Advanced Focusing Techniques

P. Böni[1] and R. Valicu[2]

[1]Physik-Department E21
[2]Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II)

Technische Universität München
D-85747 Garching, Germany

E-mail: peter.boeni@frm2.tum.de
Web: www.ph.tum.de

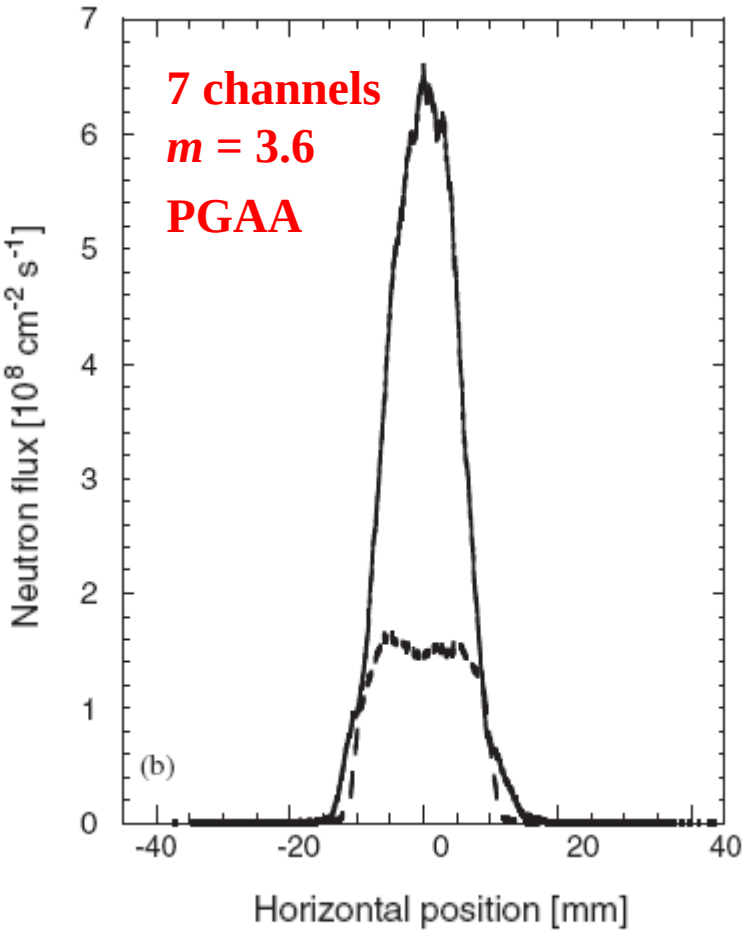
Motivation

Increase Flux for Small Samples

- multi-channel guides (JRR-3m, FRM II)
- adaptive optics:
  - o matching sample size
  - o matching divergence

