

# C PET

*State of the Art Clinical Full Ring Positron Emission Tomograph*

ADAC

*ADAC Laboratories*

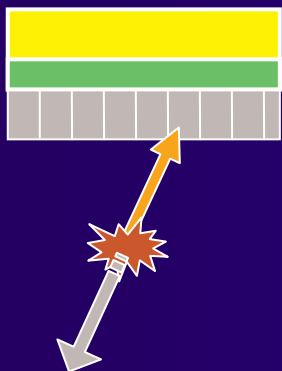


# C PET

## Coincidence imaging today

*State of the Art Clinical Full Ring Positron Emission Tomograph*

3/8" NaI(Tl)  
collimator



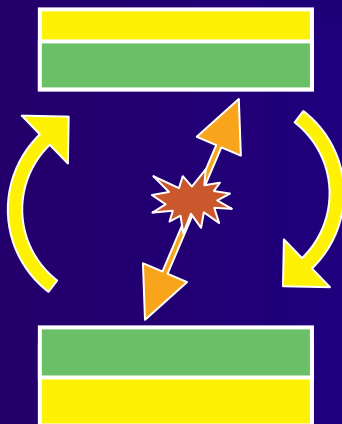
2D only

1

no coinc.

38 cm

5/8" NaI(Tl)  
coincidence



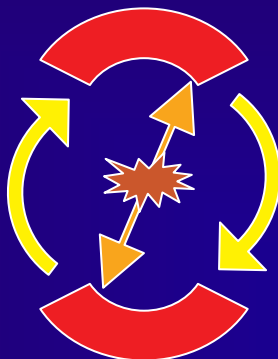
2D/3D

10

1

38 cm

20 mm BGO  
rotating



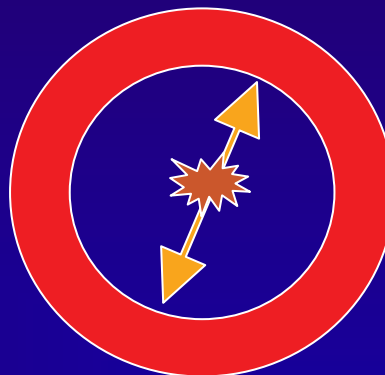
3D only

20

2

16.2 cm

20/30 mm BGO  
full ring



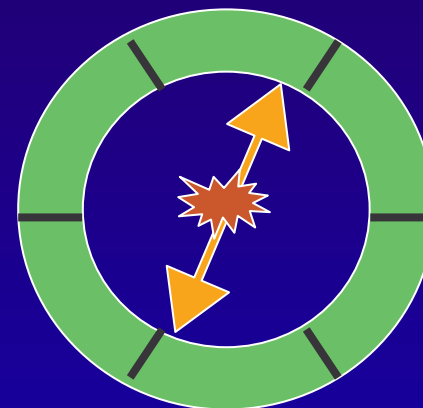
2D WB/3D brain

20 (2D)/100 (3D)

4

15/16.2 cm

1" NaI(Tl)  
6 x curved, full ring



3D only

40

5

25 cm

**Legend:** - mode of operation  
- rel. sensitivity  
- rel. trues rates  
- AFOV

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## Cost Efficient PET

- short investigation times
- high patient throughput
- no replacement of transmission sources
- lower injected doses ( $< 185$  MBq)
- excellent reliability
- secure investment - upgrade pathway
- easy (no water cooling, no extra electronics rack), fast installation
- minimal space requirements



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## summary



- dedicated full ring PET
- large 25 cm AFOV
- SinglePass™ acquisition w. post injection Cs-137 singles transmission
- SUN Ultra Sparc™ processing
- full 3D operation
- 3D iterative recon using FORE/OSEM
- excellent reliability

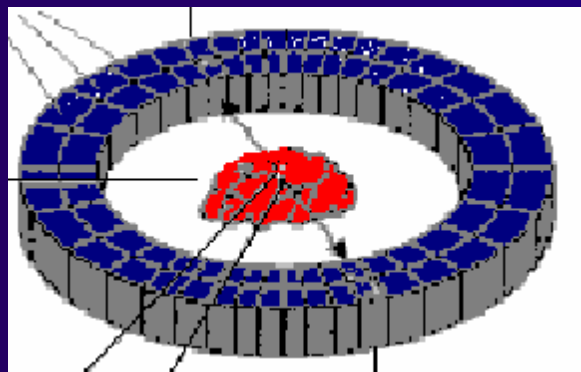


### The changing focus of PET....

neurology

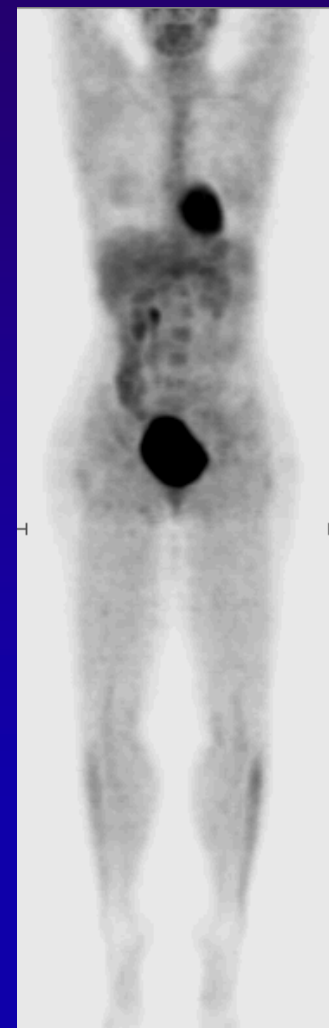


oncology

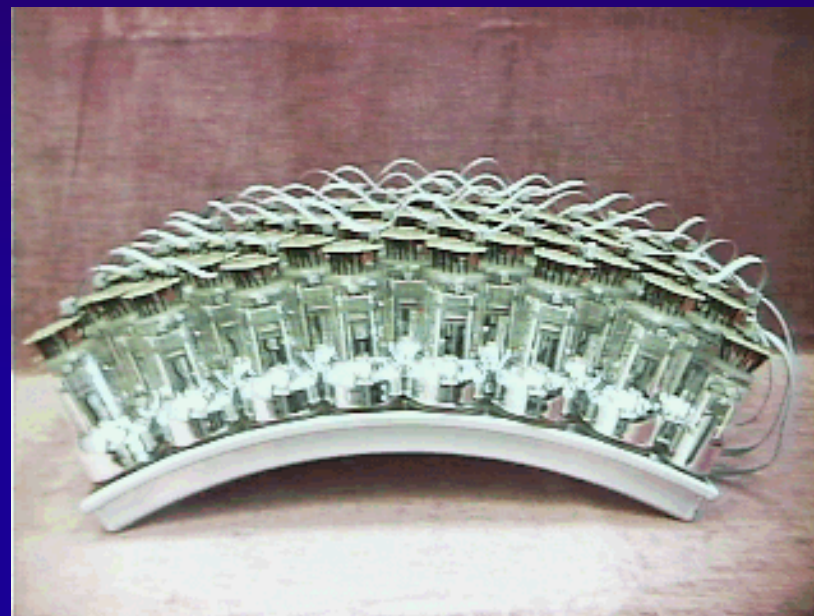


- homogenous organ
- defined shape
- high activities
- attn. can be modelled
- single organ - single FOV

- inhomogenous body
- wide variety
- small lesions
- low activity concentrations
- quantitation
- WB - multiple FOV



### Patented Innovative Detector Technology:



- Curved Crystal Technology
- Good spatial resolution  $< 5$  mm
- No dead spaces, 6 crystals form a full ring
- Maximum sensitivity (400 kcps/ $\mu$ Ci/ml)
- 25 cm axial field of view
- Excellent energy resolution of 12 %

### .... changes technical requirements

neurology



oncology

- high count rate
- multiple crystal BGO design
- measurement time not crucial
- dynamic studies
- attn. corr. modelled/measured
- single FOV - time no issue
- 2D imaging sufficient

