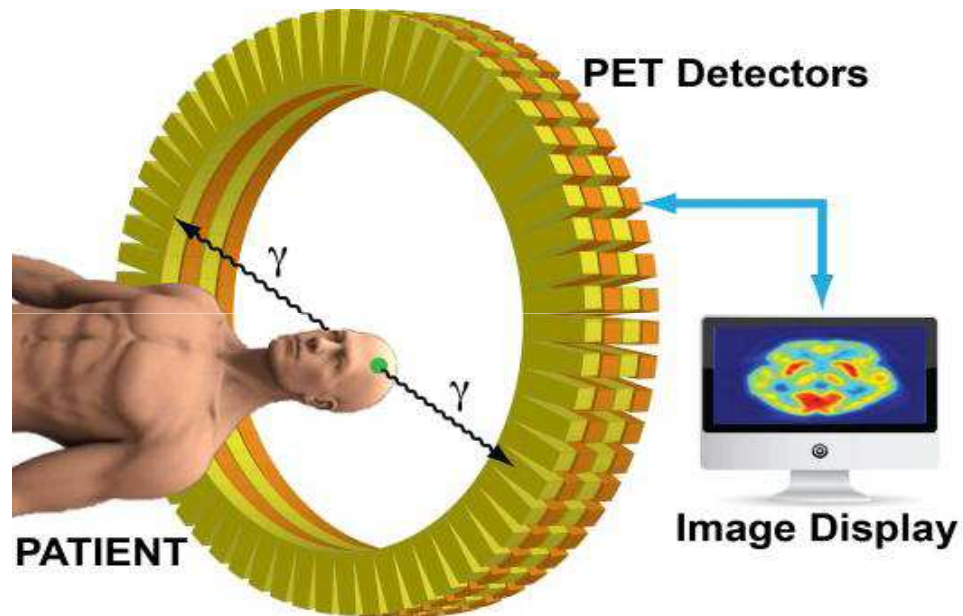


Development of TOF-PET scanner based on plastic scintillator strips

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Principles of PET



Spatial density
distribution of
injected substance

Diagnostics
(oncology,
cardiology, etc.)

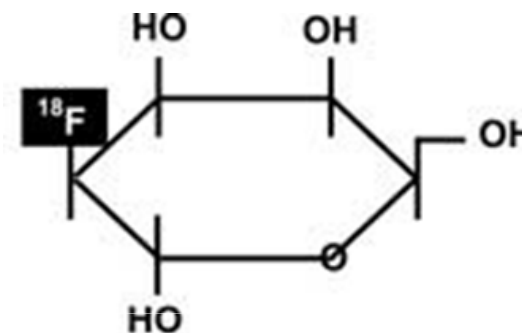
Changes in brain
of people with
mental diseases

