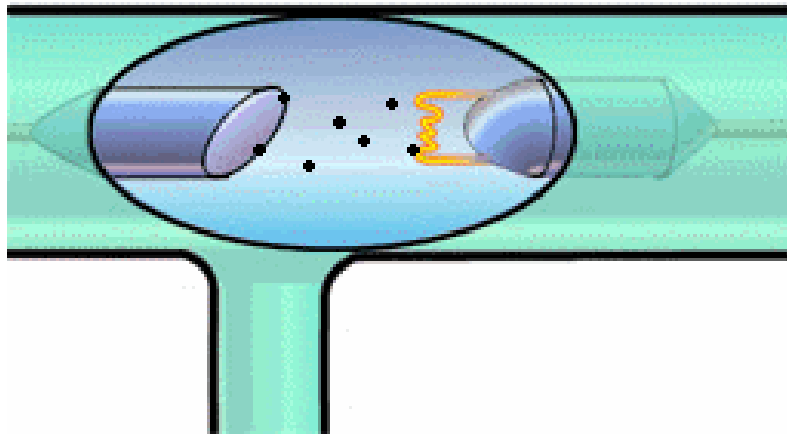


Erzeugung von Röntgenstrahlung...

...durch abgebremste / beschleunigte Elektronen



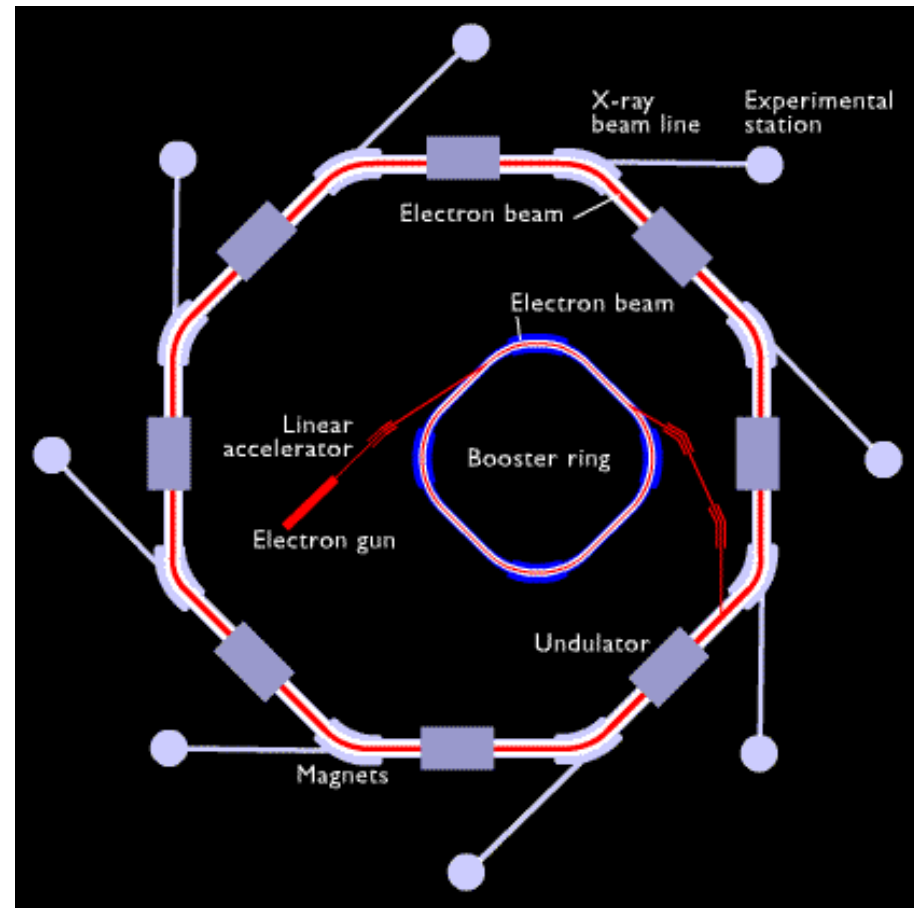
Röntgenröhre (-anode)



