

Workpackage 7.2 Photon Diagnostics

**“...measuring the lateral and temporal
structure of focused radiation.”**



DESY action

WP 7.2

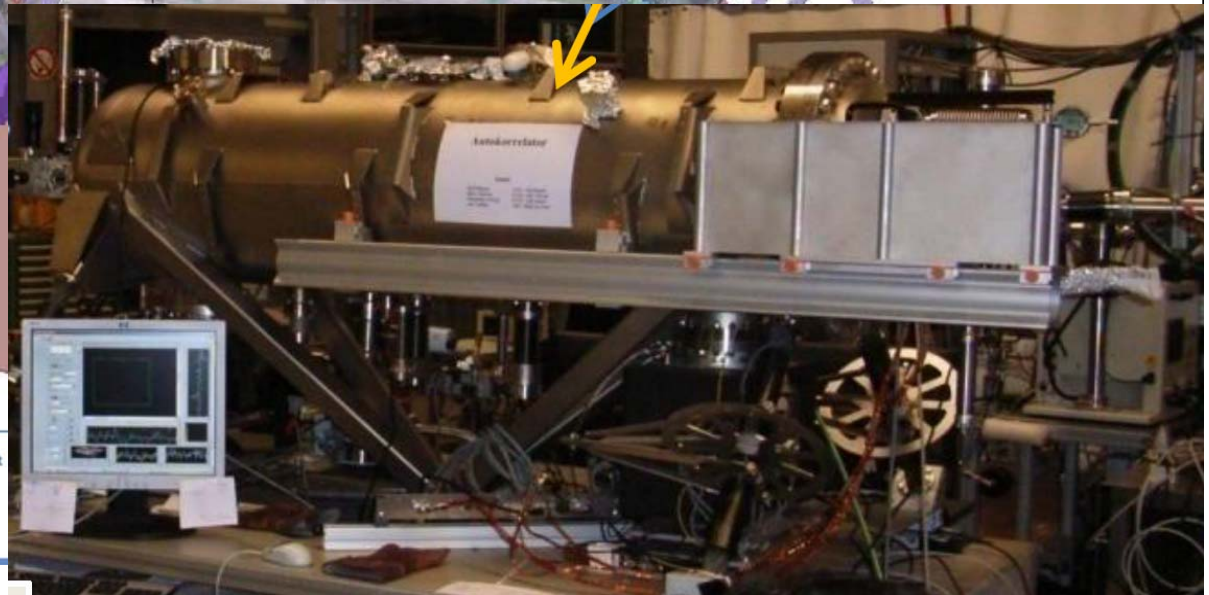
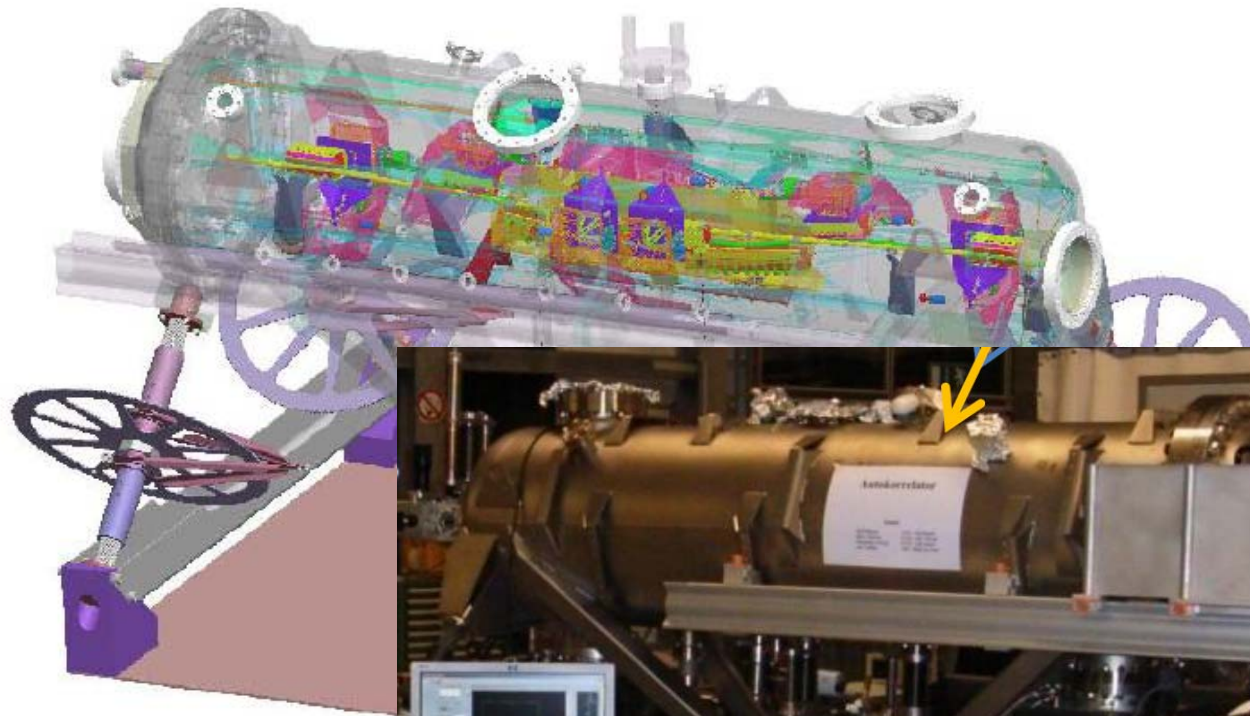
Demonstration of temporal intensity measurement

