JRA NEUTRON OPTICS

New spectrometer designs implementing advanced optical components

JRA presentation

General Assembly

Barcelona

May 2010

PARTICIPANTS

- BNC Budapest Neutron Center
- DTU Danmarks Tekniske Universitet
- EPFL Ecole Polytechnique Fédérale de Lausanne
- HZB Helmholtz Zentrum Berlin
- ILL Institut Laue Langevin
- INFM Istituto Nazionale per la Fisica della Materia
- JCNS Jülich Center for Neutron Scattering
- LLB Laboratoire Léon Brillouin
- NPI Nuclear Physics Institute
- PSI Paul Scherrer Institute
- TUM Technischen Universität München
- UCPH University Copenhagen

Hired people

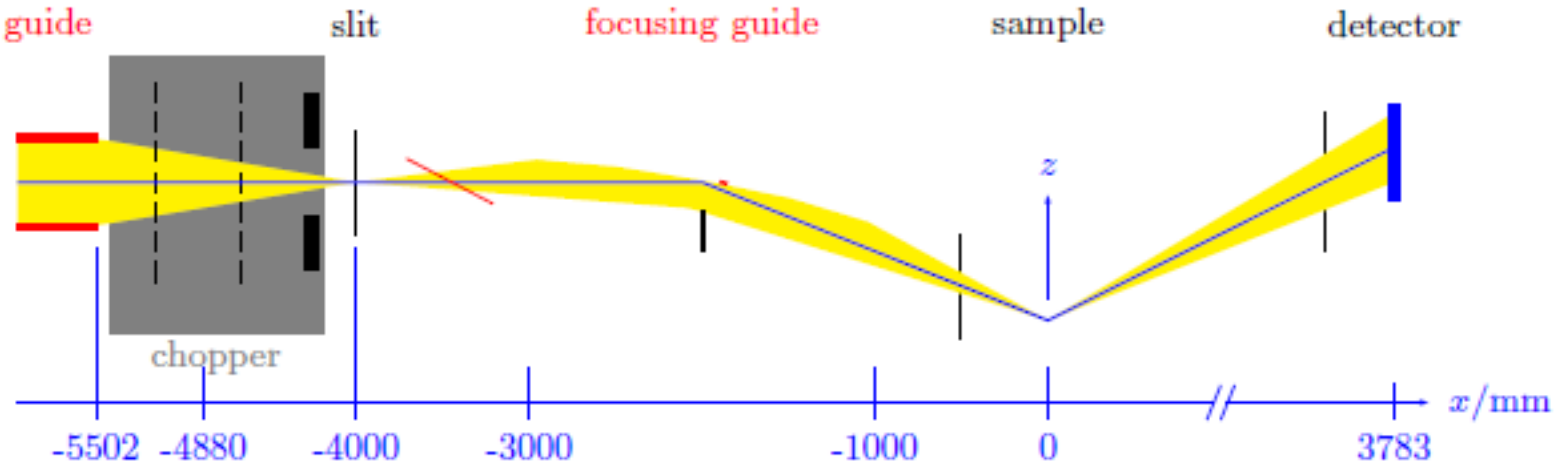
- PSI: J. Stahn
  - **Tobias Panzner**: Monte-Carlo simulations McSTAS
  - New component for elliptical and parabolic guides (tested)
  - Modeling of a modified REFOCUS concept: SELENE
- TUM: P. Böni
  - **Roxana Valicu**
    Work on adaptive optics
- HZB: T. Krist
  - **Jennifer Schultz**, PhD student (since January 2010)
    Refraction by prisms
- INFM: F. Sacchetti
  - **Lorenzio Sani**
    Work on Fresnel Zone plates
- University Copenhagen: K. Lefman
  - **Jonas Okkels Birk**
    CAMEA project

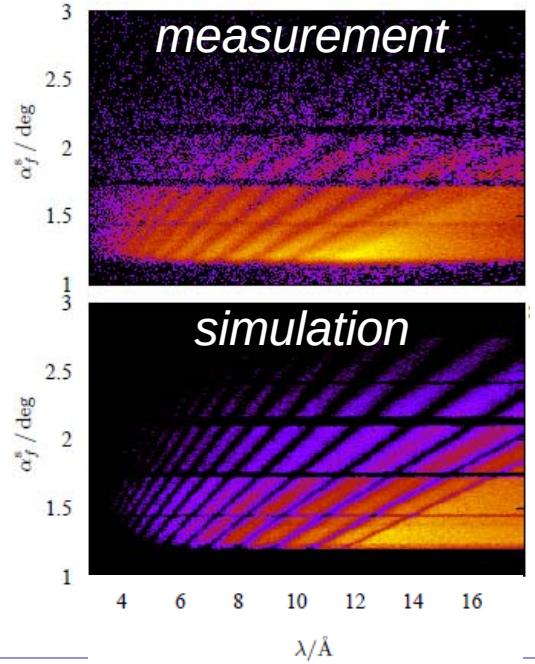
Working plan

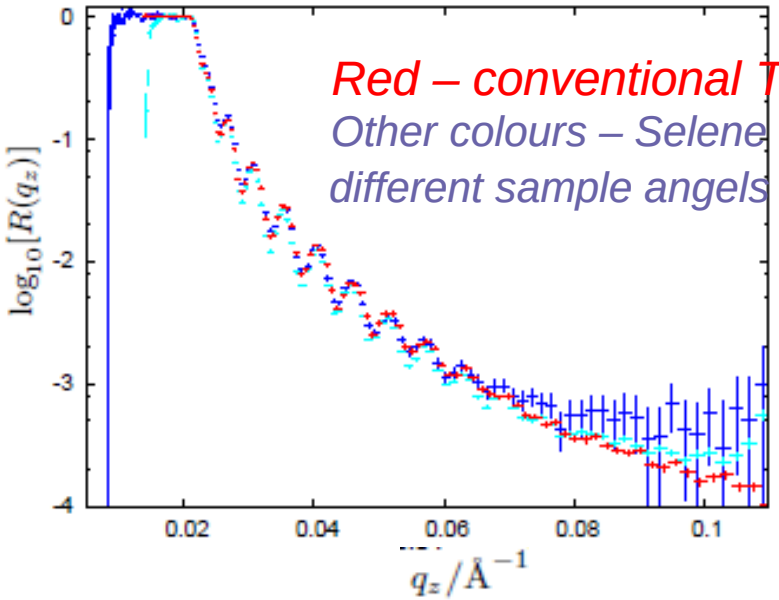
- Task 2: High flux reflectometry and energy analysis
- Task 3: Advanced Focusing Techniques
- Task 4: Monte-Carlo simulations of complex optics

