



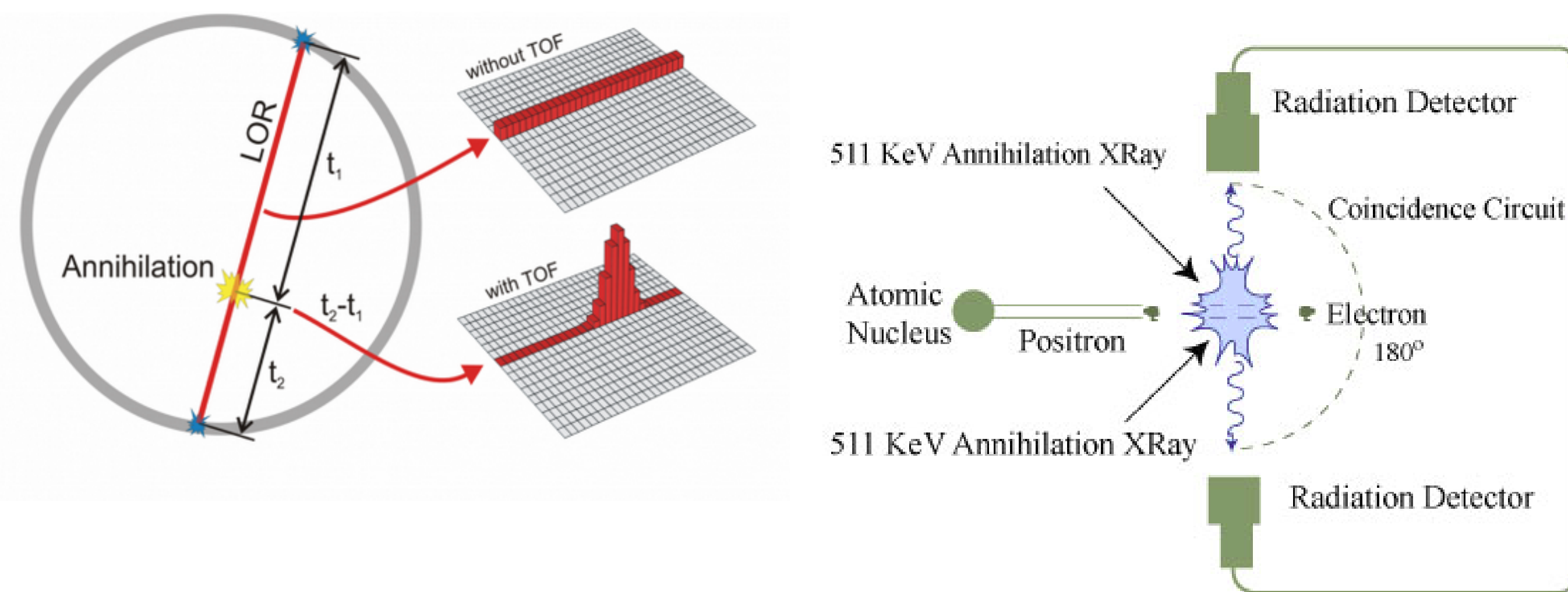
# Dark matter search for the medical physics: the 3DPi project

## Michela Lai\*, M.Wada, A. Renshaw, X. Li, A. Ramirez, A. Zabihi



### TOF-PET scanner

Positron Emission Tomography (PET) is a not-invasive technique for the diagnosis of cancers or brain diseases.



The add of the Time-of-flight (TOF) increases the PET spatial resolution, eventually fastening the data acquisition

### Sensitivity

Two possible designs have being compared:

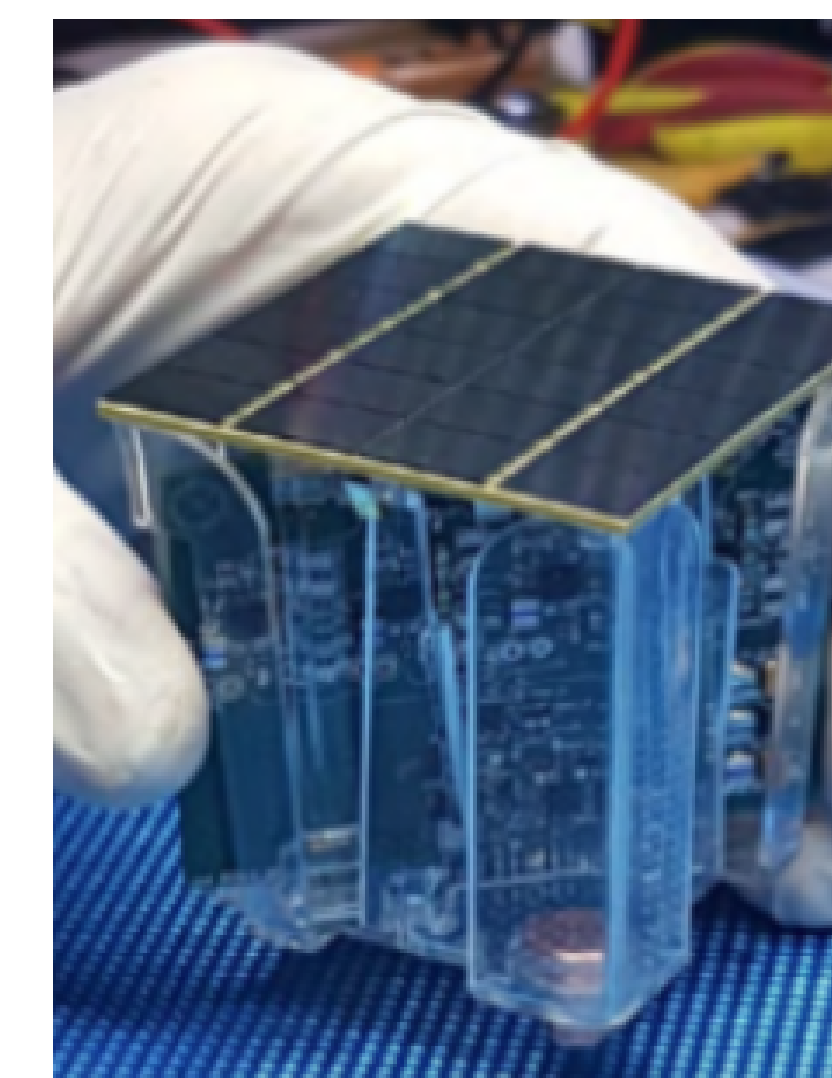
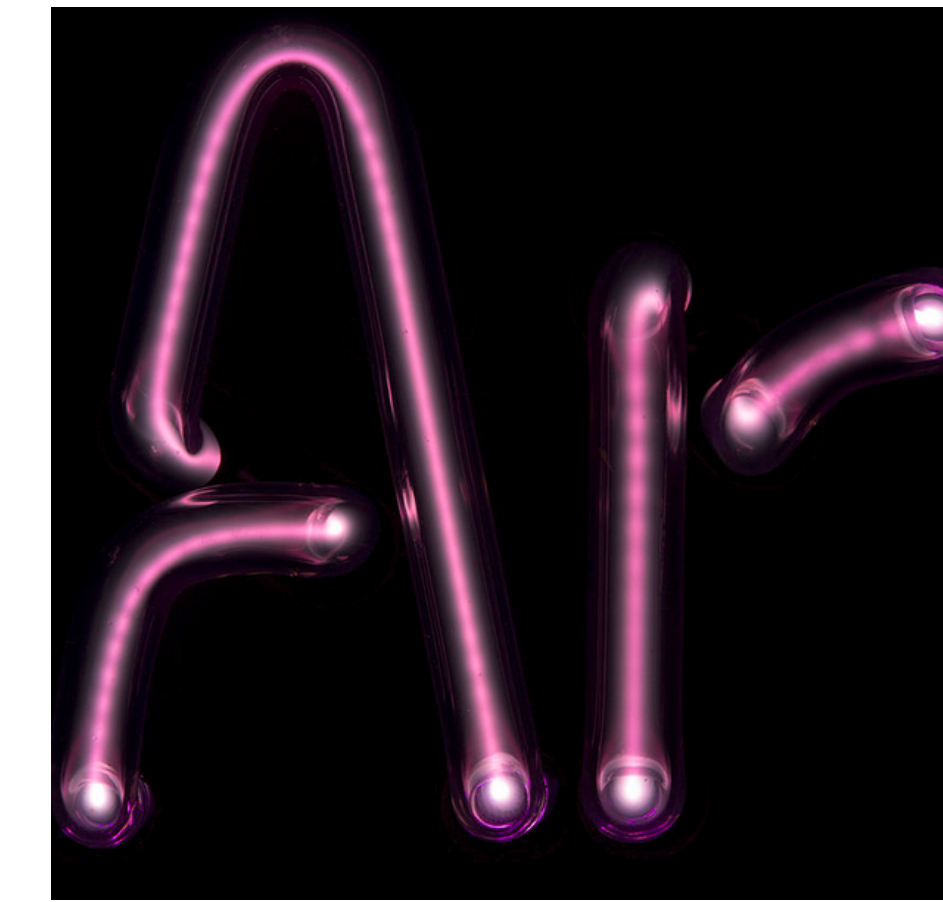
- LAr summed to the Tetraphenyl-Butadiene (TPB)
- LAr doped Xenon, with a concentration of 220 ppm

