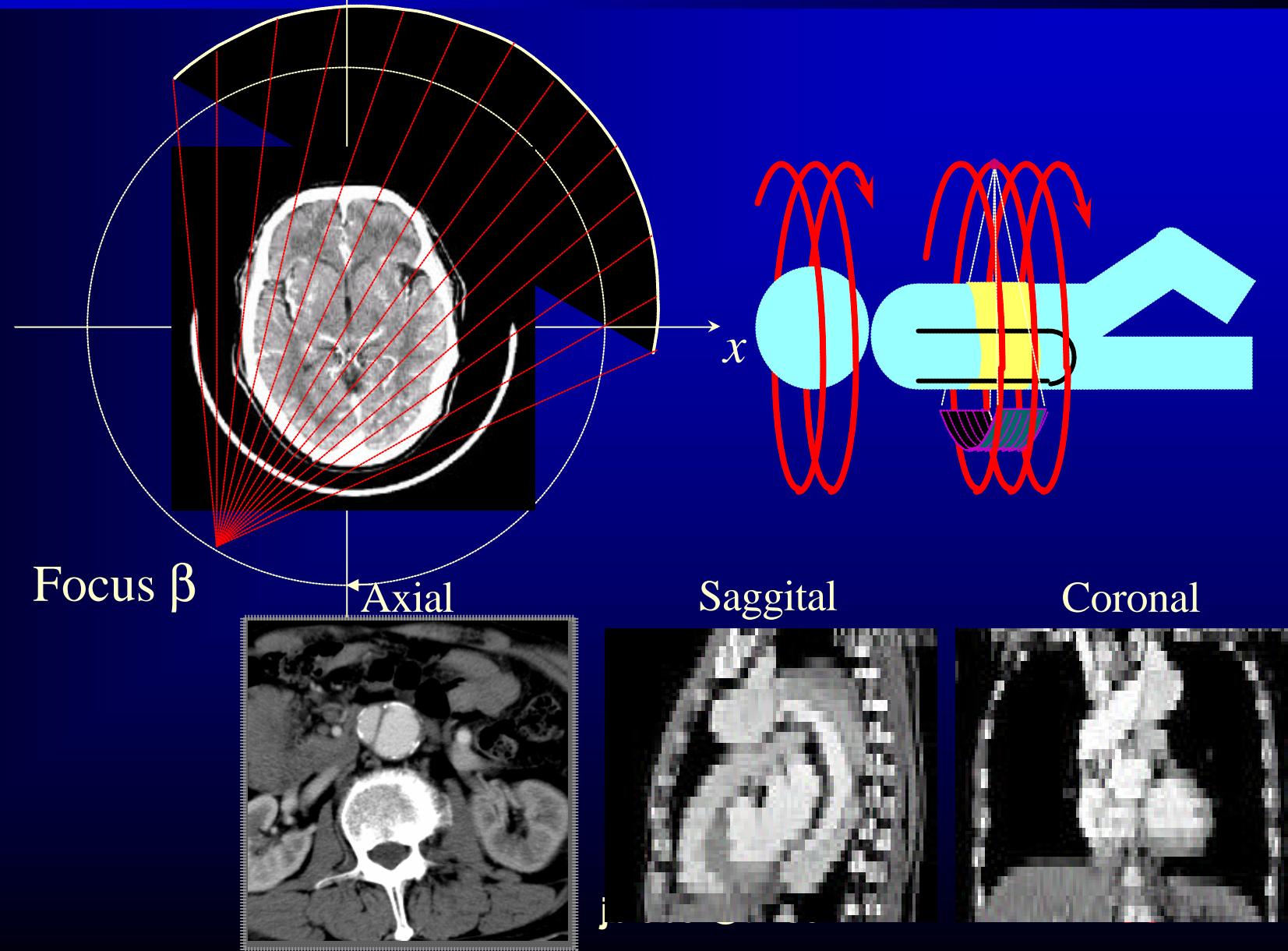


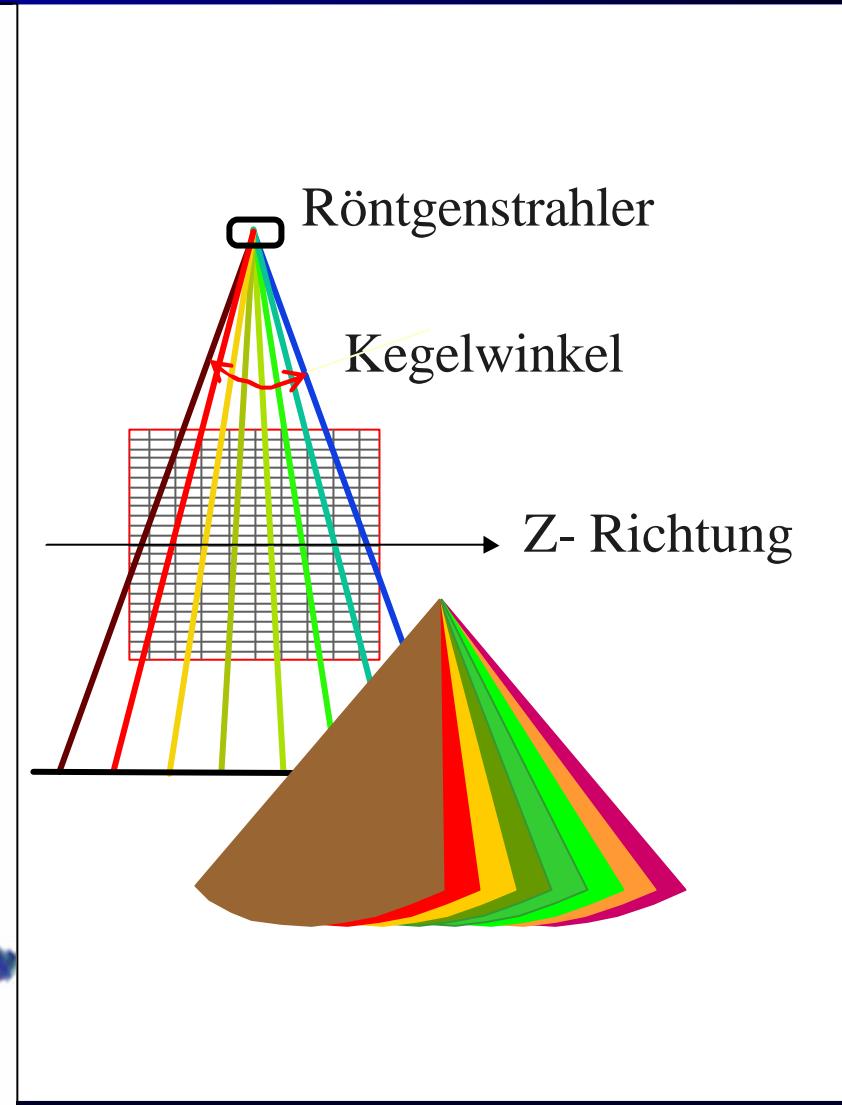
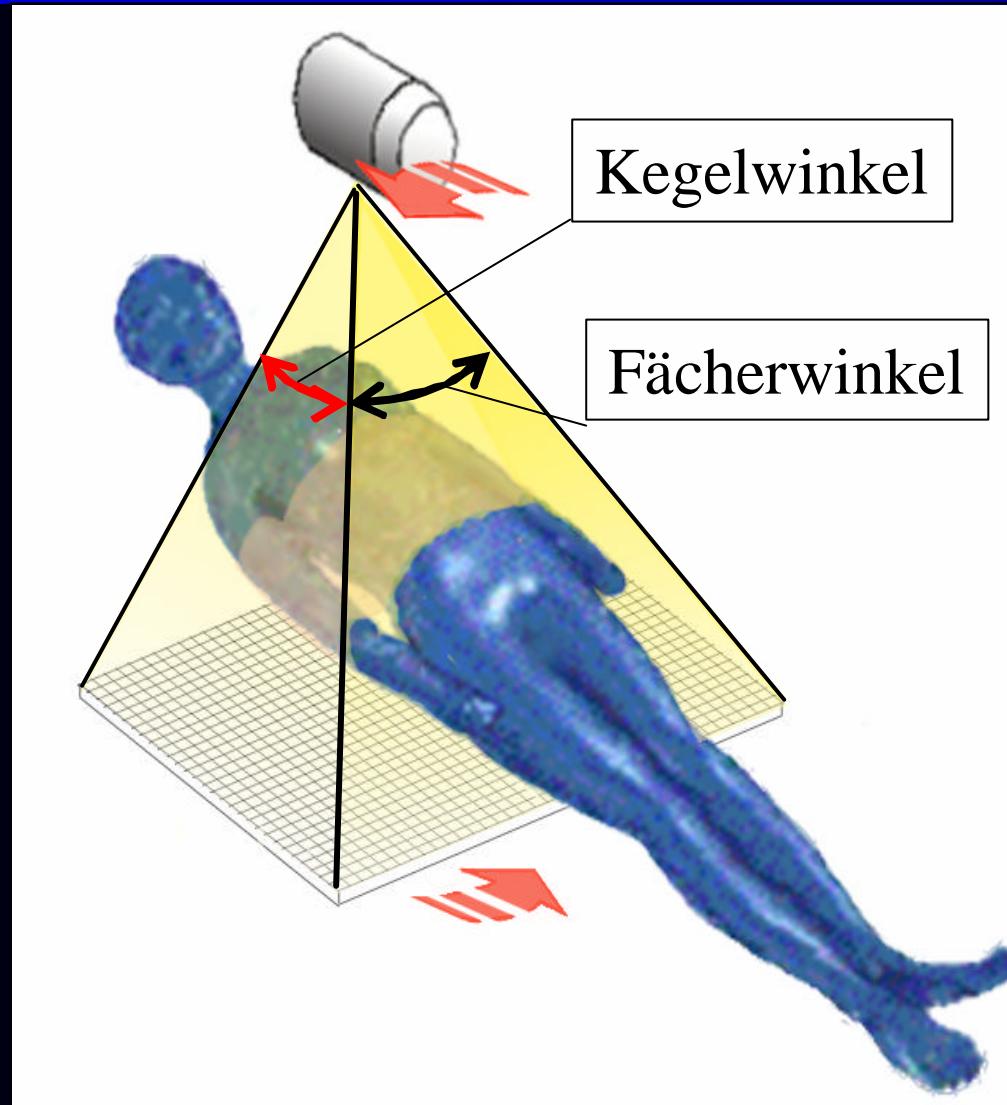
CT-Volumenrekonstruktion
mit dem
MUSCOT-Algorithmus
und
TCOT-Algorithmus

(**MU**lti**S**lice **C**Onebeam **T**omographie)
(**T**rue **C**onebeam **T**omographie)

Einzelschicht- Helical CT



Conebeam- Geometrie



Outline

Step-and-shoot (non-helical) scan

fan-beam reconstruction

Cone-beam reconstruction (Feldkamp)

