



Stable Isotope Priorities



DOE Isotope Program -- Federal Workshop

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DOE Isotope Program

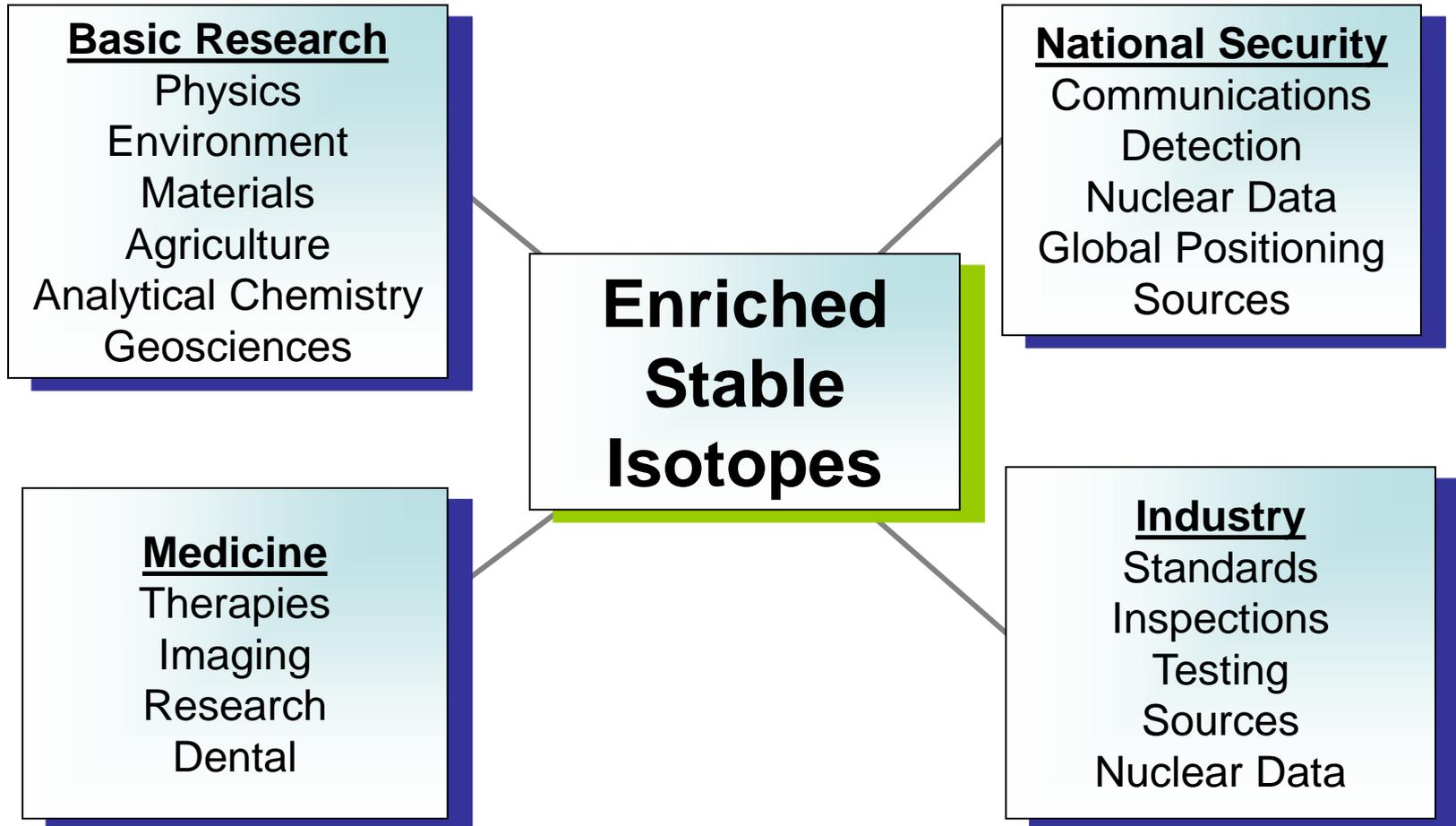
Office of Nuclear Physics, Office of Science, U.S. Department of Energy



