INTERNSHIP @ MEDICIS & COLLAPS

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1. WEEK: MEDICIS

PRODUCING A NEW GENERATION OF RADIOISOTOPES FOR PRECISION MEDICINE

- MEDICIS = **Med**ical **I**sotopes **C**ollected from **IS**OLDE
- produces **non-conventional radioisotopes** for medical research
  - have the potential to be used in new and innovative diagnostic and therapeutic applications
- MEDICIS uses **two targets** to produce radioisotope
  - The first target is bombarded with a high-energy proton beam from CERN's Proton Synchrotron Boosters (PSB). This produces a variety of radioactive ions, which are then transported to the second target.
  - The second target is heated to a high temperature, which causes the radioactive ions to evaporate. The evaporated ions are then extracted and mass-separated, and the desired radioisotope is collected on a small foil.

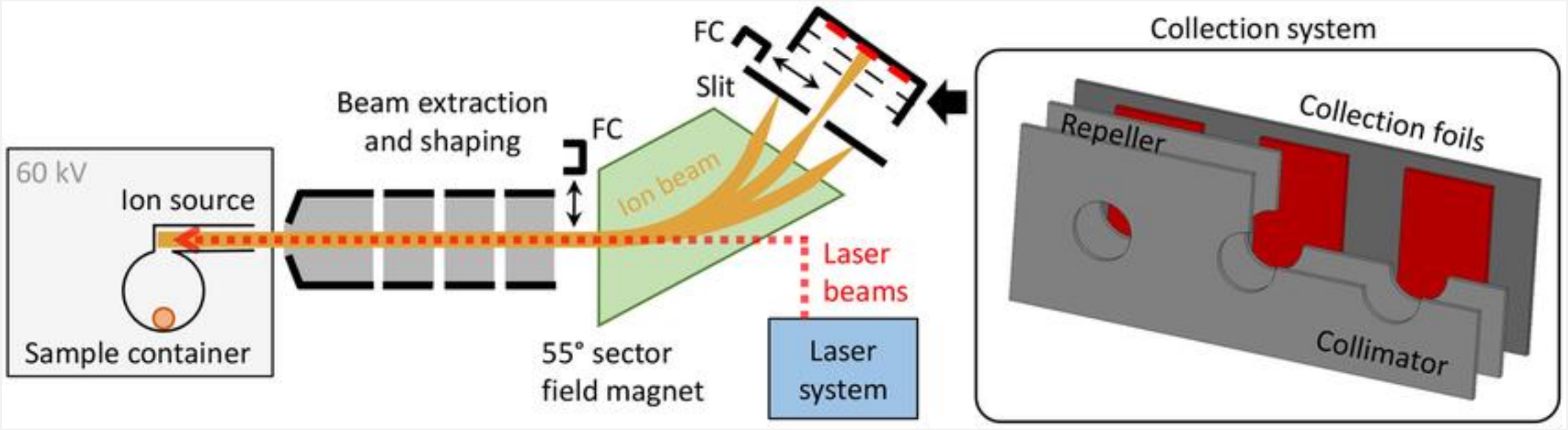
1. PRODUCING THE TARGET

- Uranium + Graphite

→ Uranium-Carbide-Pellets

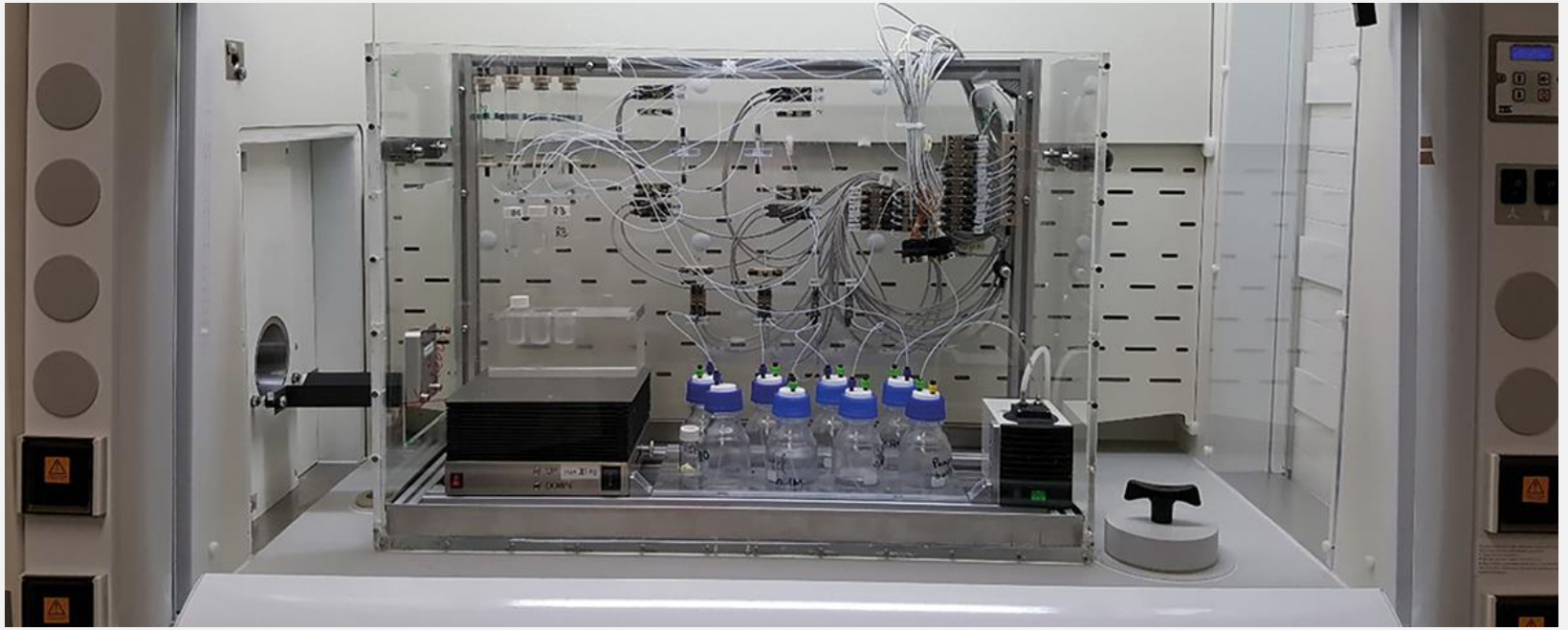
- Often radioactive targets from other research labs or hospitals are directly sent to Medicis
- Robots can transport radioactive targets to beam

