KINECTRICS

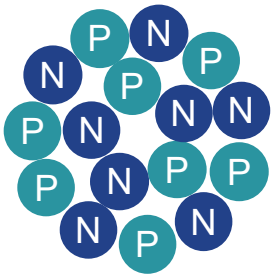
Medical Isotopes

Nuclear at the Service of Medicine

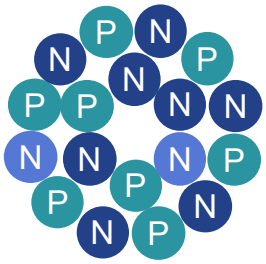
WHAT IS AN ISOTOPE?

All the matter in our world is made up of different elements, such as Carbon (C), Oxygen (O), or Nitrogen (N). However, each of these elements may exist under different nuclear compositions called **isotopes**. Isotopes have the same number of protons, but a different number of neutrons in the nucleus. For example, Oxygen (O) has 2 main isotopes: Oxygen-16 (noted ^{16}O) and Oxygen-18 (noted ^{18}O). Both are stable, but other isotopes can be unstable and will need to emit radiation in order to become stable making it **radioactive**.

OXYGEN-16 (^{16}O)
- Occurs naturally
- 99.8% of the air
- 8 protons & 8 neutrons

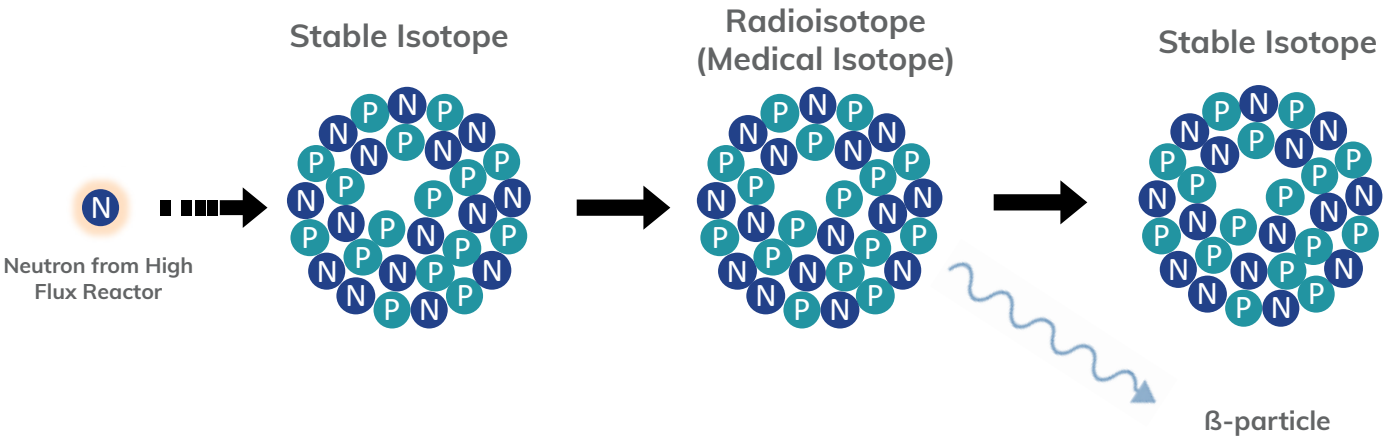


OXYGEN-18 (^{18}O)
- Occurs naturally
- 0.2% of the air
- 8 protons & 8+2 neutrons

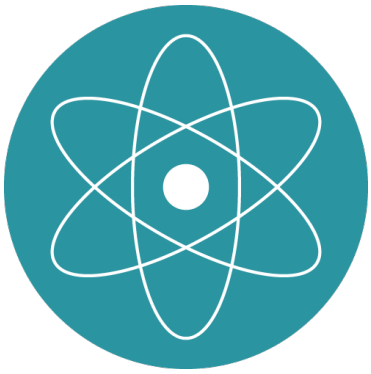


ISOTOPES AS MEDICAL TOOLS

Some unstable isotopes can emit radiation that's useful to treat diseases such as cancer or to image diseases using specialized cameras. These are called **medical isotopes**. Medical isotopes must be produced artificially by either adding a neutron or a proton to an otherwise stable element. For example, Fluorine-18 (^{18}F) is used to image cancer, but it is created by using a special particle accelerator installed in hospitals that adds a proton to natural Oxygen-18 (^{18}O).