„Autocorrelator measurements“

Demonstration of lateral intensity measurement

„Set up wavefront measurement system“

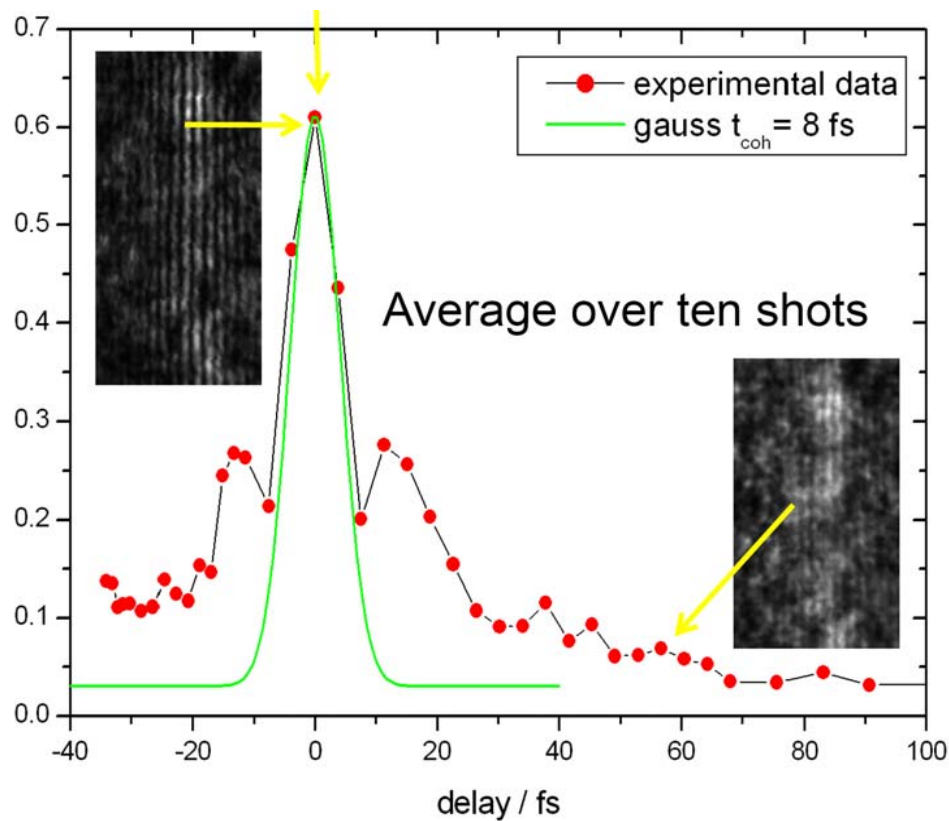
Temporal intensity - Autocorrelator set-up