Helical scan

Review of single-slice and 4-slice CT

HFK (TCOT): Cone-beam

ASSR (AMPR & SMPR): Quasi cone-beam

HFI+ (MUSCOT): Fan-beam

Cone-beam
geometry

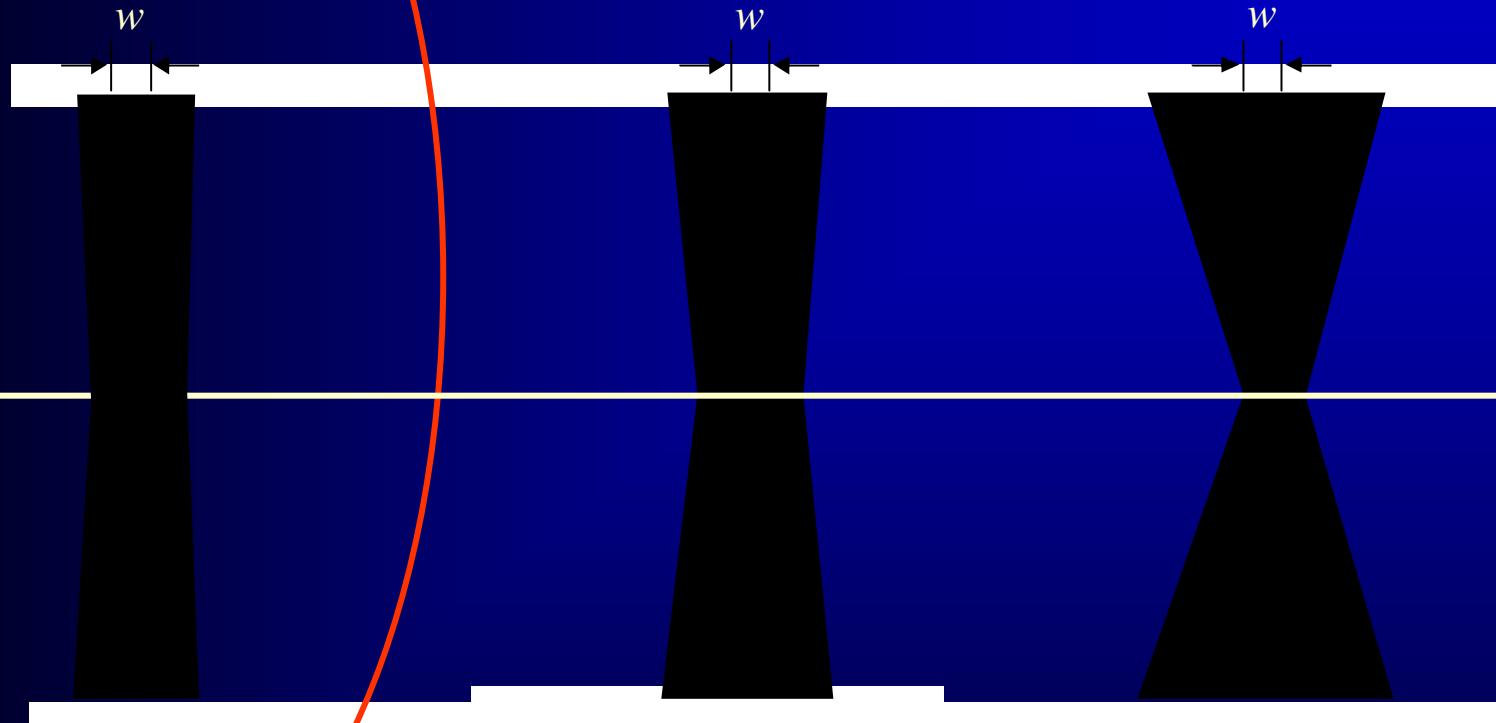
Quasi cone-beam
geometry

Fan-beam
geometry

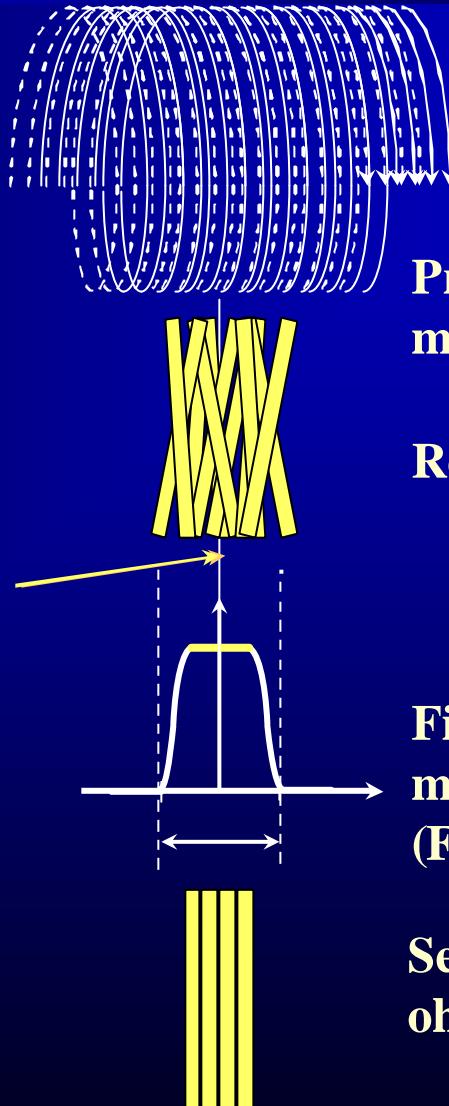
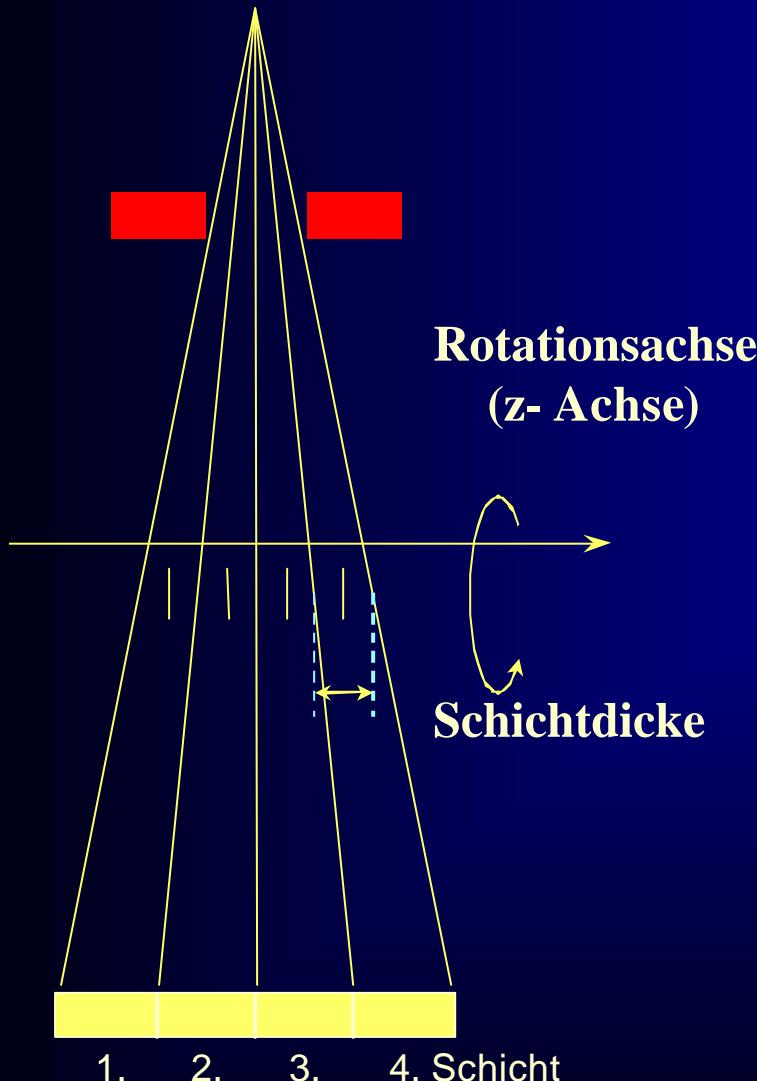
HFK

