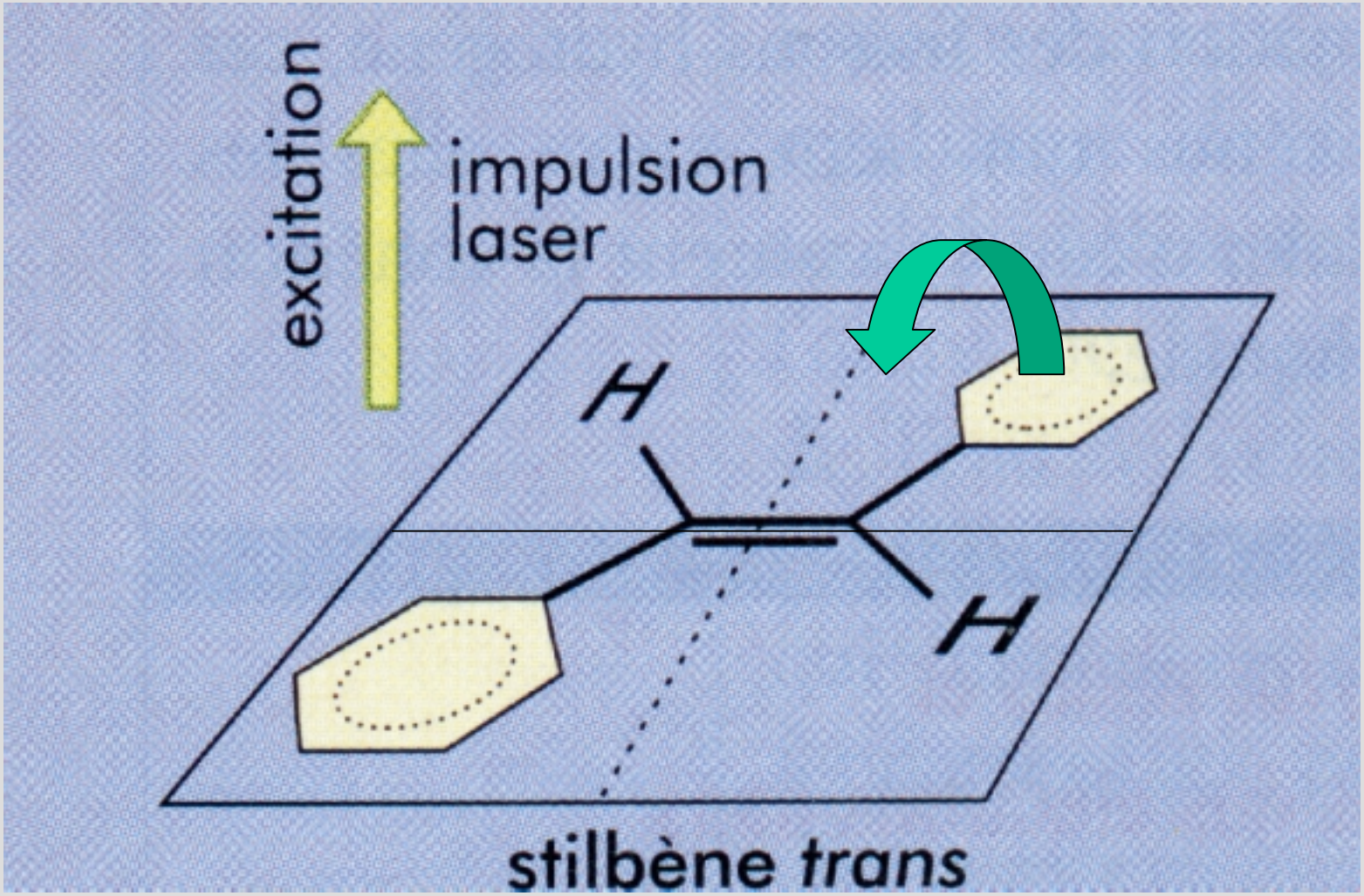
Napa Valley, April 2002

Picosecond pump and probe experiments at the ESRF

Michael Wulff

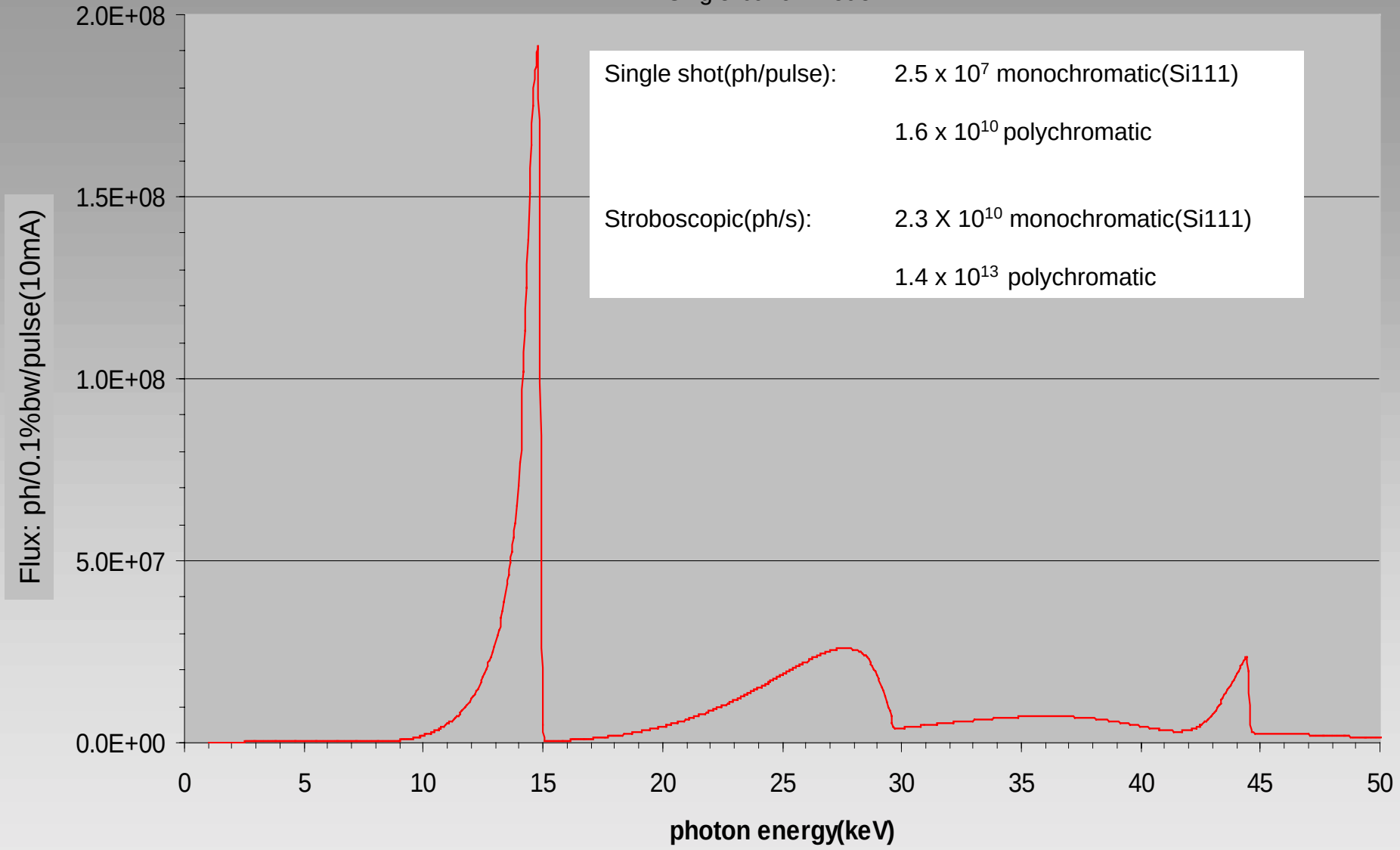
The ultra fast isomerization of Stilbene from a trans to cis configuration



Scattering methods:
Laue Diffraction, Oscillation Diffractometry, Powder Diffraction, Liquid Diffraction, Bragg Reflectivity