Task 2: High flux reflectometry and energy analysis

SELENE (J. Stahn, T. Panzner, PSI)





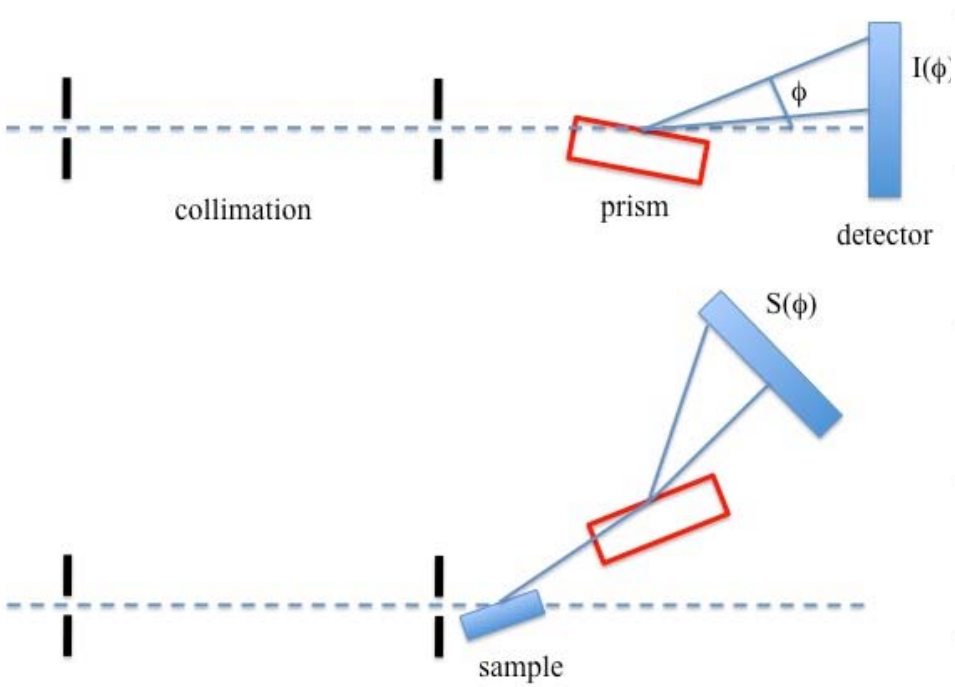


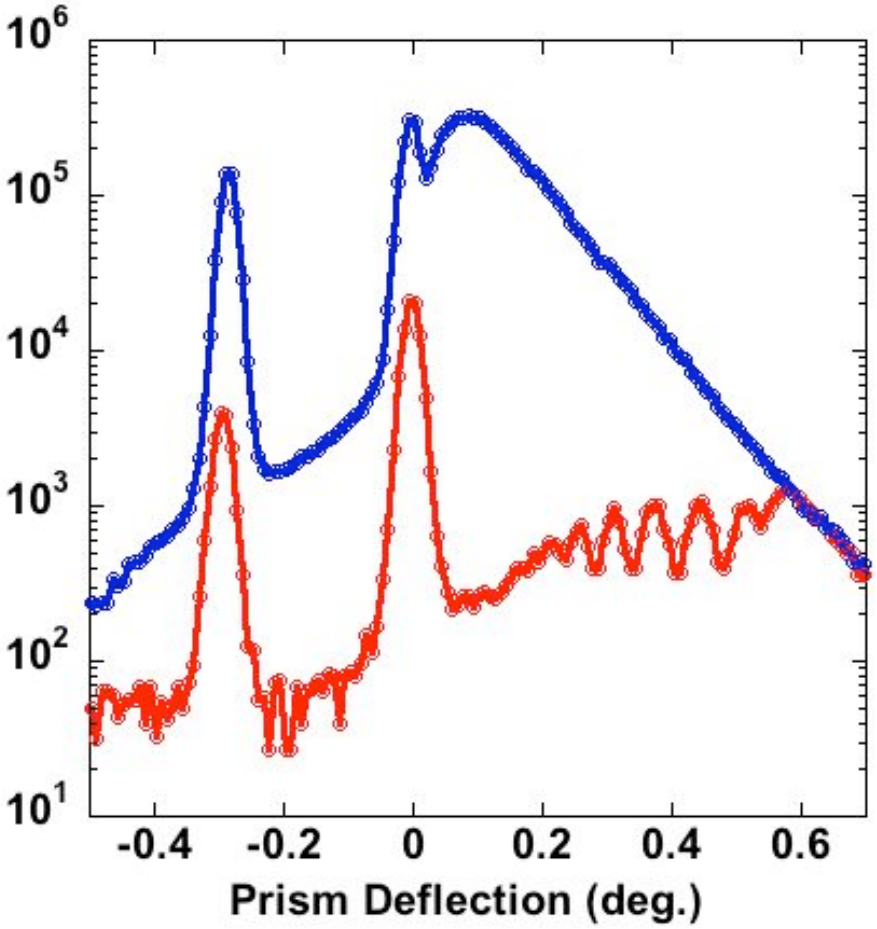
Red – conventional TOF

Other colours – Selene with different sample angels

detailed results can be found on http://arxiv.org/abs/1102.2747v1

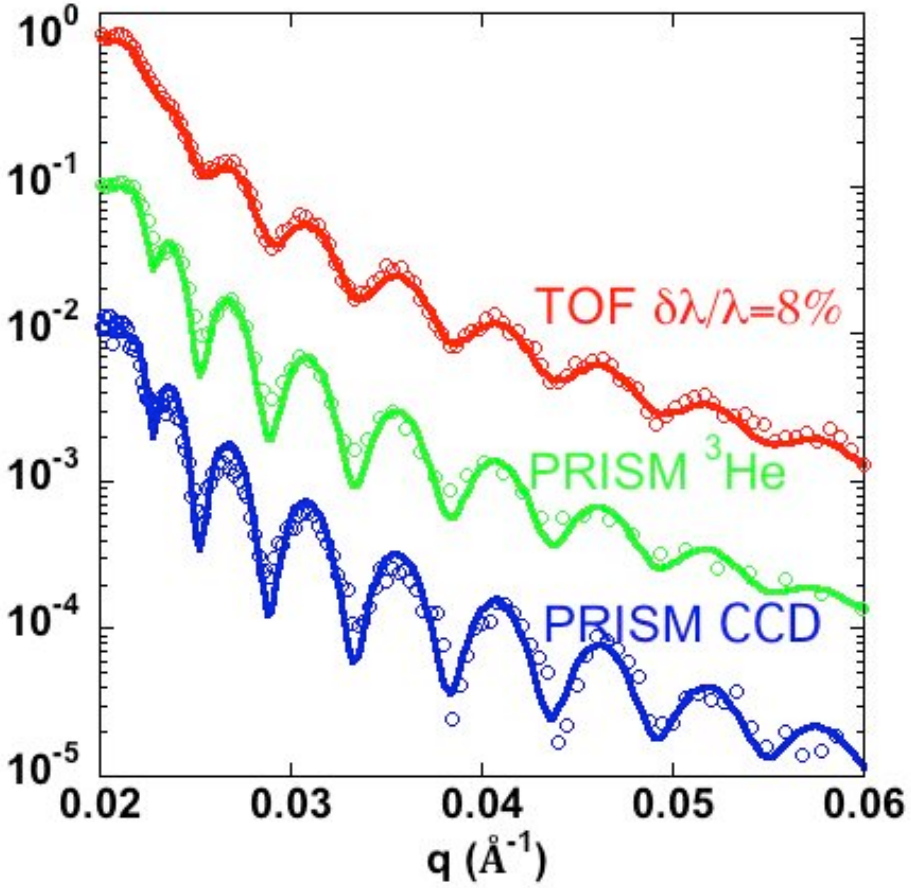
SYSTEM USING A SINGLE PRISM (R. Cubitt, ILL)





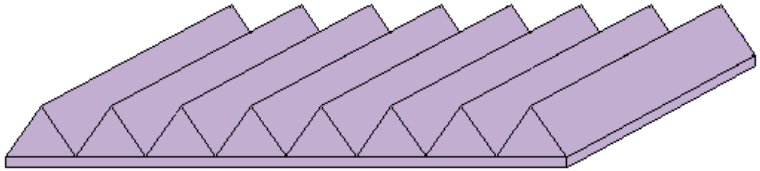
Collimations 0.5mm / 1.6m apart
PRISM set 0.742m after the sample
^{3}He detector (6m from the sample) / resolution 2.4mm FWHM
