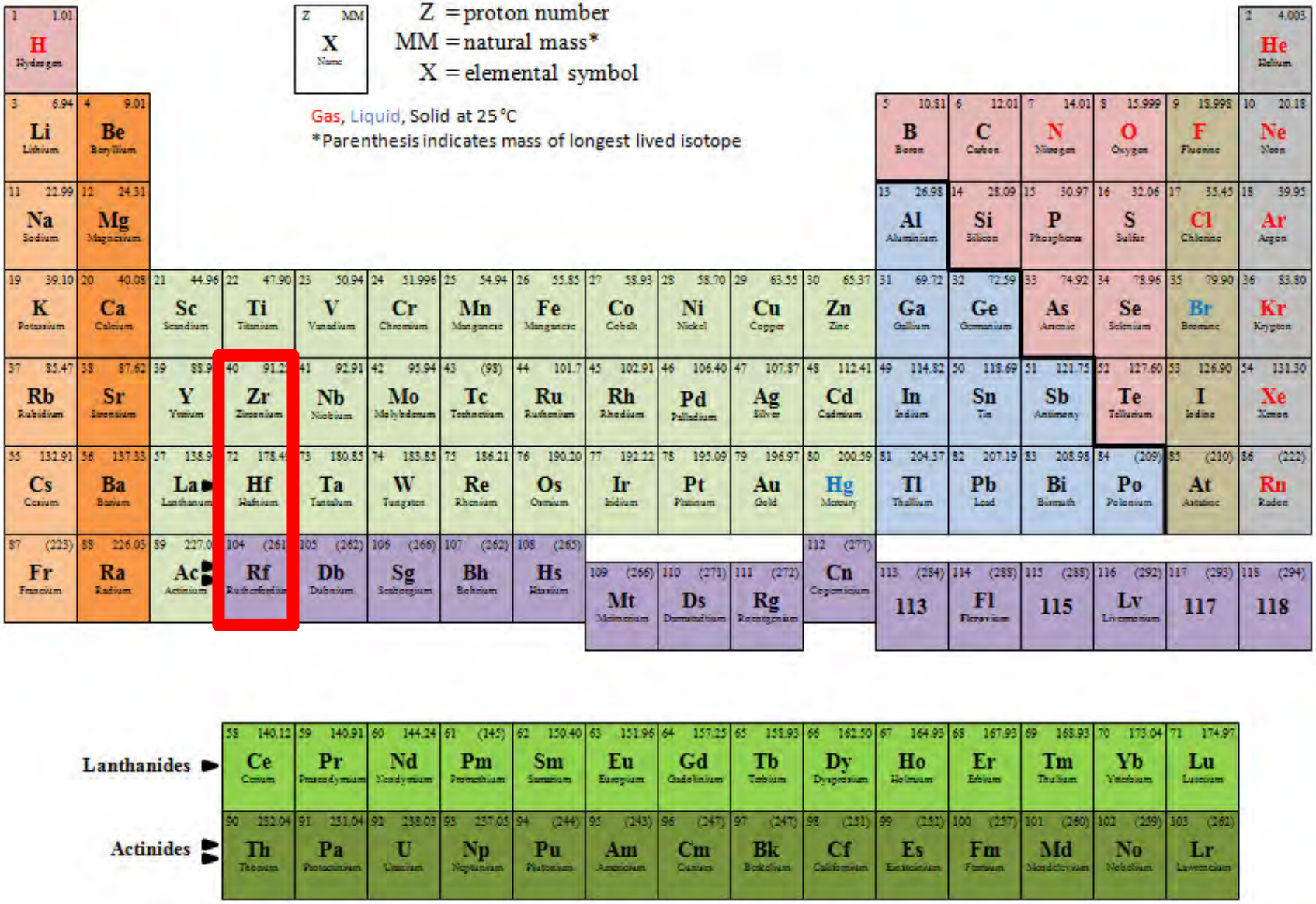
Heavy Element Chemistry At TAMU: From Off-line to On-line

M.E. Bennett[1], M.C. Alfonso[1,2], C.M. Folden III[1]

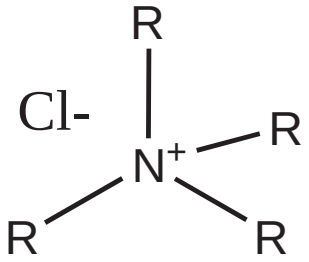
[1] Texas A&M University Cyclotron Institute, College Station, TX 77843
[2] Texas A&M University Chemistry Department, College Station, TX 77843


Z = proton number
MM = natural mass*
X = elemental symbol
Gas, Liquid, Solid at 25 °C
*Parenthesis indicates mass of longest lived isotope
Lanthanides
Actinides

