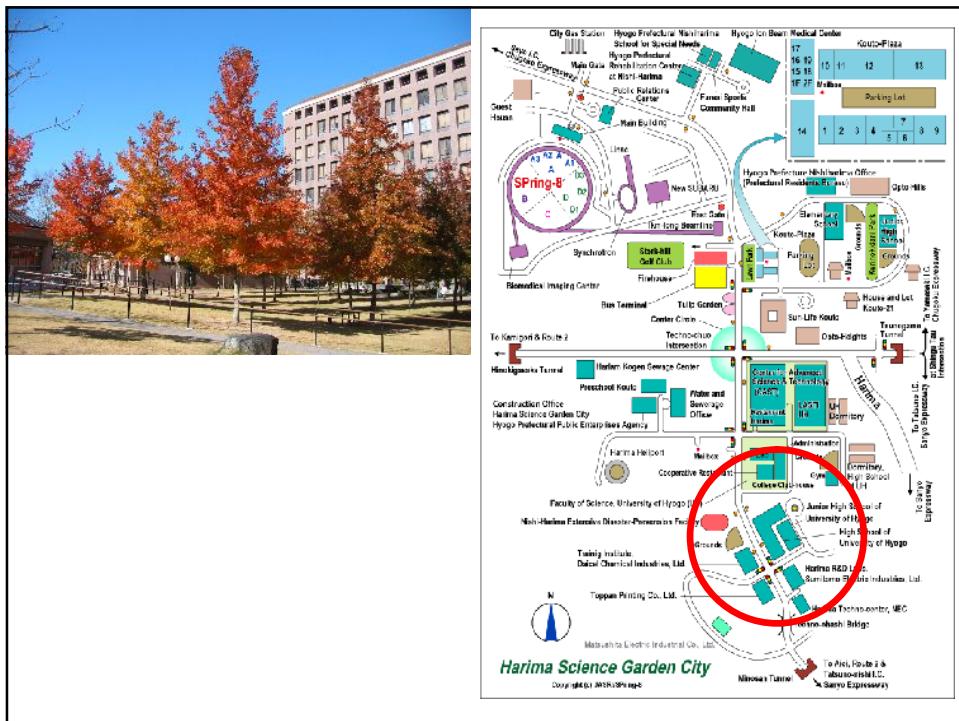


Pump/Probe Experiments

T. Gejo
(*University of Hyogo*)

Today's Topics

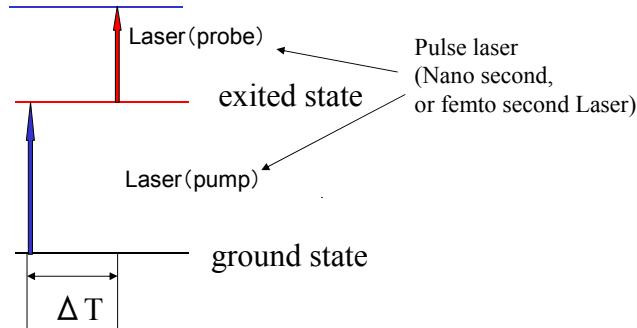
- Univ. of Hyogo? Where is it?
- General aspects of pump/probe experiments
- Laser/Synchrotron pump/probe experiments
- FEL/Laser pump probe experiments
- Storage-Ring-FEL/SR pump probe experiments



Today's Topics

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What is pump/probe experiment?