CCD camera / 5.1m from sample / resolution 0.2 mm / efficiency 10%
Sample Ni/glass (50 x 140mm^2)

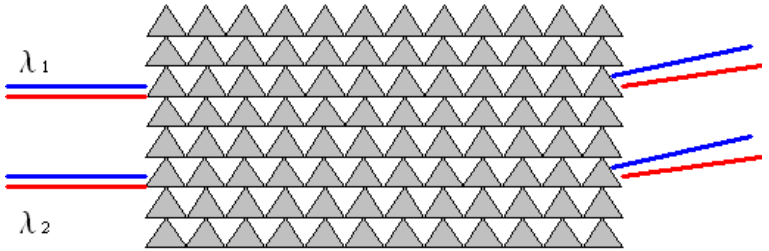
Measurement on a thick Ni layer

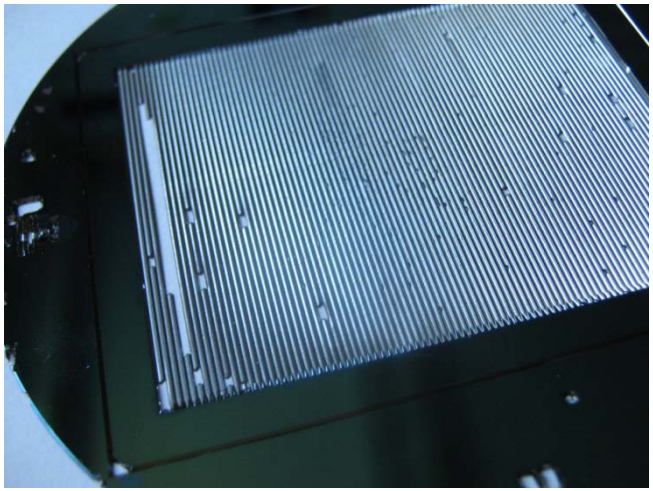


- *Very efficient for high resolution experiments (gains x30 – x90)*
  - *Kinetic measurements*
  - *Small samples*
- *Limitation: high resolution detector required (δx~0.2mm)*
- *Results to appear in EuroPhysicsLetters*

Increase the deflection angles using a multiple prisms set-up (HZB, J. Schultz, T. Krist)

