

THE $N = 126$ FACTORY: A NEW MULTI-NUCLEON TRANSFER REACTION FACILITY AT ANL



ADRIAN A. VALVERDE
Argonne National Laboratory

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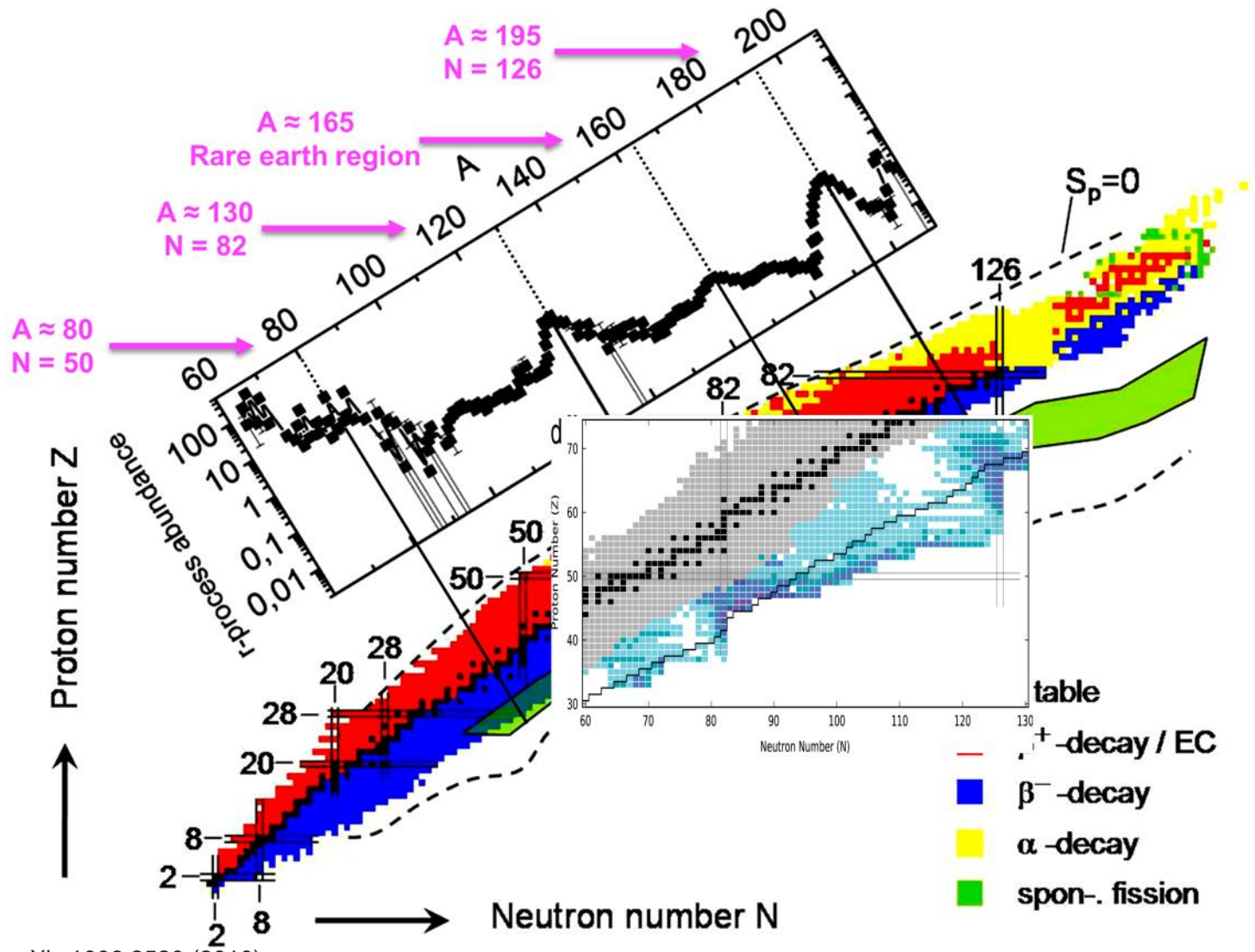