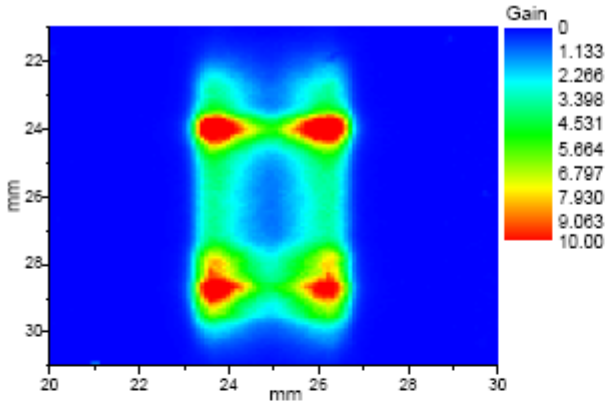
Challenges

- large *m*'s (> 6)
- alignment of samples
- chromatic aberration in TOF

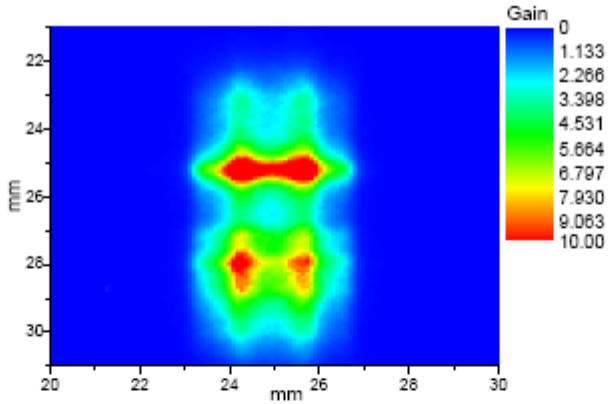


S. Yamada et al., Physica B **385-386**, 1243 (2006).

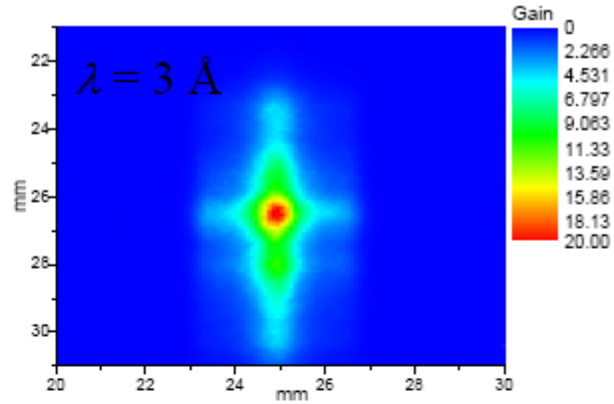
Parabolic Focusing: Gain = 20 (m = 3)