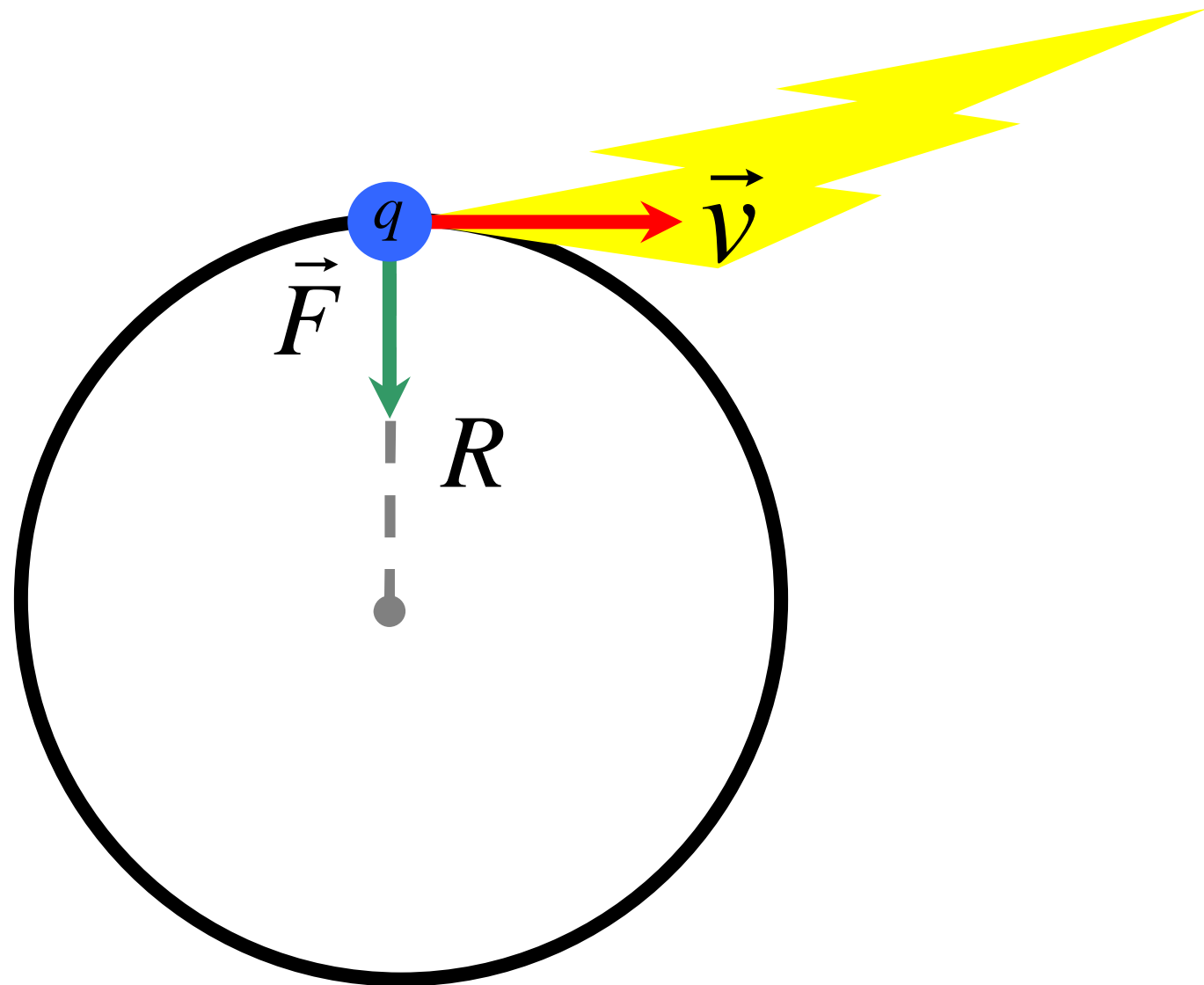
1895



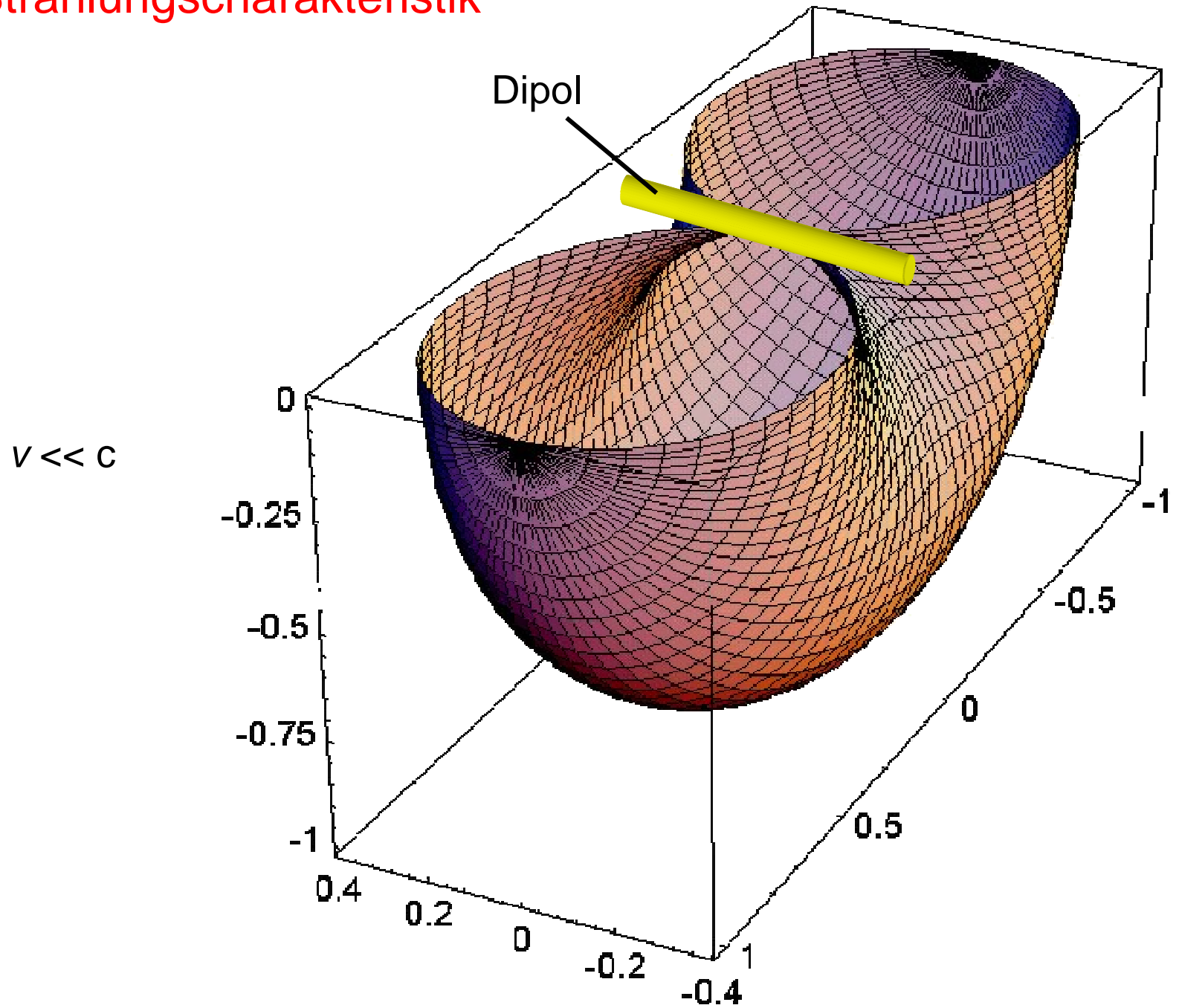
Elektronen-Synchrotron



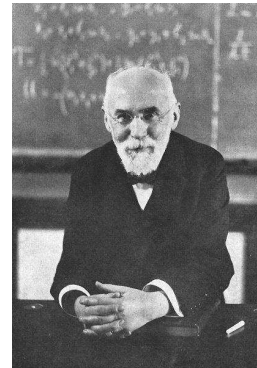
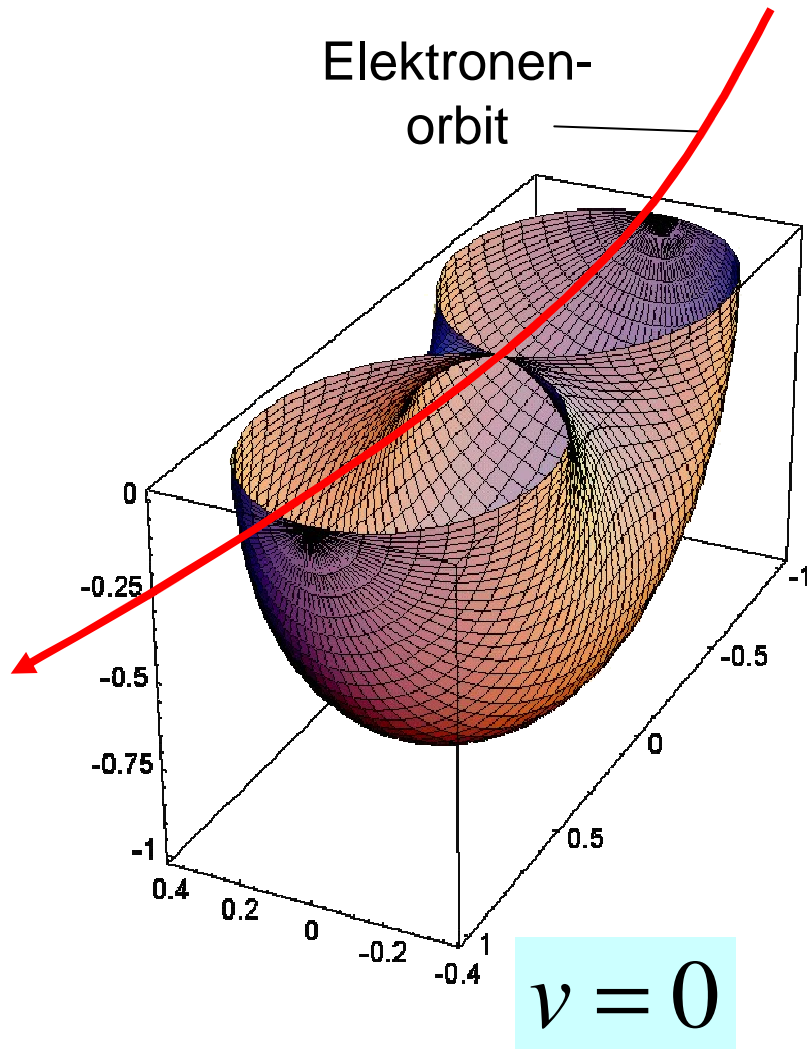
Ladung (z. B. Elektron) auf einer Kreisbahn



