NMI3-II: report on Work Package WP19

“Advanced Methods and Techniques”

October, 2015

Instituto de Ciencia de Materiales de Aragón

icma / Instituto de Ciencia de Materiales de Aragón /

CSIC Consejo Superior de Investigaciones Científicas

Universidad Zaragoza 1542

WP19: Introduction

WP19: "Advanced Methods and Techniques"

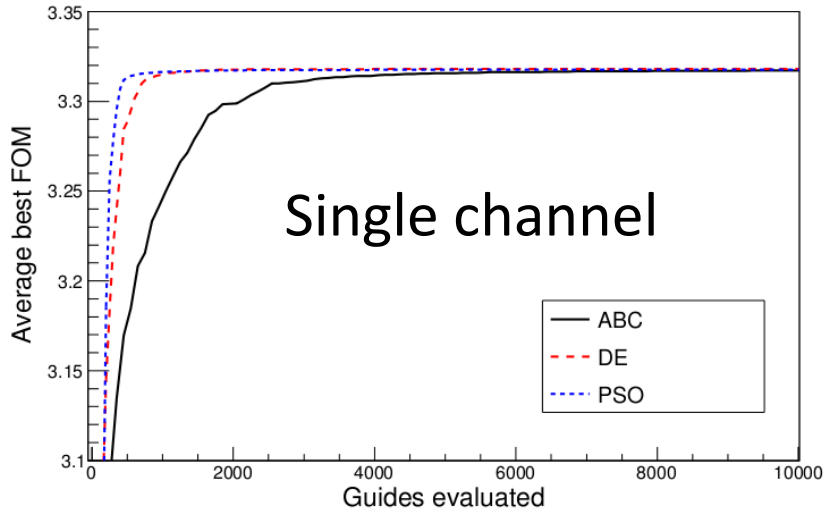
Partners: ILL, STFC, TUM, JCNS, TUD, ICMA (Coordinator), ESS

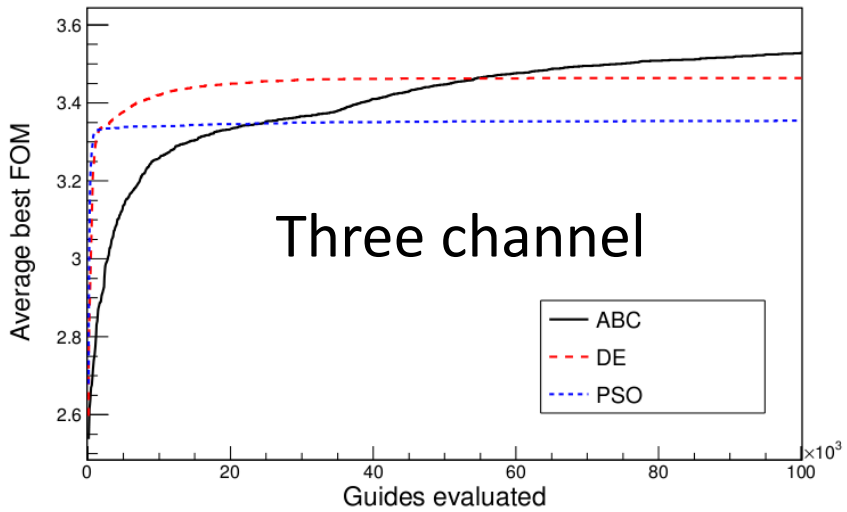
Tasks

- Task 19.1: Sub-mm^3 samples for extreme environments
- Task 19.2: Replaced by an extension of task 19.1
- Task 19.3: Spin echo with Oscillating Intensity for the ESS
- Task19.4: Choppers for the ESS instrumentation
- Task 19.5: Polarising all neutrons in a beam

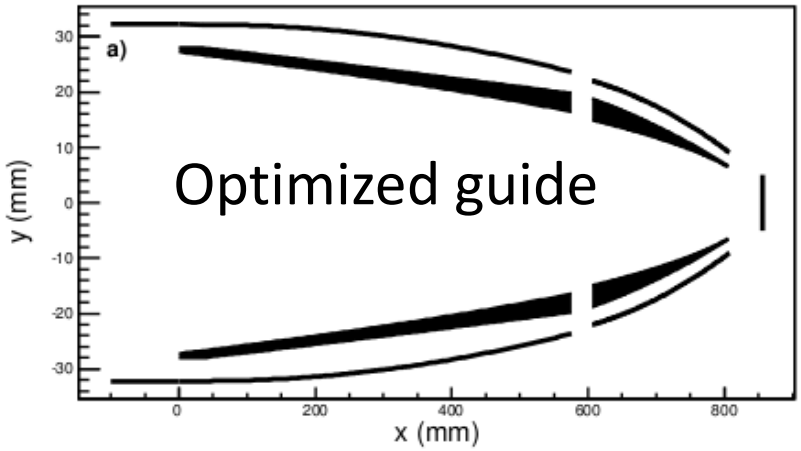
Task 19.1: Sub-mm³ samples for extreme environments

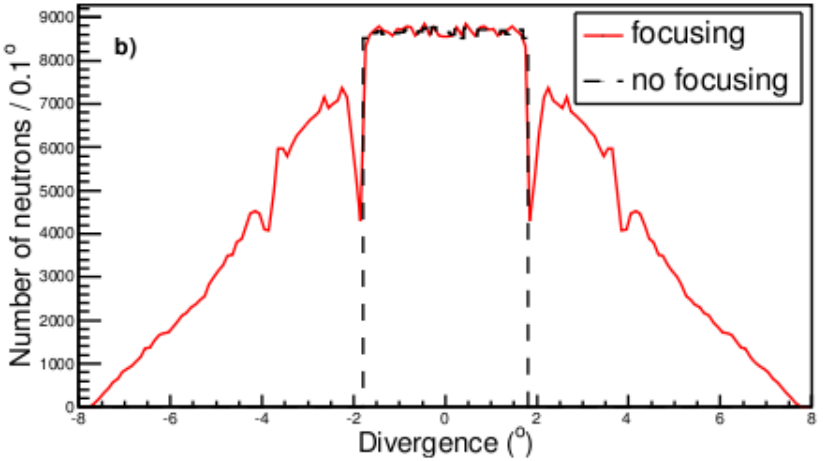
- Software to optimize multi-channel focusing guides developed (Di Julio et al.)
- Implementation of three optimization algorithms





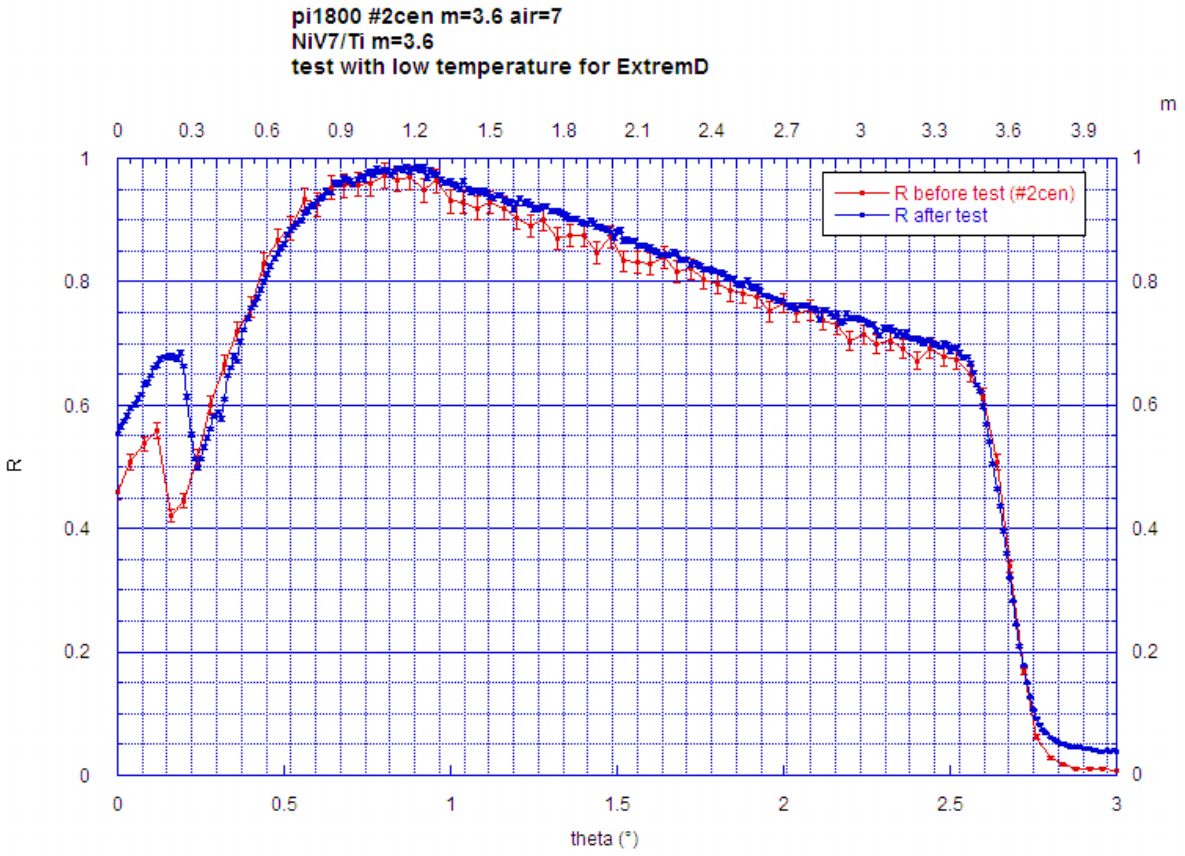
Software tests:





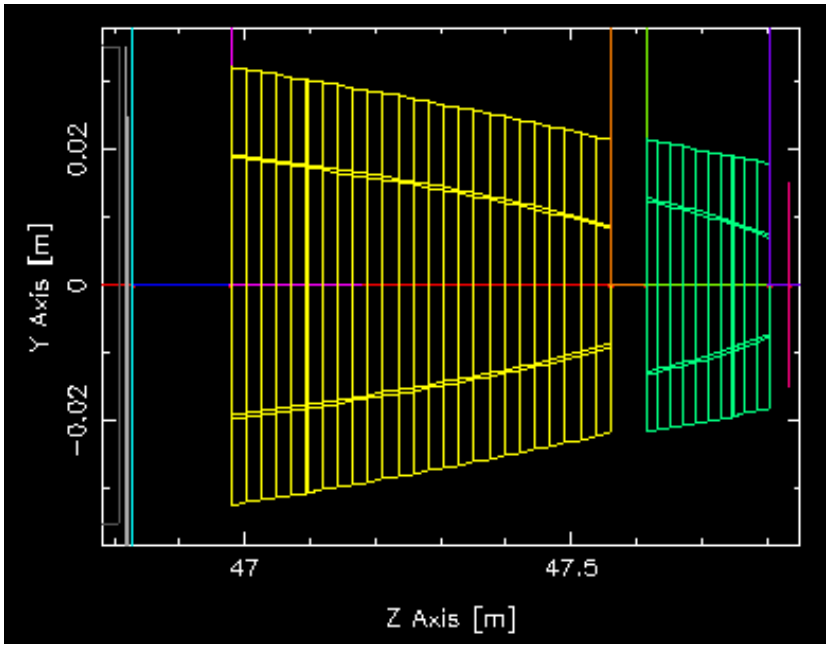
Robustness of supermirrors in extreme conditions

