Physics at high energy x-ray radiation

Veijo Honkimäki

OUTLINE

MOTIVATIONS TO WORK AT HIGH PHOTON ENERGIES

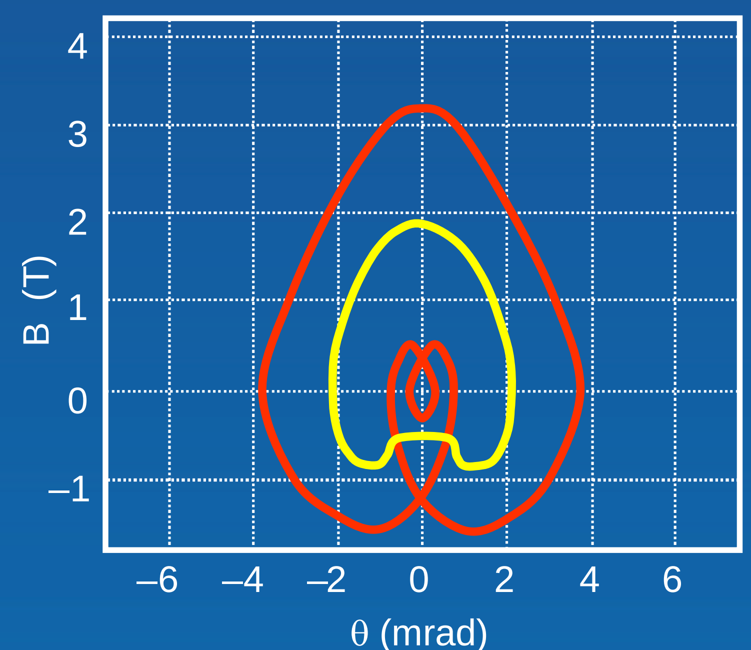
EXAMPLES

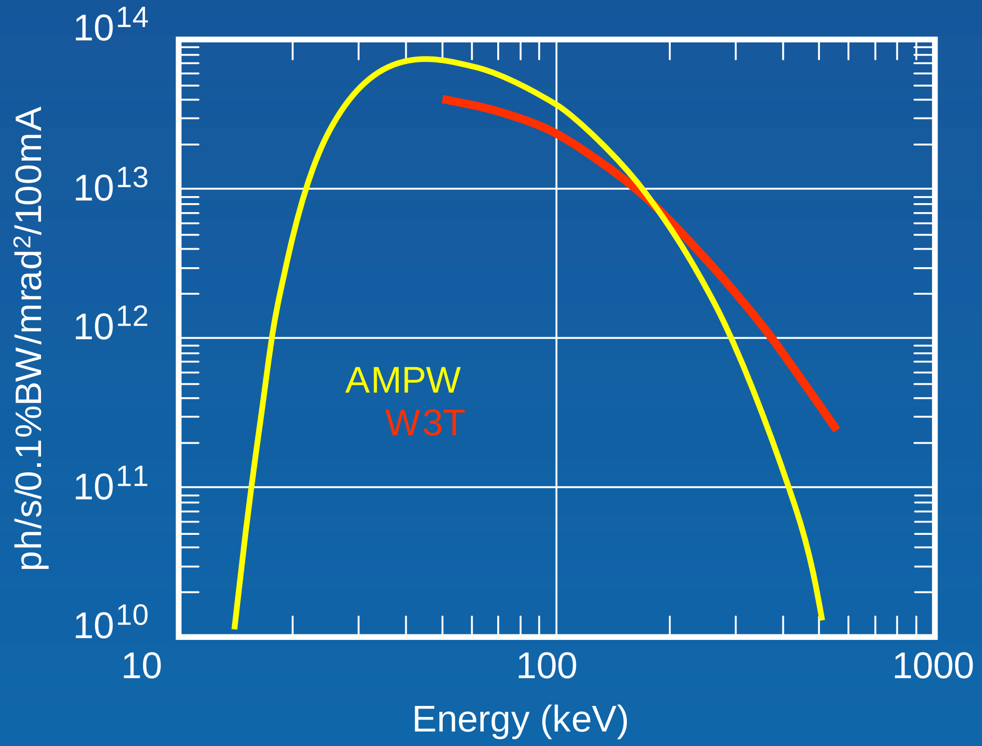
- SCREENING COMPLETE TERNARY PHASE DIAGRAMS
- VOID FORMATION IN Nb_3Sn SUPERCONDUCTOR
- GIANT METAL COMPRESSION AT LIQUID-SOLID SCHOTTKY JUNCTION
- MORPHOLOGICAL STUDIES OF WET GRANULAR MATTER

SOURCES AT ID15

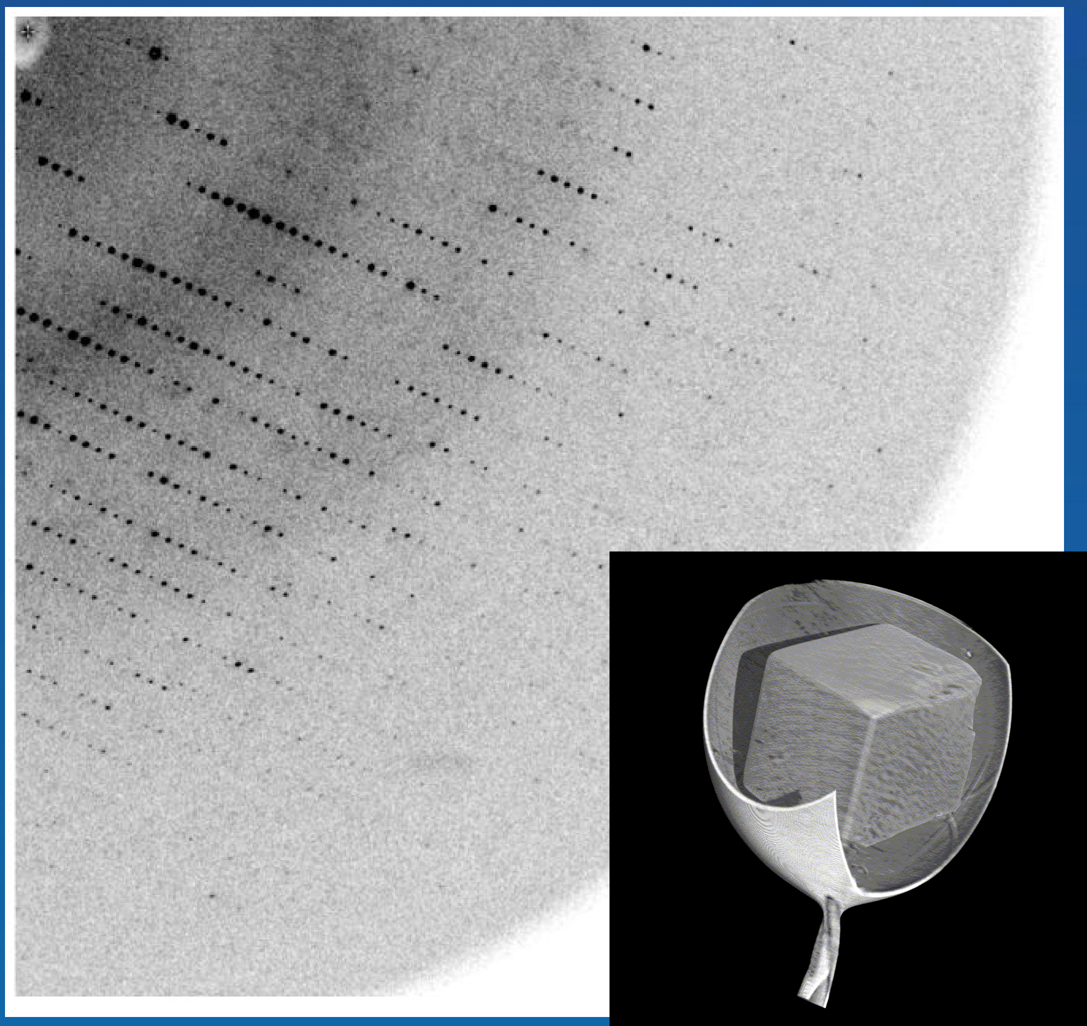
	B (T)	# poles	E_c (keV)
AMPW	1.8	7	45
W3T	3.2	2	76

J.E. McCarthy et al.
The cross-section for magnetic Compton scattering up to 1 MeV
***NIM A* 401 (1997)**





