Novel production pathways for the ^{64,67}Cu theranostic pair

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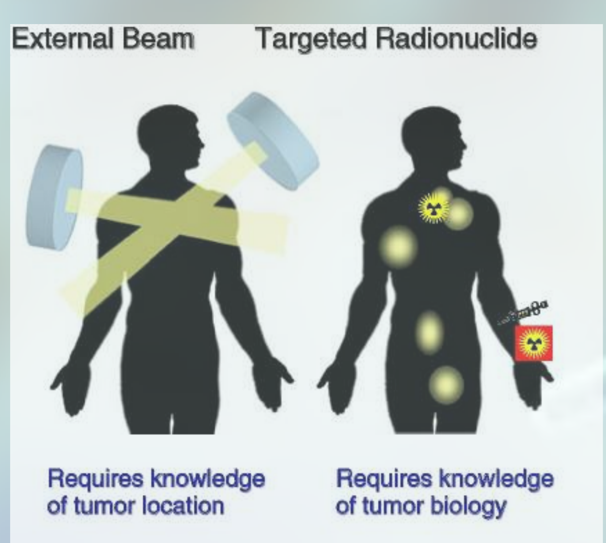
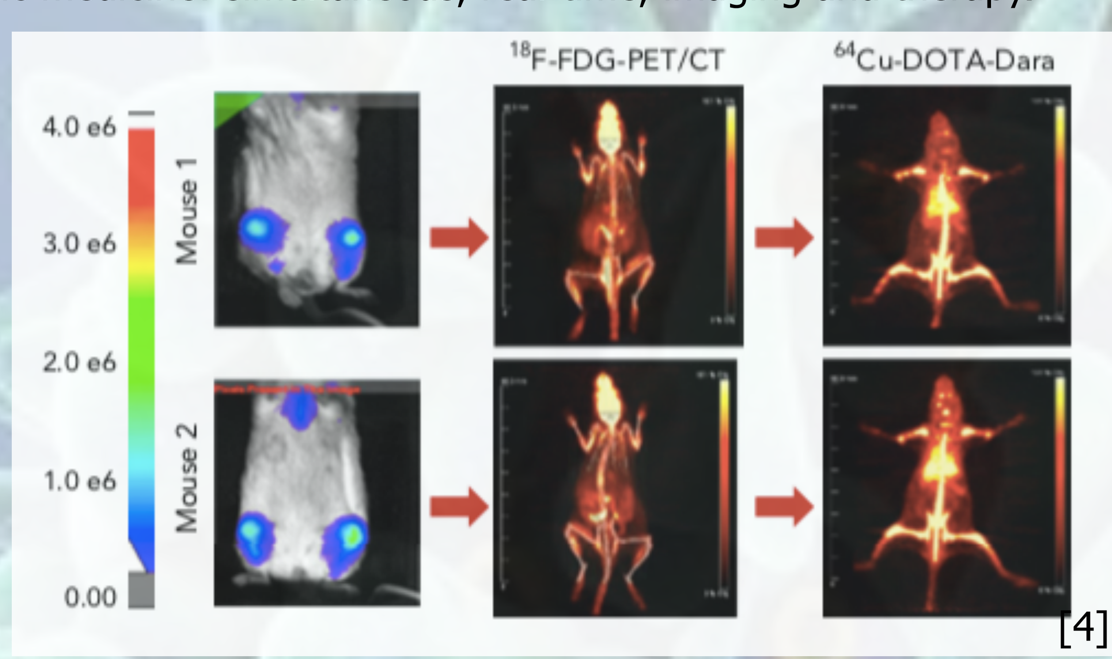
Abstract



- The experiment was performed on August 2018 in Lawrence Berkeley National Laboratory where we wanted to study the Zn(n,x)^{64,67}Cu reaction.
- We want to measure the cross-sections for production of ^{64,67}Cu, two emerging medically-valuable radionuclides.

