

# Chapter 14.

## The Commercial HRRT

### 14.2.7~14.2.17

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## 14.2.7 Count Rate Performance

### ◆ 14.2.7.1 Water Phantom (200mm)

- 200mm diameter, 200mm long water phantom
- Initial activity 285MBq(FDG)= 45.33kBq/ml
- Measurement duration > 8 half-lives(880min)
- Energy window = 350~650keV

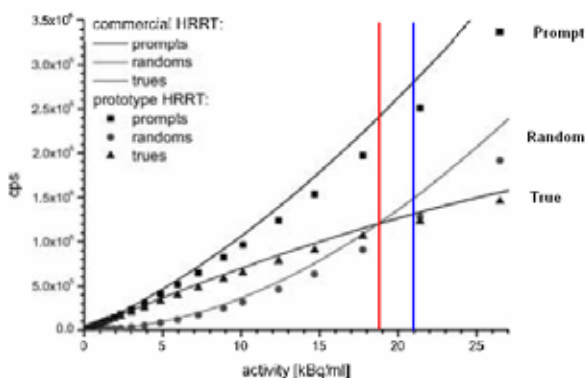


Fig 14.11

## 14.2.7 Count Rate Performance

### ◆ 14.2.7.2 700mm NEMA Phantom

- 200mm diameter, 700mm long water phantom
- Position : Center of FOV
- Initial activity 168MBq(FDG)
- Measurement duration > 17 half-lives(31.2h)
- Energy window = 350~650keV

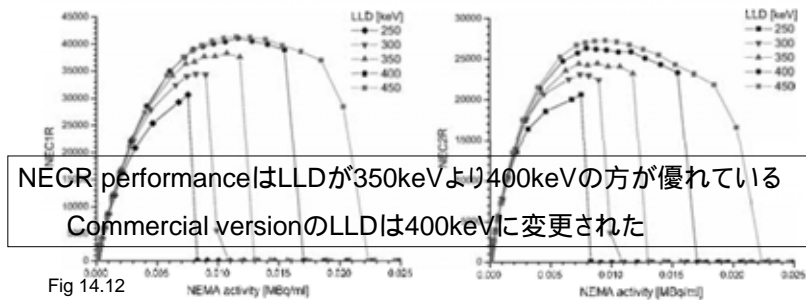
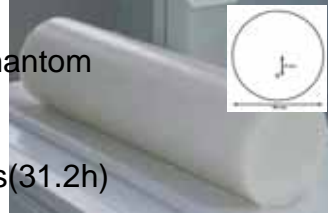


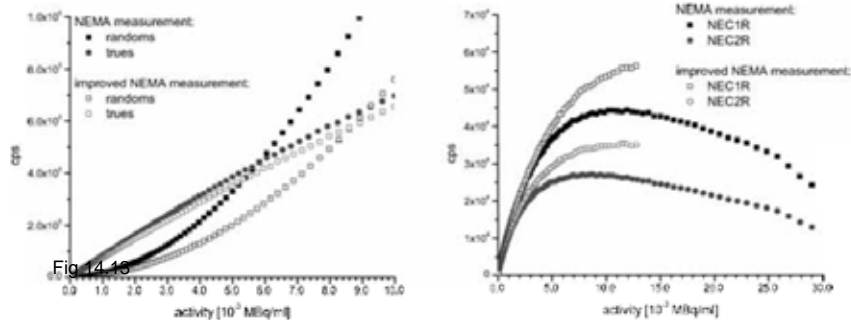
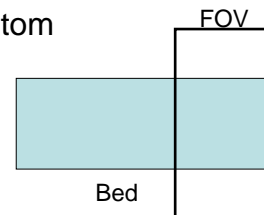
Fig 14.12