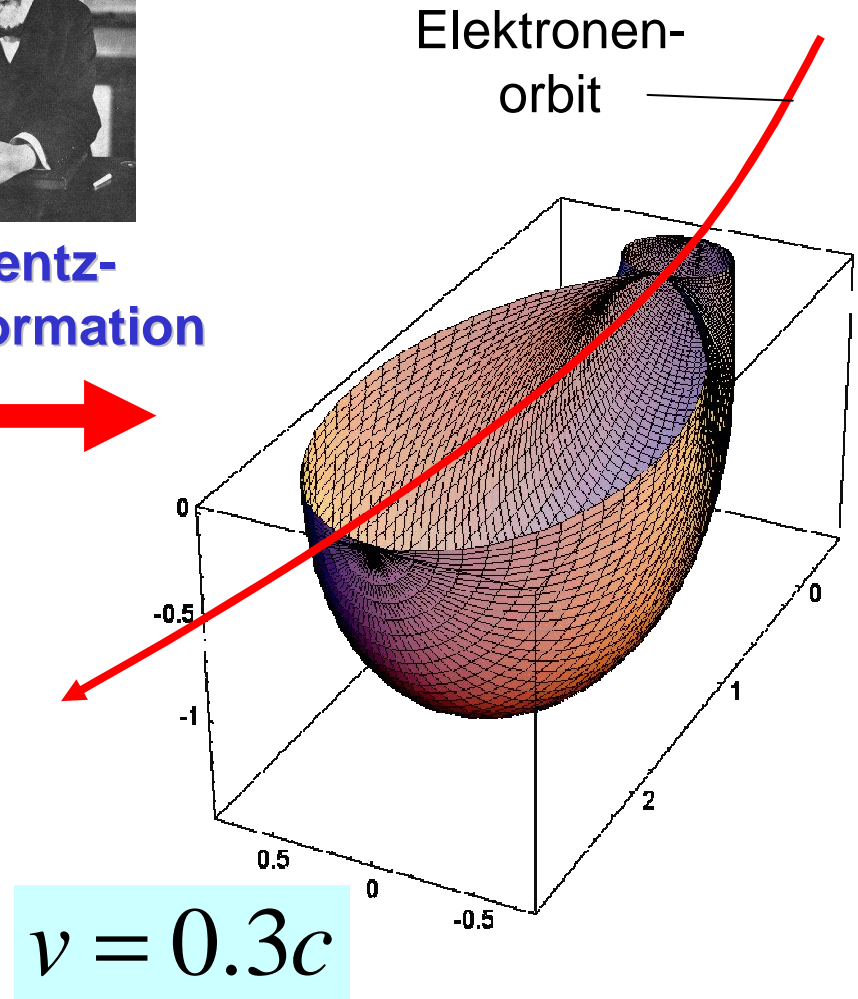
Dipol-Strahlungscharakteristik



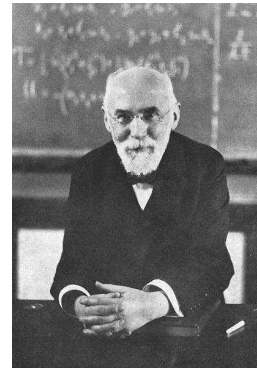
Lorentz-Transformation



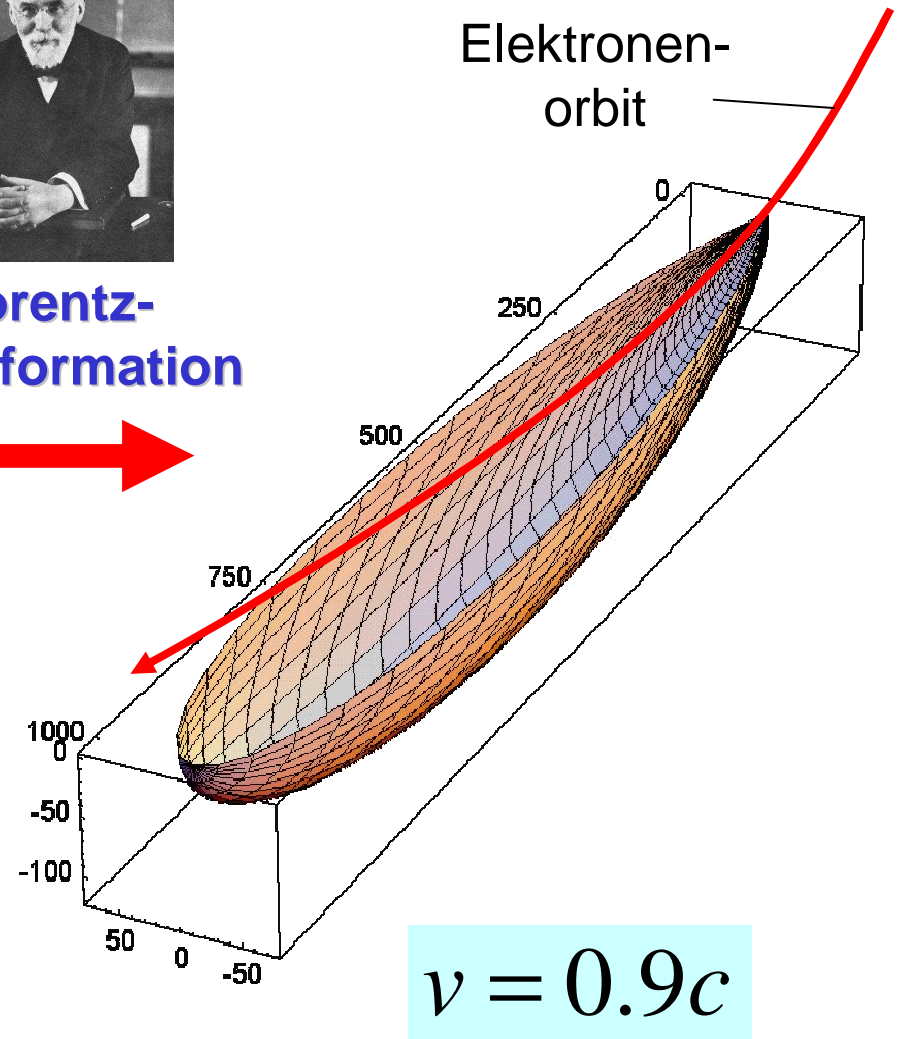
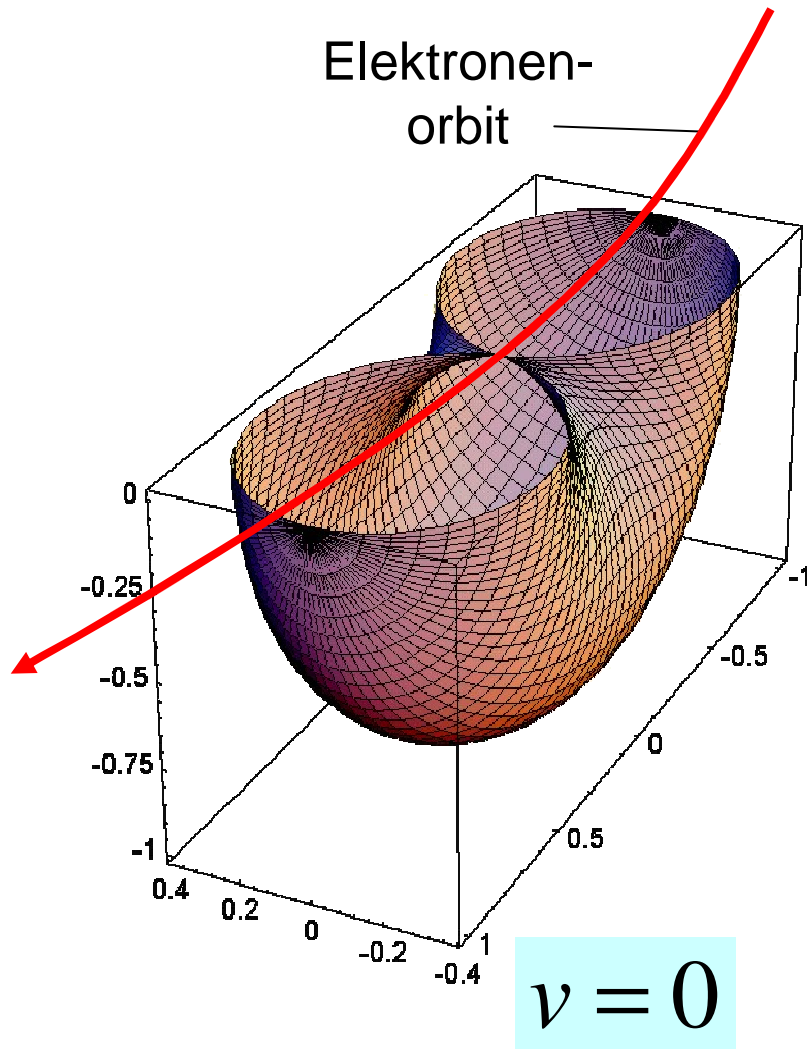
Lorentz-Transformation



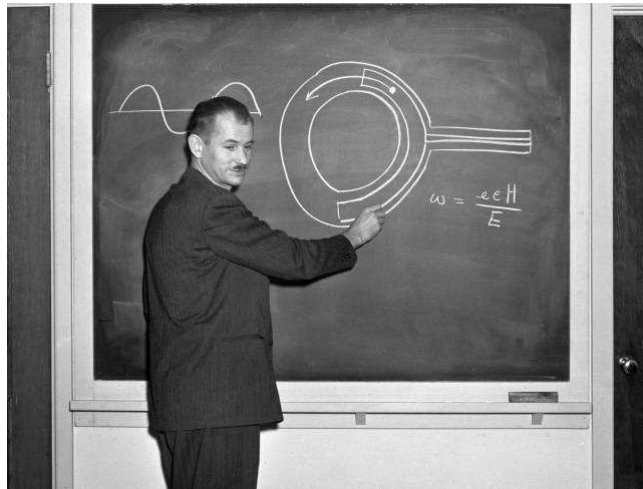
Lorentz-Transformation



Lorentz-Transformation



The first synchrotron (1948)