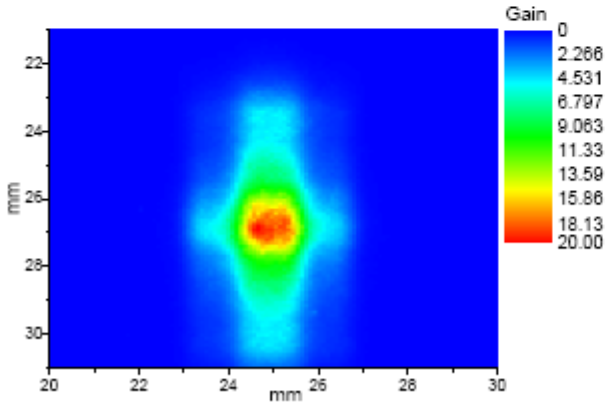
Distance: 0 mm



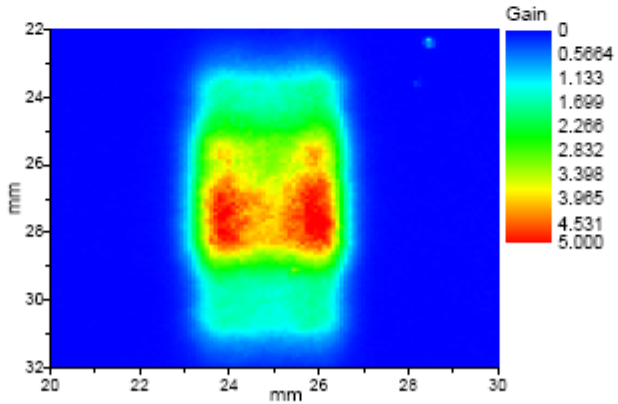
40 mm



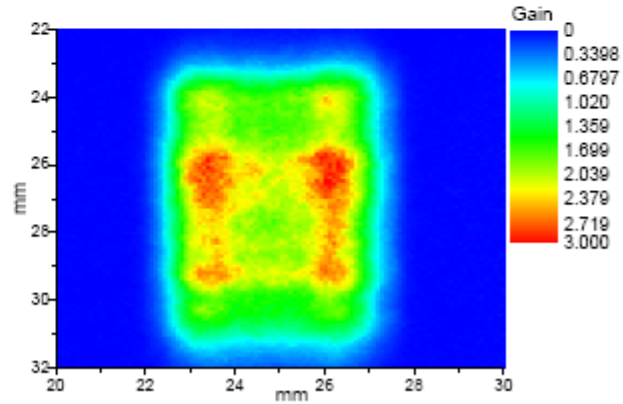
80 mm



Distance: 100 mm



150 mm



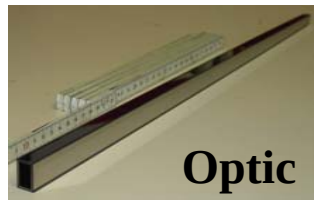
200 mm

N. Kardjilov et al., NIMA **542**, 248 (2005).

Application: Inelastic Neutron Scattering

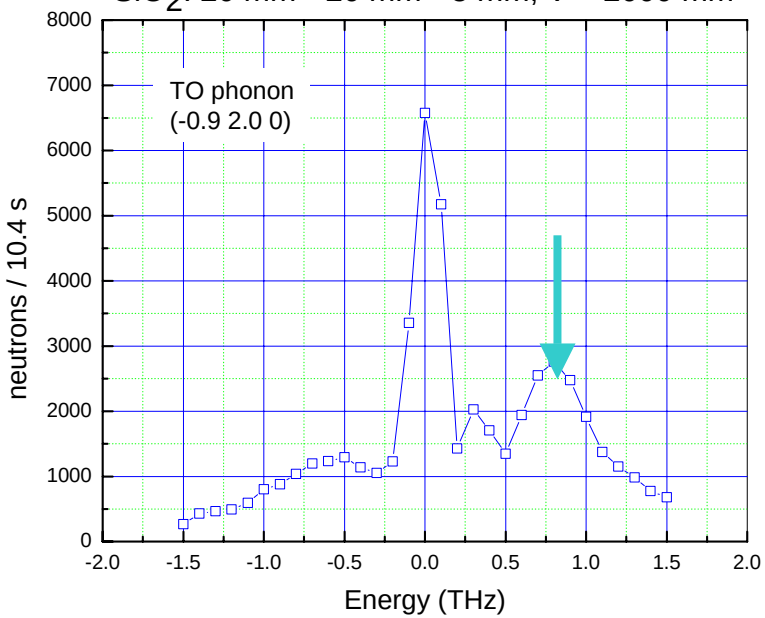
Annual Report E21, TUM, 30 (2007)

