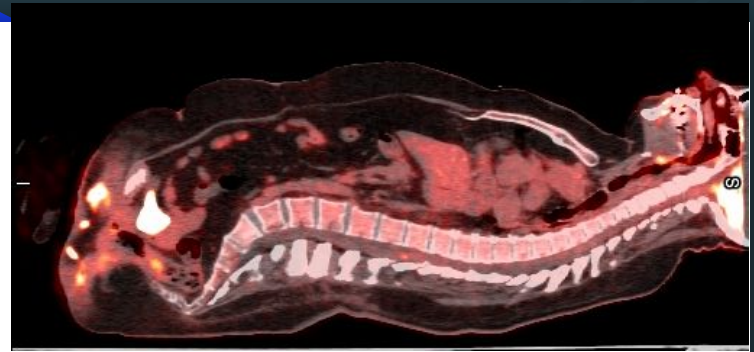




[https://healthjade.net/  
pet-scan/](https://healthjade.net/pet-scan/)



Karupakula E, 23 Nov 2023,  
<https://doi.org/10.53347/rID-178635>

# Novel Method for PET Radioisotope Photoproduction

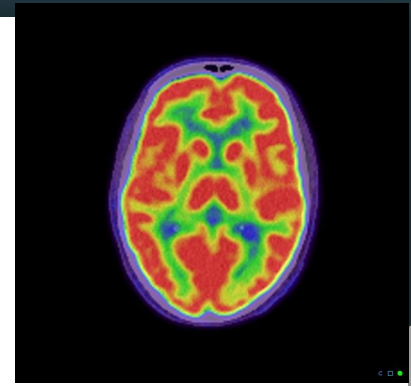
Josephine Stone  
University of York



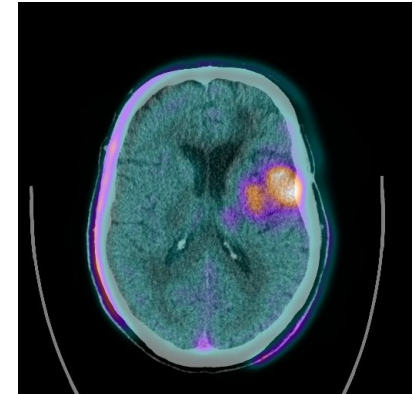
UNIVERSITY  
*of York*

# What is Positron Emission Tomography (PET) ?

- Medical imaging technology used to view activity inside the body.



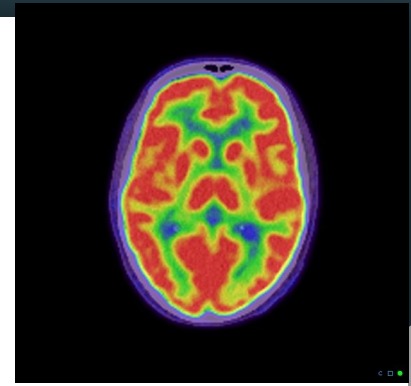
Hacking C, 23 July 2020,  
<https://doi.org/10.53347/rID-80429>



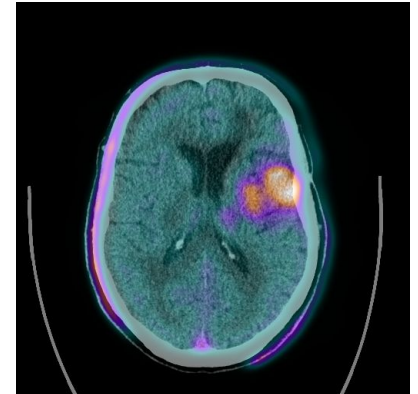
Ayesa S, 11 April 2024,  
<https://doi.org/10.53347/rID-187490>

# What is Positron Emission Tomography (PET) ?

- Medical imaging technology used to view activity inside the body.
- Inject the patient with radioactive Fluorine-18



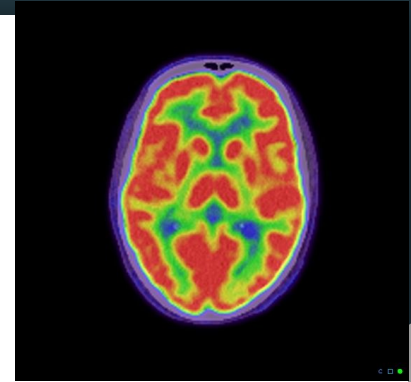
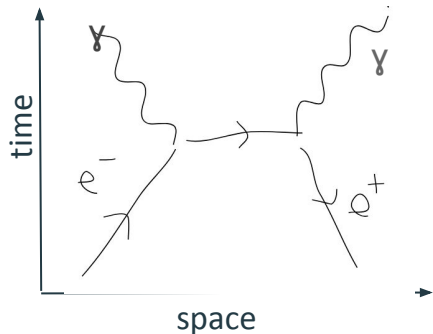
Hacking C, 23 July 2020,  
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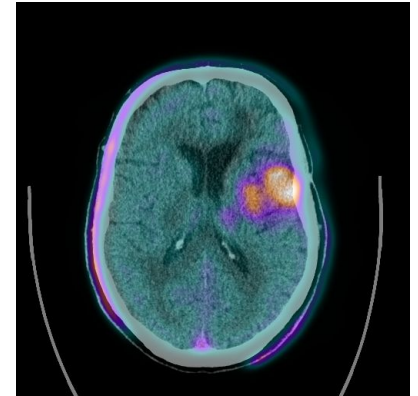
Ayesa S, 11 April 2024,  
<https://doi.org/10.53347/rID-187490>