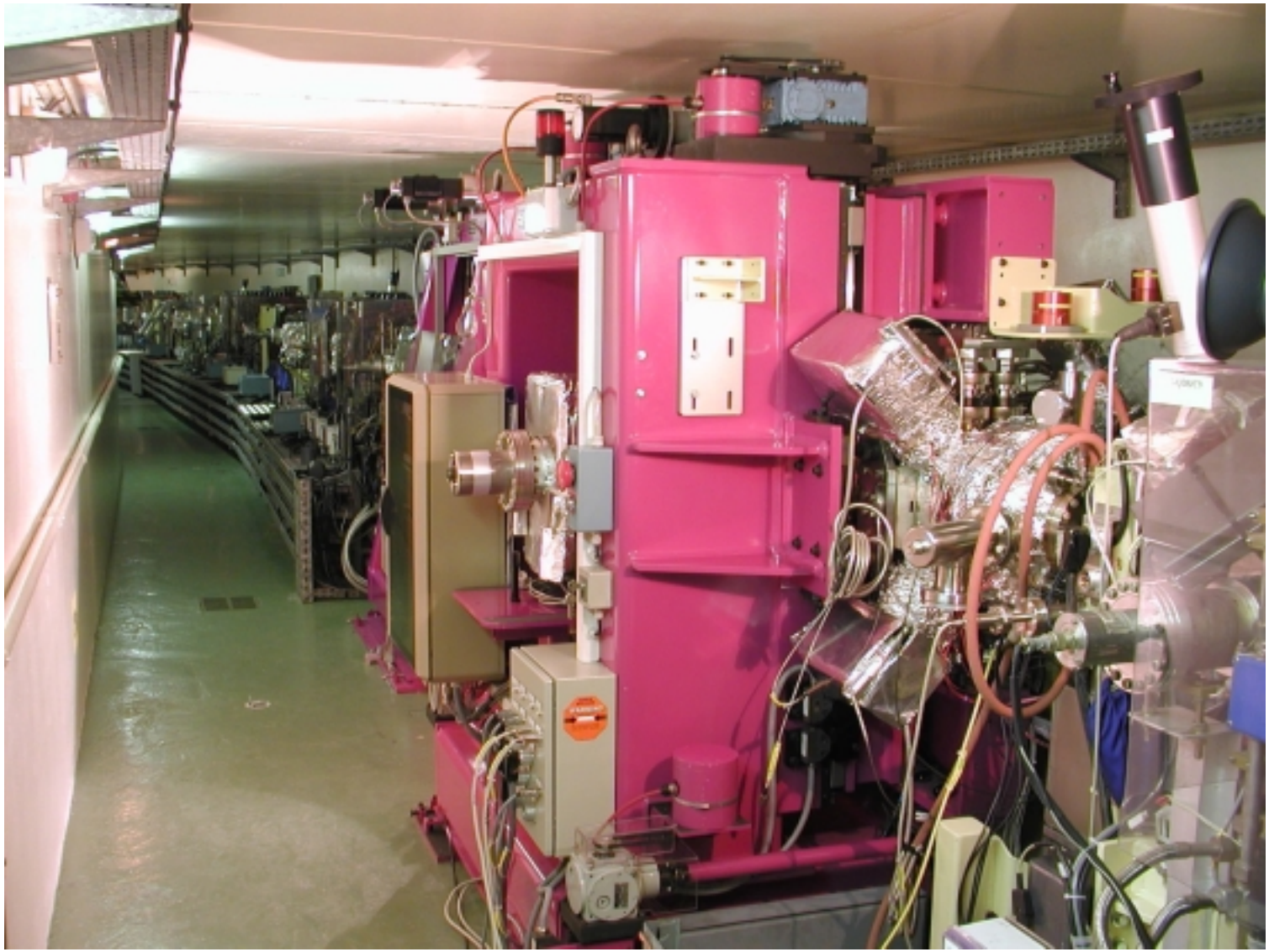
Spectral intensity of the new in-vacuum undulator U17

single-bunch mode



ID	poles	gap (mm)	E_f(keV)	E_c(keV)	K	P(W/200 mA)
U17	235	6.0	14.84	13.2	0.86	2740