- low activities/concentrations
- 3D imaging for higher sensitivity
- attn. corr. on the WB
- attn. corr. simultaneously with emission
- acquisition time big issue - patient comfort, pat. motion

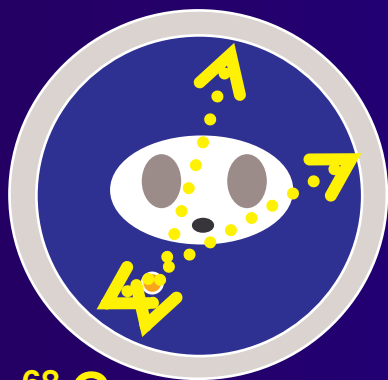


.... changes technical requirements

neurology



oncology

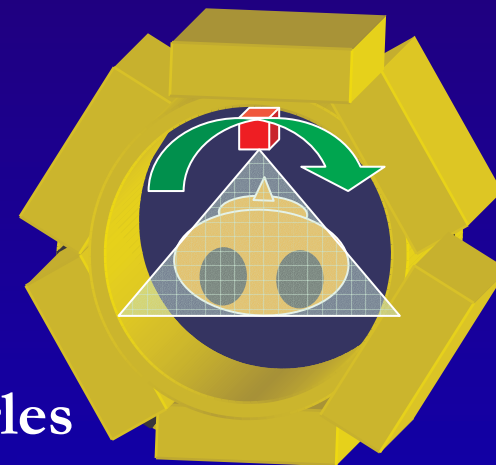


<sup>68</sup>Ge  
511 keV

- poor statistics
- long acq. times
- regular replacement -costs

attenuation correction

Ge-68 coinc.



Cs-137 singles

- good statistics
- very short acq. times
- no replacement - no costs

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C PET

design goal:

*“Deliver high PET image quality  
in reasonable time and at  
reasonable cost.”*

# C PET

*State of the Art Clinical Full Ring Positron Emission Tomograph*

stands for...

## Cutting Edge Technology

- CCT™ detector technology with < 5 mm resolution
- Cs-137 based singles attenuation correction
- Efficient 3D acquisition

## Clinical Image Quality / Ease of use

- Small tumor detectability
- Short investigation times
- Minimal motion artifacts

## Cost optimized PET

- High patient throughput
- Low operation costs
- Lower tracer costs

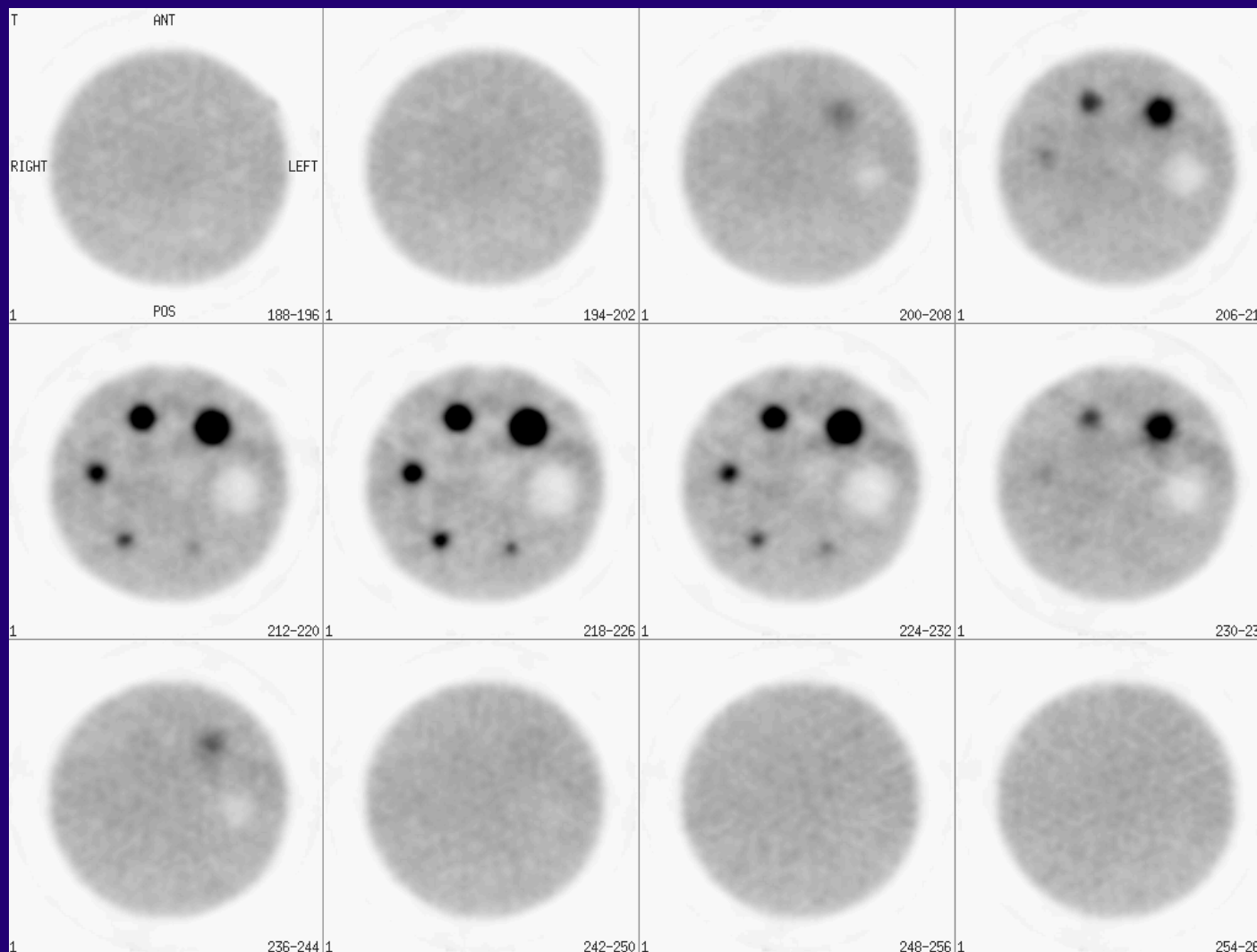


# Cutting Edge Technology

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**NEMA phantom (28,22,17,13,10 mm hot and 37 mm cold)**

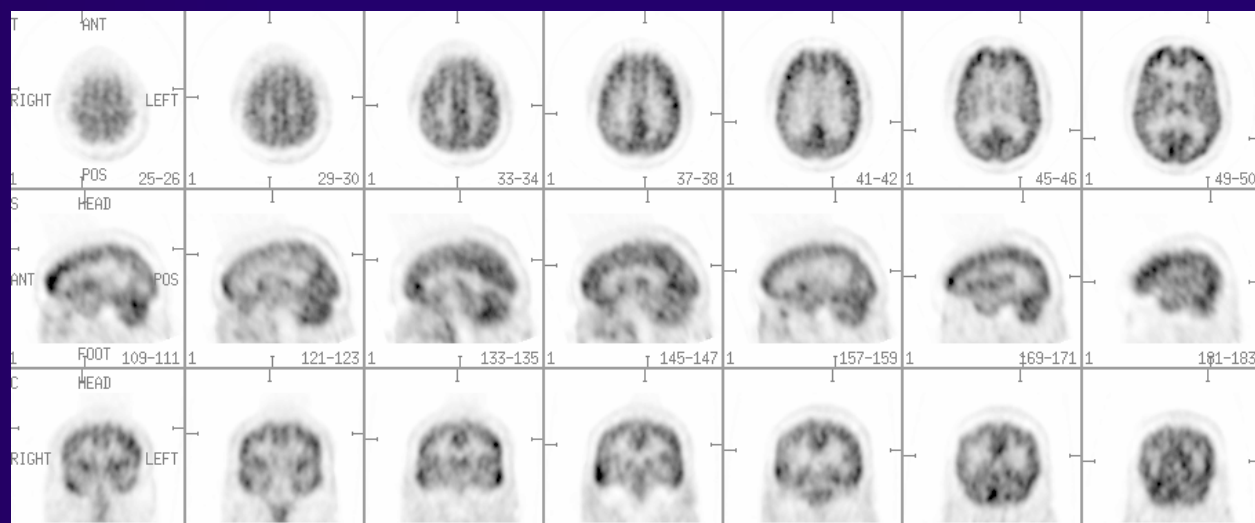
**10:1 activity  
10 min. acqu.  
attn. corr.  
FORE/OSEM  
4 iterations,  
8 subsets**