\* データロスはPrompt + Randomのcount rateが2.2Mcps以上になると起こる

## 14.2.7 Count Rate Performance

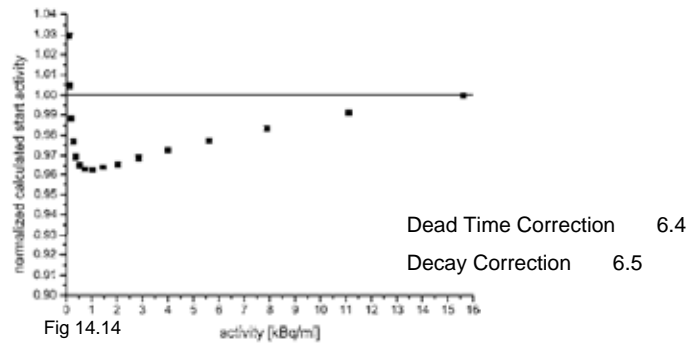
### ◆ 14.2.7.1 Improved 700mm NEMA Phantom Measurement

- 200mm diameter, 700mm long water phantom
- Position : Off center
- Initial activity 282MBq(<sup>11</sup>C)
- Energy window = 350~650keV



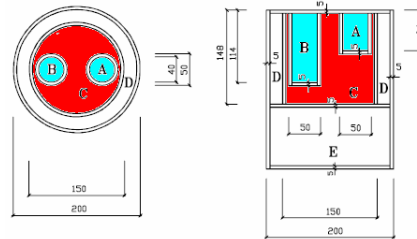
## 14.2.8 Evaluation of Dead Time and Decay Correction

- 200mm diameter, 200mm long water phantom
- Initial activity 98MBq(11C)
- Measurement duration > 11 half-lives(223min)
- Rebin: Span 3 (rd 67)
- Frame duration = 10 min

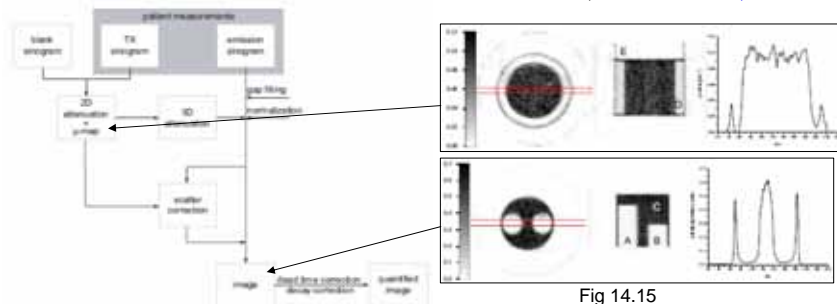


## 14.2.8 Scatter Correction (Utah Phantom Measurement)

- Measurement duration = 6h
- Energy window = 350~650keV
- Recon. : 3D-OSEM

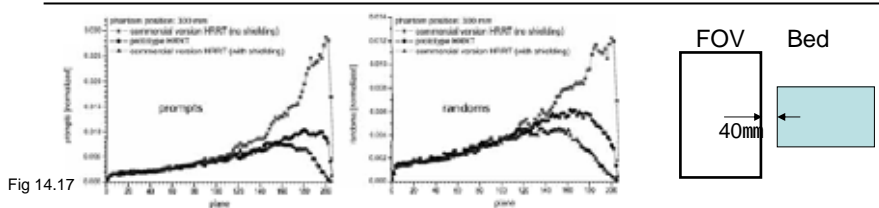
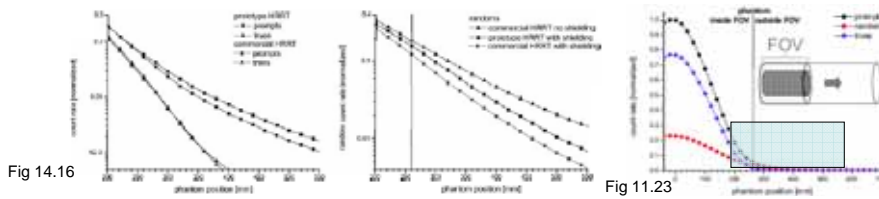