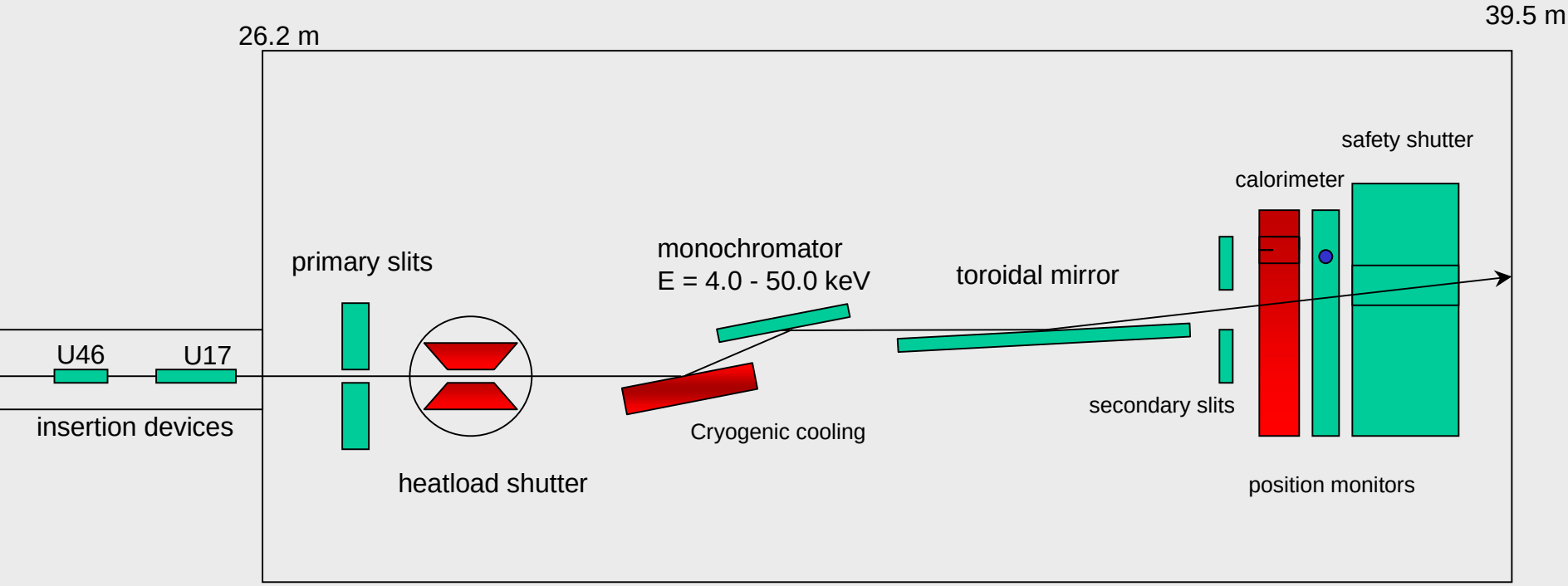
The U17 in-vacuum undulator on ID09



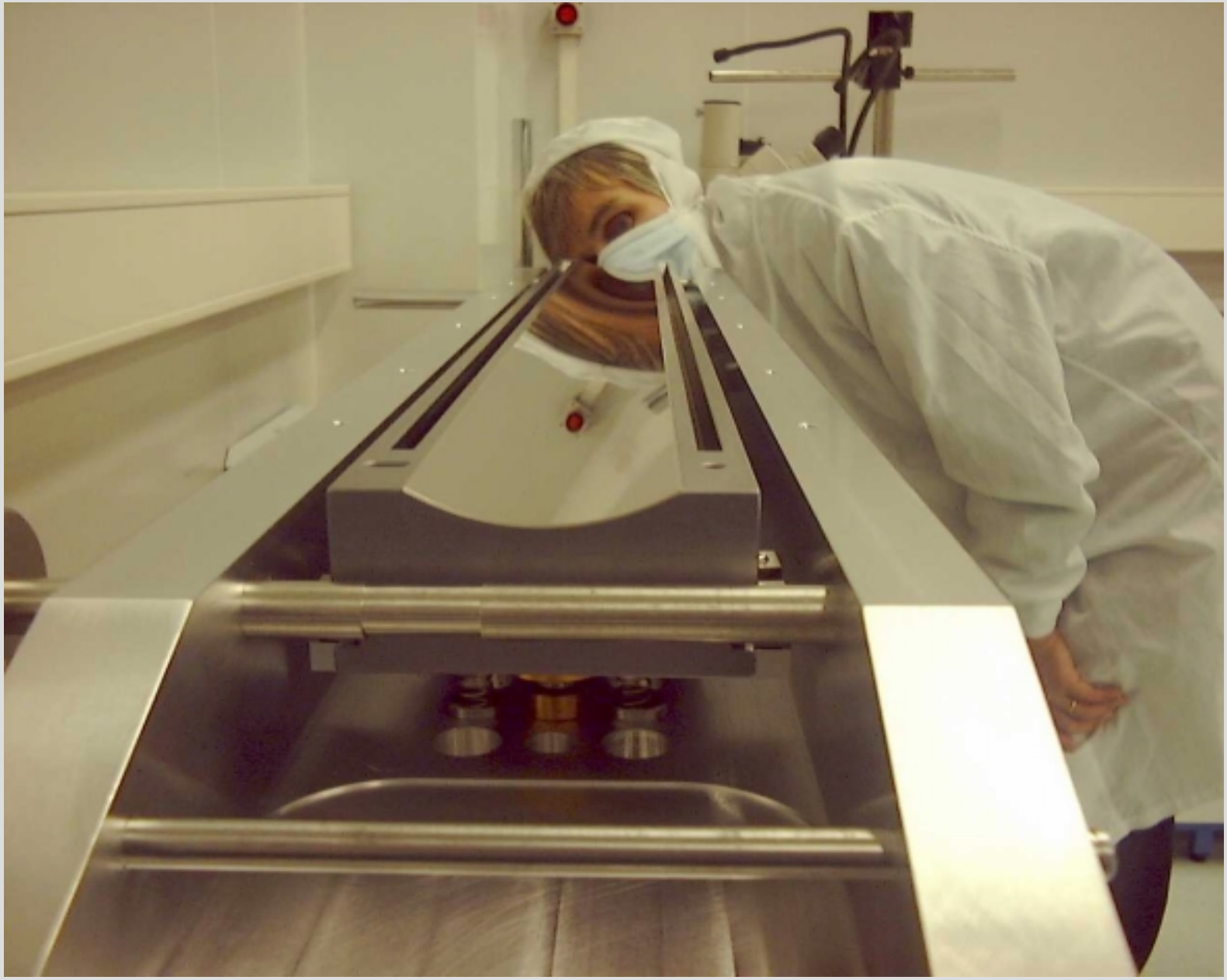
December 2001

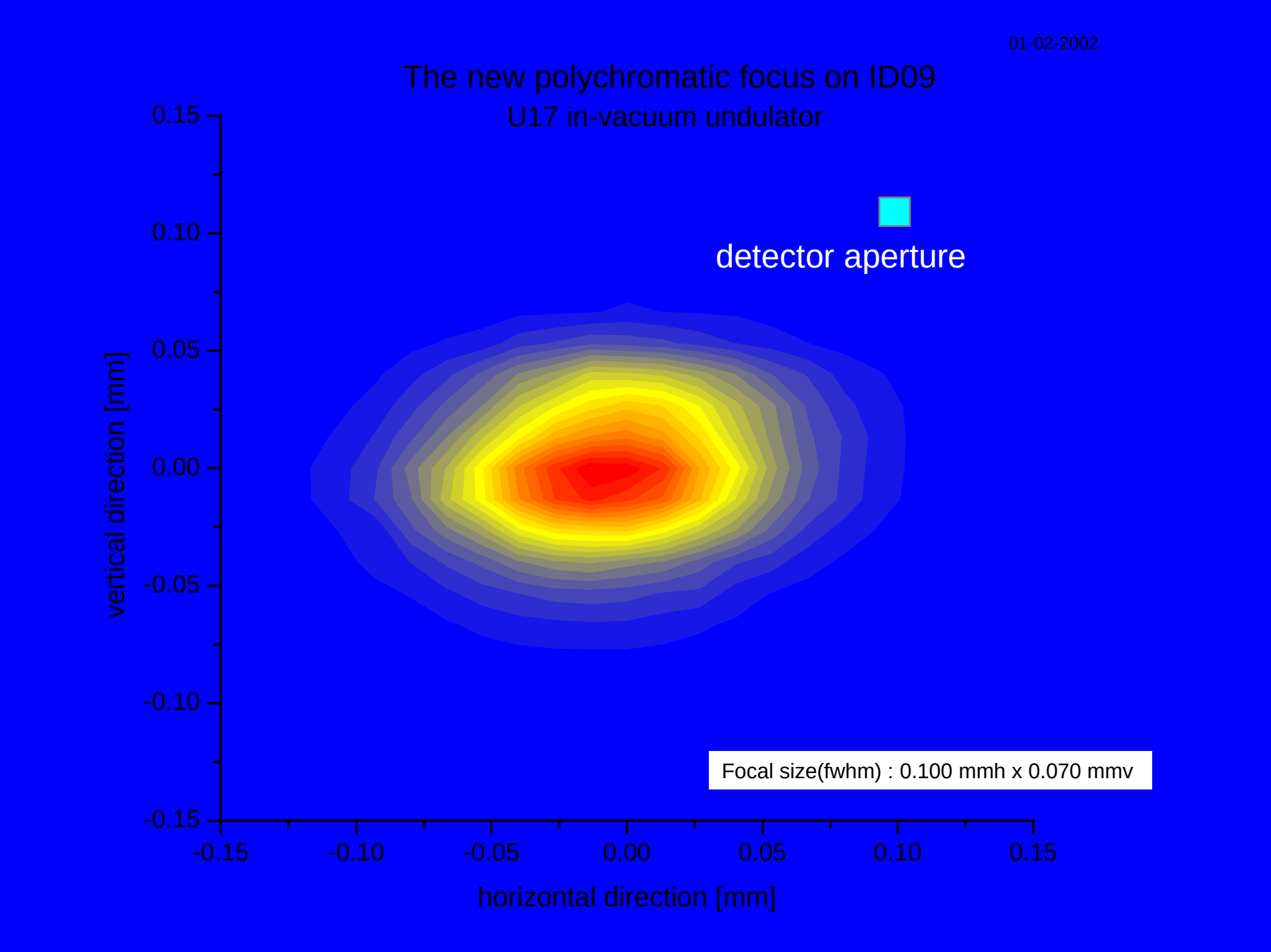
Optic hutch on ID09

vertical plane

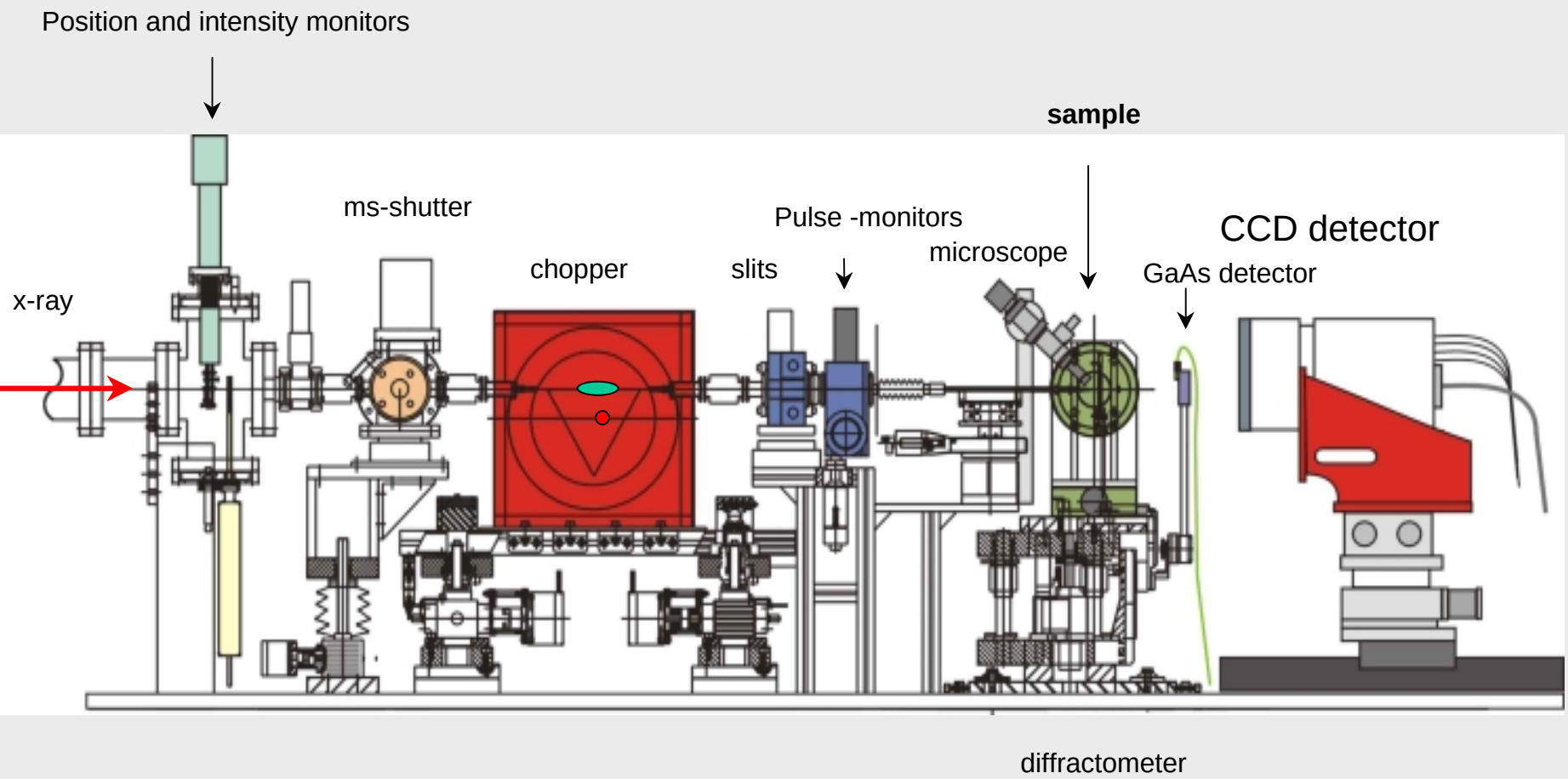


The new toroidal mirror from Seso. Slope error 0.7 µrad(rms)