connection to action of Elettra and STFC in WP7.2

First commissioning

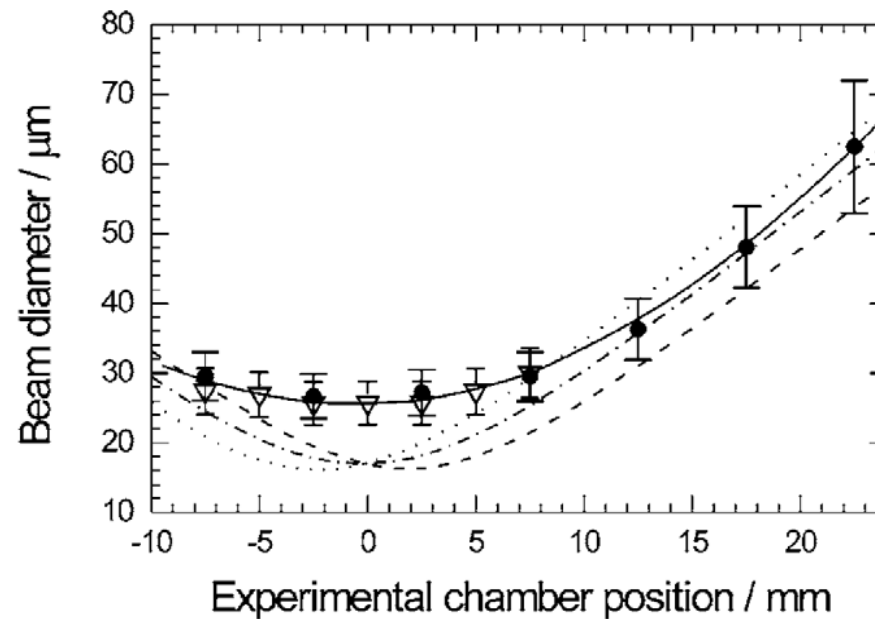
Zero delay



**Pulse duration
with nonlinear autocorrelation**

Lateral intensity- Focus determination

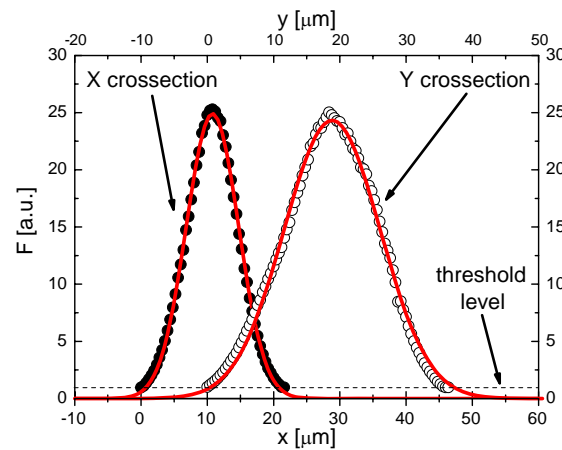
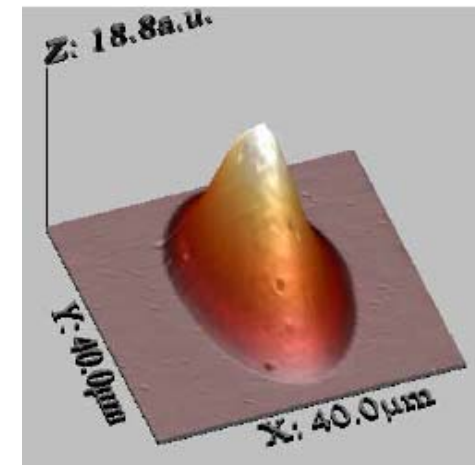
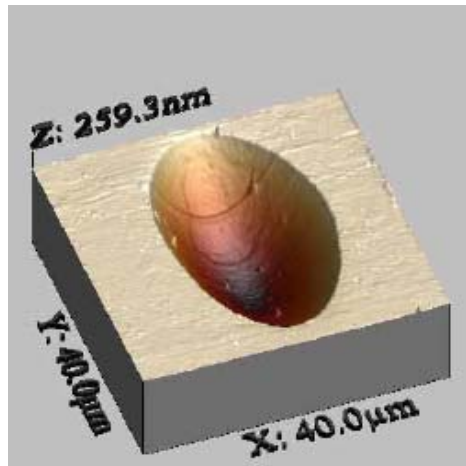
Method based on depletion of a gas target
→ Multi-Shot Determination