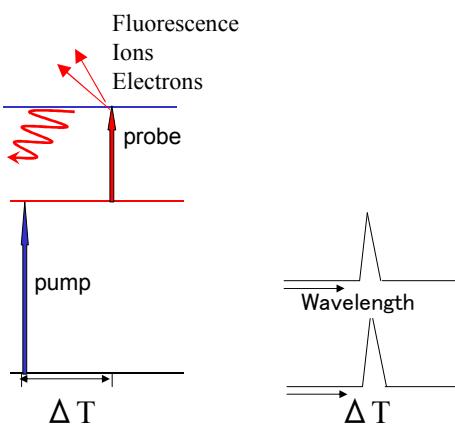


Time dependent measurements

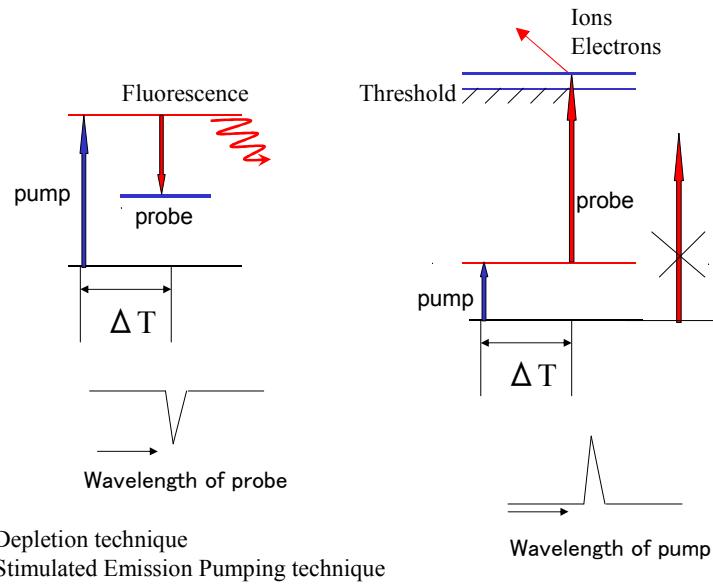
Spectroscopy

Quantum Information

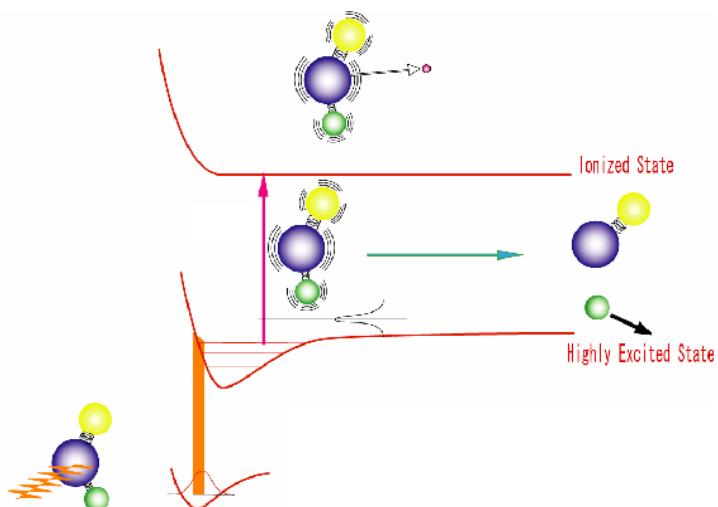
Basic scheme of pump/probe experiments



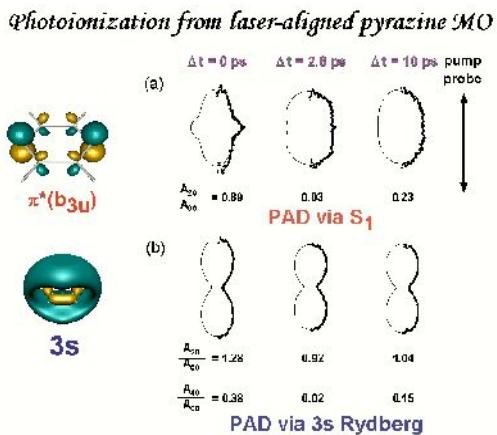
Other spectroscopic techniques of pump/probe experiments



Example pf pump/probe experiment



One of the examples (Angular distributions of photoelectrons)



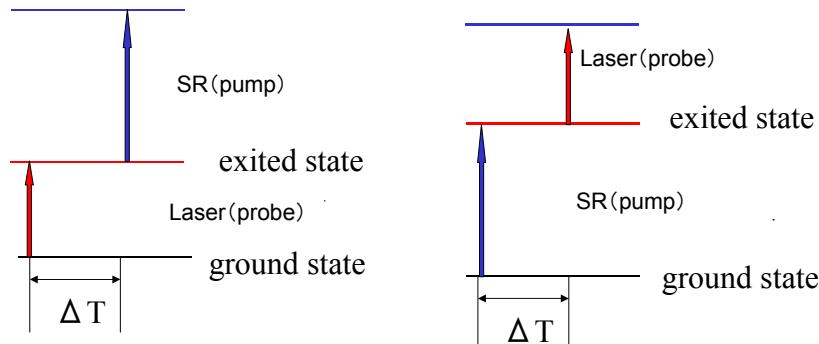
"Non-adiabatic dynamics effects in Chemistry revealed by time-resolved charged particle imaging"

Toshinori Suzuki and Benjamin J. Whitaker, Int. Rev. Phys. Chem. 20, 303 (2001).

Today's Topics

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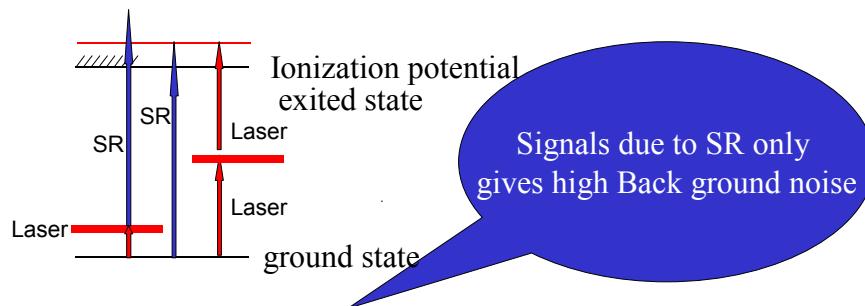
Laser/Synchrotron pump/probe experiments



Time dependent
measurements :
photoelectron spectra,
X-ray diffraction

Spectroscopy of
highly excited
state

One big difficulty of pump/probe experiments with Laser/SR



When you measure of
photoelectron spectra....

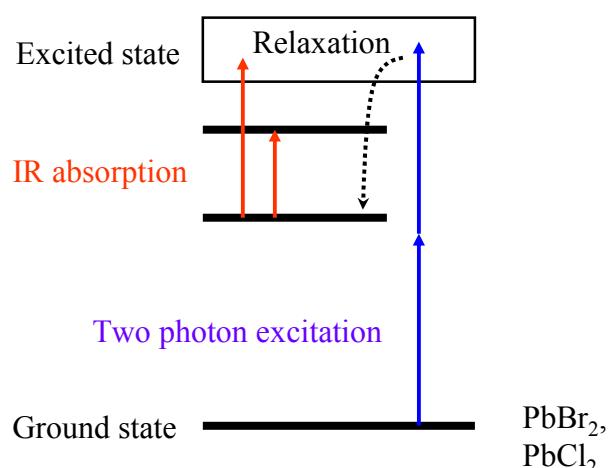
Other problems
X-ray penetrates deeper.
Repetition frequency of the pump-probe experiment
is limited by sample.

Examples 1

Laser/SR(IR)

