

# **Niowave, Inc. and the SBIR/STTR Program**

Chase Boulware, on behalf of  
Terry Grimm and the team at Niowave

November 2019



1



## **History of Niowave, Inc.**

**NIOWAVE**  
www.niowaveinc.com

- Founded by Terry Grimm and a small group of private investors in 2005
- Terry was a senior physicist at the Cyclotron Lab at MSU, helped pursue FRIB
- First SBIR Award in 2007
  - DOE SBIR/STTR Small Business of the Year 2010
  - 2016 SBA Tibbetts Award
  - To date, received around 20 Phase II projects
- In 2019, became Coop Agreement partner with NNSA on isotope production (Mo-99)

2

2



## Lansing, Michigan Facilities

**NIOWAVE**  
www.niowaveinc.com



- HQ Building (2006) and 14,000 sqft R&D Facility (2012)
- 14,000 sqft Commercial Airport Facility (2014)
- Capable of expanding within property



3



## Niowave's Experience with SBIR/STTR

**NIOWAVE**  
www.niowaveinc.com

Niowave would not exist without the SBIR/STTR program

- Very complicated technology
- Long, expensive R&D path
- New or nonexistent commercial markets
  - Very limited private sector funding
- SBIR/STTR funding bridged 10 year “valley of death”
- DOE research partners
  - transfer knowledge, AND
  - give huge credibility to our undertaking

Terry Grimm presented at  
National Academies STTR  
Workshop, Wash DC, May 2015

4

4



## Company-side Perspective on SBIR/STTR

**NIOWAVE**  
www.niowaveinc.com

SBIR and STTR projects...

- ...create partnerships between businesses and national labs, university groups.
- ...are research and development funding toward commercialization.
- ...can succeed individually or be part of a larger story.

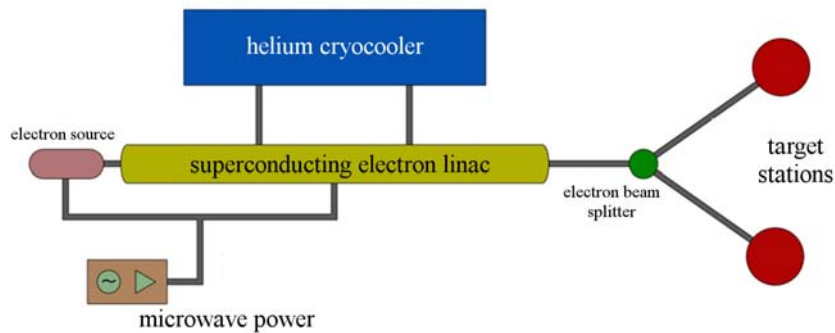
5

5



## Superconducting Linac Facility

**NIOWAVE**  
www.niowaveinc.com




### Turn-key Systems

- Superconducting Linac
- Helium Cryoplant
- Microwave Power
- End Station
- Licensing


Beam Energy	~9 MeV
Average Beam Power	10-100 kW
Duty Cycle	10-100%
Closed-loop Cooling Capacity	40-110 W @ 4 K

6

6



## Niowave's Commercial Markets







Superconducting Electron Linacs

< 9 MeV → **Sterilization & Advanced Manufacturing**  
Eliminate dirty bomb material

9 MeV → **Radiography & Active Interrogation**  
Cargo inspection for contraband and shielded nuclear bombs


> 9 MeV → **Medical & Industrial Radioisotopes**  
Domestic supply without nuclear reactor and weapons-grade uranium

→ **Free Electron Lasers**  
High power, tunable at wavelengths not available today







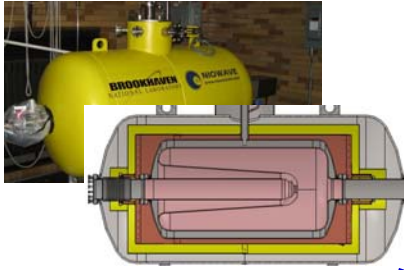
7

7




## SBIR Project: 112 MHz Electron Gun







- First PhII SBIR for Niowave, 2008
- By the Office of Nuclear Physics
- Collaboration with BNL (Ilan Ben-Zvi)
- Led to several million in contracts (DOE, DOD, universities)**