Off-Line Studies with TEVA Resin

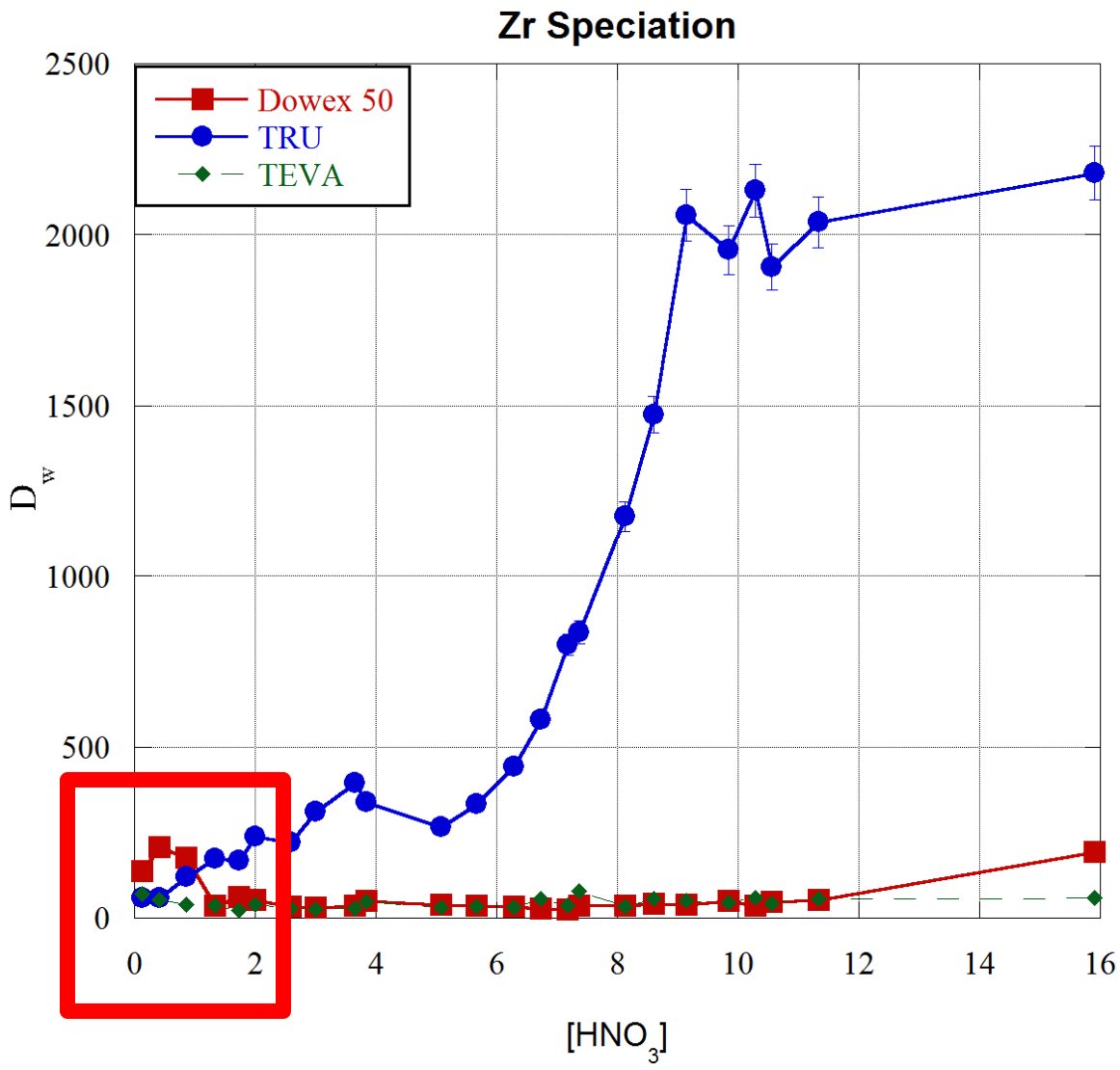
- Performed in a traditional radiochemistry laboratory
- ~ 5 cps of ^{95}Zr ($t_{1/2}$=64 d) and ^{175}Hf ($t_{1/2}$ = 70 d) per sample
- Want separation of Zr and Hf

TEVA resin available from Eichrom International, INC.