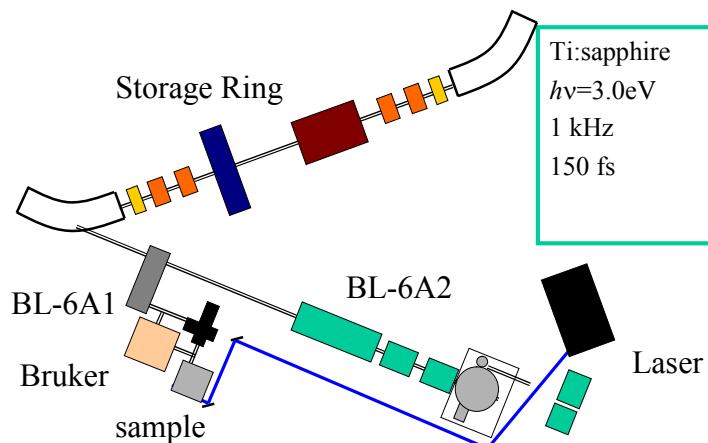
@UVSOR

IR and Laser spectroscopy at UVSOR

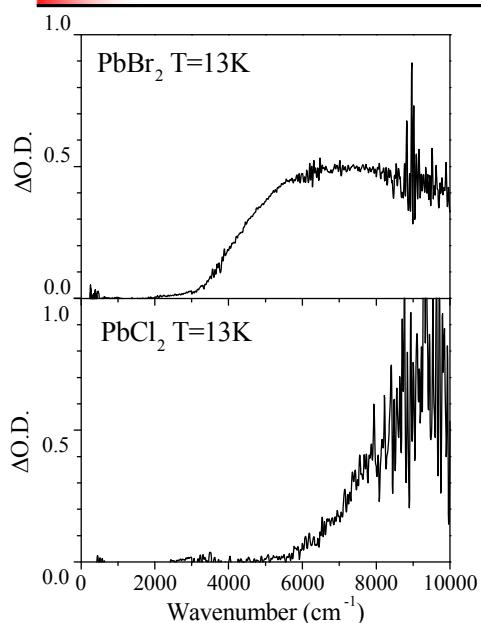


J. Azuma, M. Kamada, M. Itoh et al. (UVSOR)

Experimental set up



Results



• PbBr_2 , PbCl_2

—) Laser ON

-) Laser OFF

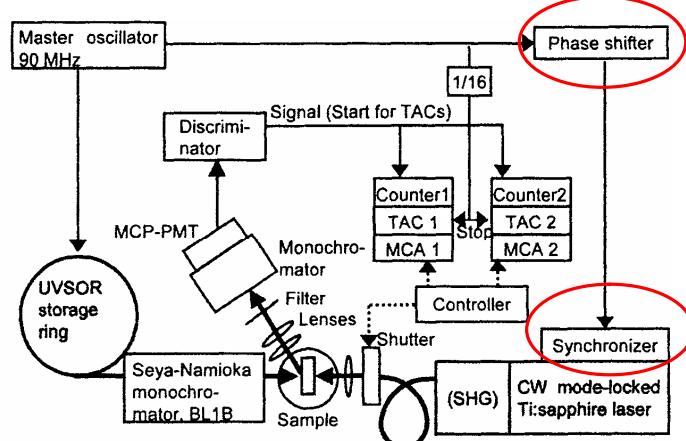
$\Delta\text{O.D.}$

J. Azuma, M. Kamada,
M. Itoh et al.

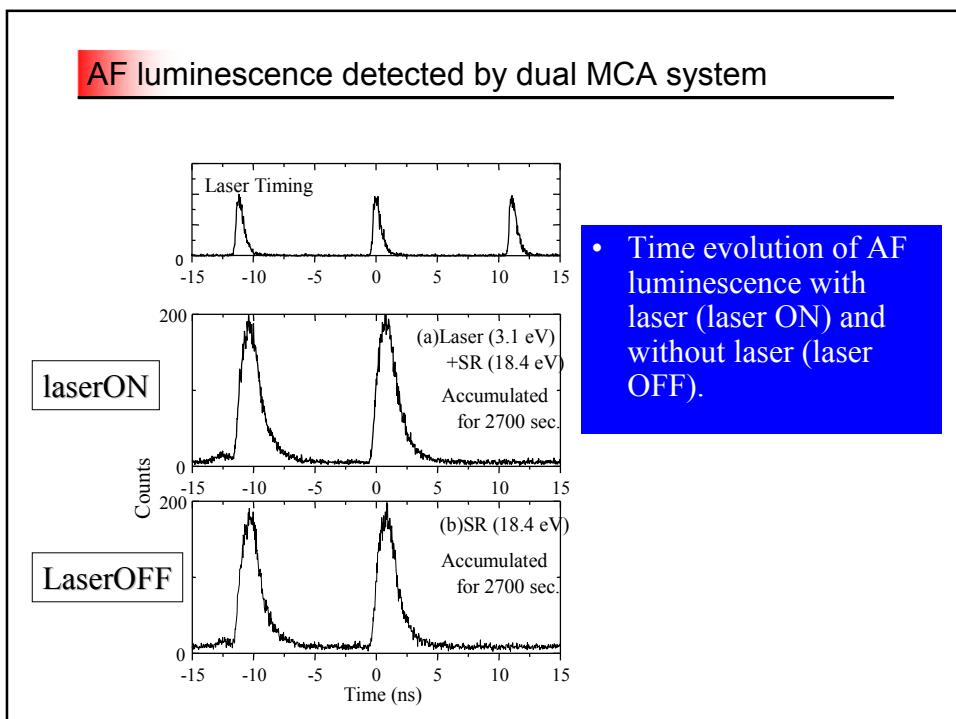
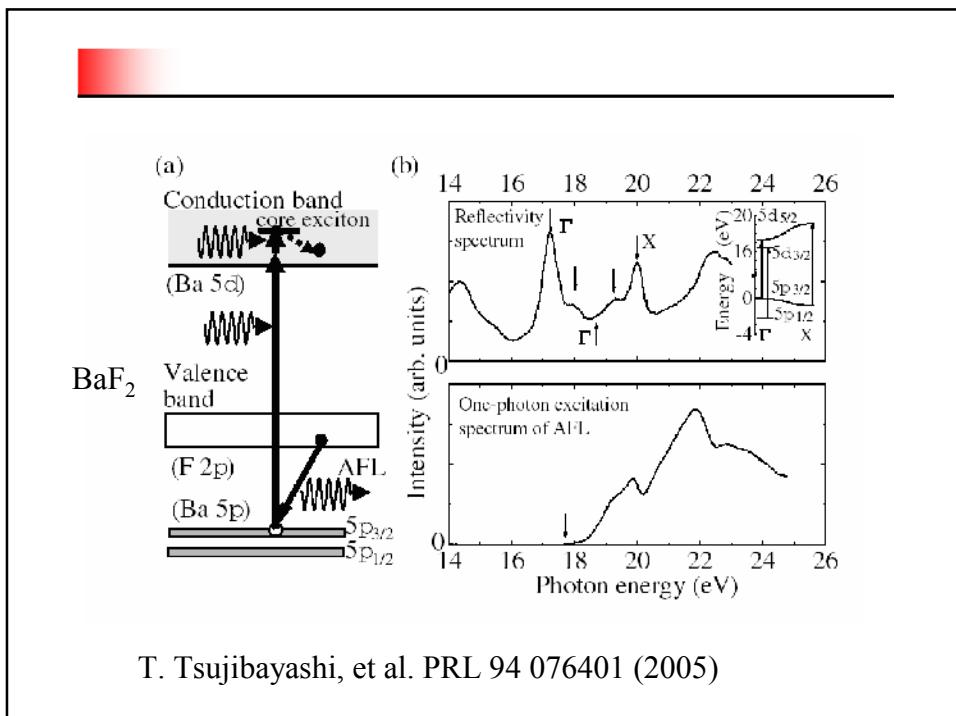
Examples 2