C: FDG、A&B: Water、D&E: Air



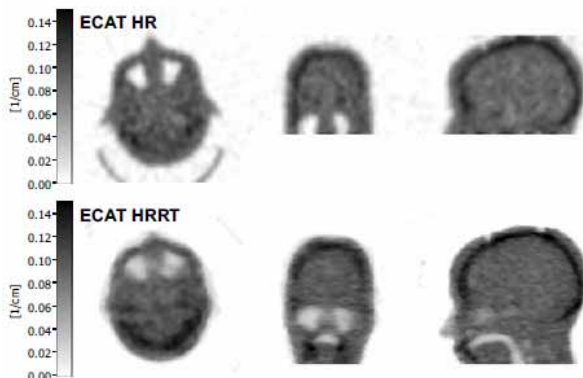
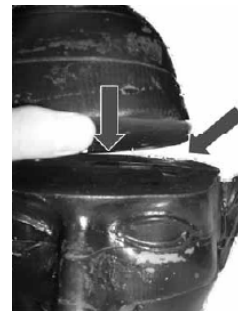
## 14.2.10 Shielding

- ◆ Shield material : Lead Tungsten
  - Homogeneous  $^{68}\text{Ge}$  phantom (200mm diameter, 300mm long)
  - Measurement duration = 300 s
  - Energy Window = 350~650keV



## 14.2.11 Transmission Measurement

- ◆ Alderson head phantom
  - Measurement duration = 10min(HR),6.2min(HRRT)
  - Recon. : HR - standard ECAT software  
HRRT - NEC-OSEM

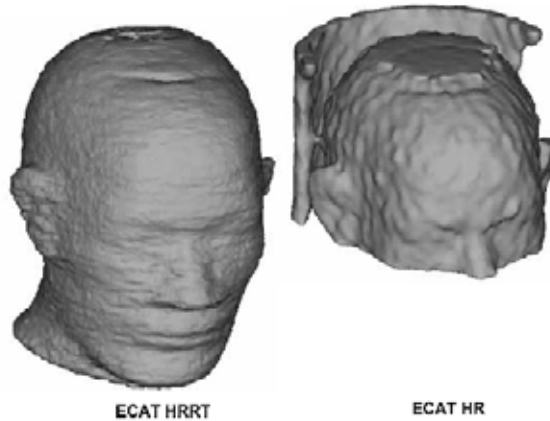


Resolution : HRRT

Scatter rejection capability : HR

## 14.2.11 Transmission Measurement

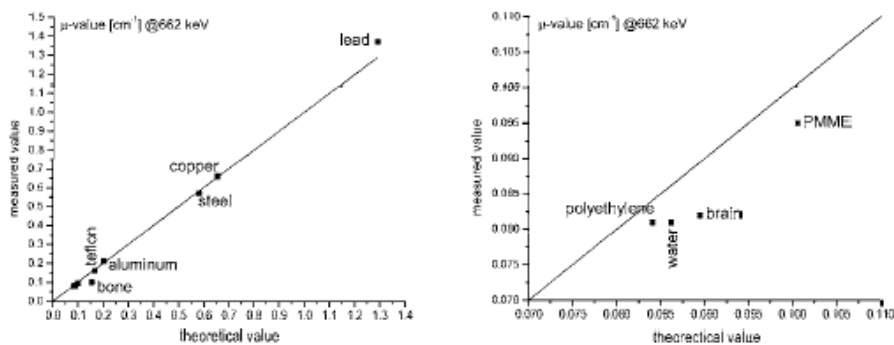
- ◆ Surface Image ( $\mu$ -value > 0.02 cm<sup>-1</sup>)



This image illustrates the improved statistics (through the better skin definition) and the extended axial FOV of the HRRT.

