Radioactive [^{18}F]-Fluorine in the Medical Imaging Toolbox

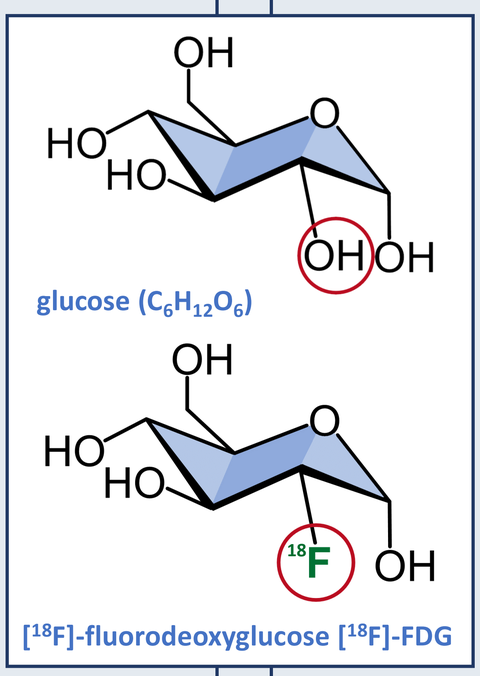
Positron Emission Tomography

Positron Emission Tomography (PET) is a non-invasive imaging technique used in hospitals.

It is a sensitive **diagnostic tool** which can detect early disease including conditions such as: heart disease, brain disorders (Alzheimer's disease) and cancer.

It uses a small amount of a **radioactive drug (*radiotracer*)** to create a 3D image of areas of the body.

Often, PET images are combined with CT or MRI scans to create more detailed views of the body.



