

AAPM2017 Scientific Symposium: Emerging and New Generation PET, Instrumentation, Technology, Characteristics and Clinical Practice  
Aug 2 Wednesday 10:45am - 11:15pm

### Solid State Digital Photon Counting PET/CT Instrumentation and Technology

Jun Zhang, PhD, DABR  
Assistant Professor

Wright Center of Innovation in Biomedical Imaging  
Department of Radiology  
The Ohio State University Wexner Medical Center



---

---

---

---

---

---

---

---

### Disclosure

Philips Healthcare (Cleveland, OH) provided the pre-commercial investigational PET/CT system (Vereos).



---

---

---

---

---

---

---

---

### DPC PET/CT (Vereos, Philips Healthcare) at OSU



Pre-commercial release unit of digital photon counting PET/CT system (Vereos, Philips Healthcare) operational at The Ohio State University (*Dr. Michael V. Knopp, MD, PhD*) since October 2014. PET detector technology moving from PMT to solid state DPC is a technology leap.



---

---

---

---

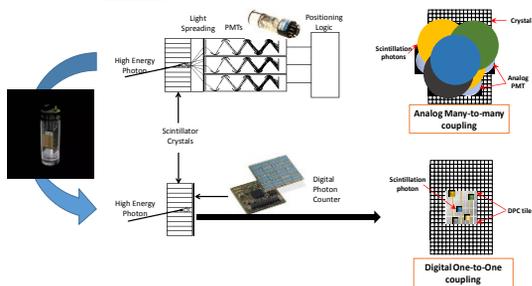
---

---

---

---

### From PMT to Solid State DPC




---

---

---

---

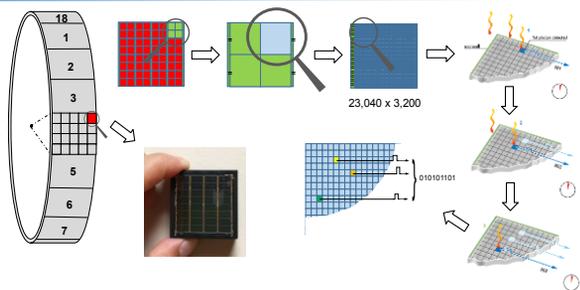
---

---

---

---

### Vereos PET Detector Geometry




---

---

---

---

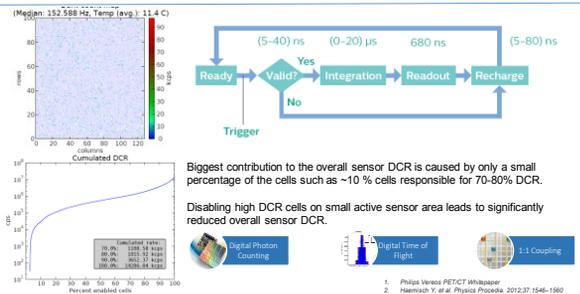
---

---

---

---

### DPC Data Acquisition Sequence




---

---

---

---

---

---

---

---

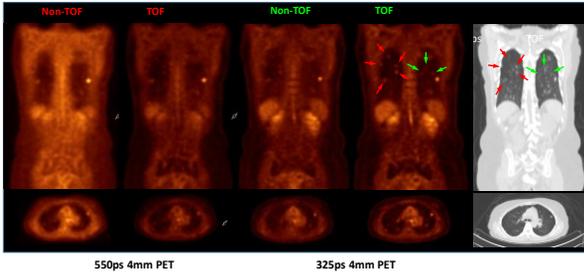








PMT PET vs DPC PET




---

---

---

---

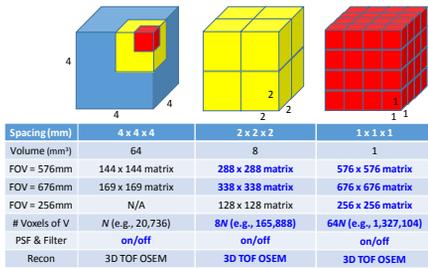
---

---

---

---

PET Image Resolution (Recon)




---

---

---

---

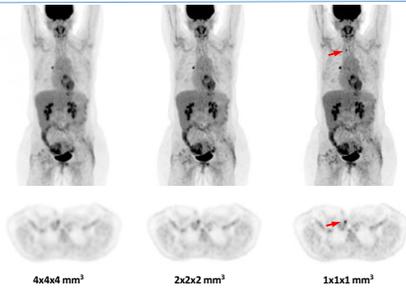
---

---

---

---

Small Lesion Detectability with Less PVE




---

---

---

---

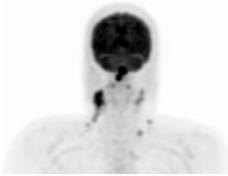
---

---

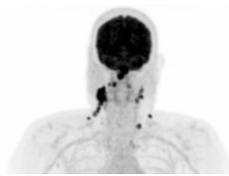
---

---

Lesion Detectability with Less PVE



Gemini (64mm<sup>3</sup>)