# C PET

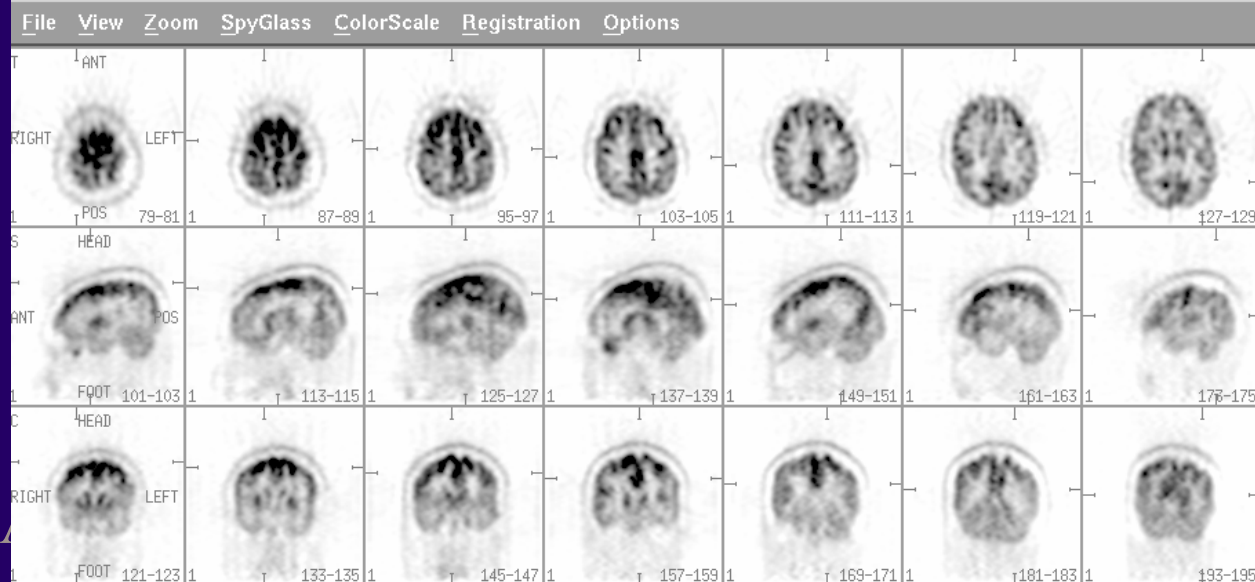
*State of the Art Clinical Full Ring Positron Emission Tomograph*

...see the improvement  
in the brain images



QUEST 1997

Display/Image Registration 5.1



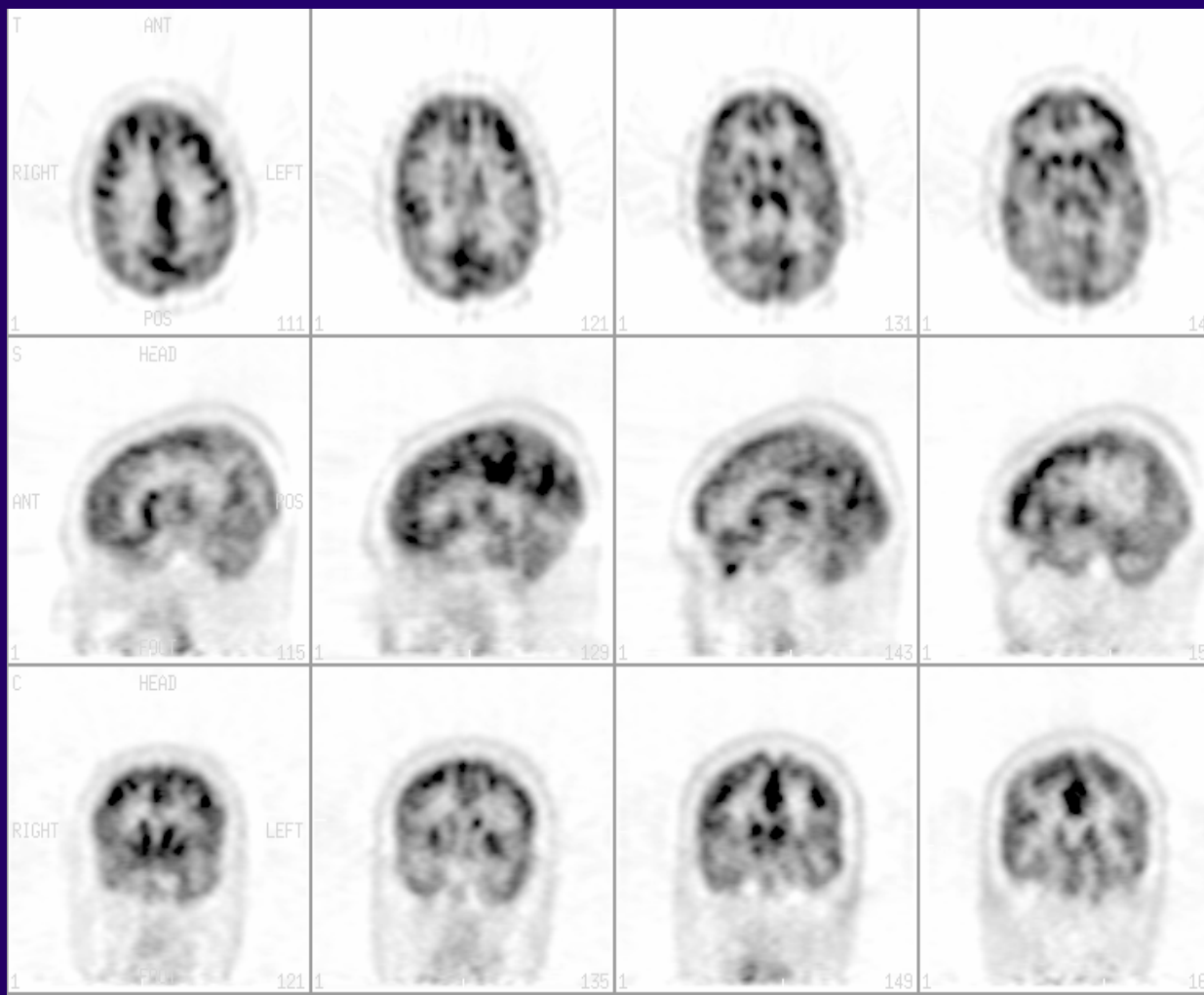
C PET  
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ADAC Laboratories