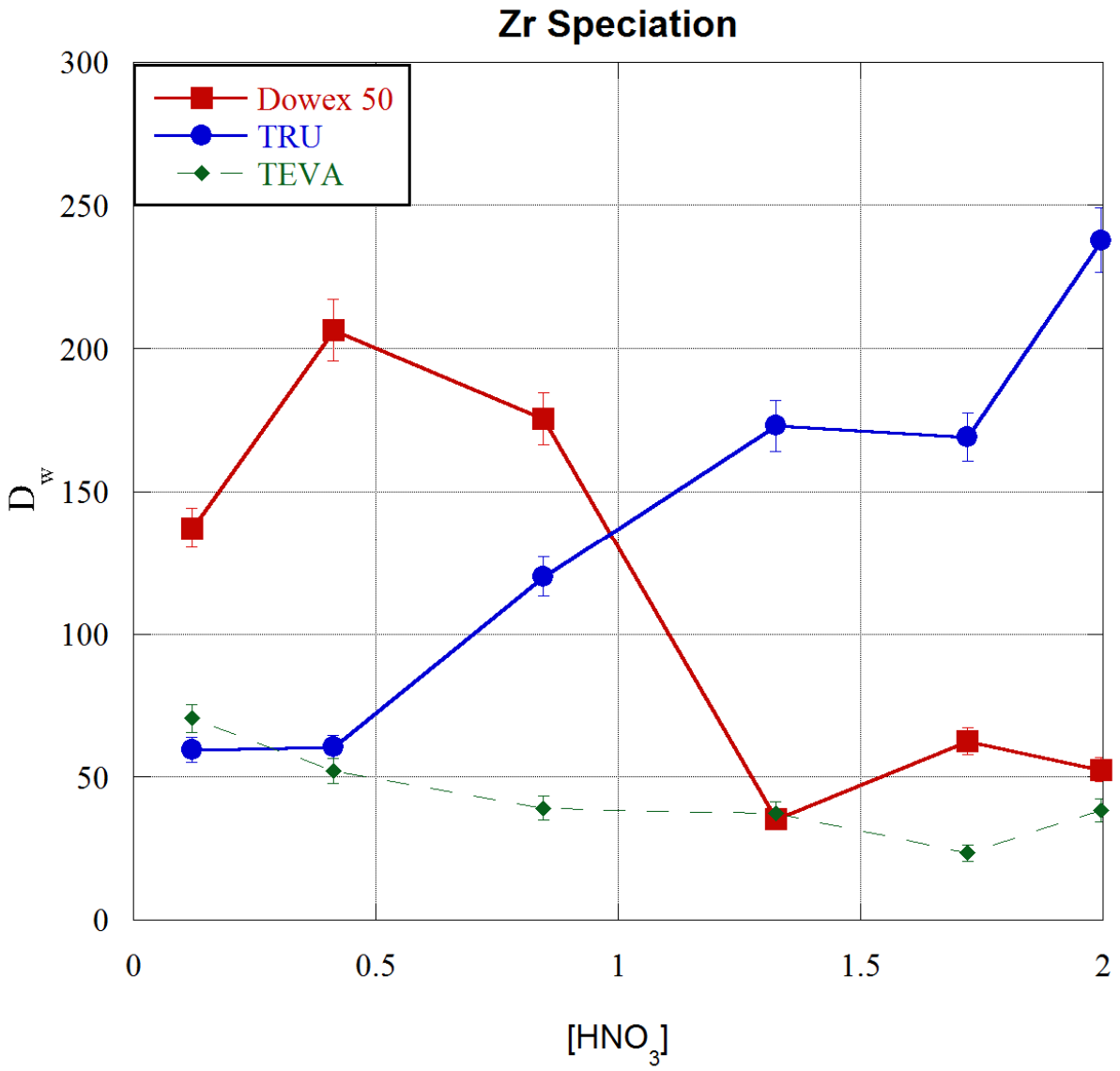


R= C_8H_{17} and $C_{10}H_{21}$

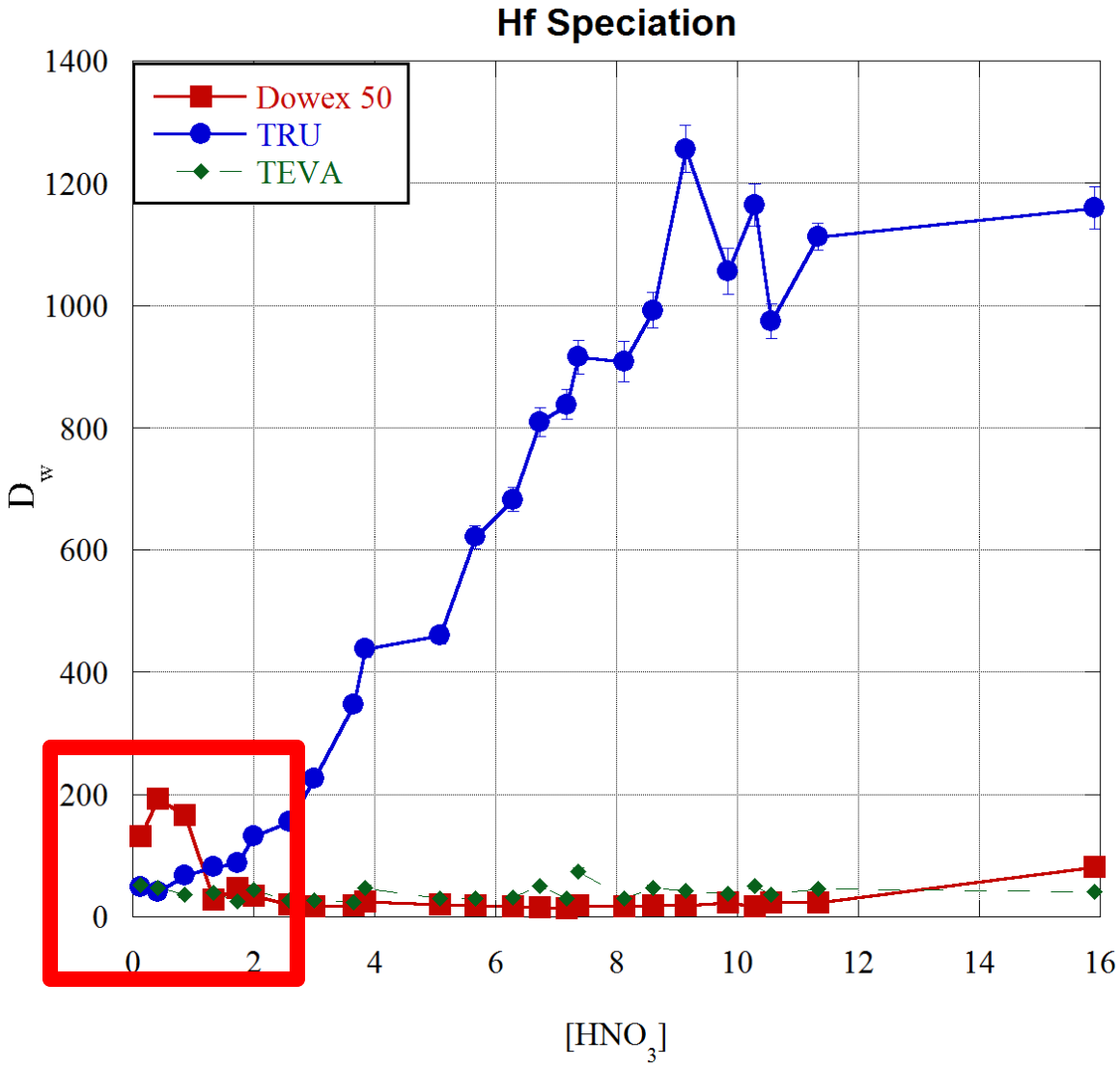
Speciation of Zr in HNO_3



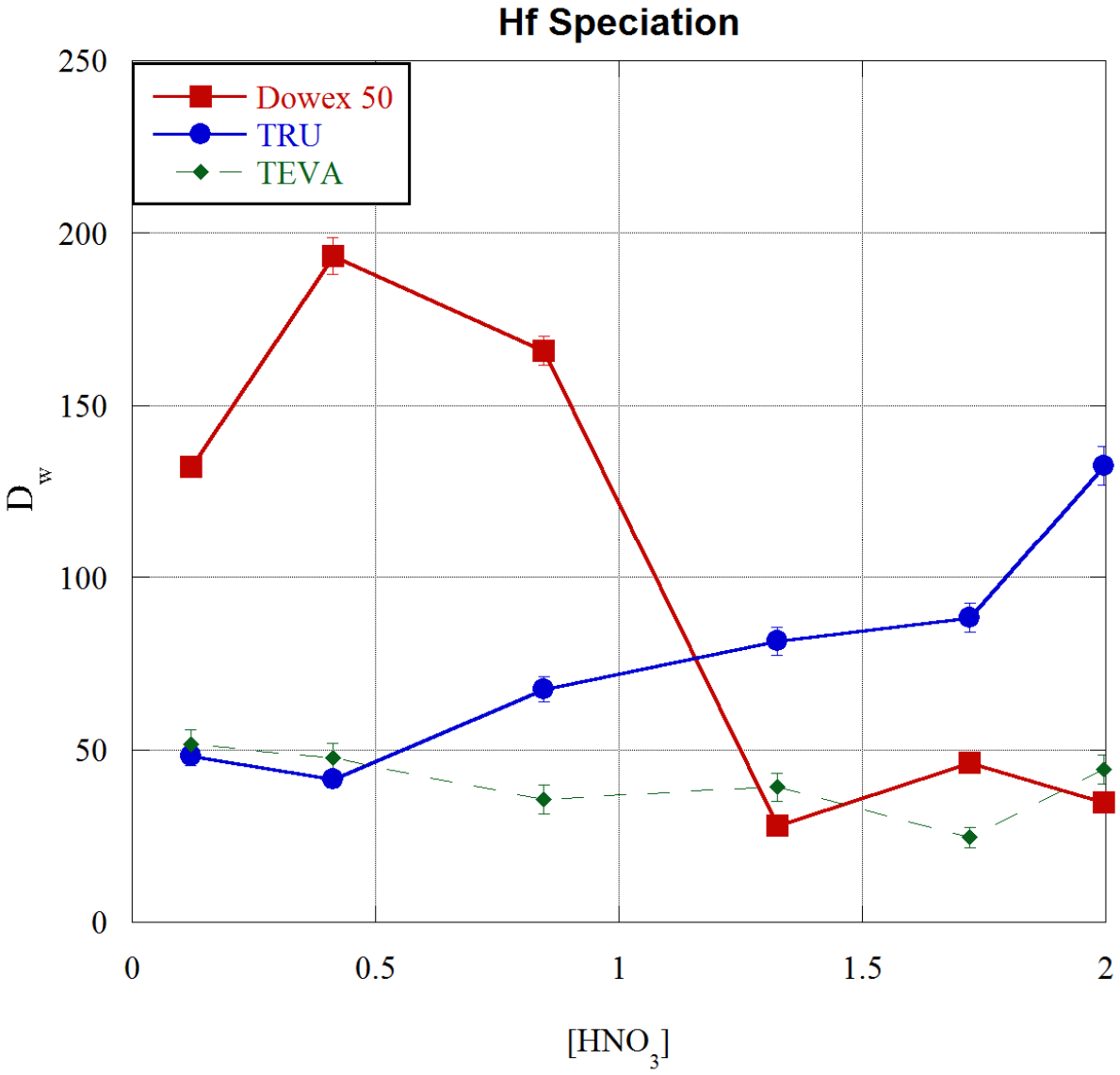