ASSR

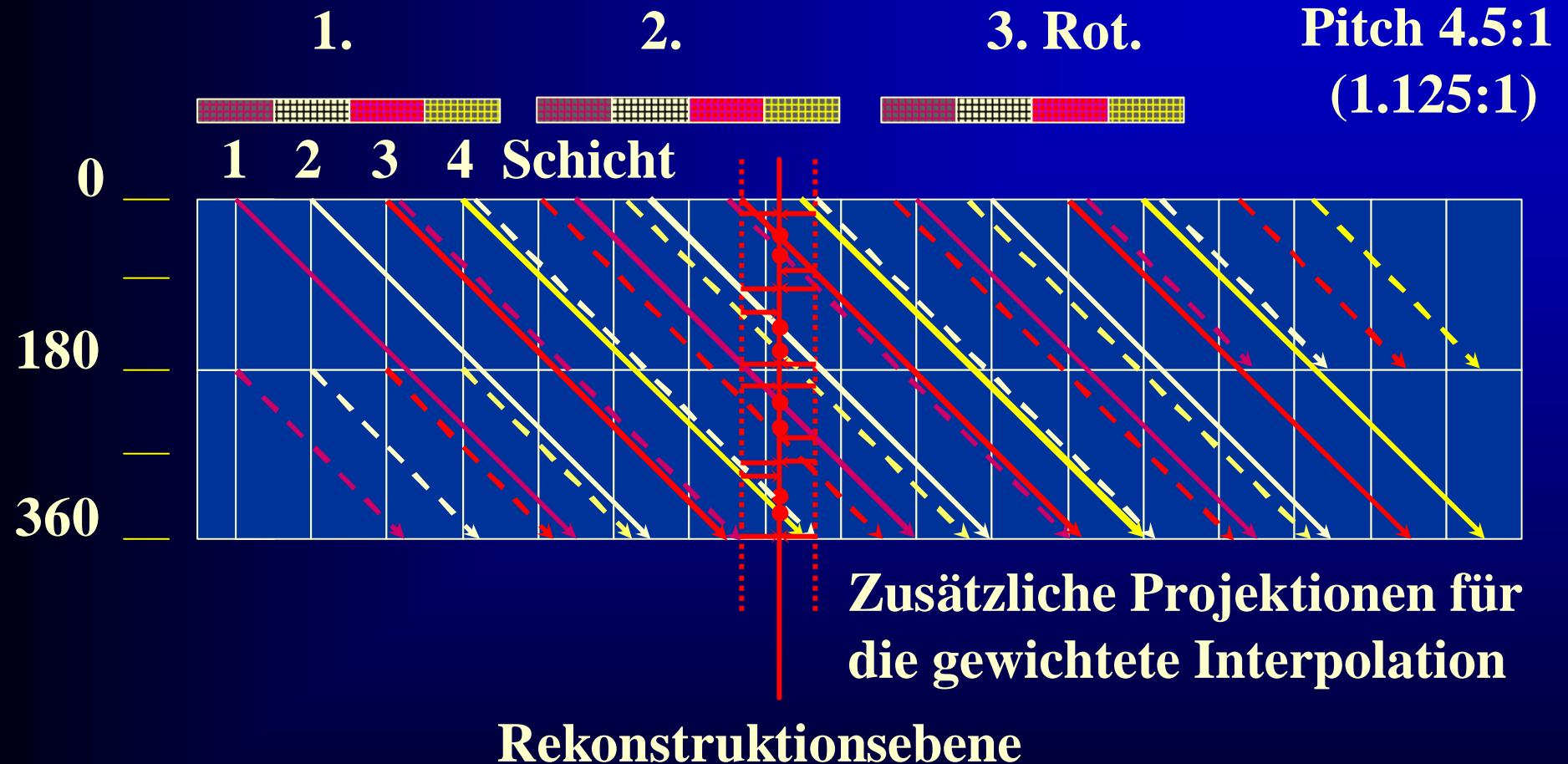
HFI+



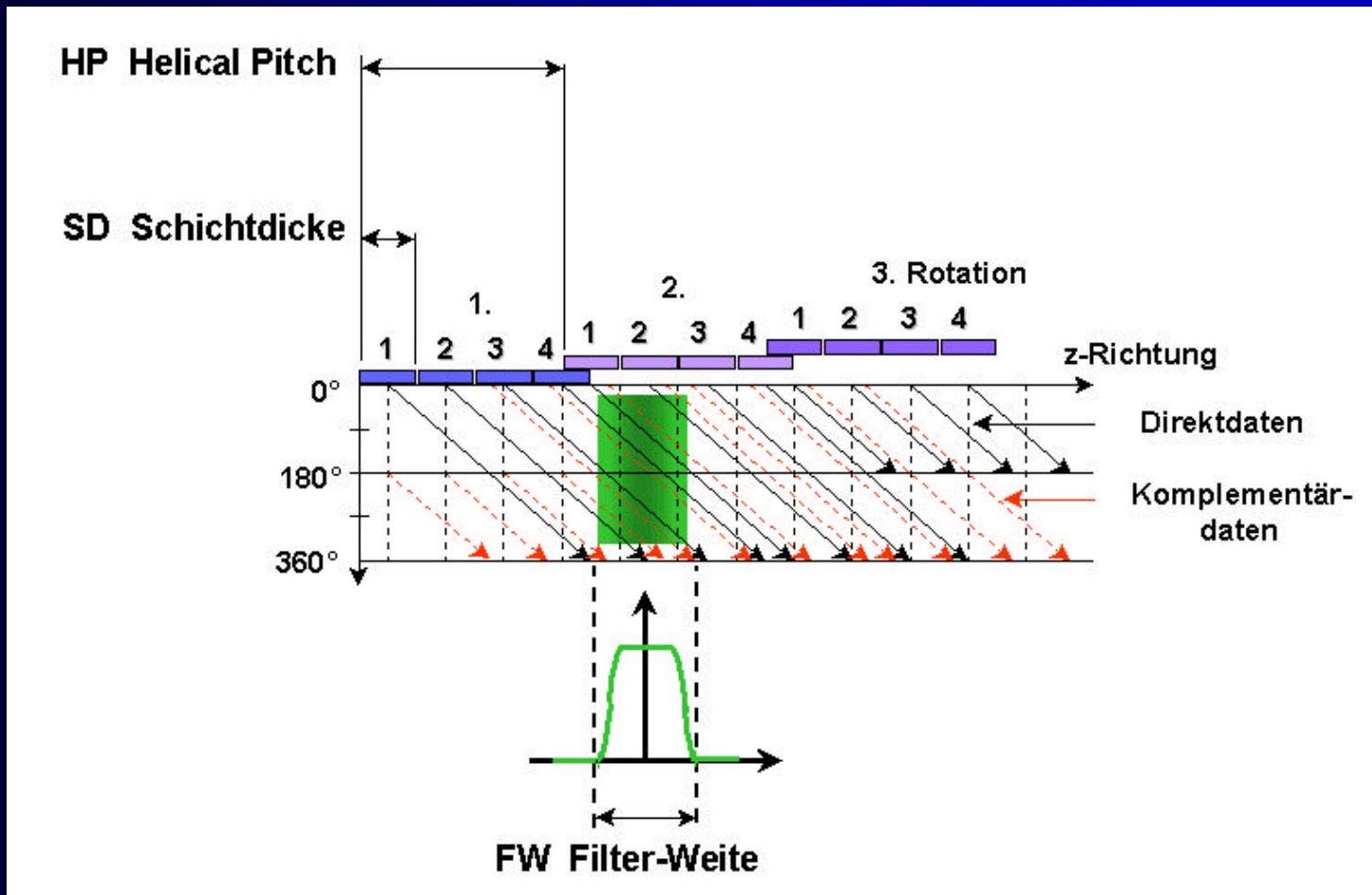
MUSCOT- Rekonstruktion



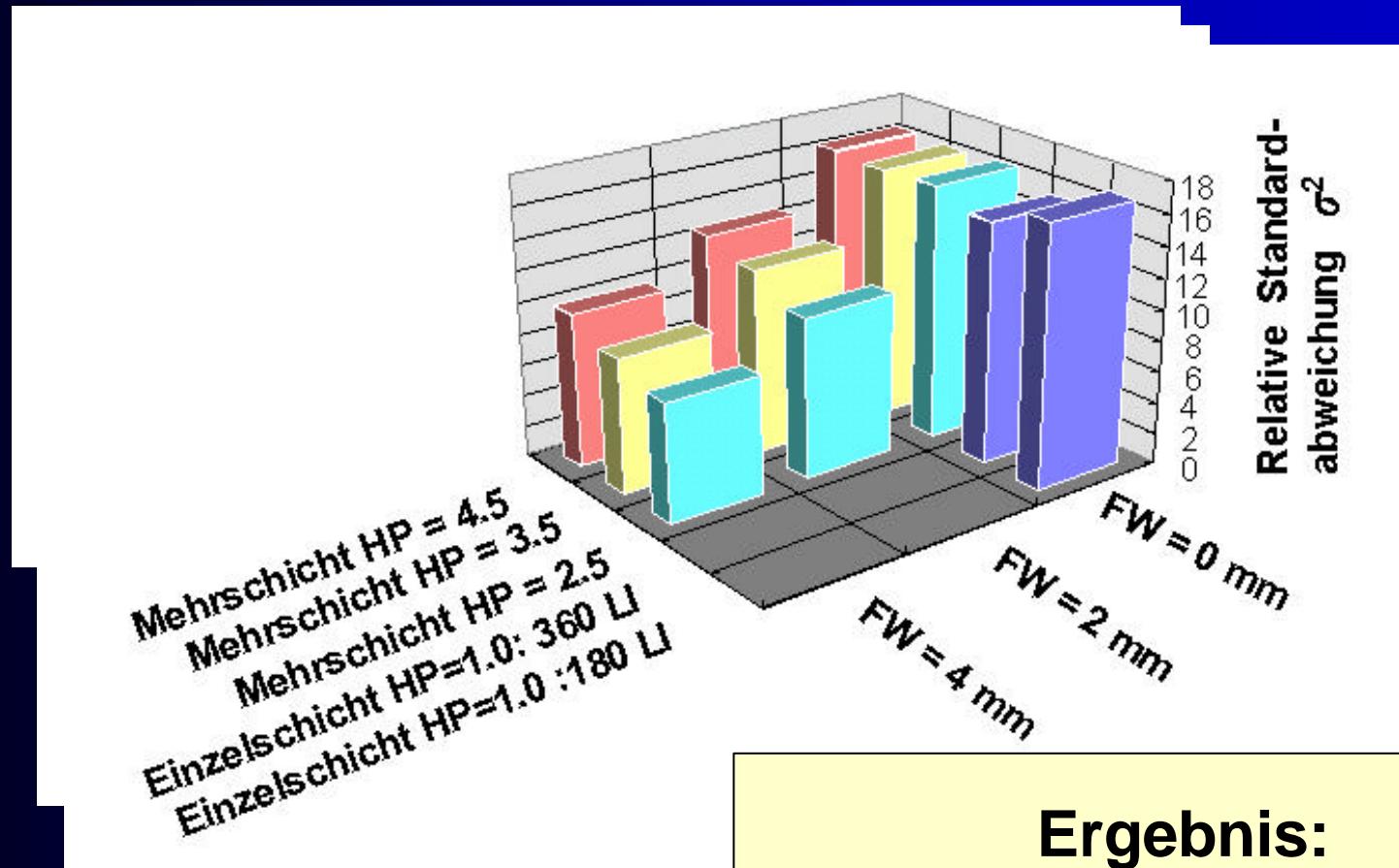
MUSCOT- Rekonstruktion



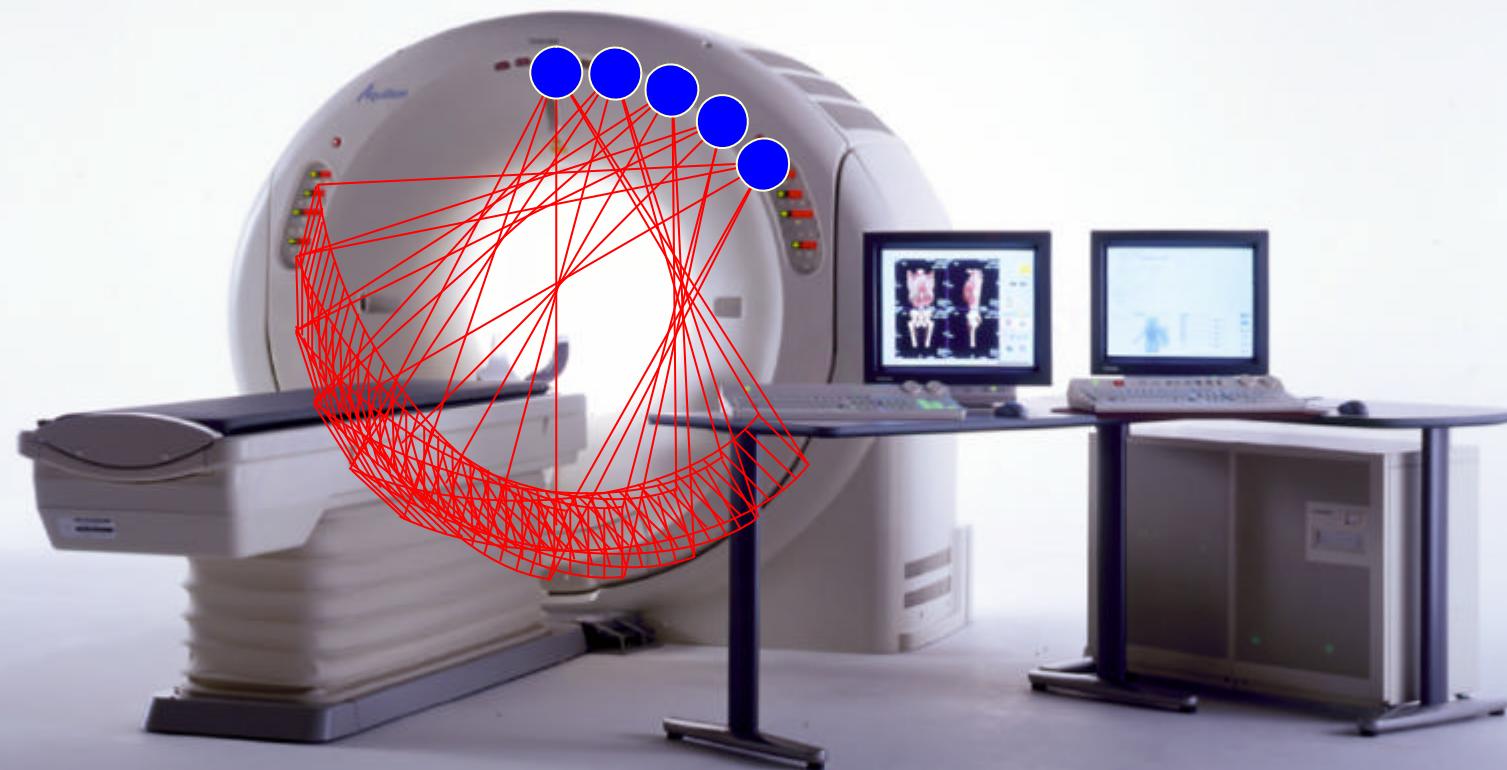
MUSCOT- Rekonstruktion



MUSCOT- Rekonstruktion



**Ergebnis:
Dosiseinsparung » 30- 40%**

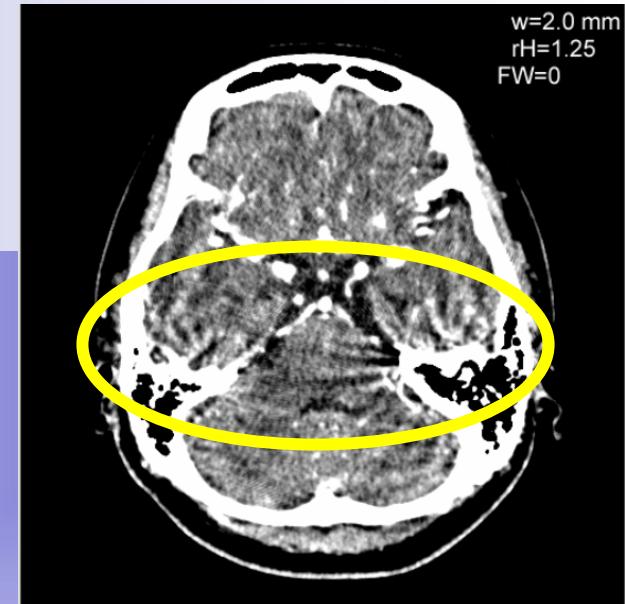


jblobel@tmse.nl