1998

# C PET

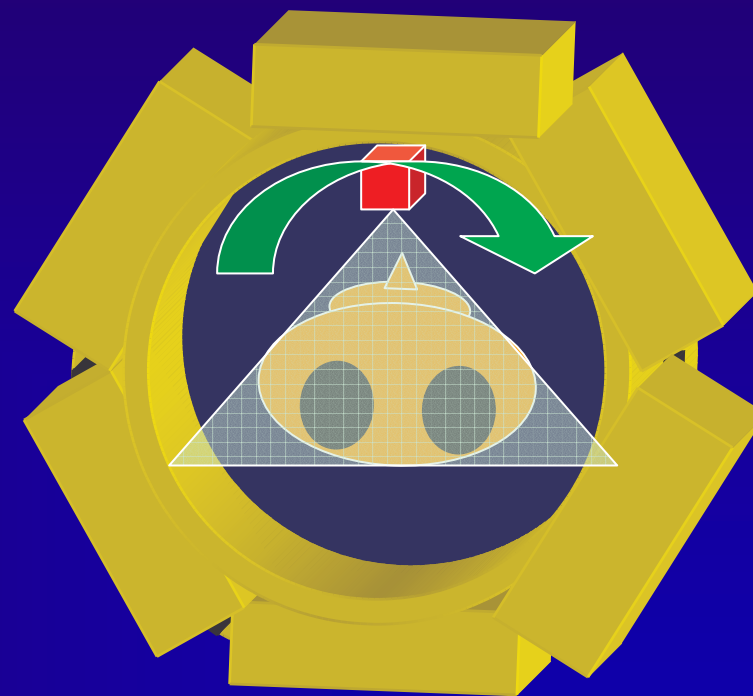
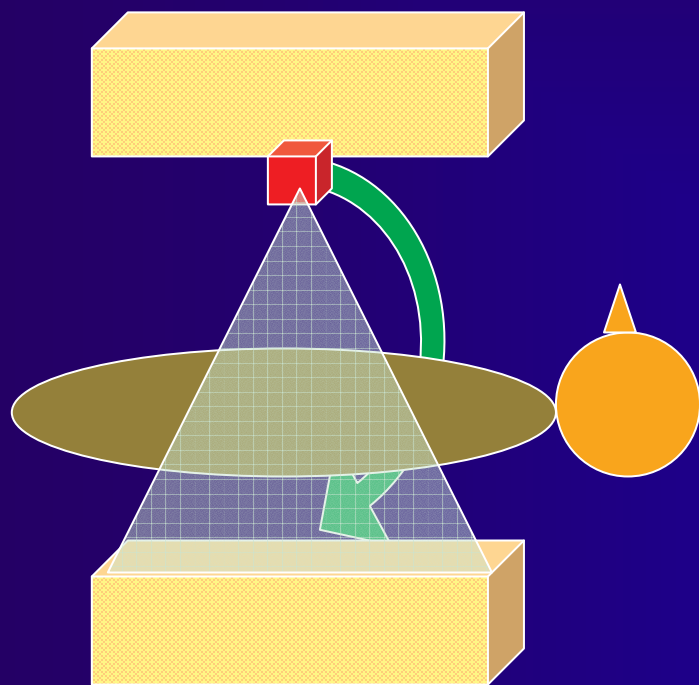
excellent resolution in brain imaging

*State of the Art Clinical Full Ring Positron Emission Tomograph*



1998

### Post Injection Cs-137 Singles Transmission



- max. 2 min. additional measurement time per bed position

### Post Injection Cs-137 Singles Transmission



emission only

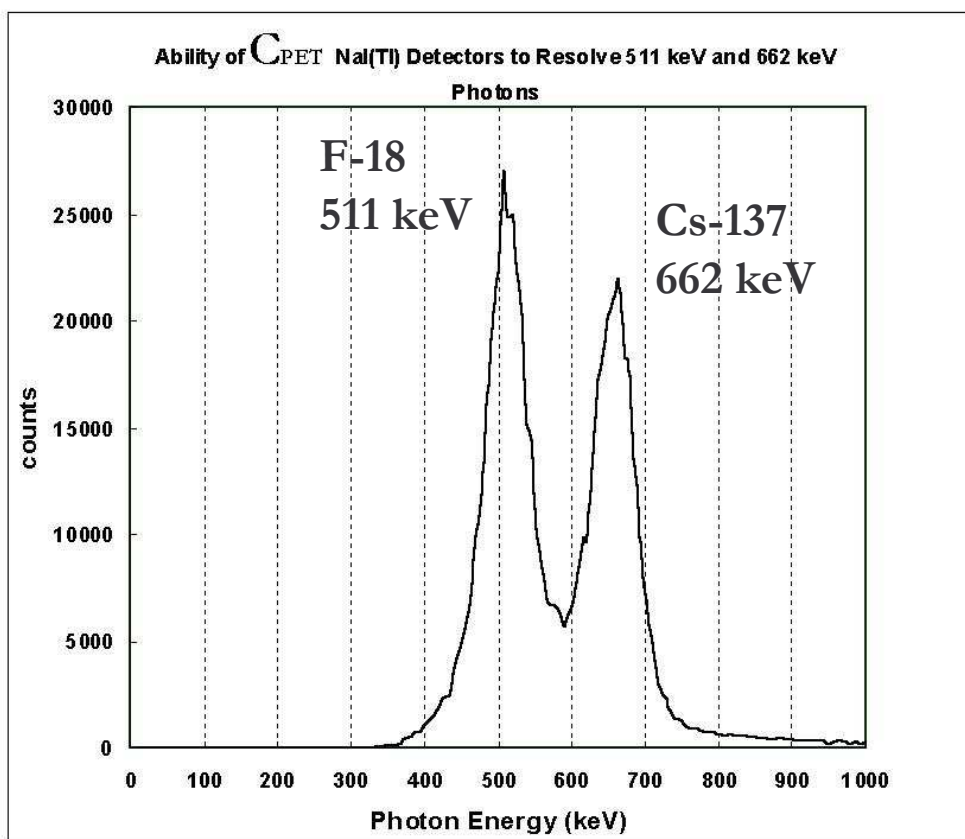
corr. emission

transmission only



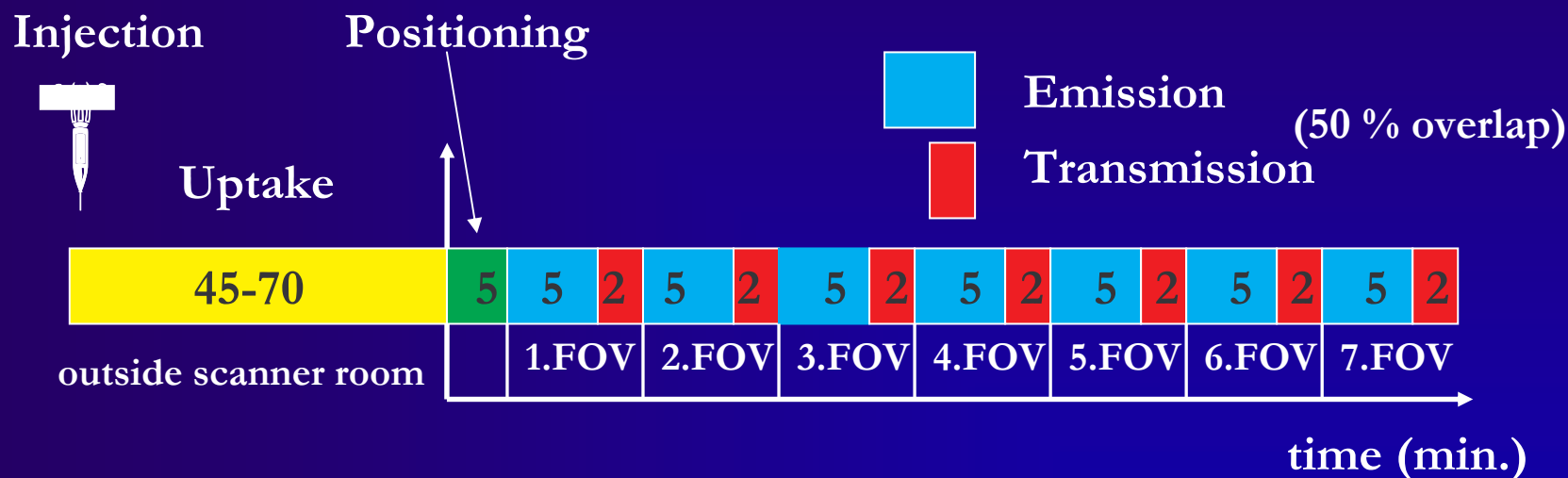
## detectors - energy resolution

Post-injection singles transmission enabled by NaI  
excellent energy resolution



- 12 % energy resolution
- clear photopeak separation (511 and 662 keV)
- enables Post-injection transmission imaging
- minimal cross talk of 511 keV emission into 662 keV transmission (< 5 %)