Speciation of Zr in HNO_3



Speciation of Hf in HNO_3



Speciation of Hf in HNO_3



The MIGS System

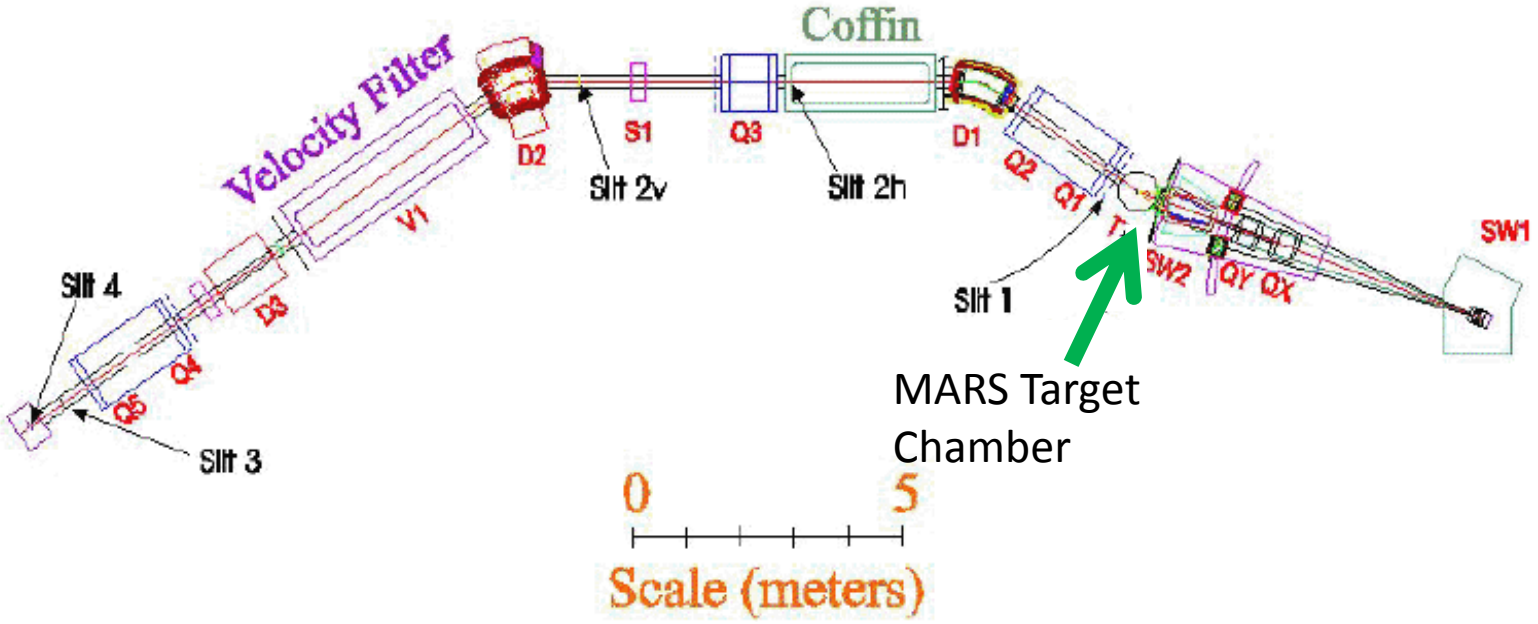
M: MARS (Momentum Achromat Recoil Spectrometer)