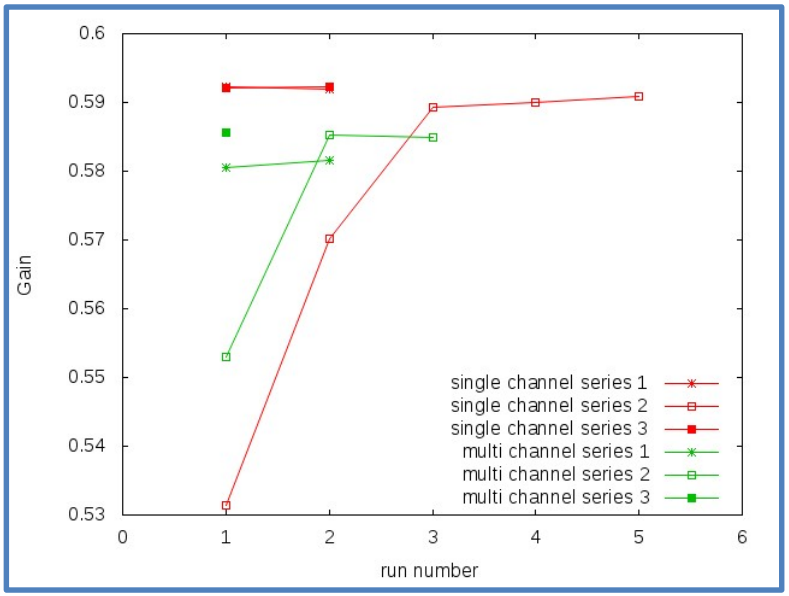
10 K
6 Tesla



Simulations of ILL IN5 cryomagnet (H16 – IN5), McStas

Two channel vs. single channel

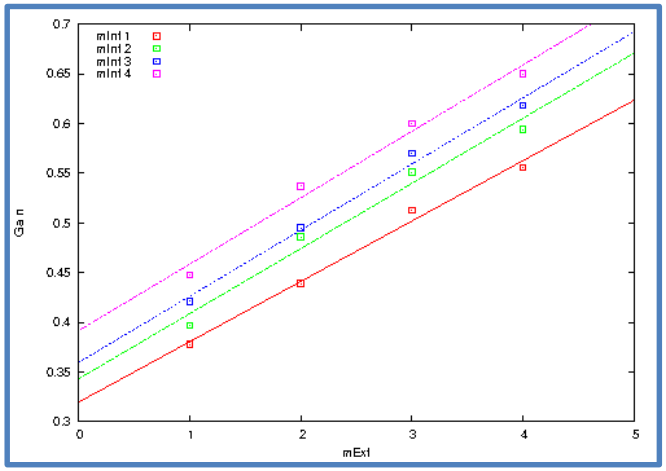




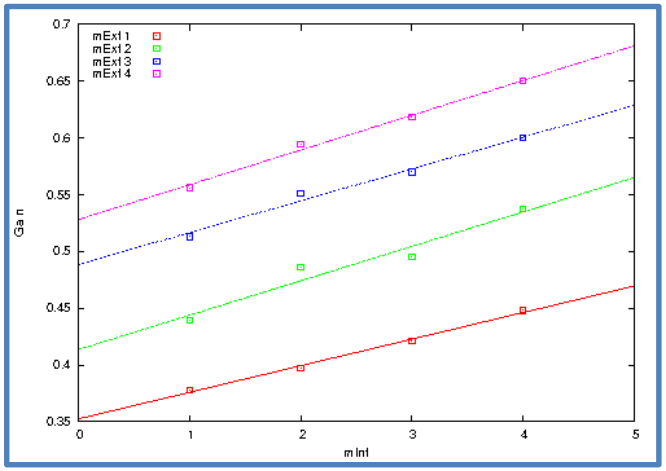
Single channel performs better

Simulations of ILL IN5 cryomagnet (H16 – IN5), McStas

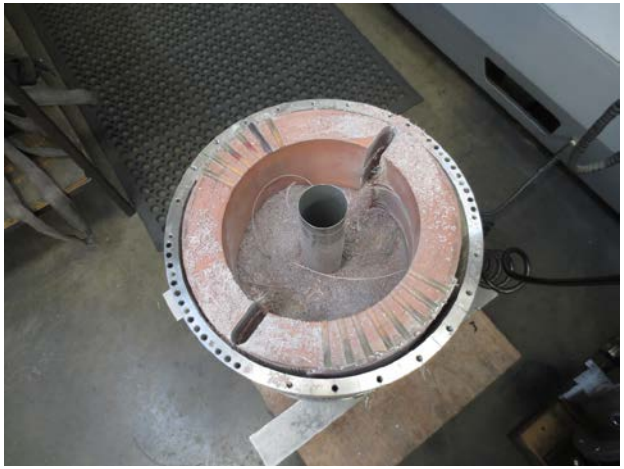
External guide coating



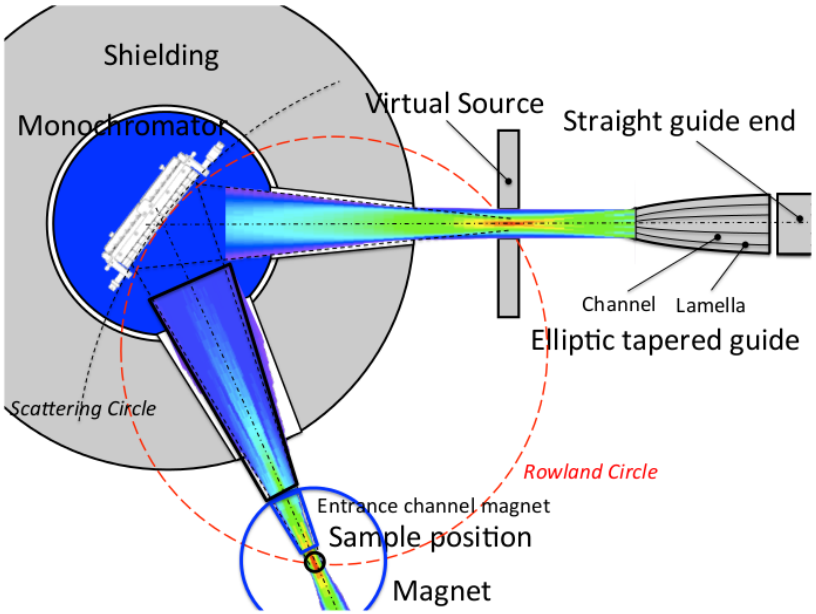
Internal guide coating



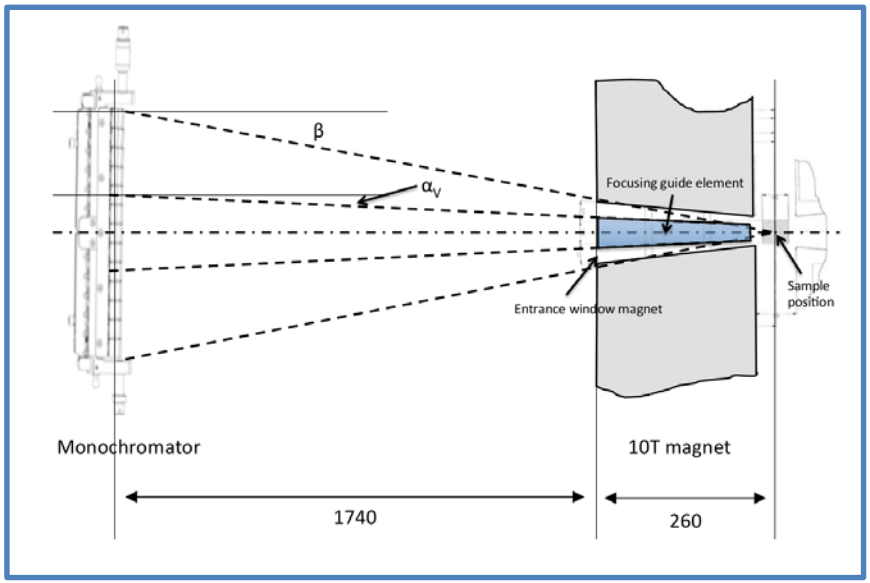
Simulations completed but construction of the calculated guided postponed by magnet manufacturer



Optimization of ILL ThALES TAS, SimRes*



PG002 monochromator,
30’ mosaic spread

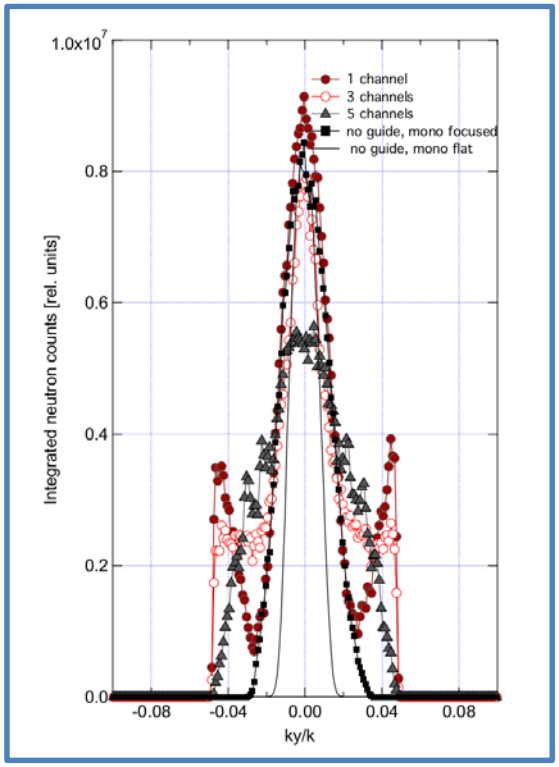


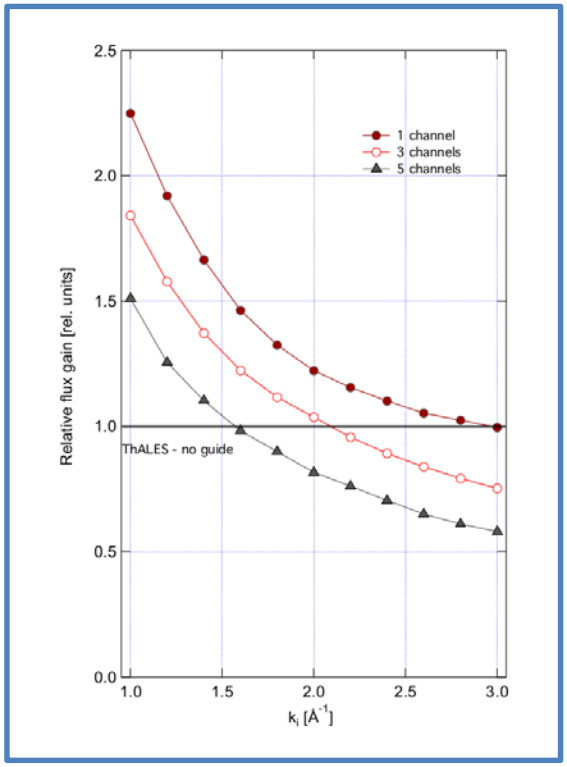
*Martin Boehm ILL

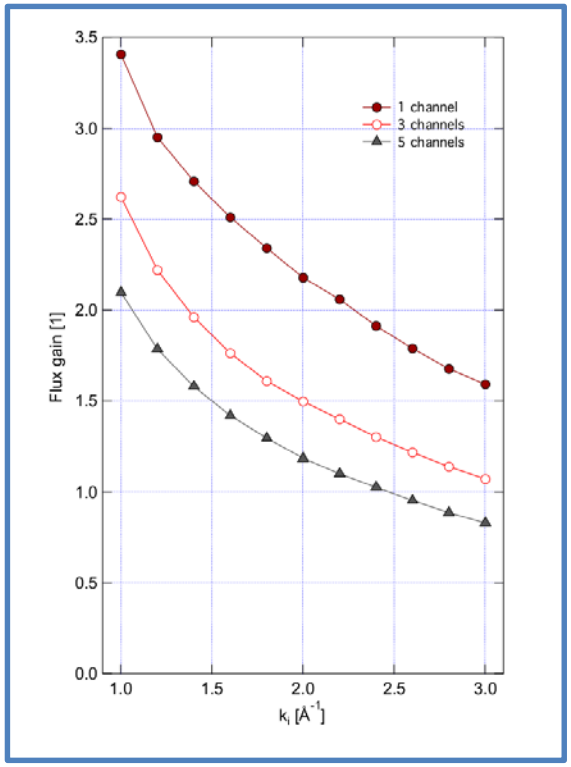
Task 19.1 (D19.2)

Optimization of ILL ThALES TAS, SimRes

Linearly tapered guides







- Single channel performs better than multi channel guides
- Multi channel provides better phase space quality

Task 19.1 (D19.3)
XtremeD Characteristisc

Guide H24

- Refurbishment project
- New location

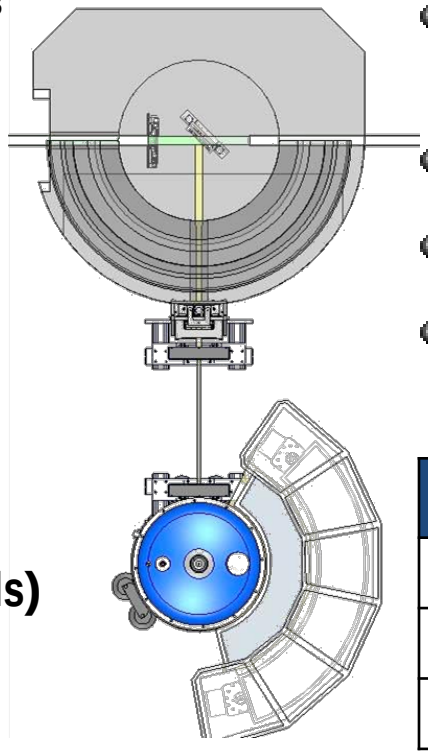
Monochromator:

- Two (double focusing):
  - Si(BP)/HOPG

Monochromators	
λ	0.8 – 3.5Å
Q	0.1 - 15.6 $Å^{-1}$
take-off angle	35 - 120º

Sample environment

- Sample size down to 1mm^3
- Maximum magnetic field: 15-17T continuous
- Non-magnetic mechanics
- Two main configurations: medium H + high P / medium P + high H
- Existing equipment (magnets and pressure cells)
- Set of new pressure cells (>30GPa → MALTA)



