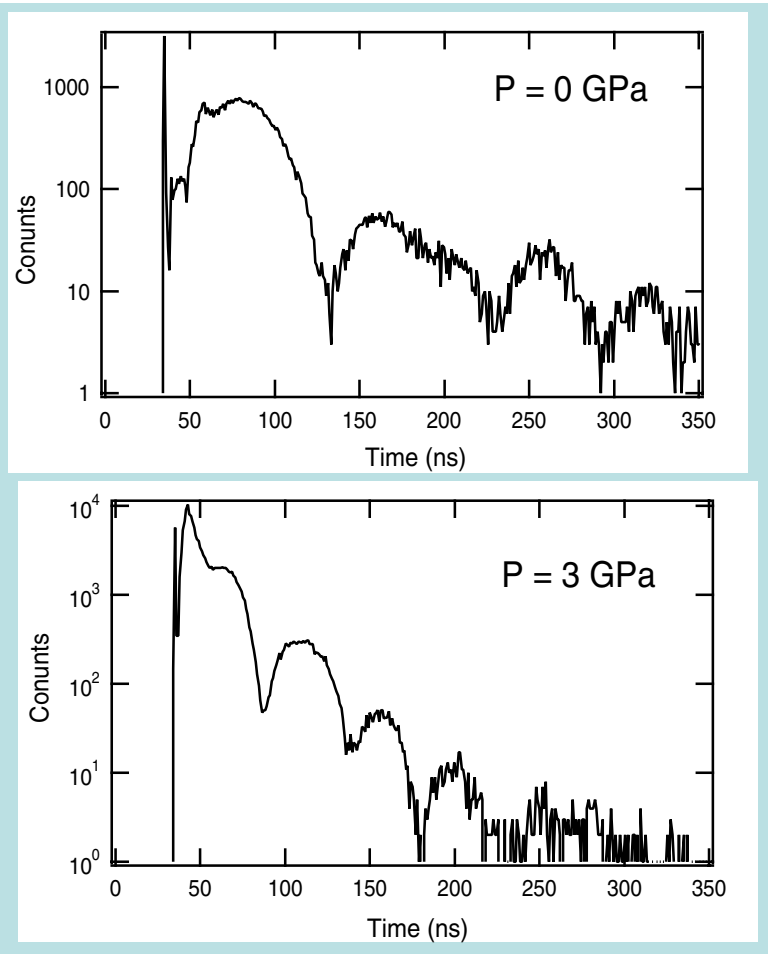


Nuclear resonant scattering under high pressure condition

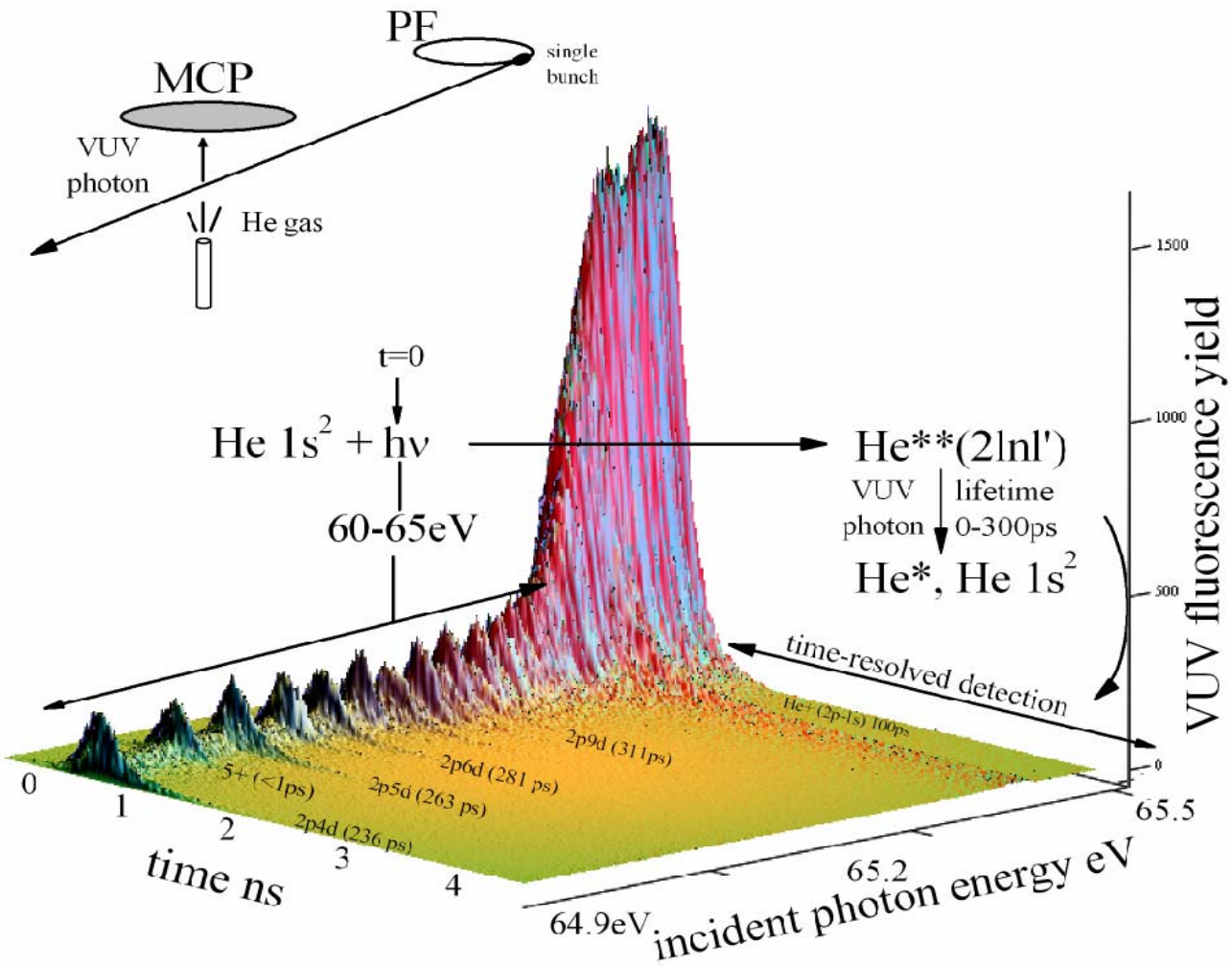




Pressure effect of mixed valence iron complex