I: ICE (Ion Catching and Extraction)

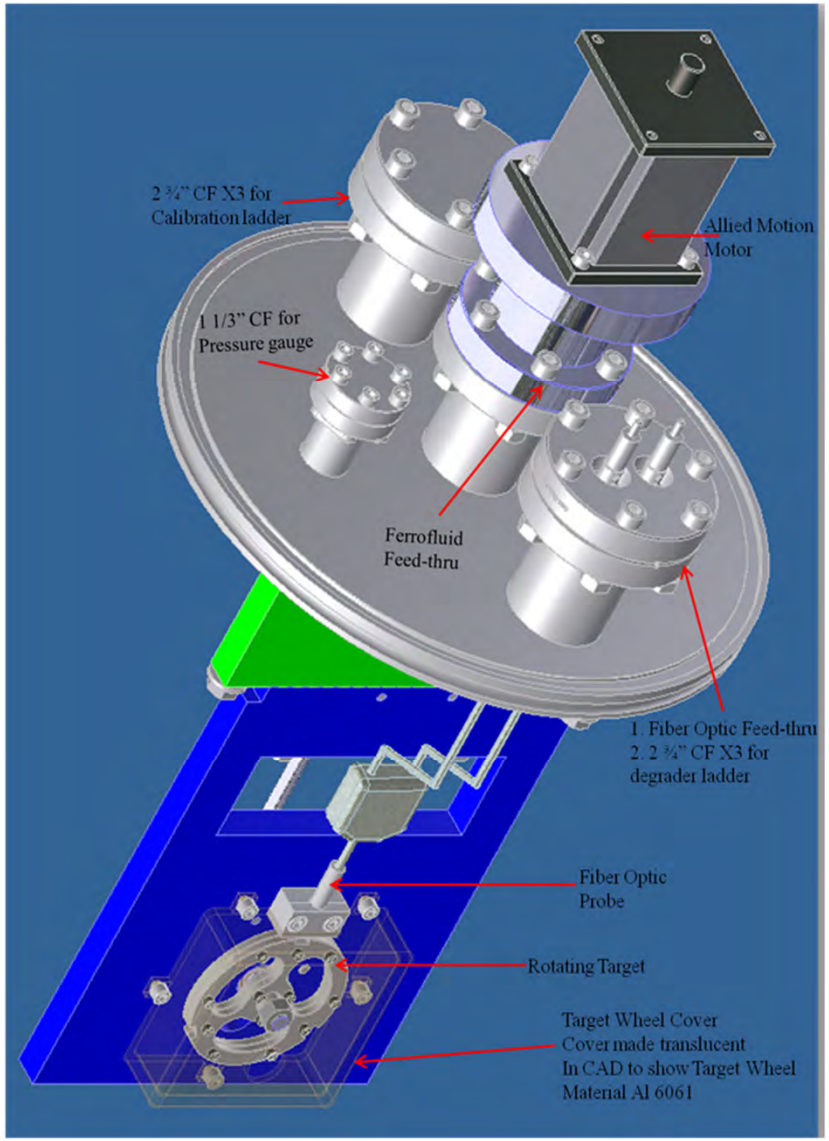
G: GLITTAR (Gas-Liquid Interface for Transactinide Transportation to Automated Radiochemistry)