# What is Positron Emission Tomography (PET) ?

- Medical imaging technology used to view activity inside the body.
- Inject the patient with radioactive Fluorine-18
- Fluorine-18 decays through positron emission (beta plus)
- The positrons annihilate into two gamma rays



Hacking C, 23 July 2020,  
<https://doi.org/10.53347/rID-80429>



Ayesa S, 11 April 2024,  
<https://doi.org/10.53347/rID-187490>

# Motivation

Proton beams fired at heavy water ( $\text{H}_2^{18}\text{O}$ ) in proton accelerator facilities.



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**Inefficient!** Fewer than 1 in 20 million protons fired results in a F-18 isotope due to energy loss.

**Expensive!** An entire PET dose costs around £500. Only 10% of patients needing a PET scan obtain one in the UK.

# Solution: Photon Beam!

- Photon beam instead of proton beam using hospital LINAC



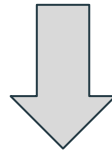
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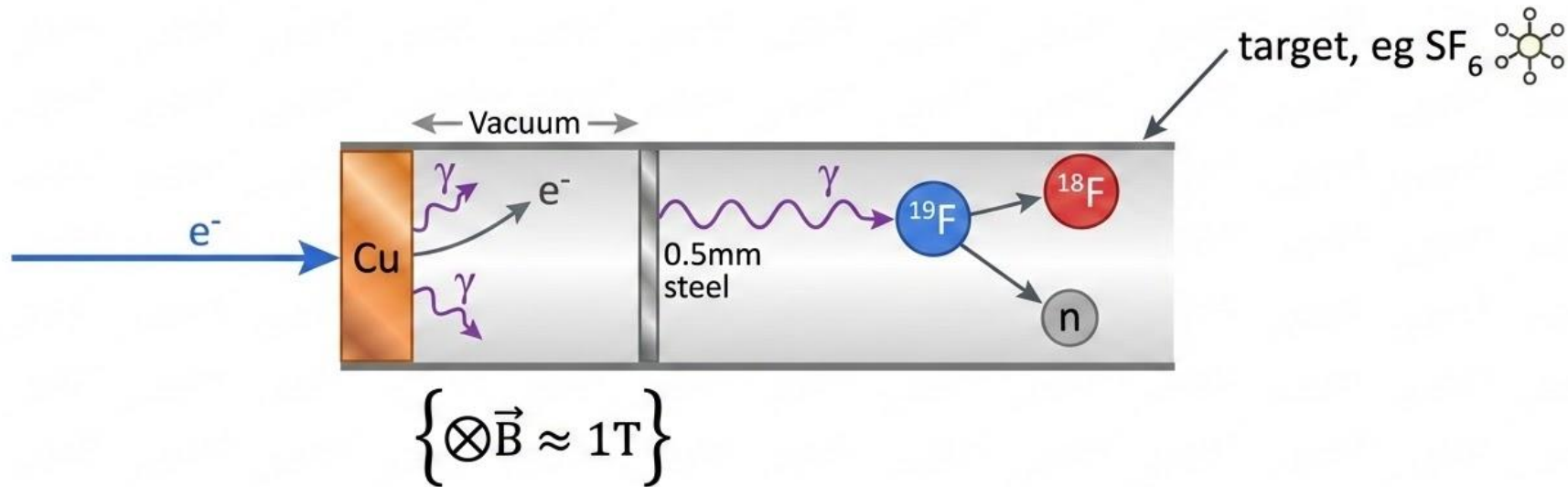
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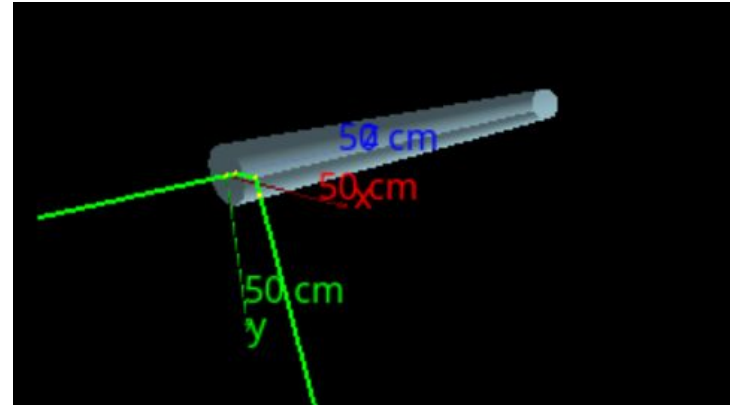
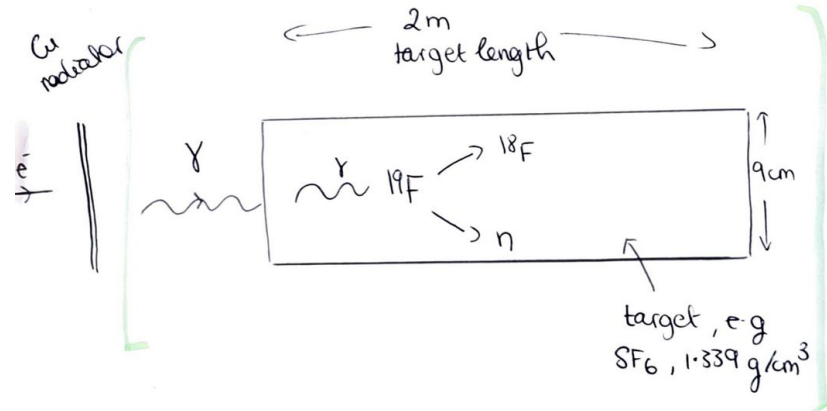
**Outcome!** Expected cost <\$200 per dose