Detector

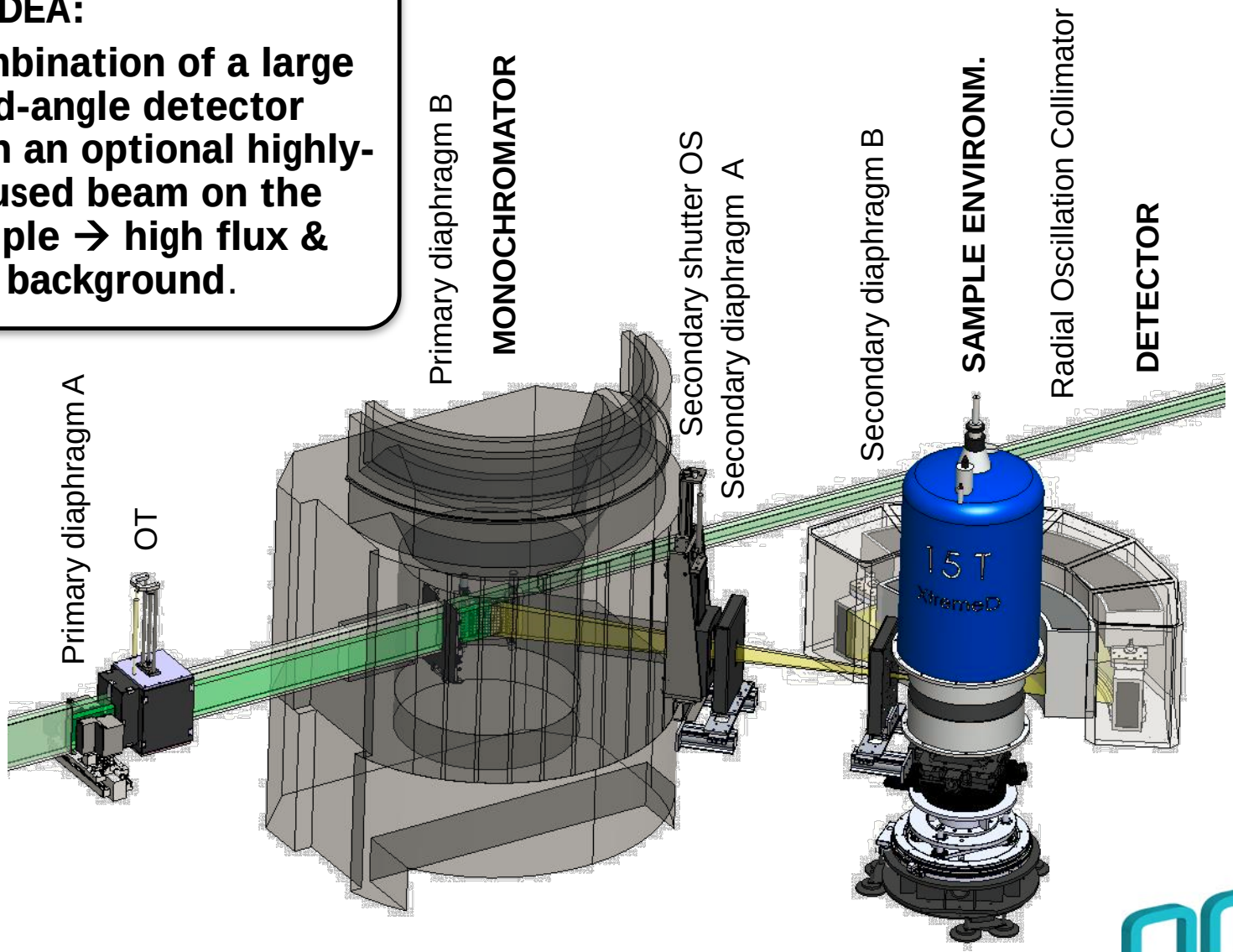
- "Banana" position sensitive detector
- Technology: ^{3}He
- High counting rate (>MHz)
- Radial oscillating collimator to suppress background

Detector	
2θ (horizontally)	**>120º**
2θ (vertically)	**±10º**
Resolution (HxV)	**0.15ºx0.2º**

Task 19.1 (D19.3)
XtremeD Characteristics

MAIN IDEA:

Combination of a large solid-angle detector with an optional highly-focused beam on the sample → high flux & low background.



Task 19.1 (D19.3)

Report on the characteristics for a multifunctional instrument for extreme conditions at pulsed sources

(done by ESS – HZB)

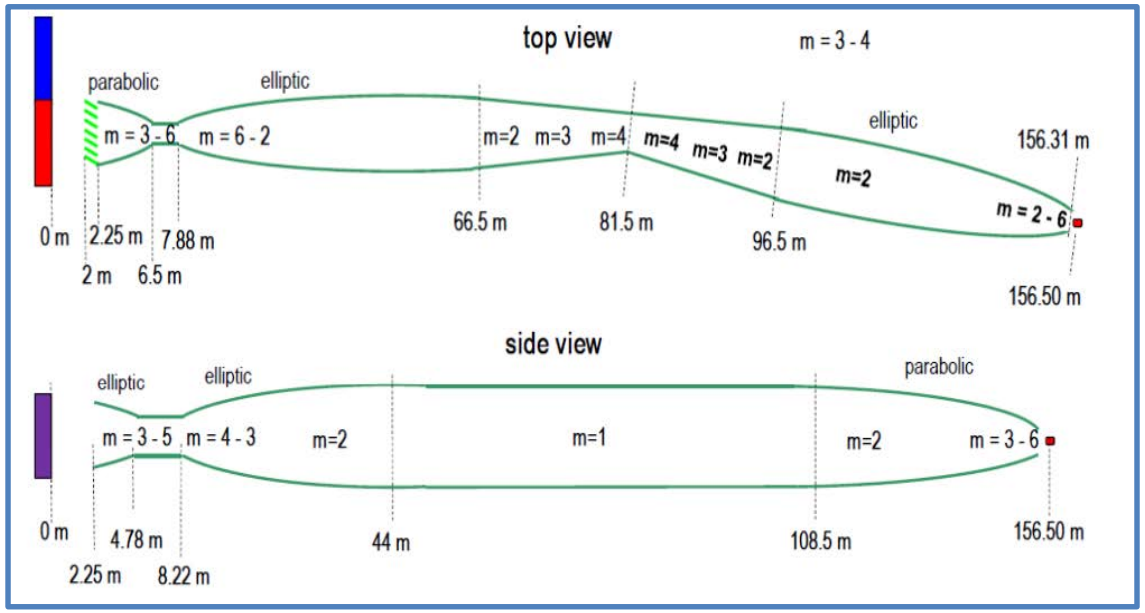
Three modes:

- Diffraction
- Inelastic
- SANS

Design of chopper cascade

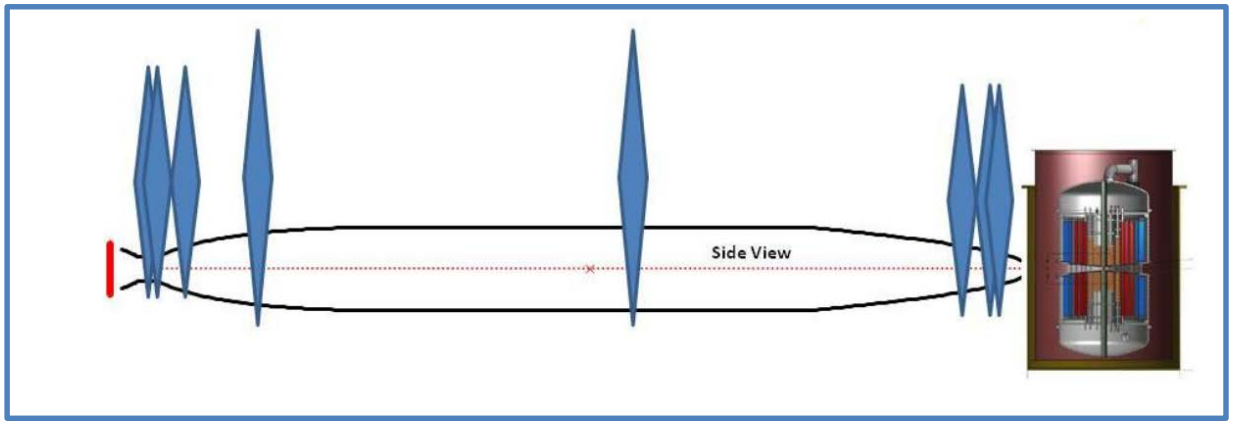
Bispectral moderator:

- Cold neutrons
- Thermal neutrons



Transport system

Chopper cascade

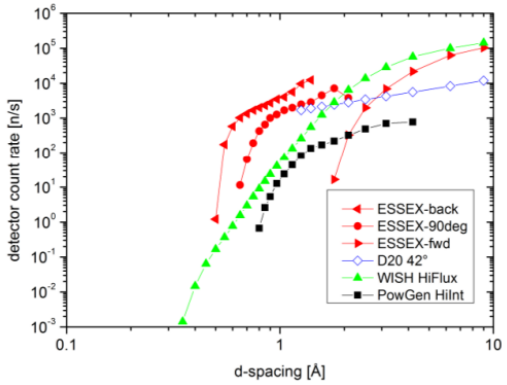


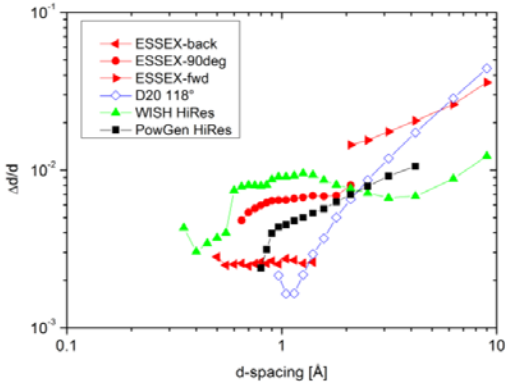
Ch #	Distance / Guide Height	Function	Radius	Window, opening/depth	Frequency (Hz)		
					DIF	Inelastic	SANS
1a	6.474 m/ 6 cm	Pulse shaping (short pulse)	30 cm	8˚ / 14 cm	224	0	0
1b	6.526 m/ 6 cm		30 cm	8˚ / 14 cm	210 /	0	0
2	7.0 m/ 6 cm	Pulse shaping (long pulse)	30 cm	32˚ / 14 cm	14	≥ 14	≥ 14
3	19.9 m/ 15.29 cm	Frame overlap	100 cm	59˚ / 22 cm	14	14	14
4	79.0 m/ 20 cm	Bandwidth	100 cm	166.3˚ / 22 cm	14	14	14
5	153.35 m/ 5.842 cm	Pulse suppression	30 cm	14˚ / 14 cm	0	140	0
6a	153.468 m/ 5.66 cm	RRM λ choice	30 cm	12˚ / 14 cm	0	280	0
6b	153.532 m/ 5.66 cm		30 cm	12˚ / 14 cm	0	280	0

Task 19.1 (D19.3)

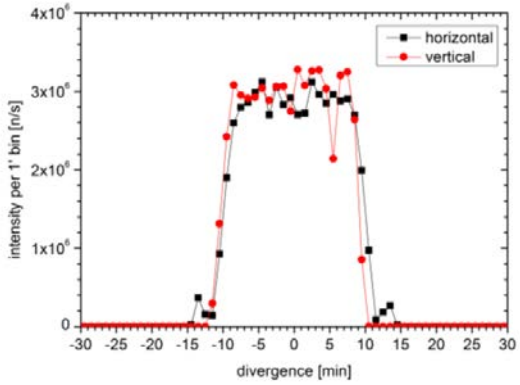
Performance the three modes tested and compared with existing instruments

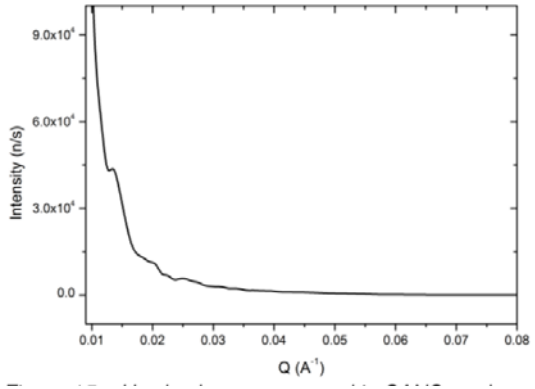
DIF



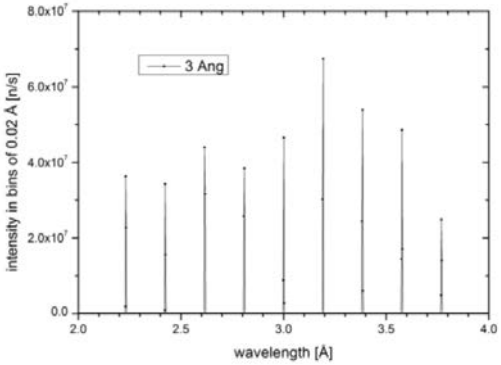


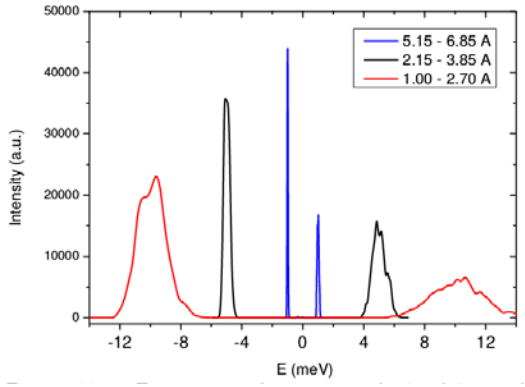
SANS





SPEC





Status of deliverables:

- D19.1 *Report on the performance of a prototype guide* **(M48)**
- D19.2 *Report on multichannel simulations* **(M48)**
- D19.3 *Report on the characteristics for a multifunctional instrument for extreme conditions in pulsed and constant sources* **(M48)**
- D19.4 Included in D19.3 **(M48)**
- D19.5 Responsible retired. Substituted by an extension of D19.3 **(M48)**

<u>Task 19.3</u>: Spin echo with Oscillating Intensity for the ESS (Häussler et al.)

- RF circuit designed and tested.
- Flipping efficiency optimized

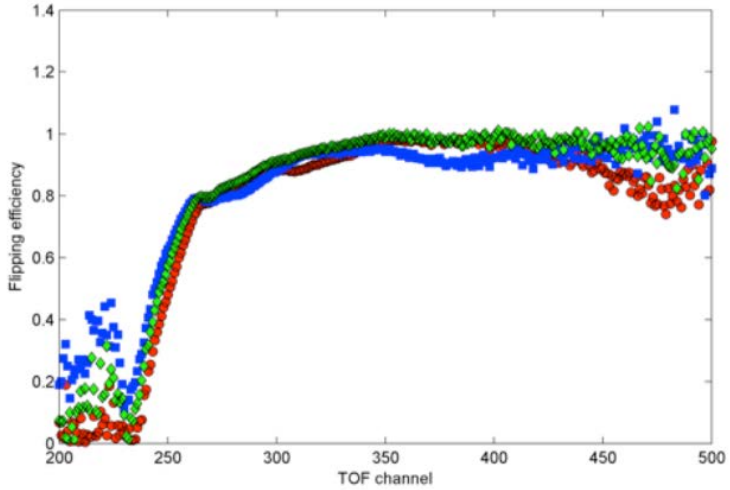
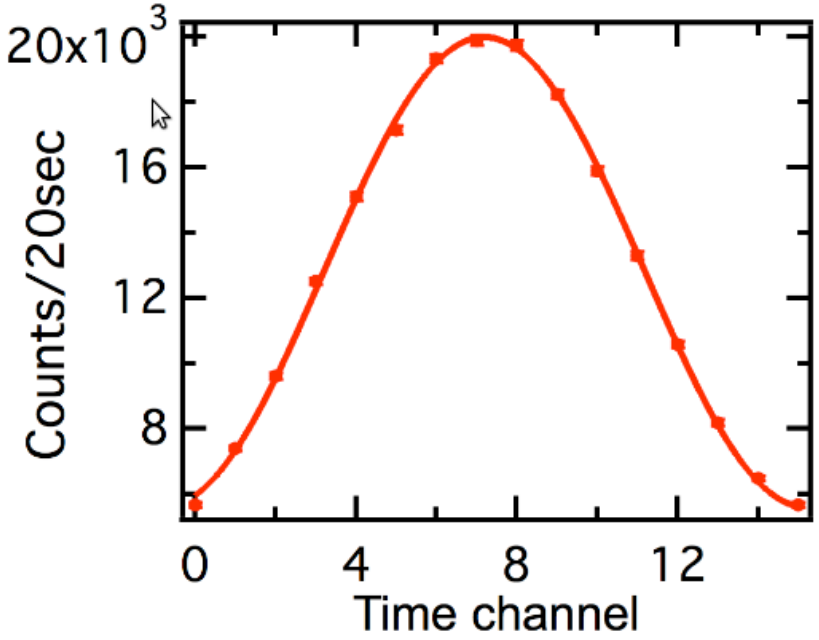


Fig. 2. The Flipping efficiency recorded in 500 time channels.

Fig. 1. The radio frequency generator, amplifier (left) and capacitors (right) used.