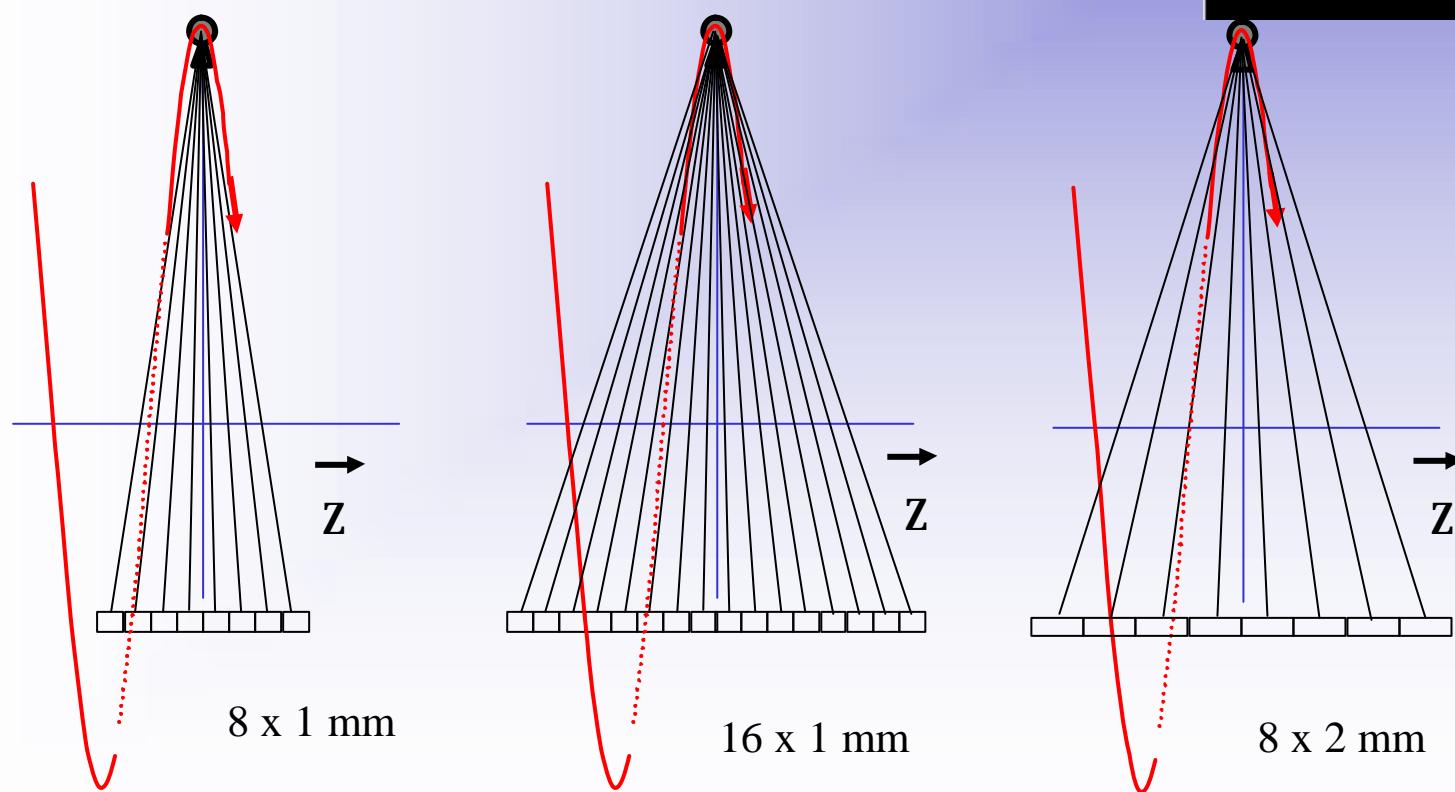
TOSHIBA

Problem für Cone-beam Helical Scan

- Verstärkter Kegelwinkel
- Kleine Messintervalle in z-Richtung
- Tischgeschwindigkeiten (Bewegung)

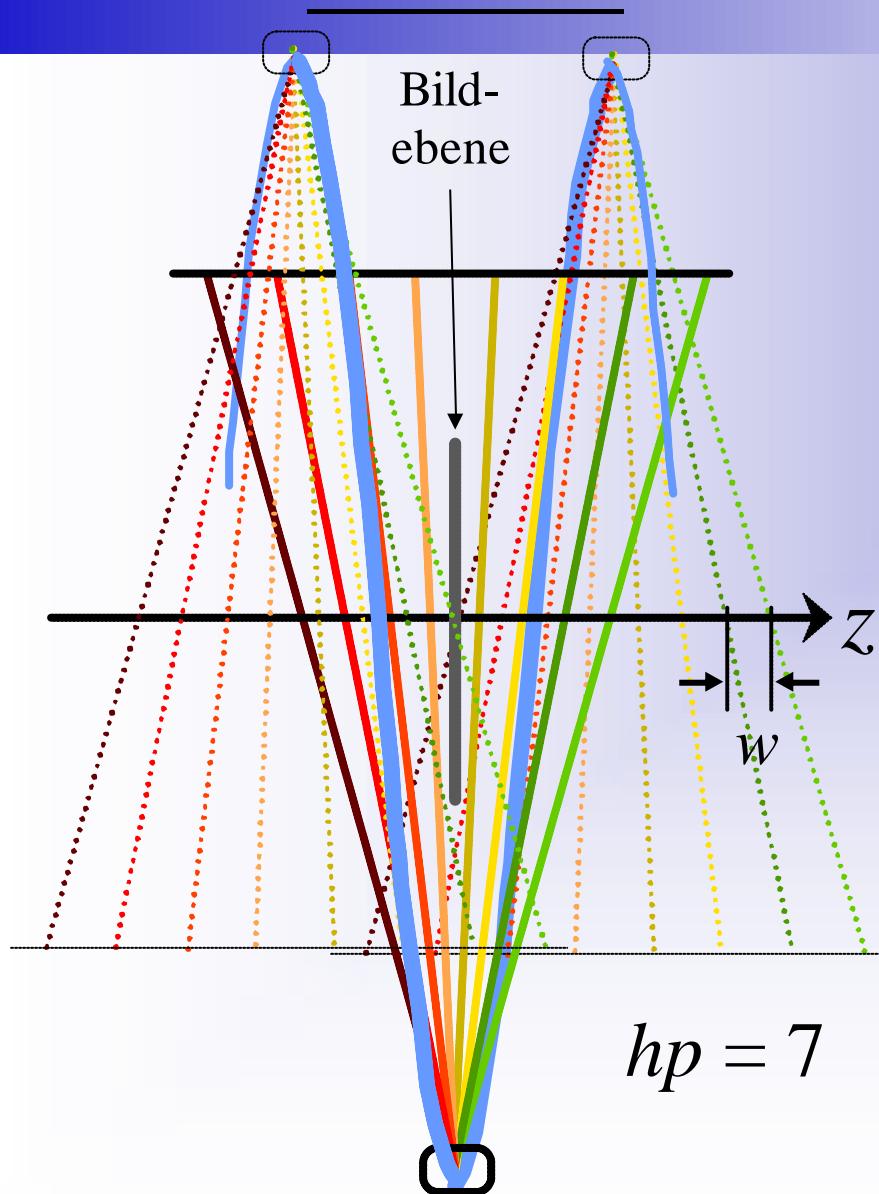


Problem wird stärker



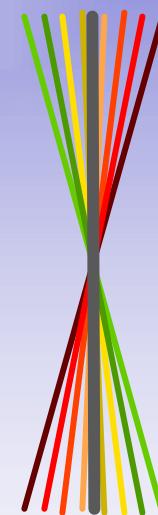
HFK (TCOT)

Datenbeitrag zur Bildebene



HFI

$\gg w$



Gut im Zentrum

HFK
(TCOT)