Vereos (1mm<sup>3</sup>)

---

---

---

---

---

---

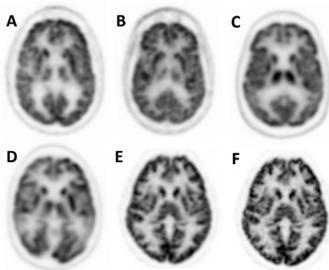
---

---

---

---

Brain PET



	A	B
Vendor A		
<b>PET/CT</b>		
<b>XY resolution</b>	2mm	2mm
<b>Slice Thickness</b>	2mm	2mm
<b>FDG Injected</b>	4.3mCi	5.0mCi
<b>Uptake time</b>	45min	45min
<b>Acquisition Time</b>	10min	10min
Vendor B		
	E	F
	1mm	1mm
	3mm	3mm
	10.0mCi	12.0mCi
	50min	49min
	10min	10min
	E F	
	Vereos	Vereos
	2mm	1mm
	2mm	1mm
	13.9mCi	13.9mCi
	118min	118min
	90sec	90sec

---

---

---

---

---

---

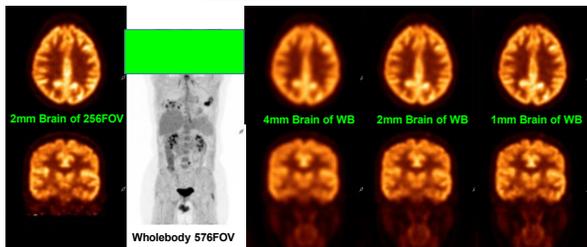
---

---

---

---

Brain PET Redefinition – Speed, Convenience, Dose, IQ



10min FDG

90s/bed FDG

---

---

---

---

---

---

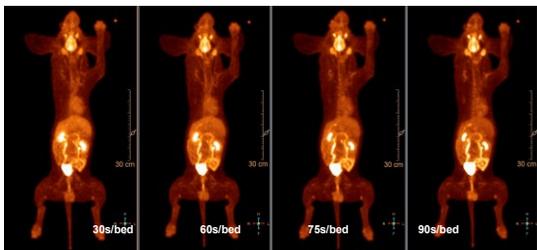
---

---

---

---

WB PET Redefinition



---

---

---

---

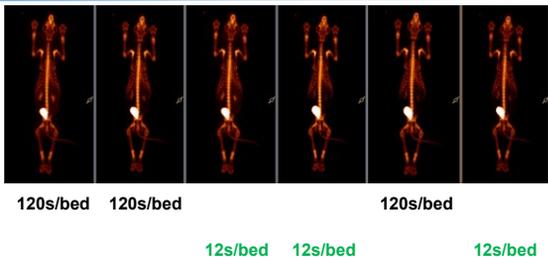
---

---

---

---

WB NaF PET



---

---

---

---

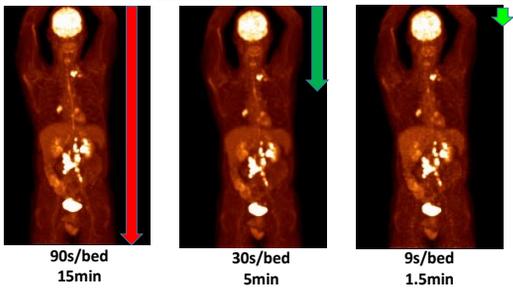
---

---

---

---

Clinical Ultrafast PET



---

---

---

---

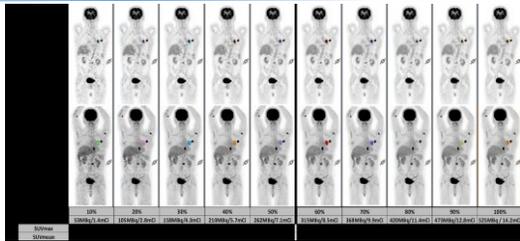
---

---

---

---

Low Dose FDG PET



THE OHIO STATE UNIVERSITY  
WEXNER MEDICAL CENTER  
Wright Center of Graduate Medical Education