Task 19.3

- Data acquisition strategy with CASCADE detectors adapted to ESS
- Requirement profile for the detectors for ESS defined (high time resolution)



The MIEZE signal recorded on one CASCADE GEM foil at RESEDA.

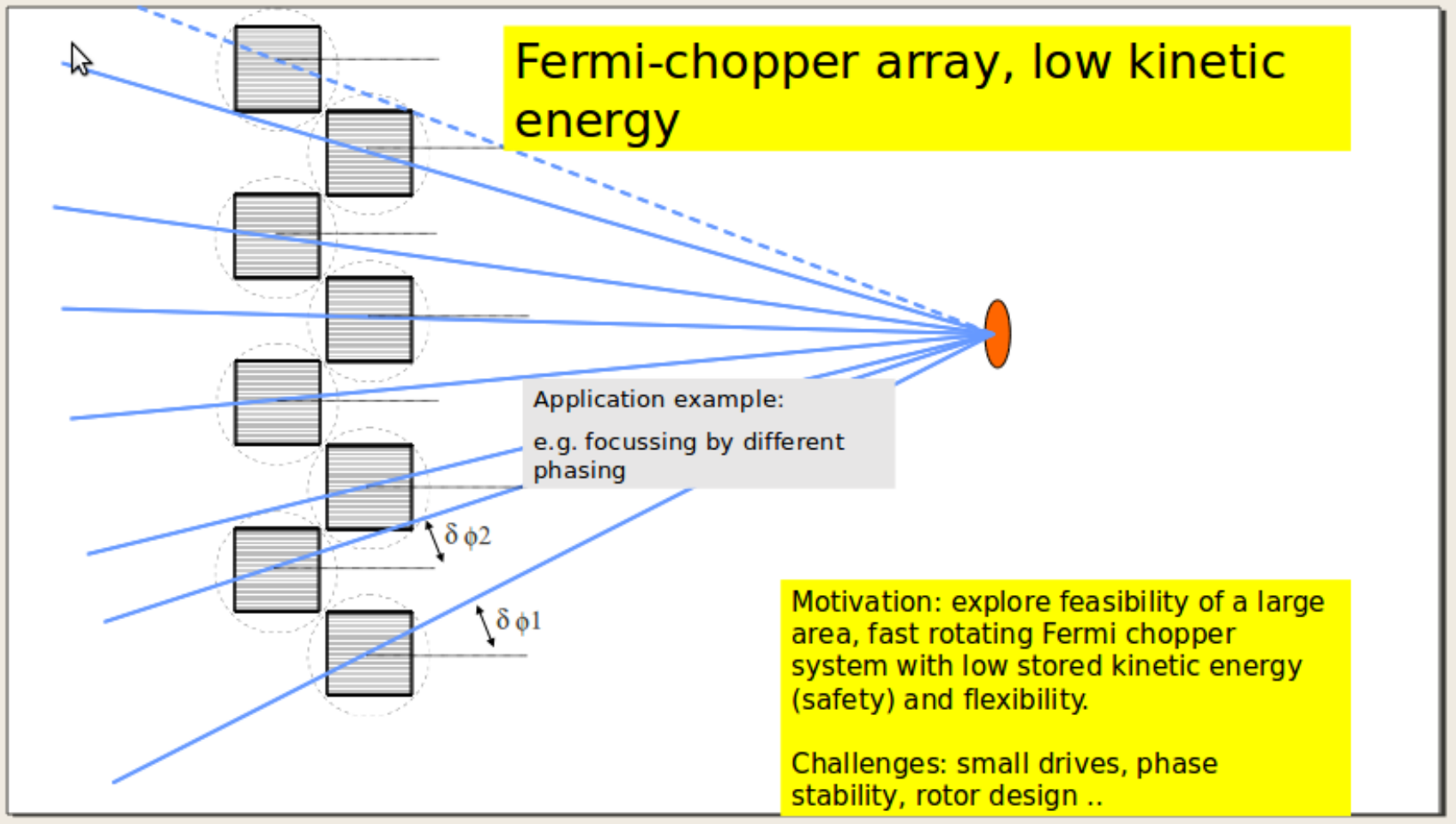
CASCADE detectors at RESEDA

Status of deliverables:

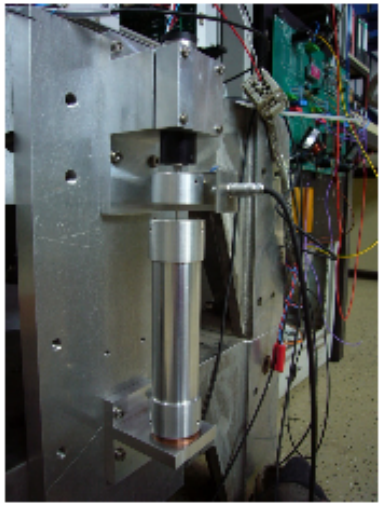
- D19.6 Design *report of the circuit wavelength adapted amplitude control* **(D)**
- D19.7 Performance *report of the resonance circuits* (draft) **(M36 → M46)**
- D19.8 *Report on the requirement of detectors* **(D)**
- D19.9 *Report on the measurement strategies and the design of data analysis system* (part of the ESS proposal of the instrument RESPECT) (draft) **(M36 → M46)**
- D19.10 *Report on the proof of principle measurements* (following measurements at OFFSPEC) STFC **(M48)**

Task 19.4 Choppers for the ESS instrumentation

(Monkenbusch et al., Jülich)

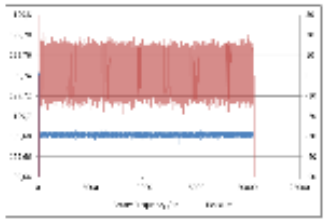


Achieved:



Drive concept

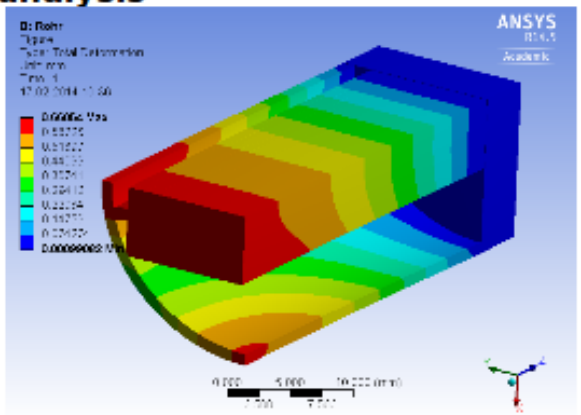
with excellent phase stabilty



phase stability of 0.04° was recorded during test runs at 200Hz over 6 hours

Evaluation of rotor concepts with respect mechanical stability and deformation at rotation frequency up to 1KHz

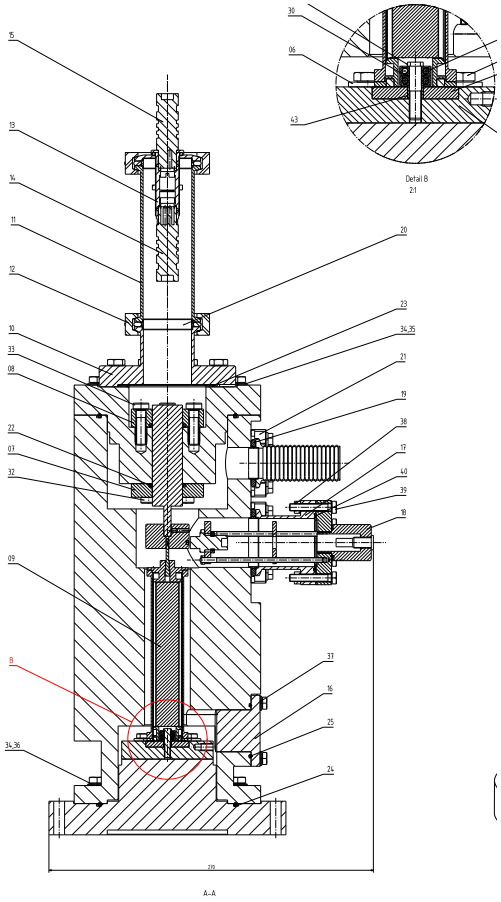
Preliminary rotor models: **strain analysis**