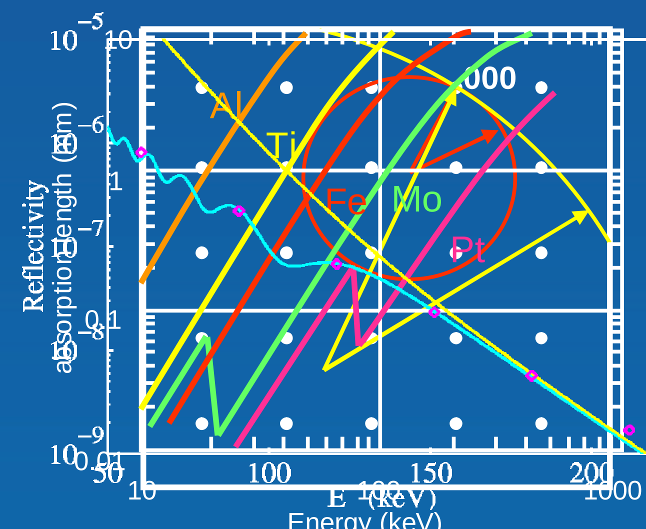
DIFFRACTION AT HIGH ENERGIES



LOW ABSORPTION
- penetration depth
- sample environment
- low dose

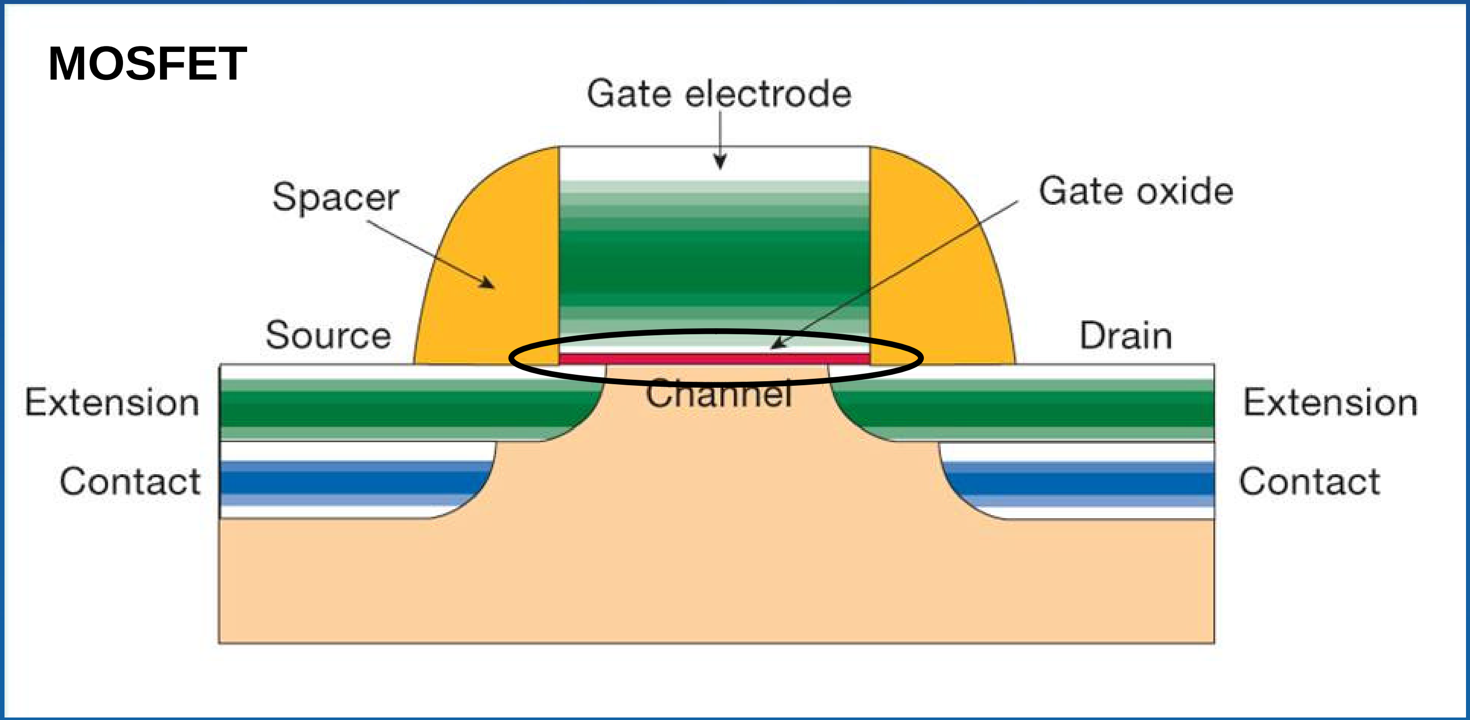
FLAT EWALD SPHERE
- diffraction on forward direction