system, $(n\text{-}C_3H_7)4N[Fe^{II}Fe^{III}(dto)_3]$(dto=$C_2O_2S_2$)

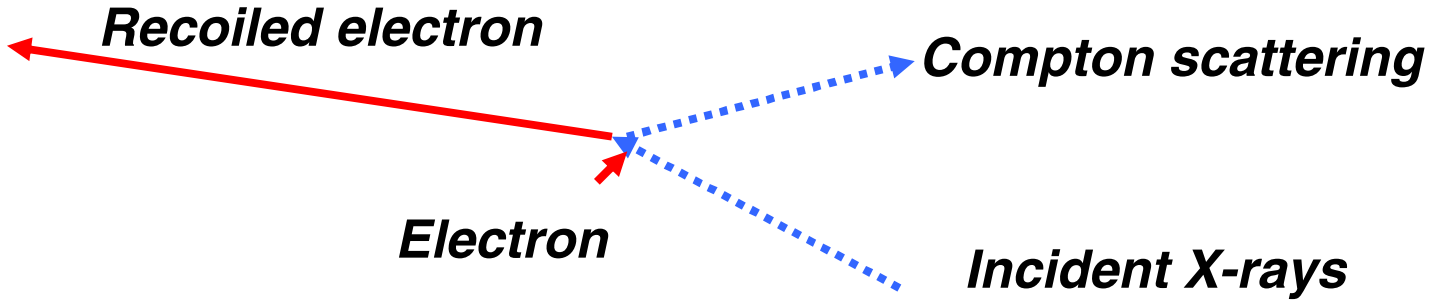


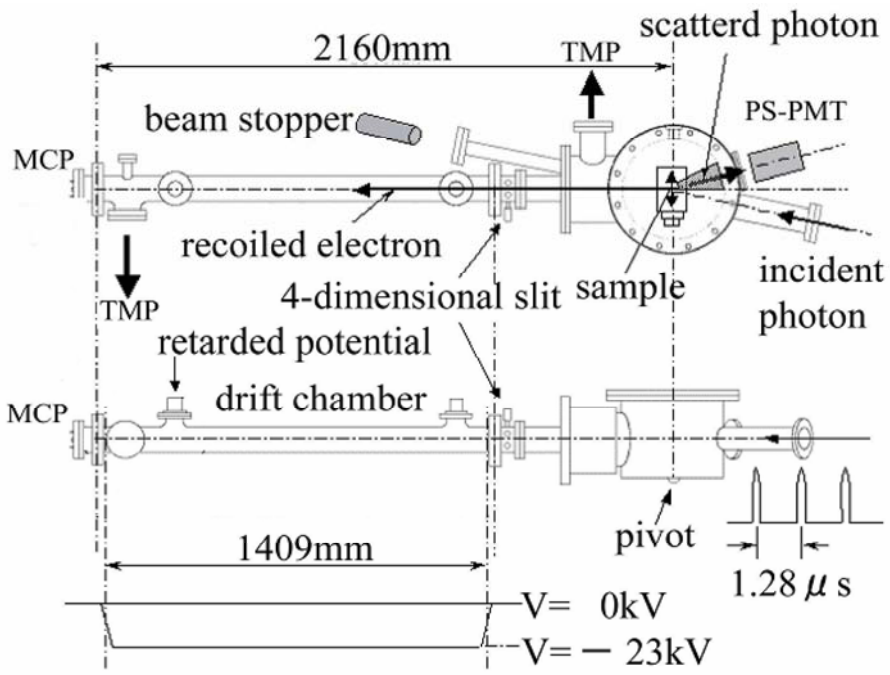
Lifetime-resolved fluorescence spectroscopy