- **Stable Isotopes**
 - Historical inventory and operations
 - Inventory available from DOE legacy
- **NSAC recommendations**
 - New infrastructure activities
- **New Enrichment Capabilities**
 - EMIS and GCIS Research
 - Transition for R&D to pilot scale operations



Stable Isotopes Uses





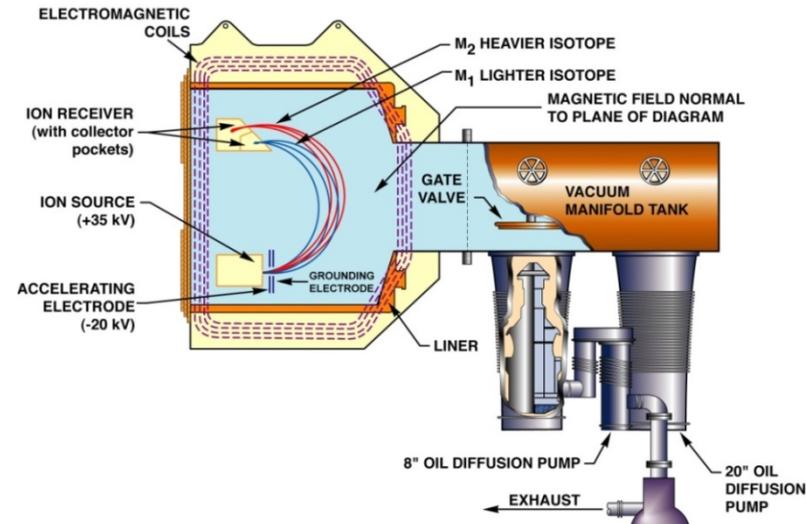
Stable Isotope Operations at ORNL

- Enriched more than 230 stable Isotopes
- Unique materials with few other suppliers
- No existing domestic broad-scope enrichment
- 323 purchase orders FY 2013



Stable Isotope Production

- Y12 Plant Calutrons
- Designed and operated for uranium enrichment
- Enrichment 1945 - 1998
- Inventory of 11 has been exhausted
- Procure selected stables from international brokers since 2009
- Inventory of 10 more is below 20-year supply



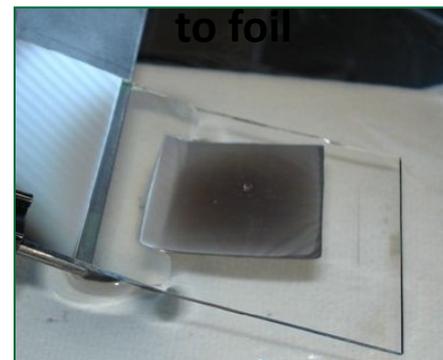
Enriched Pd foils
 $\text{Ø}2 \text{ cm} \times 1.5 \text{ mg/cm}^2$



- Maintain and dispense enriched stable isotopes
- \$360M of stable inventory
- Custom chemical conversion capabilities

- State-of-the-art assay capabilities including: ICP-MS and SEM/XES
- ISO 9001:2008 certified

Enriched Sn evaporated
to glass and floated off





Stable Isotopes from Legacy

- **Lithium-6 - key replacement material for neutron detectors**
- **Lithium-7 – dosimeters and DOE Reserve for potential future sales for nuclear reactor coolant chemistry**
- **Helium-3 – detectors, cryogenics, basic research**