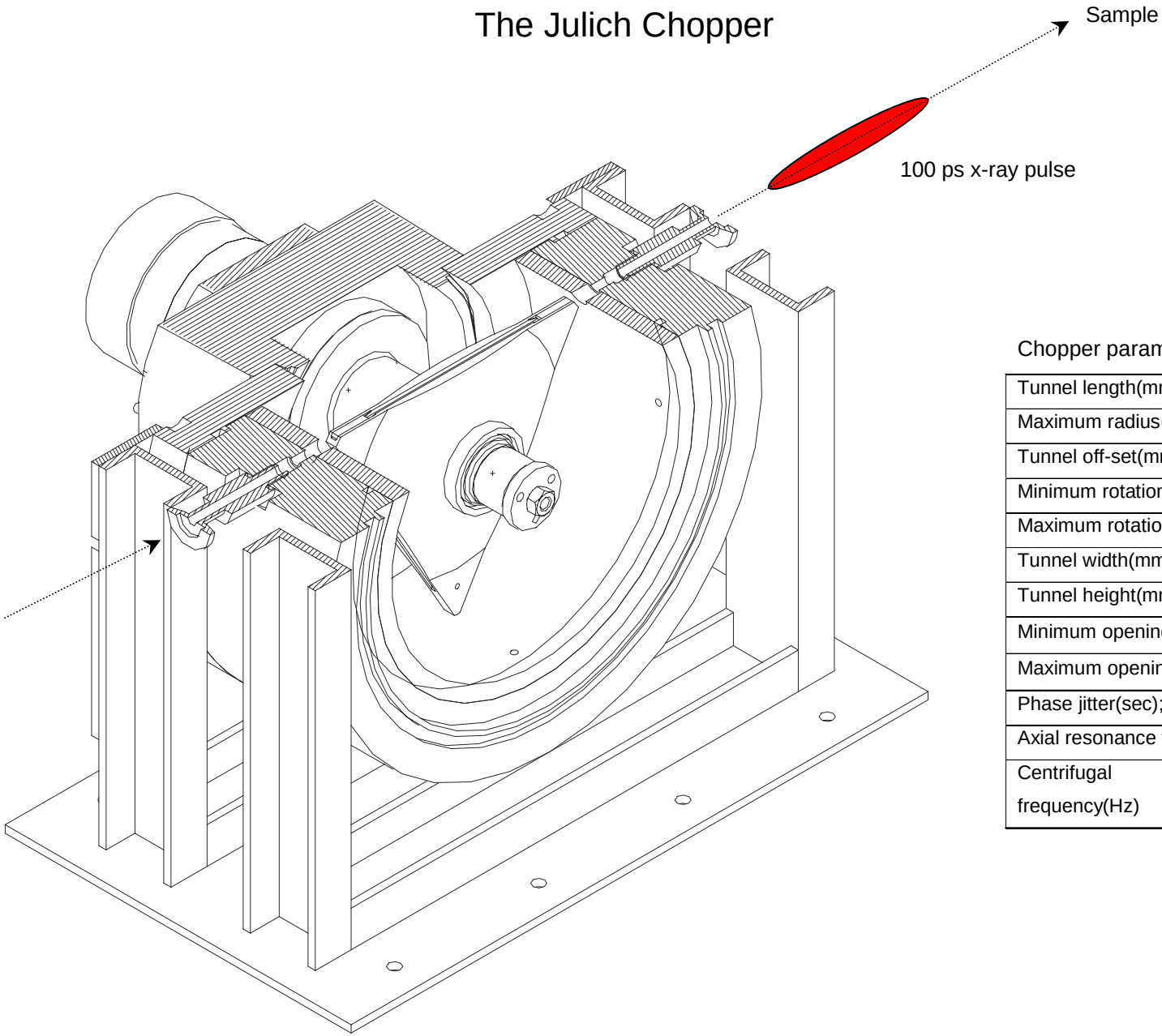



01-02-2002
The new polychromatic focus on ID09
U17 in-vacuum undulator
detector aperture
Focal size(fwhm) : 0.100 mmh x 0.070 mmv
vertical direction [mm]
horizontal direction [mm]
0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.15
-0.10
-0.05
0.00
0.05
0.10
0.15