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R-PROCESS STUDIES AT ANL



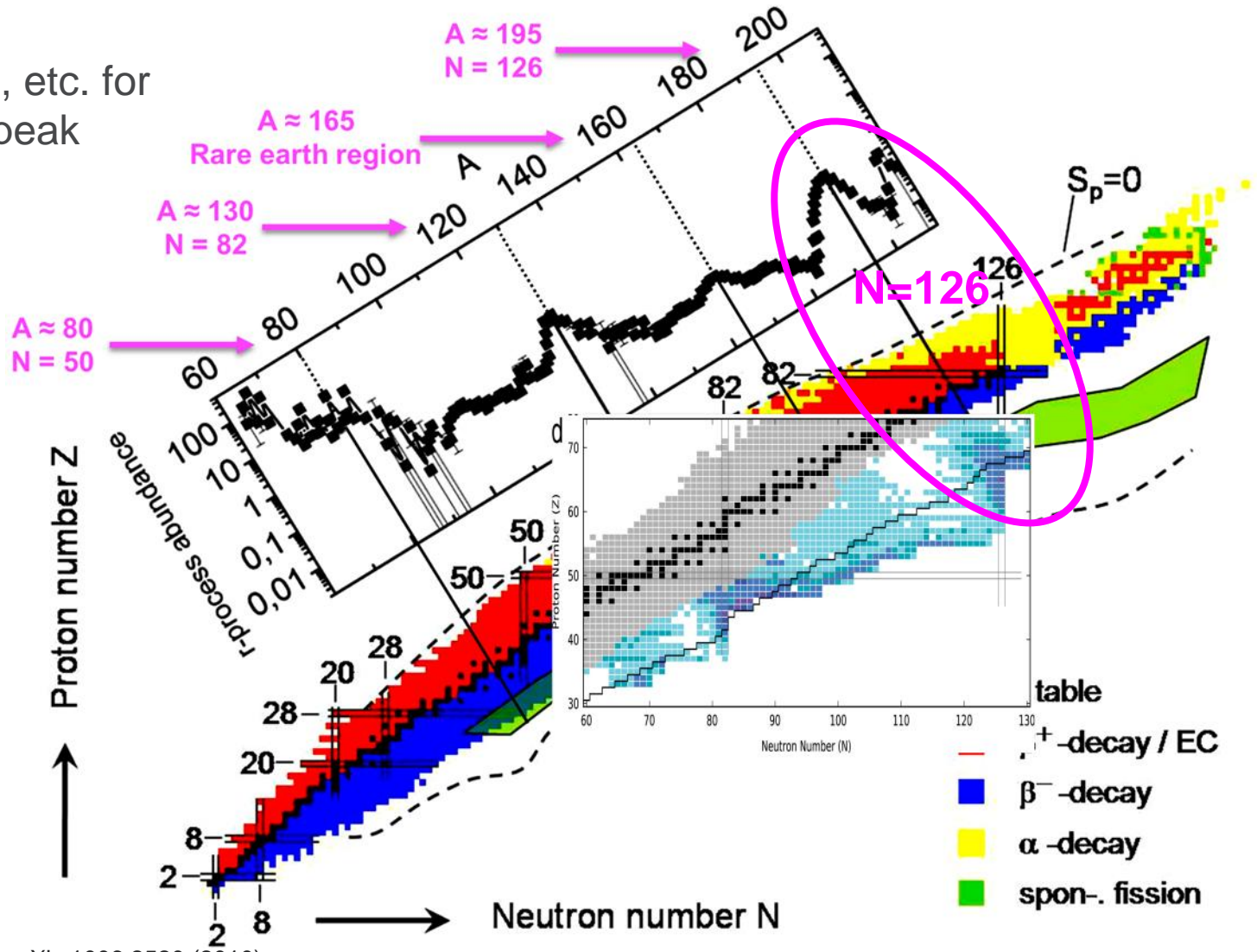
R. Kruecken, arXiv:1006.2520 (2010),

M.R. Mumpower et al., PPNP, 86 (2016)

R-PROCESS STUDIES AT ANL

N=126:

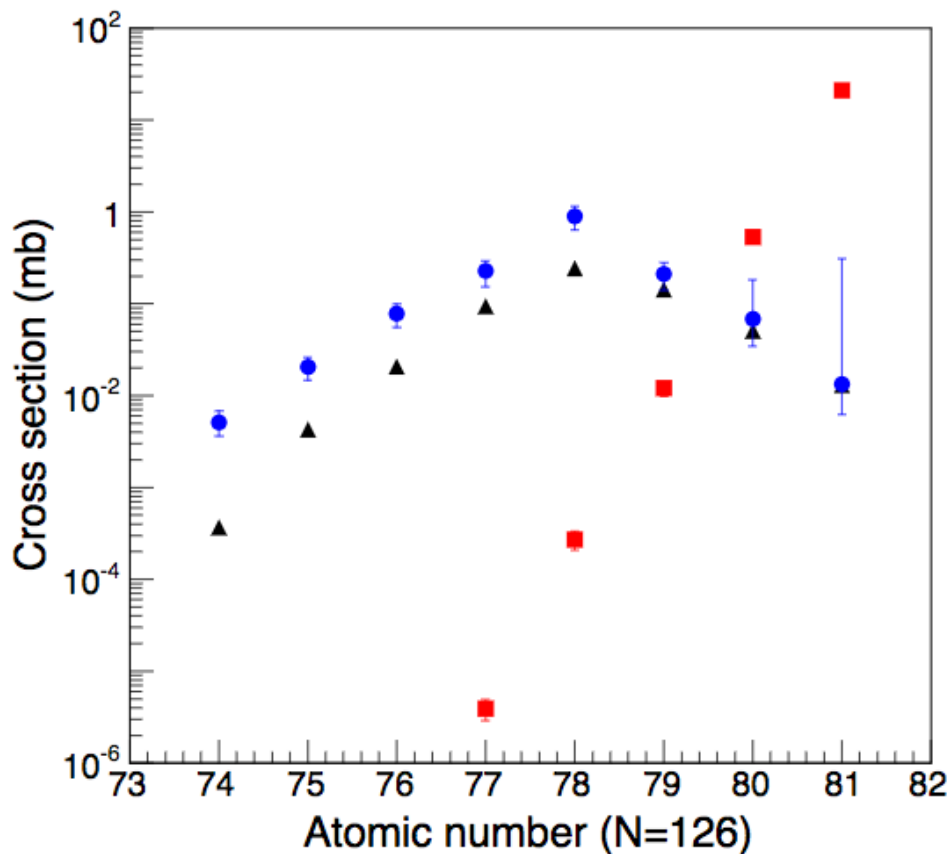
Masses, etc. for
A~195 peak



R. Kruecken, arXiv:1006.2520 (2010),

M.R. Mumpower et al., PPNP, 86 (2016)