2. BEAM AND FOIL COLLECTION



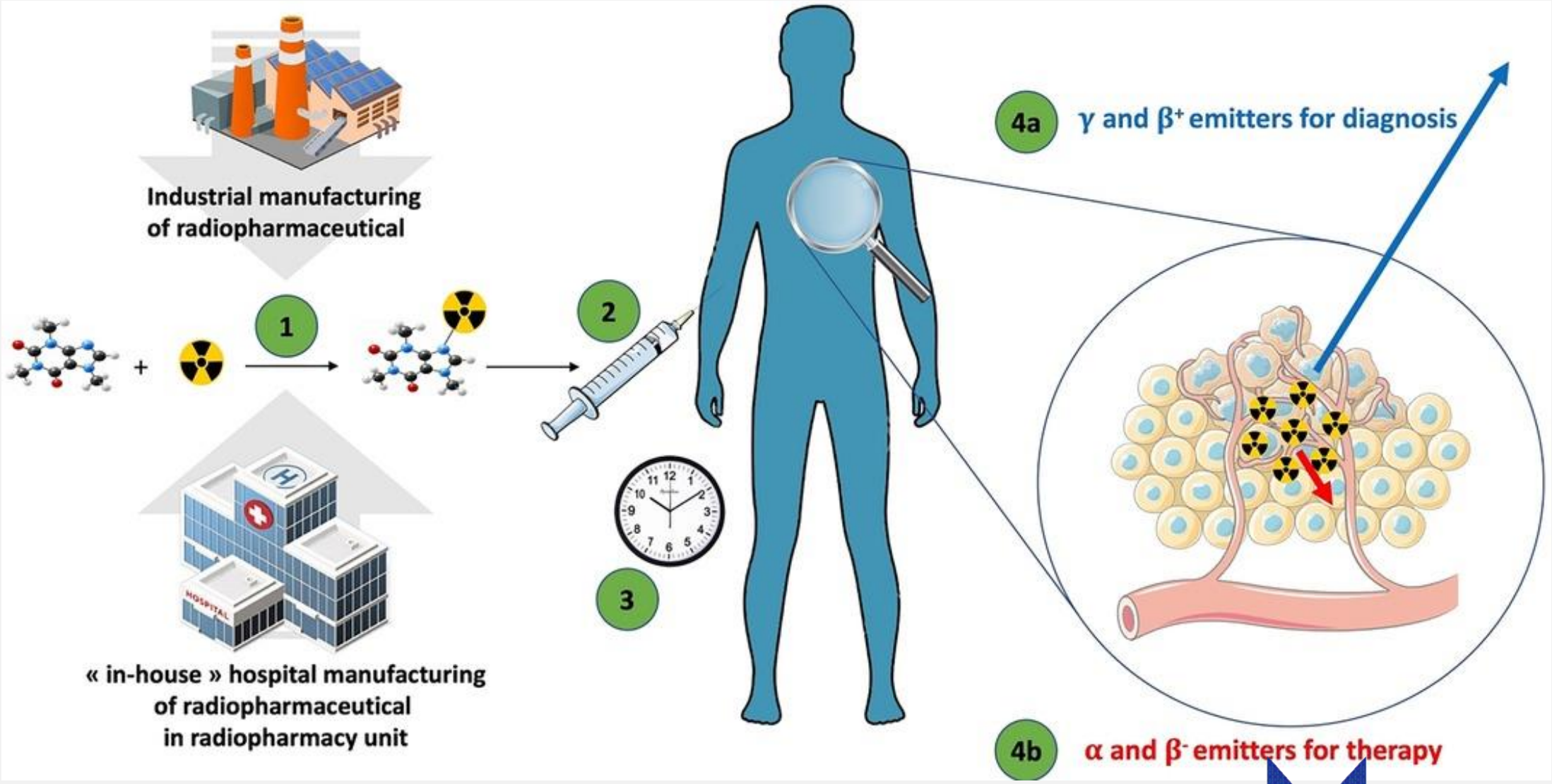
- Mostly gold foils or salt coating
  - Depends on isotope and use-case

3. RADIOCHEMISTRY AND PURIFICATION



APPLICATION OF MEDICIS-PRODUCED RADIOISOTOPES

- **Diagnostics**: radioisotopes can be used to develop new and more sensitive diagnostic *imaging techniques*.
  - MEDICIS-produced scandium-44 can be used to image tumors with high resolution and contrast.
- **Therapy**: radioisotopes can be used to develop new and more targeted radiotherapies.
  - For example, MEDICIS-produced terbium-161 can be used to treat tumors with high doses of radiation while minimizing damage to healthy tissue.
- **Theranostics**: new field of medicine that combines diagnosis and therapy into a single procedure.
  - MEDICIS-produced radioisotopes can be used to develop new theranostic agents that can be used to both image and treat tumors.

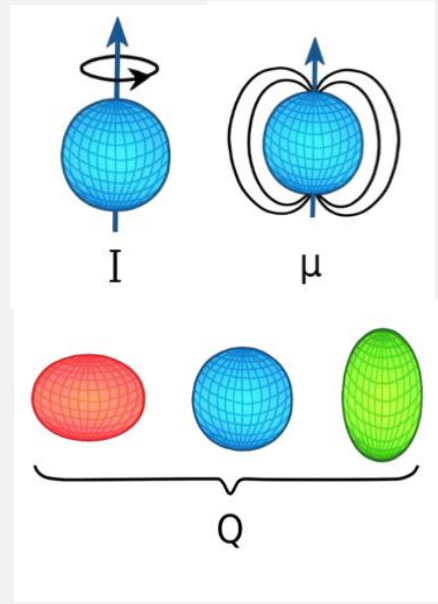

Industrial manufacturing
of radiopharmaceutical
1
2
3
« in-house » hospital manufacturing
of radiopharmaceutical
in radiopharmacy unit
4a
γ and β+ emitters for diagnosis
4b
α and β- emitters for therapy