Shutters and detectors near the sample



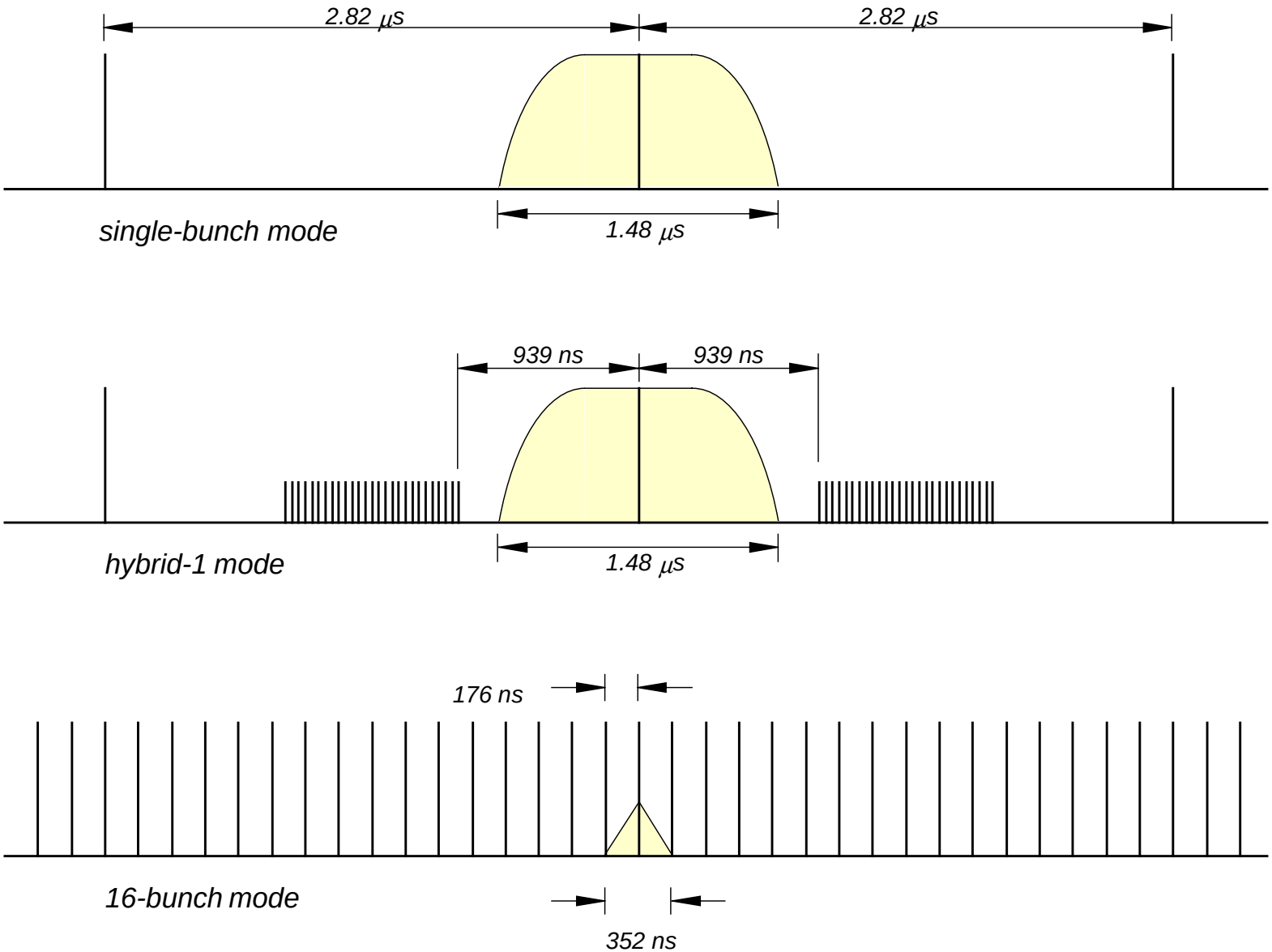
The Julich Chopper

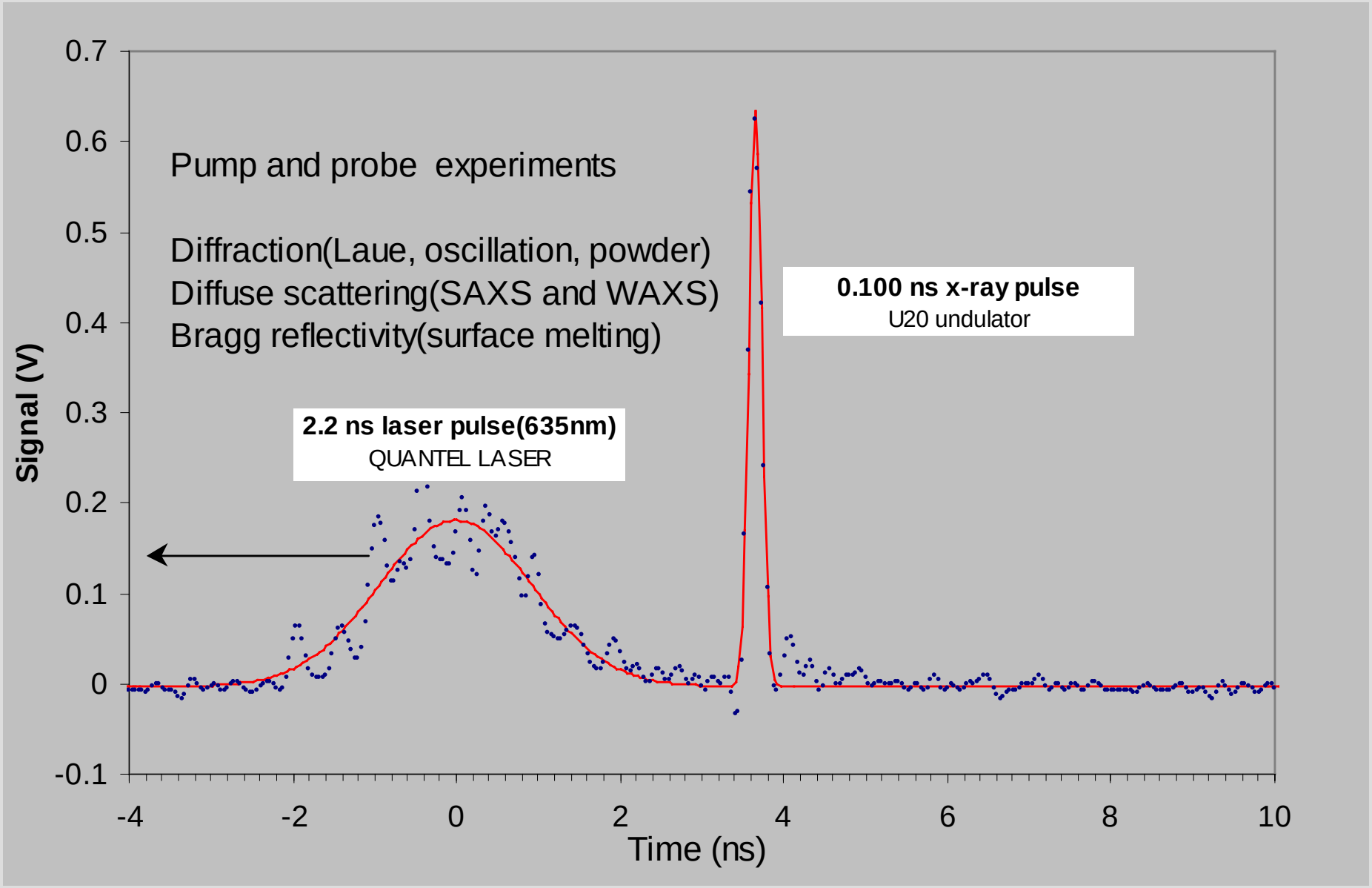


Chopper parameters

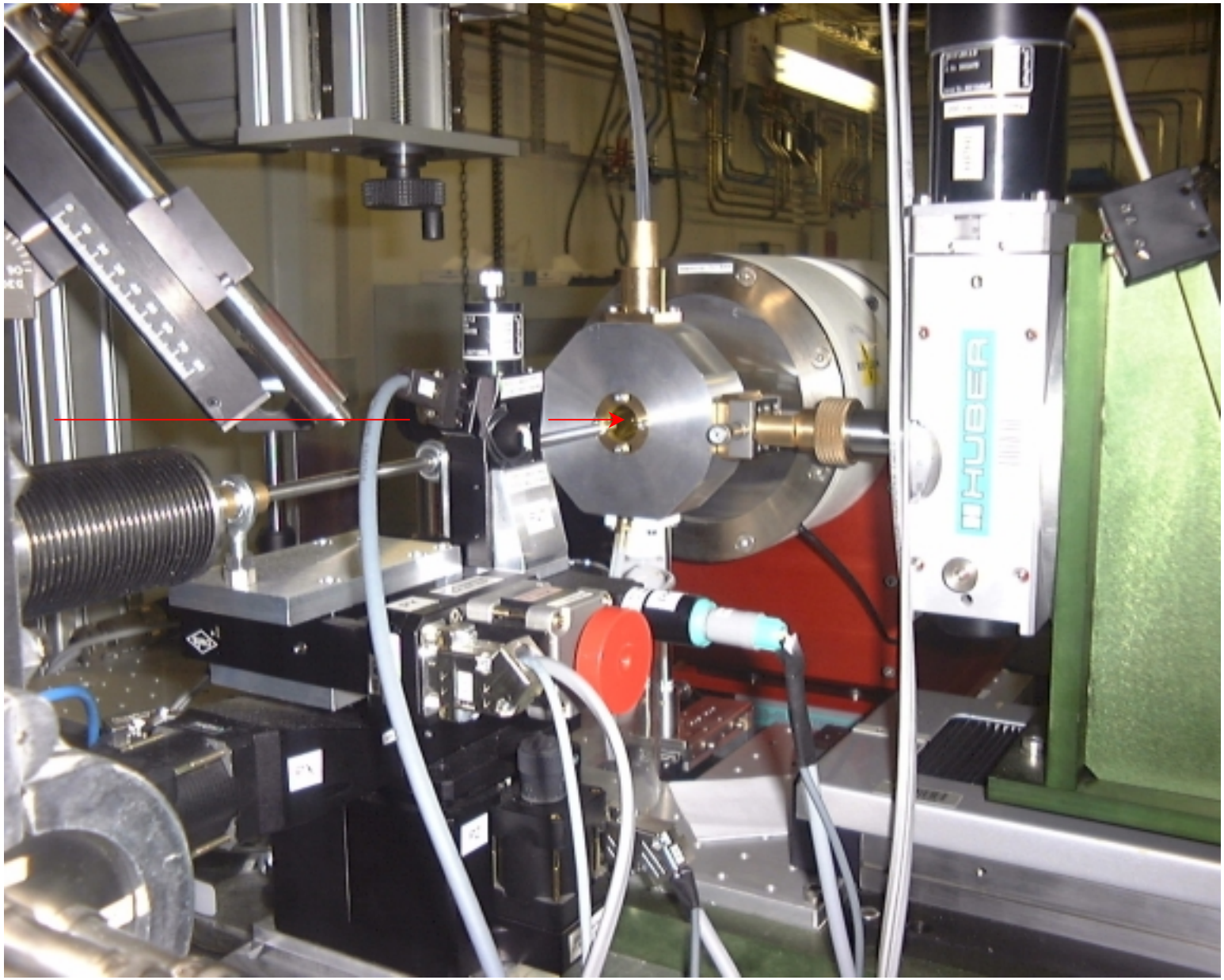
Tunnel length(mm)	165.0
Maximum radius(mm)	96.8
Tunnel off-set(mm)	47.35
Minimum rotation frequency(Hz)	10.0
Maximum rotation frequency(Hz)	896.6
Tunnel width(mm)	4.0
Tunnel height(mm)	0.05 to 0.90
Minimum opening time: δt_{min}(sec)	0.10×10^{-6}
Maximum opening time: δt_{max}(sec)	0.17×10^{-3}
Phase jitter(sec); RMS	10×10^{-9}
Axial resonance frequency(Hz)	998
Centrifugal breakdown frequency(Hz)	1300

Single-bunch selection at the ESRF(ID09)

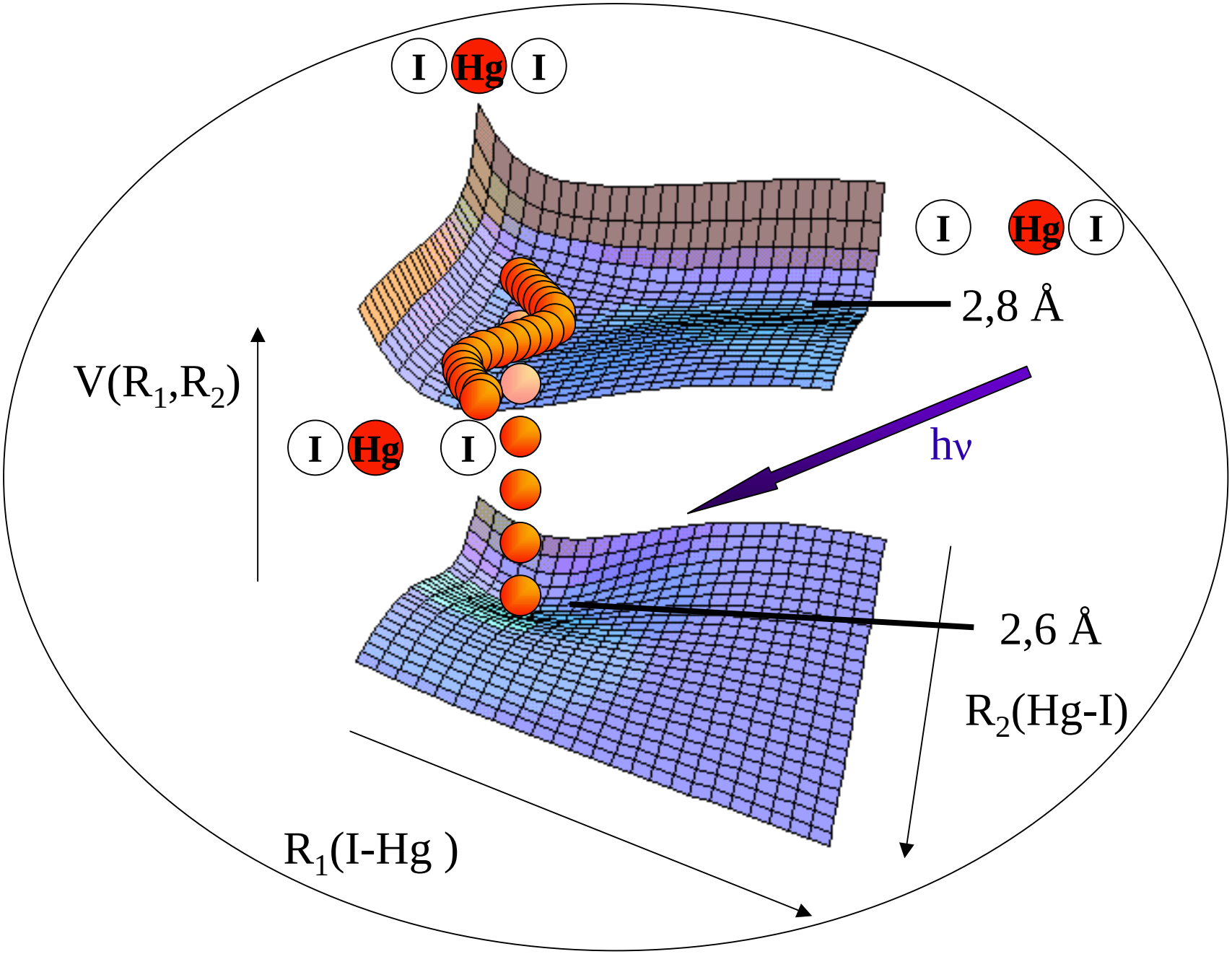



Pump and probe experiments
Diffraction(Laue, oscillation, powder)
Diffuse scattering(SAXS and WAXS)
Bragg reflectivity(surface melting)
0.100 ns x-ray pulse
U20 undulator
2.2 ns laser pulse(635nm)
QUANTEL LASER
Signal (V)
Time (ns)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-4
-2
0
2
4
6
8
10