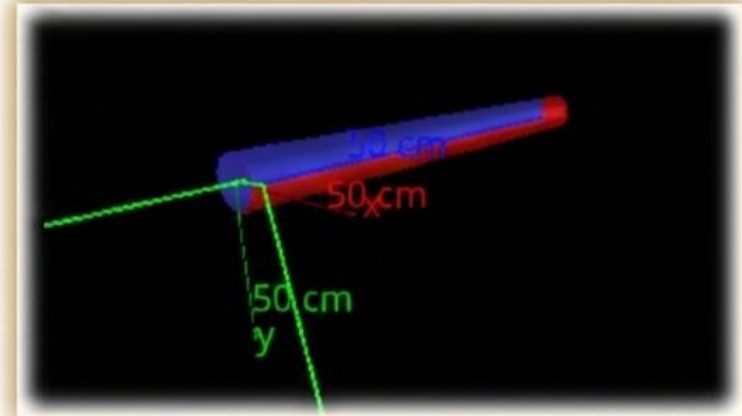
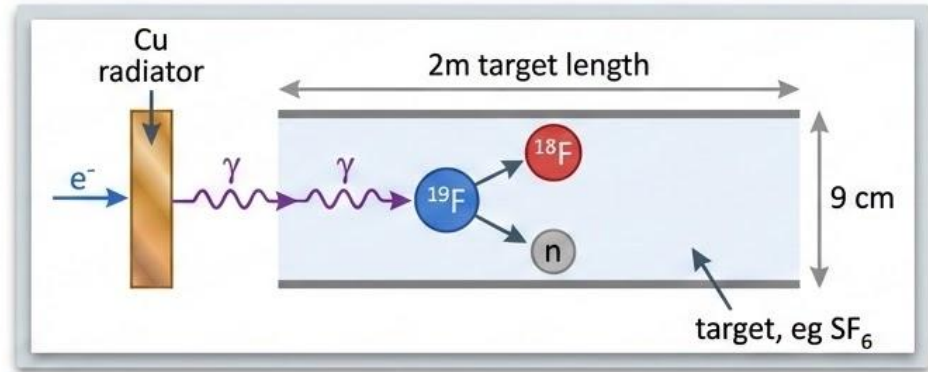
# Variables to Optimise:

- Fluorine-containing fluid
- Pressure
- Temperature
- Beam energy
- Radiator type
- Radiator thickness
- Magnetic field
- Dimensions including length, radius