Effect of drugs on
patient body

Figure courtesy of M. Zieliński

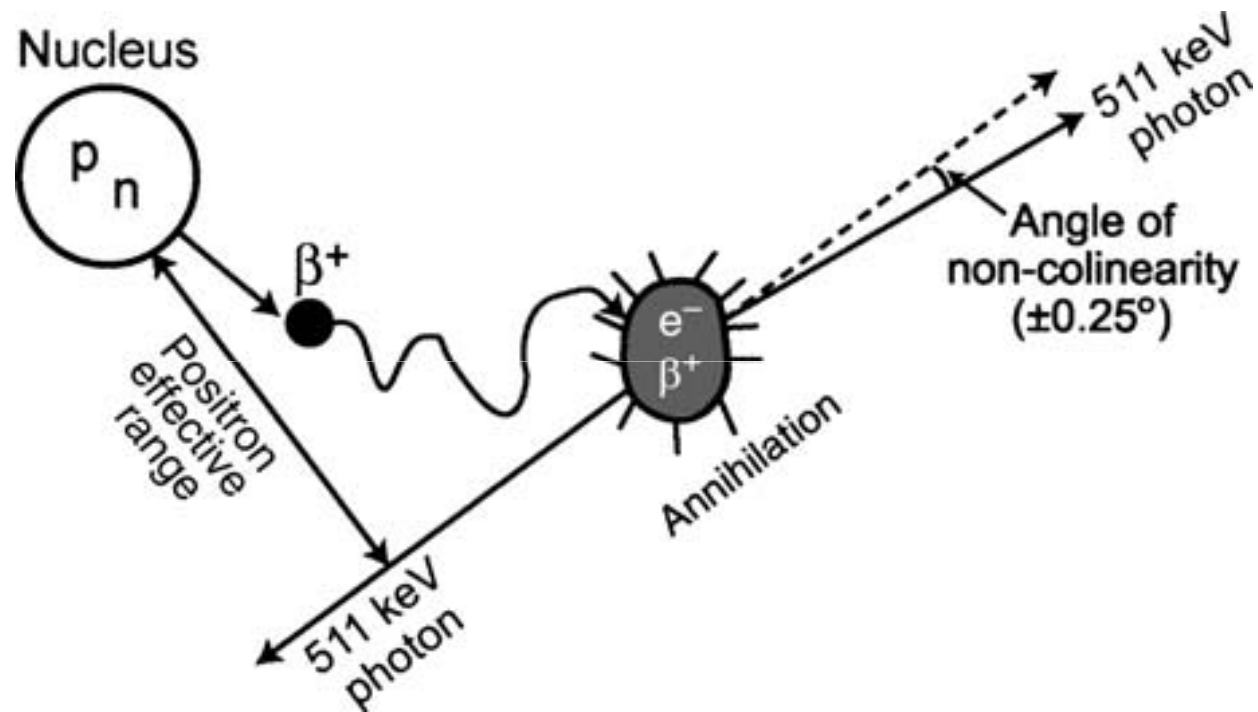
Isotopes used in PET scans

Isotope	Average range of positrons in water [mm]	Maximum energy of positrons [MeV]	Half-life [minutes]
^{11}C	1.7	0.960	20.4
^{13}N	2.0	1.198	10.0
^{15}O	2.7	1.732	2.0
^{18}F	1.4	0.633	109.8