	3DPi		Ge Sigma
	LAr + TPB	LAr + LXe	
Sensitivity [kcps/kBq]	505	513	22

### 3DPi TOF-PET

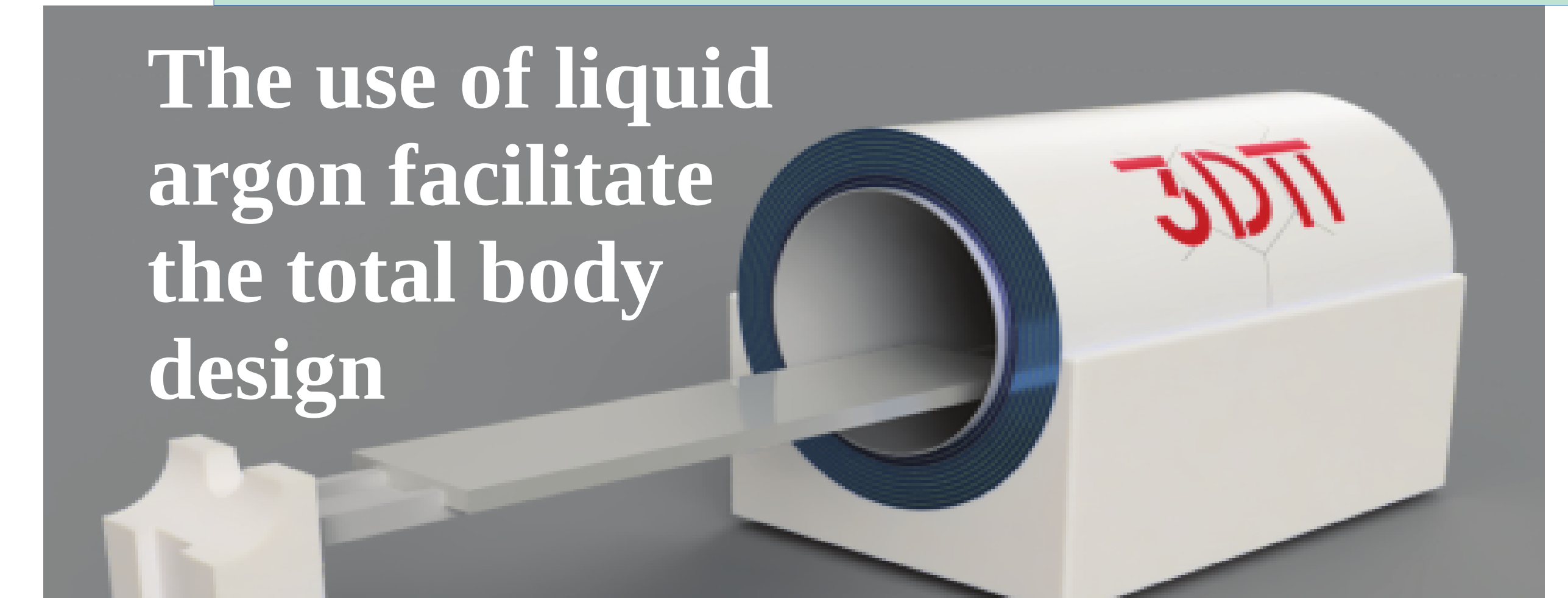
3DPi, as spin-off of the dark matter search in DarkSide collaboration, will be a TOF-PET scanner based on

- Liquid argon as scintillator instead of usual solid scintillators, eventually doped with Xenon
- Silicon Photomultipliers custom developed from Fondazione Bruno Kessler



### The design

The use of liquid argon facilitate the total body design



Inner radius	45 cm
Outer radius	64 cm
Length	200 cm
LAr thickness	16.2 cm
Number of LAr layers	9