Motivation

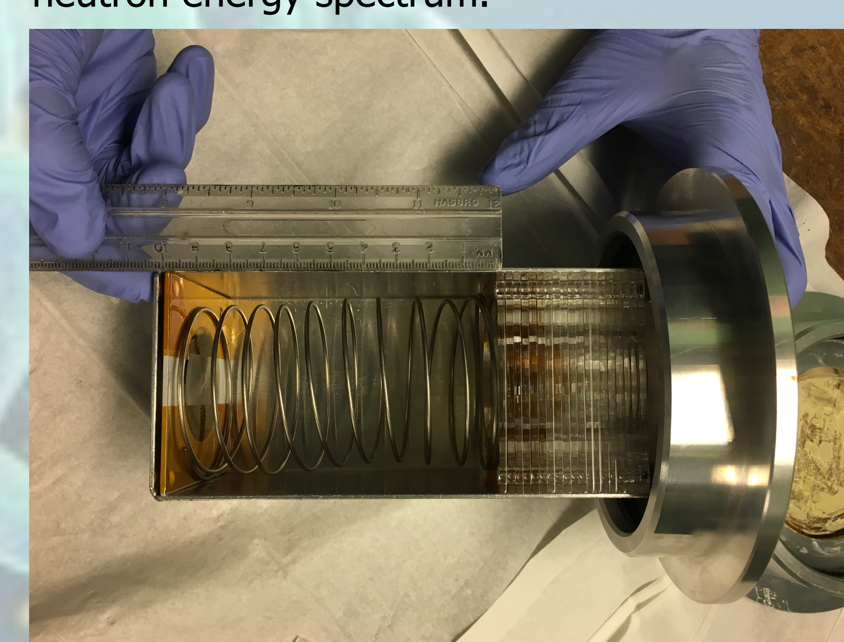
- The production of novel radionuclides are important in the development for both diagnostic and therapeutic techniques in nuclear medicine.
- ^{64}Cu and ^{67}Cu are two interesting radionuclides for detection and treatment of cancer, respectively.
- We want to see if we can produce the radionuclides in a customizable ratio for theranostic medicine: simultaneous, real-time, imaging and therapy.



[4]

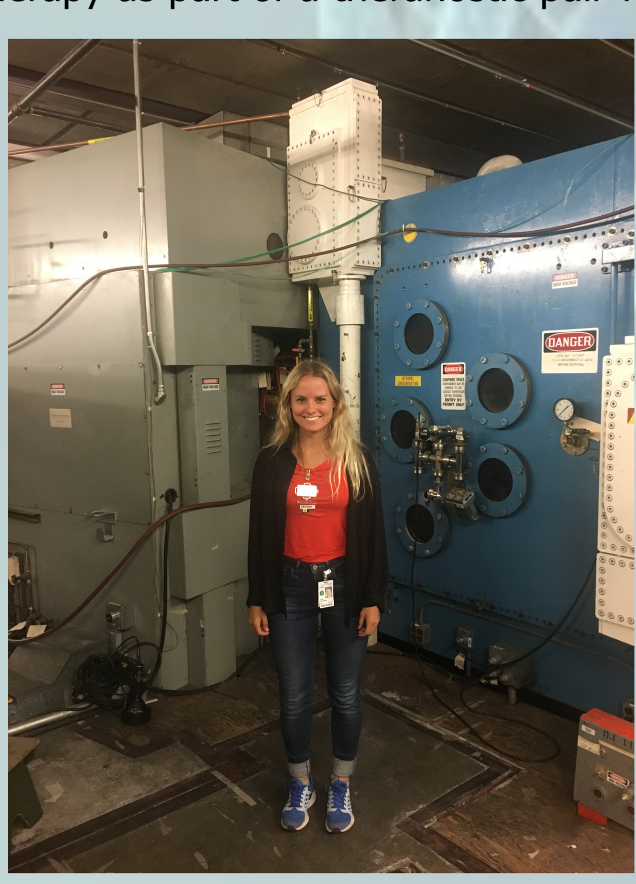
Target stack

- The neutron flux was used to irradiate 0.5mm-thick targets of Zinc, as well as Indium, Aluminum, Zirconium, Yttrium and NaCl neutron monitors.
- Zinc and the monitor targets were placed 10 cm away from the Beryllium disk to utilize the hard neutron component of the spectrum at zero degrees (w.r.t. beam axis).
- Neutron flux was measured using monitor data from the IRDFF cross-section database.
- The six different targets were made into small "packings" using kapton tape to tightly seal them.
- Loading of foil packings at various angles off beam axis will be used to measure the angle-differential neutron energy spectrum.