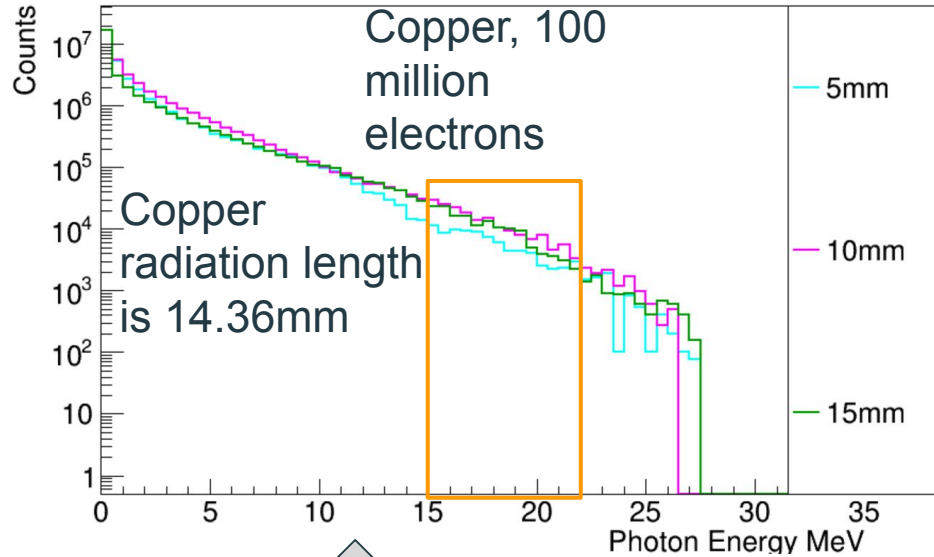


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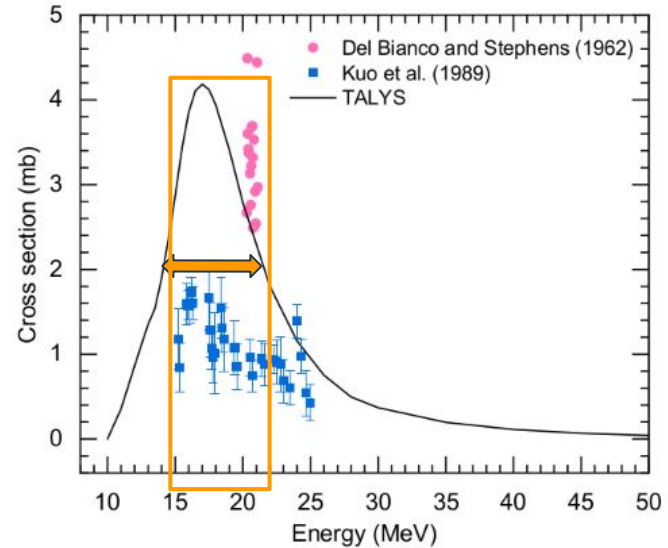
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# Projected Photon Spectra from 30MeV electrons

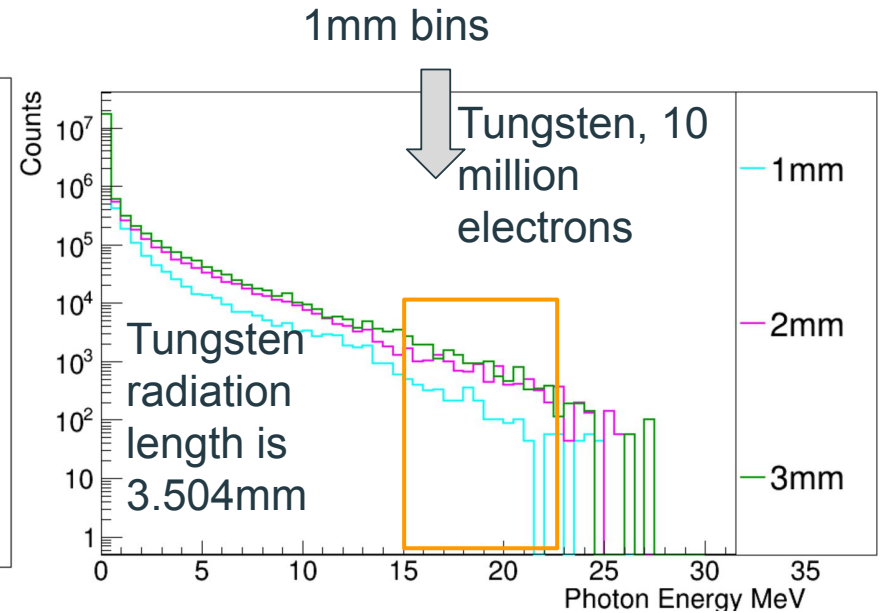
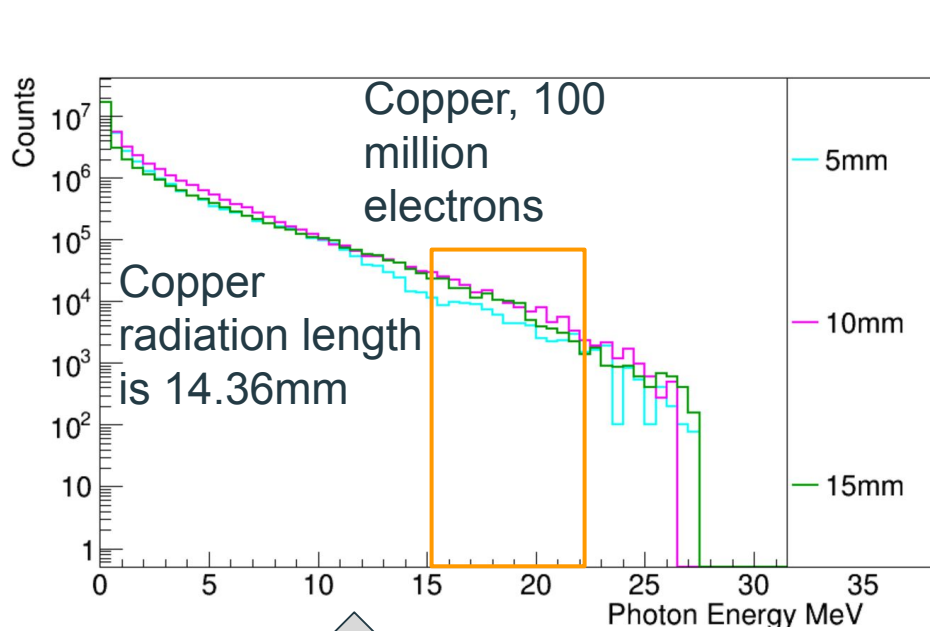