e- source for  
Coherent Electron  
Cooling at RHIC



Univ. of Wisconsin FEL  
electron gun



Navy SRF  
electron guns


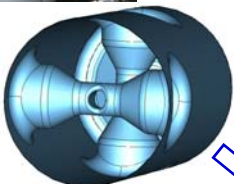

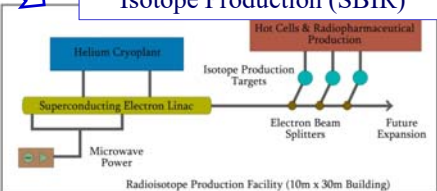
8

8

**SBIR Project:**  
**Spoke cavity for electrons**

**NIOWAVE**  
www.niowaveinc.com

- PhII SBIR for Niowave, 2009
- By the Office of Nuclear Physics
- Collaboration with Old Dominion University (Jean Delayen)
- **Niowave then built more spokes for the Navy free-electron laser program**

Linear accelerator for Medical Isotope Production (SBIR)

700 MHz Double Spoke for Joint Technology Office (DOD)



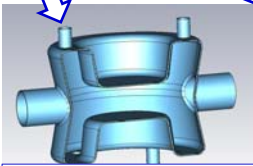

9

9

**SBIR Projects:**  
**Crab Cavity for the LHC**

**NIOWAVE**  
www.niowaveinc.com

- PhII SBIR for Niowave, 2010
- By the Office of High Energy Physics
- Collaboration with Old Dominion University (Jean Delayen)
- **Niowave then built five LHC crab cavity designs**

499 MHz Deflecting Cavity (ODU/Niowave Phi STTR, then built at JLab)

4-bar Crab for LHC (Daresbury)

Quarter-Wave Crab for LHC (BNL)

10

10





## Key Technology: Cavities and Cryomodules

NIOWAVE  
www.niowaveinc.com



Cryomodules

Superconducting cavities  
in specialized geometries

11

11



## Cavity Testing in the Early Days

NIOWAVE  
www.niowaveinc.com

liquid He supply

liquid nitrogen  
supply (to thermal  
shield)

cavity test Dewar



RF control/measurement station

12

12



# Niowave Today

**NIOWAVE**  
www.niowaveinc.com

www.niowaveinc.com



- As the cost of superconducting RF accelerators continue to come down, commercial applications are increasingly attractive.
- Niowave, Inc. is focused on using SRF electron machines to drive radioisotope production targets and make beta and alpha emitters for medicine.

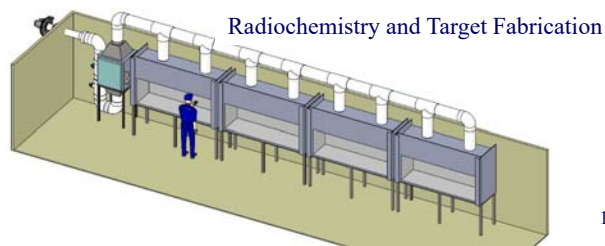
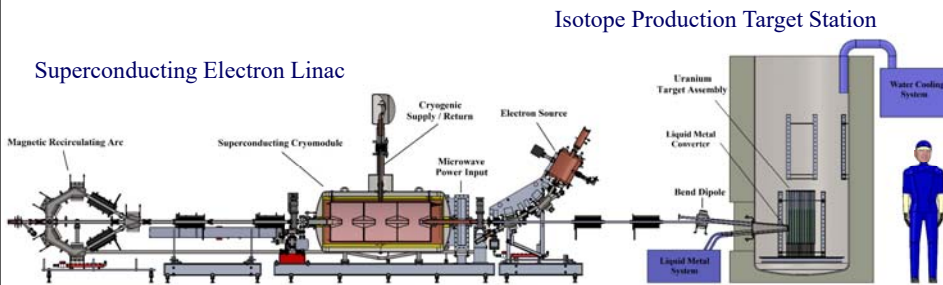
13