Laser/SR(VUV)

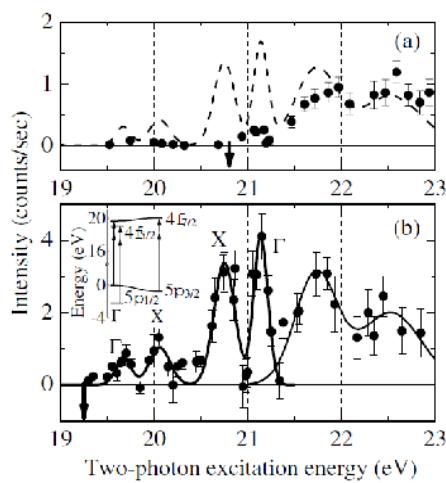
@UVSOR



T. Tsujibayashi, et al. PRL 94 076401 (2005)



BaF₂



T. Tsujibayashi, et al. PRL 94 076401 (2005)

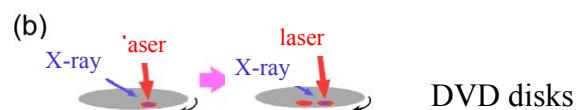
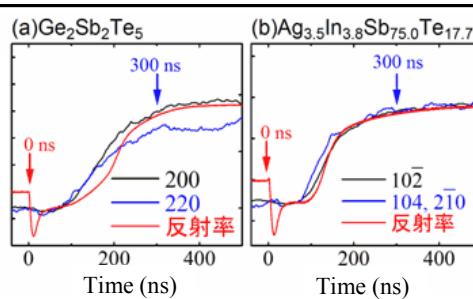
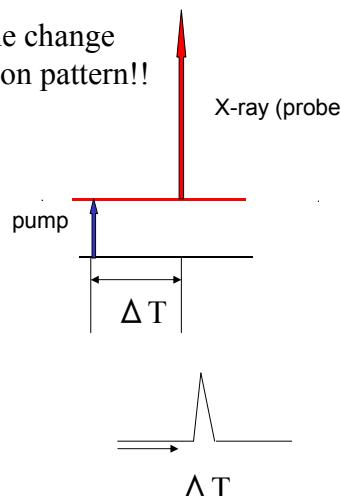
Examples 3

Laser/SR(X-ray)

@Spring-8

Time-resolved X-ray Scattering

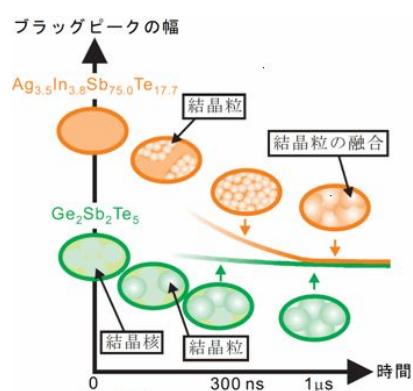
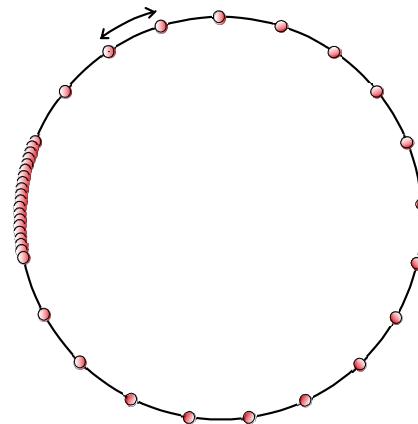
Observe the change
of diffraction pattern!!



S. Kimura, Y. Tanaka et al. (JASRI, RIKEN)

2/21-filling+18 bunches

228.1 ns



S. Kimura, Y. Tanaka et al. (JASRI, RIKEN)

Today's Topics

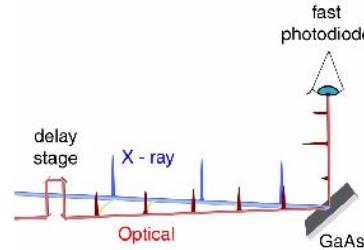
- Univ. of Hyogo? Where is it?
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Examples

Laser/FEL

@FLASH (Germany)

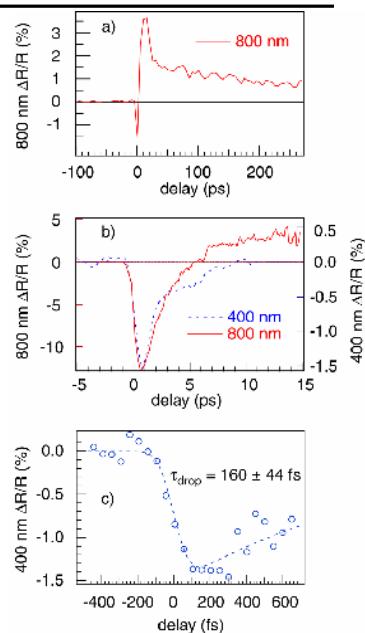
Experiments at FLASH



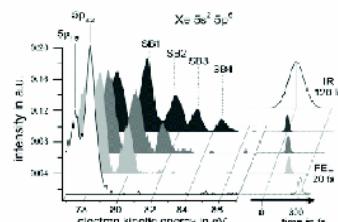
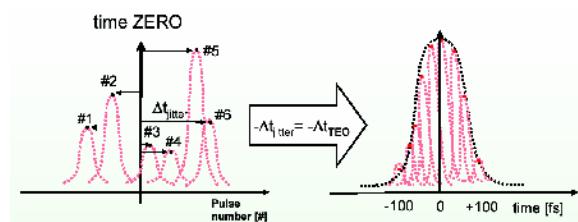
Optical Laser:
800 nm or 400 nm,
130fs, 10 μ J/pulse.

C. Gahl, A. Azima, M. Beye, M. Deppe, K. Döbrich, F. Hennies, A. Melnikov, M. Nagasano, M. Wolf, W. Wurth, A. Föhlisch

Nature Photonics (2008).