Photon Spectra in 5mm bins

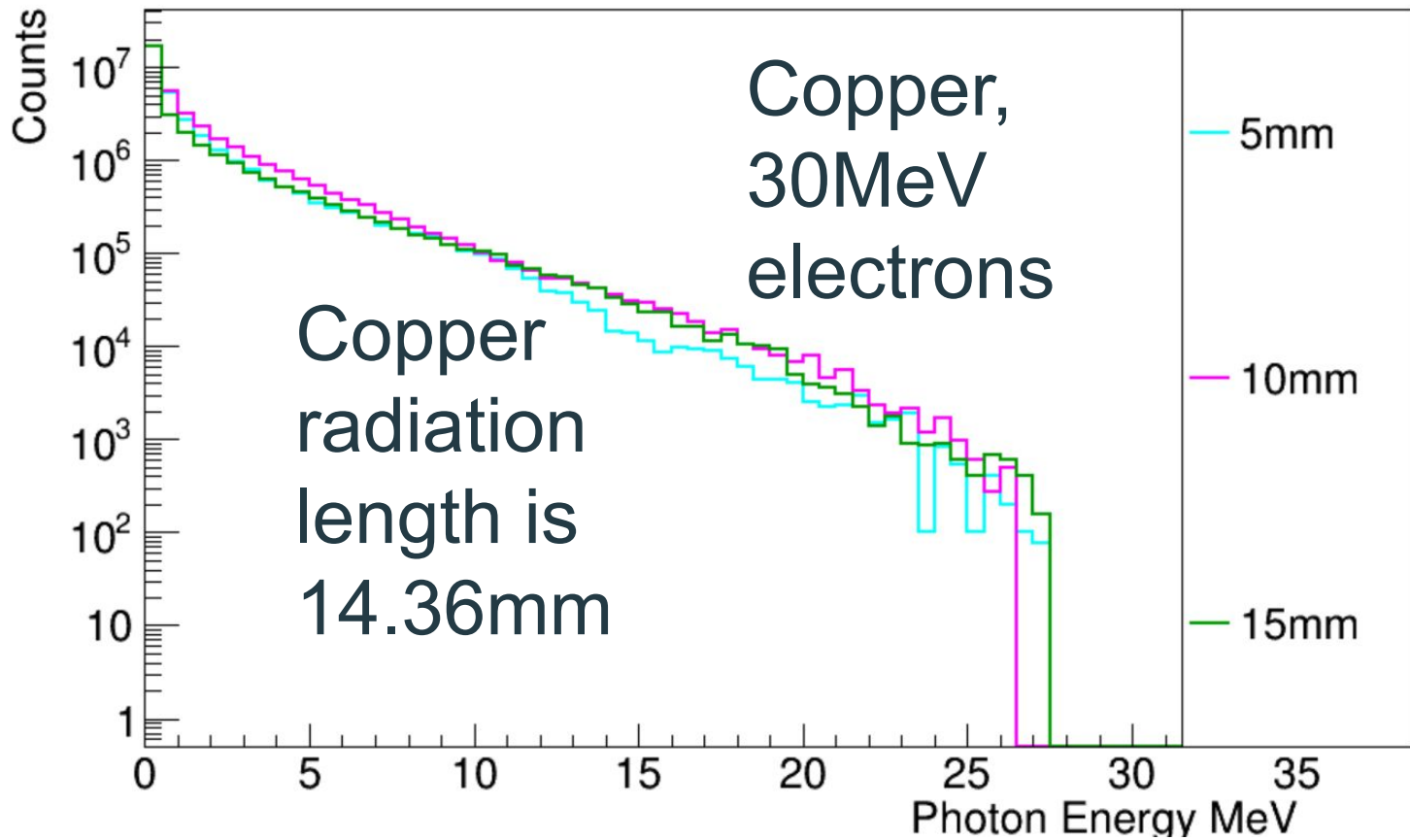


Mamad Eslami, PhD thesis, June 2025,  
University of York

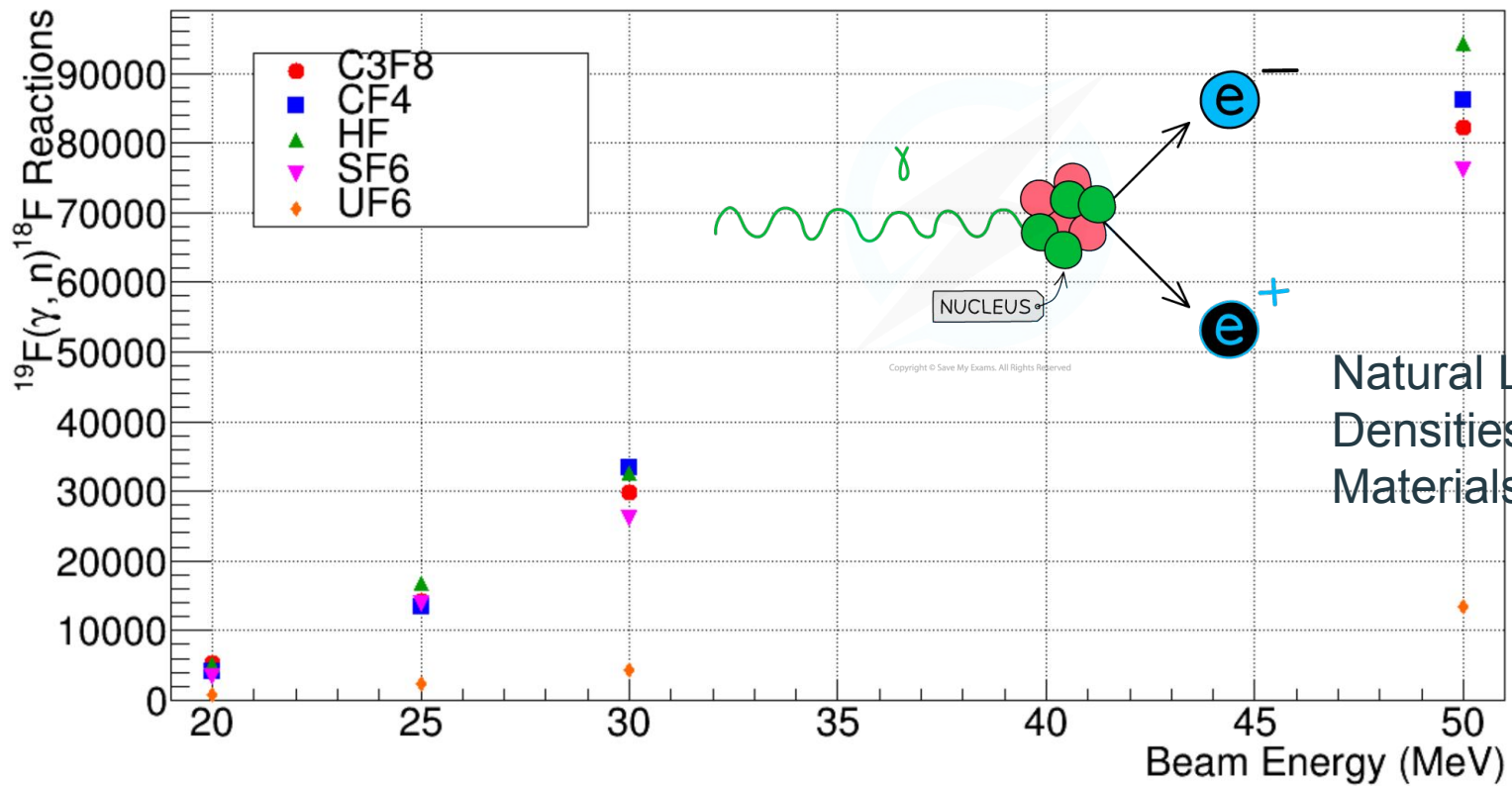
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Photon Spectra in 5mm bins