Edwin McMillan,
Berkeley Laboratory





SPring-8: $E = 8 \text{ GeV}$, $U = 1436 \text{ m}$
Harima Science Garden City (Japan)



ADVANCED
PHOTON
SOURCE



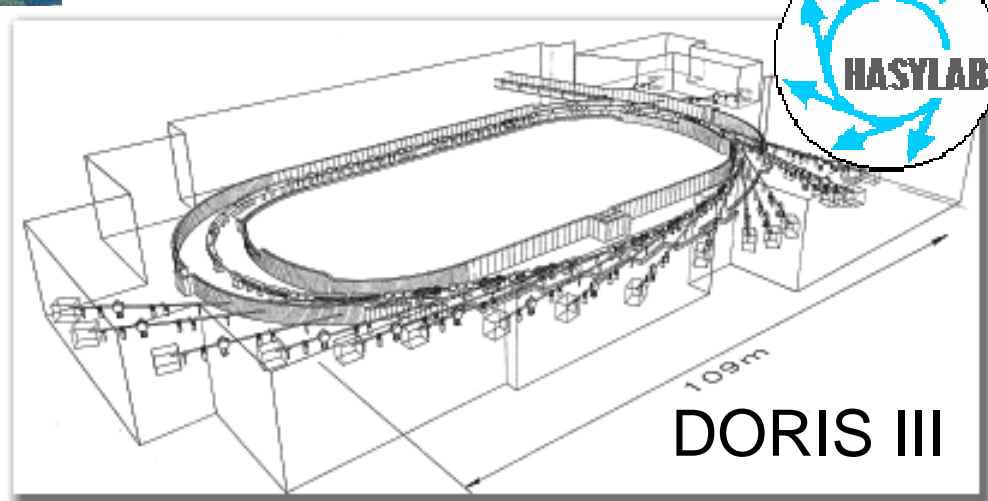
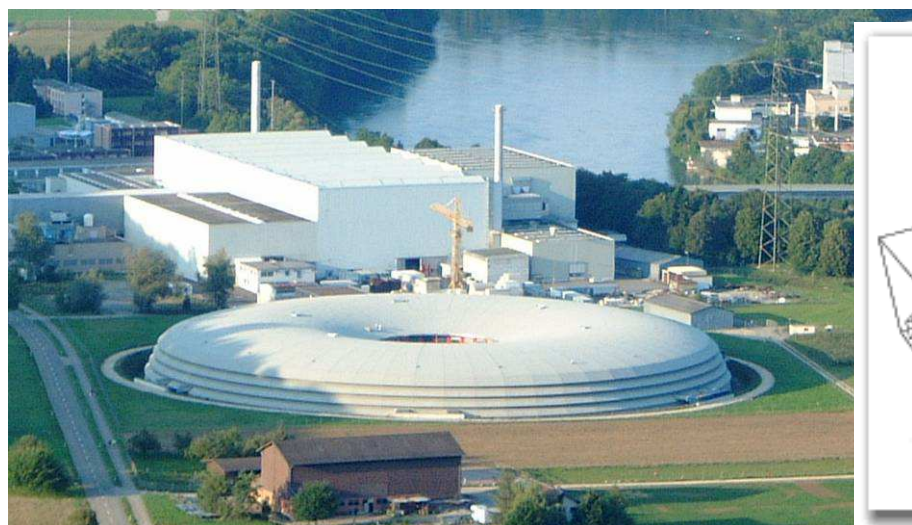
APS: $E = 7 \text{ GeV}$, $U = 1104 \text{ m}$
Argonne, Chicago





European Synchrotron Radiation Facility
Grenoble (France): $E = 6 \text{ GeV}$, $U = 844 \text{ m}$

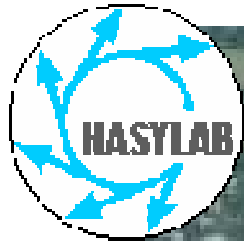
Beispiele kleinerer (nationaler) Synchrotrons



DORIS III



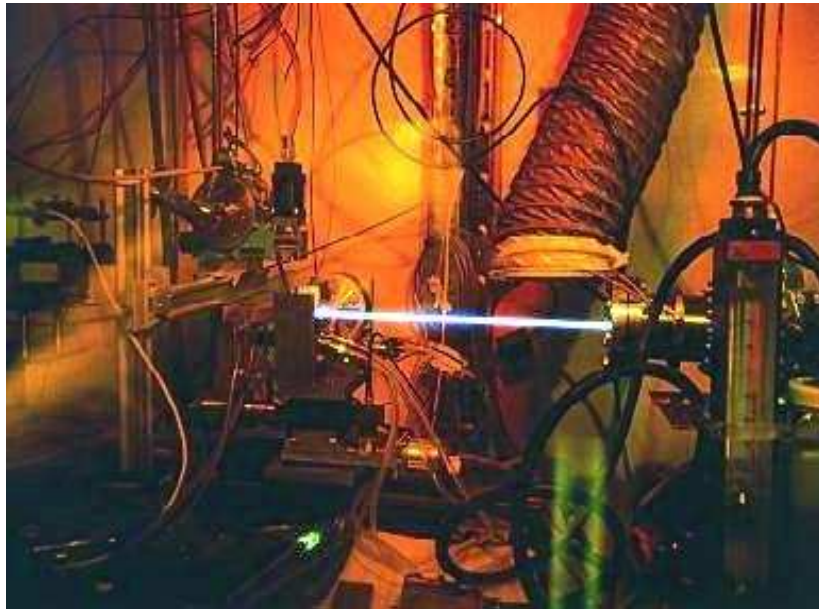
Neues Projekt ganz in der Nähe!



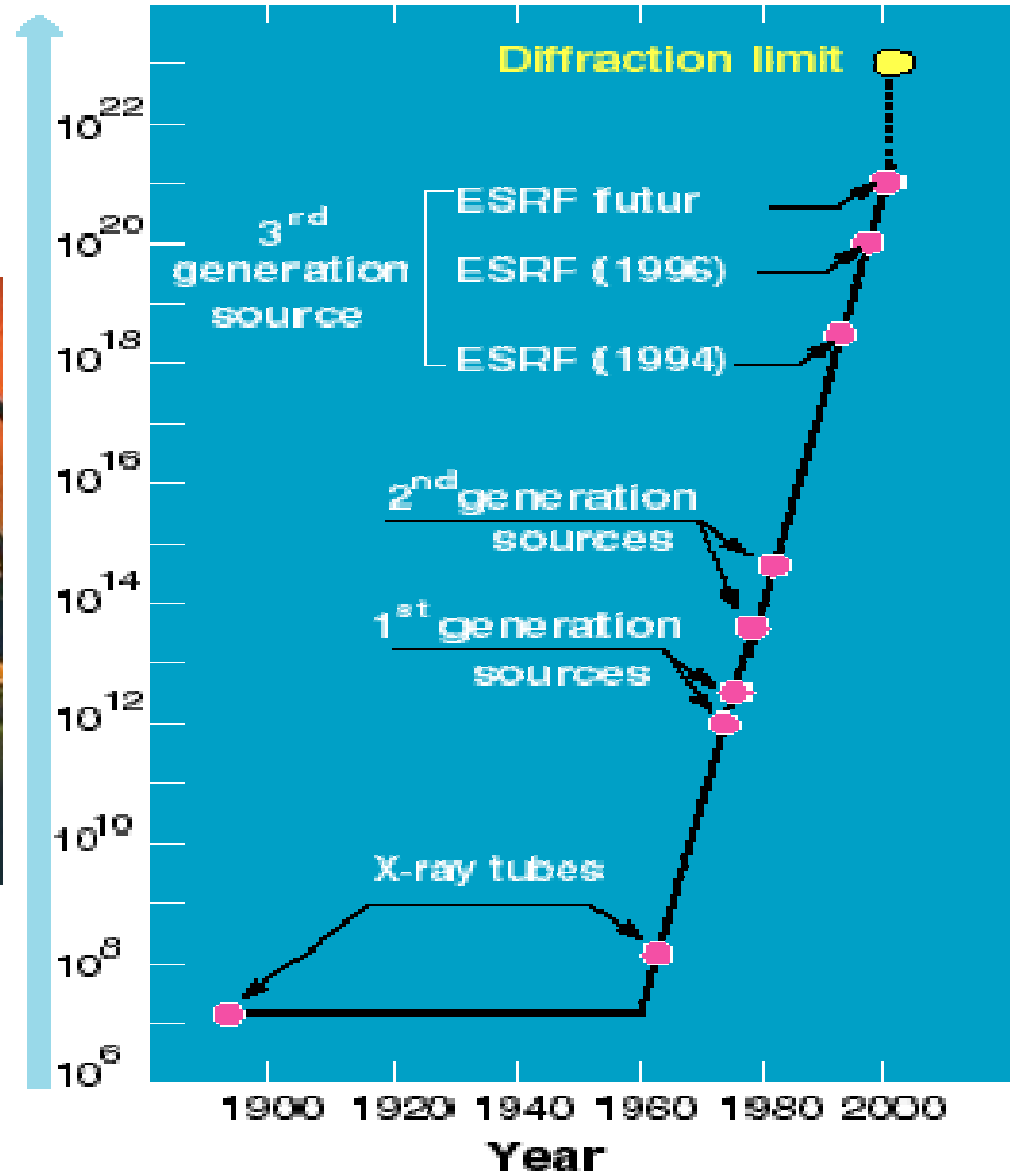
PETRA III, HASYLAB, Hamburg
E = 6 GeV, U = 2304 m