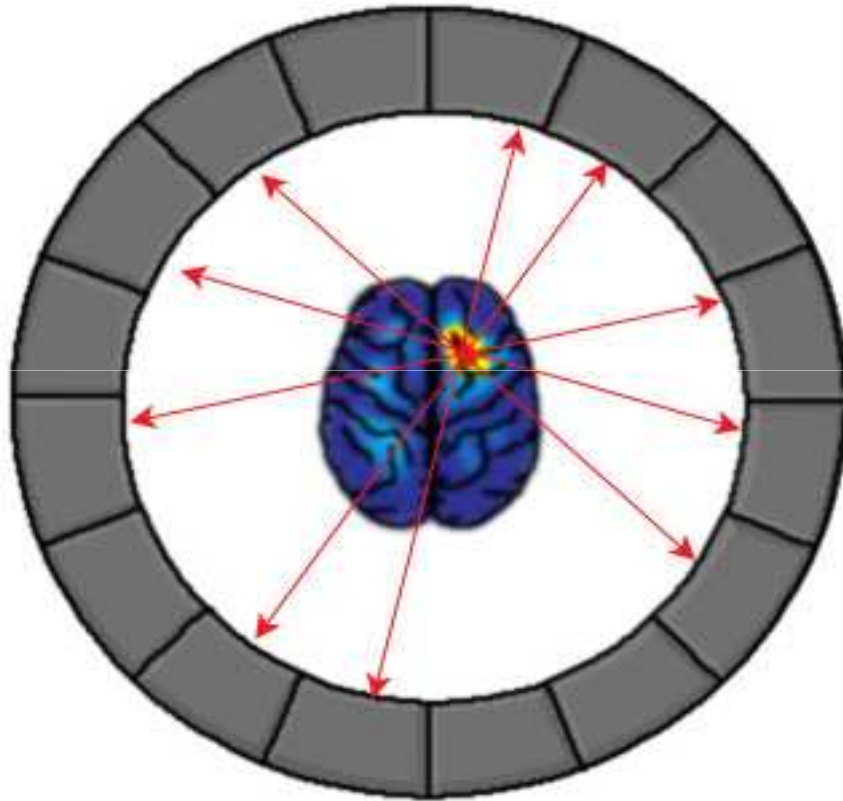
▶ fluorodeoxyglucose

Beta plus decay and annihilation

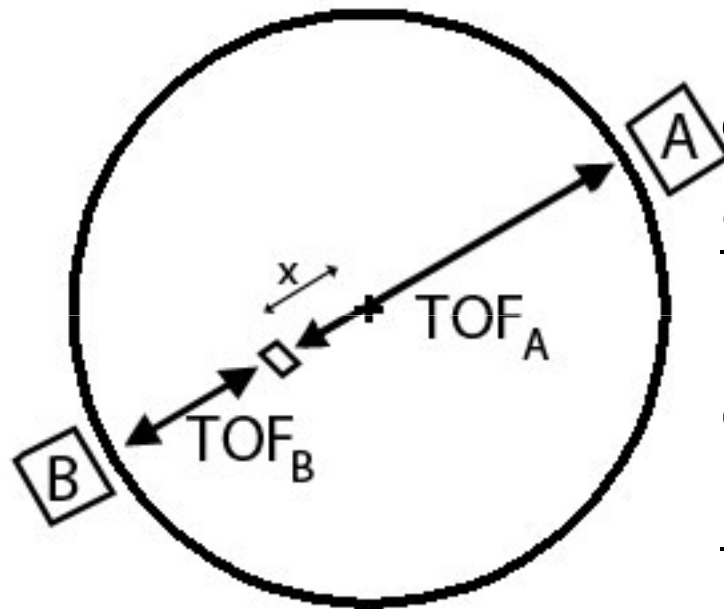


Simple example of reconstruction

- ▶ LOR – Line Of Response
- ▶ TOF – Time Of Flight



Time Resolution



The best time resolution of commercial scanner:

Gemini TF ~600 ps

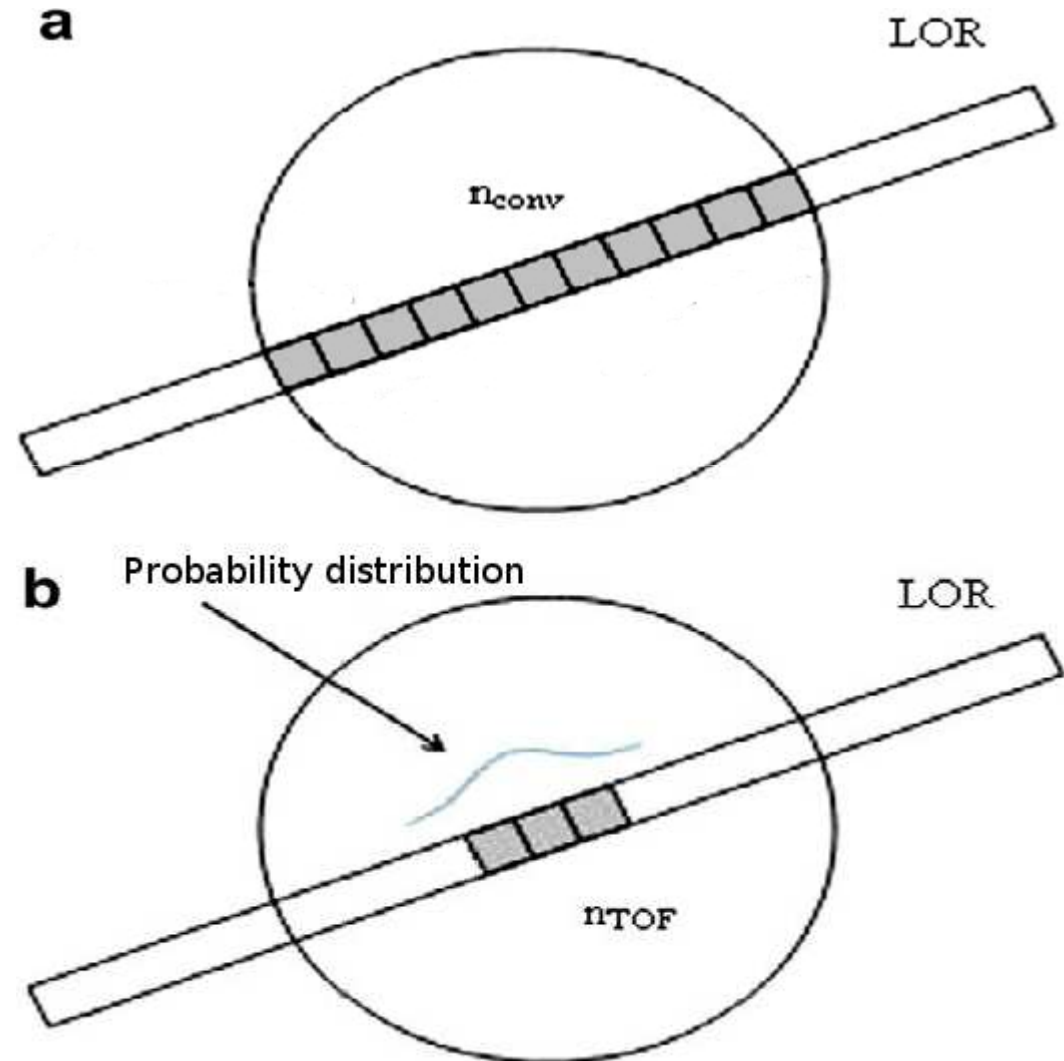
Our goal:

improve time resolution from 600 ps to 100 ps

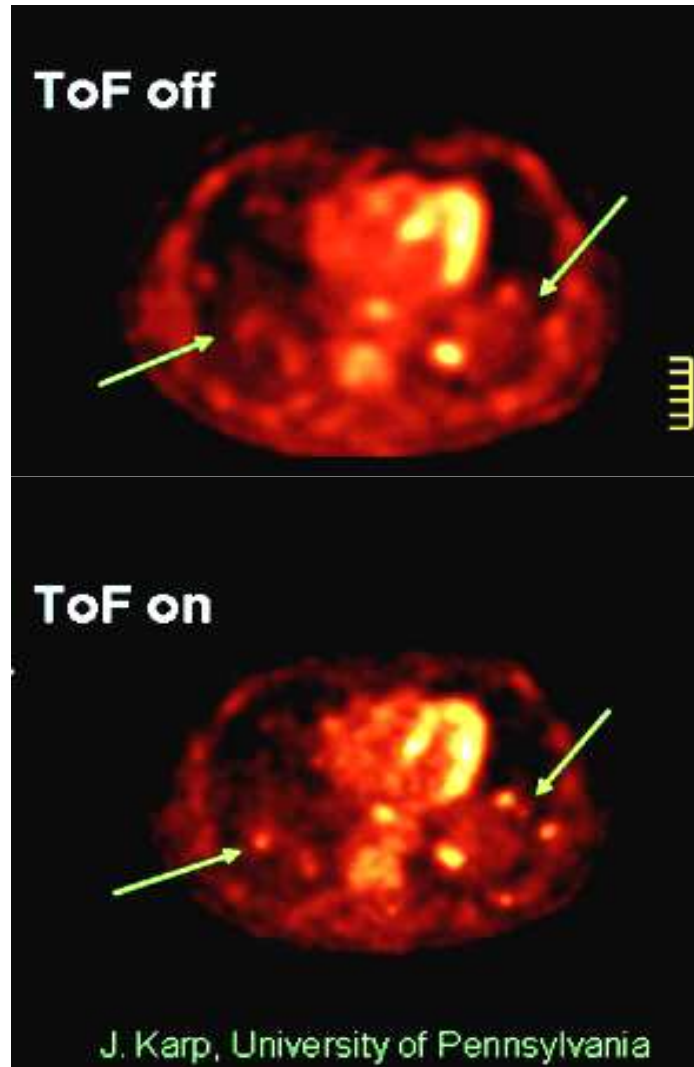
$$x = \frac{c \cdot |t_A - t_B|}{2}$$

Difference between TOF and non TOF

Reduction of signal to noise ratio improves imaging resolution!