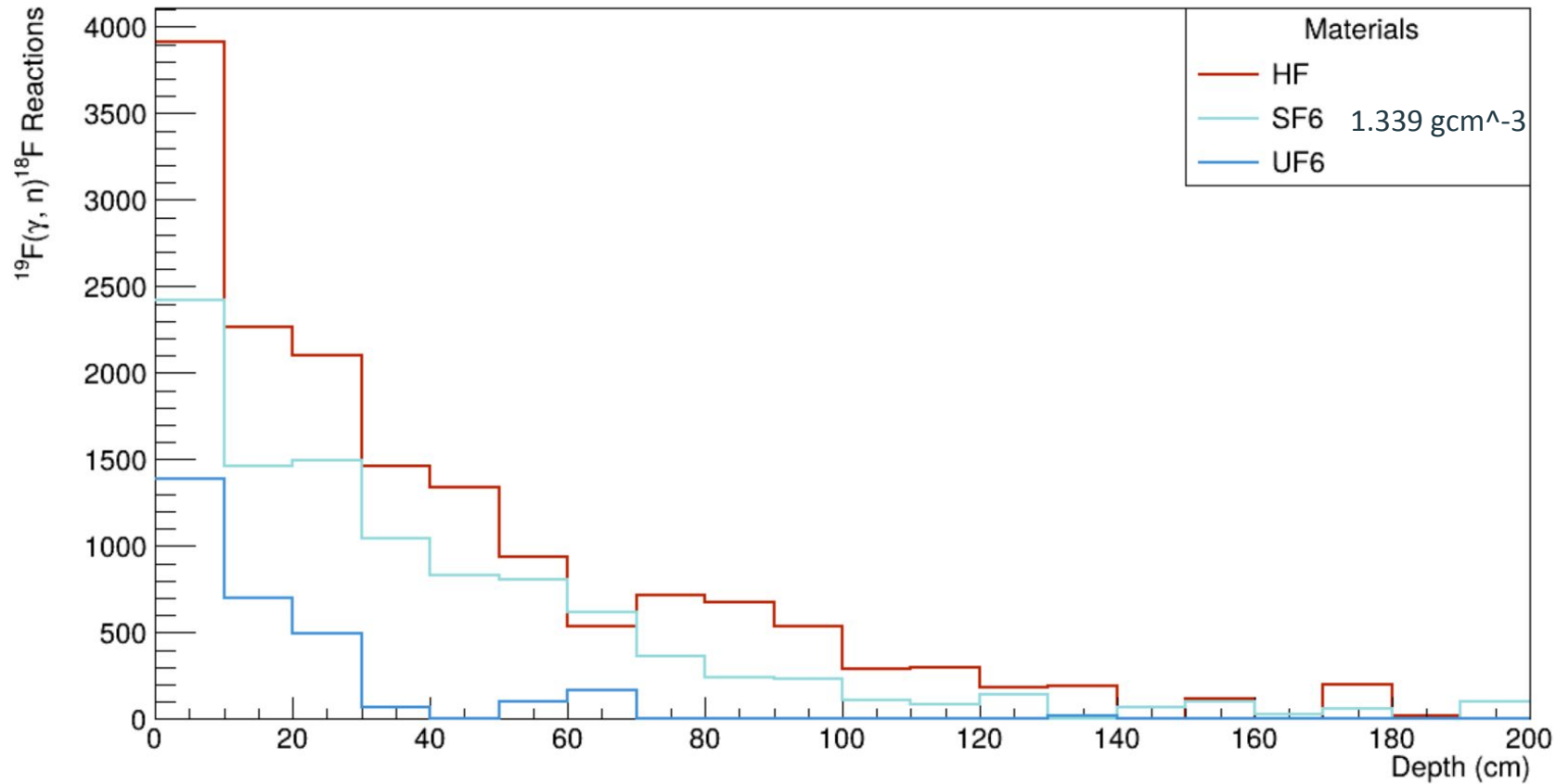


# $^{19}\text{F}(\gamma, n)^{18}\text{F}$ Reactions vs Beam Energy



Natural Liquid  