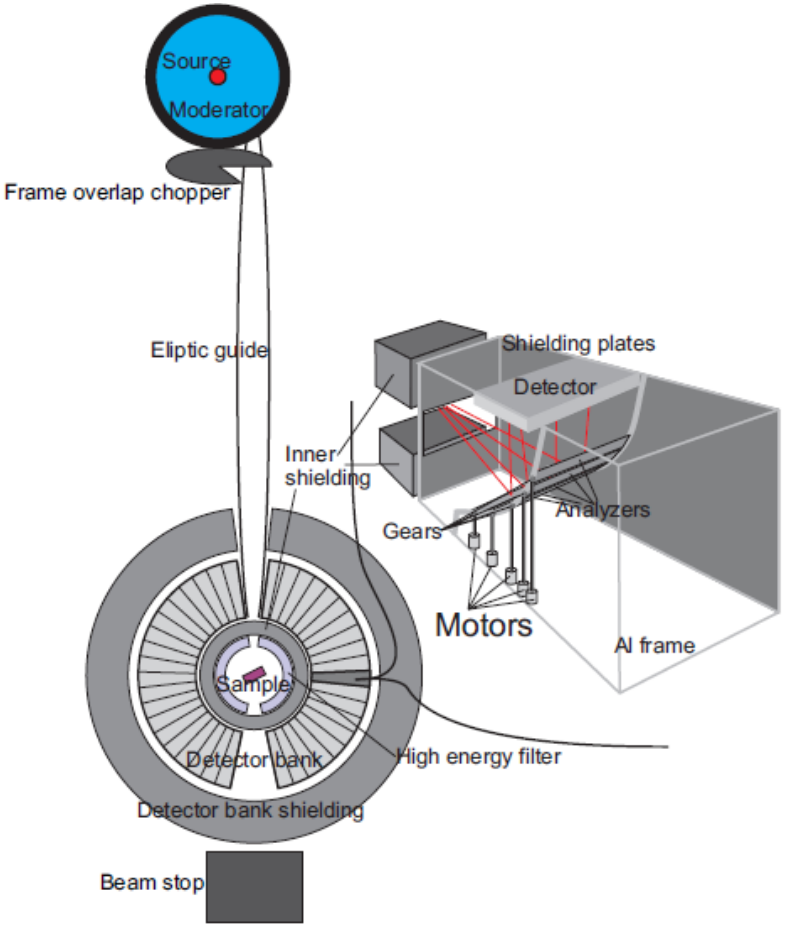






Energy analysis using crystal optics
CAMEA Project
(Univ. Copenhagen - EPFL, Jonas Birk, K. Lefman, H. Ronnow)

- Initial task aim switched from TAS to TOF
- NO is supporting MC simulations / Feasibility study for implementation on cold TOF at ESS

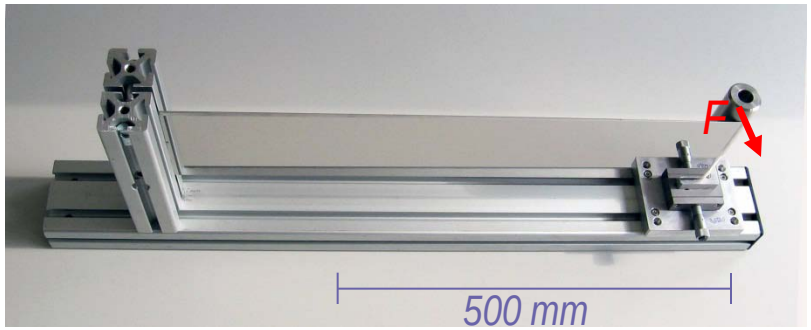


Task 3:
Advanced Focusing Techniques

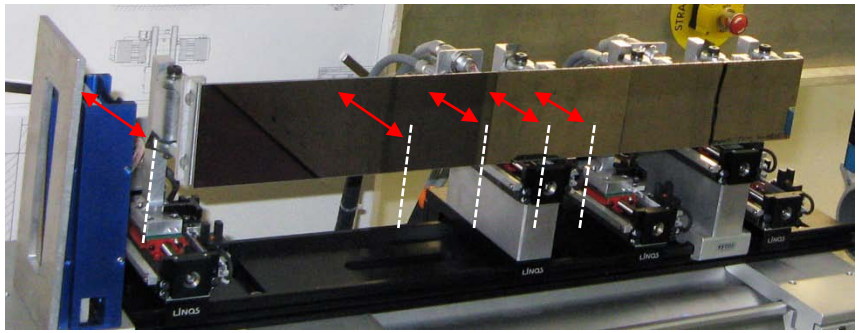
Adaptive optic (parabolic shape)

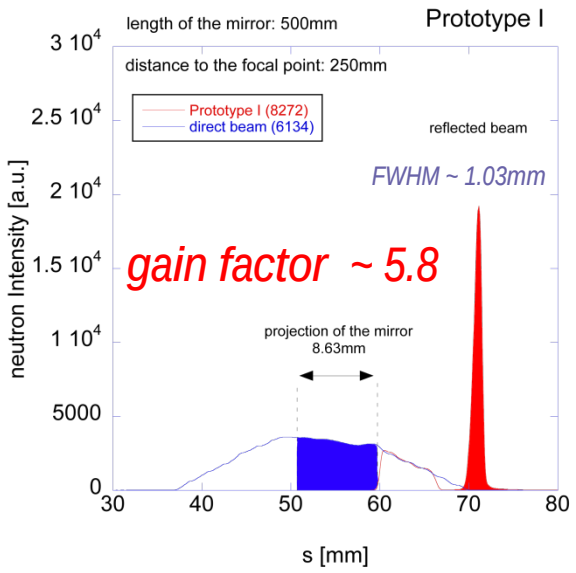
experiments performed by M. Schneider, U. Filges, T. Panzner