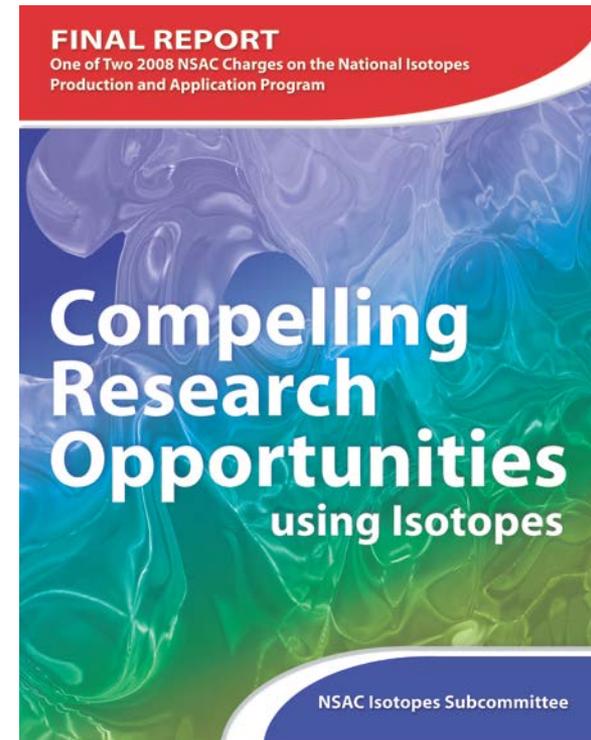


Compelling Research Opportunities

- 339 naturally occurring isotope on earth
- 250 of these are stable isotopes
- The 220 stable non-gaseous isotopes are not currently produced domestically
- Most require separation and enrichment by either electromagnetic or gas centrifuge separators

Recommendation No. 5

- **Re-establish domestic production and supply of stable isotopes.**





Enrichment Technology

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	**															

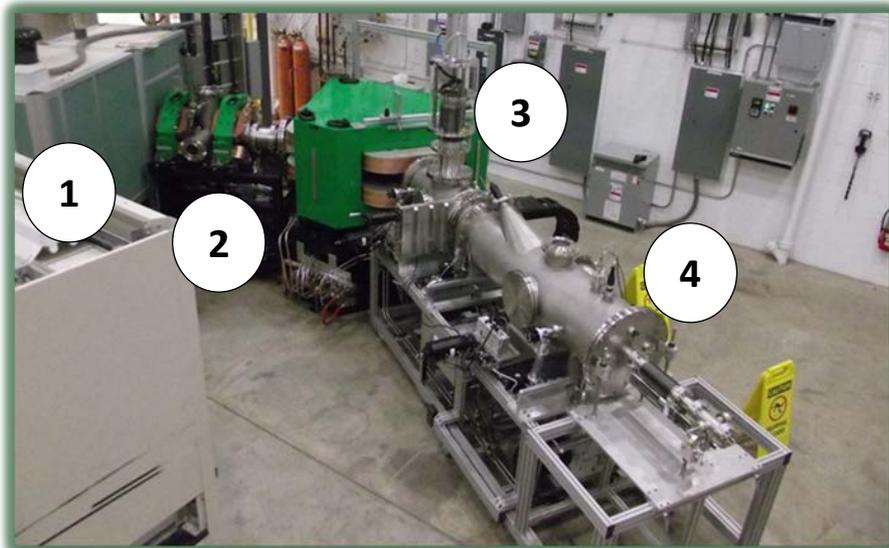
Lanthanides	*	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Actinides	**	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

 **EMIS**

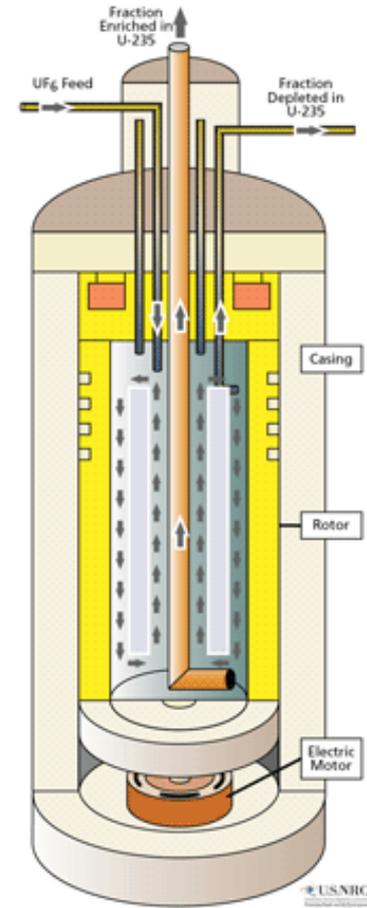
 **GCIS**



1. Power source and multiple ion source technologies
2. Magnetic quadrupole doublet for beam focus and diagnostics
3. 60-degree dipole sector magnet for separation
4. Isotope collectors
 - Based upon Calutron designs
 - Re-useable with graphite liners
 - Viable for most stable elements