MULTINUCLEON TRANSFER REACTIONS



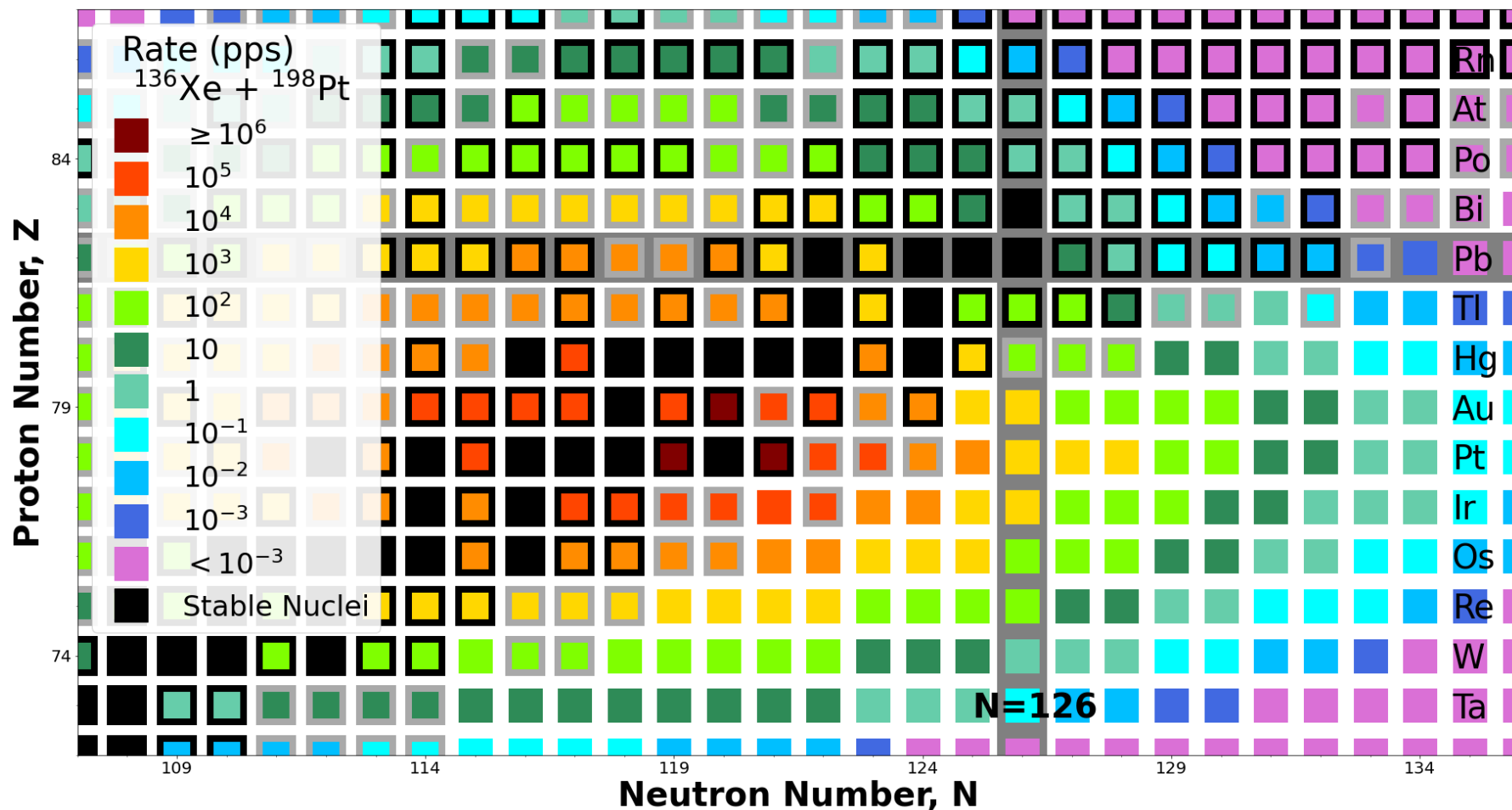
$^{136}\text{Xe} + ^{198}\text{Pt}$ at 8 MeV/u
(best multi-nucleon transfer (MNT)
reaction)

$^{208}\text{Pb} + ^9\text{Be}$ at 1 GeV
(fragmentation reaction with best
cross-sections for $N = 126$)