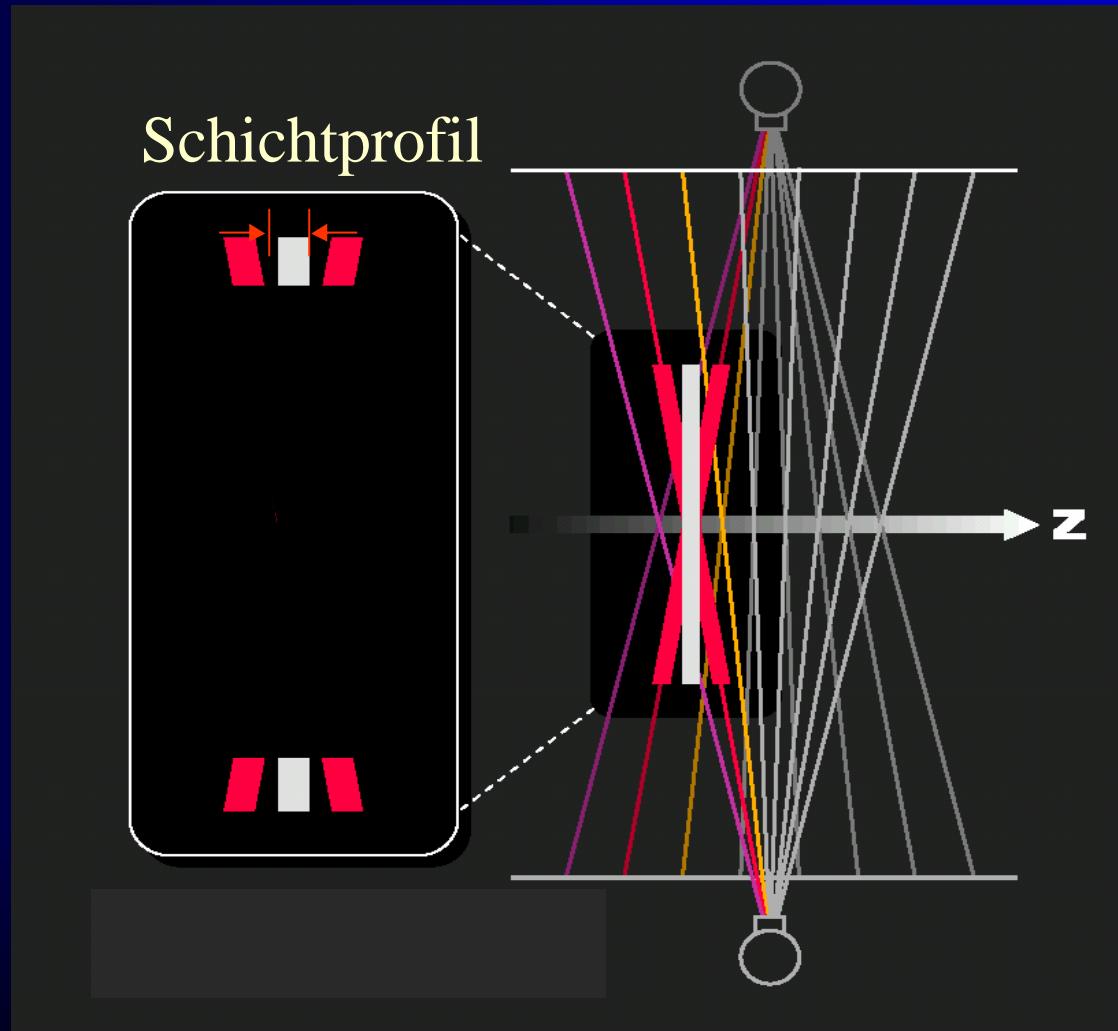


Gut im
Zentrum und
am Bildrand

jblobel@tmse.nl

TOSHIBA

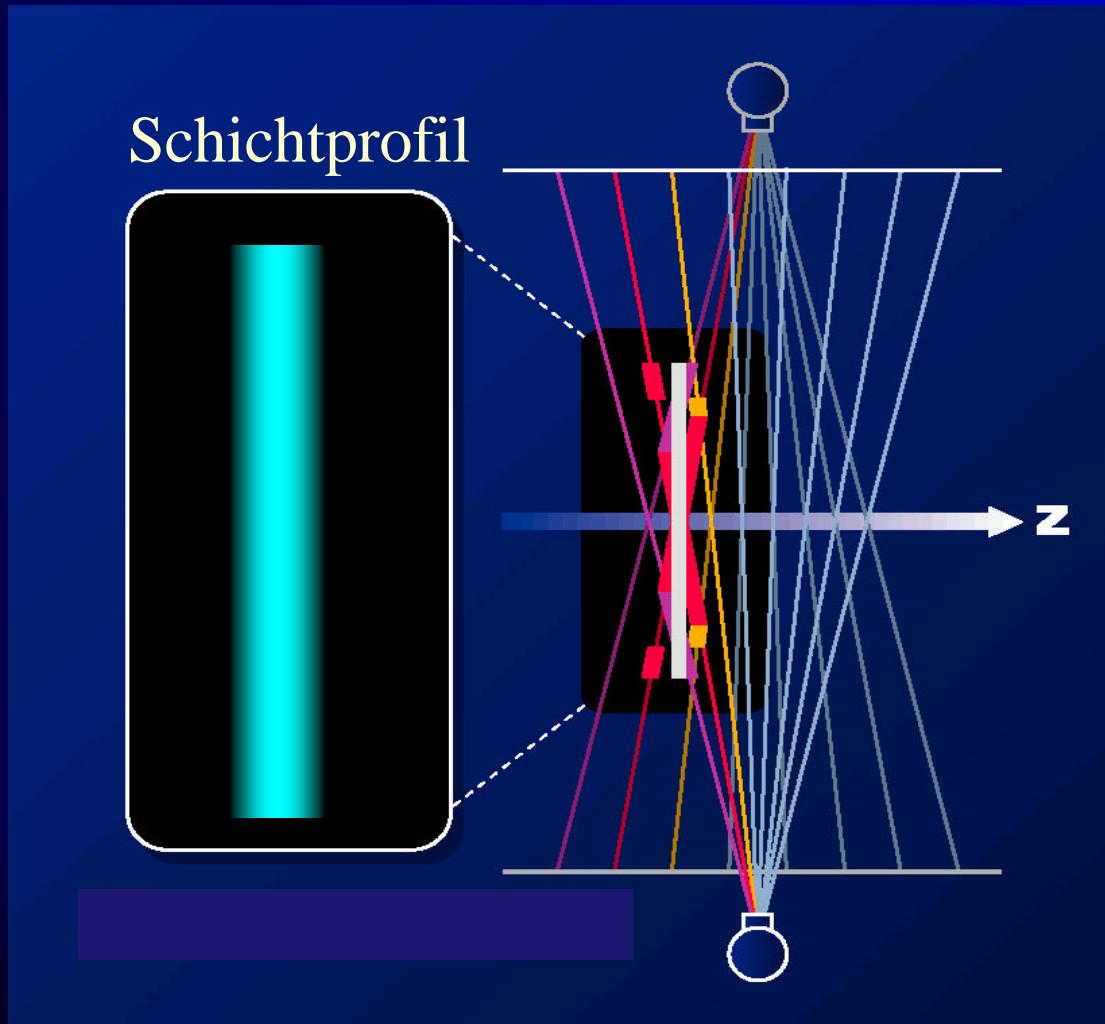
Feldkamp Algorithmus für Conebeam Geometry



jblobel@tmse.nl

TOSHIBA

Feldkamp Algorithmus für Conebeam Geometry



jblobel@tmse.nl

TOSHIBA

Relative evaluation

Algorithm

Cone-angle problem

1. Artifact

2. Z resolution (SSP) @ center

@ off-center

3. Practical maximum helical pitch

4. Required computation power

5. Easy to implement

[A > B > C]

HFK

ASSR

HFI+

accurate

A

B

A

A

C

C

partial

B

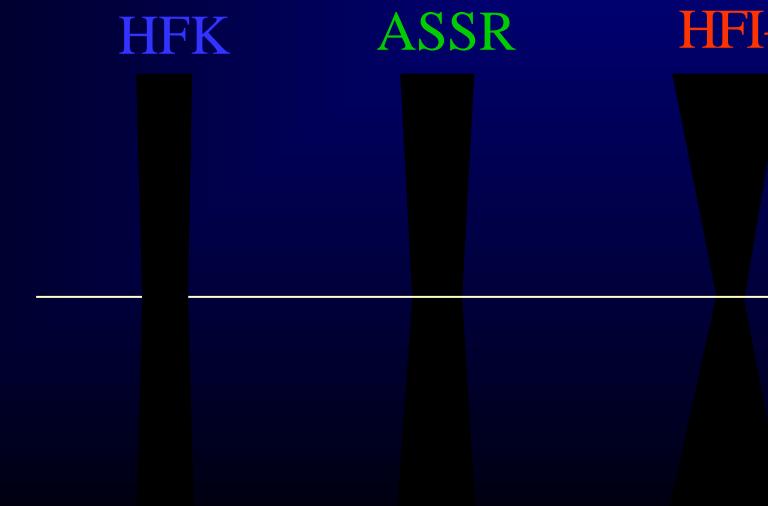
C

B

A

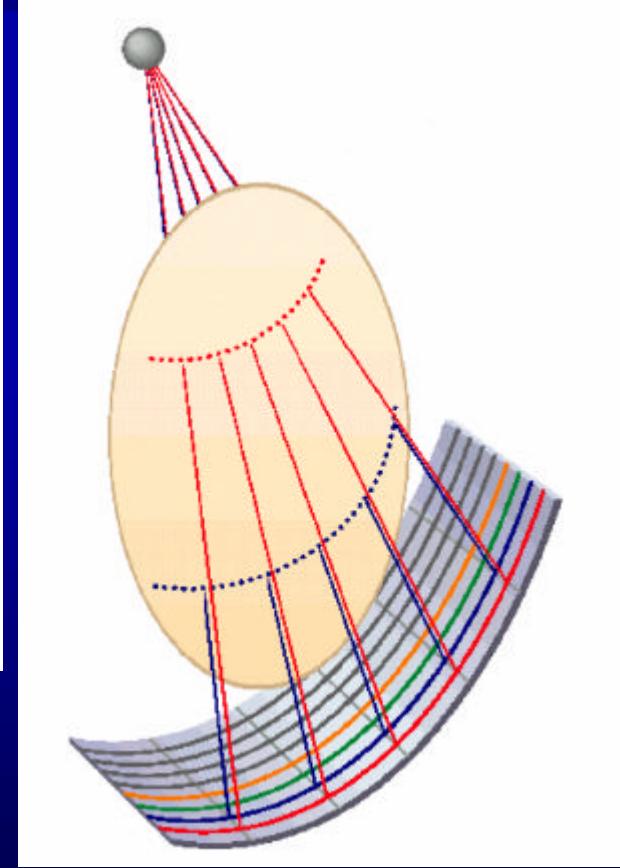
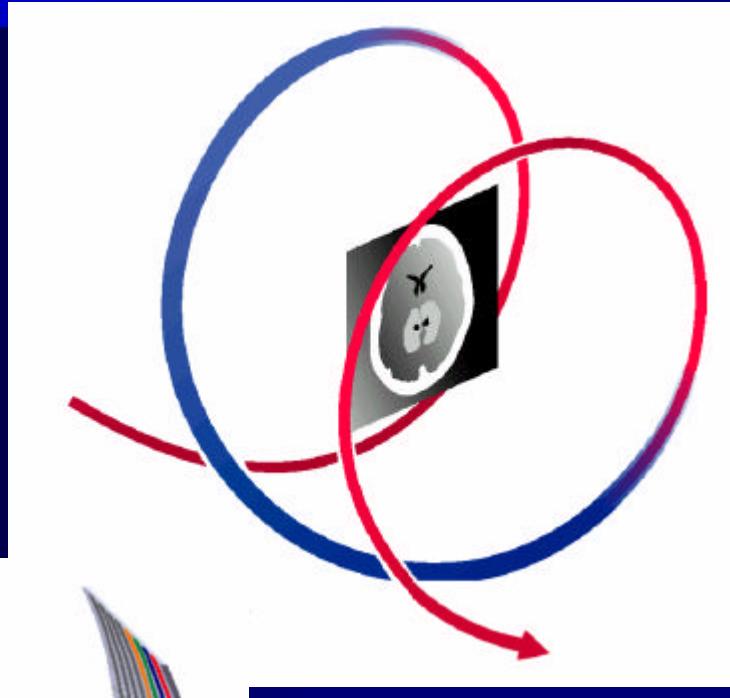
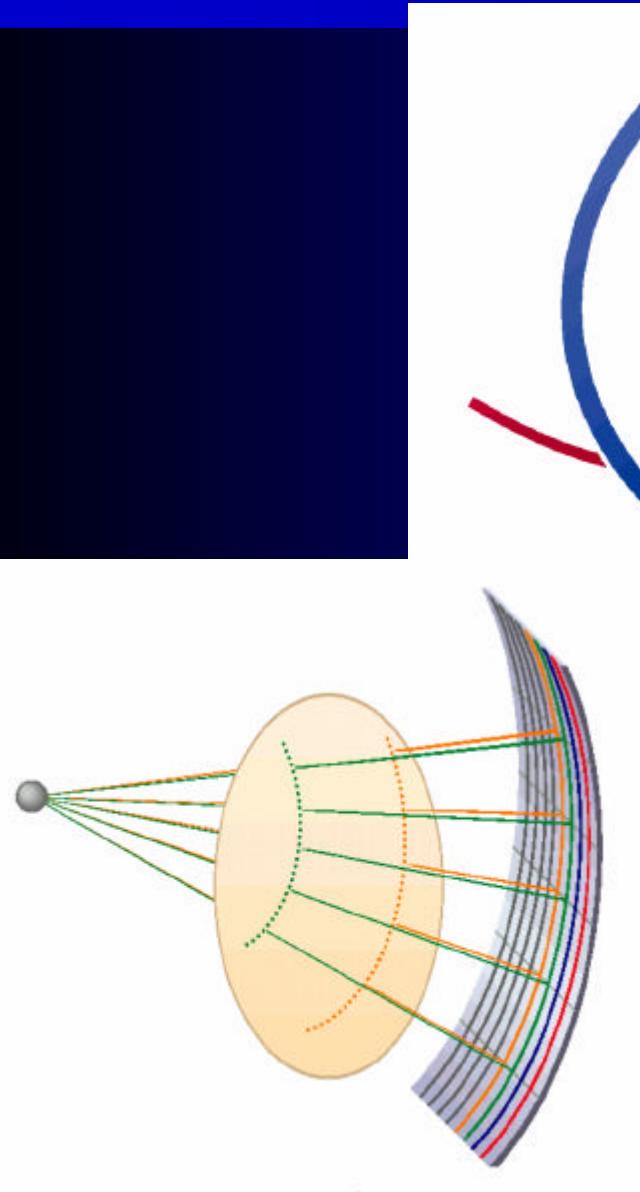
C