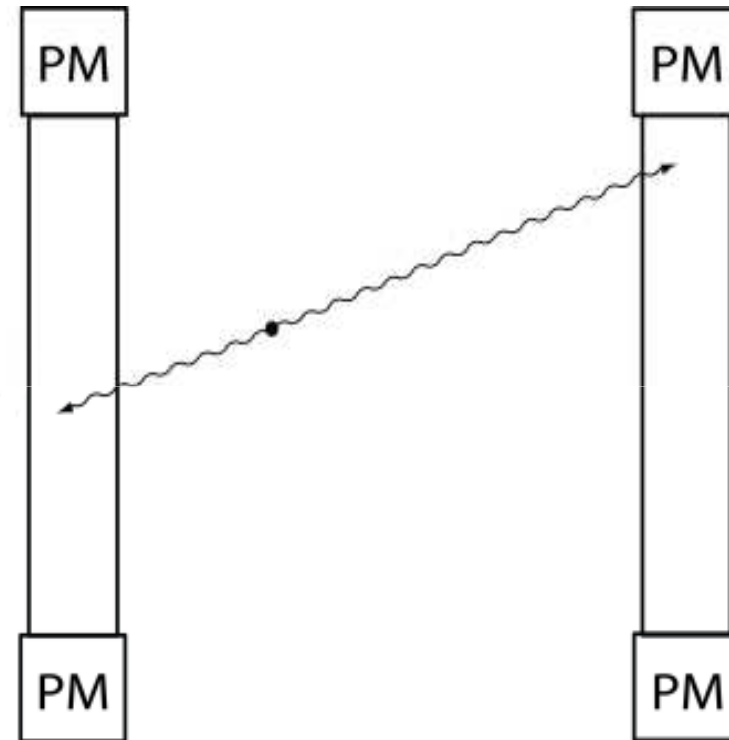
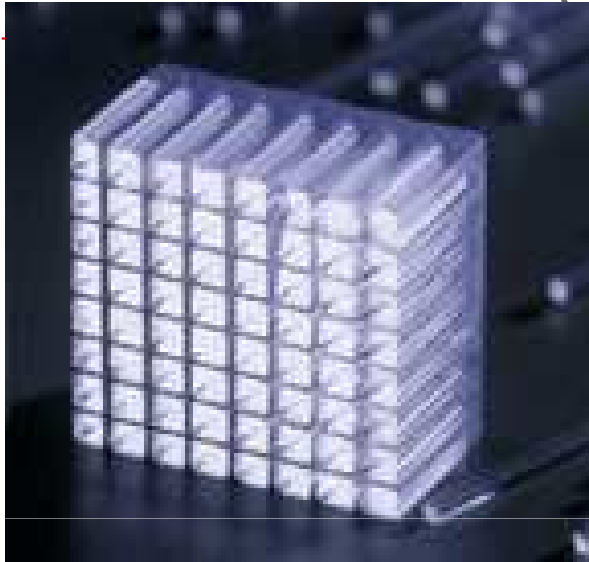
Visual difference between TOF and non TOF



Advantages of detectors

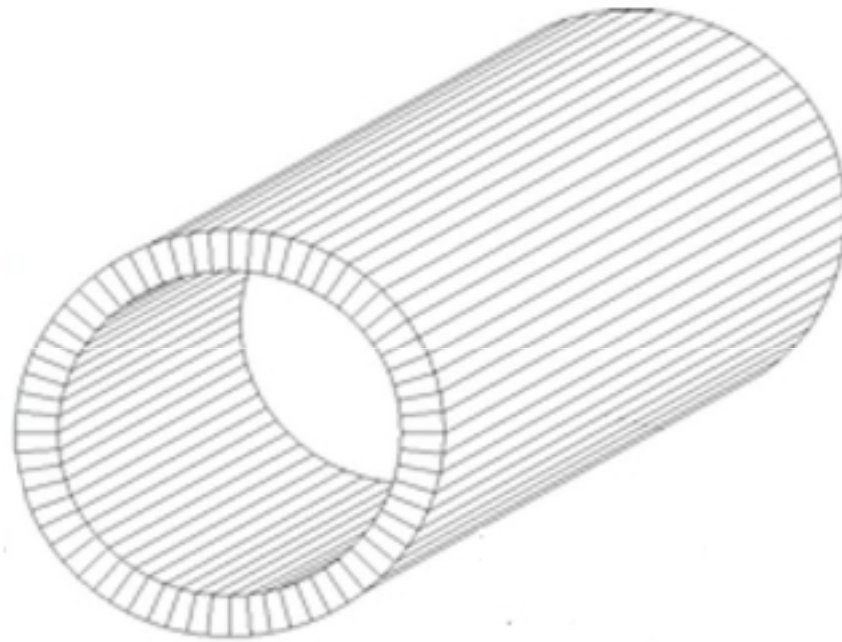
Present (crystal)	Future (plastic)
High energy resolution	Fast signals
Large stopping power	Non-hygroscopic
High light output	Low production cost