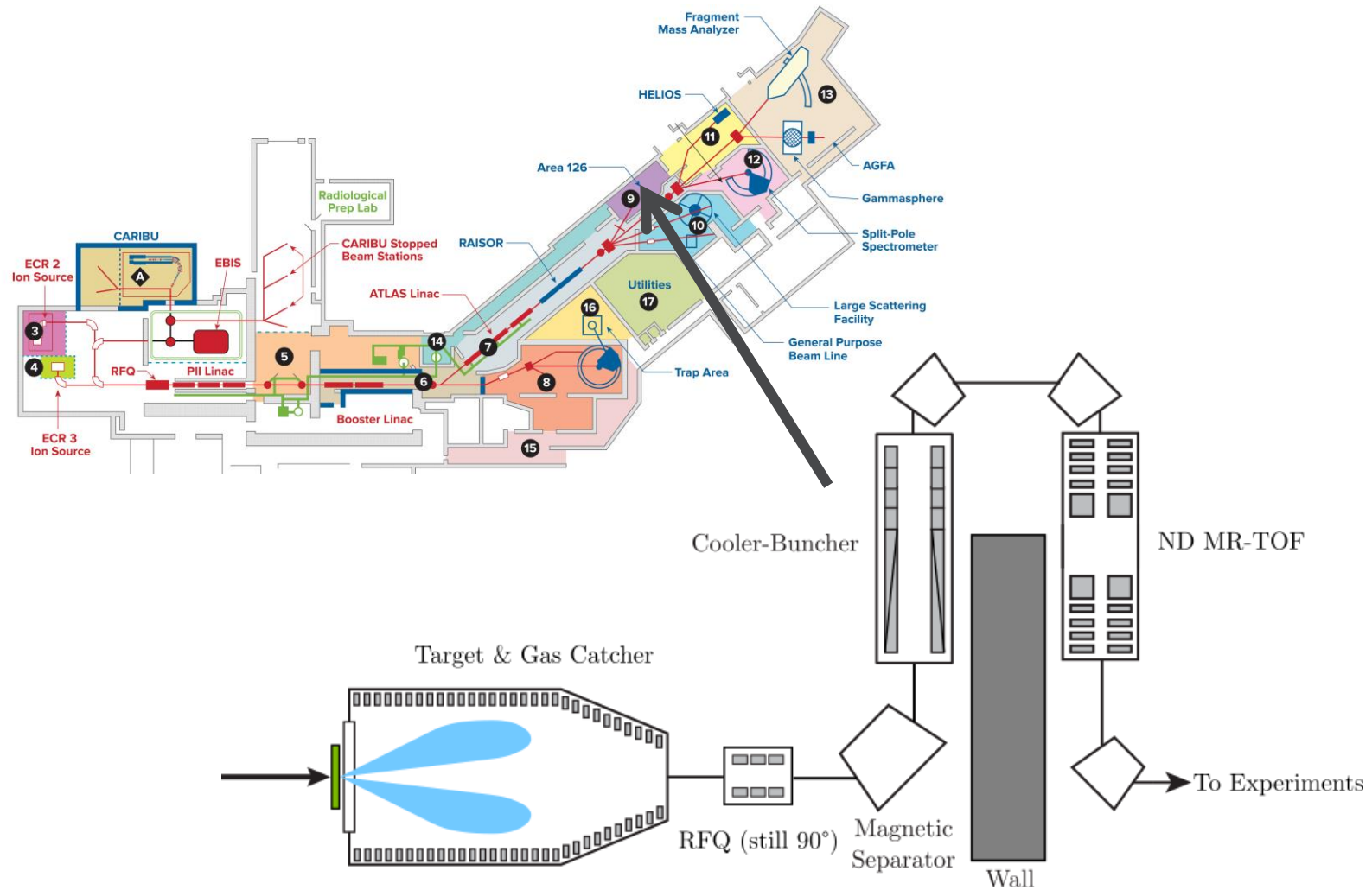
Hirayama et al., EPJ Web Conf. **109**, 08001 (2016)