### SinglePass™ Acquisition

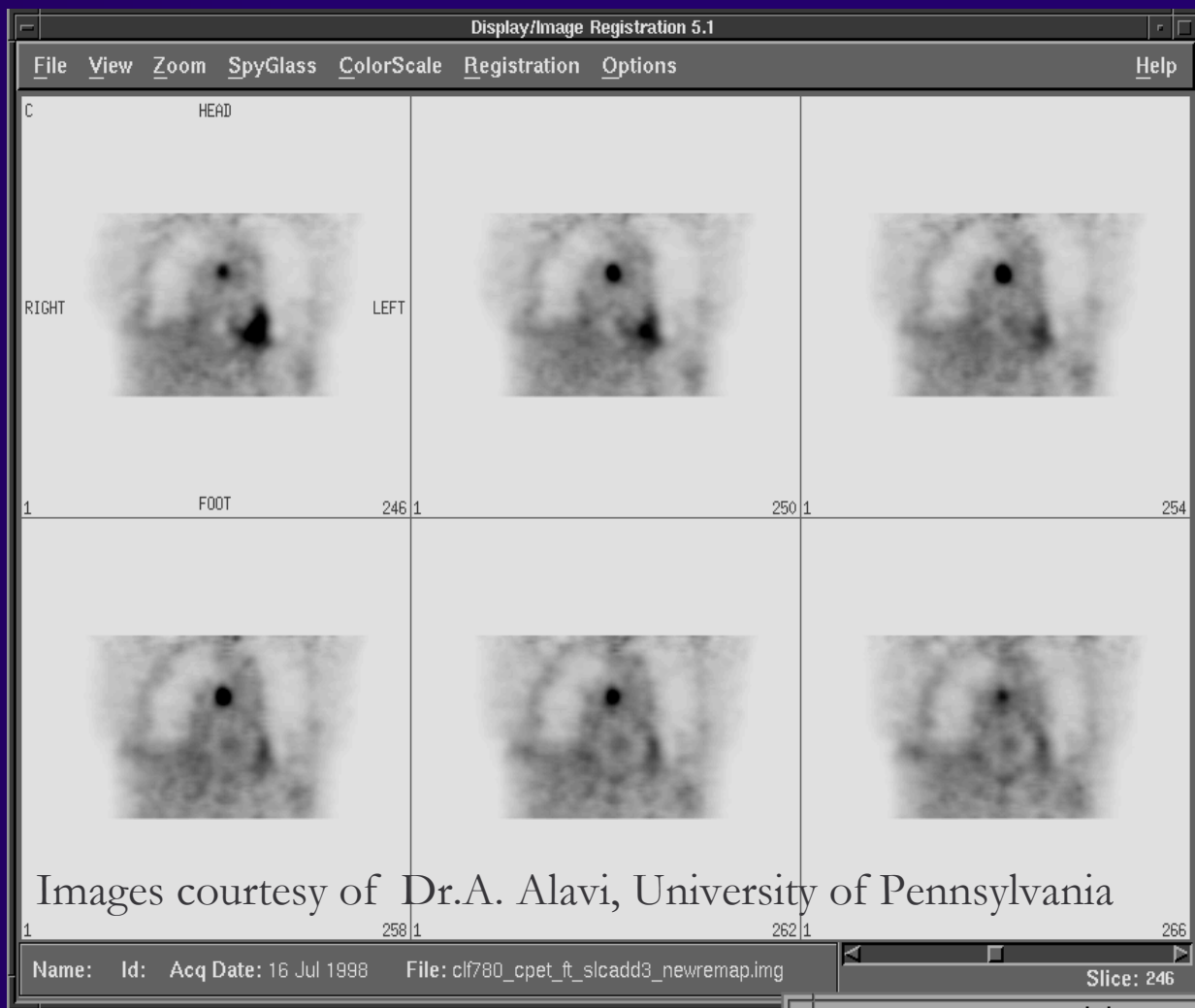


- Chin to Pelvis (100 cm) in 49 min. Emission+Transmission
- no repositioning
- no repeated acquisition
- minimized motion artifacts



# mediastinal lymph node involvement

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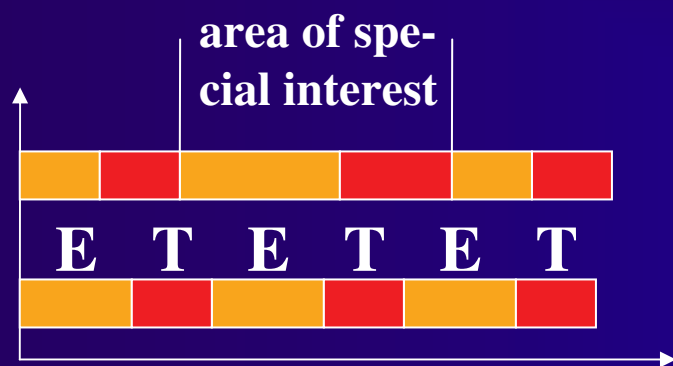
Images courtesy of Dr.A. Alavi, University of Pennsylvania



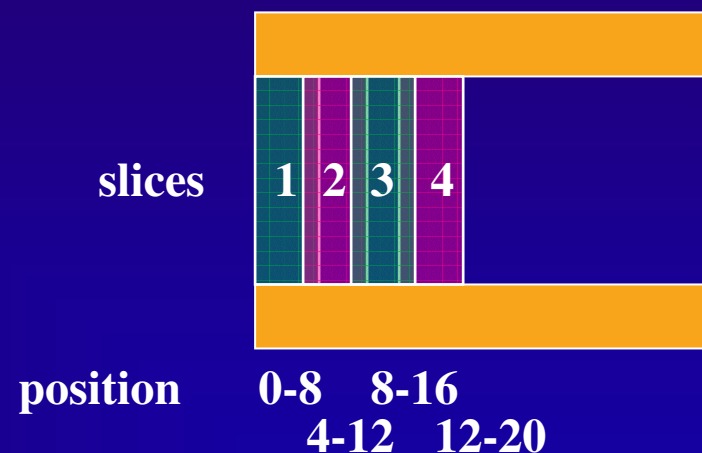
1998

12 minutes  
emission  
acquisition

*variable frame times*



*contiguous or overlapping slices* with variable thickness



- predefined and user definable acquisition protocols
- standardized and user definable analysis and documentation
- Interfile /DICOM 3.0

### Spatial Resolution



- better than **5 mm spatial resolution**
- large ring diameter of 90 cm for **good homogeneity**
- 3D iterative recon with **FORE/OSEM**

### Signal-to-Noise Ratio (SNR)



- low scatter (<30%) with excellent **energy resolution of 12 %**
- low randoms due to narrow **coincidence window of only 8 ns**
- good contrast with rapid **Cs-137 singles transmission**