Single event reconstruction

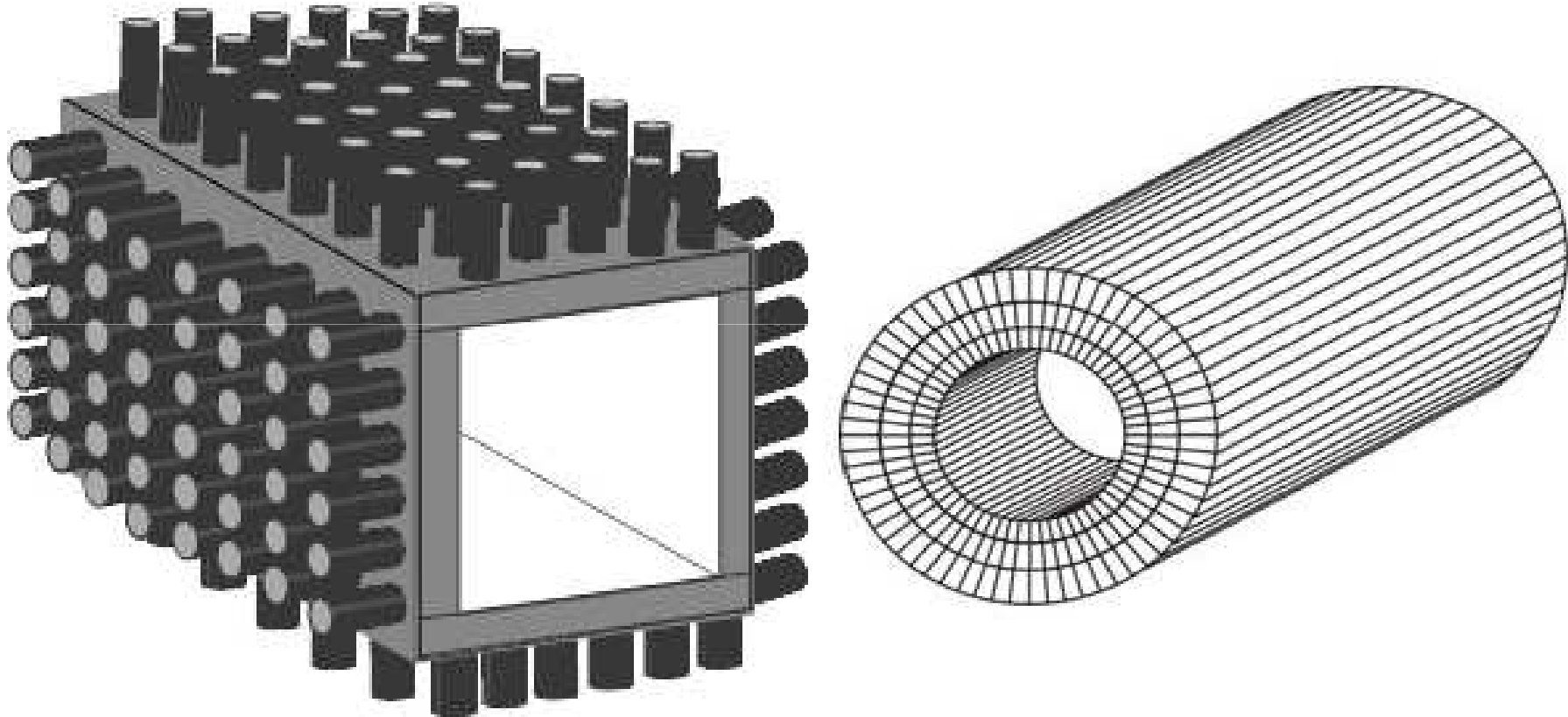


▶ Figure courtesy of M. Zieliński

Strip PET



Multi layer Strip PET and Matrix PET



More details in...

- P. Moskal et al., Bio-Algorithms and Med-Systems 7 (2011) 73-78
- Sz. Niedźwiecki, „Studies of detection of gamma radiation with use of organic scintillator detectors in view of positron emission tomography”, Master Thesis (2011)
- P. Moskal, Patent Application No: P 388 555 [WIPO ST 10/C PL 388555] (2009), PCT/PL2010/00062 (2010)

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