+

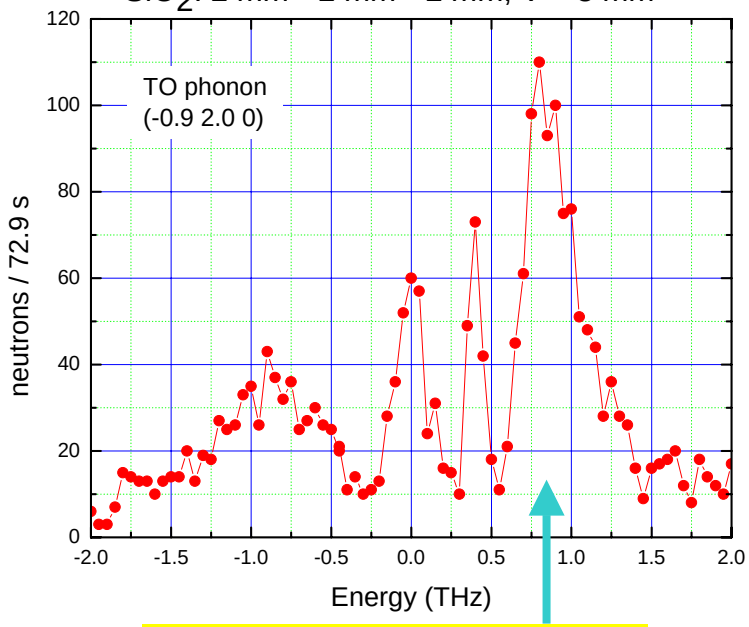


+

SiO_2: 20 mm * 20 mm * 5 mm, V = 2000 mm^3



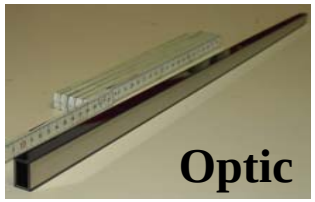
SiO_2: 2 mm * 2 mm * 2 mm, V = 8 mm^3



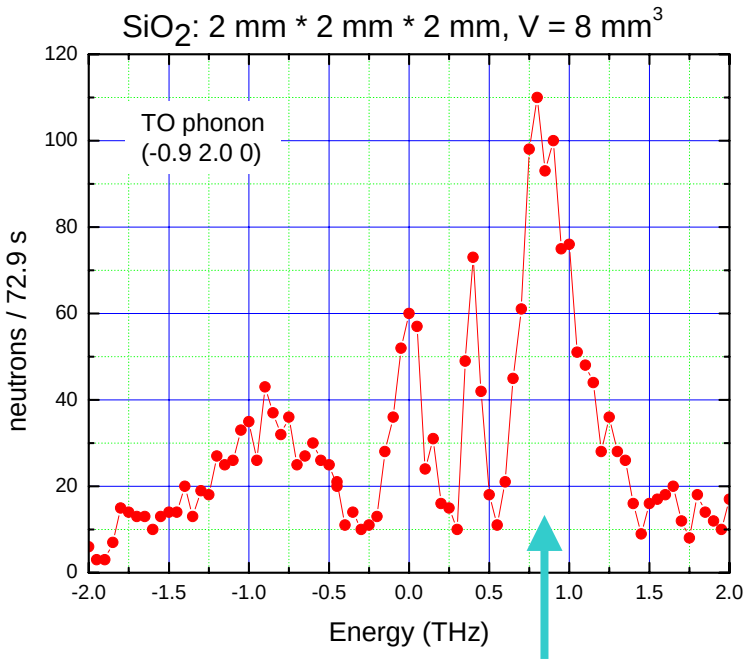
- sample: **250 times smaller**
- low background
- better resolution

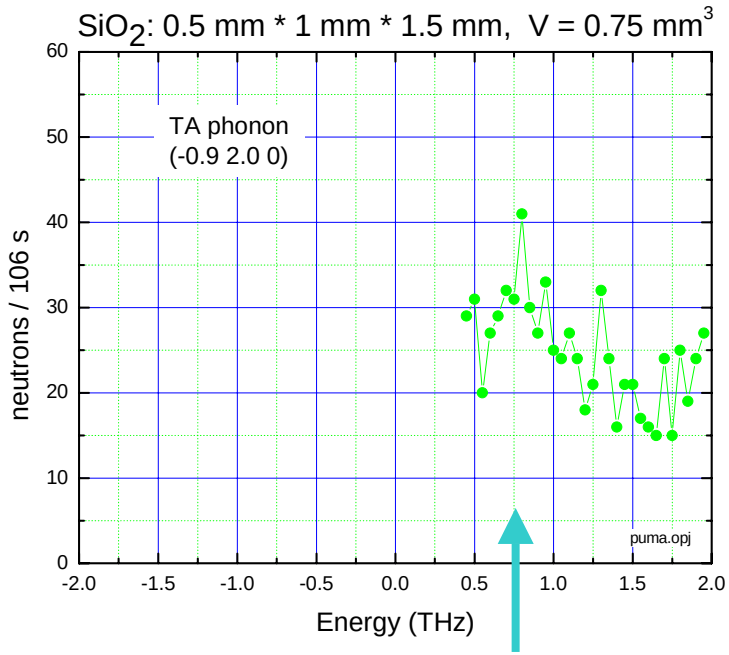
Problem:
- installation of optics
- alignment of sample

Sample Size < 1 mm^3



+





8 mm^3

0.75 mm^3

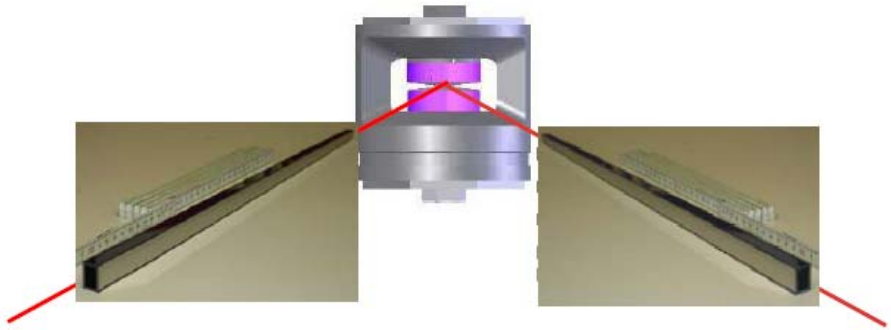
→ stronger focusing / multi-channel?