2.WEEK: COLLAPS

COLLINEAR LASER SPECTROSCOPY

- Idea: investigate ground state properties of exotic, short-lived nuclei, such as spins, electromagnetic moments, and charge radii
- Isotopes have same number of protons but different number of neutrons
  - A = Z + N
  - The larger the ration between Z and N, the more exotic
  - often very short-lived, decaying within milliseconds

→ COLLAPS uses a technique called *collinear laser spectroscopy* to study these nuclei

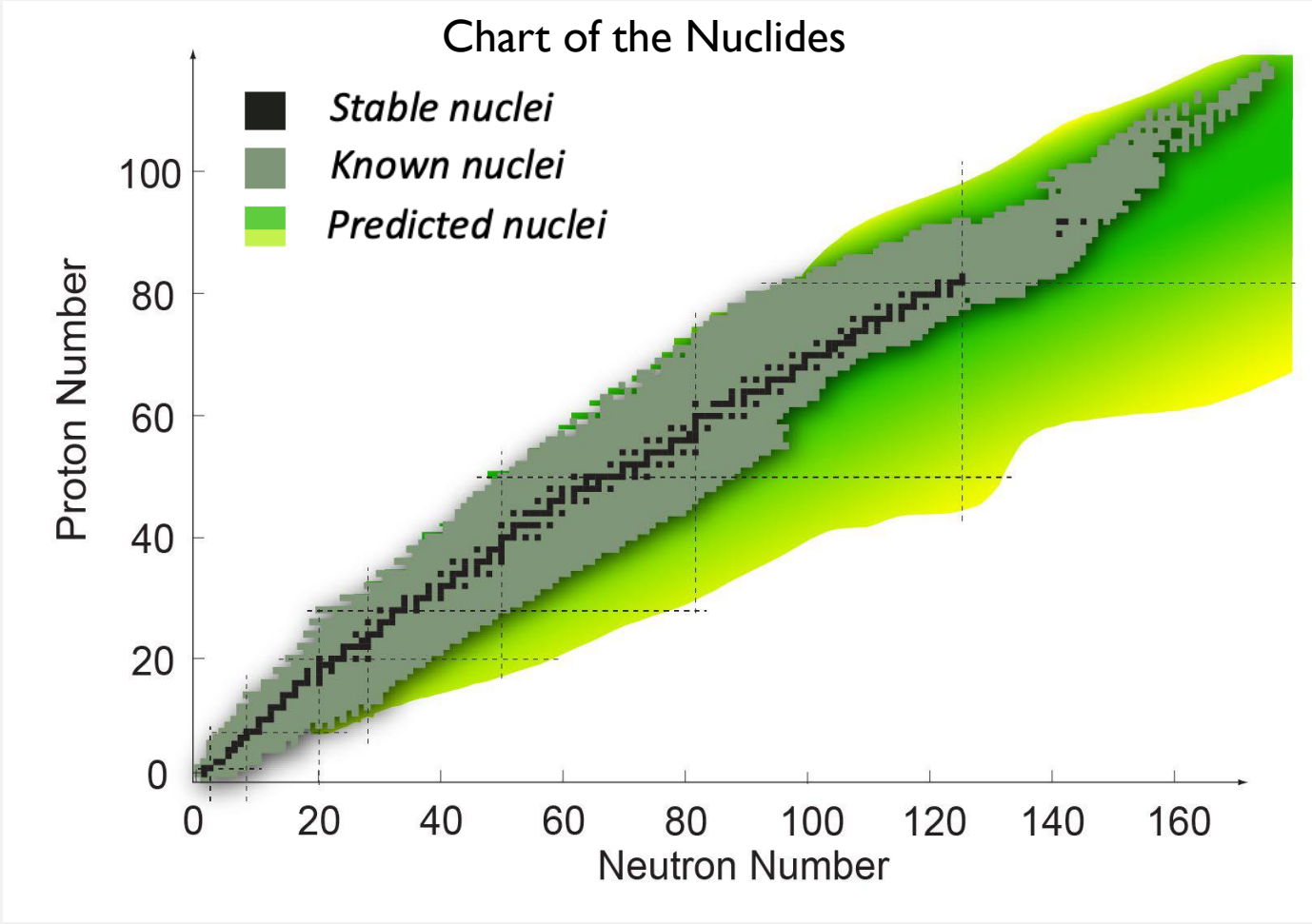


AIM

Unravel the fundamental properties of nuclei from their basic constituents

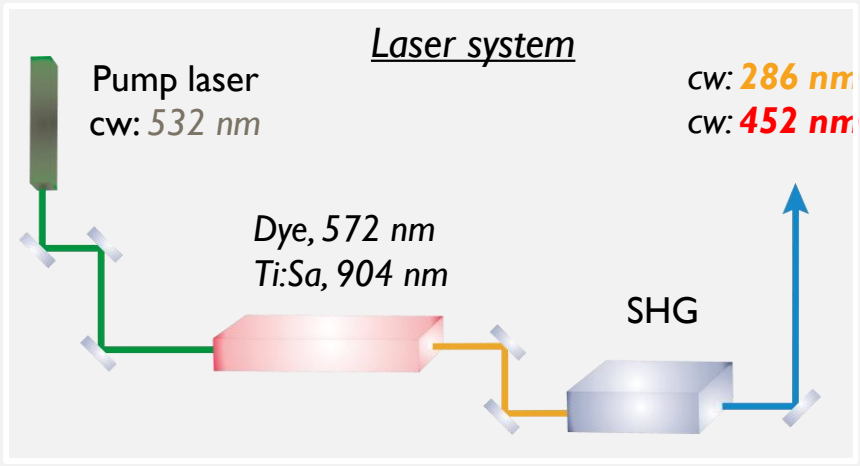
- ***Find a comprehensive and quantified model of atomic nuclei***

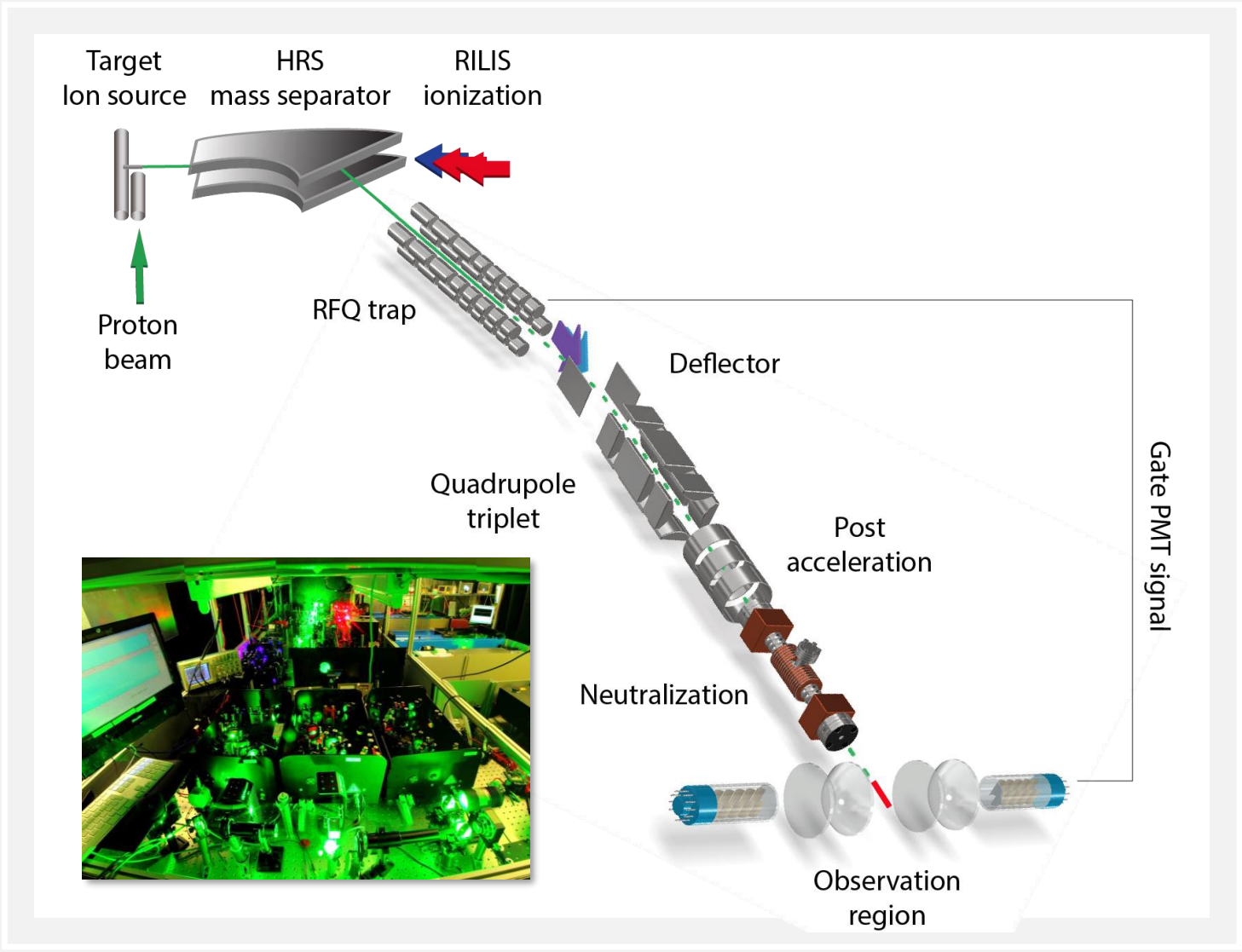
- About 286 stable isotopes
- **About 3307 radioactive isotopes**