A



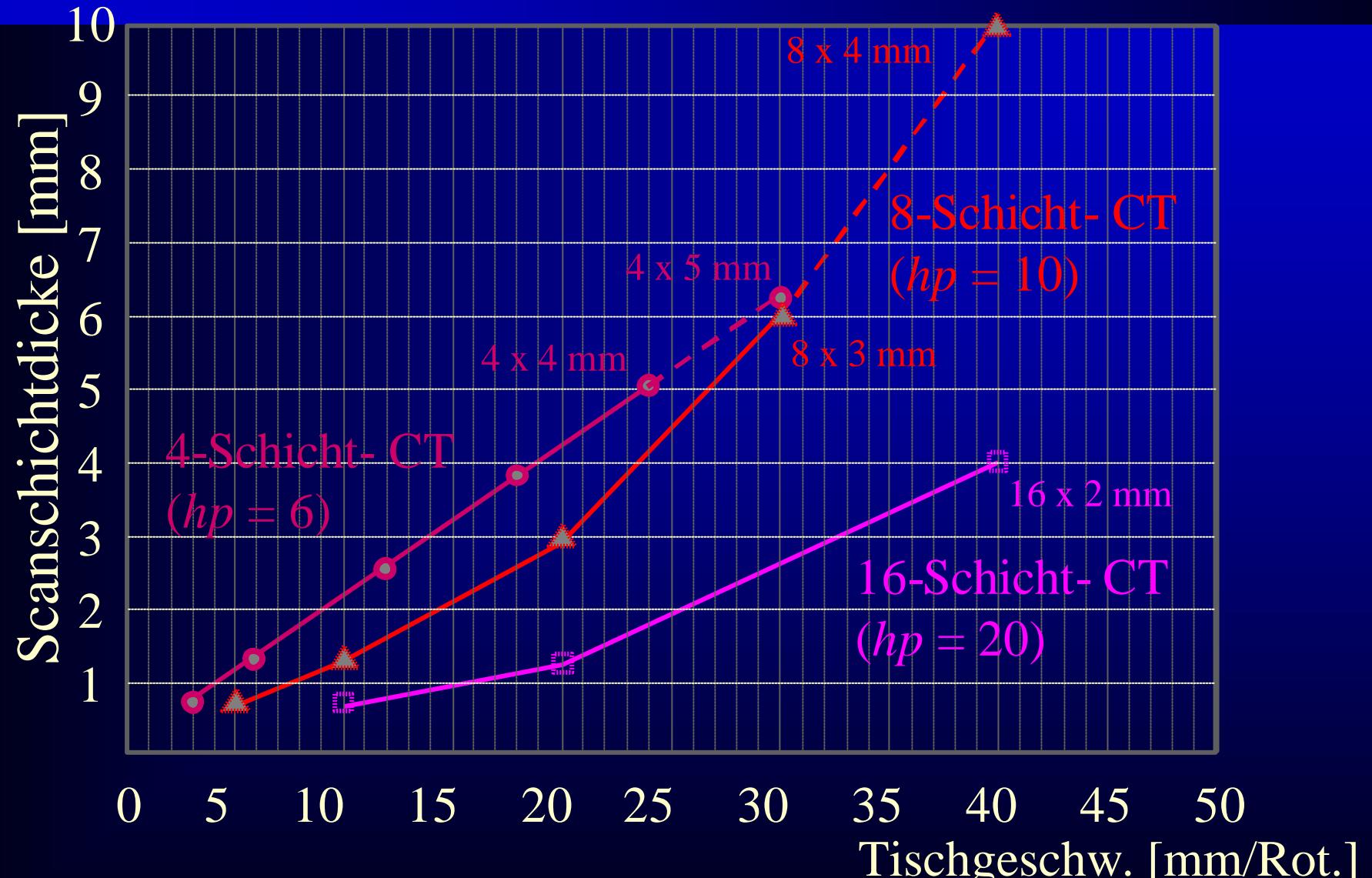
Amount of error or
z resolution

HFK (TCOT)

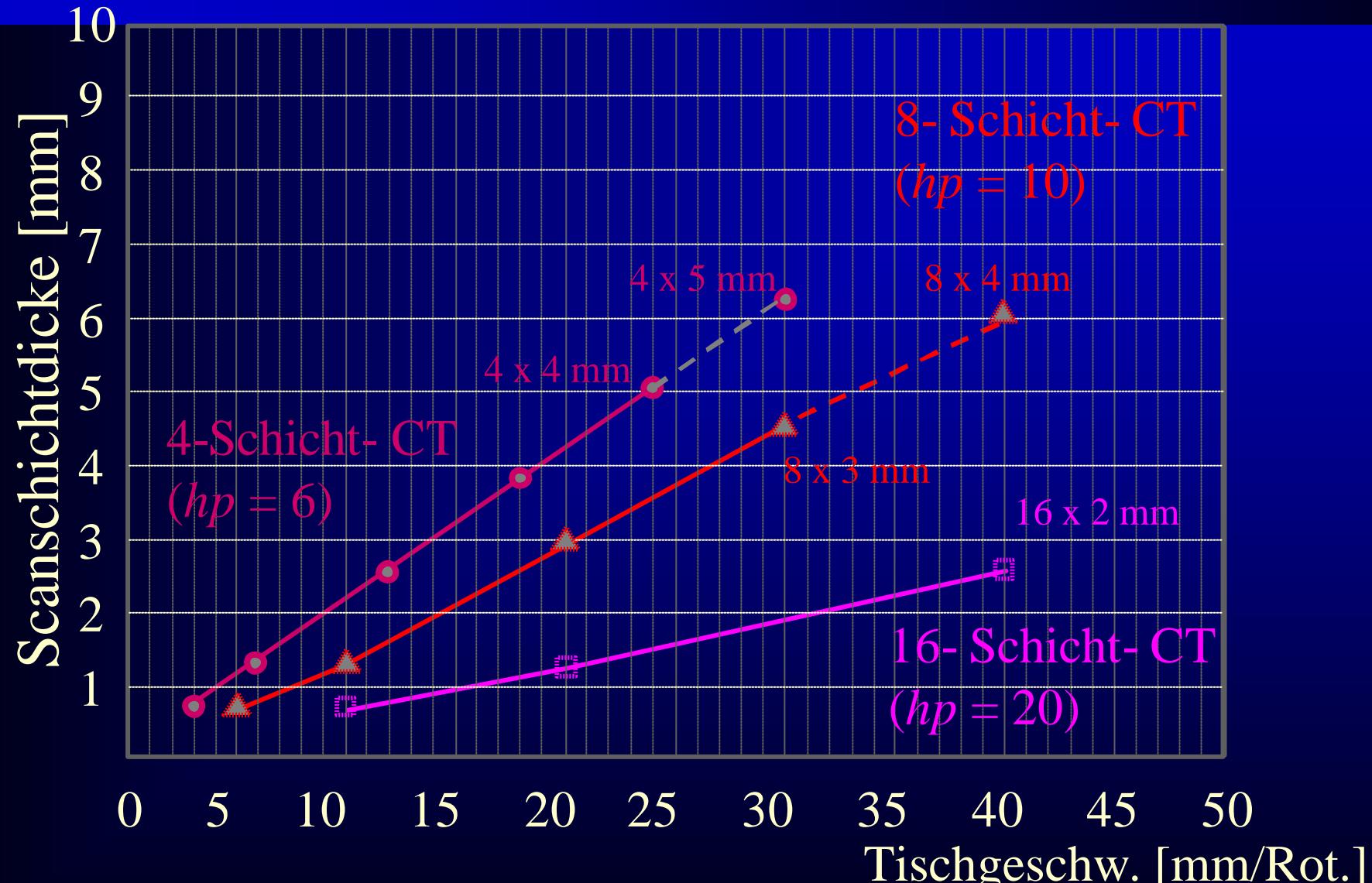


Accurate 3-D backprojection along x-ray path
Weighting data considering cone-angle and
view angle

Kopf- Scans



Abdomen-Scans



Reference of algorithms

HFK: Helical Feldkamp w/ weighting function = TCOT (True cone-beam tomography)

Aradate H and Nambu K, *Japanese Patent No. 2,825,352* (filed in 1990)

Taguchi K, *U.S. Patent No. 5,825,842* (Filed in 1995)

ASSR (Advanced single-slice rebinning)

Machida Y, Japanese patent disclosure (KOKAI) H8-187240 (Filed in 1995)

Kachelriess M, Schaller S, Kalender WA, "Advanced single-slice rebinning in cone-beam spiral CT," *Med Phys* 2000; 27: 754-772

→ AMPR (Adaptive multiple-plane reconstruction)

Schaller S, et al, "Novel approximate approach for high-quality image reconstruction in helical cone beam CT at arbitrary pitch," *SPIE* 2001; 4322: 113-127.