Densities of  
Materials!

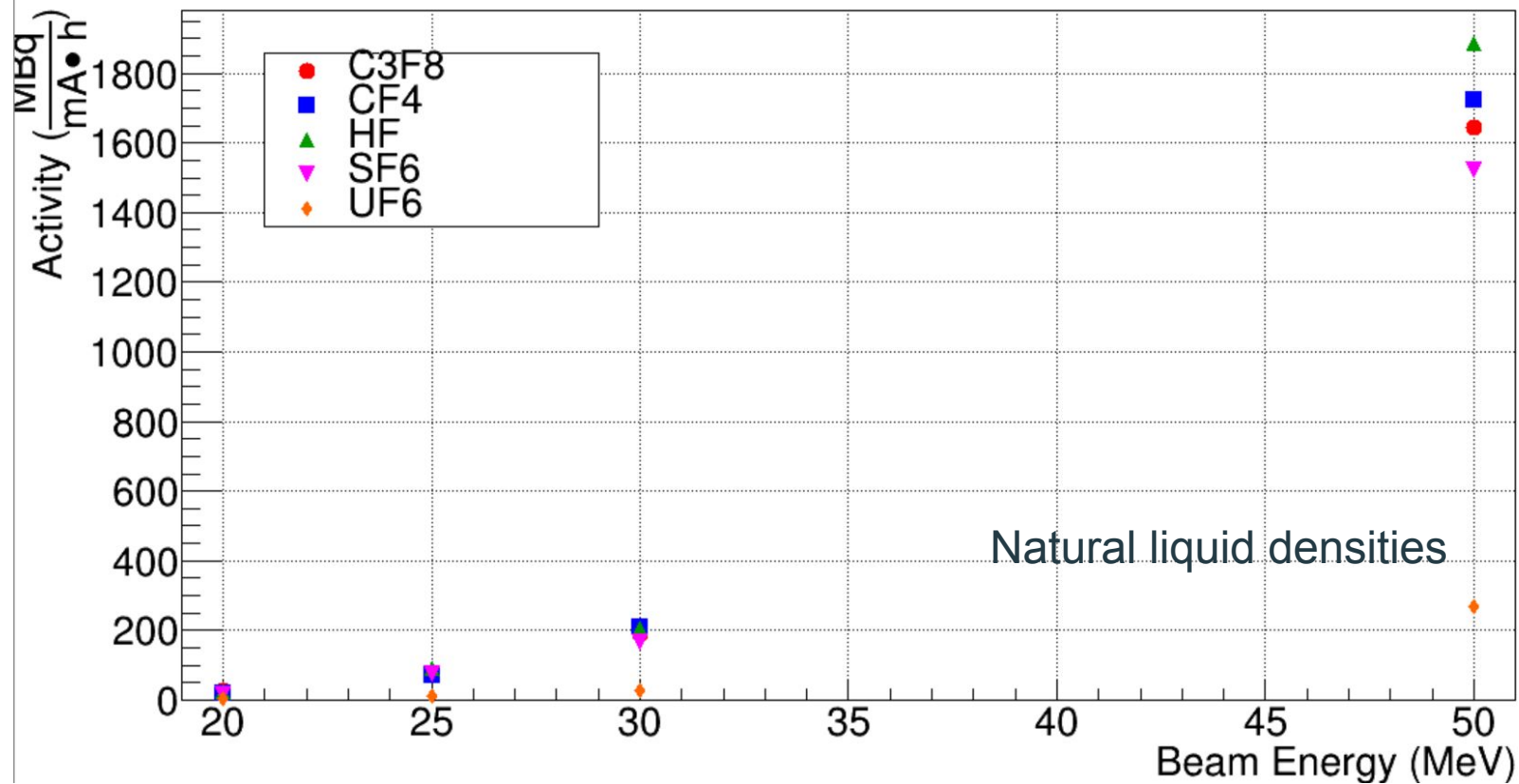
## Target Comparison (same density) at 25 MeV