SETUP

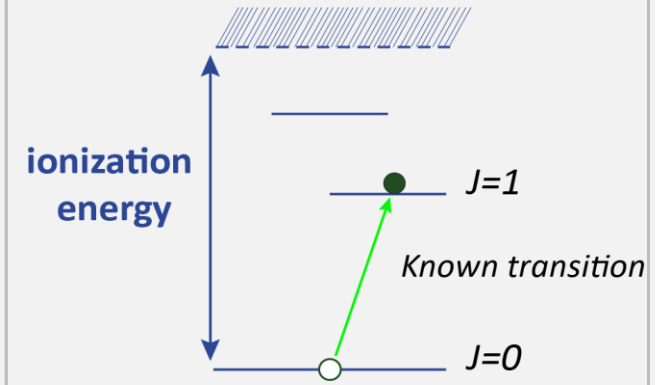
- Beam of exotic nuclei is collinear with a laser beam
- Laser is tuned to frequency that matches the energy difference between two energy levels of the nucleus





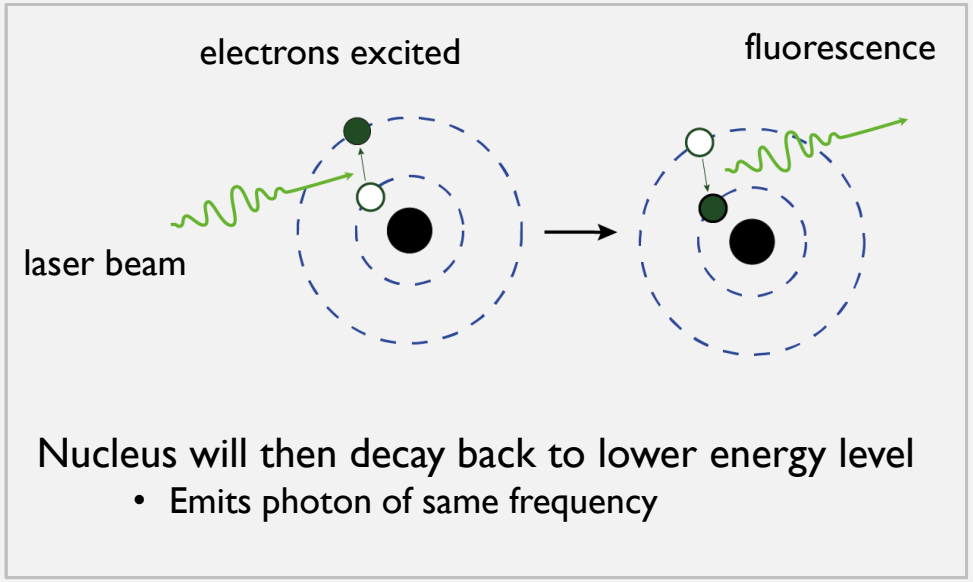
→ Laser needs to be really precise!