EXTINCTION LENGTH



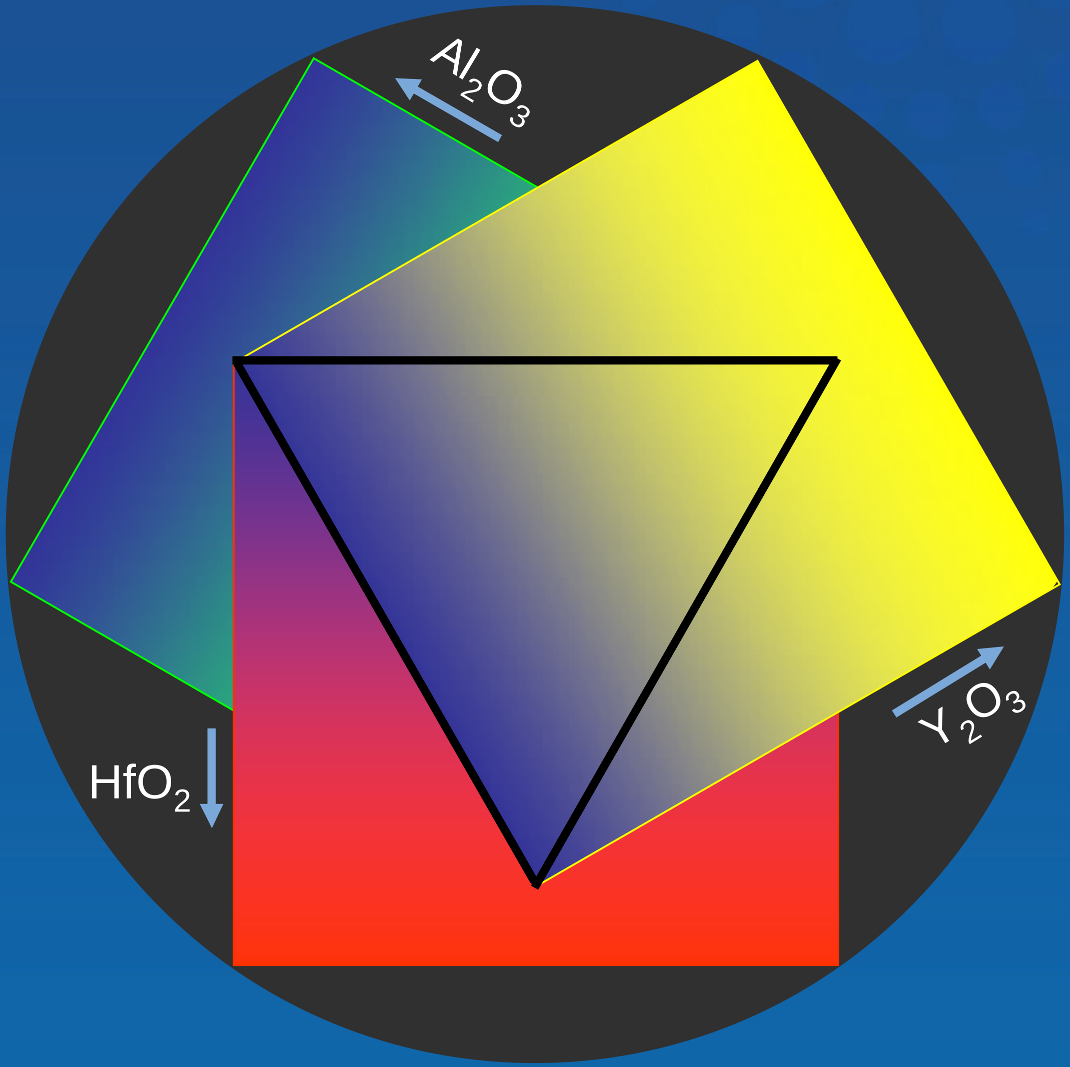
COMPLETE TERNARY PHASE DIAGRAMS

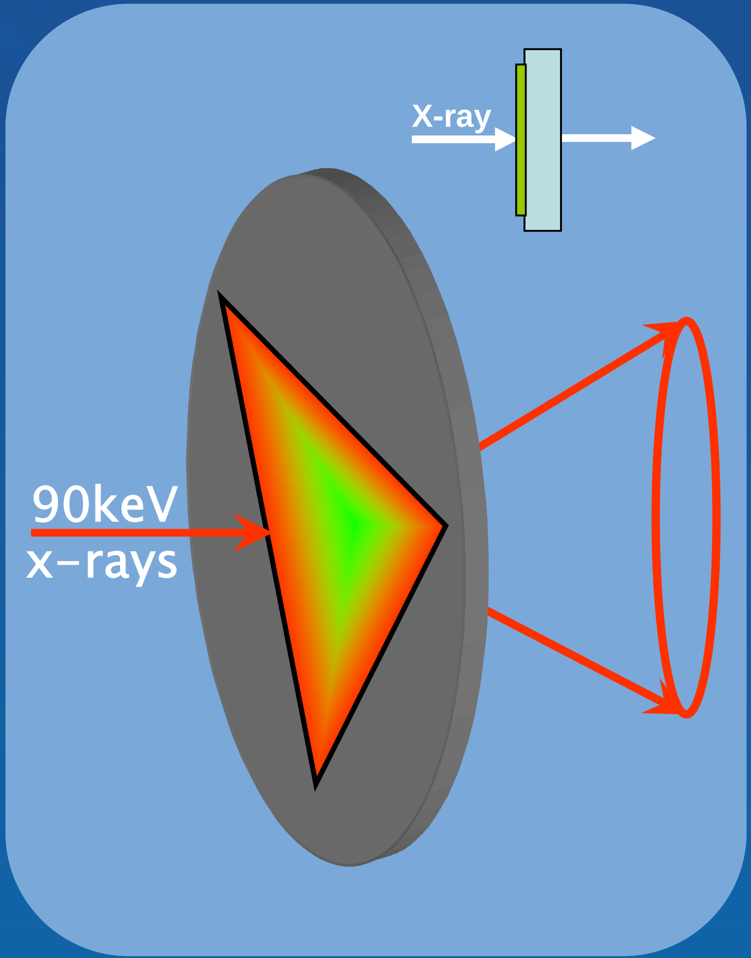
OXIDE GATES WITH HIGH DIELECTRIC CONSTANT (high-k) IN Si FETs



Industrial demand: SiO_2 (low-k) → HfO_2 (high-k)

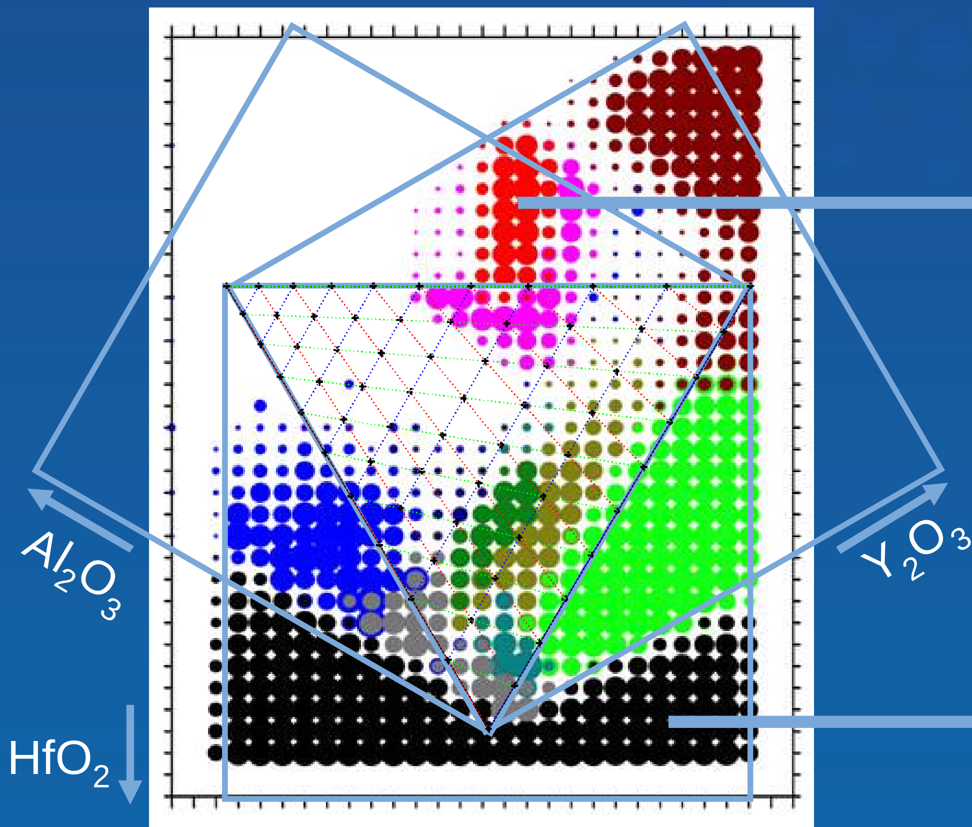
HfO_2–Y_2O_3–Al_2O_3 composition spread sample

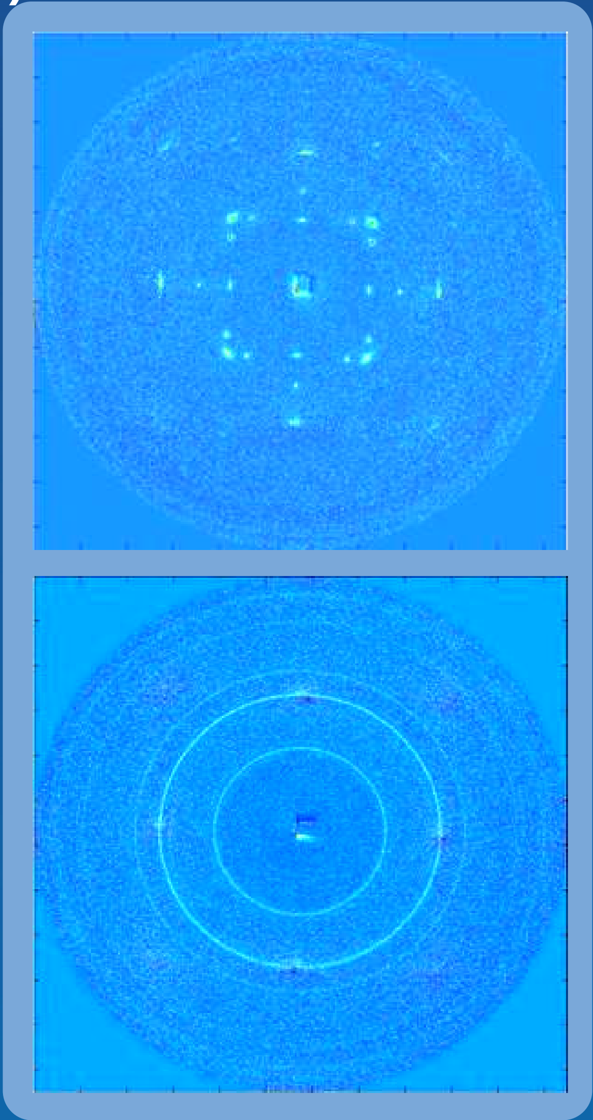




D.A. Kukuruznyak, H. Reichert, J. Okasinski, H. Dosch, T. Chikyow, J. Daniels and V. Honkimäki, *Appl. Phys. Lett*. 91 (2007)

HfO_2–Y_2O_3–Al_2O_3 composition spread sample



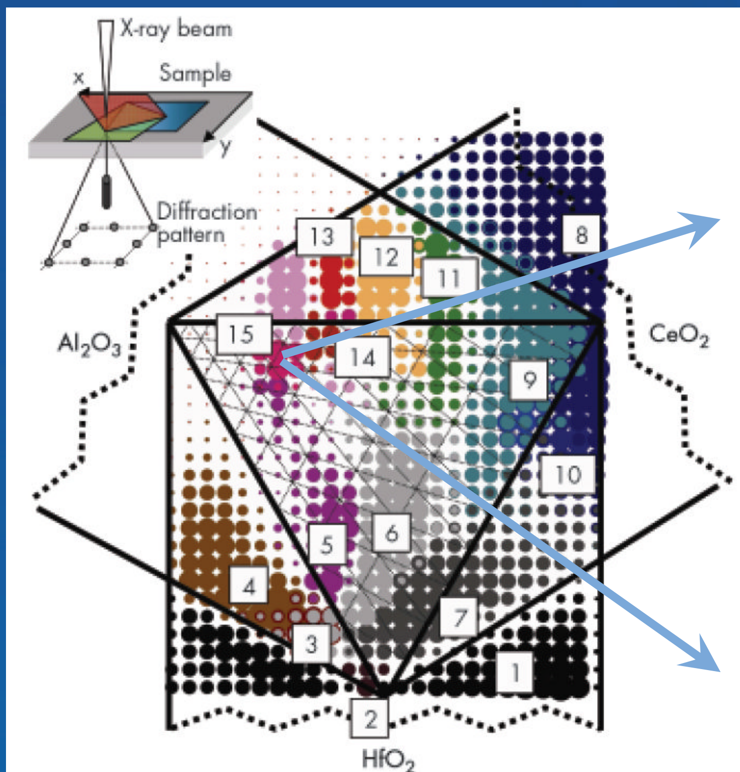


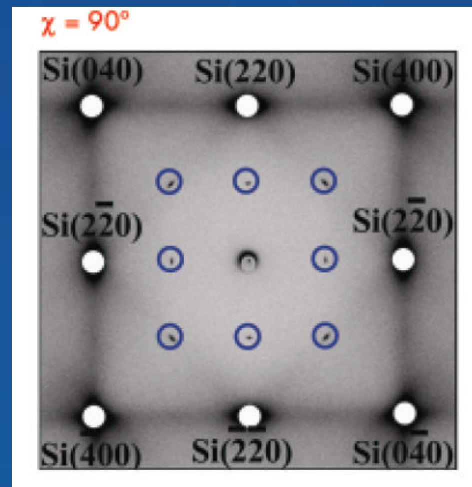
Polycrystalline HfO_2 — Epitaxial $Y_{1+X}Al_{1-X}O_3$