Warum Synchrotronstrahlung?

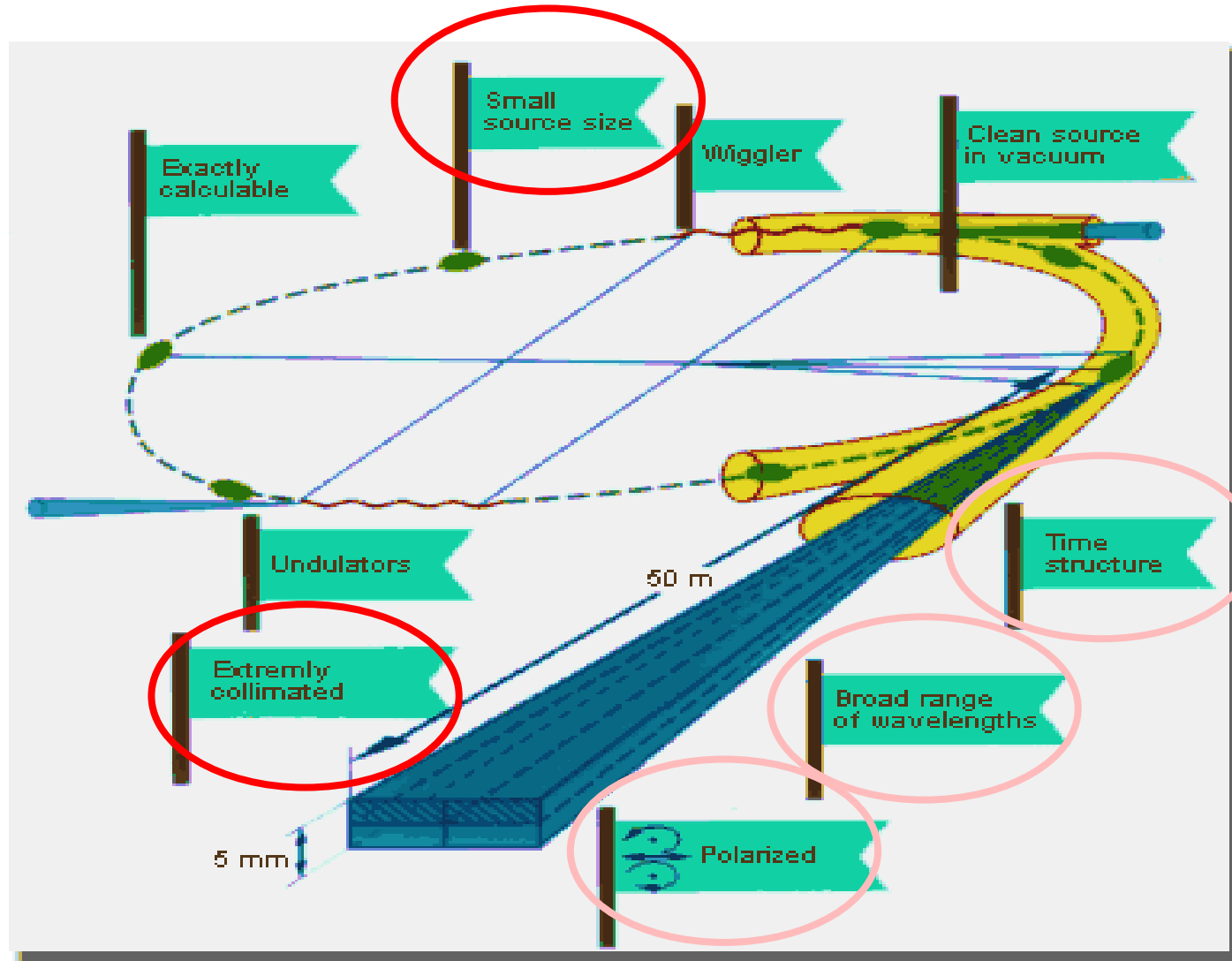
Hoher Fluß!



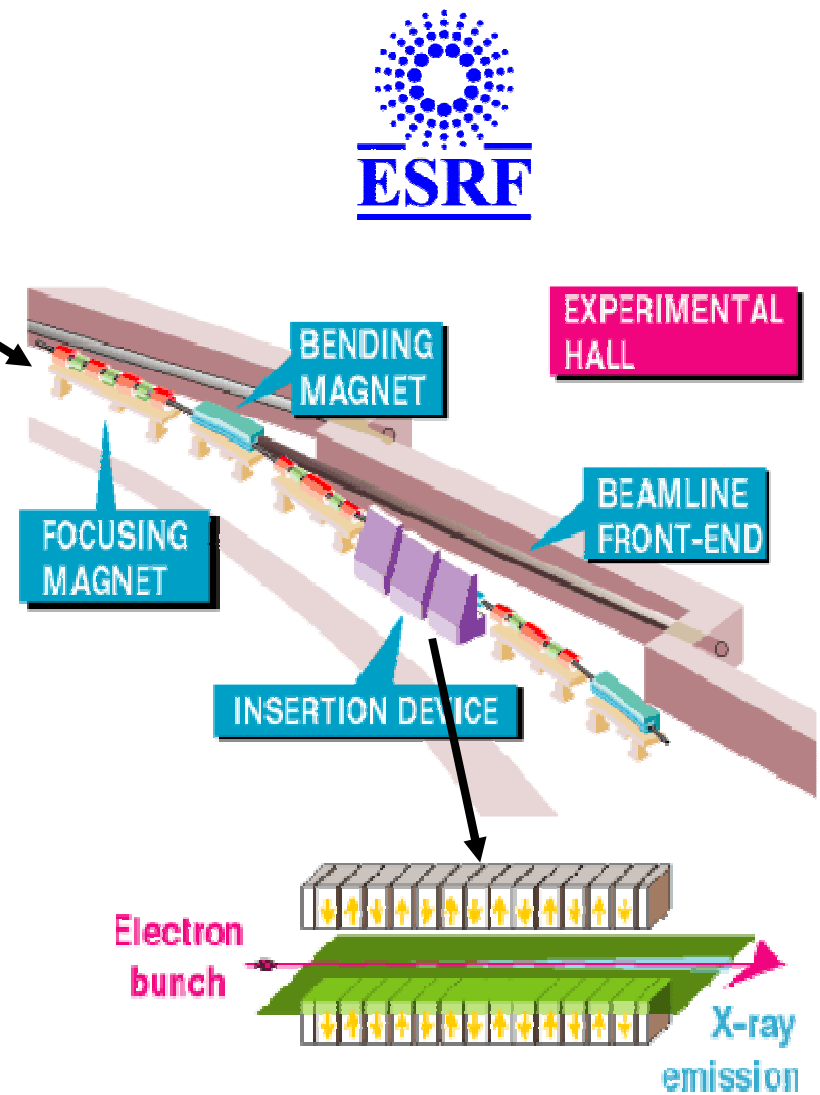
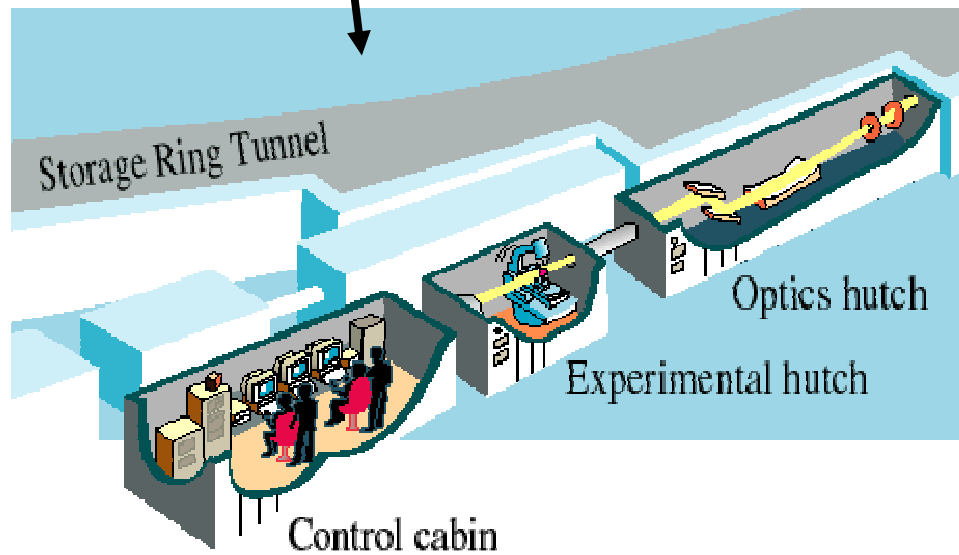
Brilliance of the X-ray beams
(photons / s / mm² / mrad² / 0.1% BW)