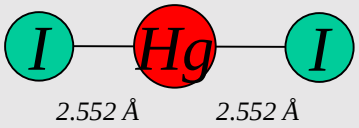
Laminar jet chamber for liquid experiments



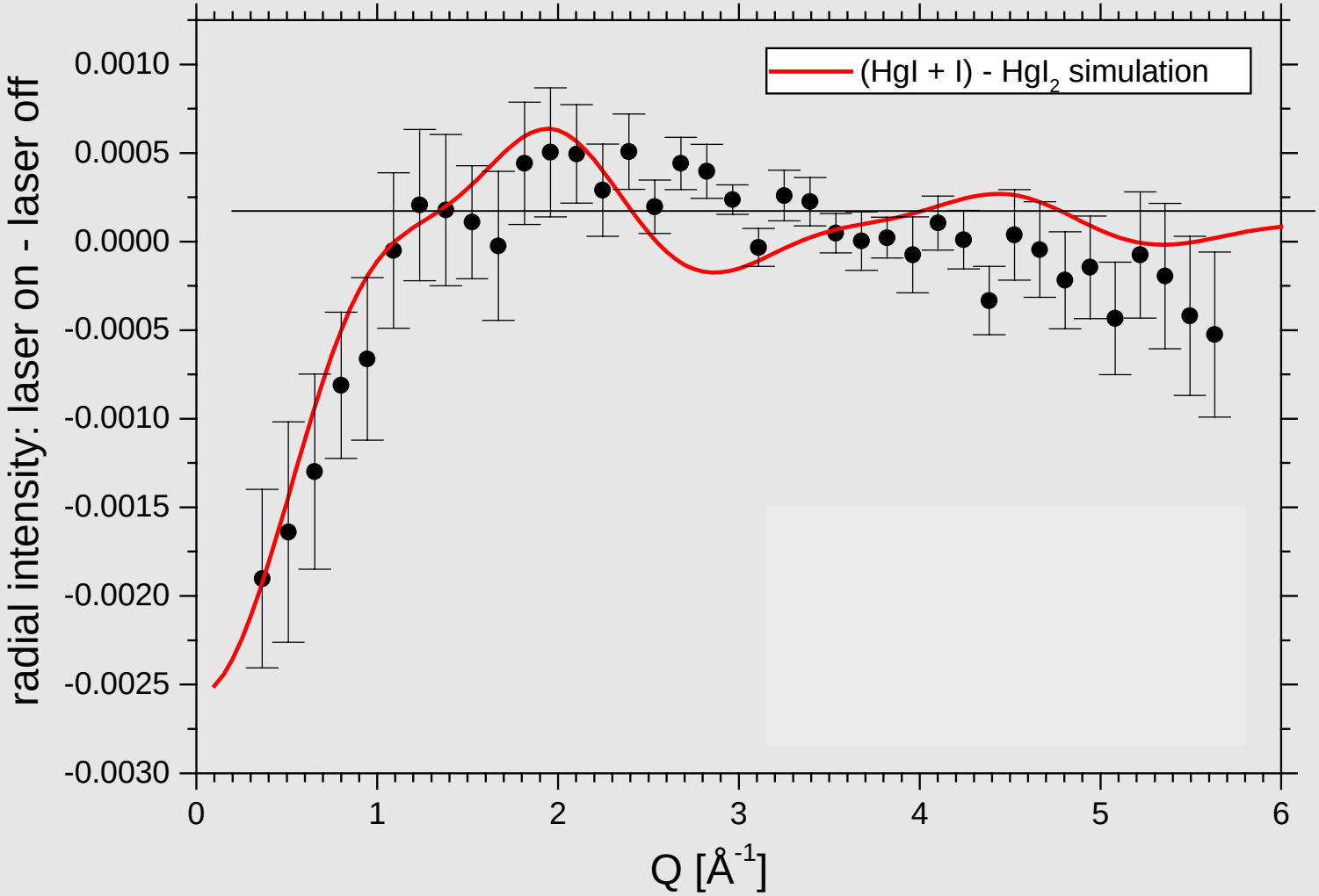
HgI_2 + hv(267nm) --> HgI + I dissolved in CH_3OH(35mM)



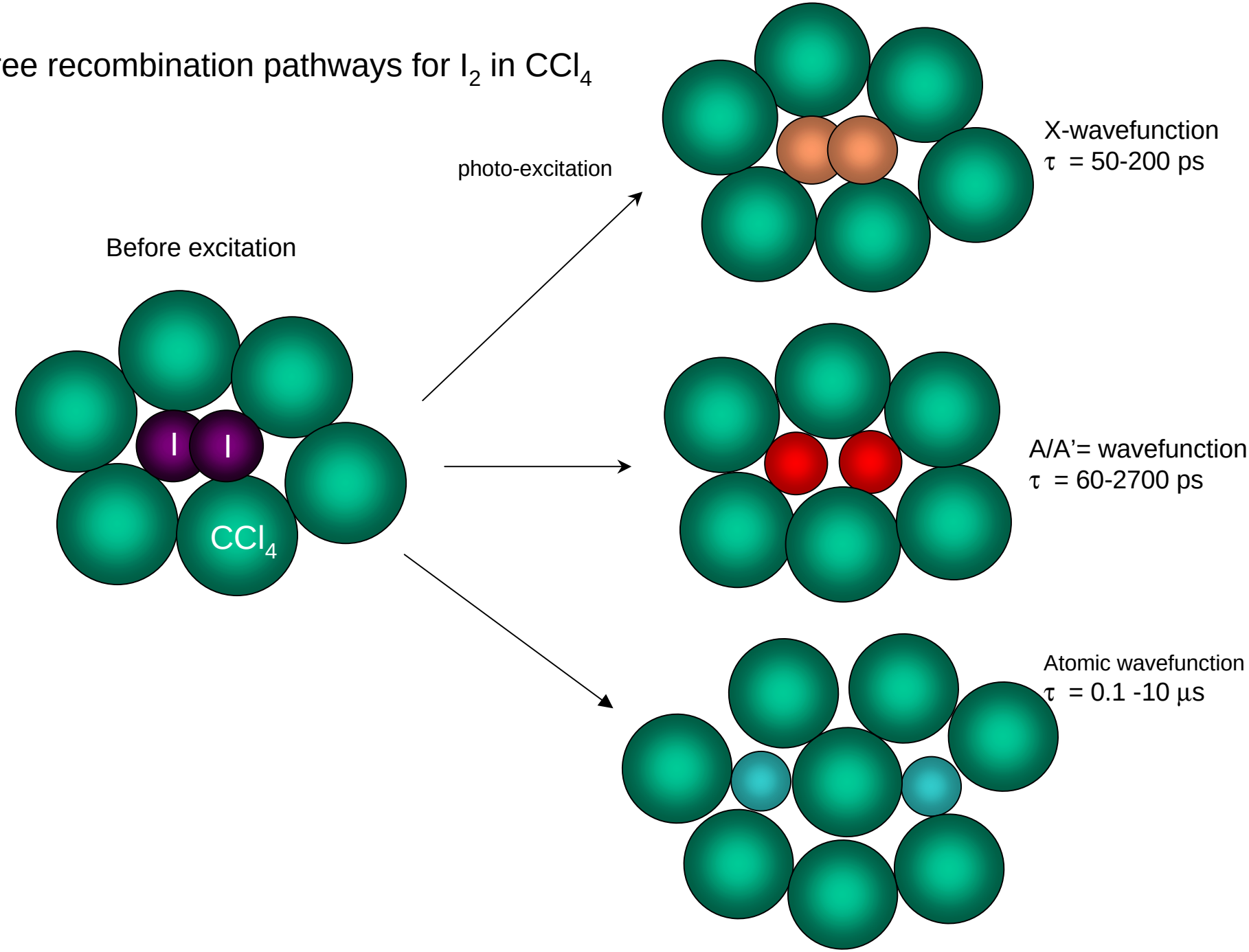
Scattering from the HgI radical 0.5 ns after breakage of bond