→ SMPR (Segmented multiple-plane reconstruction)

Stierstorfer K, et al, "Segmented multiple plane reconstruction – A novel approximate reconstruction scheme for multislice spiral CT," *The 6th international meeting of fully 3D image reconstruction in Radiology and Nuclear Medicine* 2001: 95-97.

Flohr TG, et al, "A new cone-beam spiral CT reconstruction approach for a 16-slice scanner with full dose utilization at arbitrary pitch," *Radiology* 2001; 221(P): 543.

HFI+ (Helical filter interpolation with “cross-over correction”)

Taguchi K and Aradate H, "Algorithm for image reconstruction in multi-slice helical CT", *Med Phys* 1998; 25: 550-561.

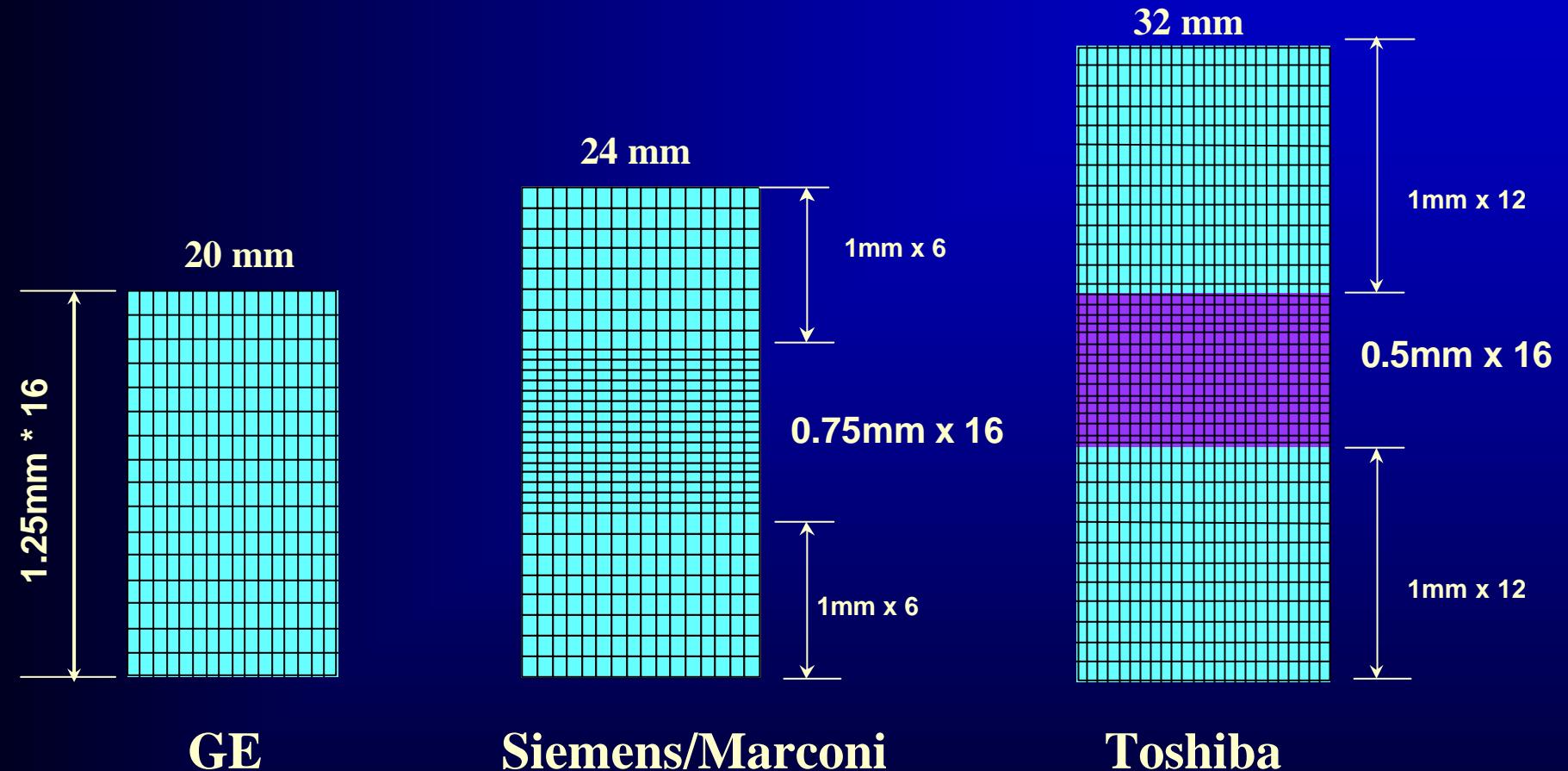
Zmora I, Taguchi K, Silver MD, and Han KS, "Correction of a new type of artifact in helical multi-slice CT," *Radiology*, 1998, 209(P): 434

Hsieh, et al, "A generalized helical reconstruction algorithm for multi-slice CT," *Radiology* 2001; 221(P): 217.

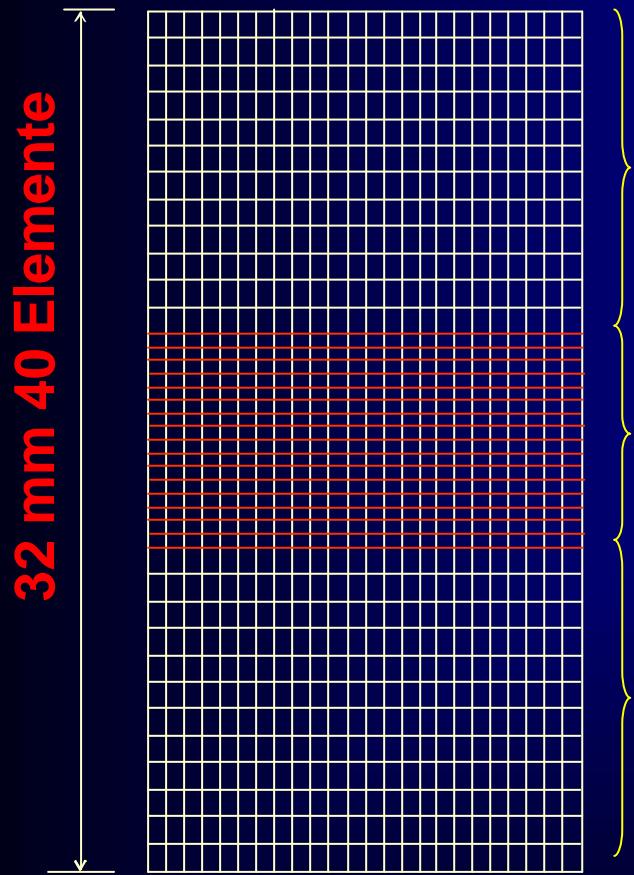
Literatur

1. Fallbeispiele von P. Rogalla, R. Klingebiel
Charit  Berlin Campus Mitte
2. K. Taniguchi et al
Algorithm for image reconstruction in multi-slice spiral CT
Med. Phys. 25 (1998) 550-561
2. Y. Saito
Multislice X-Ray CT Scanner
Medical Review 66 (1999) 1-8
3. M.D. Silver et al
Field-of-view dependent helical pitch in multislice CT
Spie Medical Imaging 2001, paper 4320-103, 2001
4. Dosiskalkulationsprogramm „CT-Expo“