Sorokin et al., Applied Physics Letters 89, 221114 (2006)

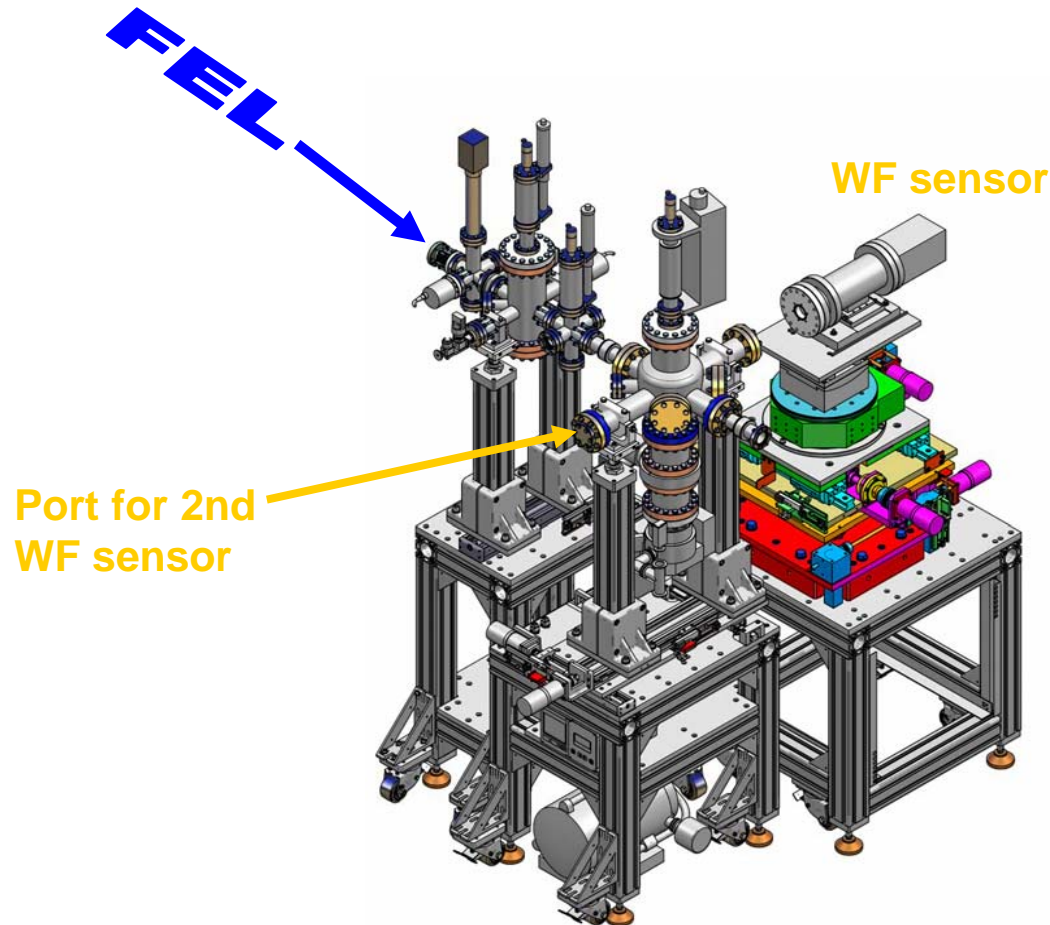
Lateral intensity – Focus determination

Method based on ablation of PMMA
→ Single-Shot Determination
(but post mortem)