→ supermirror – band pass mirrors

Alignment of Samples

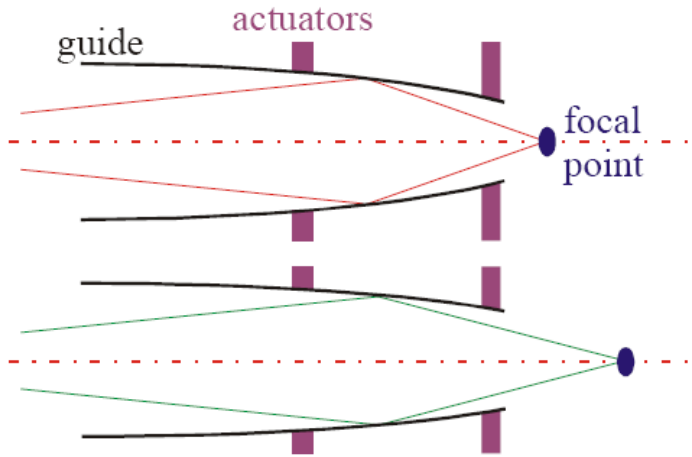
Example:

• high pressure



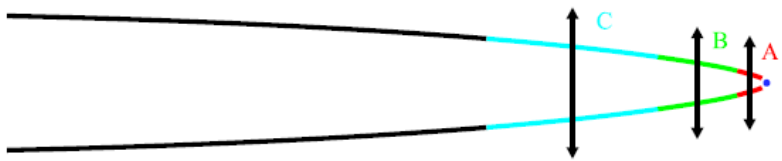
Use actuators:

• mechanical (slow)
• piezo-drives (fast)
• shape memory (fast)

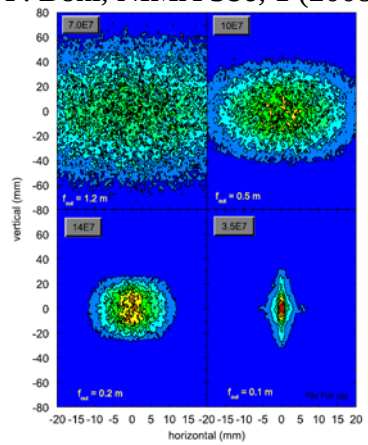


Or translations:

• mechanical (very slow)



P. Böni, NIMA **586**, 1 (2008).



Chromatic Aberration - Correction

Aberration:

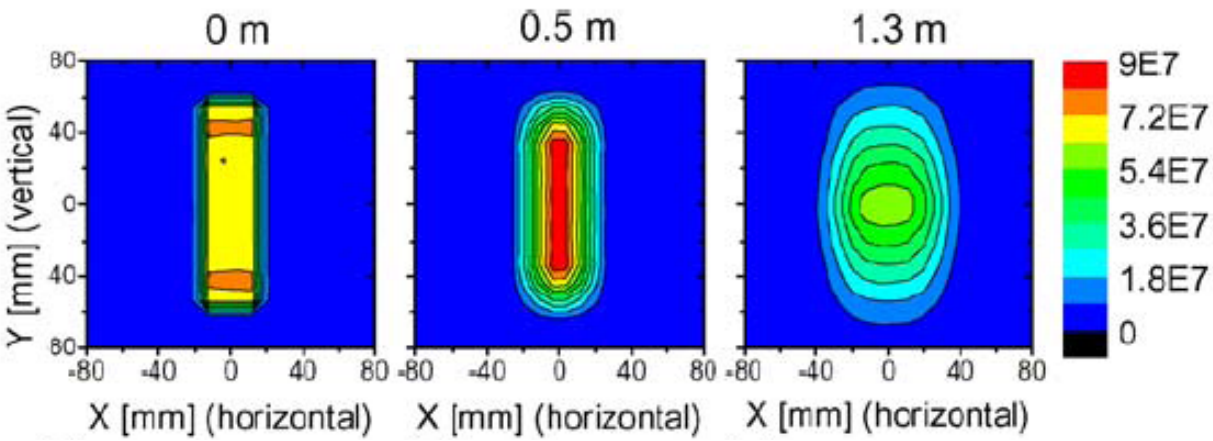
• focal length of tapered guide depends on λ

McStas simulation:

• f_{nom} = 1.3 m
• f_{eff} = 0.5 m

→ ToF: fast correction necessary

C. Schanzer et al., NIMA 529, 63 (2004).



Correction by:

• piezo-drives
• shape memory → development of such systems

Collaborations

Task 1: multi-channel devices — **Collaboration with**

- optimization: ILL, PSI, UCPH
- fabrication and testing: PSI, ILL
- installation: PSI, ILL

UCPH

Task 2: adaptive optics — **Collaboration with**

- simulation, design: PSI, UCHPH
- test, qualification: PSI
- imaging, PGAA PSI, HZB
- installation (AMOR, TASP, KOMPASS): PSI

UCPH