HOW IT WORKS



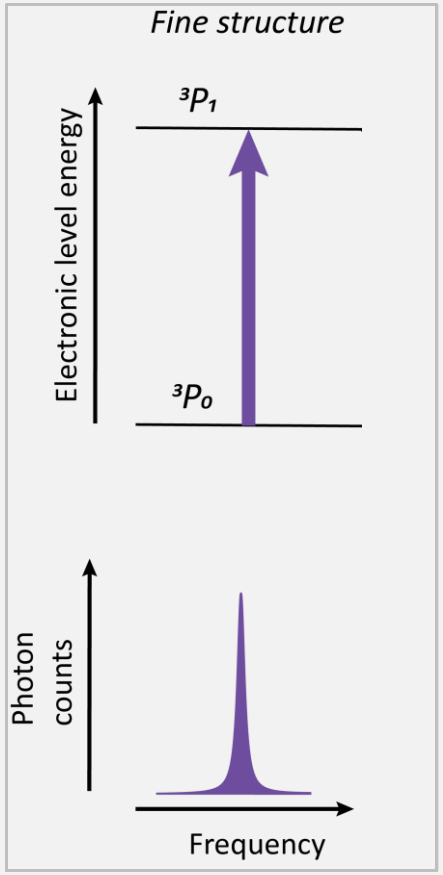
Nucleus absorbs a laser photon

- Transitions to higher energy level



Nucleus will then decay back to lower energy level

- Emits photon of same frequency

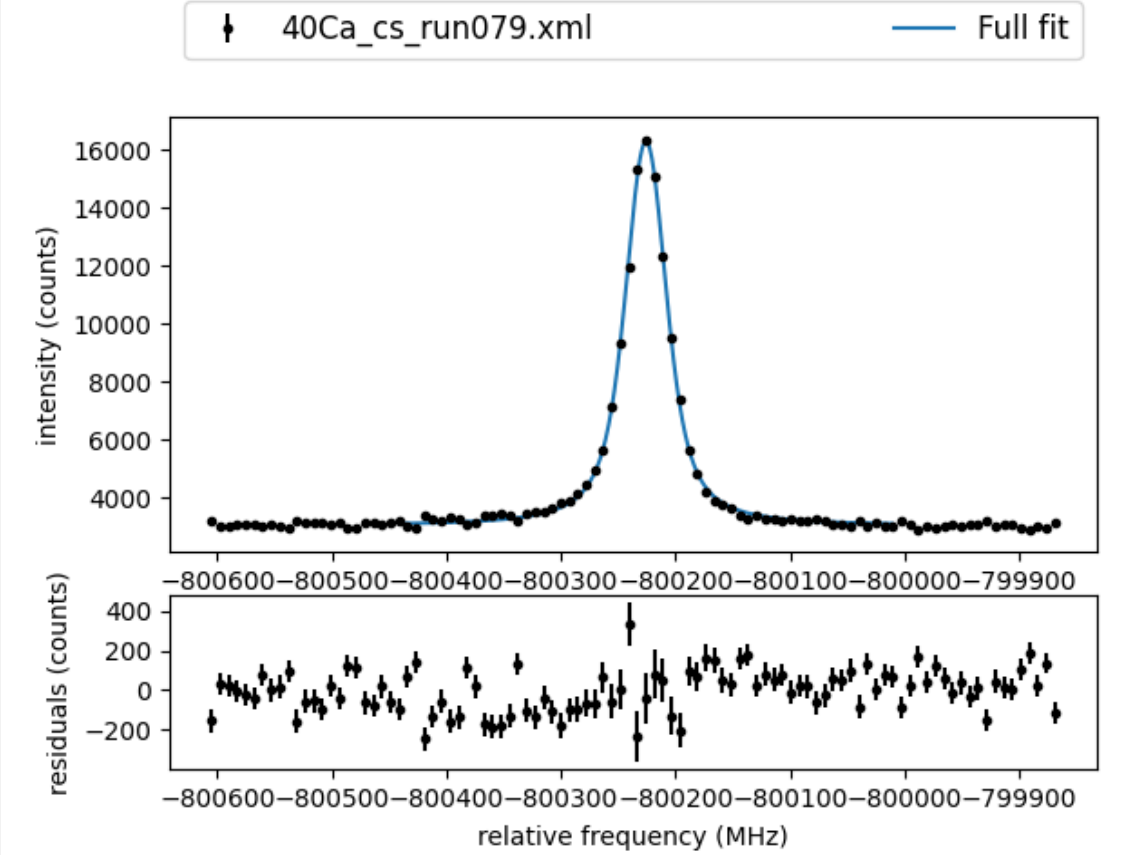