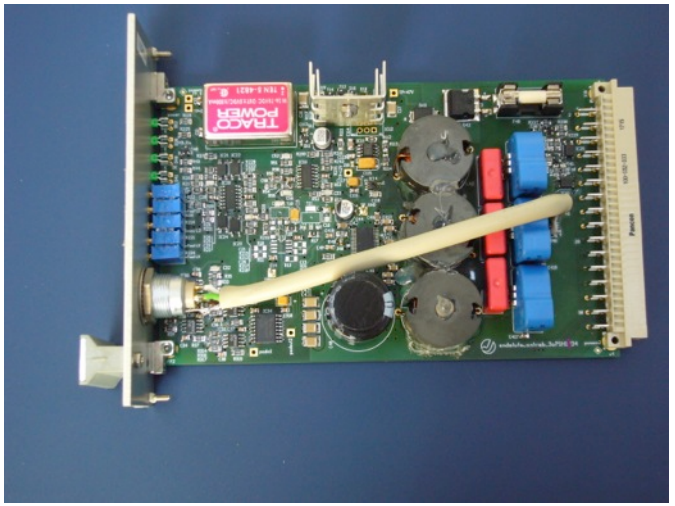


Task 19.4

Achieved:

Construction and manufacture of a single rotor test stand with electronics

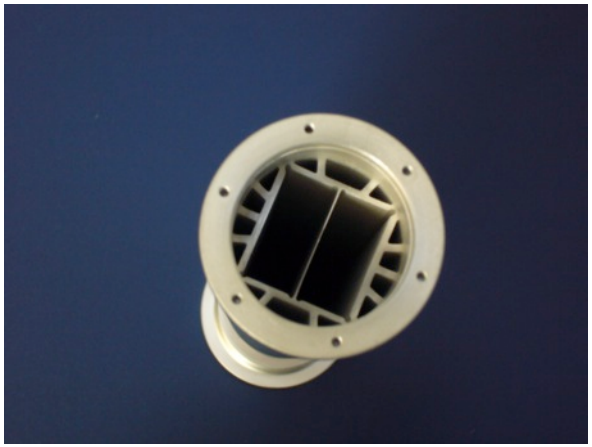




Task 19.4

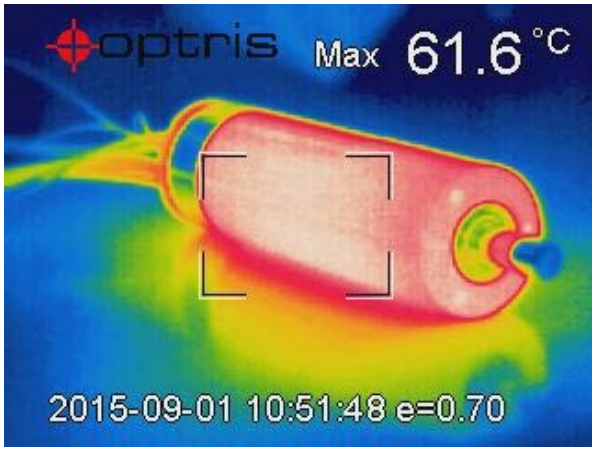
Achieved:

Manufacturing of rotor and mock up packages



Task 19.4

Achieved:



- balancing of rotor coupling at 1KHz

Motor after 1h run in air

To be done:

- Coupling of rotor and reach 1KHz
- Assembly of rotor with Gd-foil package
- Neutron tests

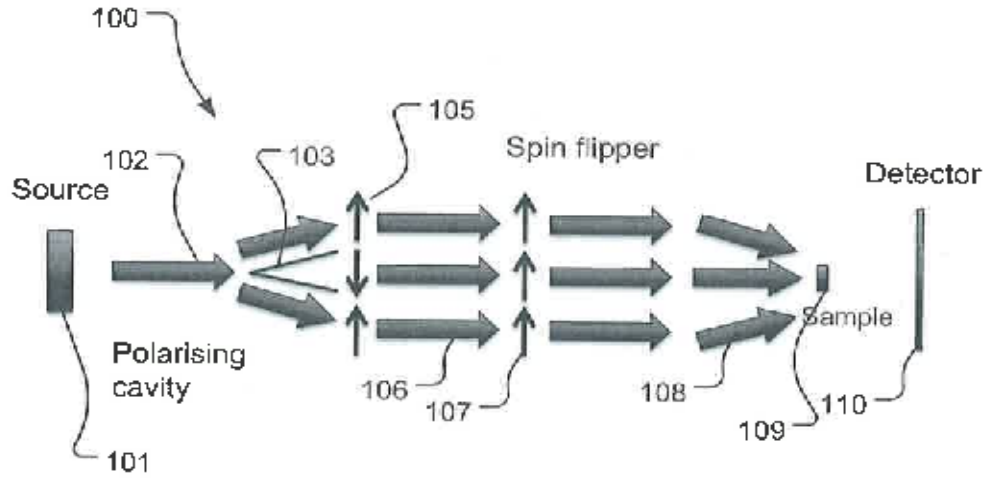
due to reactor schedules and assembly progress neutron tests will only be done in 2016

Status of deliverables:

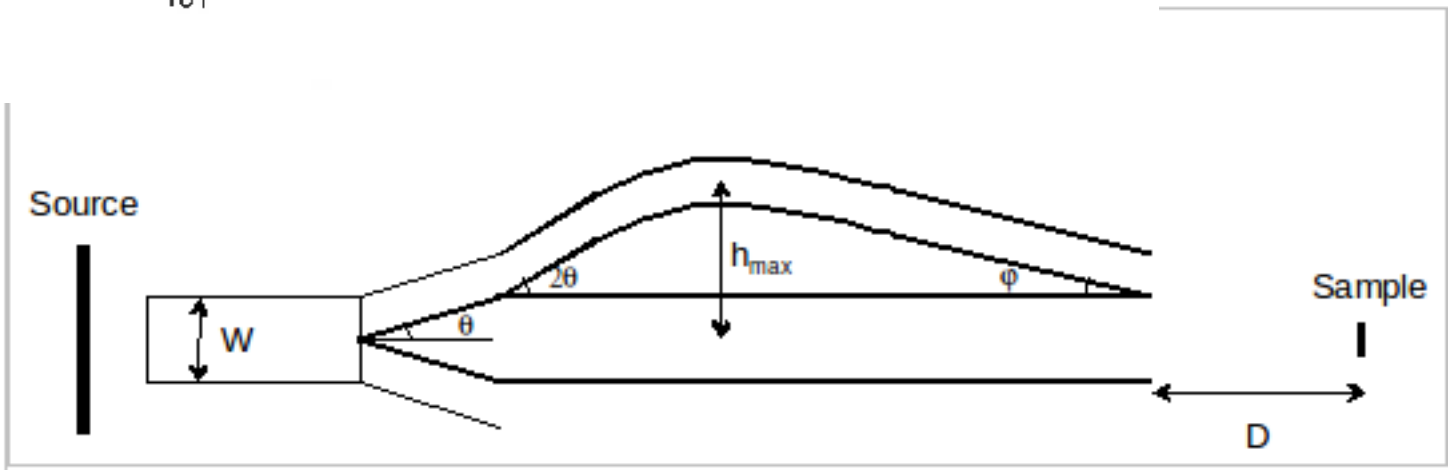
- D19.11 *Report on mechanical layout and FE-calculation* **(M36 → M47)**
- D19.12 *Report on neutronic layout of single rotor* **(neutron tests by 2016)**
- D19.13 *Report on conceptual design (of drive and sync. and system integration)* **(M36 → M47)**