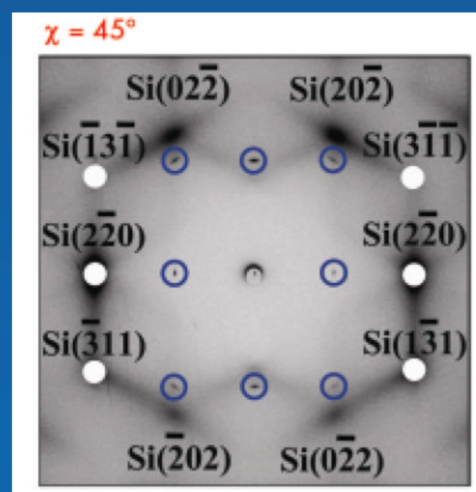
Polycrystalline Y_2O_3 — Textured $Y_{1+X}Al_{1-X}O_3$

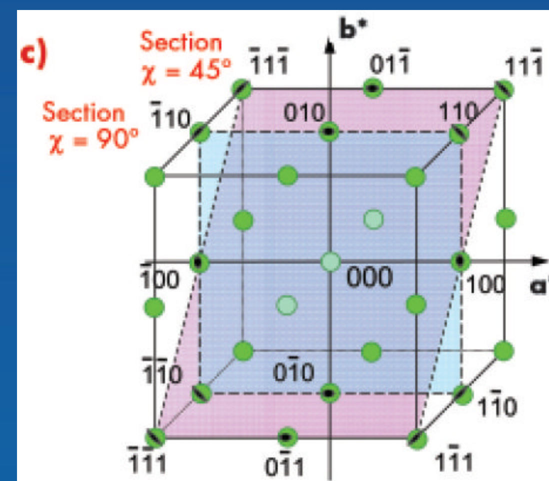
fluorites — Phase I — Phase II

HfO_2–CeO_2–Al_2O_3 composition spread sample









Polycrystalline phases: **1-11**

Epitaxial phases:

12: $Ce_{1.12}Al_{0.88}O_3$ apatite

13: hexagonal $Ce_{1.06}Al_{0.94}O_3$

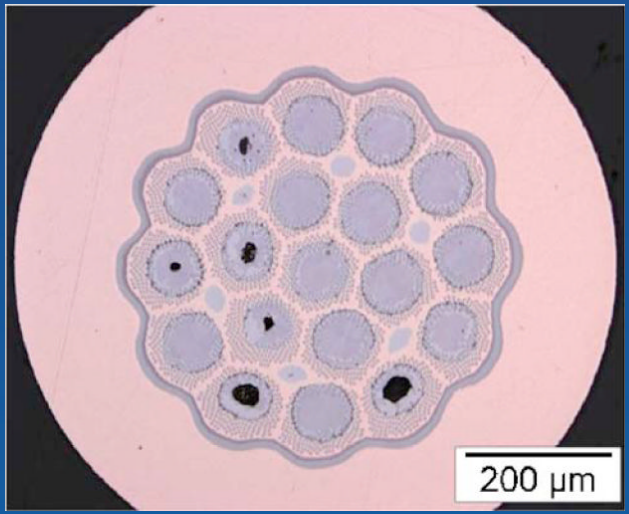
14: tetragonal $Ce_{0.95}Al_{0.95}Hf_{0.1}O_{3.05}$

15: cubic $CeAlO_3$ perovskite

ON THE FORMATION OF VOIDS IN INTERNAL TIN Nb_3Sn SUPERCONDUCTORS

C. Scheuerlein, M. Di Michiel, A. Haibel

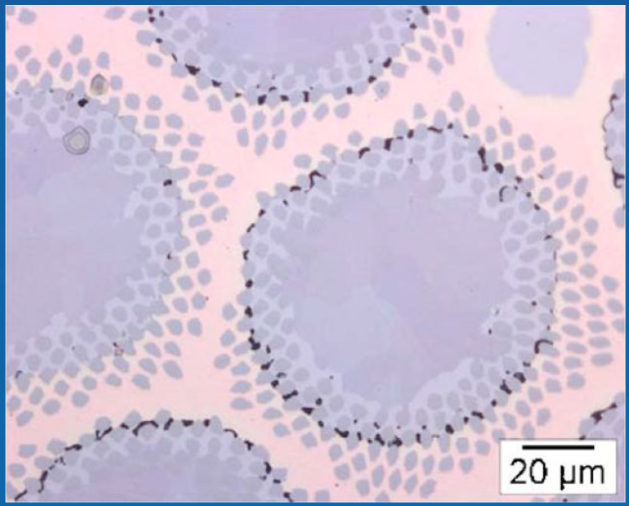
Appl. Phys. Lett. 90 (2007)



Destructive metallographic techniques: eratic and misleading due to irregularities of strands