MULTINUCLEON TRANSFER REACTIONS

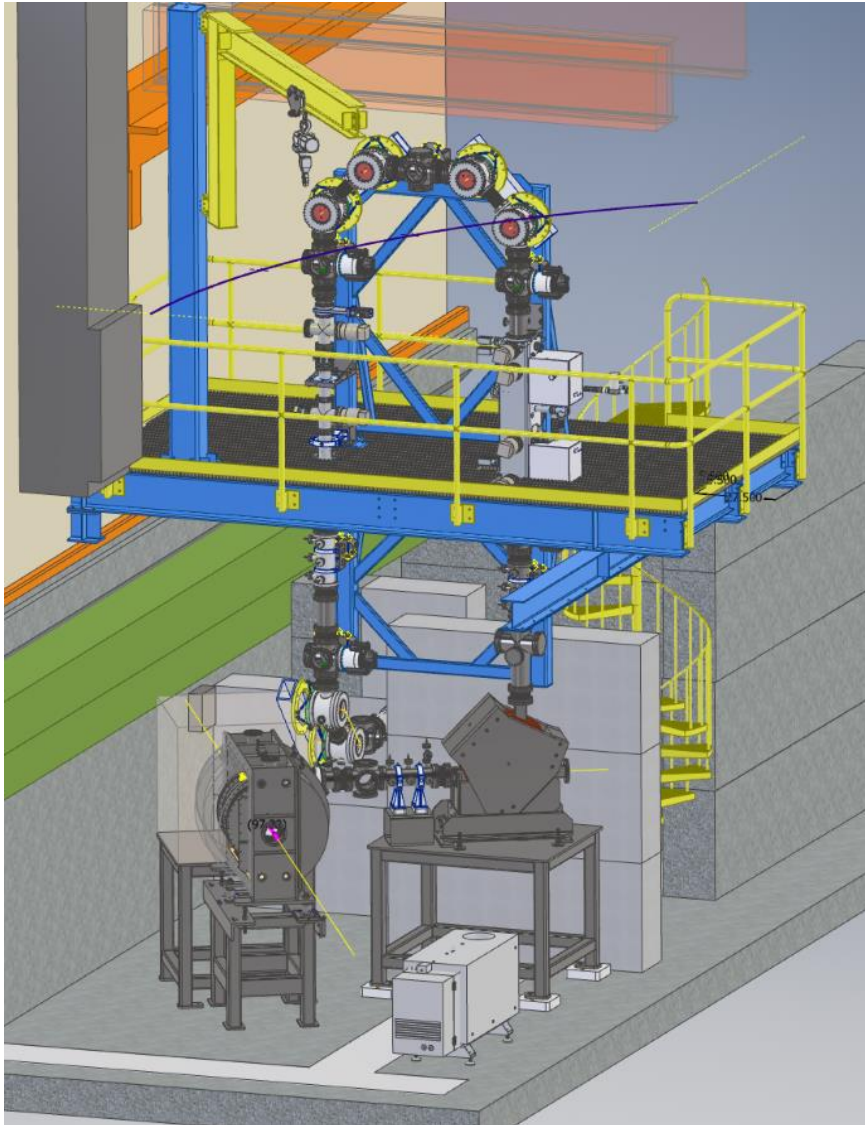
$^{136}\text{Xe} + ^{198}\text{Pt}$ at 9 MeV/u and 5 pμA