### Absence of Distortions/Artifacts

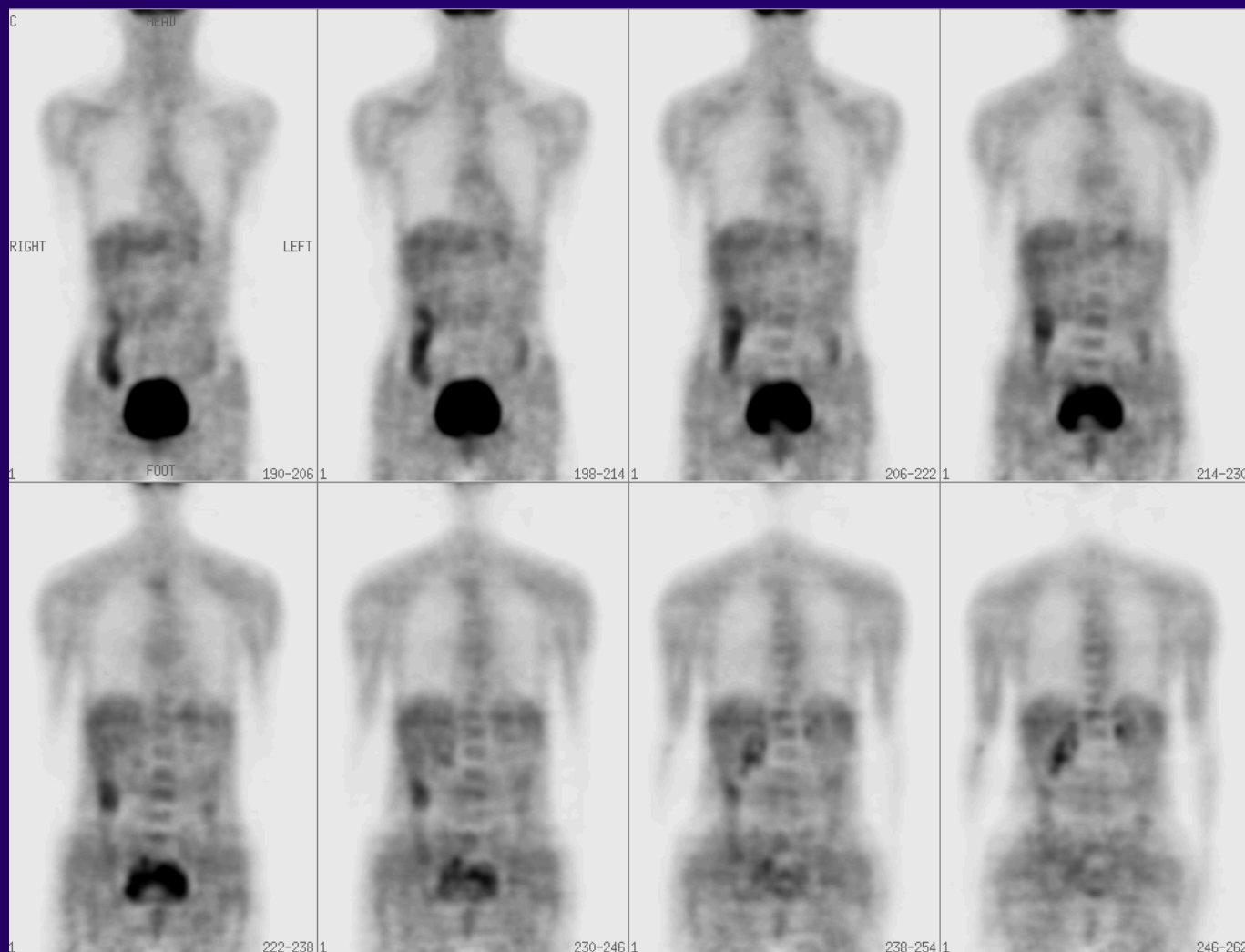


- **post-injection non uniform measured attn. correction**
- short investigation times: **< 50 min. wholebody EM+TX**
- 3D iterative recon

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## normal wholebody image



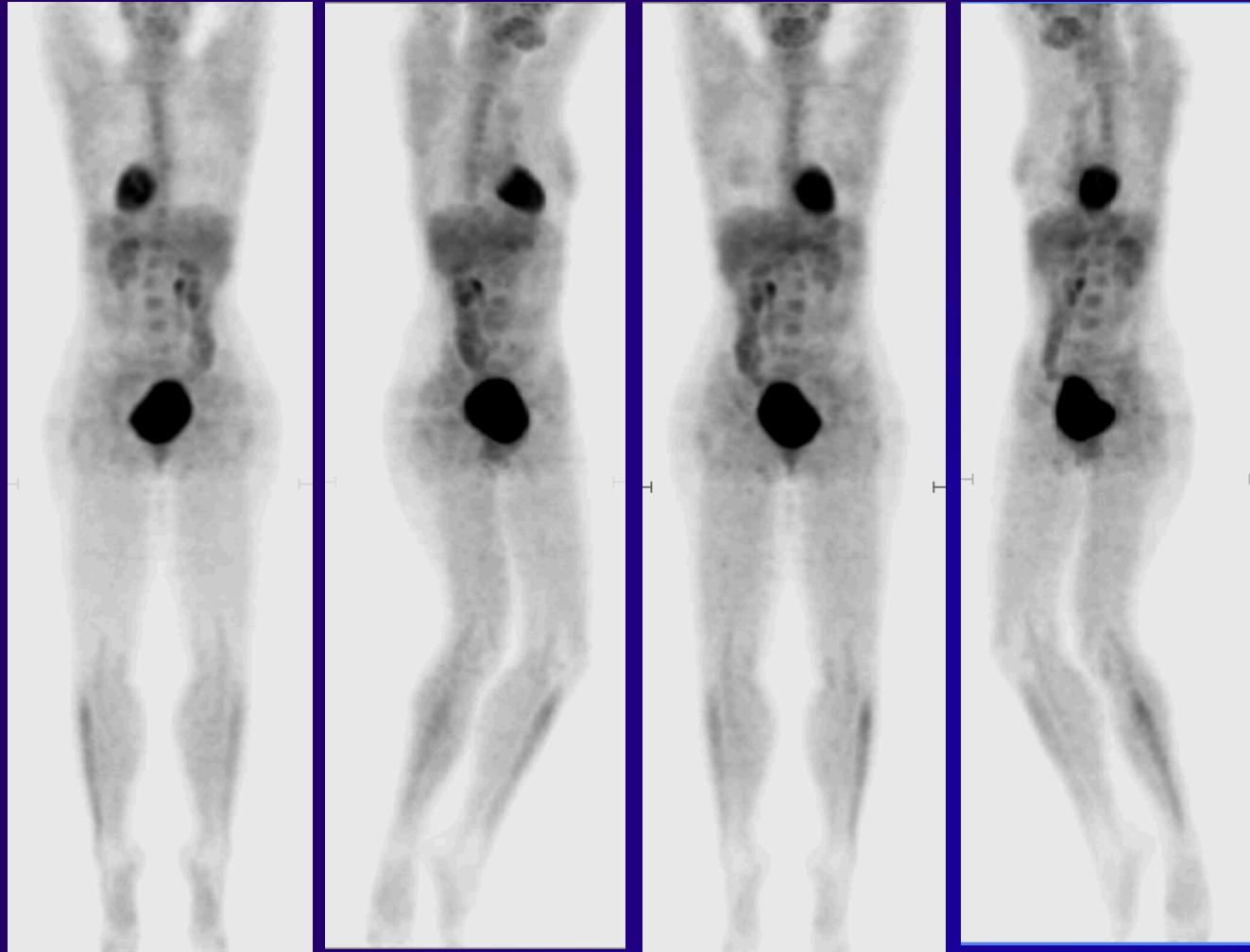
5 mCi  $^{18}\text{F}$ FDG  
45 min. p.i.  
total acq. time:  
49 min.  
including  
em. + transm.

Images courtesy of  
Dr. D. Froehling,  
Karlsruhe, Germany

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## wholebody tumor survey - negative