How to adjust timing between Laser and FEL?



published in
P. Radcliffe, S. Düsterer, M. Meyer,
Applied Physics Letters 90, (2007)

Synchronization of FEL and Laser at Spring-8

FEL RF 5712 MHz, 238 MHz, 79.3 MHz

Mode Locked Ti:Sapphire Laser with 79.3MHz

+

Amplifier (Chirp plus Amplifier, CPA)

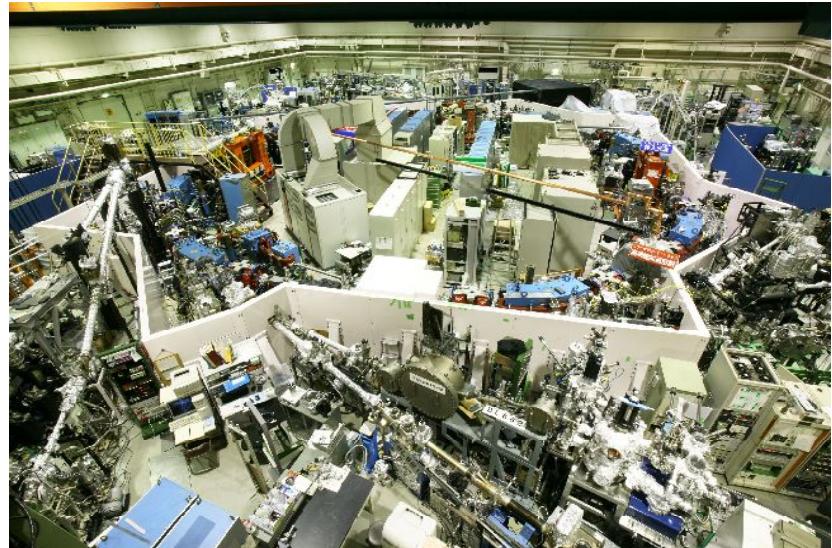
=

1 kHz

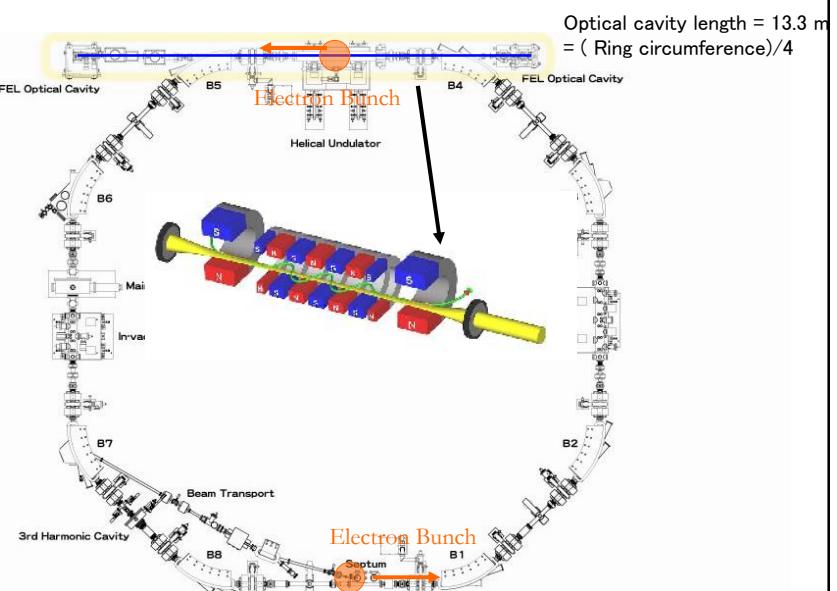
Today's Topic

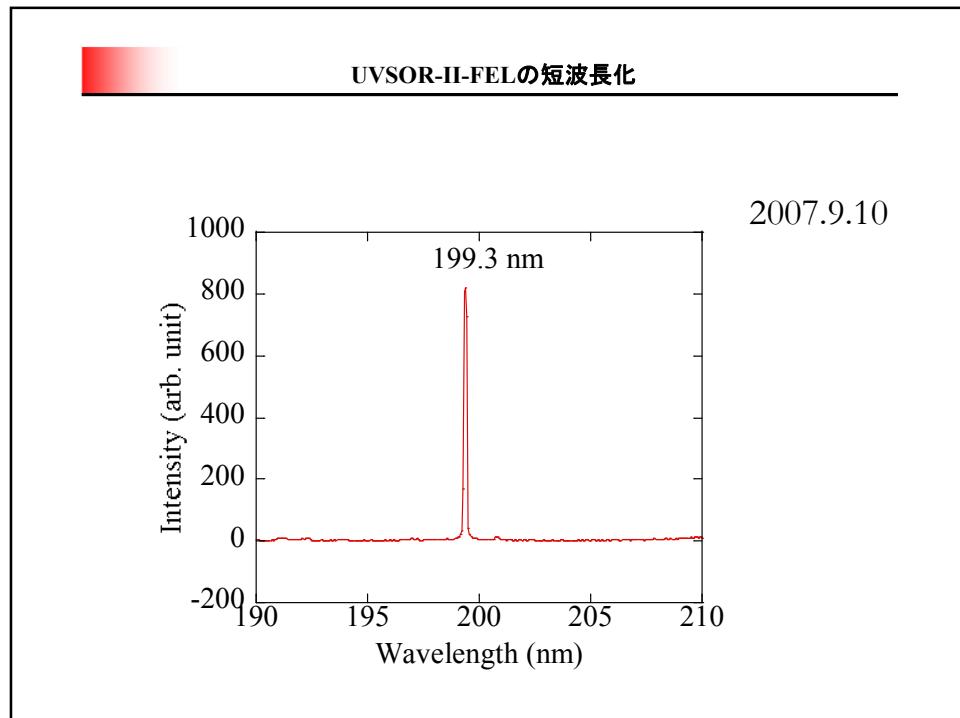
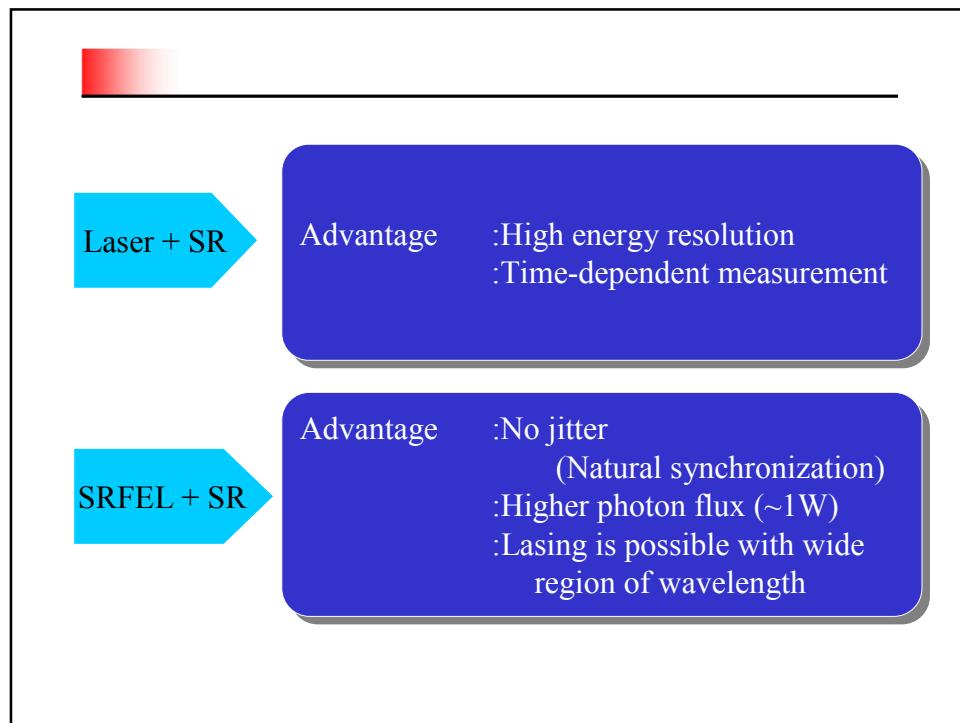
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UVSOR