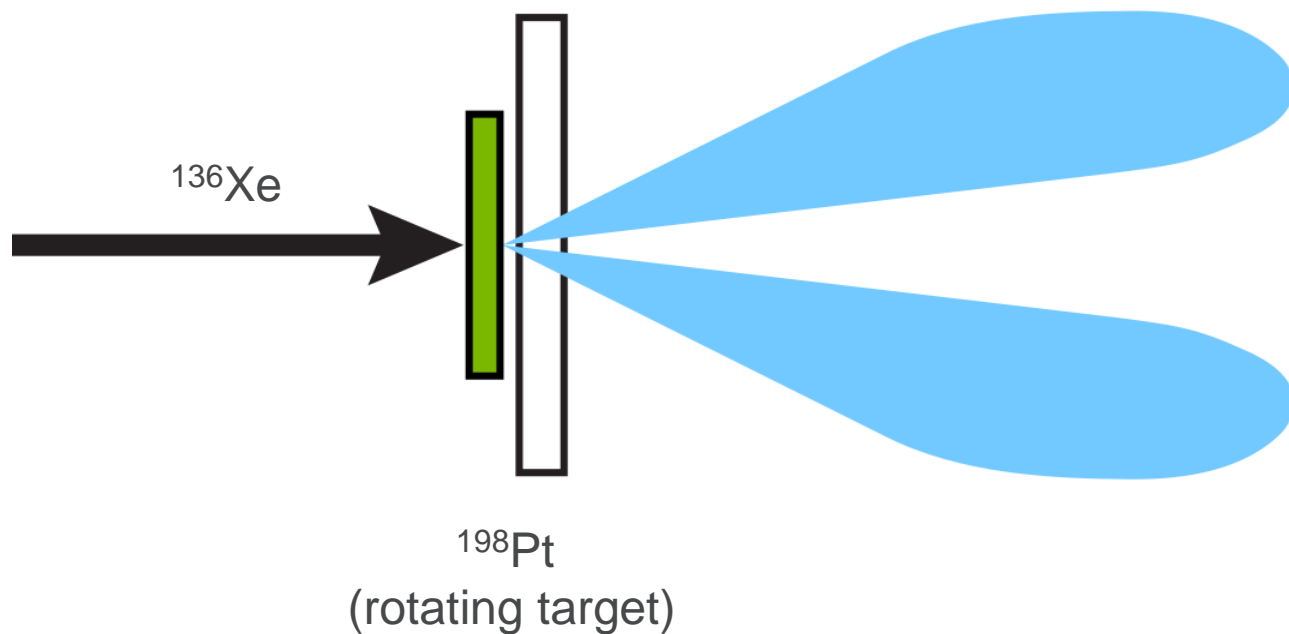
N=126 FACTORY



N=126 FACTORY

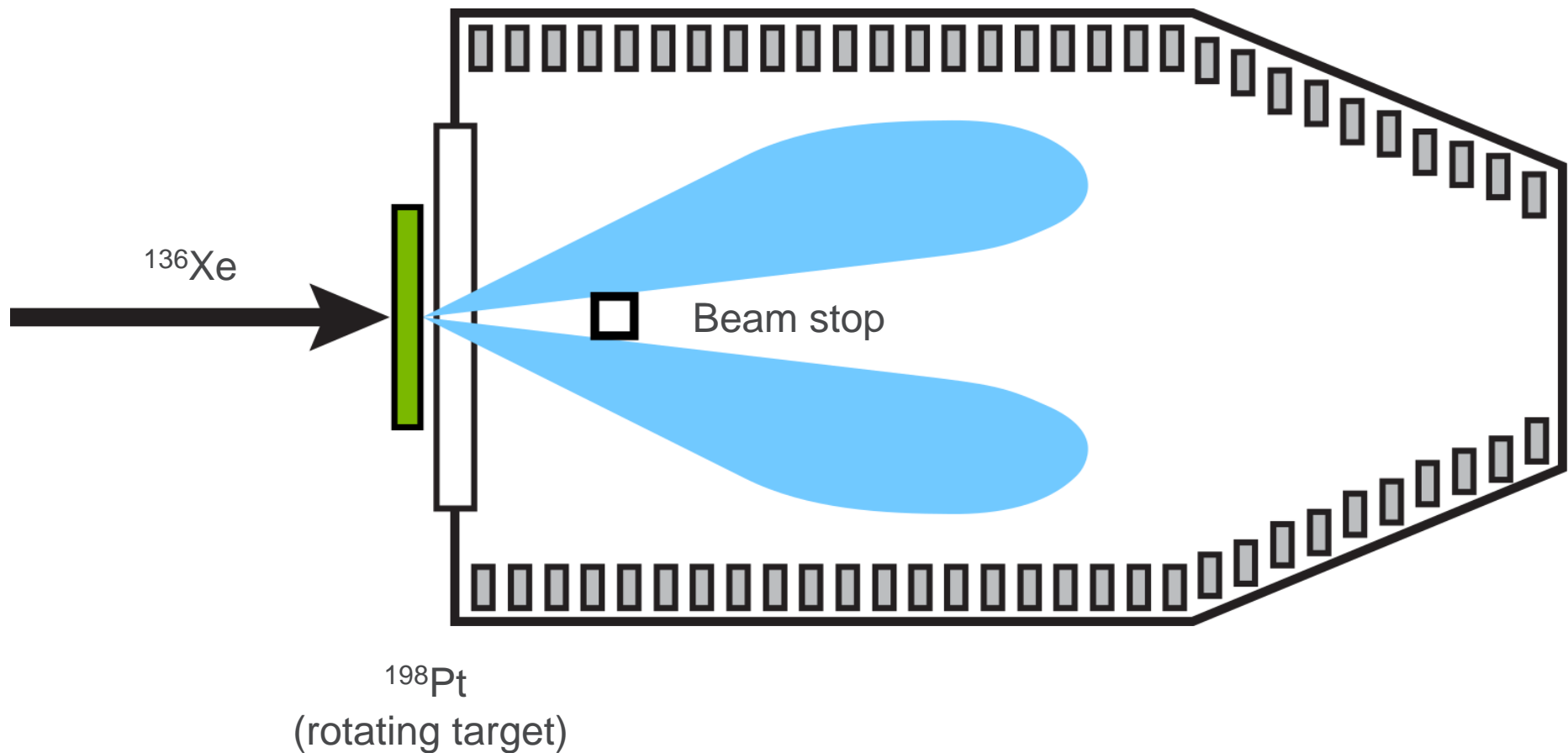


MNT REACTIONS: COLLECTION

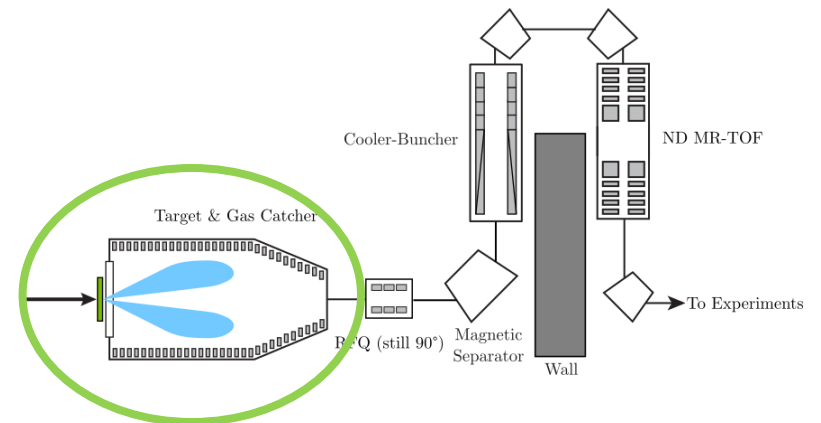
