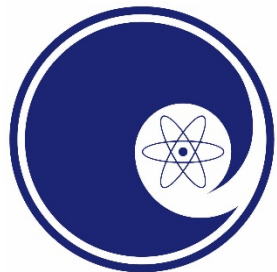


Radioisotope Production at Niowave

WOSMIP Remote

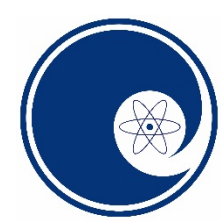
Robert Wahlen
wahlen@niowaveinc.com
Niowave, Inc.
Lansing MI

May 2020



NIOWAVE
Accelerating Your Particles



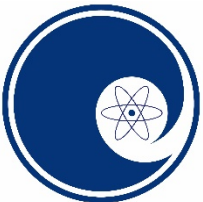


- Spun off from MSU's Facility for Rare Isotope Beams in 2005
- Began building accelerator components for US and international laboratories
 - EMMA FFAG ring at Daresbury
 - Superconducting Electron Guns for Navy, RHIC
 - Crab cavities for HiLumi upgrade at LHC



Lansing, Michigan Headquarters

- Built up infrastructure and know-how to operate superconducting linacs
- Now focused on using accelerators to produce radioisotopes and develop radiopharmaceuticals



Niowave, Inc.

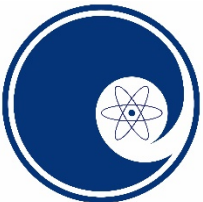
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NIOWAVE
Accelerating Your Particles
A Medical Radioisotope Company

We manufacture radioisotopes to cure cancer and save lives.

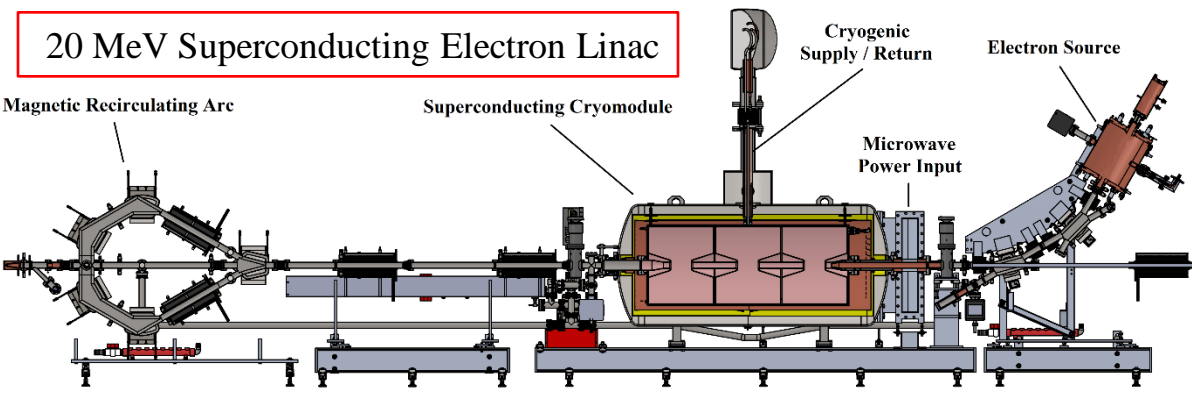


Therapeutic α & β Emitters

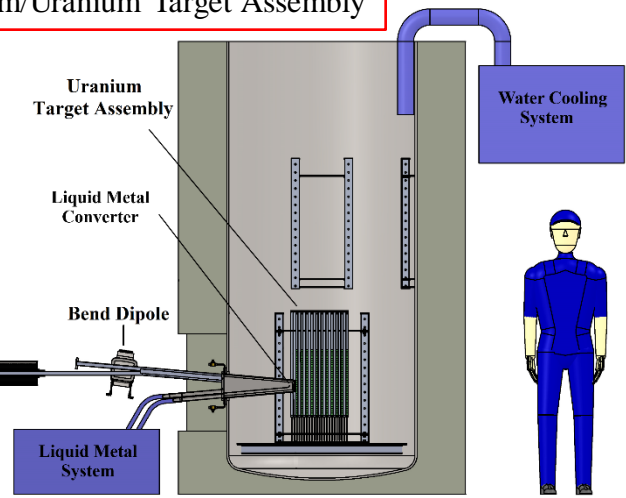
NIOWAVE manufactures radioisotopes from radium and uranium

Uses a superconducting electron linear accelerator without the need for a nuclear reactor

20 MeV Superconducting Electron Linac



Radium/Uranium Target Assembly



Radium (Ra-226)

$$e^- + \gamma + \text{Ra-226} \rightarrow \text{Ra-225} + n + \gamma$$

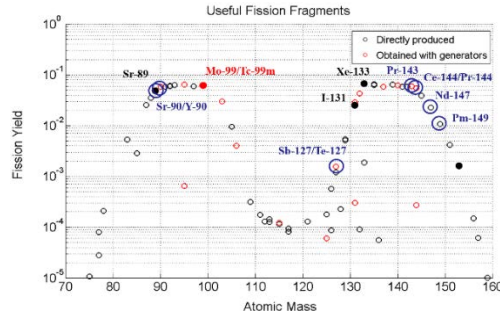
$$\text{Ra-225} \xrightarrow{\beta} \text{Ac-225}$$

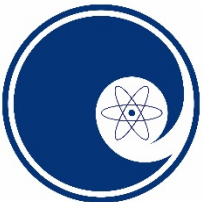
Ac-225	10 d
Rn-222	3.8 d
Po-210	138 d
Bi-210	5.0 d
Bi-213	46 m
Bi-214	20 m
Pb-214	27 m

Uranium (U-235/238)

$$e^- + \gamma + \text{U-238/235} \rightarrow \text{Mo-99} + \text{Xe-137} + n + \gamma$$

Mo-99 \rightarrow Tc-99m	I-131
Sb-127 \rightarrow Te-127	Xe-133
Ba-140 \rightarrow La-140	Sr-89
Ce-143 \rightarrow Pr-143	Y-91
Sr-90 \rightarrow Y-90	Ce-141
Ce-144 \rightarrow Pr-144	Nd-147
	Pm-149



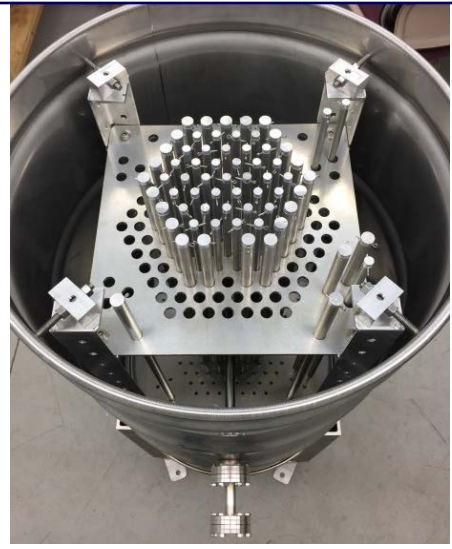


Ongoing Radioisotope Work at Niowave

Uranium Dissolution



Uranium Target Assembly



Radium chemistry



Mo-99 Liquid-Liquid Extraction



Niowave's Mo-99 Program Emissions Control Strategy

- Radioxenon:
 - Primary capture = cryotrap
 - Abatement trap = liquid nitrogen cooled charcoal bed
- Radioiodine:
 - Primary capture = alkaline scrubber
 - Abatement trap = solid sorbent (AgZ)