Measurement of emitted photons

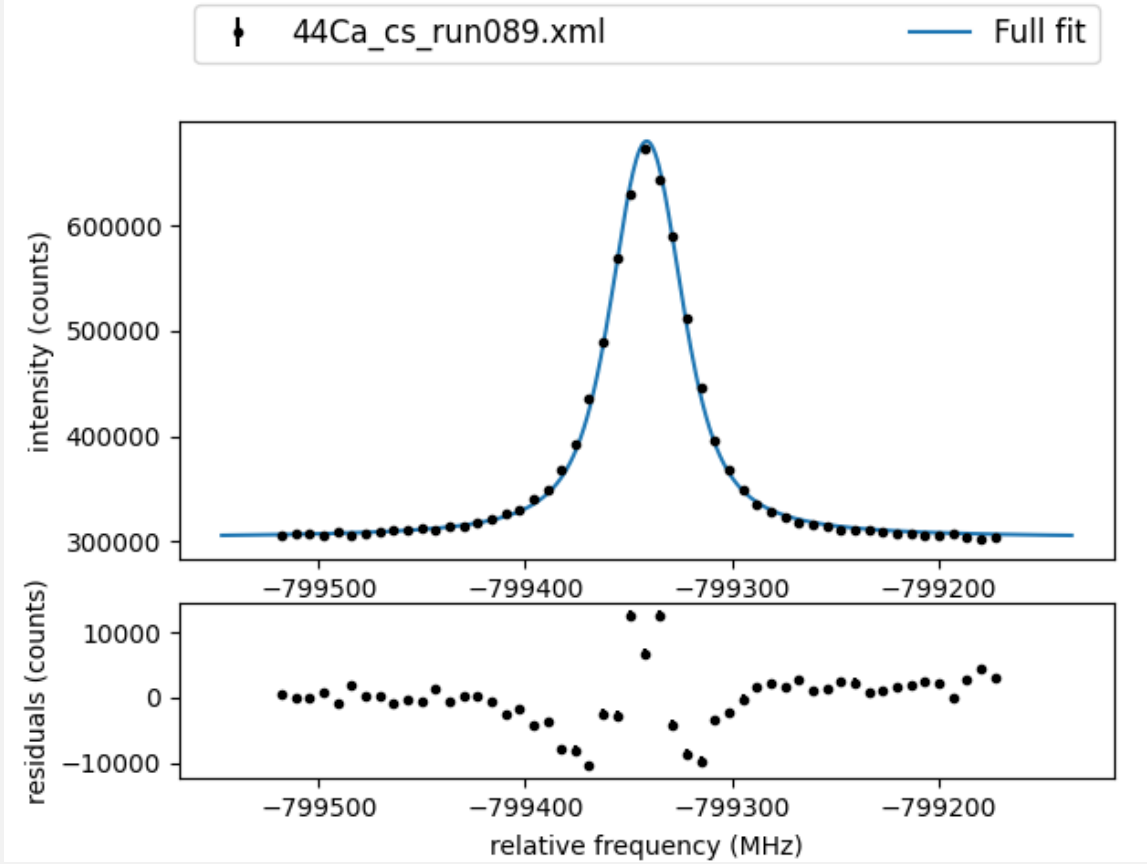
Provides information about the nuclear structure

DATA ANALYSIS

40Ca



44Ca



THANKS TO MY AWESOME SUPERVISORS LISS & LAURA !

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