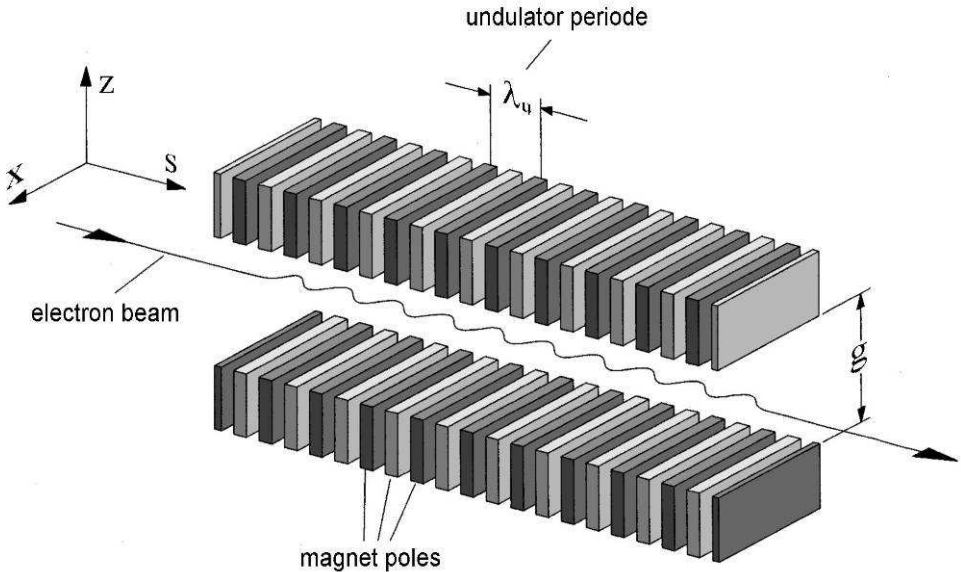
Nicht nur hoher Fluß: Eigenschaften von Synchrotronstrahlung