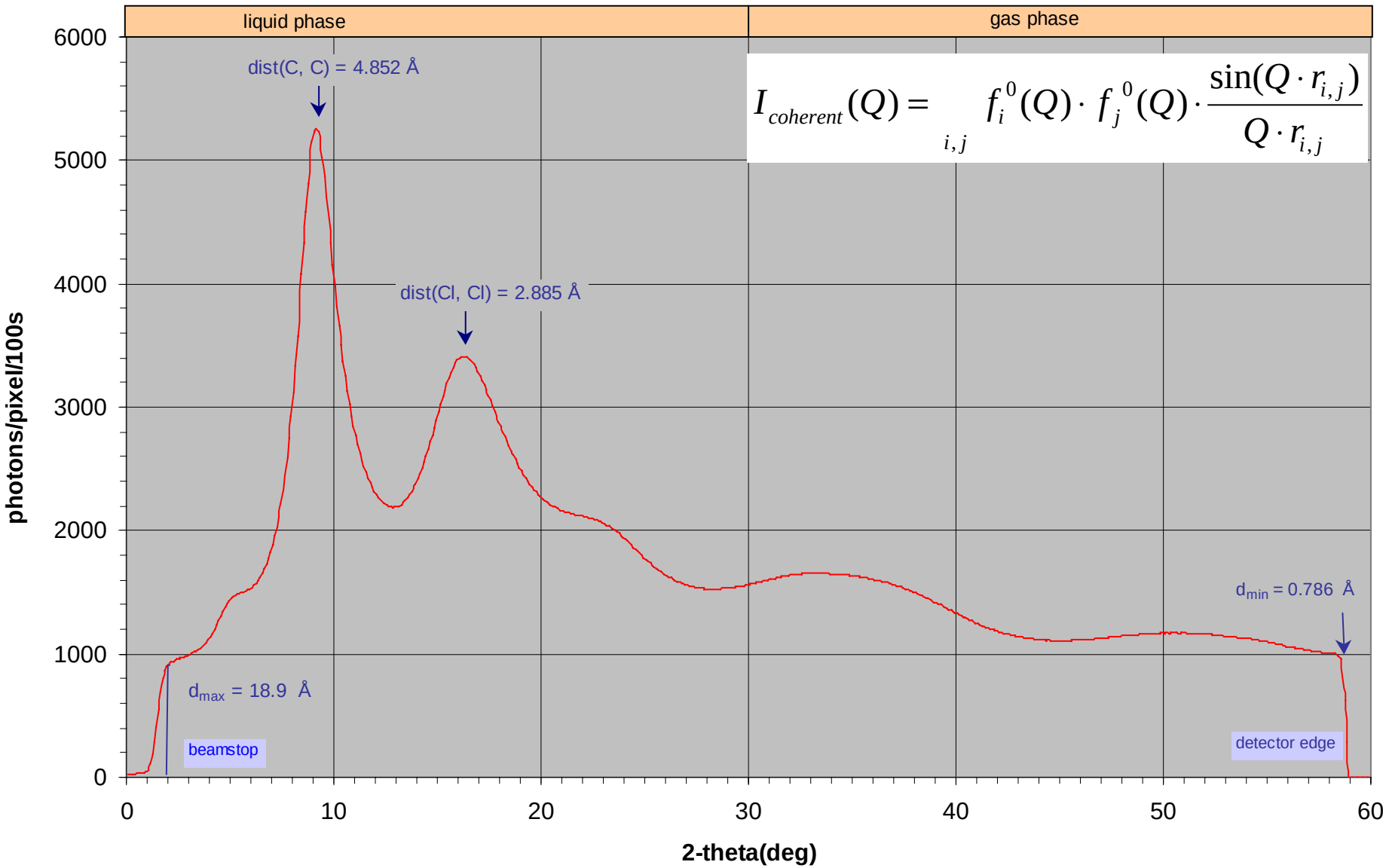
HgI_2 + hv(267nm) --> HgI + I dissolved in CH_3OH(35mM)



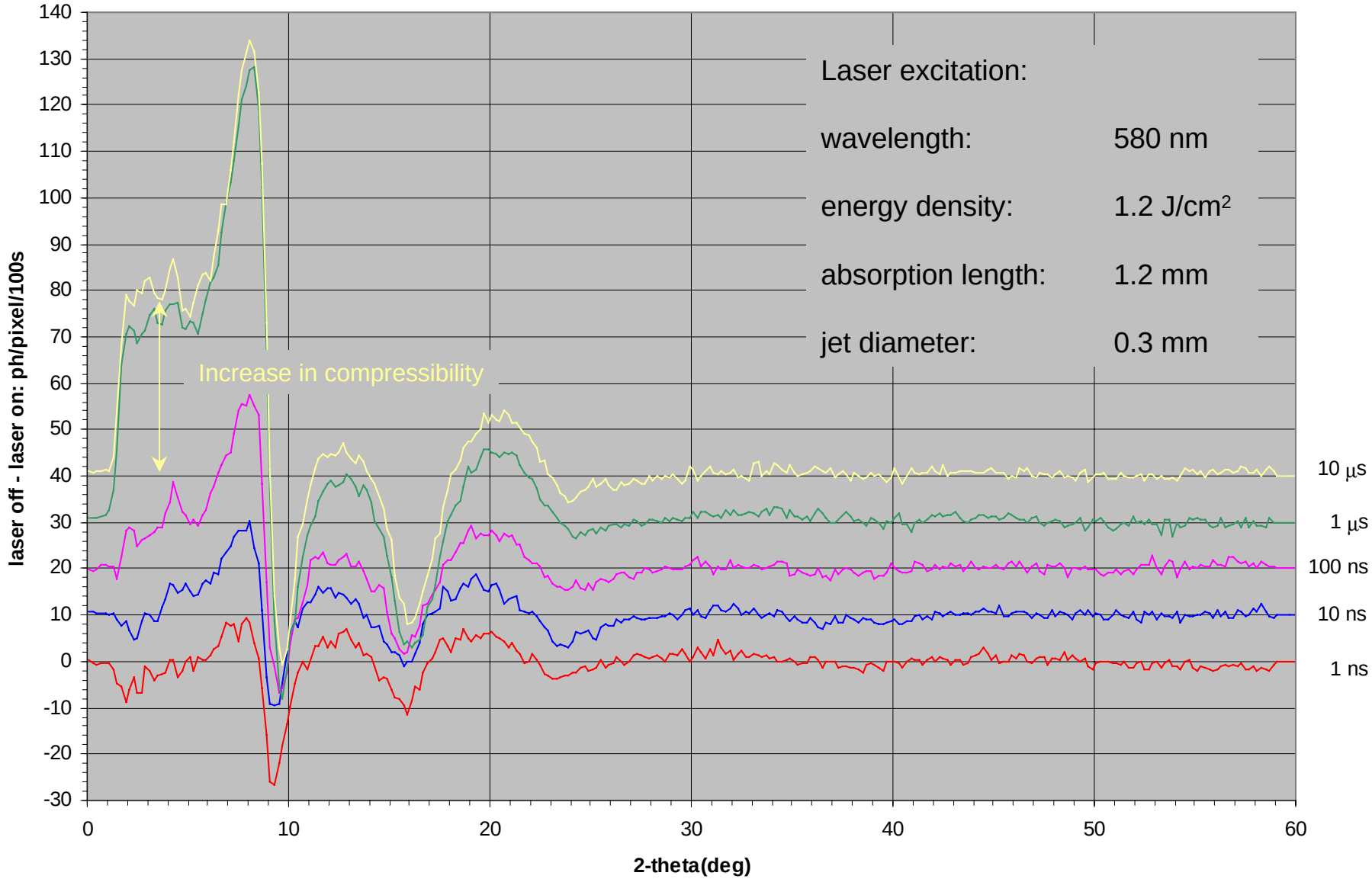
Three recombination pathways for I_2 in CCl_4



Formfactor of liquid CCl_4 + I_2(20mM)