Task 19.5 Polarising all neutrons in a beam

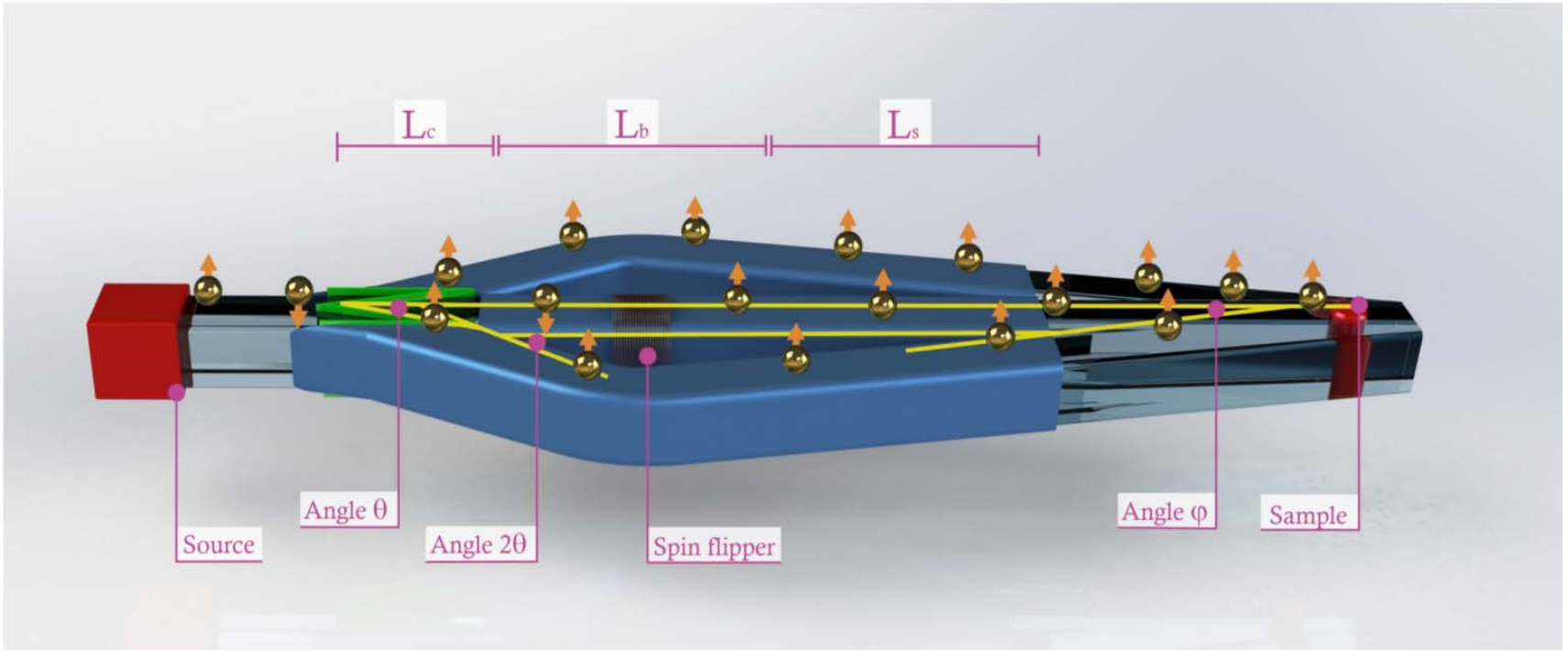
(Pappas et al., Delft, ESS)



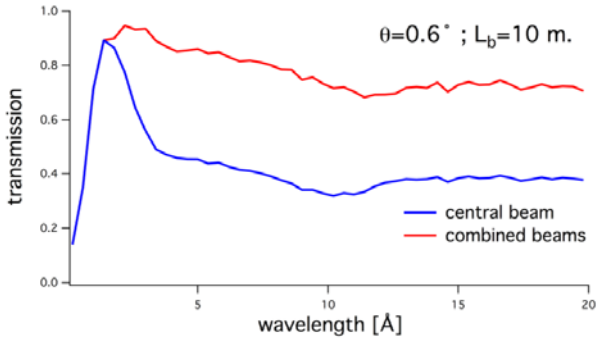
combine polarizing supermirror in reflection and transmission

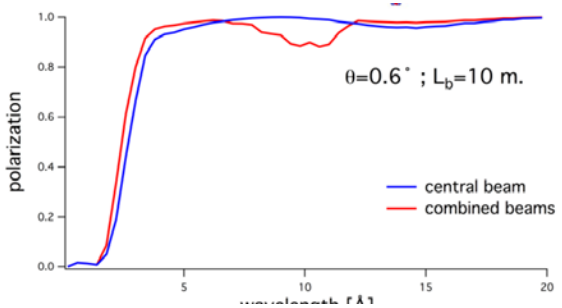


Schematic view:

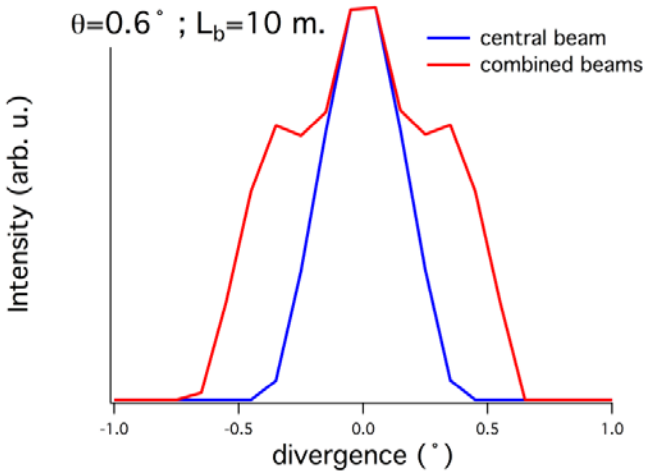


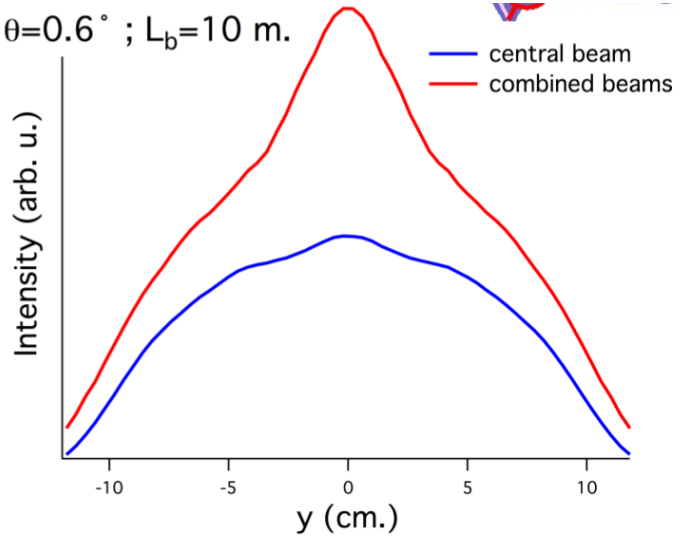
Achived: Monte Carlo simulations (Vitess)



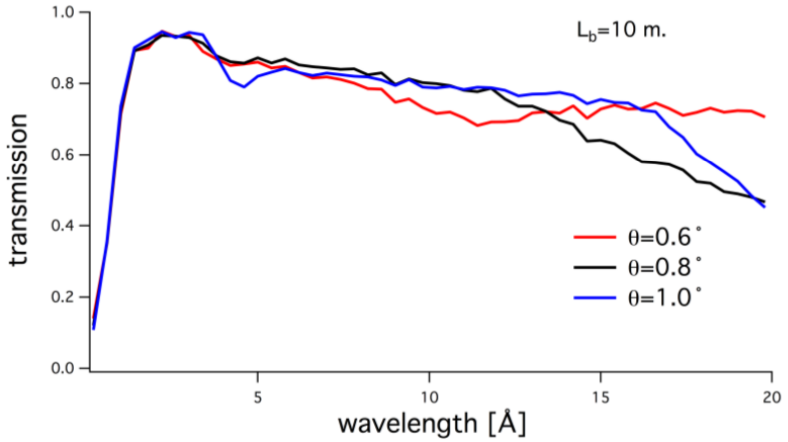


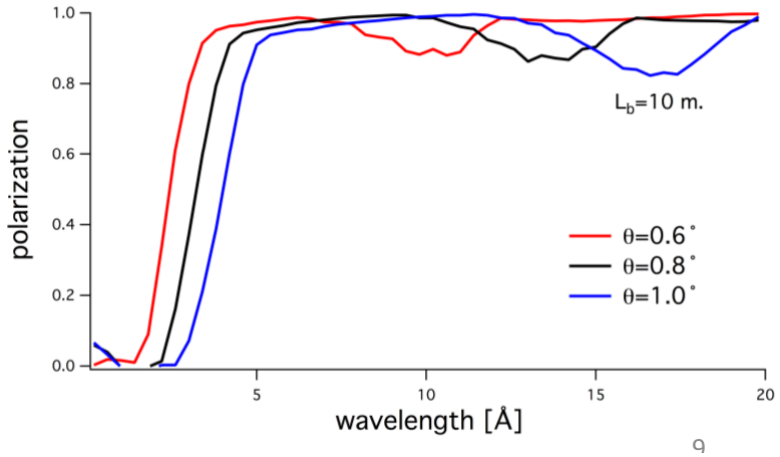
Beam and divergence distribution uniform





Achieved: **Monte Carlo simulations, parameter dependence**





Status of deliverables:

- D19.14 *Delivery of the report on Prototype, following design and procurement* (cancelled, report included in D19.15)

- D19.15 *Report and publication of the test results* **(M47)**

Summary

Status of deliverables:

- D19.1 *Report on the performance of a prototype guide* **(M48)**
- D19.2 *Report on multichannel simulations* **(M48)**
- D19.3 *Report on the characteristics for a multifunctional instrument for extreme conditions in pulsed and constant sources* **(M48)**
- D19.4 Included in D19.3 **(M48)**
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  (M36 → M46)
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- D19.13 *Report on conceptual design (of drive and sync. and system integration)* **(M36 → M47)**
- D19.14 *Delivery of the report on Prototype, following design and procurement* (cancelled, report included in D19.15)
- D19.15 *Report and publication of the test results* **(M47)**