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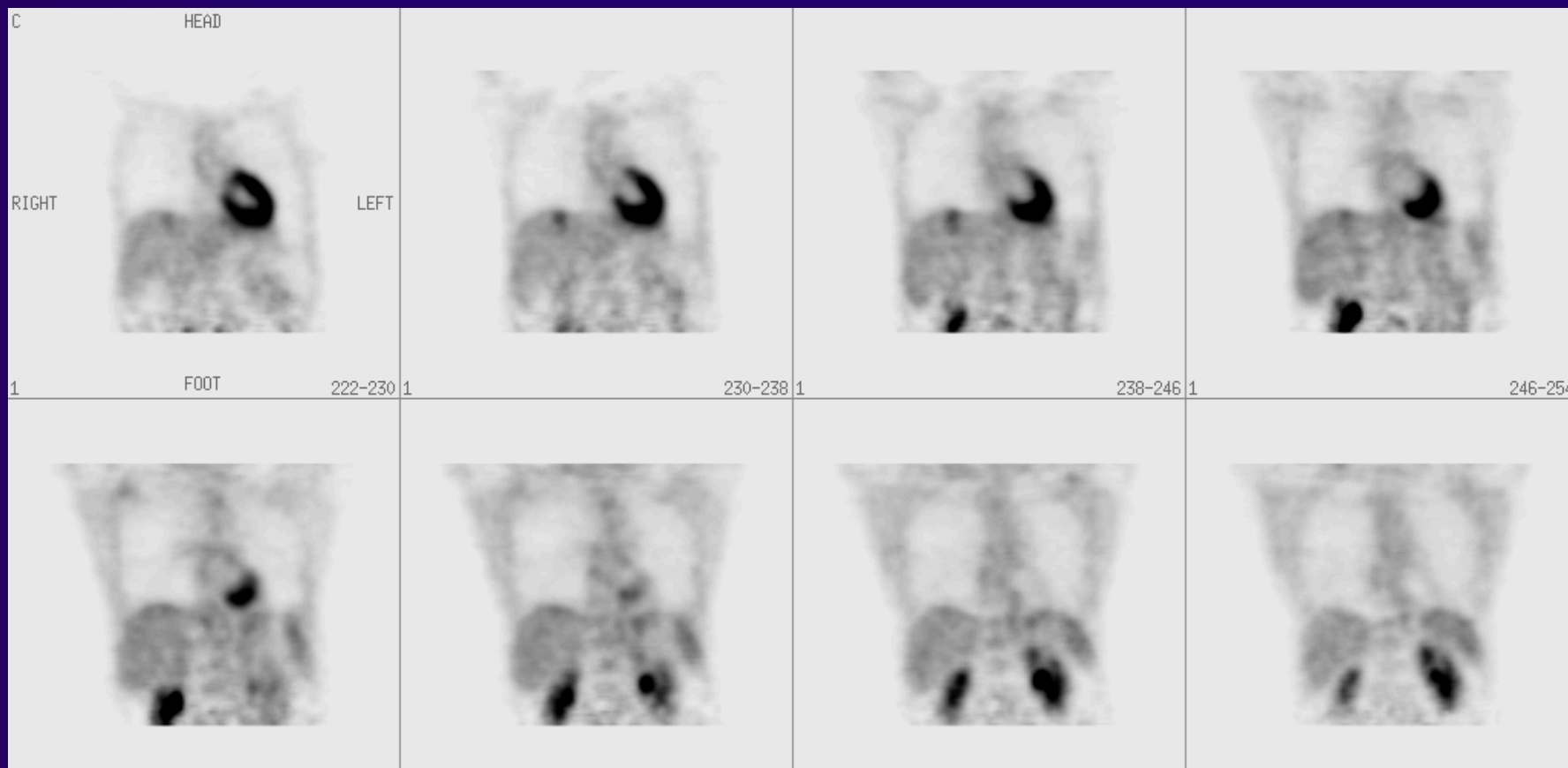
5 mCi  $^{18}\text{F}$ FDG  
60 min. p.i.  
total acq. time:  
90 min.  
including  
em. + transm.

Images courtesy of  
Dr. D. Froehling,  
Karlsruhe, Germany

# C PET

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## liver lesion



5 mCi  $^{18}\text{F}$ FDG, 70 min. p.i., total acq. time: 24 min. including em. + transm.

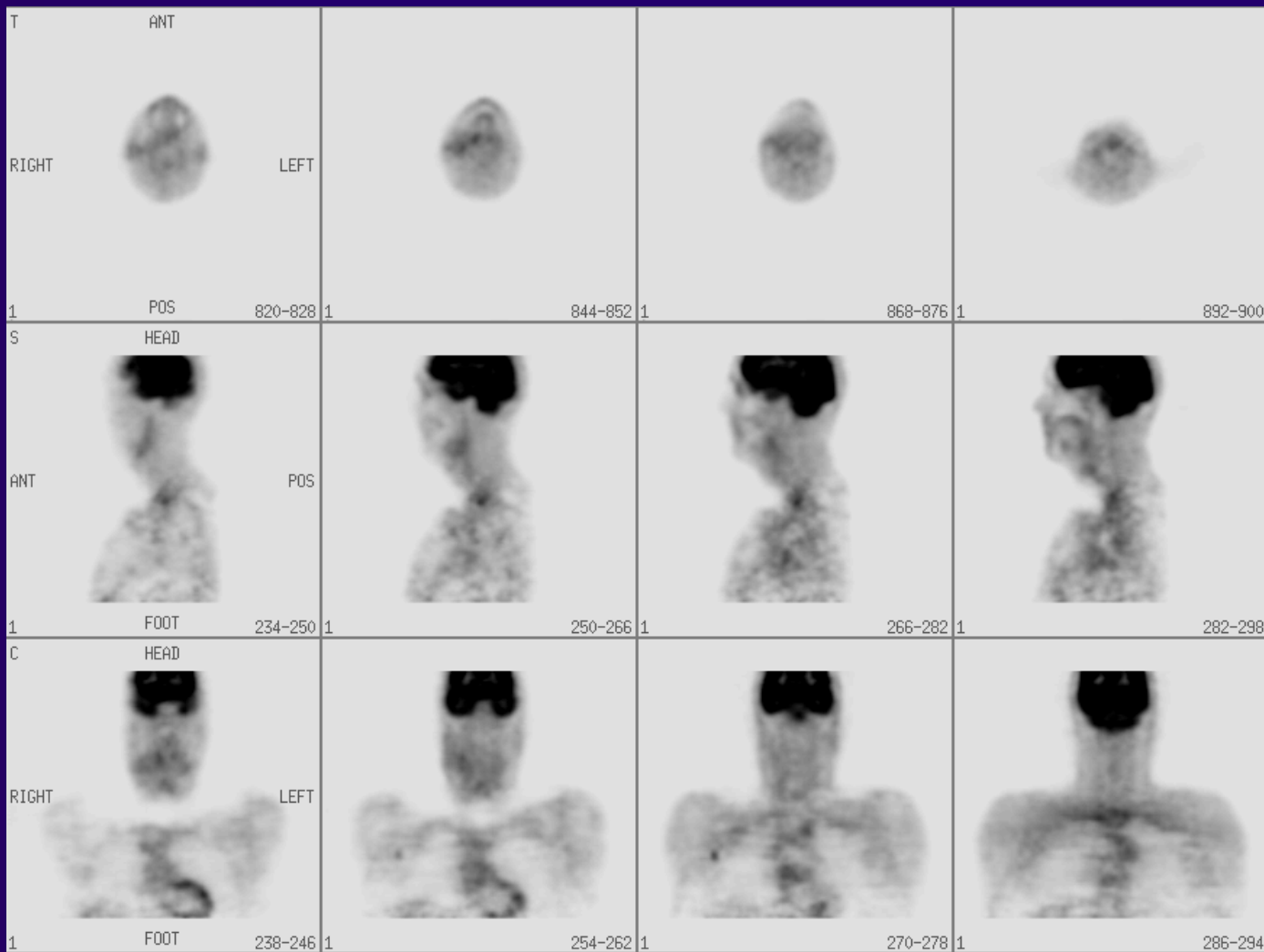
Images courtesy of Dr. A. Alavi, University of Pennsylvania



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## small axillary lymph node



4 mCi  $^{18}\text{F}$ FDG  
50 min. p.i.  
total acq. time:  
20 min.  
including  
em. + transm.