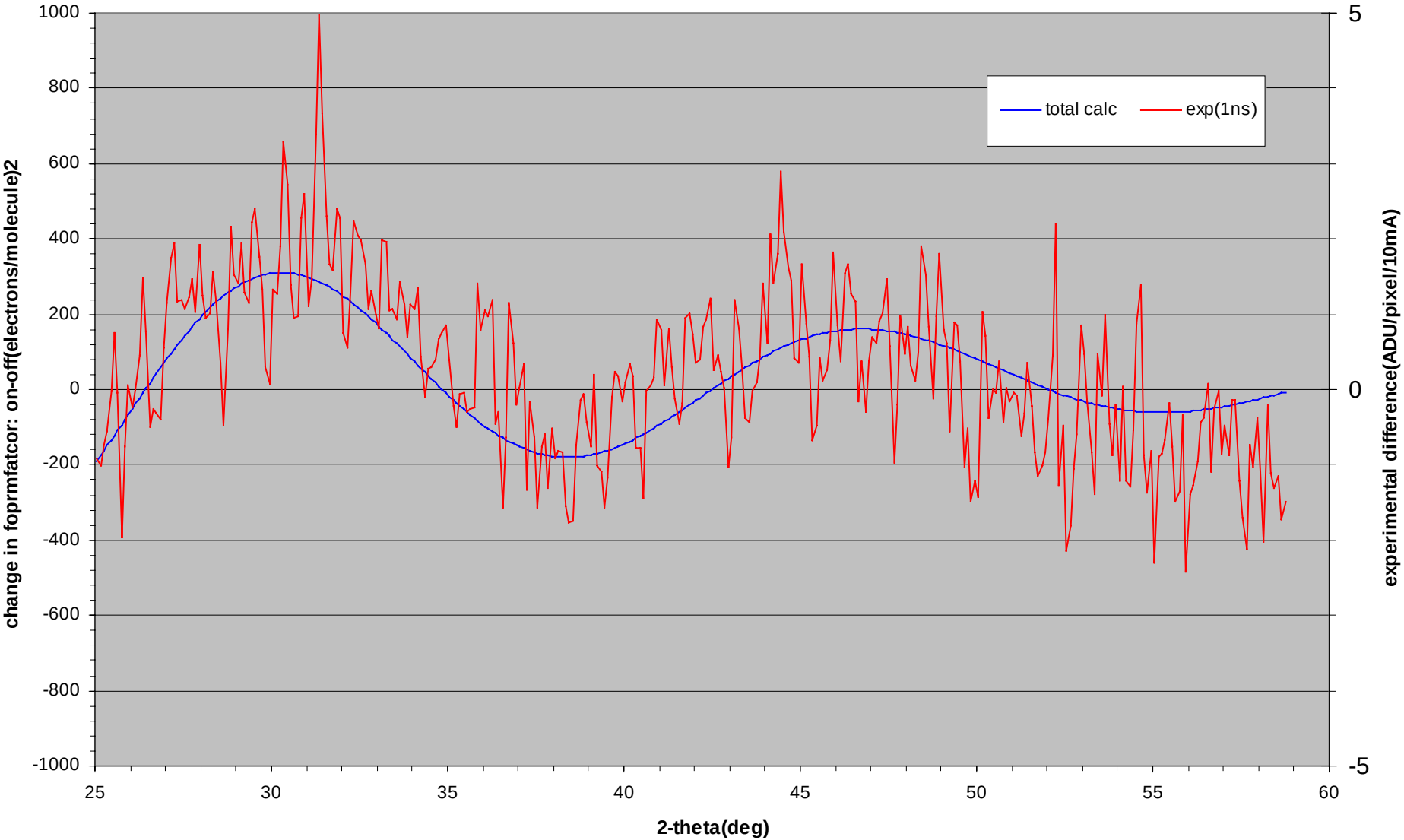


thermal expansion and structural change



The recombination of 2 I-atoms to I_2* probed 1.0 ns after dissociation

78% of excited molecules are found in the A/A'-state with dist(I, I) = 3.14 Å , 22% are split into I-atoms

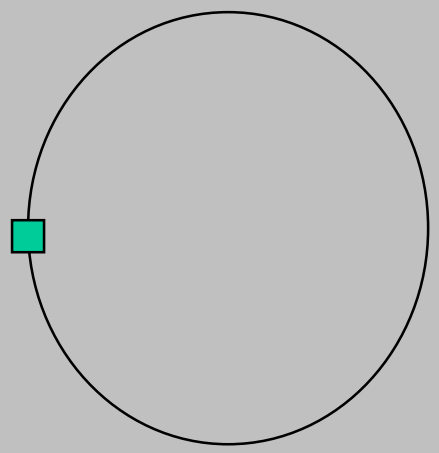


Future x-ray sources

RF cavities

Beam injector and dump

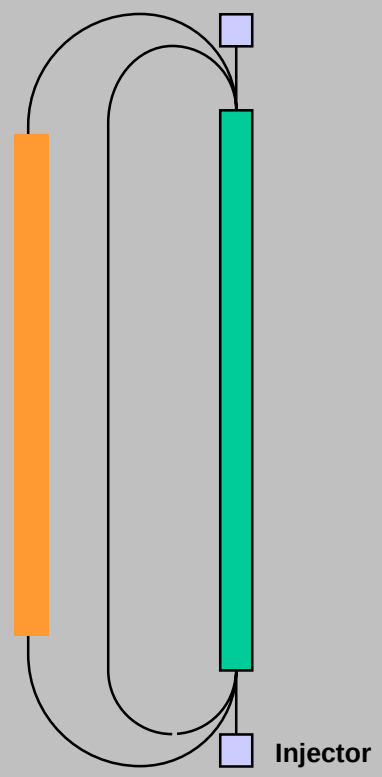
Undulator



Super Ring(0 = 2.0 km)

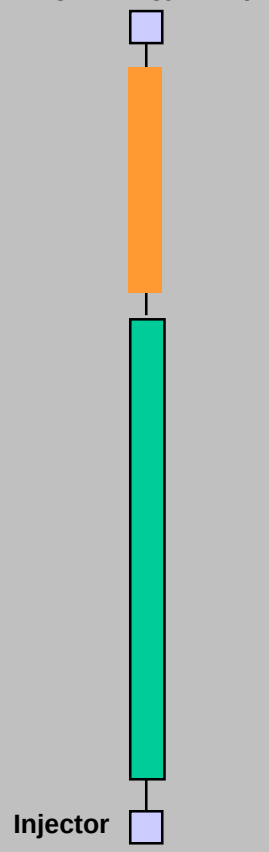
100 ps

7 GeV Super storage ring(ESRF2)



100 fs

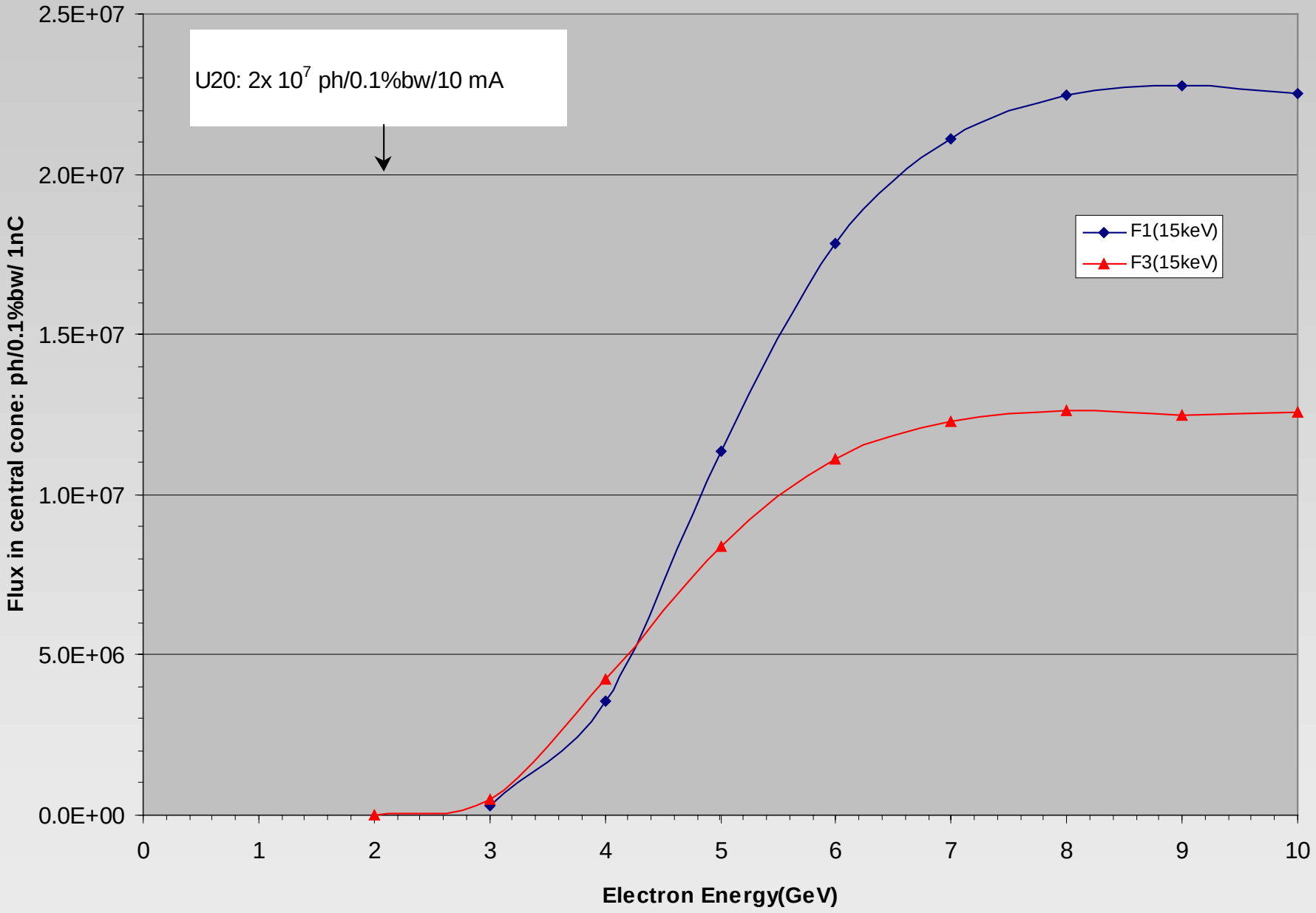
Energy Recovery Linac(ERL)



100 fs

SASE Linac

Spectral flux of a 5.0-m long undulator @ 6.0 mm gap. Bunch charge 1.0 nC, 100 fs x-ray pulse



Femtosource specifications for scattering experiments:

Pulse length(fwhm):	50-200 fs
Spectral flux:	1×10^7 ph/0.1%bw/pulse
X-ray Energy:	5-30 keV
Pulse frequency:	100 -10000 Hz
Focal spot size	< 50 μmh x 50 μmv
Source divergence:	< 100 μradh x 10 μradv
Electron energy:	5.0-6.0 GeV

Note:

Machine should perhaps run in low(0.1 ps), medium(1 ps) and high-charge(10 ps) mode to accommodate more experiments.

Acknowledgments:

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S. Bratos, R. Vuilleumier, F. Mirloup and many others…..