Experiment

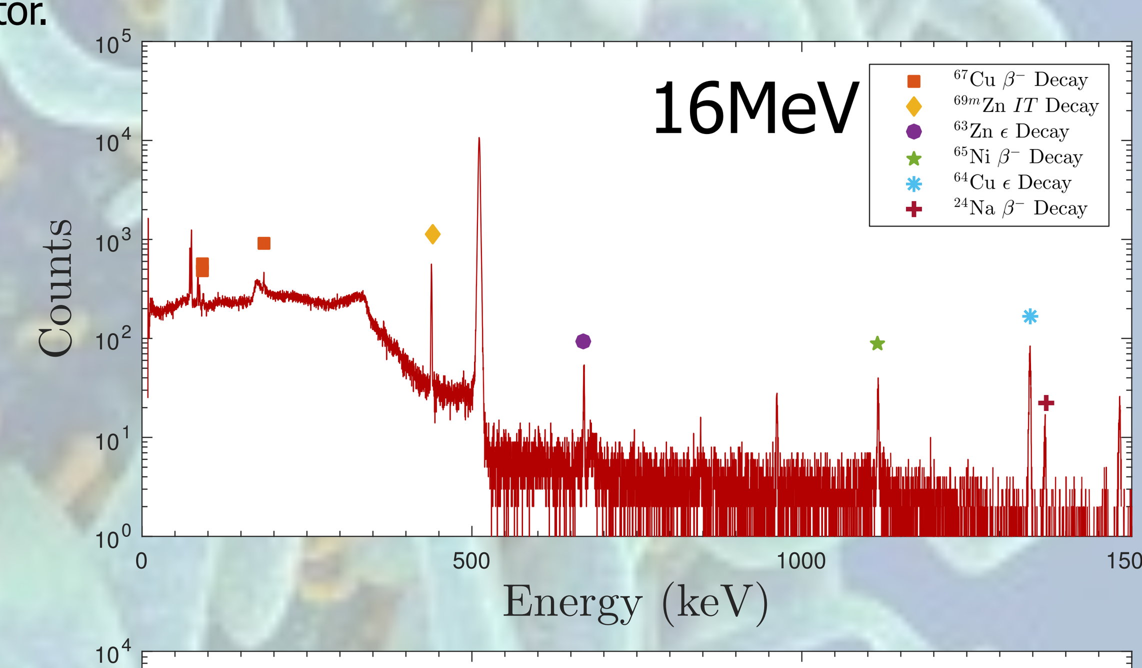
- The experiment was performed at the 88-Inch Cyclotron at Lawrence Berkeley National Laboratory in August 2018.
- By irradiating Zinc targets we were able to measure energy-integrated production rates for ^{64}Cu and ^{67}Cu.
- ^{64}Cu has a half-life of 12.701 hours and decays via β+/EC which is useful for imaging by PET.
- ^{67}Cu has a half-life of 68.3 hours and decays via β-, which makes it useful for therapy as part of a theranostic pair with ^{64}Cu.

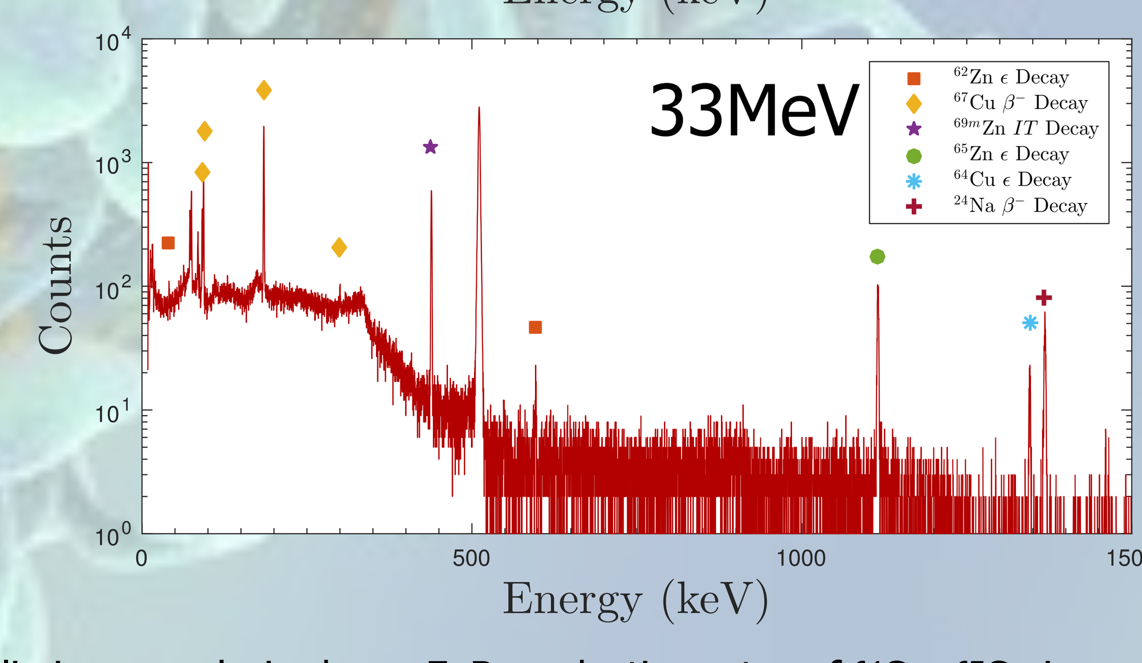


- Deuterium beams with an average energy of 16 MeV and 33 MeV were used to irradiate a 6 mm thick Beryllium disk to produce an intense, broad-spectrum neutron flux [2], through the deuterium breakup reaction.

Preliminary results

- The product activities of the irradiated foils were measured with an Ortec GMX HPGe-detector.





- Preliminary analysis shows EoB production rates of ^{64}Cu: ^{67}Cu in an approximately 75:1 ratio for 33 MeV deuterons and an 800:1 ratio for 16 MeV deuterons.

References

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4. E. Caserta., et al., Blood, 131(7), 741–745.