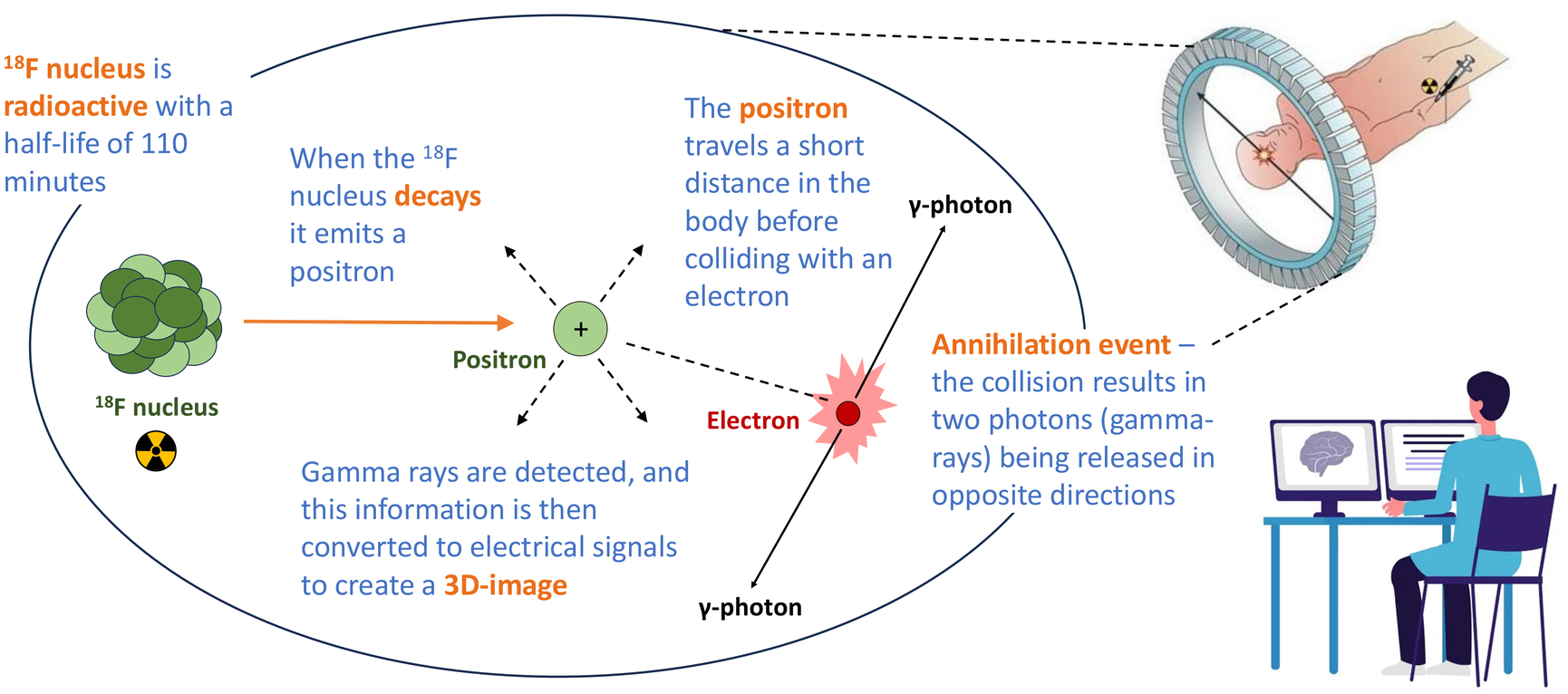
Current ^{18}F Radiotracers

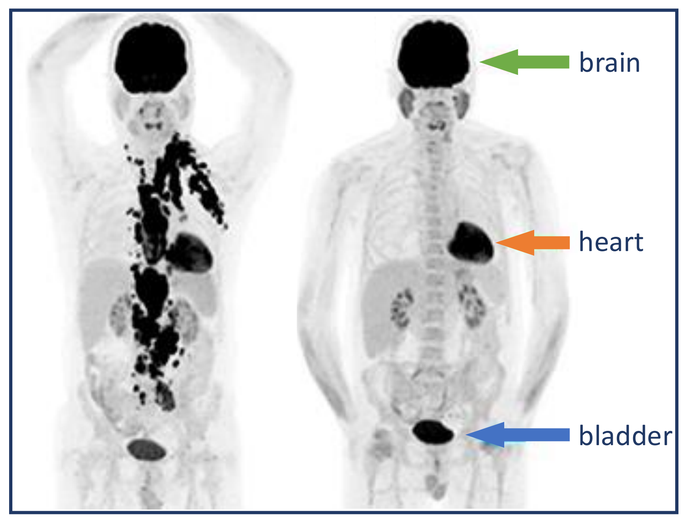
Radiotracers can be inhaled, swallowed or injected depending on the radiotracer and the area of study.

The most widely used ^{18}F-radiotracer is called **[^{18}F]-FDG** and is injected into the patient.

[^{18}F]-FDG **mimics the behaviour of glucose** (sugar), which our cells use to form energy.

As [^{18}F]-FDG is metabolised by the entire body, a higher dose of radiotracer is required obtain a detailed image of the target area.





Areas of the body with a higher level of glucose uptake e.g. tumours, infections and the brain, **show up brighter** in an [^{18}F]-FDG PET scan than normal tissues.

Our Research

At Southampton we are looking at producing new ^{18}F- radiotracers with pre-formed, **strong, metal-^{19}F bonds**.

We can swap the ^{19}F for ^{18}F *via* a process called **isotopic exchange**.

These metal-fluoride bonds are bound into a UV-active **macrocyclic** scaffold, which we use to:

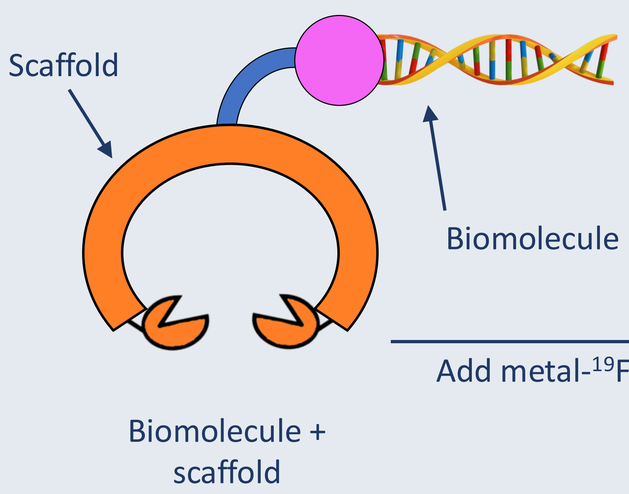
1) Make the radiotracer molecule more stable

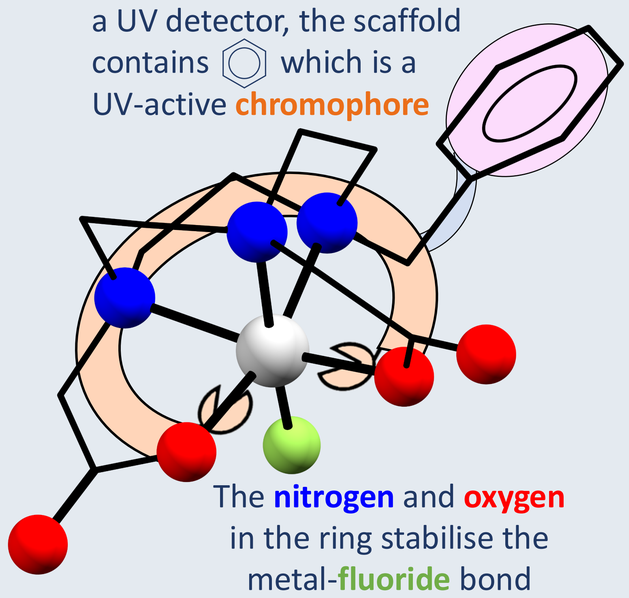
2) Monitor the isotopic exchange reaction

3) Use as a molecular bridge to attach to a **biomolecule**

Ideal Radiotracers Checklist

- ❑ Chemically stable in the body
- ❑ Effective in very tiny amounts
- ❑ Ability to treat as well as diagnose
- ❑ Selective targeting of disease
- ❑ On-site synthesis
- ❑ Fast radiolabelling





These biomolecules are used for **selective targeting** of organs or disease.

This means **smaller radioactive doses** in comparison to [^{18}F]-FDG, and more detailed scans, providing clinical information early.

EPSRC Engineering and Physical Sciences Research Council
MITHRAS NEXT GENERATION MOLECULAR IMAGING AND THERAPY WITH RADIONUCLIDES
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