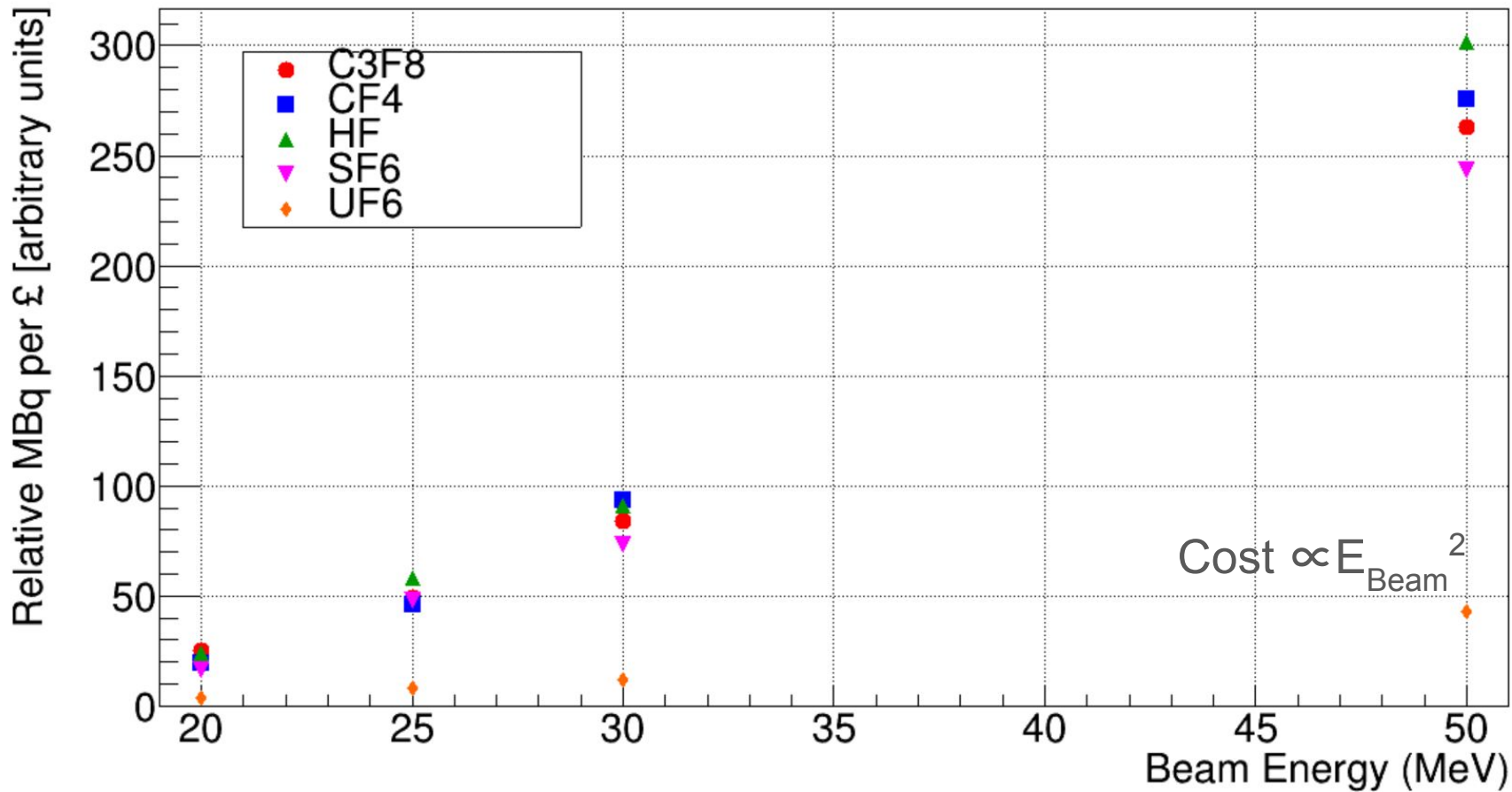


# Hospitals need doses

- Measured in MBq/mAh
- == activity per charge, per hour

# $^{18}\text{F}$ Activity vs Beam Energy

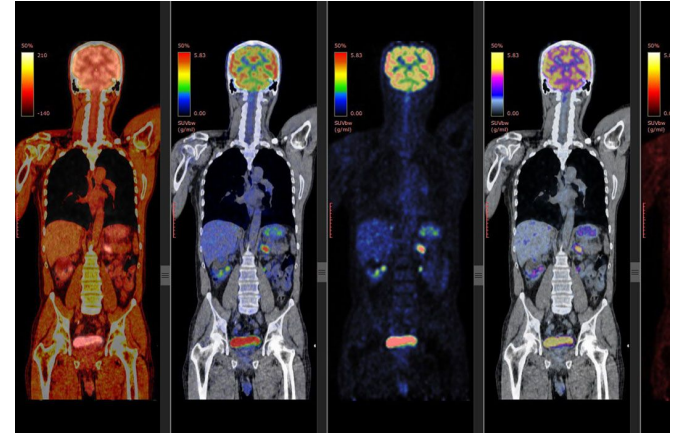




# Summary

- Target
- Radiator Thickness
- Beam Energy
- Target Length
- Extraction

Thank you!



joey.stone@york.ac.uk

Funded by EPSRC