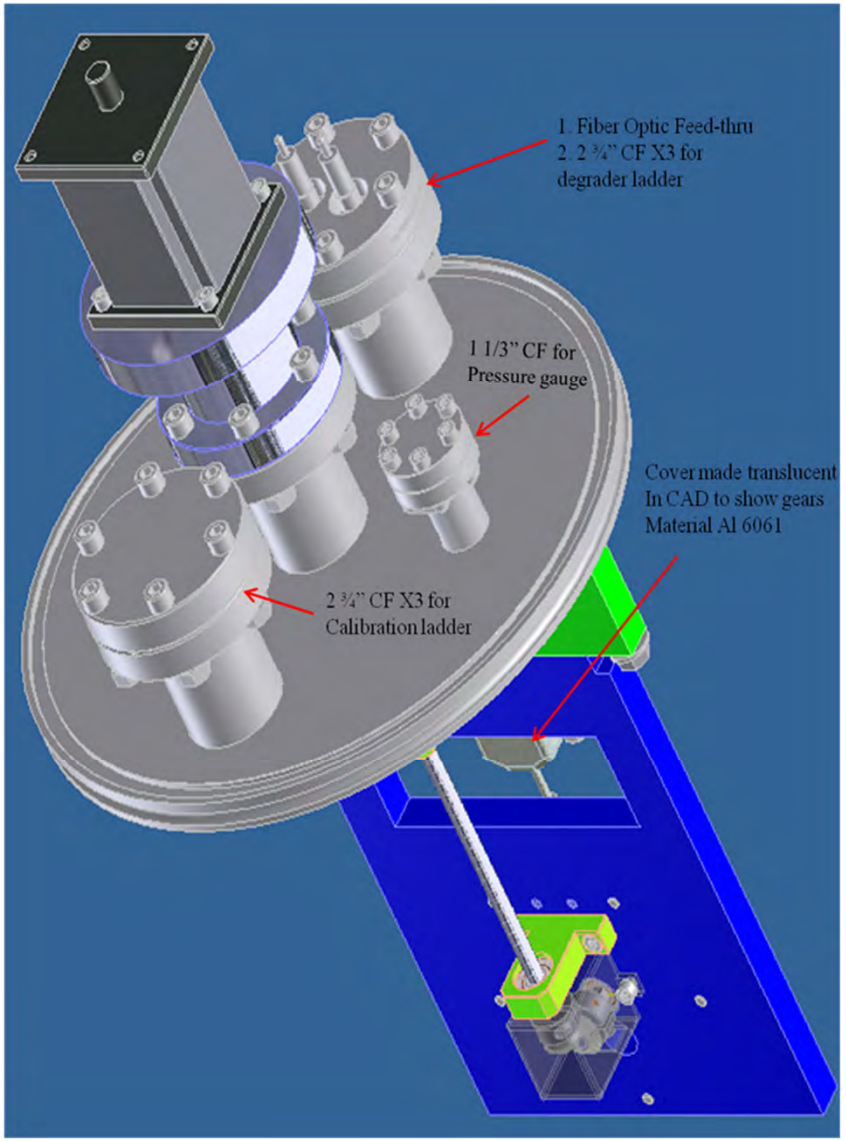
S: SHELA (SuperHeavy Element Liquid Automation)

