

K-Edge Spectral μ -Tomography (KEST)

Bando n. 18203/2016 “Giovani Ricercatori” CSN V



- Conventional K-edge subtraction X-ray imaging requires two separate images (below and above the K-edge of a contrast agent)



- Increased delivered dose
 - Potentially incorrect image registration due to sample/patient motion
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- A spectroscopic detector counts individually the incident X-ray photons and separates them in real time according to their energy (two *color* images per exposure)



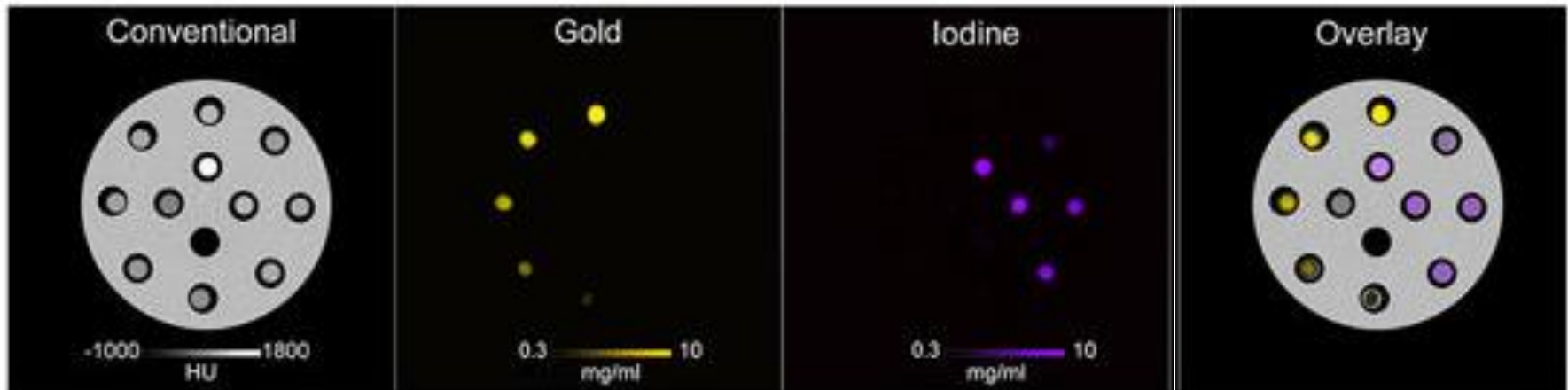
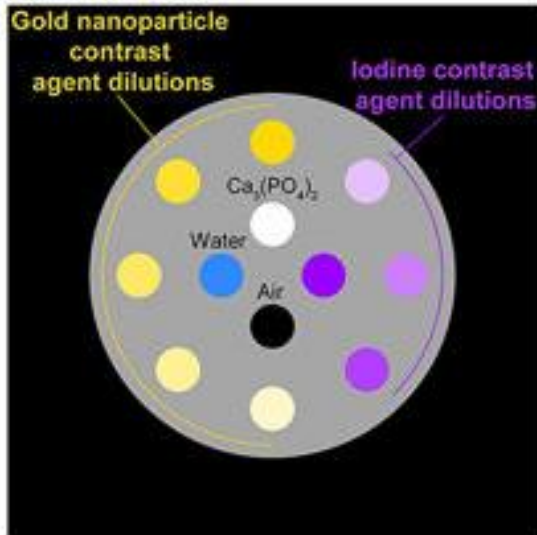
- Simultaneous acquisition of a **contrast** and **virtual non contrast** image (by setting the threshold over the K-Edge of the contrast agent)

Multicolor spectral photon-counting computed tomography: *in vivo* dual contrast imaging with a high count rate scanner

David P. Cormode, Salim Si-Mohamed, Daniel Bar-Ness, Monica Sigovan, Pratap C. Naha, Joelle Balegamire, Franck Lavenne, Philippe Coulon, Ewald Roesl, Matthias Bartels, Michal Rokni, Ira Blevis, Loic Bousset & Philippe Douek ✉

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Aim of the project

- To propose a K-edge spectral X-ray Computed Tomography (CT) protocol based on commercially available elements (Pixirad / Pixie-III and a conventional X-ray source) and **custom reconstruction software**
- Ultimate application to *in vivo* small animal imaging (fast and low dose)

- Two underlying ideas:
 - State-of-the-art photon counting detectors are now mature
 - Refined reconstruction algorithms make a difference



Team and resources

- **INFN-Trieste**
 - Francesco Brun
 - Renata Longo
 - Luigi Rigon

- **INFN-Pisa**
 - Pasquale Delogu

- **Elettra**
 - Elettra co-funds the project by offering *in house* beamtime
 - (with contribution by Diego Dreossi, beamline scientist at SYRMEP)

- Design and preparation of test objects
- Data simulation
- Detector characterization

- Data acquisition with monochromatic source (at SYRMEP – Elettra)
- Data acquisition with polychromatic source (at INFN Pisa)

- Development of the spectral CT reconstruction software

- Tentatively:
 - Comparison with Medipix III
(in collaboration with CWI – Amsterdam)
 - Pilot biomedical application
(in collaboration with Elettra and Univ. Goettingen)

Sez. & Suf.	MISS			CON			
	Sj	Dot.	Ant.	Sj	Dot.	Ant.	
TS	5.0			1.0			
	5.0			1.0			
TOTALE	5			1			
	5			1			
	5	0	0	1	0	0	
	5.0			1.0			

Ant.	INV			
	Sj	Dot.	Ant.	
47.0				
47.0				
47				
0			47	
47		0	0	
0.0		47.0		

Ant.	TOTALE			
	Sj	Dot.	Ant.	
53				
53.0			0	
53	0			
0			53	
53	0.0	0.0	0.0	
0.0		53.0		

referee: Paolo Branchini
referee: Paolo Valente
respnaz: Francesco Brun

- INV:
 - Detector
 - Chiller
 - Precision positioning stage

(X-ray source and rotator stage from Lab. di Fisica Medica – INFN Pisa)

PREVENTIVO GLOBALE DI SPESA PER L'ANNO 2018

Struttura	A carico dell'I.N.F.N.											
	missioni		consumo		altri_cons		trasporti		manutenzione		inventar	
PI												
TS	7.00											
Totali	7.00											

Mod. EC/EN 4

INFN Trieste:

- Francesco Brun (100% FTE)
- Renata Longo (20% FTE)
- Luigi Rigon (20% FTE)
- 1 mese/uomo dell'officina meccanica
- 0.5 mese/uomo del laboratorio elettronico

- KEST started March, 1st 2017
- Current status (June 2017):
 - (Still waiting for the detector...)
 - Working on **simulated data** to optimize the experimental acquisition
 - Preparation of **test objects** based on clinically used contrast agents:
 - Bracco Prontobarrio[®] – **BaSO₄**
 - Bayer Ultravist[®] – C₁₈H₂₄**I₃**N₃O₈
 - Bayer Gadovist (gadobutrole)[®] – C₁₈H₃₁N₄O₉**Gd**