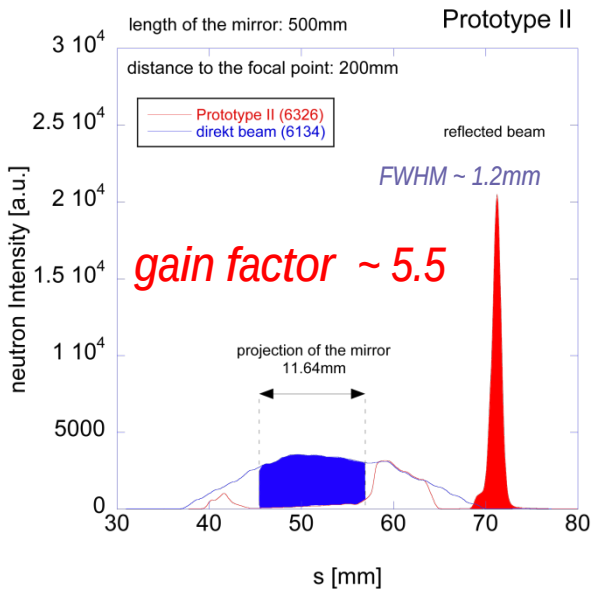
Prototype I



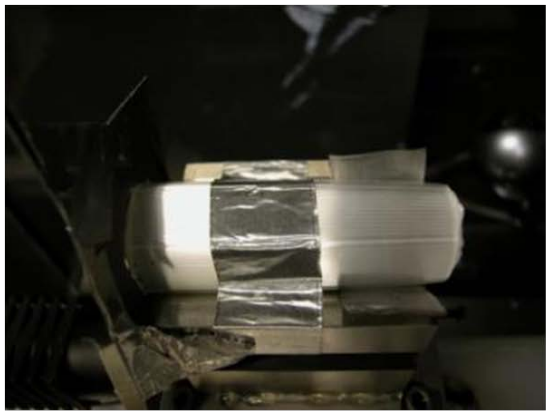
Prototype II

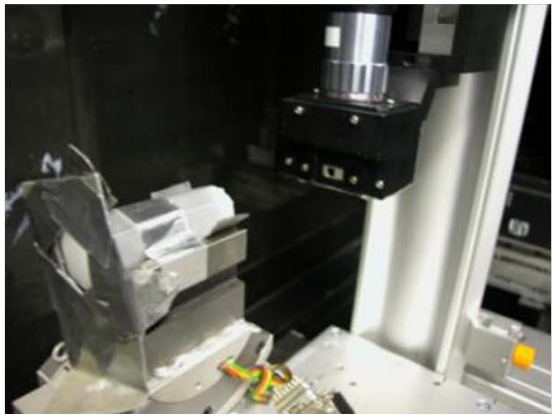


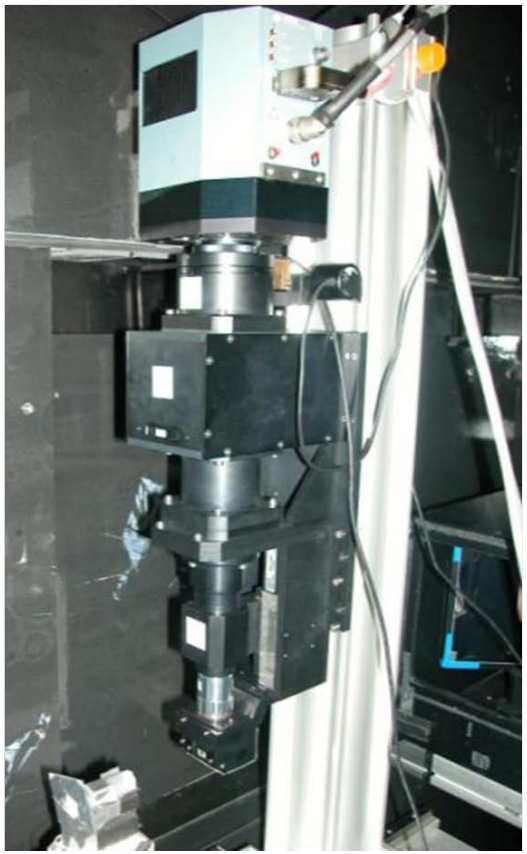




High resolution imaging using focussing optics (HZB, N. Kardjilov, T. Krist)