MARS: Momentum Achromat Recoil Spectrometer



MARS Targetry



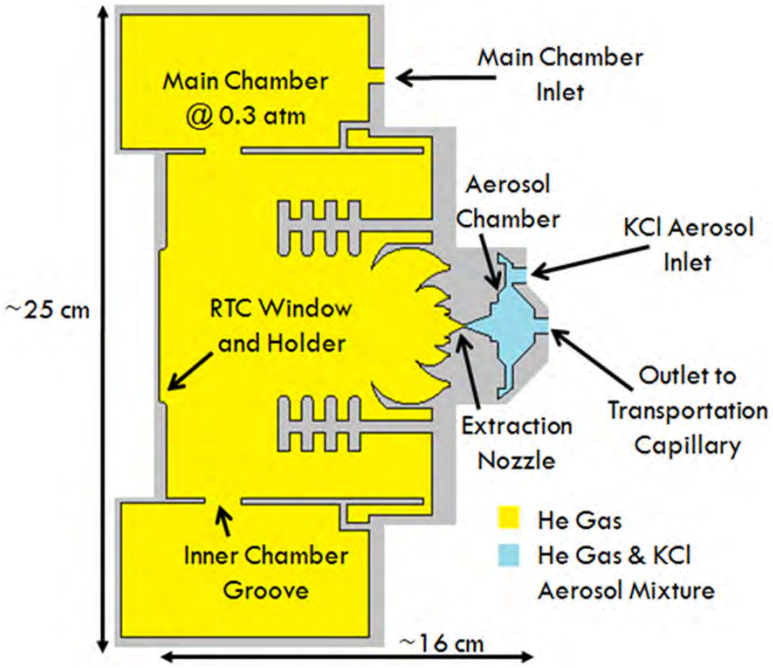


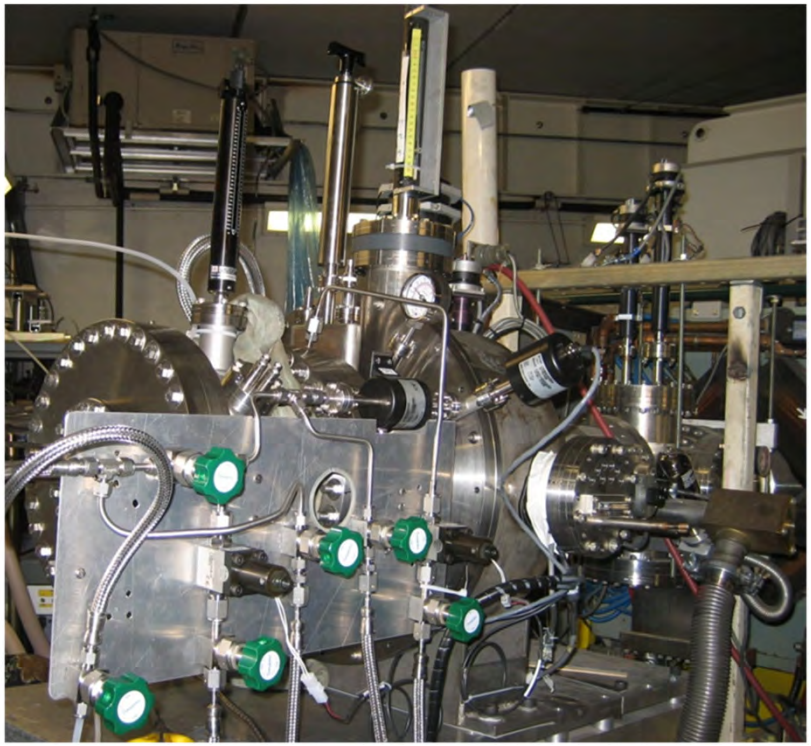
Mixed Metal Target

- ~300 nm ^{nat}Gd deposited on 1 µm Ti with e^- beam.
- ~300 nm ^{nat}Ge deposited on 1 µm Ti with thermal deposition.
  - Used to cover Gd to prevent oxidation

These targets will be used in a ^{nat}Ge,^{nat}Gd(^{18}O,xn) ^{85}Zr,^{169}Hf for accelerator based chemistry experiments, in late 2012/early 2013

ICE: Ion Catching and Extraction





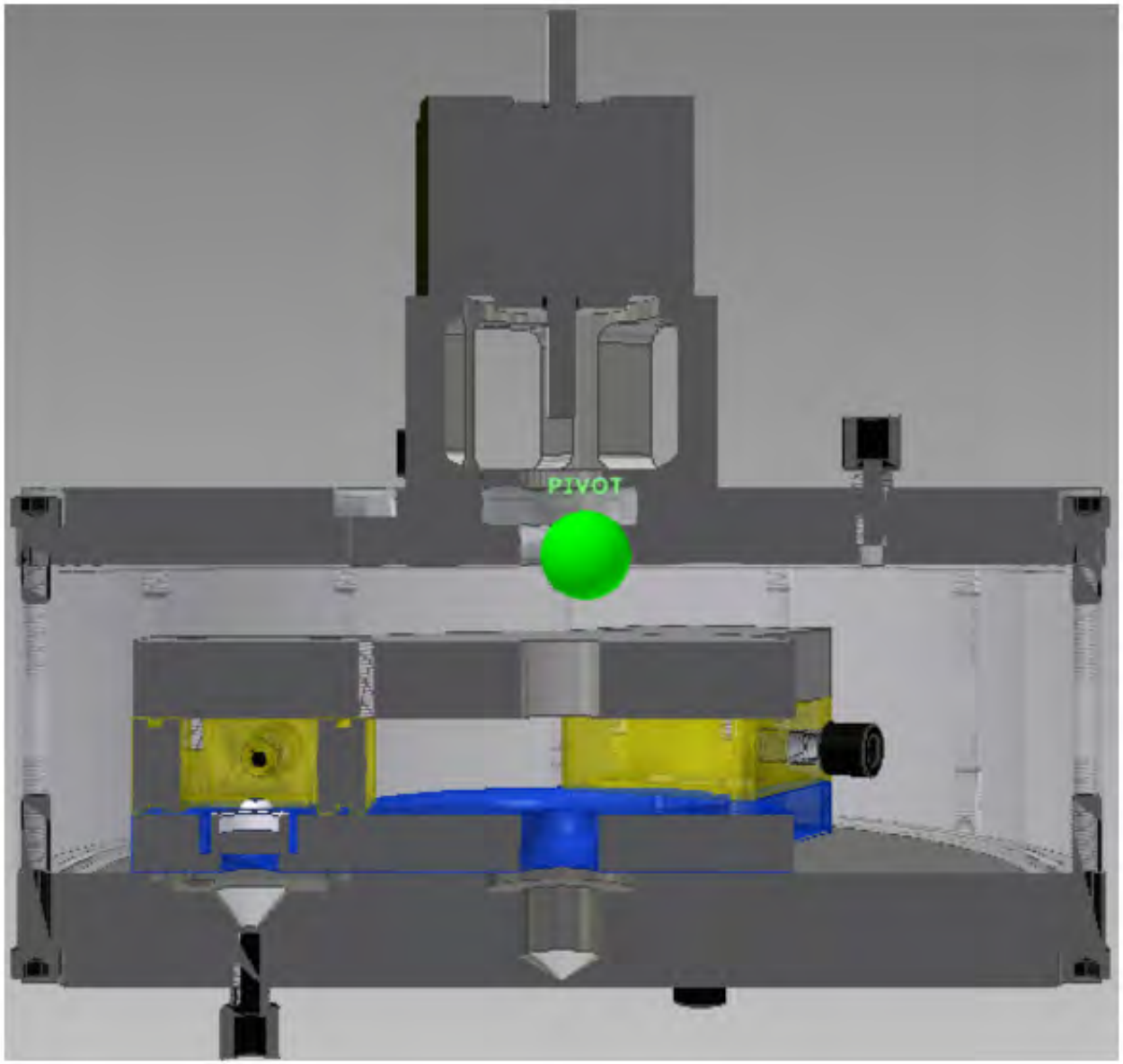
The main chamber stops the recoil ions that come out of MARS and then transport them via a capillary tube to the radiochemistry laboratory, located ~8 ft behind the MARS cave