Storage ring FEL at UVSOR





Introduction of pump/probe experiments

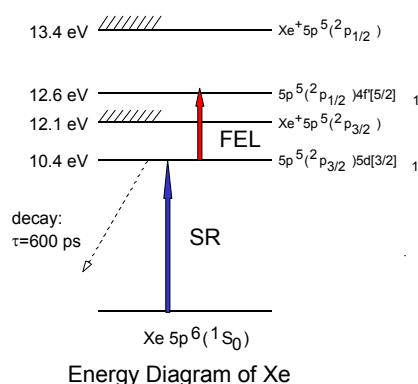
FEL

SRFEL at UVSOR
Wavelength 200-600 nm
Intensity MAX 1.2W (~100nJ)
Frequency 10MHz

Experiment

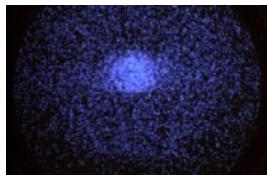
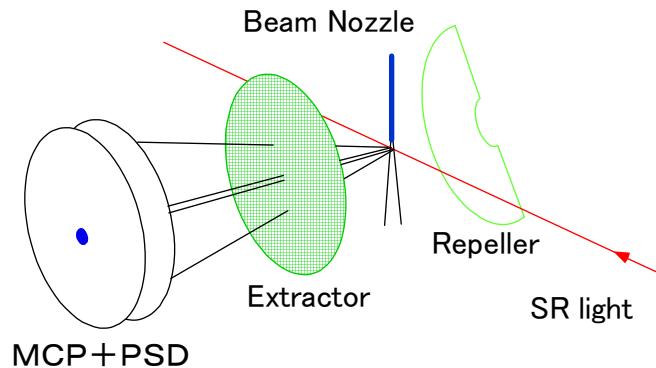
Sample Xe
Pump light Undulator light + LIF filter
VUV SR
Probe light FEL