Chalupsky et al., Opt. Express, **15**, 6036 (2007)

Lateral intensity - Wavefront sensor



Motivation:

- Wavefront characterisation
 - Beamline optics characterisation
 - Alignment of focussing optics
 - Alignment of adaptive optics
 - Online focus determination for transparent experiments
- connection to STFC in WP 7.2 and Elettra in WP 7.3.2



DESY action

WP 7.3.1 (lead by STFC)

Characterisation of optics performance

„Damage investigations“

„Develop improved wavefront sensor concept“

Damage investigations

First measurements of damage thresholds

$\lambda = 32.5 \text{ nm}$	mJ/cm^2
Si	87 ± 45
a-C	65 ± 30
SiC	141 ± 70
B ₄ C	197 ± 100
CVD diamond	156 ± 75

Hauriege et al., APL, **90**, 173128 (2007)

Collaborations

STFC, Daresbury Laboratory
ELETTRA, Sincrotrone Trieste
BESSY, Berlin
 SPring-8, Hyogo
 LCLS

Thin Film Technology GKSS-Geesthacht
 Institute of Physics, Warsaw
 Institute of Physics/ASCR, Prague
 FOM-Institute for Plasma Physics, Rijnhuizen
 Zeiss
 Lawrence Livermore Lab



Summary

Deliverable 7.3 Demonstration of lateral intensity measurement

First commissioning of improved wavefront sensor set-up in few weeks time

Deliverable 7.4 Demonstration of temporal intensity measurement

- First commissioning of autocorrelator set-up last fall
- First autocorrelation traces currently analysed

Deliverable 7.6 Demonstration of in-situ characterisation of optics performance

- Collaboration for damage investigation of optics established
- First test of two different wavefront sensors in few weeks time



END

Del. no.	Deliverable name	WP no.	DESY	BESSY	ELETTRA	MAXLAB	STFC
D7.1	Report by user group 1 and 2	7.1	-			Consultant contracts and report of first experiences (M12)	-
D7.2	Generic beamline concept based on user reports	7.1	-		Modify the drawing of the new Fermi beamlines on the basis of the Flash experience (12 months)	Conclusions and design issues for beamlines, based on consultant groups experiences and consortium member's performance (M20)	assessment of generic design concept for 4GLS proposed science case (M18)
D7.3	Demonstration of lateral intensity measurement	7.2	Setup wavefront measurement system (delivery month 18)			-	survey of existing techniques (M12)
D7.4	Demonstration of temporal intensity measurement	7.2	autocorrelator measurements (delivery month 24)		Cross check of autocorrelation measurement with other experimental techniques (30 months)	-	survey of existing techniques (M12)
D7.5	Demonstration of online jitter monitoring	7.2				On-line monitoring of the shot-to-shot jitter (m34)	-
D7.6	Demonstration of <i>in situ</i> characterisation of the optical performance	7.3.1	Experimental test of Long trace profiler concept at FLASH / develop improved wavefront sensor concept ((delivery month 34)		Define the limit and possible improvement of the Long Trace Profile to be used also as an on line measurement device / Comparison with toher metrological devices (24 months)	-	summary of issues, modelling of thermal effects, conclusions on best methodology, survey of metrology tools (M 34)
D7.7	Demonstration of the improved fabrication scheme for adaptive mirrors	7.3.2	-		Survey and metrological characterisation of existing polishing procedure / Realisation, metrology measurement test with radiation of a prototype (28 months)	-	survey of fabrication techniques (M12)
D7.8	Demonstration of a beam splitting technique	7.3.3	-		Test of the adopted beam splitter(s) with the FEL radiation (36 months)	-	survey of distribution techniques, modelling of concepts, requirements for electron beam (M24)