Radiochemistry Laboratory

Equipped with:

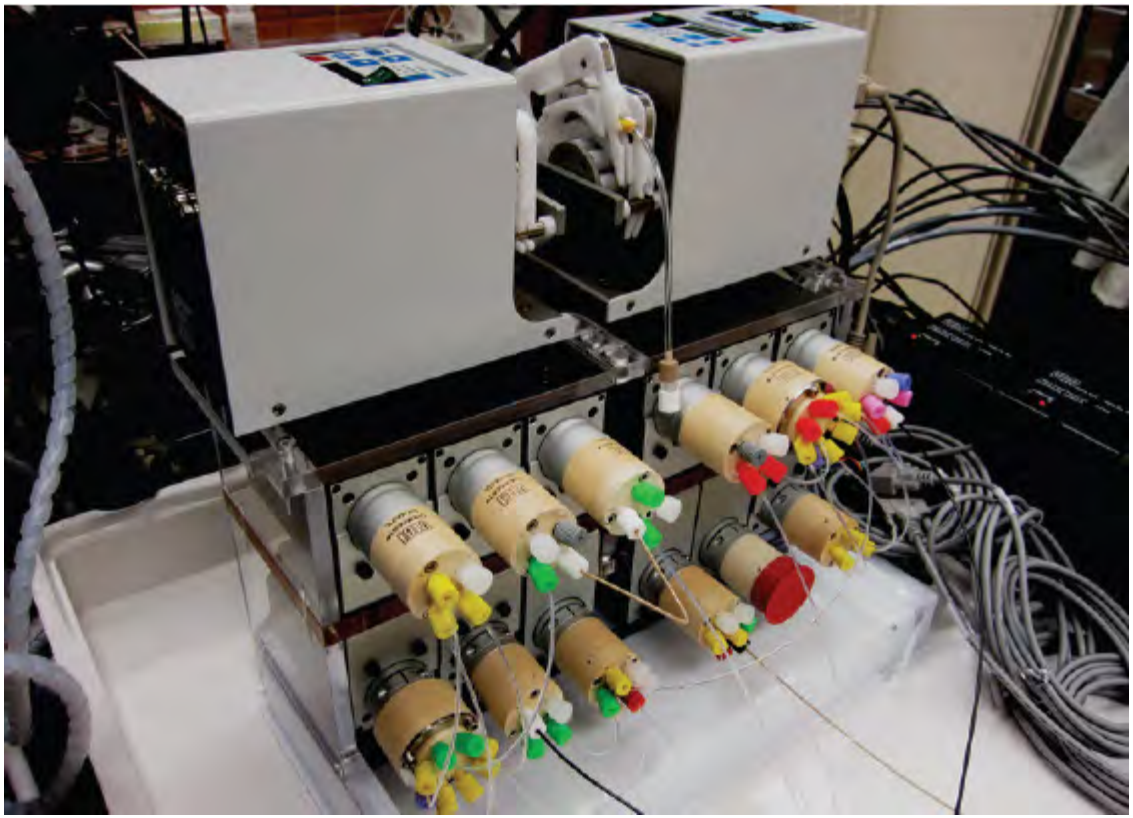
- ✓6 ft HF/$HClO_4$ fume hood
- ✓Eyewash, safety shower
- ✓Lab grade sink
- ✓Isolated waste system
- ✓Climate controlled
- ✓Chemical/Fire resistant interior
- ✓Non-slip flooring
- ✓GFI 110/220 outlets
- ✓Lab benches
- ✓Chemical storage cabinets
- ✓Moveable via crane, forklift, rolling
- ✓Track lighting
- ✓OSHA/State of Texas/NRC compliant

GLITTAR: Gas-Liquid Interface for Transactinide Transportation to Automated Radiochemistry



SHELA: SuperHeavy Element Liquid Automation

- LLNL has developed version 2 of the SHELA – Super Heavy Element Liquid Automation - chemistry system
- Improvements include better resistivity to acids, portability to accelerator facilities, integration with beam lines



Courtesy of D. A Shaughnessy

Conclusions

- Assessment of chemical systems for Rf chemistry has been done
- New facilities are in place for on-line homolog studies
- Customized targets are available

Acknowledgements

CMF Group
Dr. Charles M. Folden III
Dr. Megan E. Bennett
Marisa C. Alfonso
Dmitriy A. Mayorov
Tyler A. Werke

LLNL
Dr. Dawn Shaughnessy
Dr. Ken Moody
Dr. Roger Henderson
Dr. Julie Gostic
Dr. Evgeny Tereshatov

ANL
John Greene

Cyclotron Institute
Operations staff
Accelerator Group

UNLV
Dr. Ralf Sudowe
John Despotopolus
Jeff Rolfes