Vergleich der 16 Schicht- Detektoren



Advanced V-Detektor



1mm x 12 Elemente

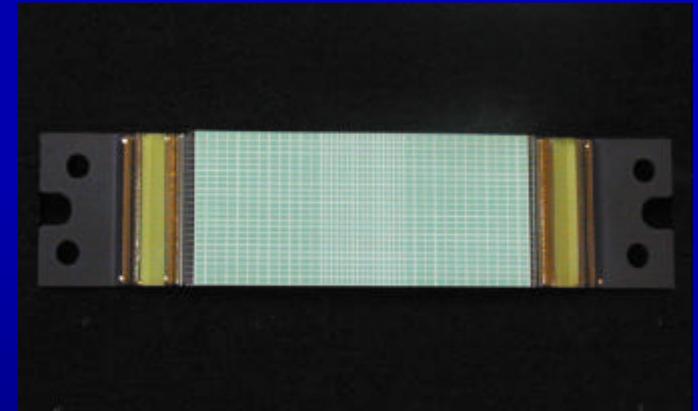
0.5mm x 16 Elemente

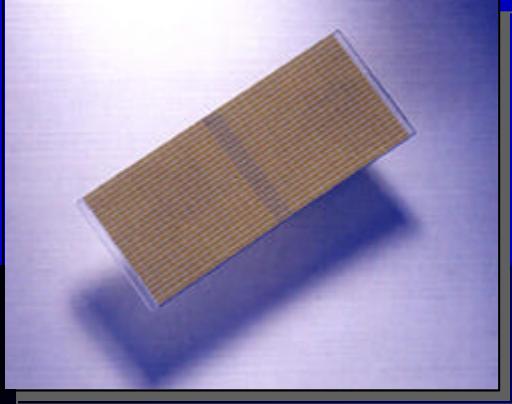
1mm x 12 Elemente

? Septendicke in μm - Technologie

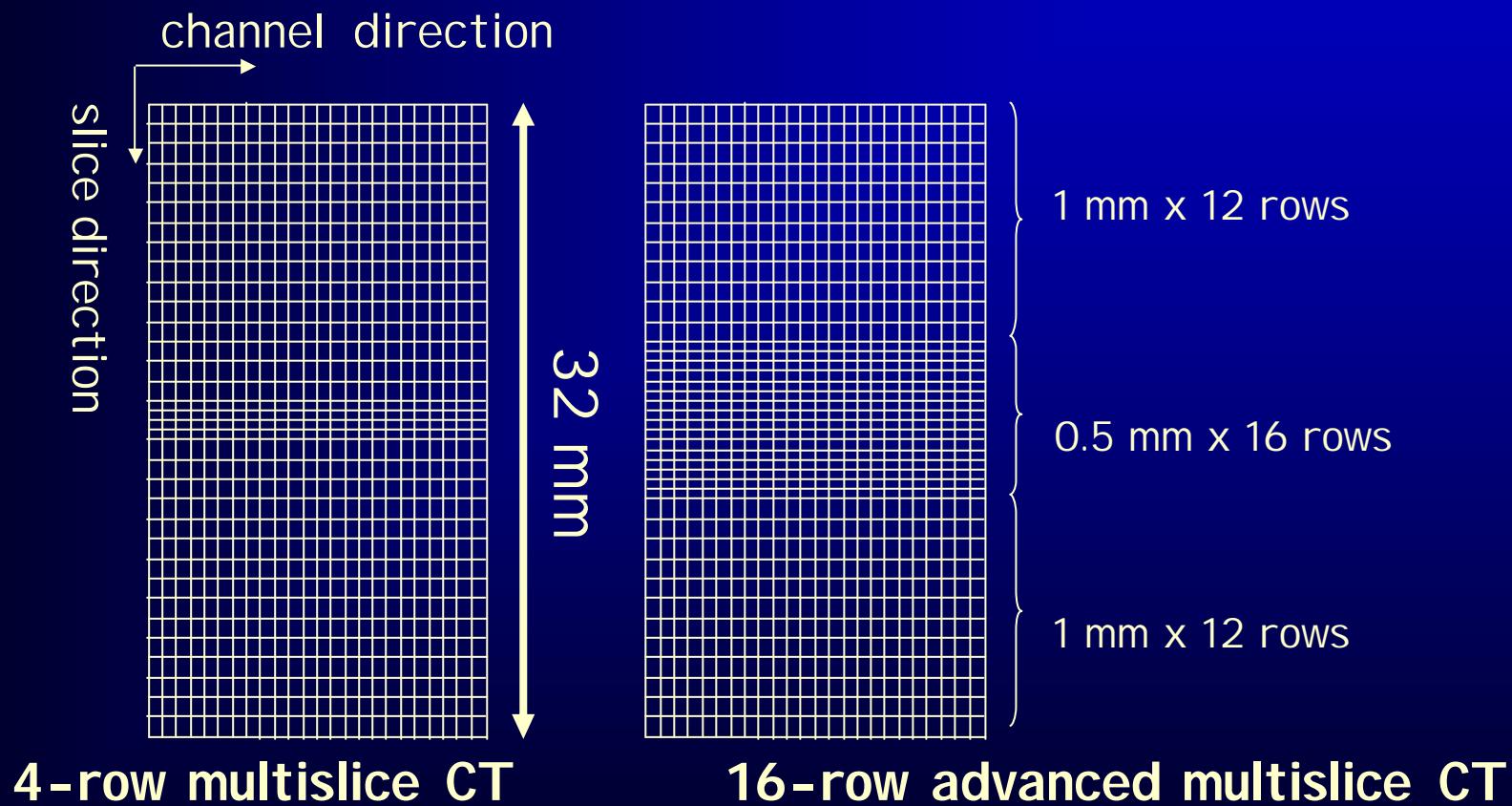
? Streustrahlenenergie-

Unterdrückung

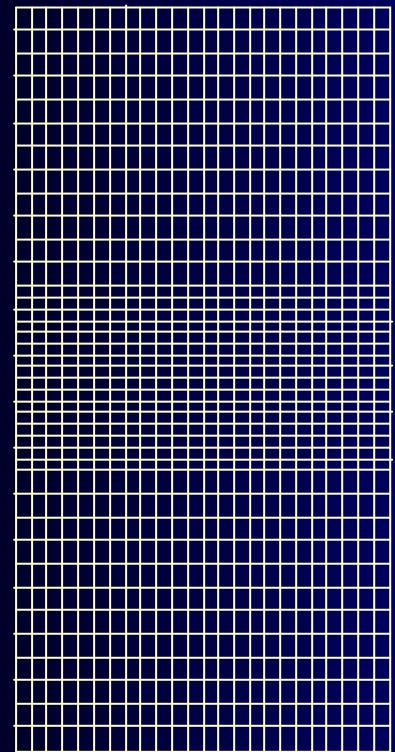




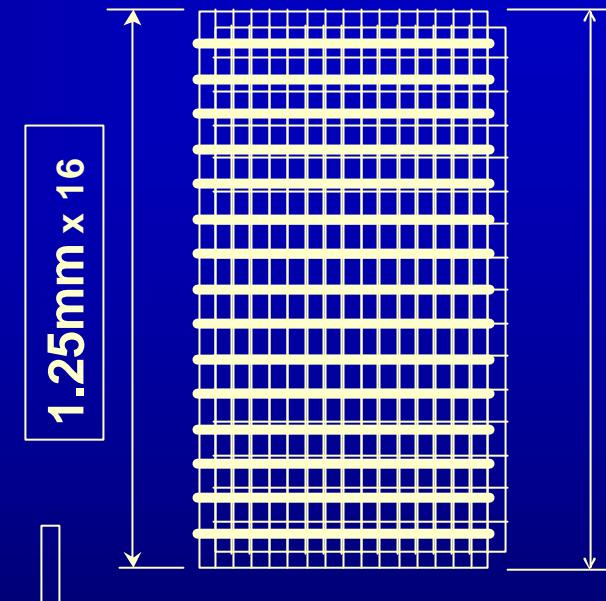
Combination of proven 0.5 mm technology and detector system for 32-mm/16-row acquisition



Detector Comparison



**4 slice x 0.5/1/2/3/4/5/8mm
8 slice x 0.5/1/2/3/4mm
16 slice x 0.5/1/2mm**



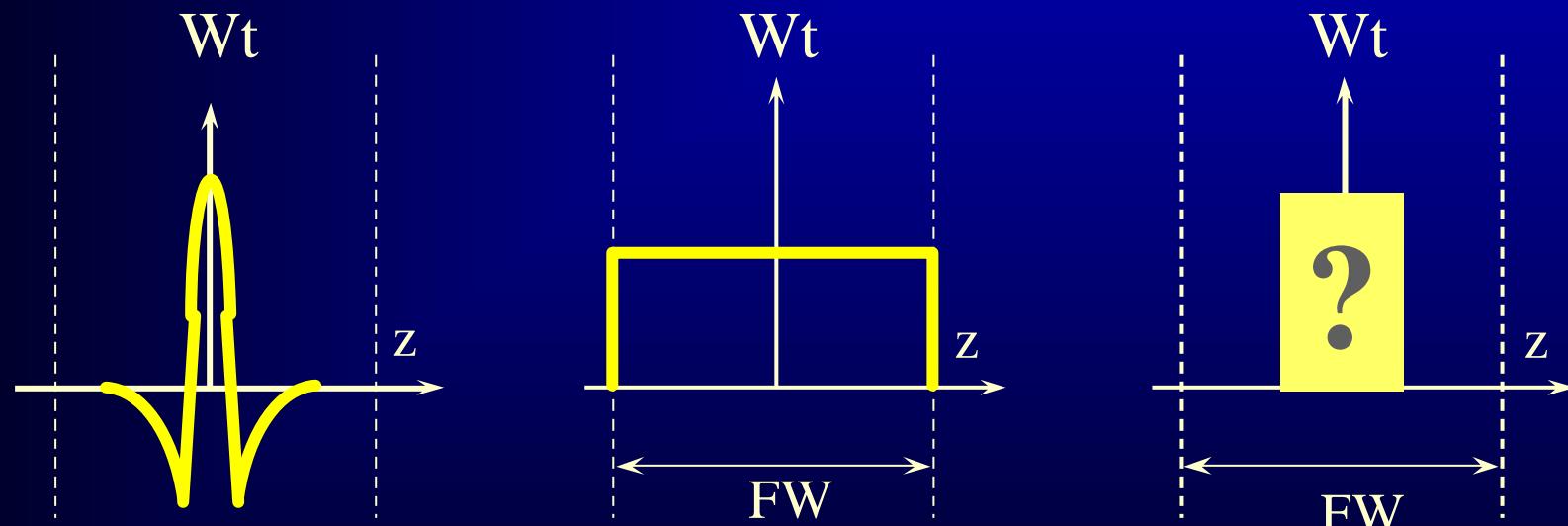
Competitor

**4 slice x 1.25/2.5/3.75/5mm
8 slice x 1.25/2.5mm**

Adaptive Filterung in z- Richtung

MUSCOT kann die Schichtbreite und das Rauschen rekursiv verändern und optimieren.

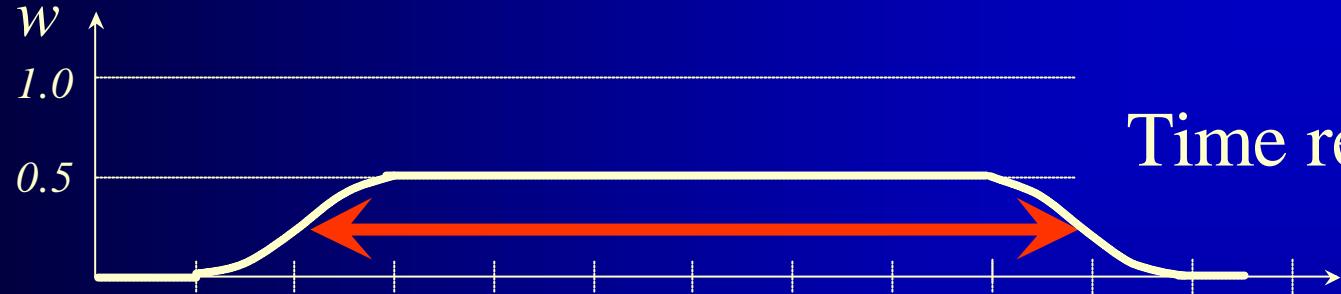
Parameter : Filter Weite (FW) und Filter Form (FF).



Weighting function in TCOT

(a) OS

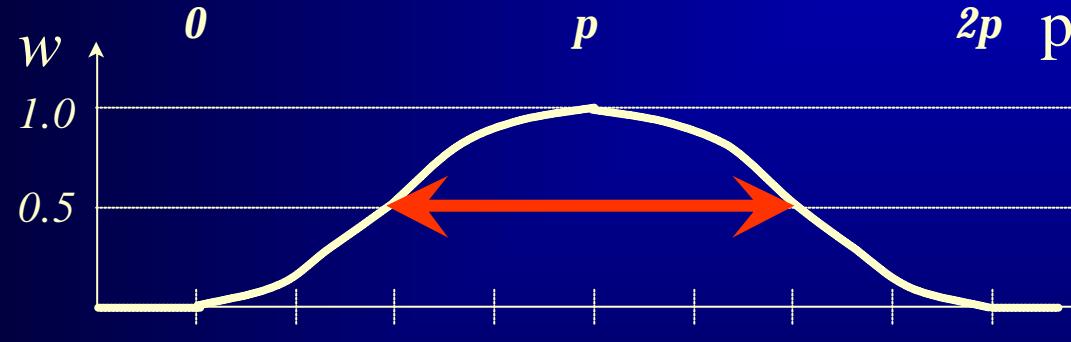
$$hp \leq 8$$



$$\text{Time reso.} = T$$

(b) NHS

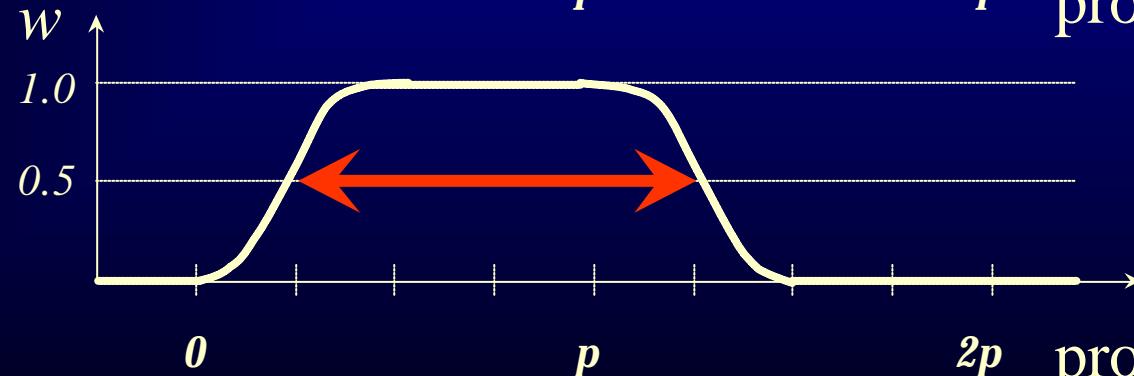
$$hp \geq 9$$



$$\text{Time reso.} = T/2$$

(c) HS

$$hp \approx \max$$



$$\text{projection angle: } \beta$$