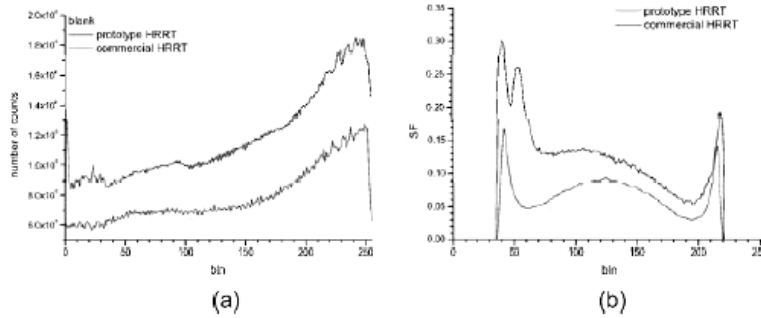
## 14.2.12 Evaluation of Measured $\mu$ -Value

- ◆  $\mu$ -Value @ 662keV



グラフの  $\mu$ -Valueは再構成画像中の物質部分のピクセルデータをヒストグラミングし、ピークに対してガウスフィッティングを行い、その重心として求められた値である。

## 14.2.13 Scatter in Transmission Scans



(a) : Summed blank profiles

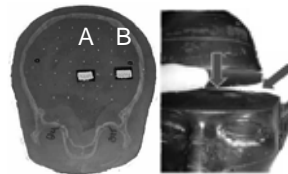
(b) : Scatter Fraction 
$$SF_{TX}(x) = \frac{TX_{measured}(x) - TX_{theory}(x)}{TX_{measured}(x)}$$

## 14.2.14 Radiation Dose to Patients for Transmission Measurement

◆ TLD (thermoluminescent dosimeter, 熱蛍光線量計)を用いての積算線量測定。

・ HR -  $^{68}\text{Ge}$  rod source( $\sim 100\text{MBq}$ )  $\times 3$   
scan time : 18h (108 scans  $\times 10\text{min}$ )

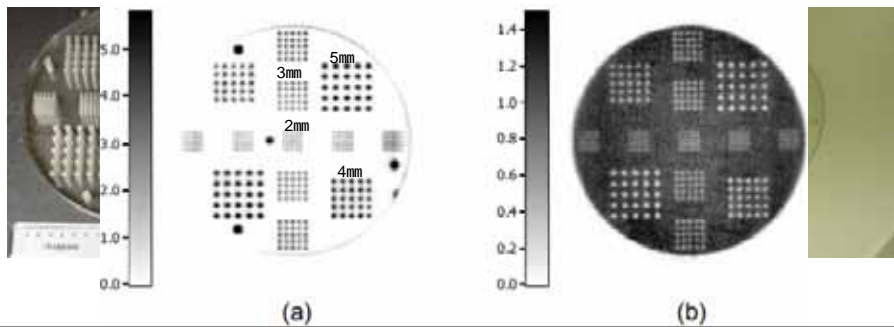
・ HRRT -  $^{137}\text{Cs}$  point source(740Bq)  
scan time : 217min(35 scans  $\times 6.2\text{min}$ )



	TLD - A (mSv)	TLD - B (mSv)	mean (mSv/TX)	Dose equivalent (mSv/MBq·h)
HR	5.3	7.0	0.057	$1.1 \times 10^{-3}$
HRRT	0.43	0.54	0.014	$0.2 \times 10^{-3}$

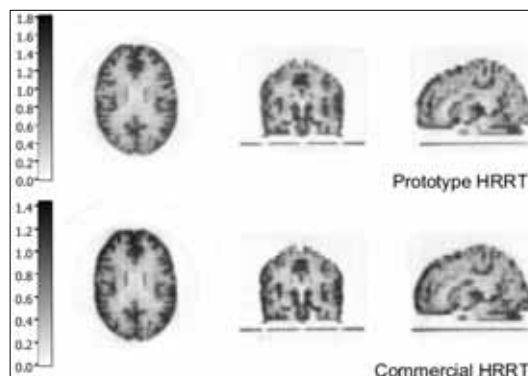
## 14.2.15 Cologne High Resolution Phantom