Röntgenstrahlung aus dem Synchrotron



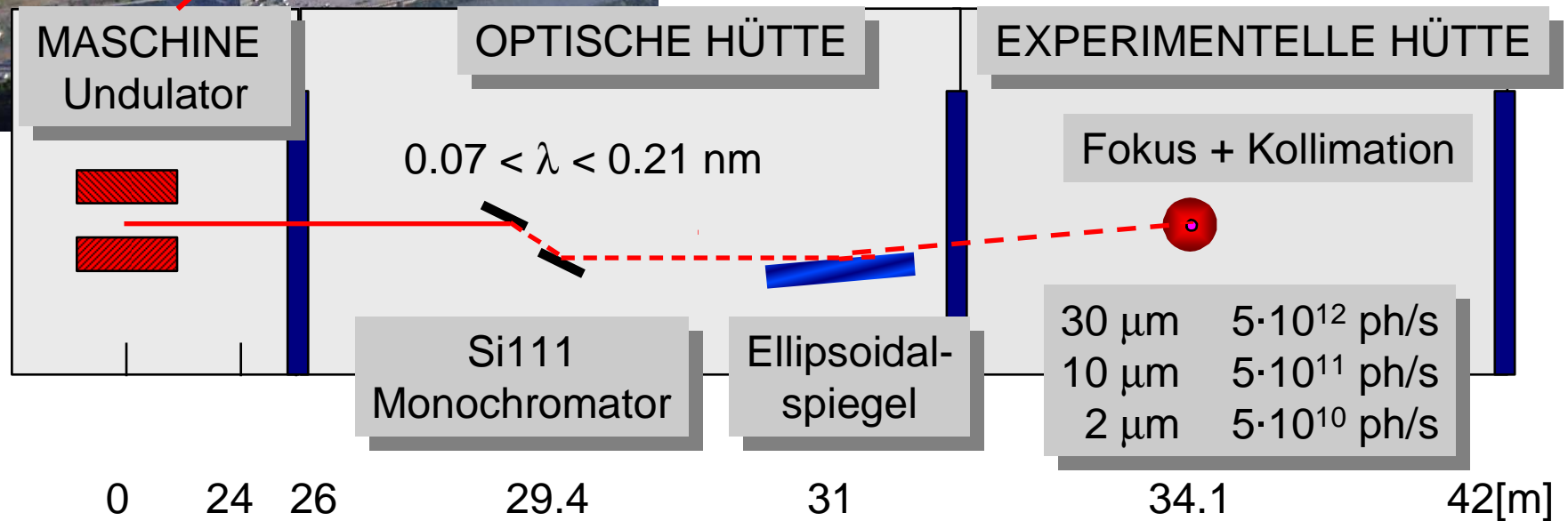
Speicherring und Undulator



user@work

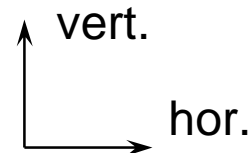


Beispiel: Mikrofokus Beamline ID13



Quelle

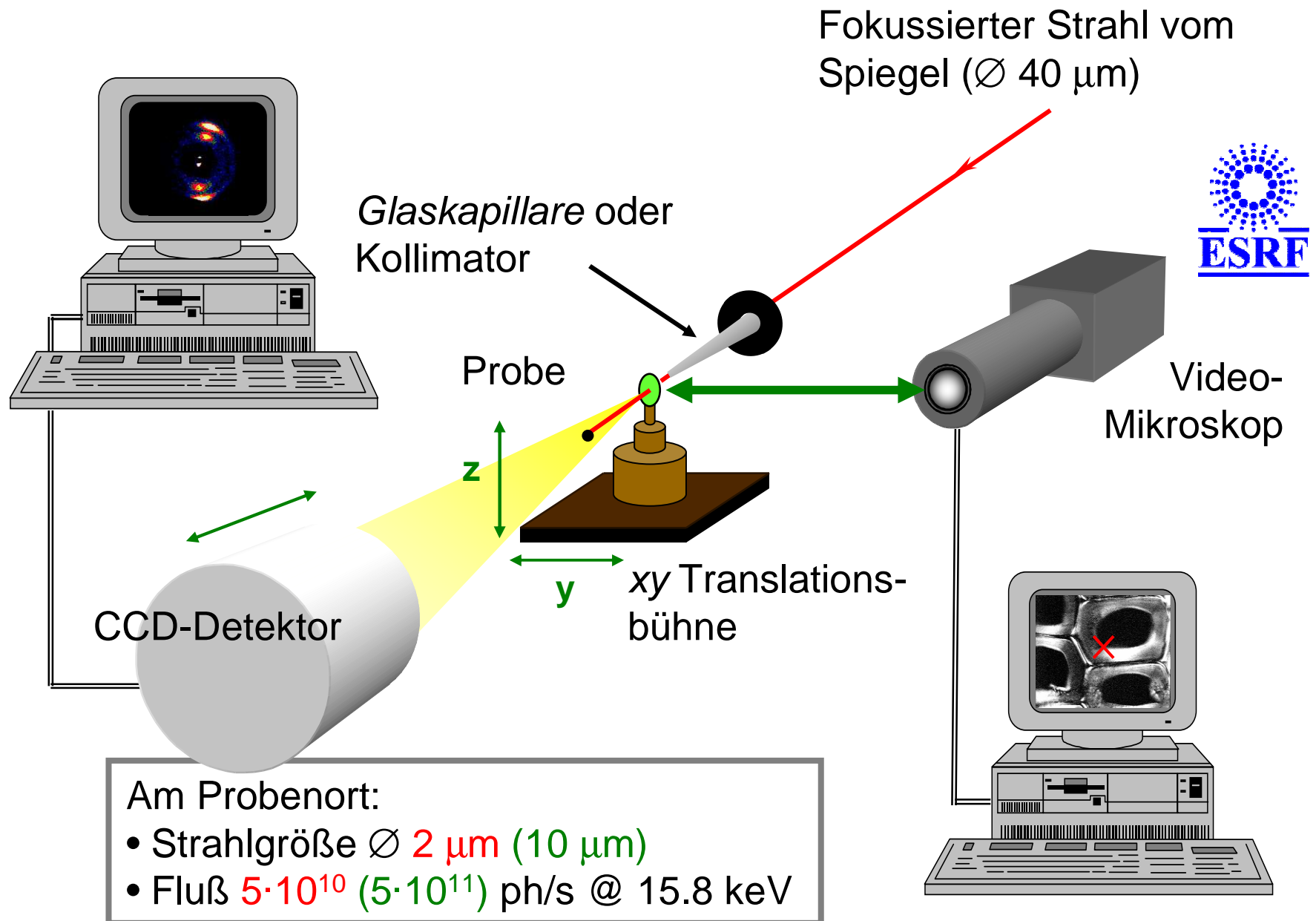
$134 \cdot 24 \mu\text{m}^2$
 $0.21 \cdot 0.02 \text{ mrad}^2$
 Größe
 Divergenz



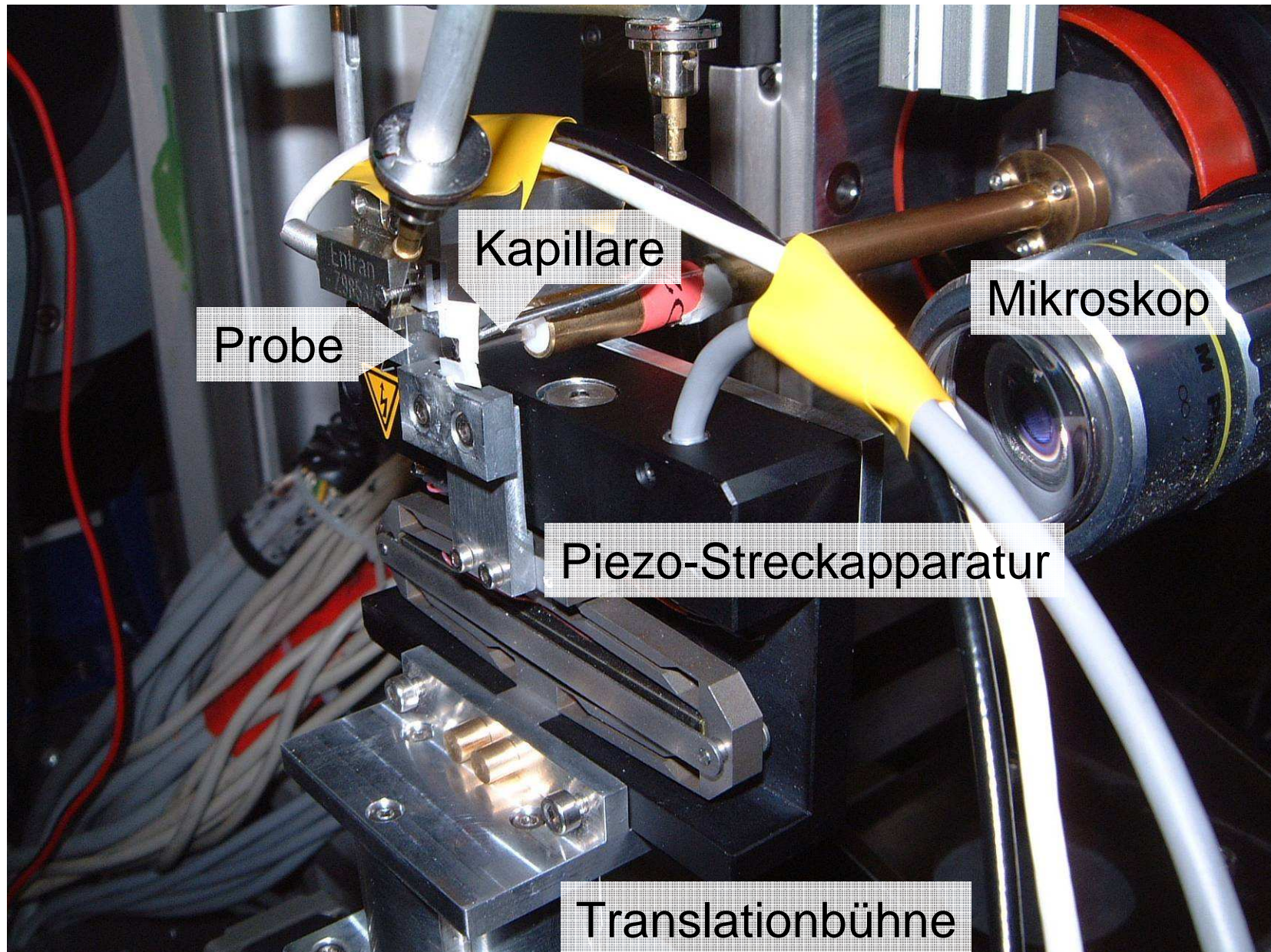
Fokus

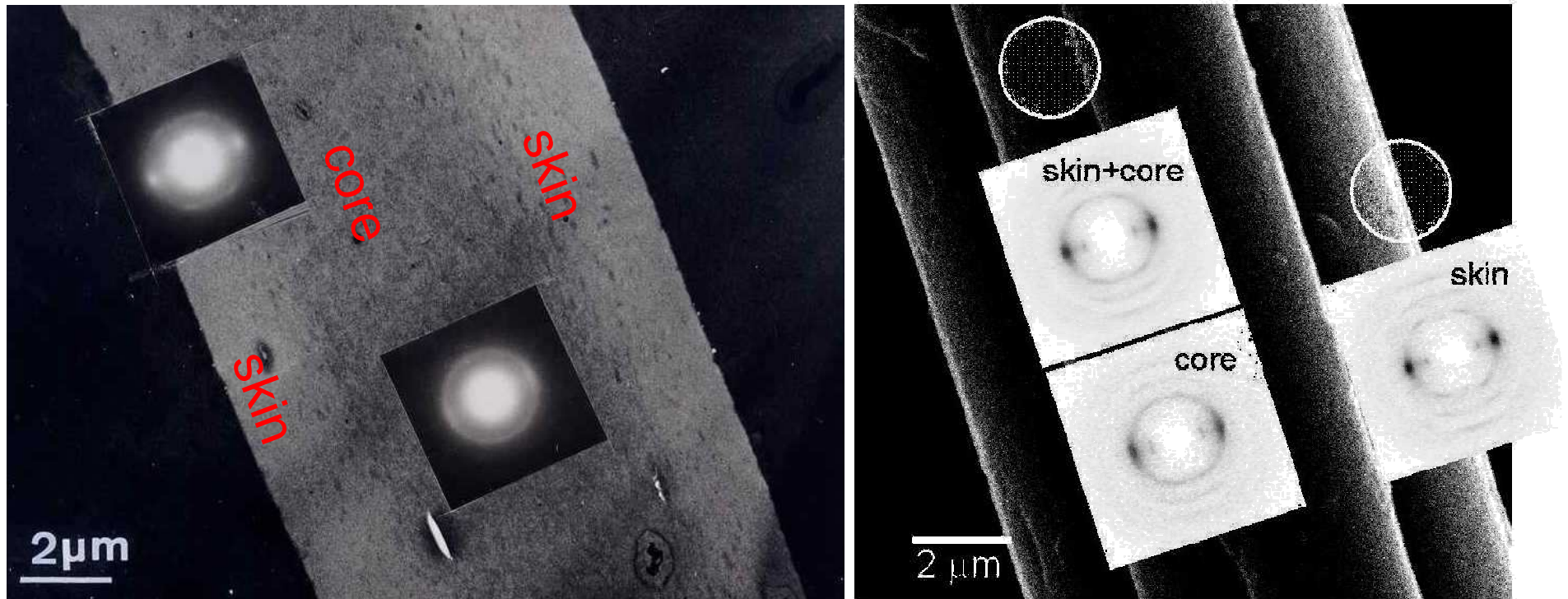
$20 \cdot 40 \mu\text{m}^2$
 $2.1 \cdot 0.2 \text{ mrad}^2$