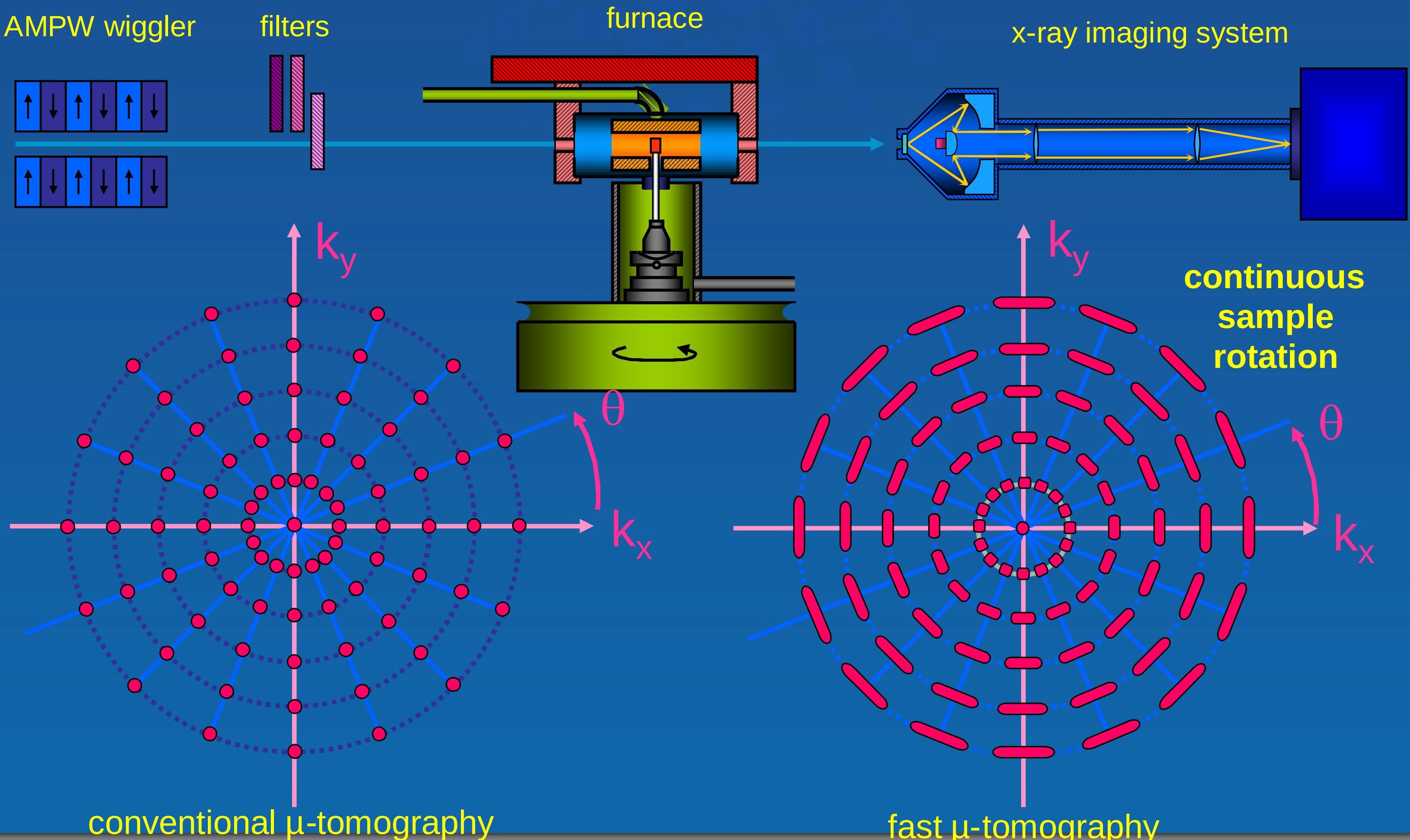
⇓

In-situ combined diffraction and tomography study



ID15A: HIGH ENERGY μ-TOMOGRAPHY

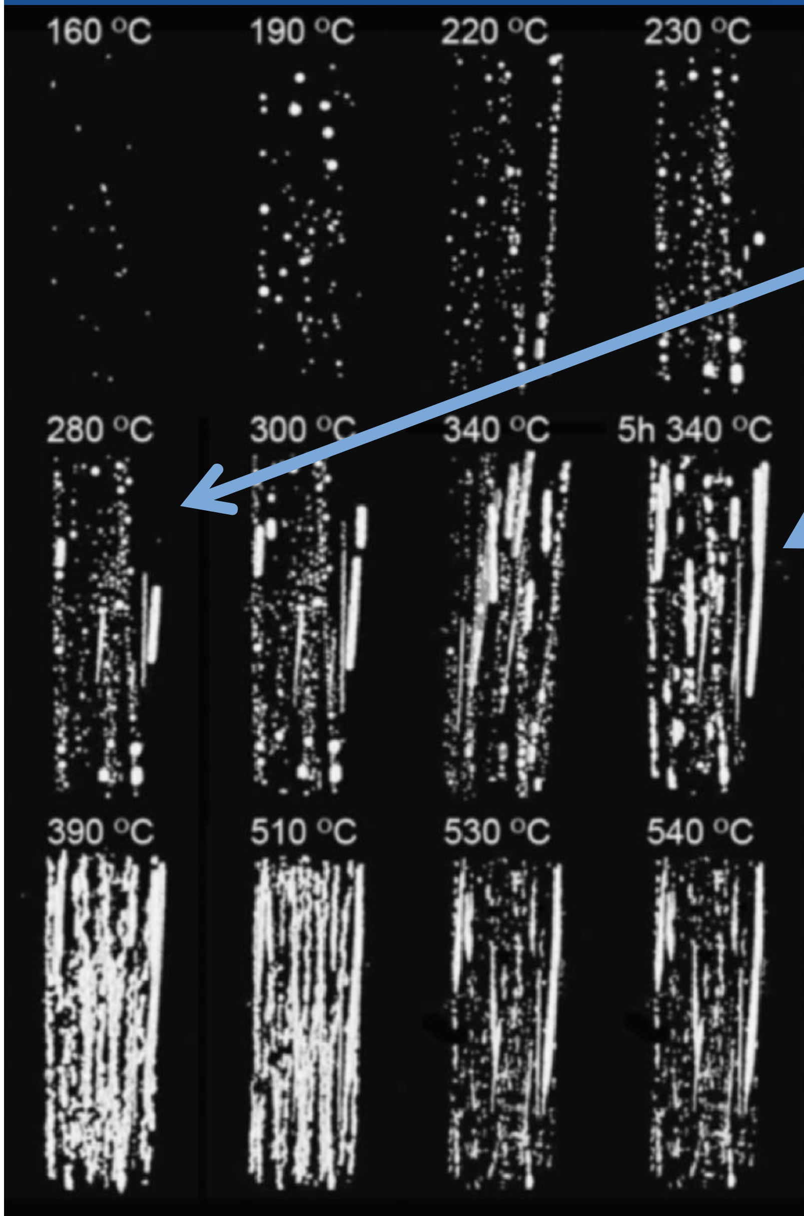
Di Michiel et al., *Rev. sci. instrum.* 76 (2005)