- ◆ Resolution measurement
  - Hot & Cold Cologne High Resolution Phantom
  - Initial activity 90MBq(FDG)
  - Measurement duration = 6 h
  - Energy window = 400~650keV
  - Rebin : span 3(rd 67)
  - Recon. : 3D-OSEM



## 14.2.16 Hoffman 3D Phantom

- ◆ Evaluation of resolution
  - Hoffman 3D Phantom
  - Initial activity 74MBq(FDG)
  - Measurement duration = 6 h
  - Energy window = 400~650keV
  - Rebin : span 3(rd 67)
  - Recon. : 3D-OSEM



## 14.2.17 Patient Studies

- ◆ 2003年5月に改良版HRRTがMPIfmrに再設置された。  
9人が各種トレーサ (FDG, DOPA, methionine, AMP)を用い、ボランティア測定を行う。
- ◆ 2003年11月までに22人の測定を行う。

Study Type	# Normals	# Patients
FDG	10	4
DOPA	2	3
Methionine	—	2
AMP	1	—

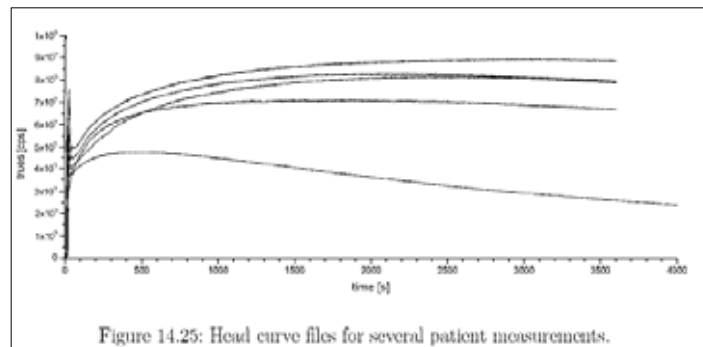
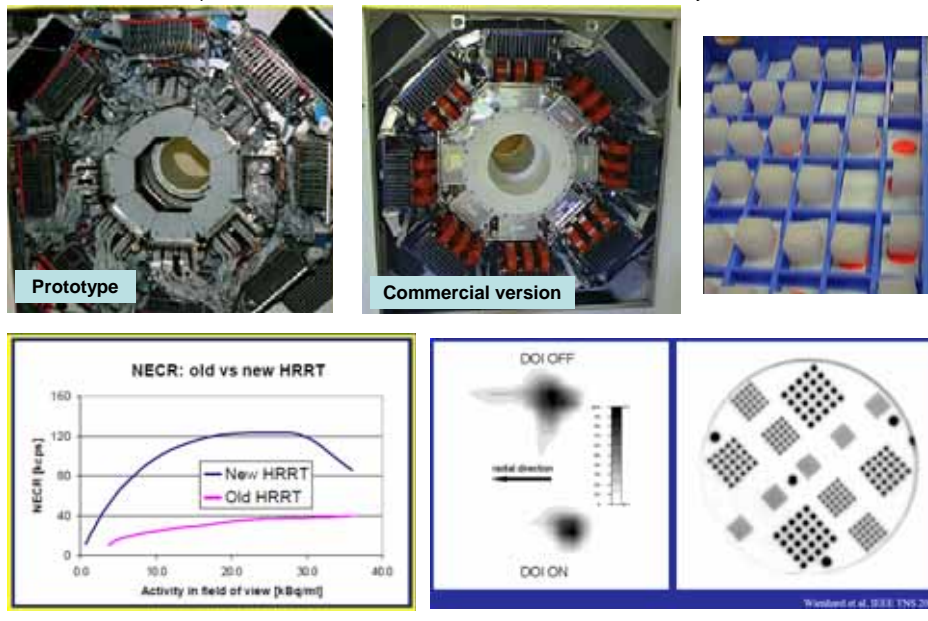


Figure 14.25: Head curve files for several patient measurements.

## appendix 1. Prototype vs. Commercial version

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## appendix 2. HRRT as Small Animal PET