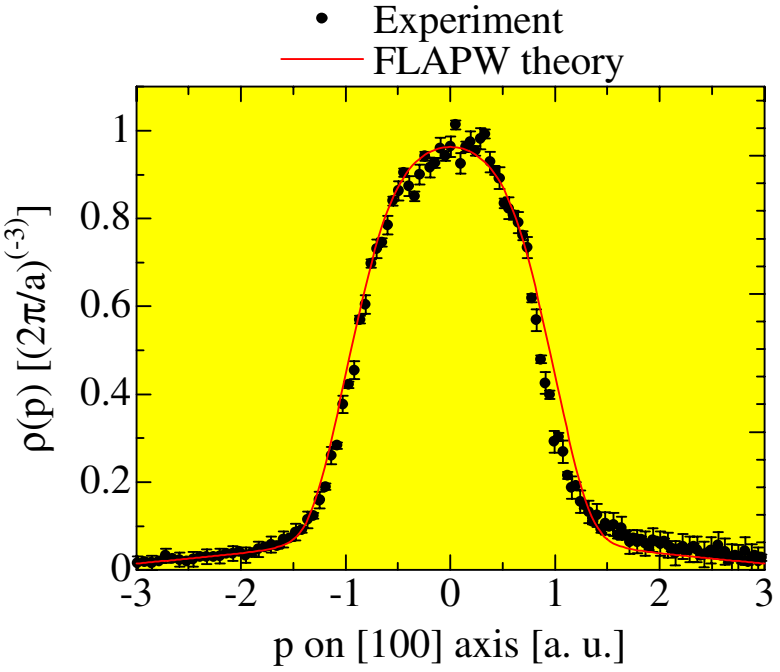
Time and incident photon energy dependence of fluorescence yield on He

Electron spectroscopy at Compton scattering process





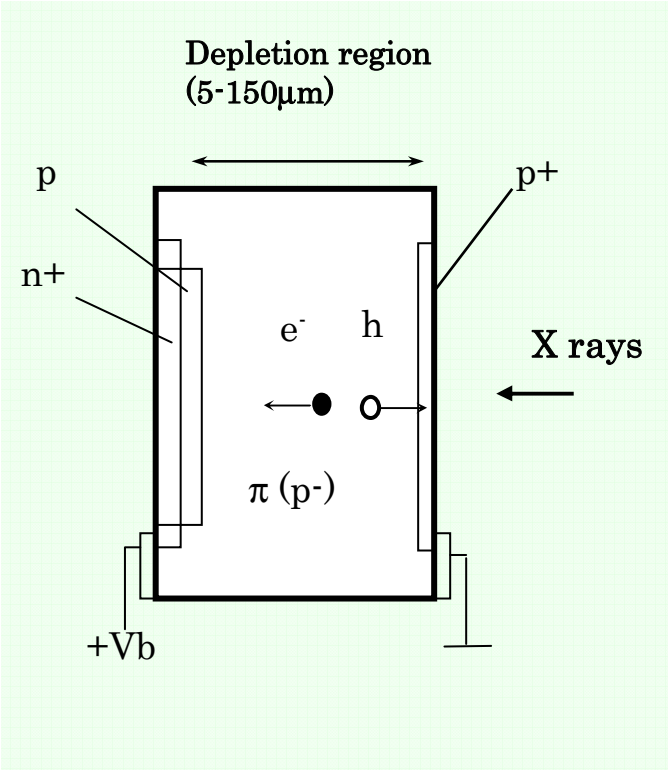
Time of flight method



Obtained electron momentum density at Si

Avalanche diode detectors

A silicon avalanche photodiode (Si-APD) detector is a powerful tool for Synchrotron X-ray experiments.