Medical Isotope Irradiation



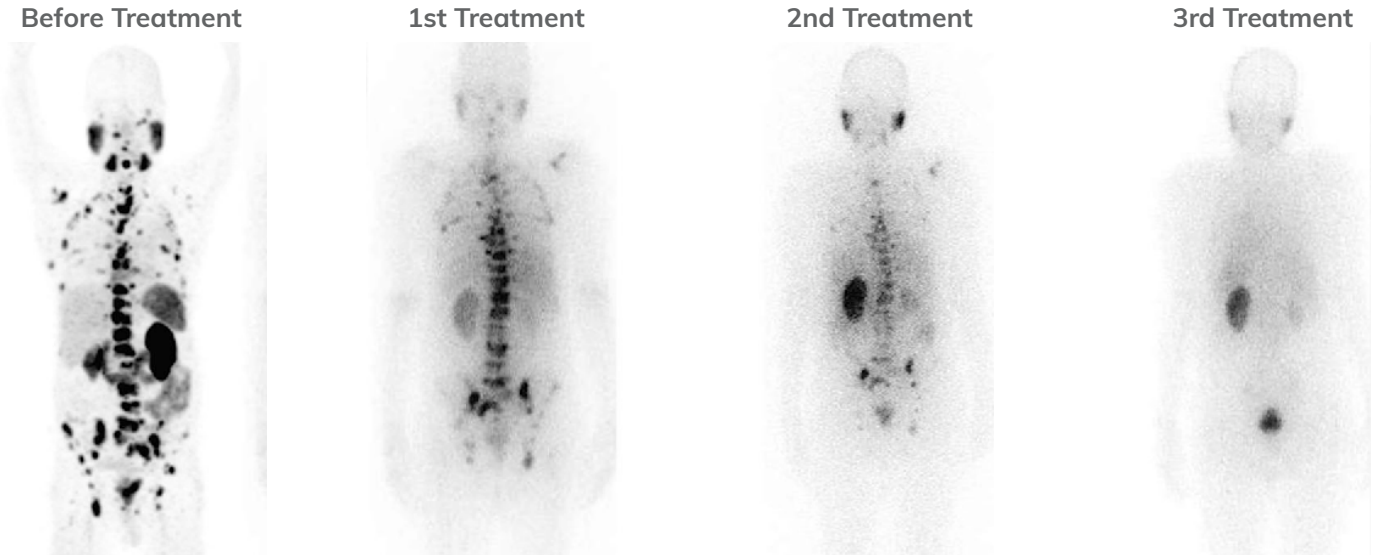
Nuclear Reactor

Medical Isotope Purification

Processing Facility

BRUCE POWER AND LUTETIUM-177

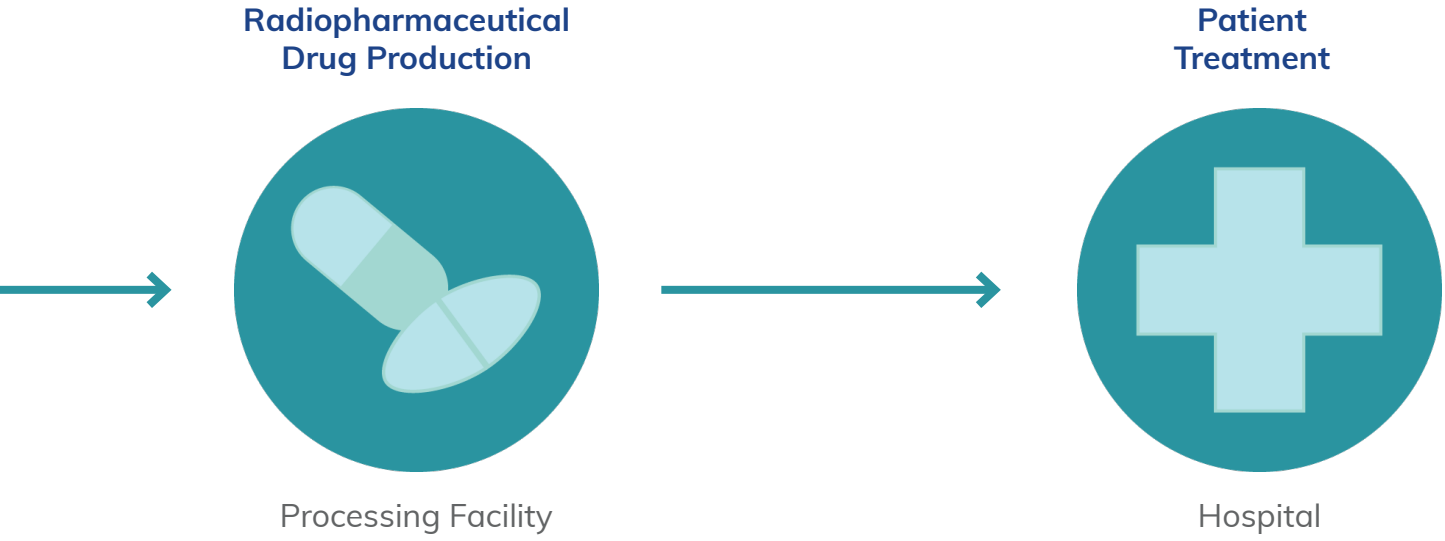
Kinectrics and Bruce Power are working together to create a supply of Lutetium-177 (^{177}Lu), a medical isotope used to treat patients afflicted with rare neuroendocrine tumors and prostate cancer. It is made by irradiating particles of Ytterbium-176 (^{176}Yb) in a nuclear reactor core. The stable isotope is sealed in special containers and placed in the reactor for about 2 weeks. A small amount of Ytterbium-176 (^{176}Yb) is converted to Lutetium-177 (^{177}Lu), and this mixture is then placed in transport casks that are shipped to an isotope purification facility in either North America or in Europe. Each cask will contain enough Lutetium-177 (^{177}Lu) to treat about 200 patients, and no nuclear waste will be generated given that the unused matter will be recycled to produce more isotopes.



Black Spots are Tumours

RADIOISOTOPES FAST FACTS

- Over 40 million nuclear medicine procedures are performed each year using radioisotopes
- Demand for radioisotopes is increasing up to 5% annually
- Over 10,000 hospitals worldwide are using radioisotopes in medicine
- The use of radio pharmaceuticals in diagnosis is growing at over 10% each year
- The global radioisotope market was valued at $9.6 billion in 2016 and poised to reach $17 billion by 2021



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