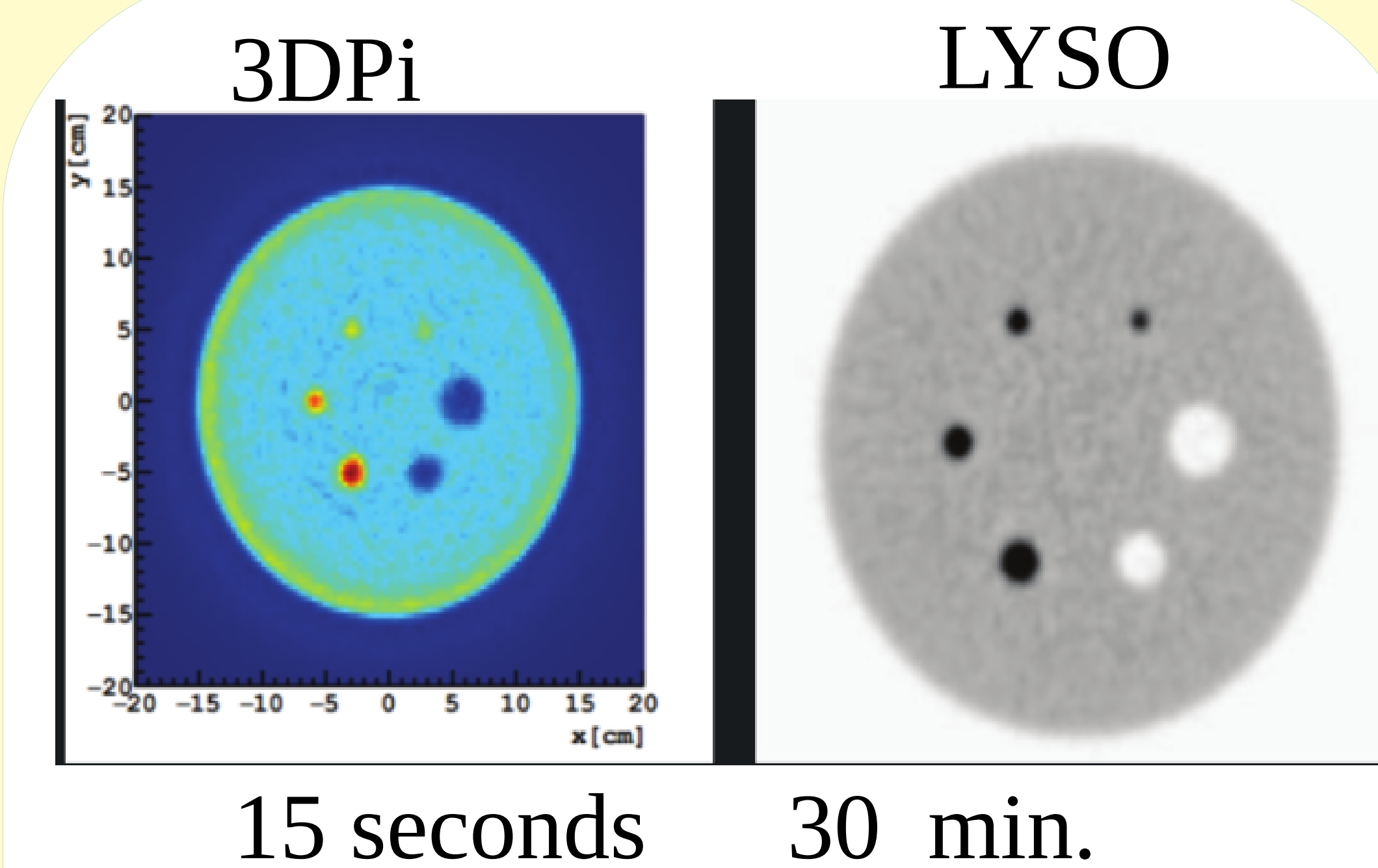
### Space & Time resolution

The spatial resolution is described by looking at five different sources along the scanner.

	3DPi (LAr +TPB)	3DPi (LAr +LXe)	GE Sigma
$\sigma$ -transverse [mm]	10.0	4.70	4.30
$\sigma$ -radial [mm]	8.50	6.70	5.79
$\sigma^*$ transverse-Tan[mm]	7.80	5.00	4.40
$\sigma^*$ transverse-rad[mm]	8.10	5.00	5.79
$\sigma^*$ axial[mm]	10.0	6.80	7.26

Simulations yielded Time-of Flight resolution of ~ 100 ps

### Conclusion



The 3DPi scanner will allow for a detailed scanner at a much lower dose for the patient or lower time exposure, making it available for a wider class of patients.