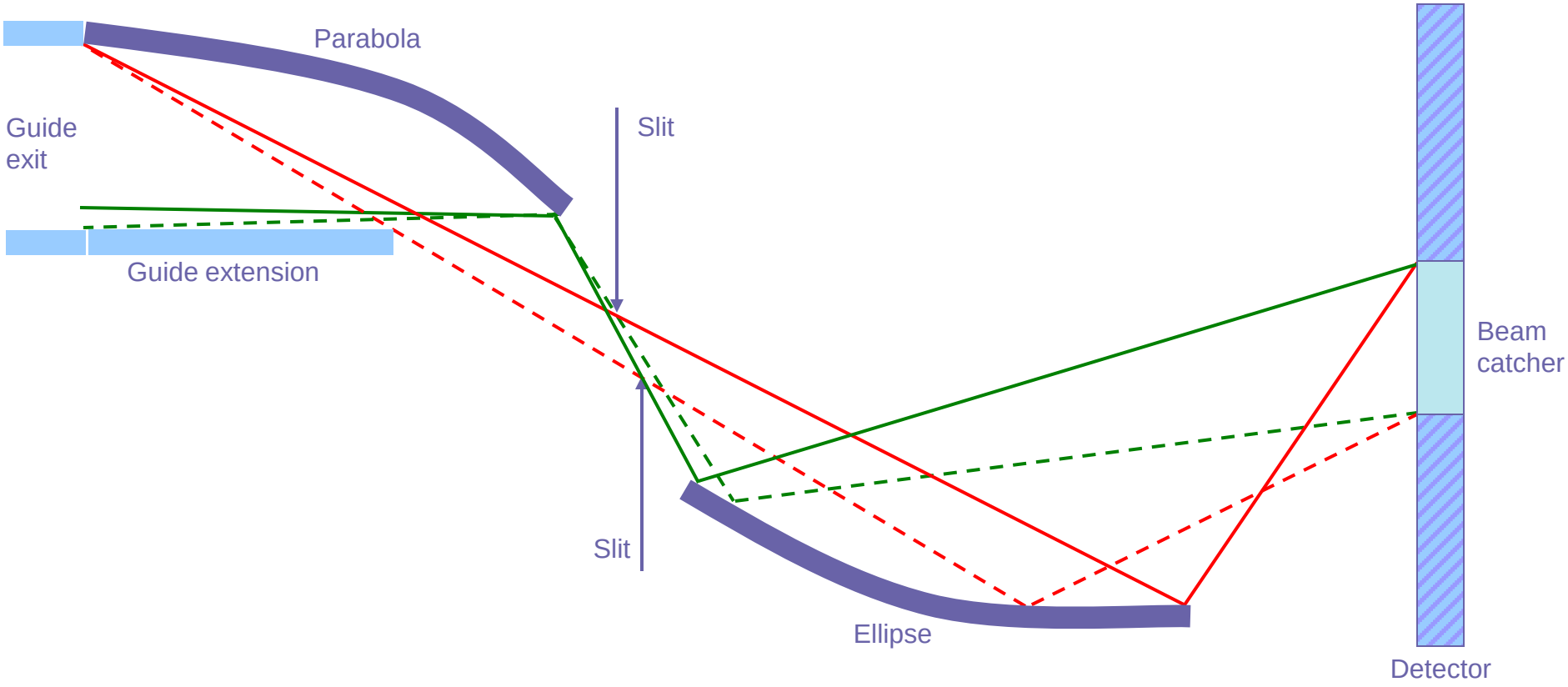




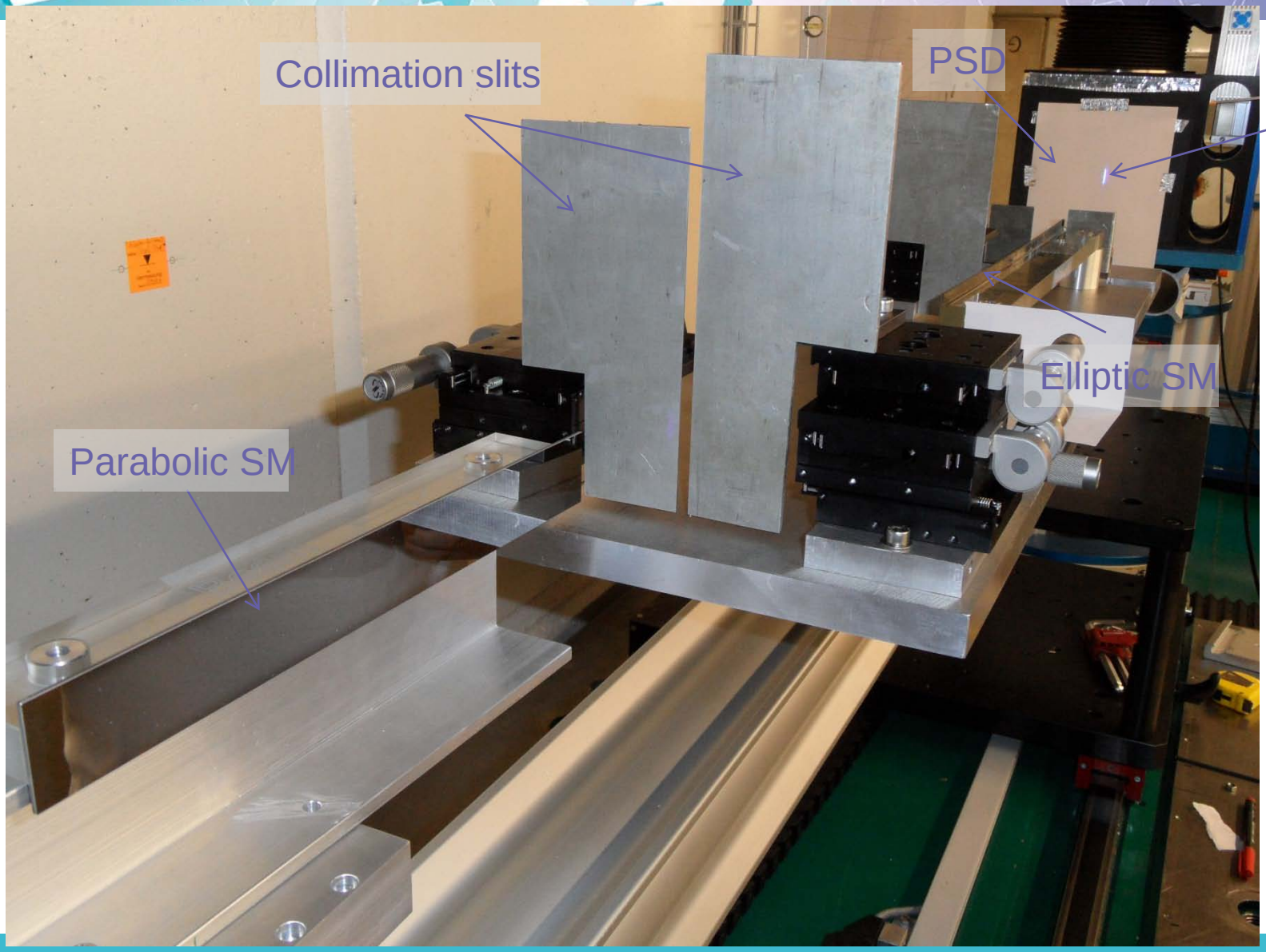


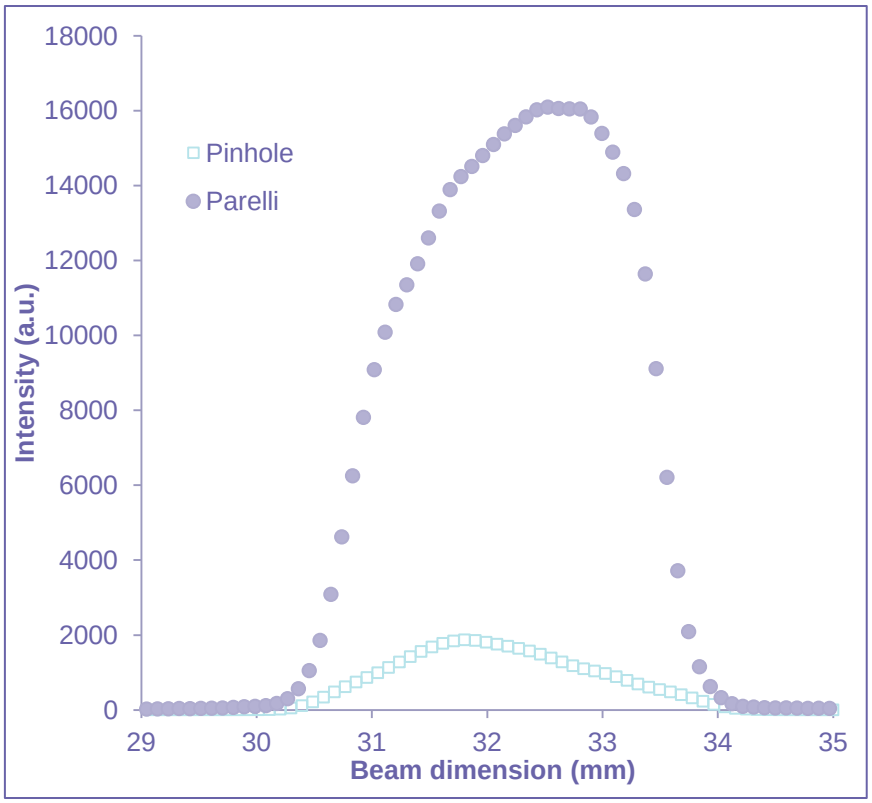
- *Focussing over an area of 2x2mm² using a Kumakhov lens*
- *CCD associated with scintillator with a 1µm² effective resolution*