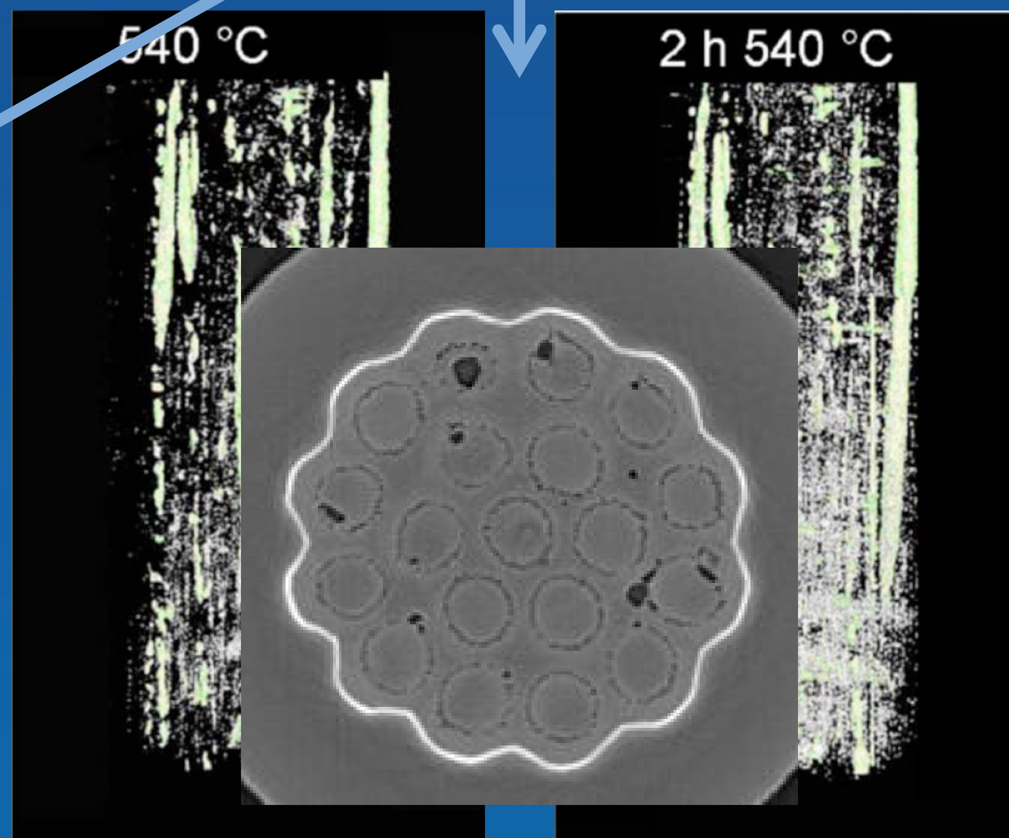


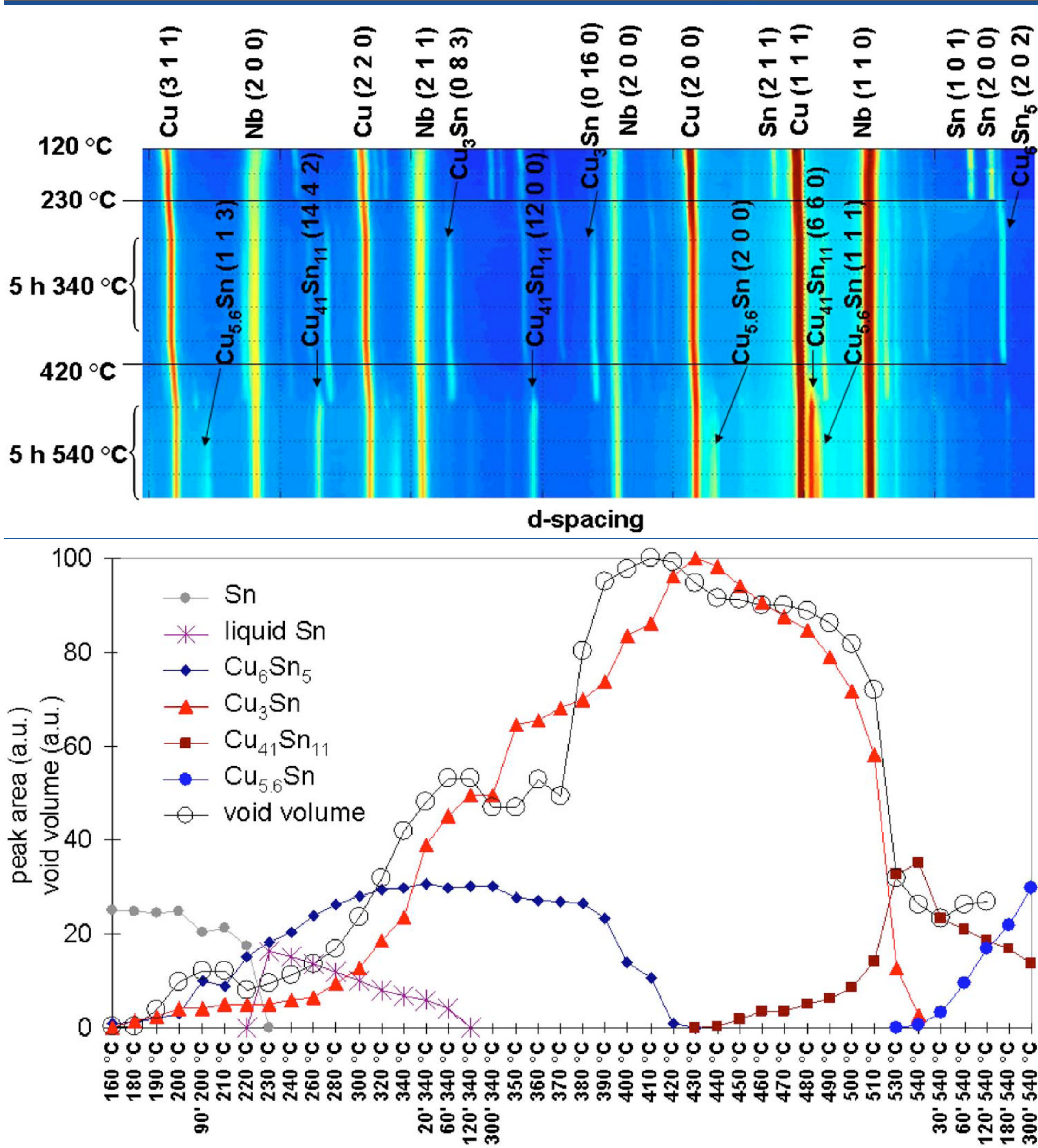
Elongation of voids at 280°C

Agglomeration of globular voids during isothermal step at 340°C

Strong increase of small interfilament voids during isothermal step at 540°C

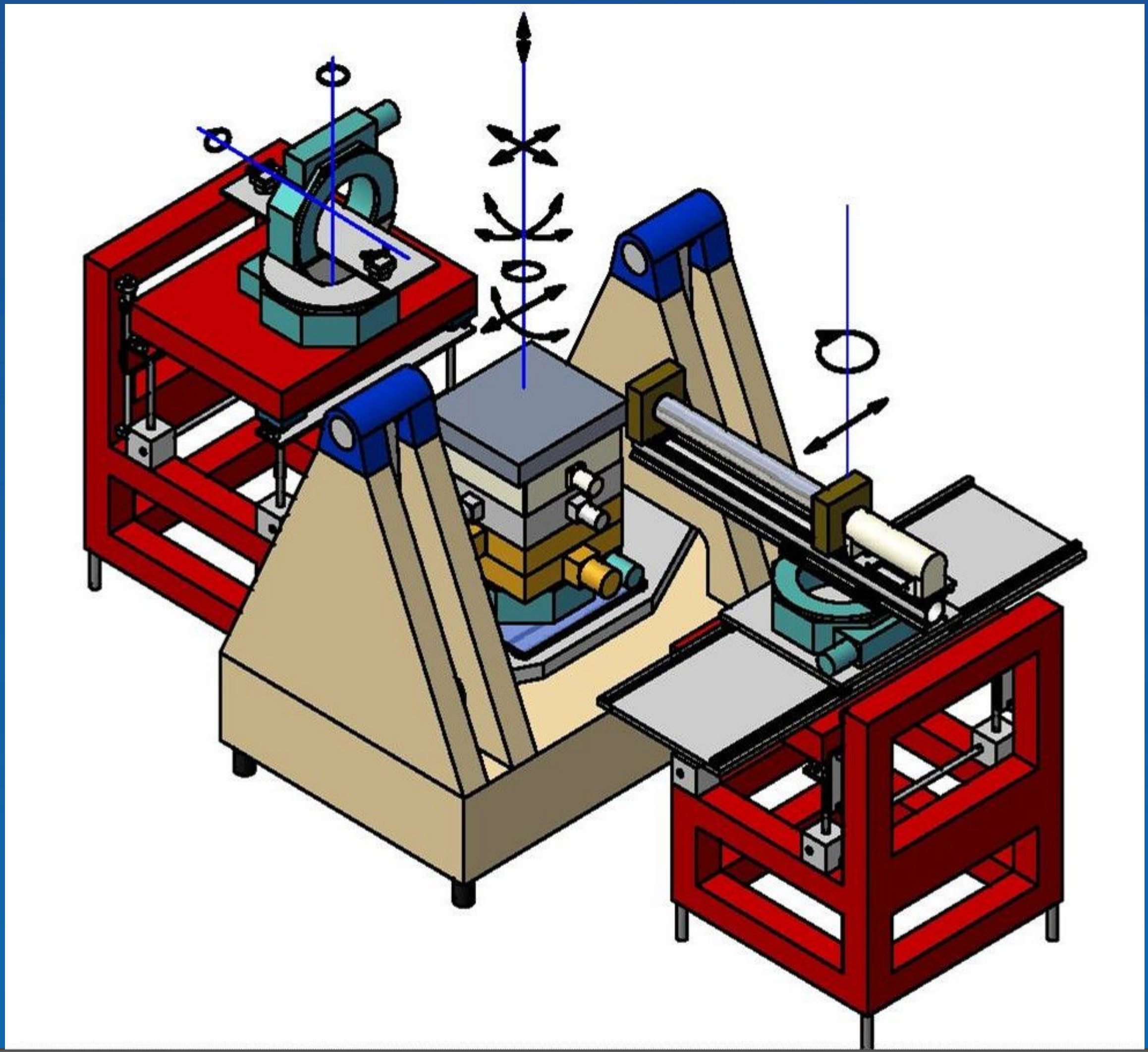






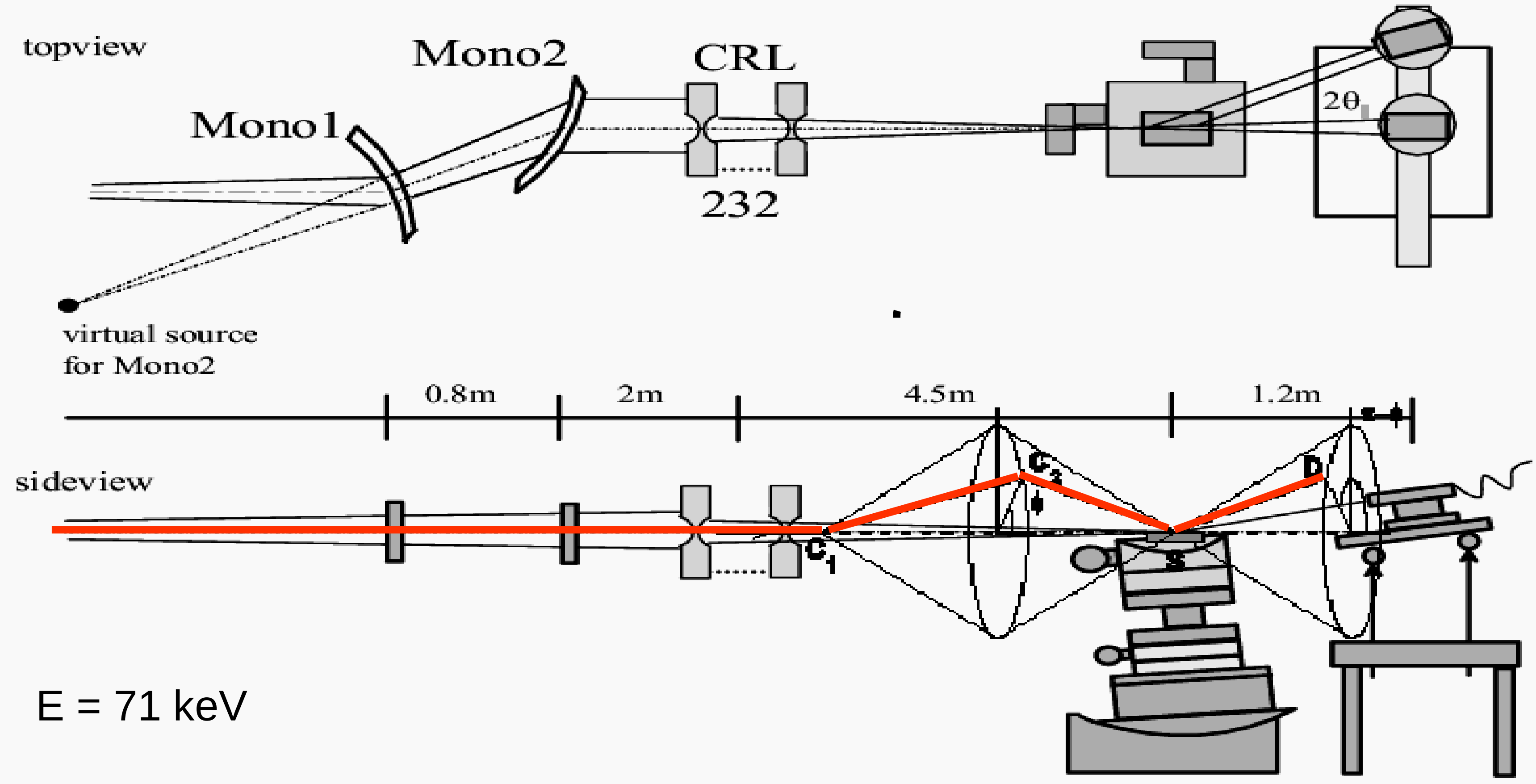
- Agglomeration of voids up to 200°C
- Void growth through density changes; strong correlation with Cu_3Sn content
- Strong increase of small interfilament voids during isothermal step at 540°C but no phase transitions
- **Isothermal holding steps at 340 and 540°C are counterproductive**