13



# Radioisotope Production with High-Power Electron Beams

**NIOWAVE**  
www.niowaveinc.com



14

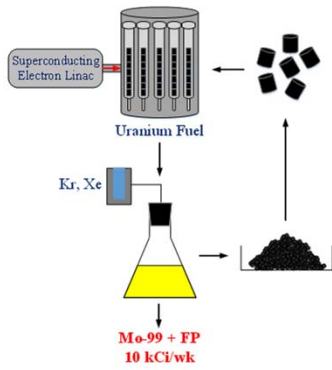
14



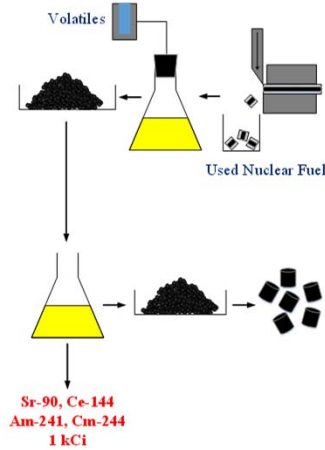
# Isotope Program Overview

NIOWAVE  
www.niowaveinc.com

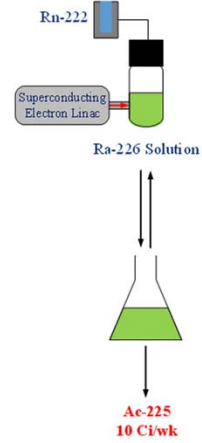
## Mo-99 Program



## Used Nuclear Fuel Program



## Ac-225 Program



15

15

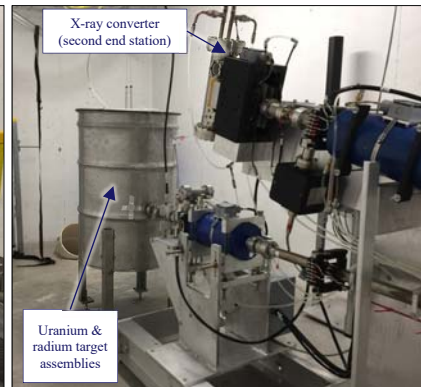
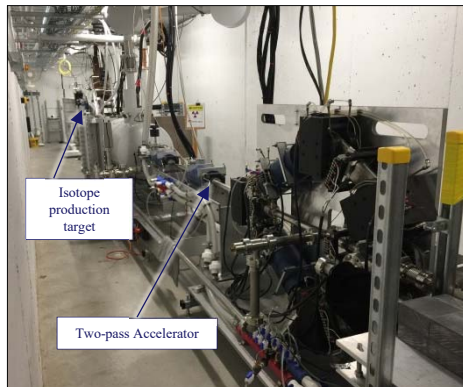
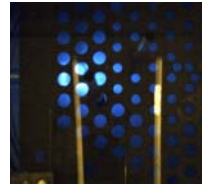


# Isotope Production

NIOWAVE  
www.niowaveinc.com

Successfully operational fully coupled system:

- Superconducting linac coupled to UTA
- Neutron production verified and validated
- $\alpha$  and  $\beta$  emitters produced



16

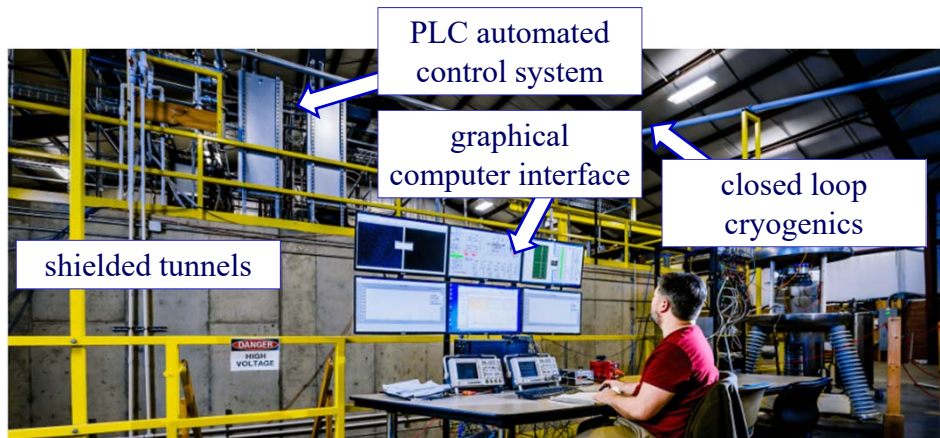
16





## Accelerator Testing Now

NIOWAVE  
www.niowaveinc.com



17

17



## Company-side Perspective on SBIR/STTR

NIOWAVE  
www.niowaveinc.com

SBIR and STTR projects...

- ...create partnerships between businesses and national labs, university groups.
- ...are research and development funding toward commercialization.
- ...can succeed individually or be part of a larger story.

As that story is "in the works," the fit for SBIR/STTR changes over time.

18

18