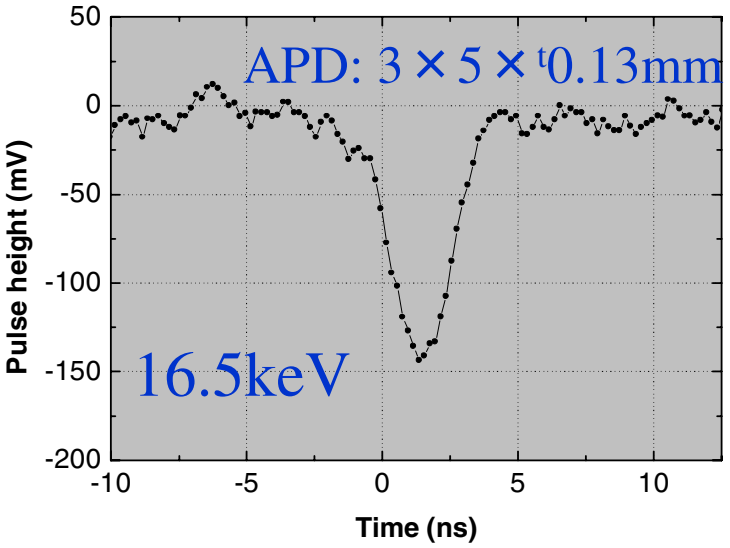
Detecting radiation Without a scintillator

Processing signals With a wide-band amplifier (gain>100)

⇨ a nanosecond-width pulse for one X-ray photon

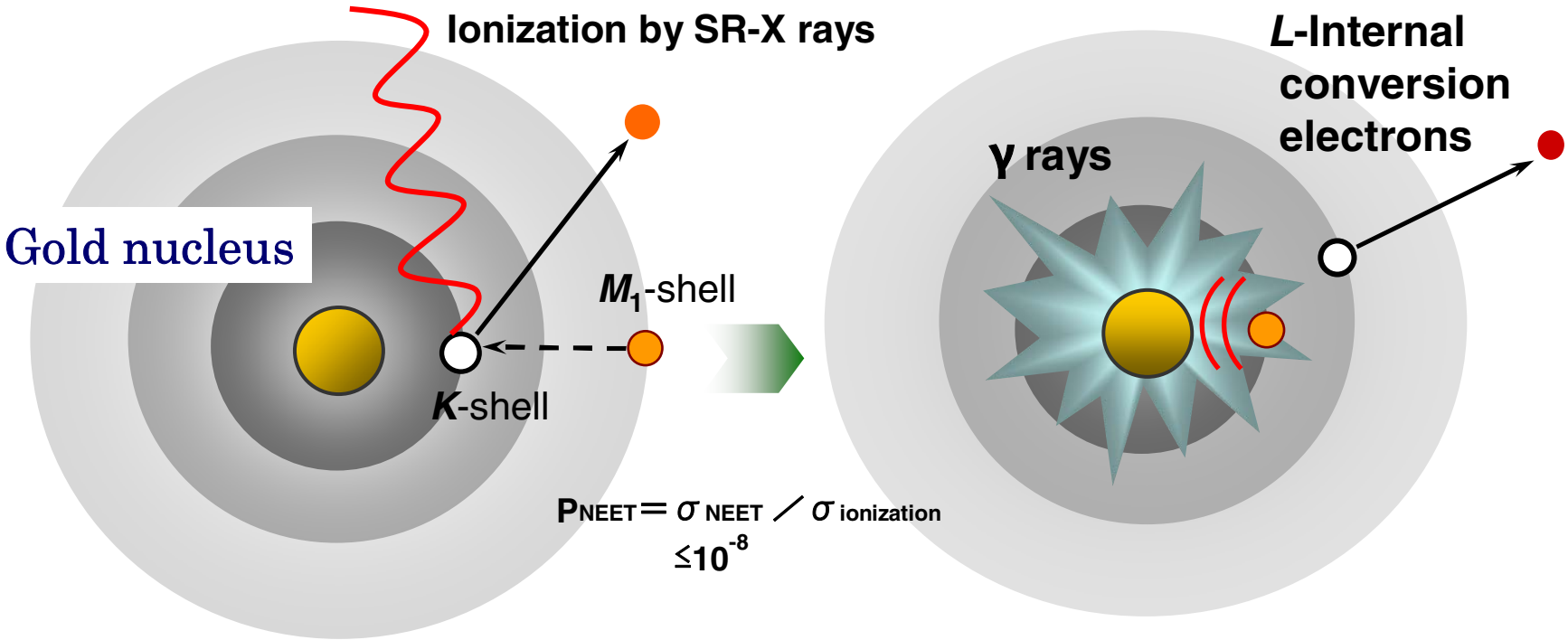
high-rate capacity : up to 10^8 s^{-1}

time resolution : < 50ps – 1.5ns



Nuclear Excitation by Electron Transition (NEET)

Ex. ^{197}Au



***K*-holes are made by ionization, and filled by an atomic transition from an outer orbit.**

The nucleus is excited, followed by emitting radiation with a lifetime of the excited level.

Future development

#) Much shorter light pulse!!

Pico second → Femto second

#) What kind of hardware will be available in a future??

Thank you for your attention!!