Ortsaufgelöste Mikrodiffraktion (ID13)



“Scanning” Mikrodiffraktion an ID13





0.1 μm dicke **Scheibe aus Faser**:
Elektronen-Mikrograph / -Diffraction
mit 1 μm^2 beleuchteter Fläche

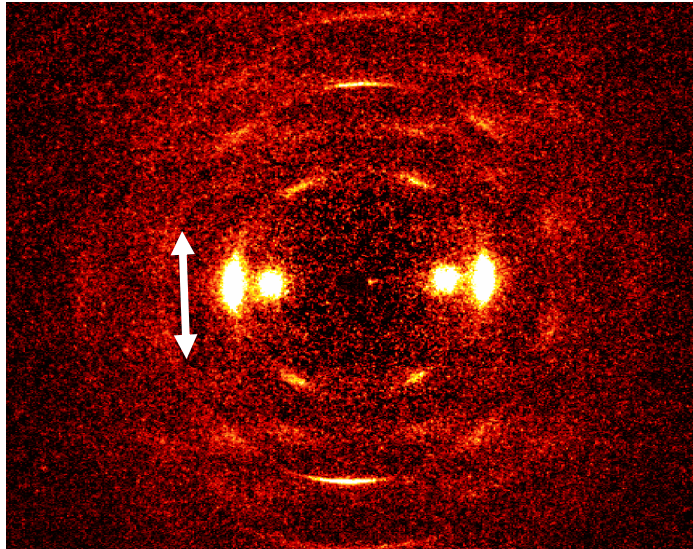
Einzelfaser (SEM-Bild):
Röntgen-Mikrodiffraction
mit 3 μm^2 Strahlquerschnitt

M. Müller, C. Riekkel,
R. Vuong, H. Chanzy
Polymer **41**(7), 2627-2632 (2000)

quantitative Information:
Kristallinität unverändert,
core 75 % schlechter orientiert

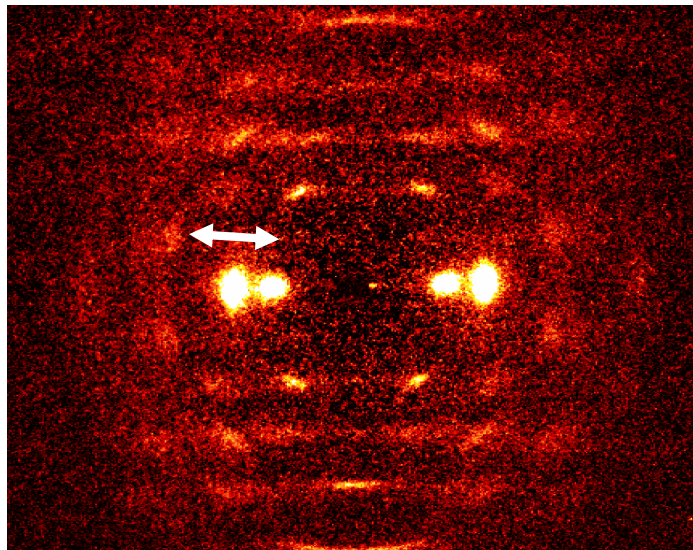


2.1.3 Morphologie von Zellulose

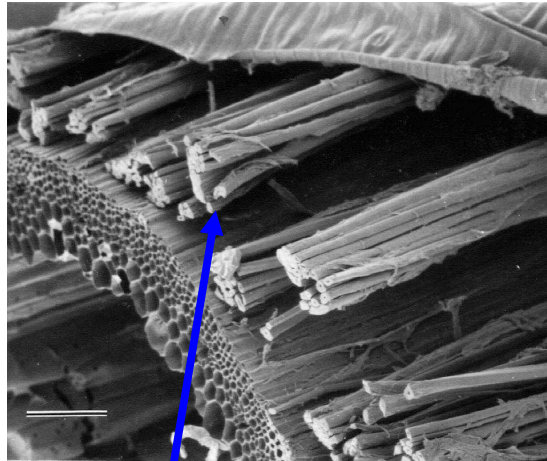


Untersuchung **einzelner** Fasern möglich; **lokale** Bestimmung von Parametern wie:

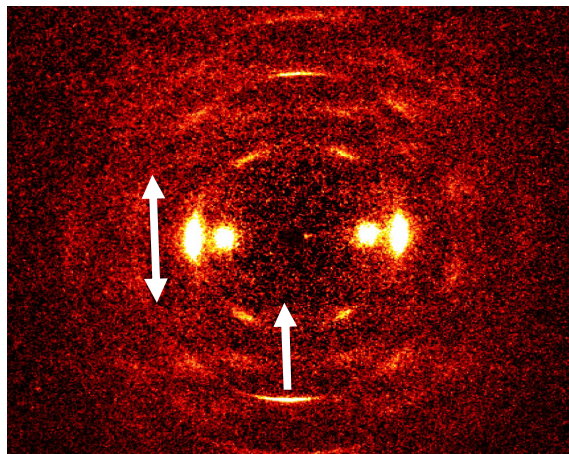
- *Orientierungsverteilung* der Mikrofibrillen
- *Kristallgröße*
- *Kristallinität* (Anteil kristallinen Materials)



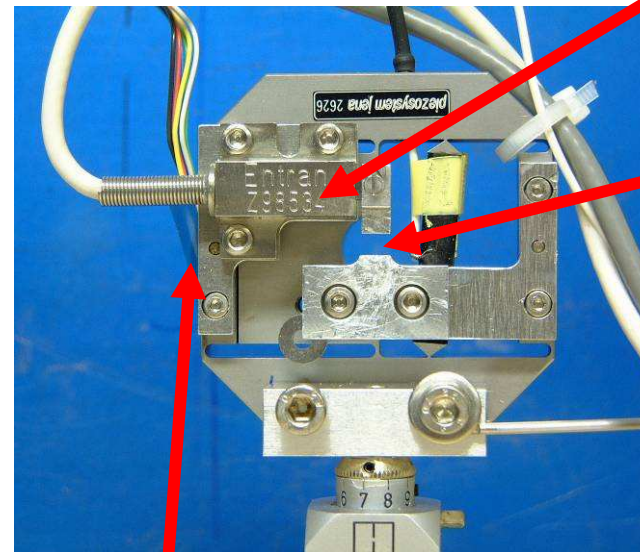
Mikroskopische *in situ* Streckexperimente



Flachfasern:
hochorientierte Zellulose



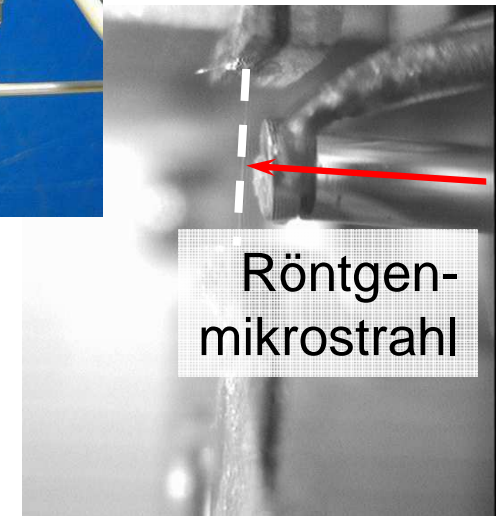
Piezo-Streckzelle für
in situ Röntgenstreuung an
Einzelfasern



Dehnungs-
meßstreifen

Kraftsensor

Faser



Röntgen-
mikrostrahl