EMIS

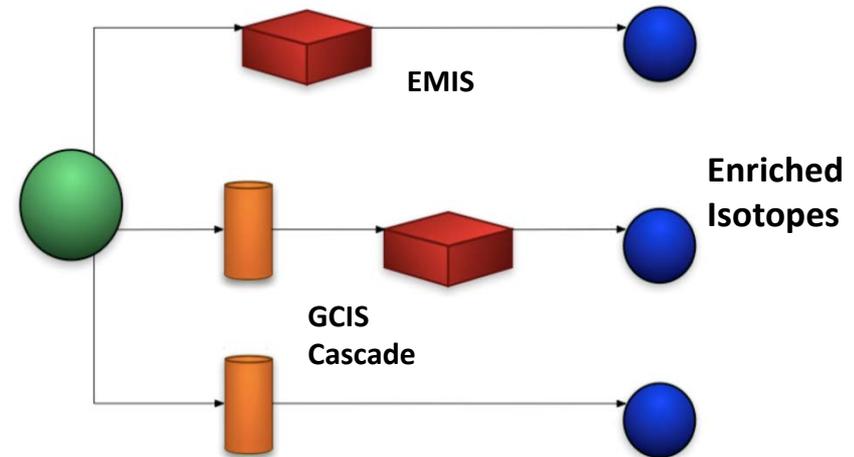


Gas
Centrifuge

Schematic of a centrifuge

Enriched Stable Isotope Pilot Facility (ESIPF)

- Developing new pilot capability at ORNL
- Transition from R&D EMIS to pilot-scale operations
- Adding limited gas centrifuge cascade for pre-enrichment
- DOE investing approximately \$7M over 3 years
- Implementation to be complete late FY 2016
- Working with ORNL and the user community to strategize enrichment priorities





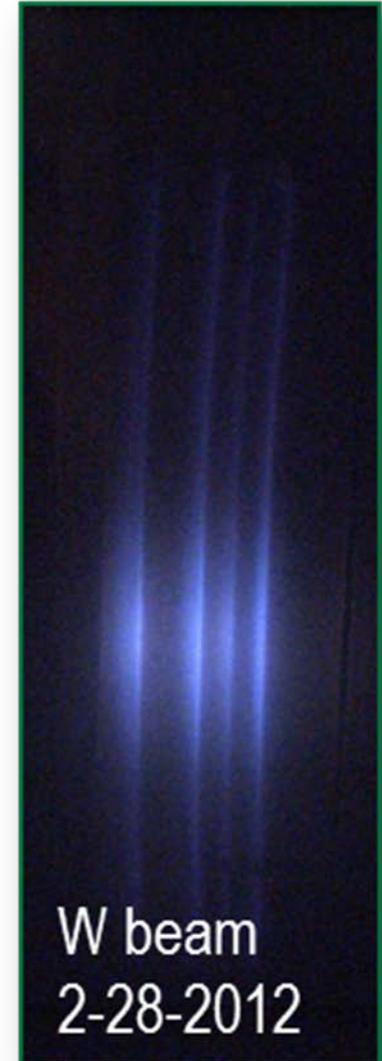


Transition R&D to Pilot Operations FY 2016

Key Performance Parameters

- Molybdenum-98 and -100
- Nickel-62 and -64
- Gadolinium-157 and -160
- Calcium-48

- Vanadium-51
- Tungsten-186





- **Stable Isotopes**
 - Historical inventory and operations
- **NSAC recommendations**
 - New infrastructure activities
- **Enriched Stable Isotope Pilot Facility**
 - Transition to Operations
- **Gathering Demand Data and Prioritizing Starts Now**