Energy Diagram of Xe

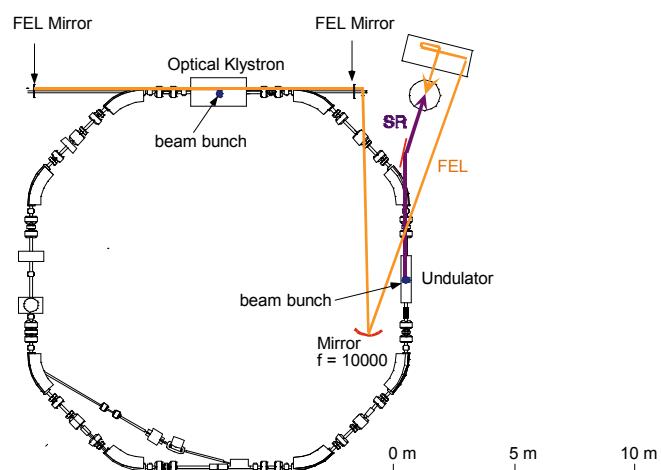


Energy Diagram of Xe

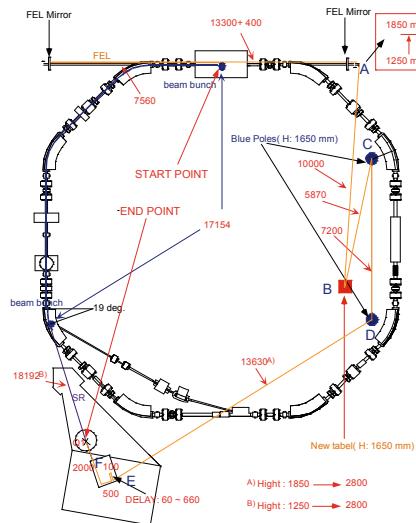
Imaging technique



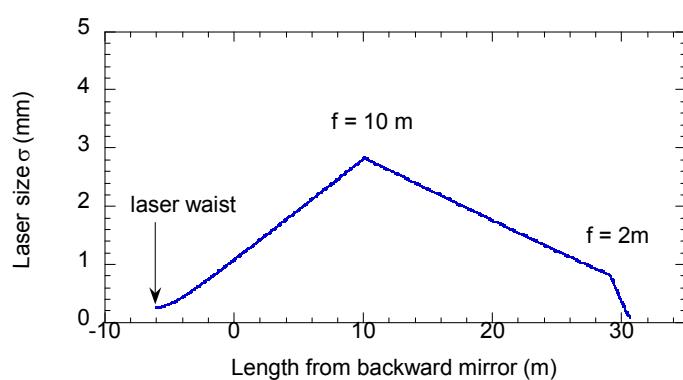
FEL Transport



Future Plan

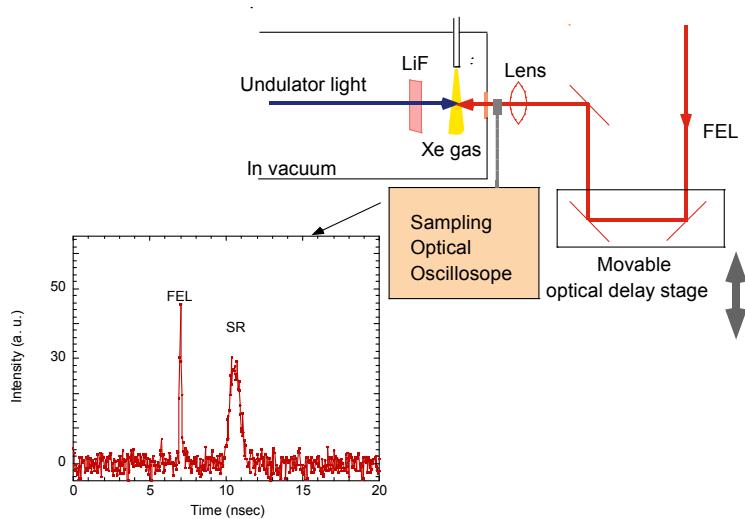


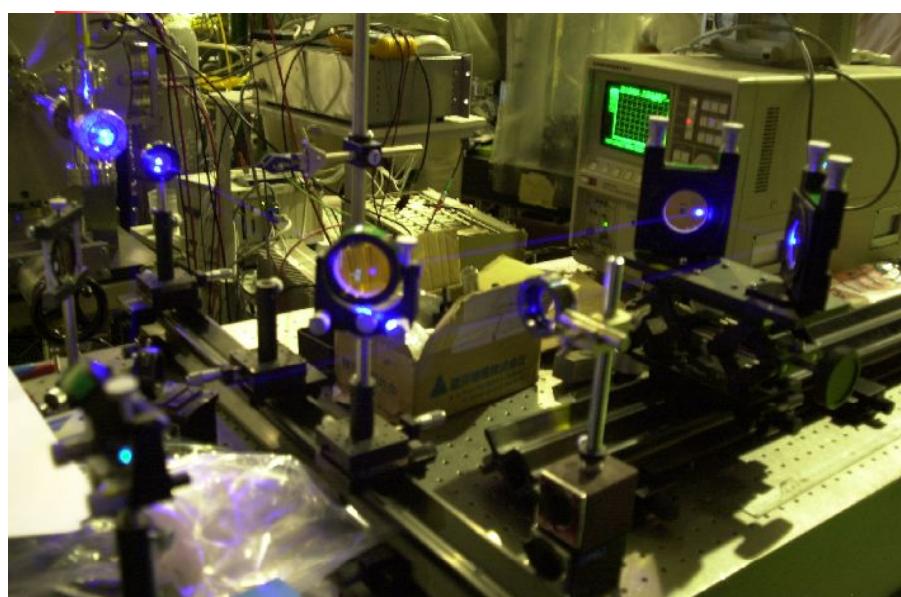
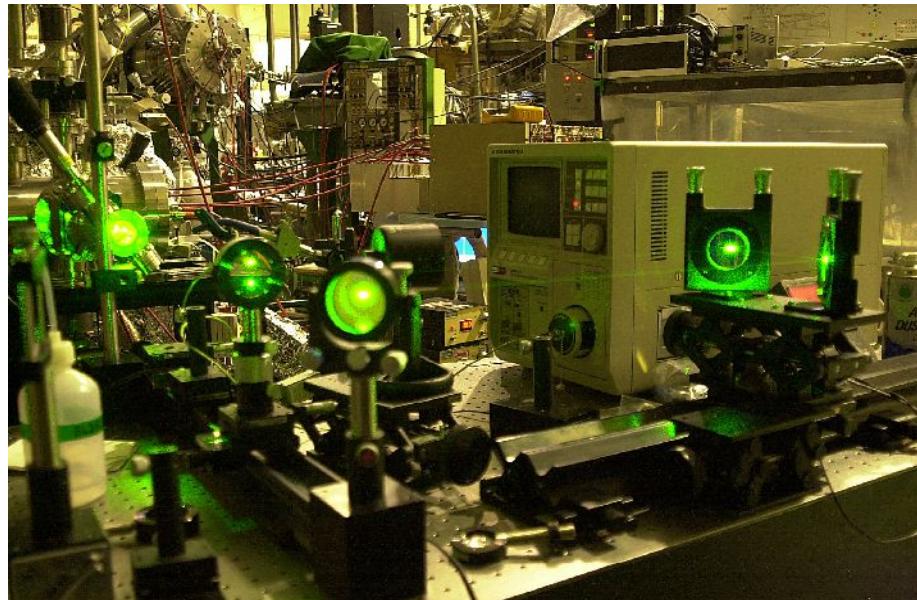
Optics