MICRO-DIFFRACTION SETUP AT ID15 BY MPI / STUTTGART

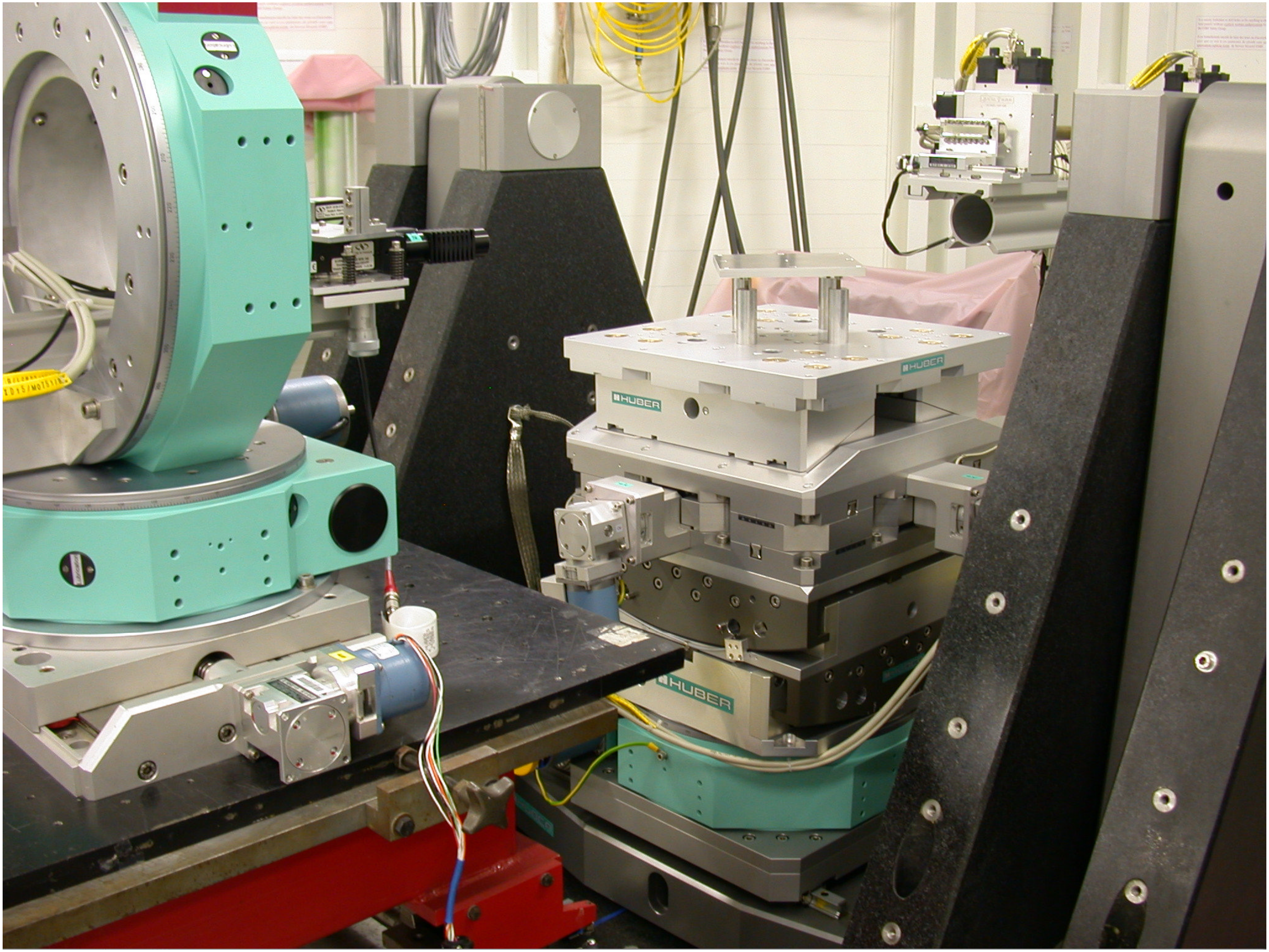


Study of Deeply Buried Interfaces using High Energy Microbeams

H. Reichert, S. Engemann, H. Dosch (MPI, Stuttgart)
A. Snigirev, J. Okasinski, V. Honkimäki (ESRF, Grenoble)



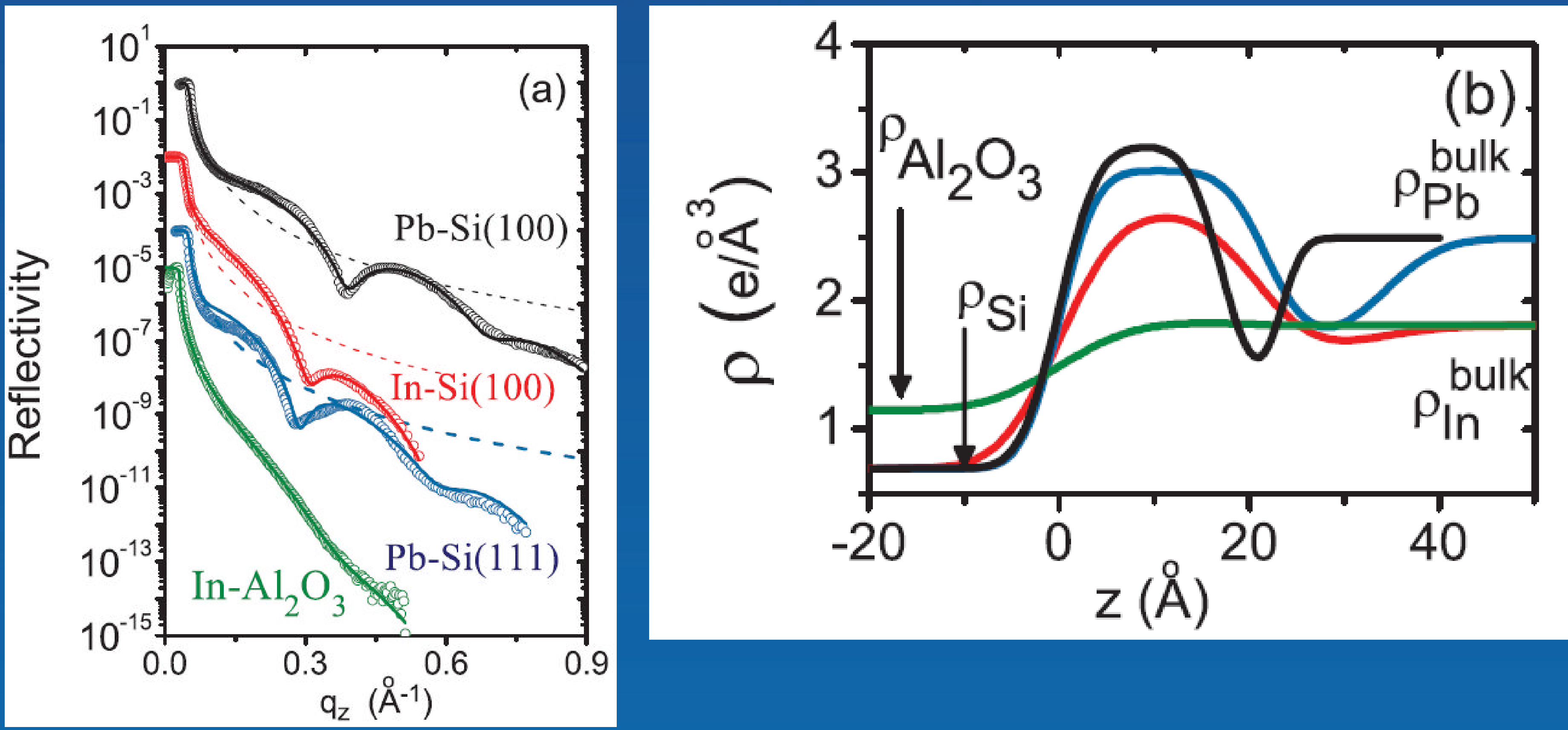
E = 71 keV


HUBER
HUBER
HUBER

GIANT METAL COMPRESSION AT LIQUID SOLID (Pb-Si, In-Si) SCHOTTKY JUNCTION

H. Reichert, M. Denk, J. Okasinski, V. Honkimäki, H. Dosch

***Phys. Rev. Lett.* 98 (2007)**



Morphological clues to wet granular pile stability

M. SCHEEL et al., *Nature Materials* 7 (2008)


nature materials

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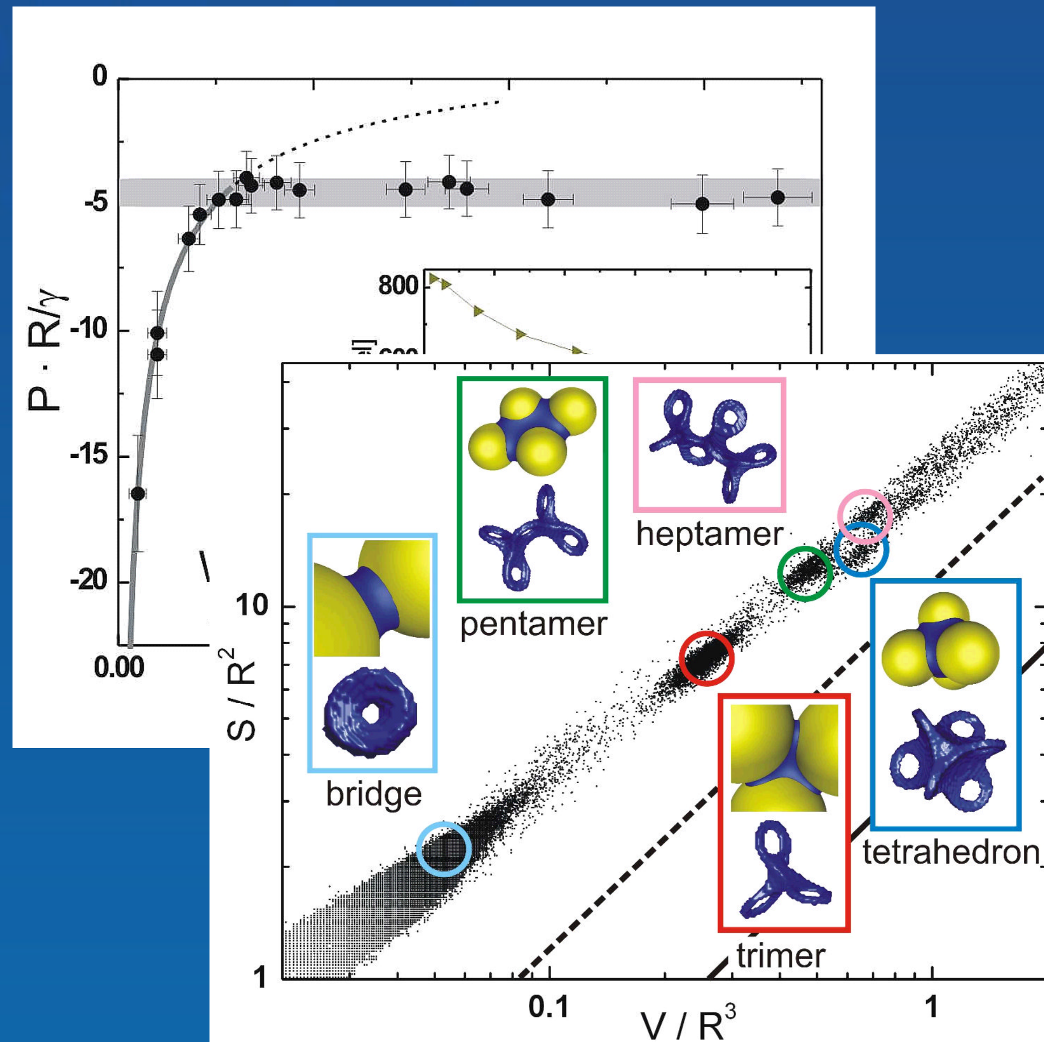
About the cover