Focussing SANS using reflective optics (LLB, S. Désert et al)



Test of prototype on BOA (T. Panzner) @ PSI, 03-06 Oct. 2011

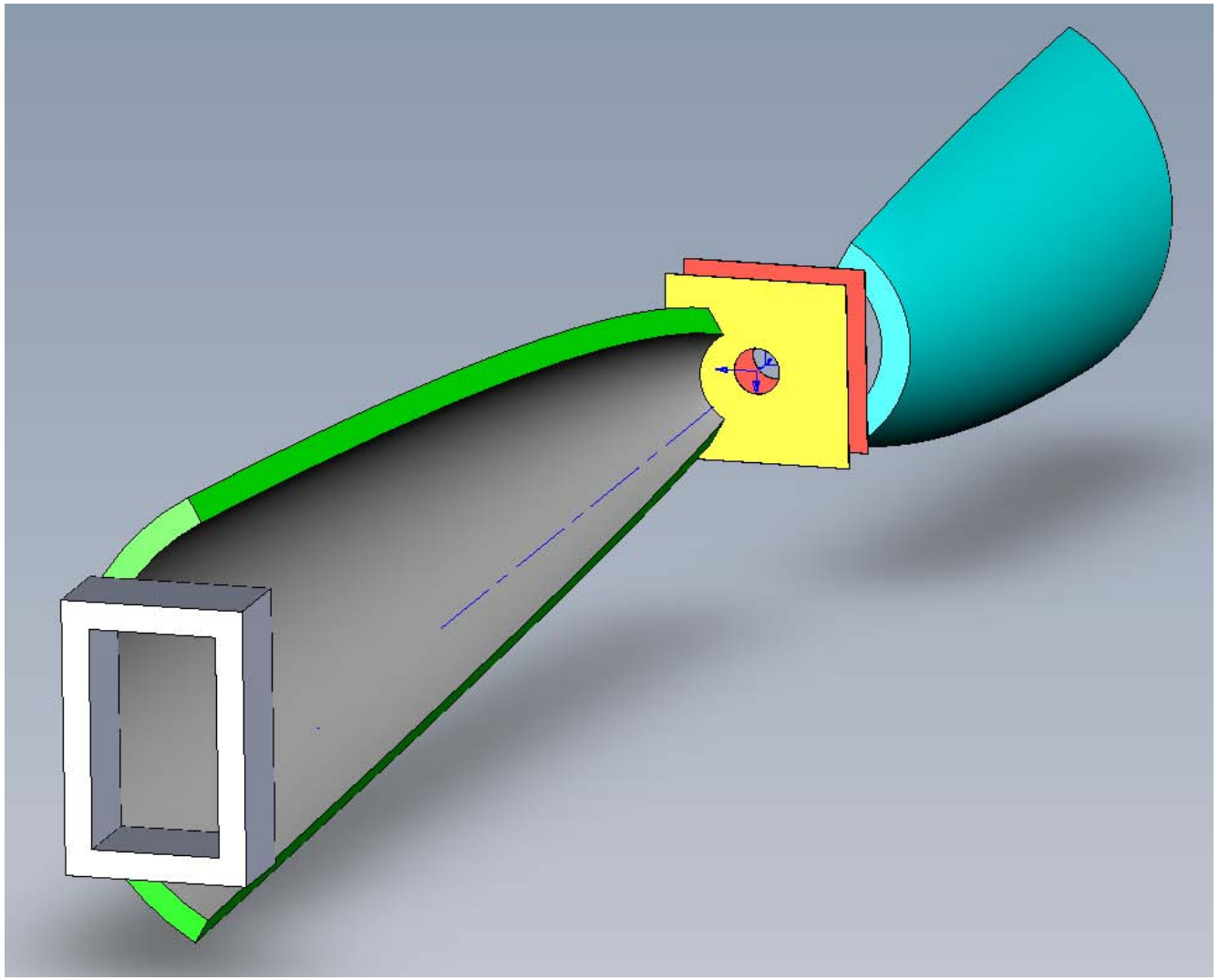




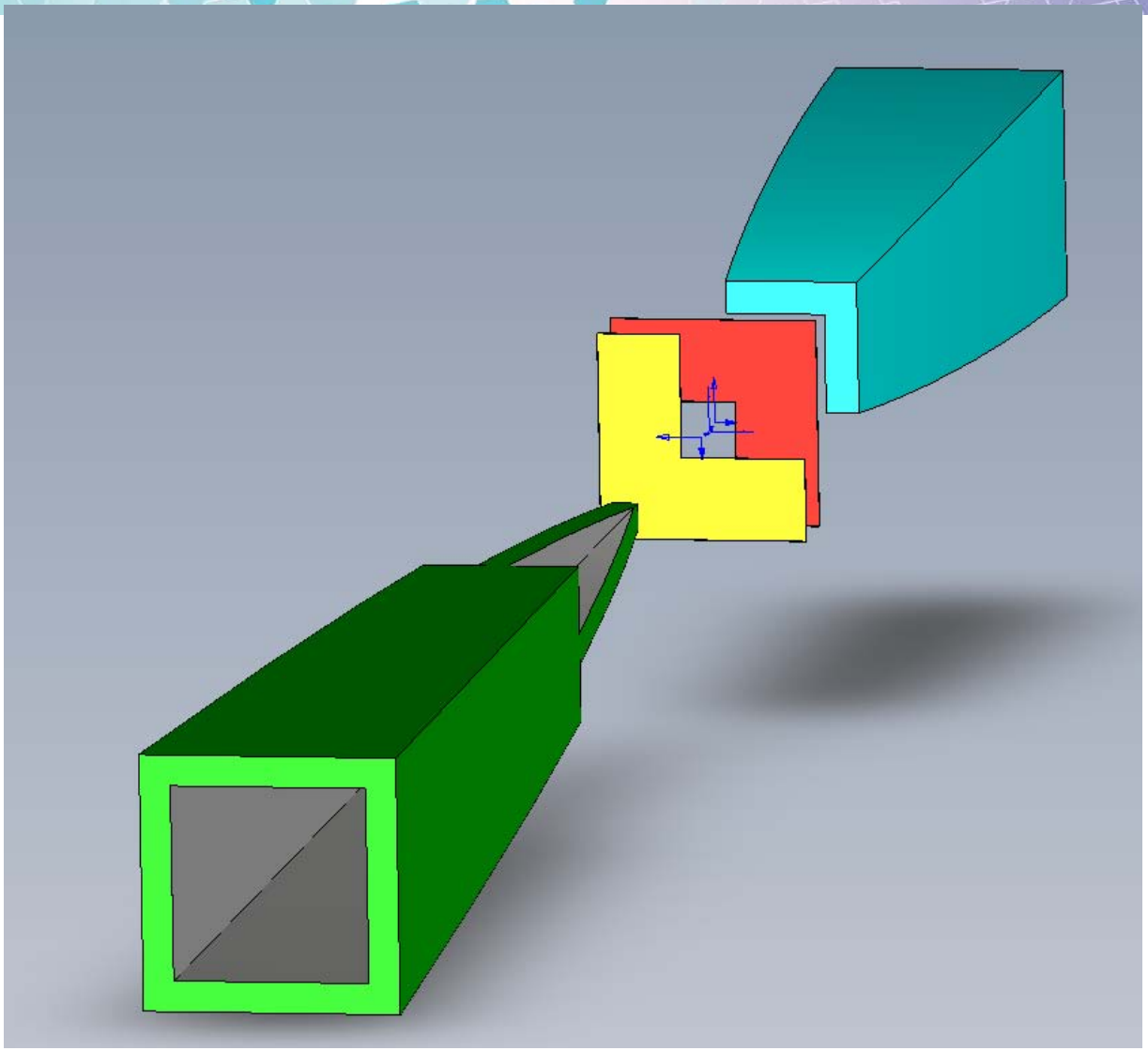
Gain 10 along one axis
➔ 100 with a 3D setup.

- Interests of the setup:
  - Beam focusing without abberation
  - Gain approx. 3 compared to pinhole with same sample size
- The beam size on the detector is independant of the sample size
- Large samples can be used for large intensity gains

3D View (2 reflections)

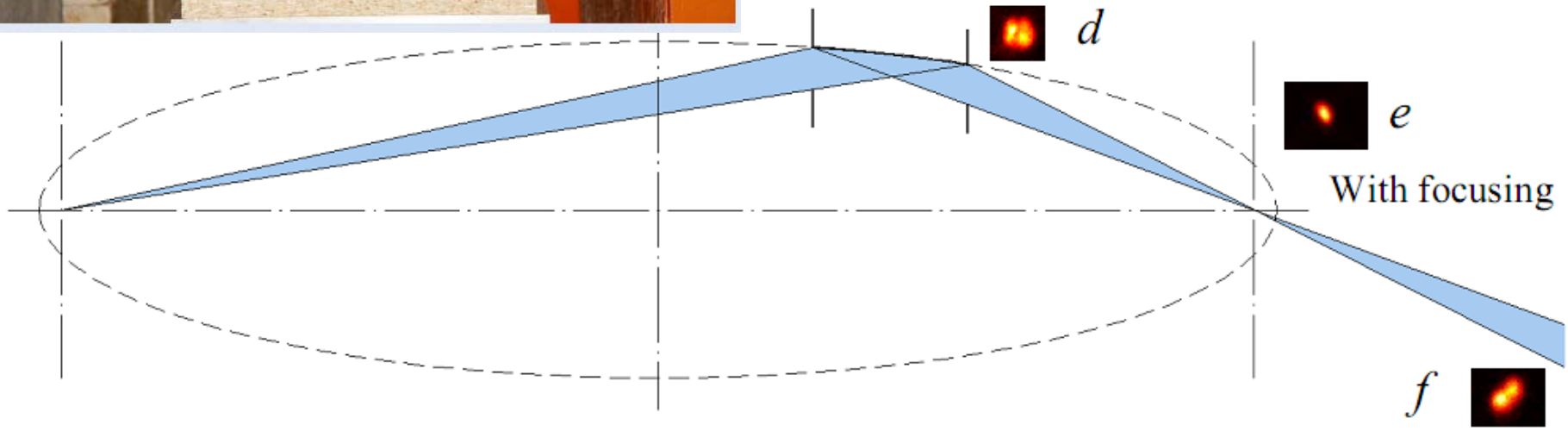


3D View (4 reflections)



Focusing SANS with Nested Elliptical Mirrors (J. Fuzi et al, BNC)
KB set-up

Proceedings of ECNS Prague



Collaborations - Common experiments

- LLB (S. Desert et al) performed experiments at PSI on BOA
  with T. Panzner
  on Focussing SANS with reflective optics

- ILL (R. Cubitt) performed experiments at PSI on AMOR
  with J. Stahn
  on Energy Encoding using prisms

- HZB (J. Schultz et al) performed experiments on EROS at LLB
  with F. Ott
  on Energy Encoding and focussing using prisms

- INFM (F. Sacchetti et al) performed experiments at PSI

DELIVERABLES

- No major deviations
- No major hurdles

- Some deliverables somewhat delayed
- But all Tasks should be fullfilled by the end of the project

- A number of proofs of concepts have already been done
- Need to be used/evaluated in « real life »