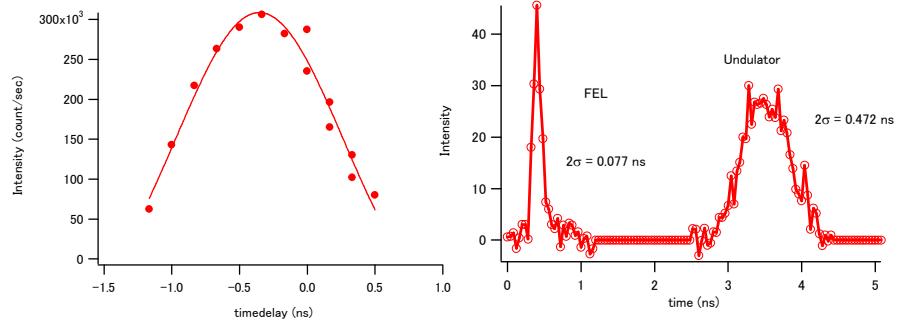


Timing

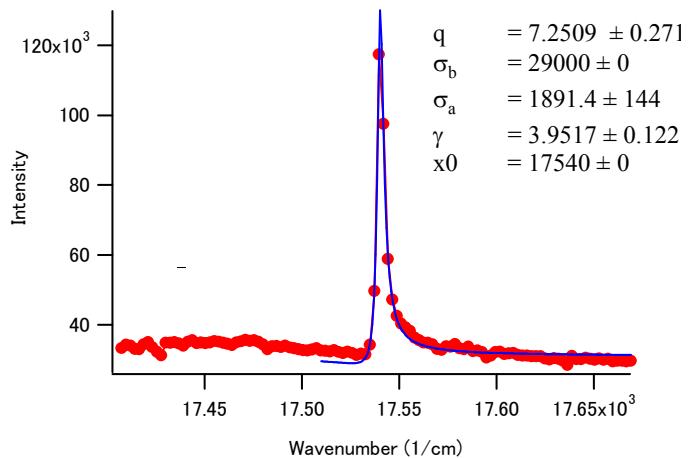




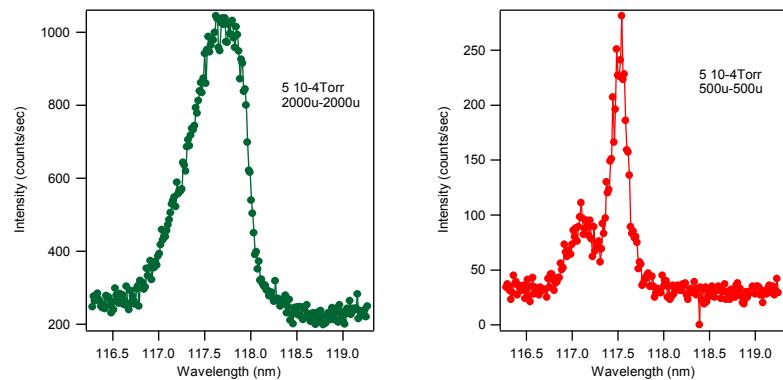
Synchronization of FEL and SR pulses



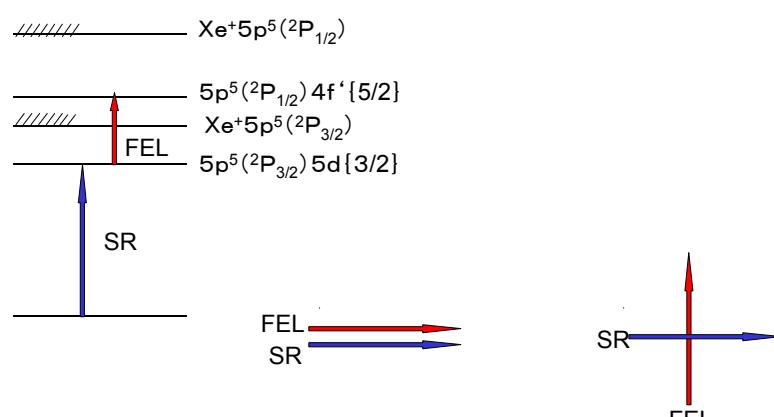
Ion yield spectrum



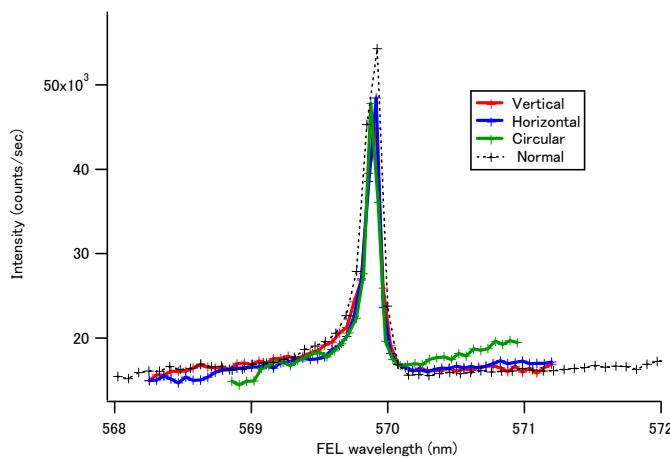
Ion yield spectrum with changing wavelength of SR



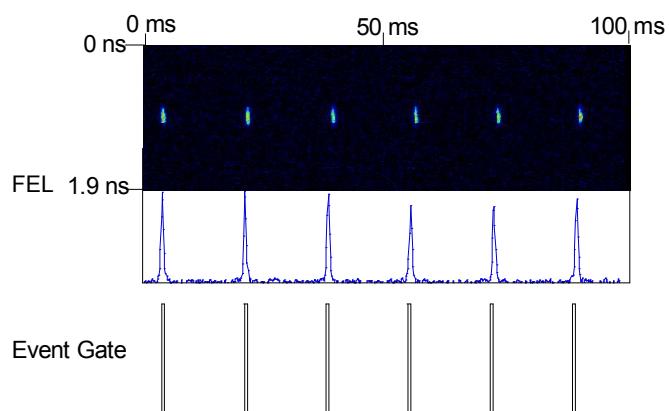
Energy Diagram of Xe



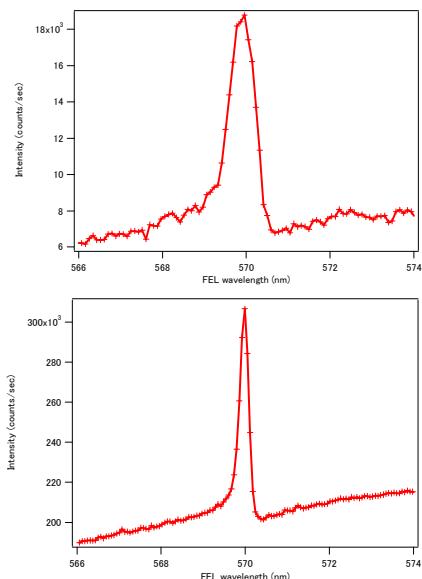
Polarization effect



Experiment with Q-switching FEL



Q-switching FEL



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