Images courtesy of  
Dr. A. Alavi,  
University of  
Pennsylvania

Name: \*\*\*\*\* Id: \*\*\*\*\* Acq Date: 13 Aug 1998 File: p8s0\_clf824p2nb.img

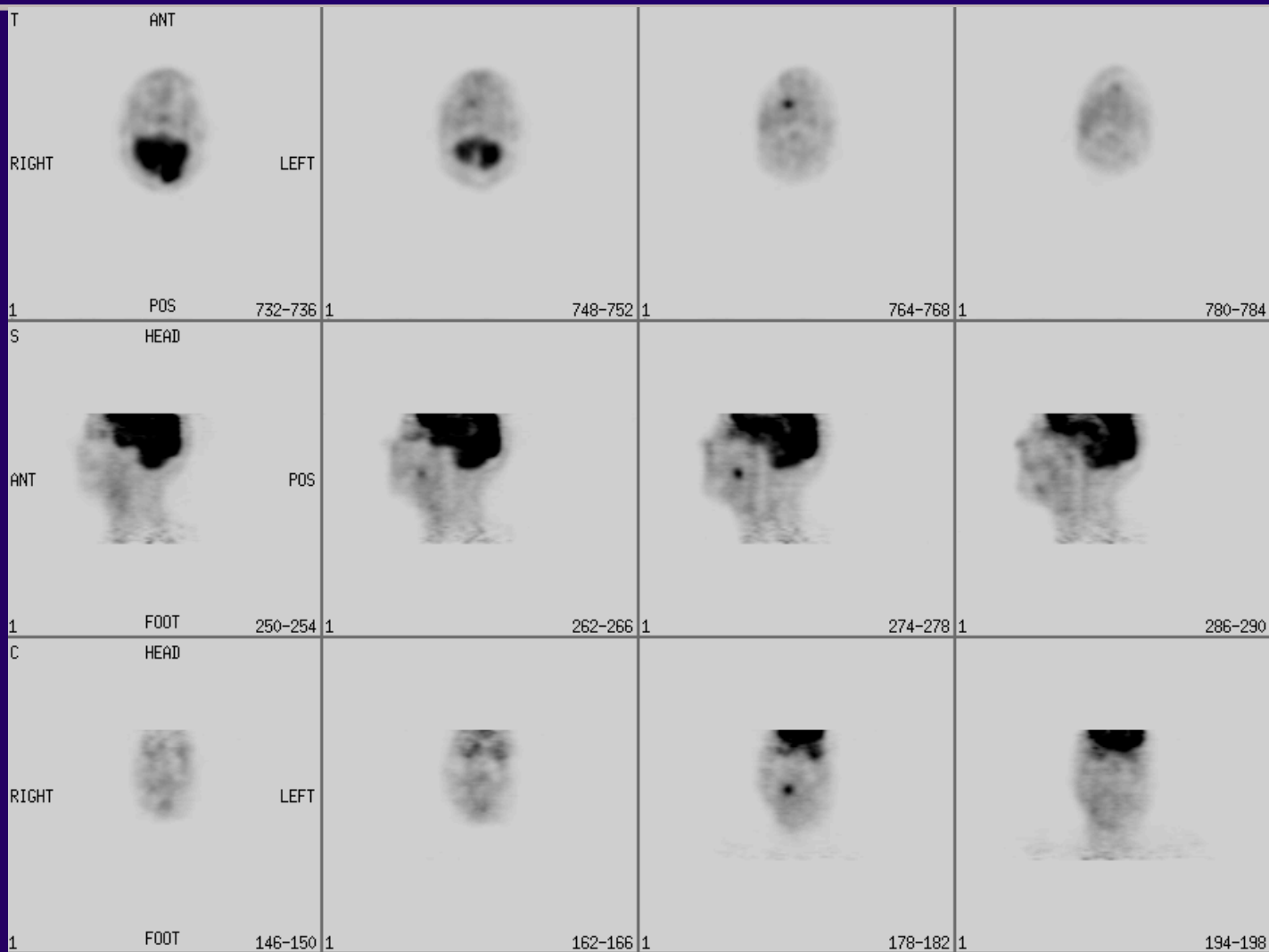
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## hypopharynx carcinoma

4 mCi  $^{18}\text{F}$ FDG  
60 min. p.i.  
total acq. time:  
12 min.  
including  
em. + transm.

Images courtesy of  
Dr. A. Alavi,  
University of  
Pennsylvania

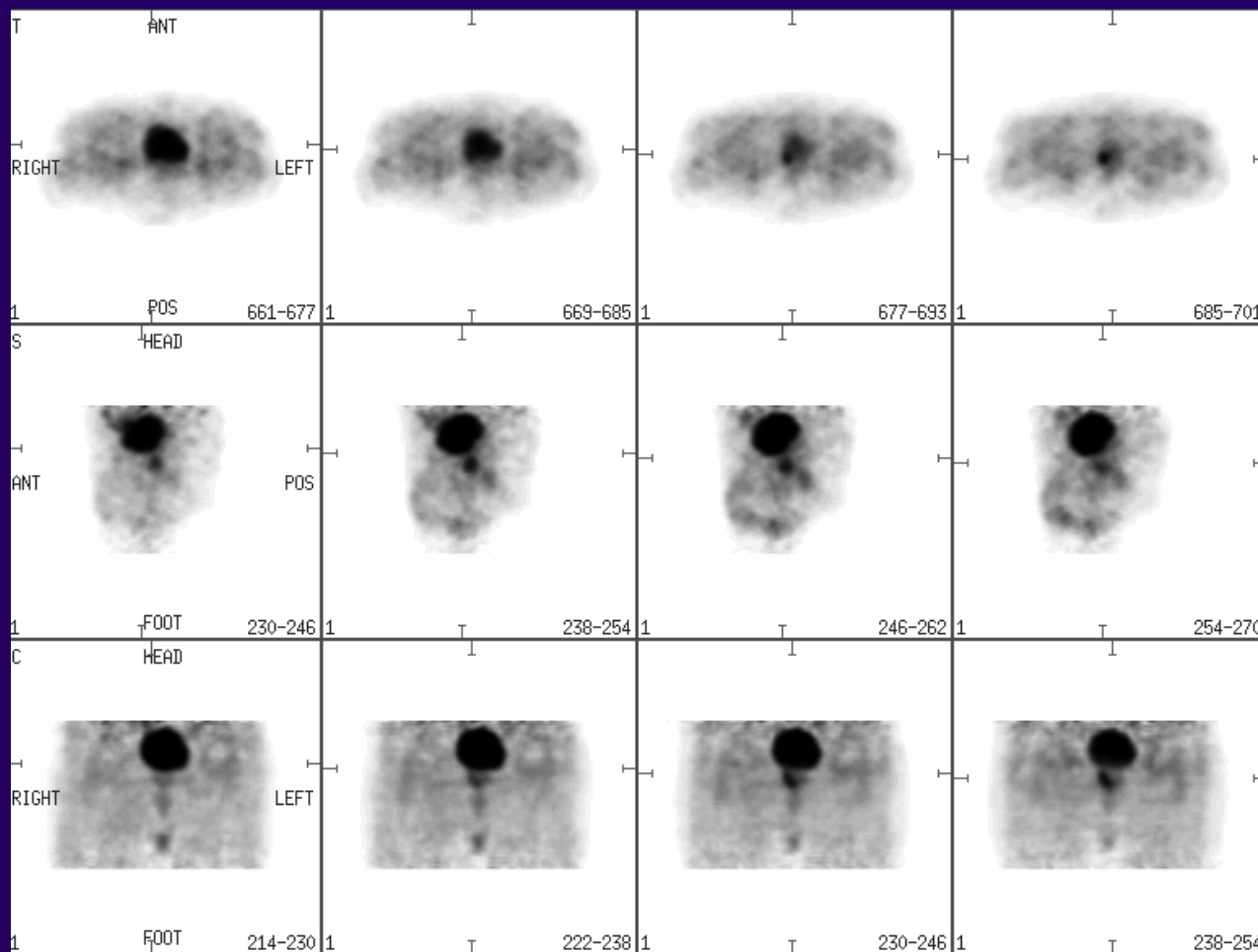


Name: \*\*\*\*\* Id: \*\*\*\*\* Acq Date: 14 Aug 1998 File: p10s0\_clf827\_nkp2u.img

# C PET

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## prostate cancer



5 mCi  $^{18}\text{F}$ FDG  
45 min. p.i.  
total acq. time:  
15 min.  
including  
em. + transm.

Images courtesy of  
Dr. D. Froehling,  
Karlsruhe, Germany