NIH R01 PIs: Knopp, Zhang

---

---

---

---

---

---

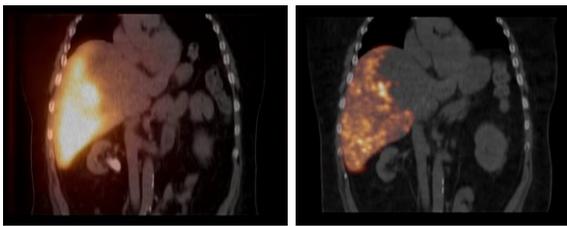
---

---

---

---

Clinical Post <sup>90</sup>Y Microsphere Radioembolization



Bremsstrahlung SPECT/CT

DPC PET

---

---

---

---

---

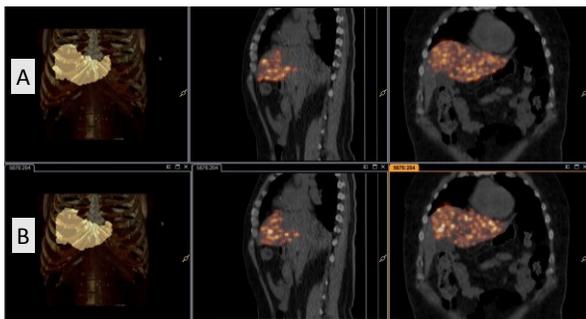
---

---

---

---

---



A - 10min/bed; B - 7min/bed

---

---

---

---

---

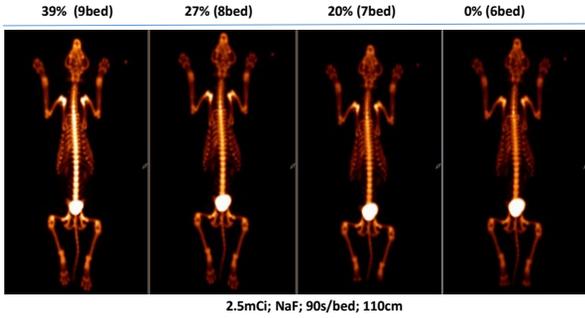
---

---

---

---

---



---

---

---

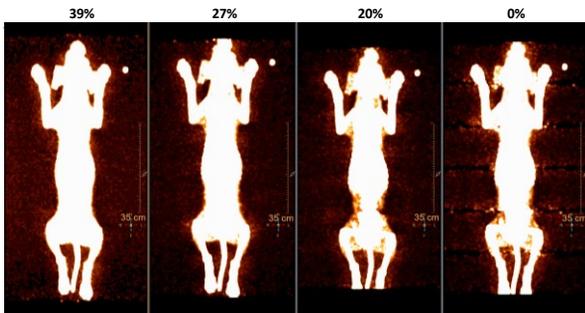
---

---

---

---

---



---

---

---

---

---

---

---

---

### Highlights

- 1:1 coupling eliminates need for position decoding
- Timing and energy calibrations per crystal
- Improved timing resolution
- Reduced dead time
- Increased count rate performance
- Early digitization eliminates as much as possible analog noise and distortion.

---

---

---

---

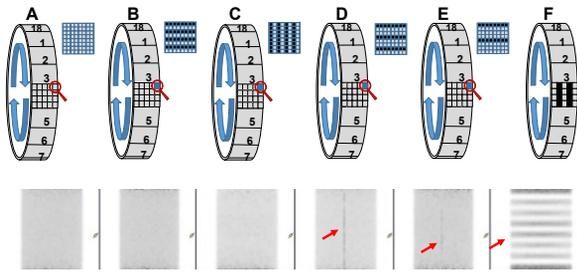
---

---

---

---

How much SiPM DPC Detector Coverage Do We Really Need?




---

---

---

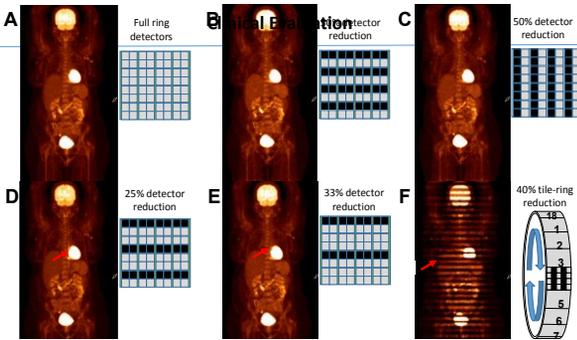
---

---

---

---

---




---

---

---

---

---

---

---

---

Acknowledgement

- This research was supported by the Ohio Third Frontier OSDA TECH 09-028 (PI: Michael V Knopp, MD PhD) and NCI R01CA195513 (PI: Michael V Knopp, MD PhD; Jun Zhang, PhD)
- Philips Healthcare provided the pre-commercial investigational PET/CT system (Vereos) hardware and technical support
- Wright Center of Innovation in Biomedical Imaging (PI: Michael V Knopp, MD PhD)

---

---

---

---

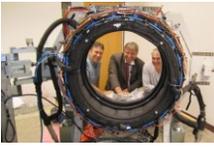
---

---

---

---

## Thank You



 THE OHIO STATE UNIVERSITY  
Wright Center of Innovation in Biomedical Imaging

AAPM 2017 Oct 15-18, 2017  


---

---

---

---

---

---

---

---