March 2008 Volume 7 No 3

The insensitivity of the mechanical properties of wet, granular matter - such as sandcastles - to their liquid content is not well understood. X-ray microtomography demonstrates that this behaviour results from the organization of the liquid into a variety of bridges and clusters. For spherical as well as non-spherical grains, a simple geometric rule relating the macroscopic properties to the internal liquid morphologies is proposed.

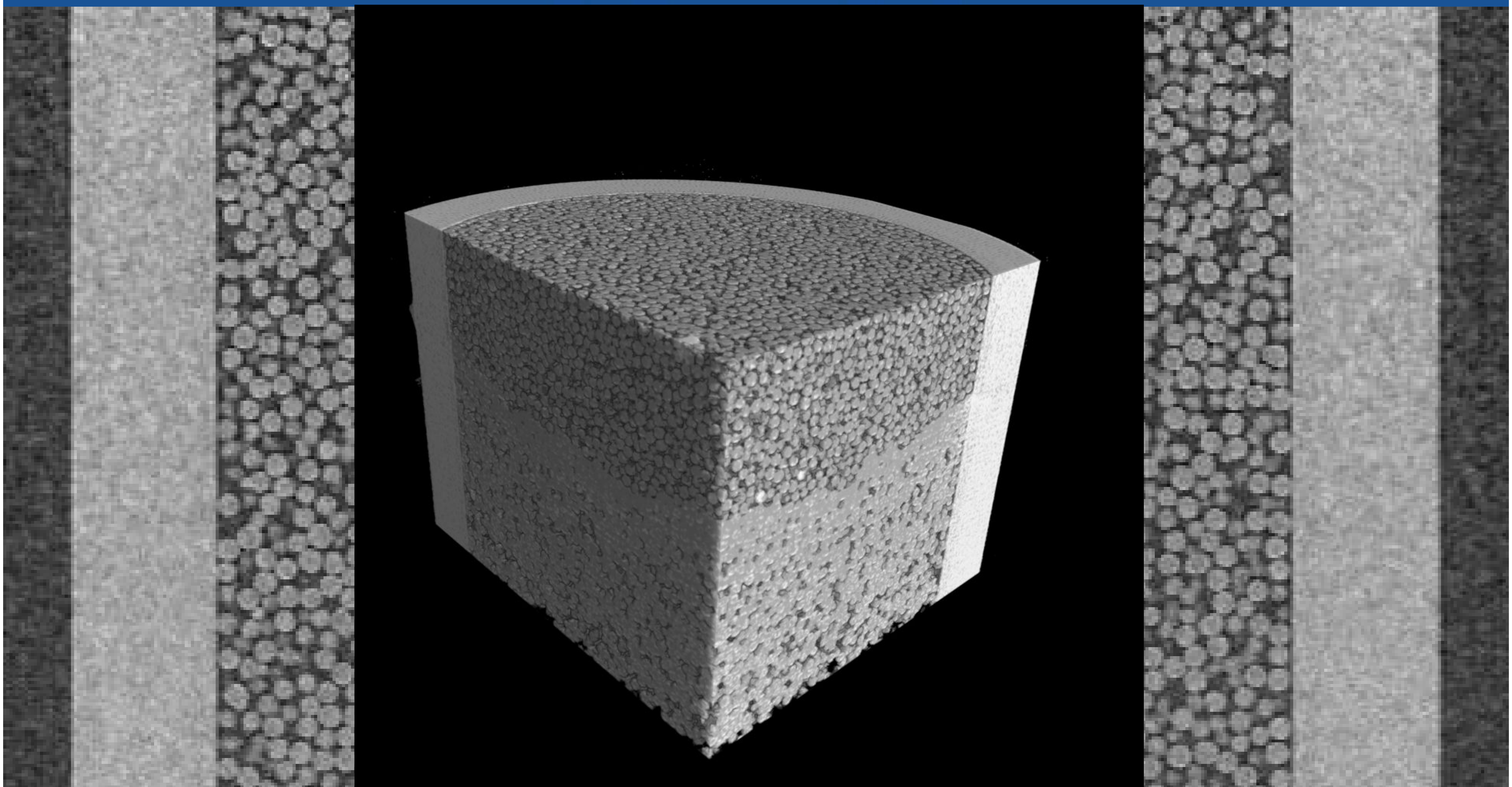
Cover image ©iStockphoto.com/Ron Hohenhaus

Letter by Scheel *et al.*



EVOLUTION OF MICRO-TOMOGRAPHY AT ID15A

PROPAGATION OF LIQUID FRONT IN GRANULAR MATERIAL



ID15 A + B

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