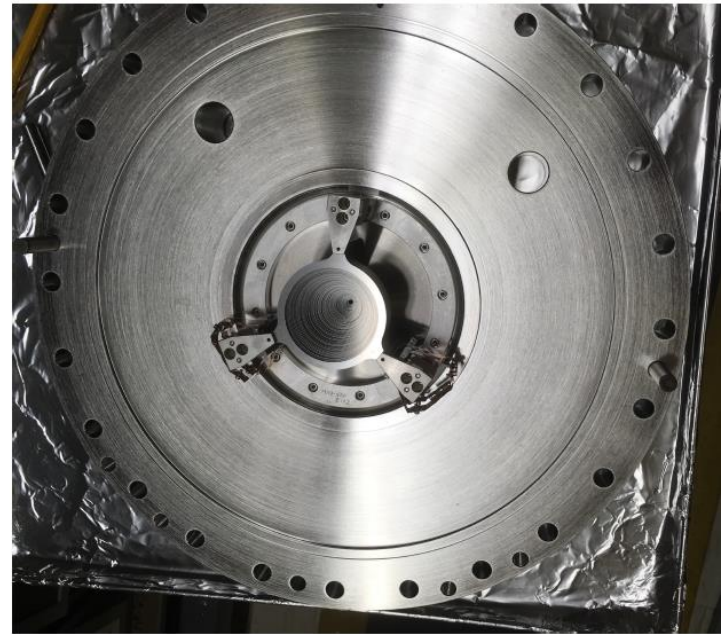
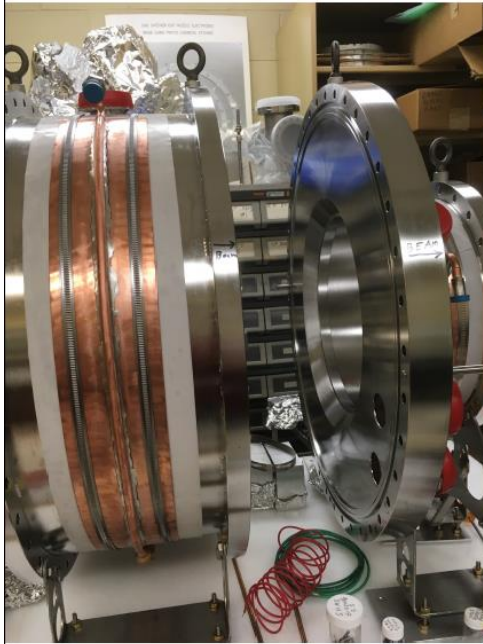


MNT REACTIONS: COLLECTION

- Thermalize fragments in 50-100 mbar He gas
- Transport to end using gas flow, electric fields

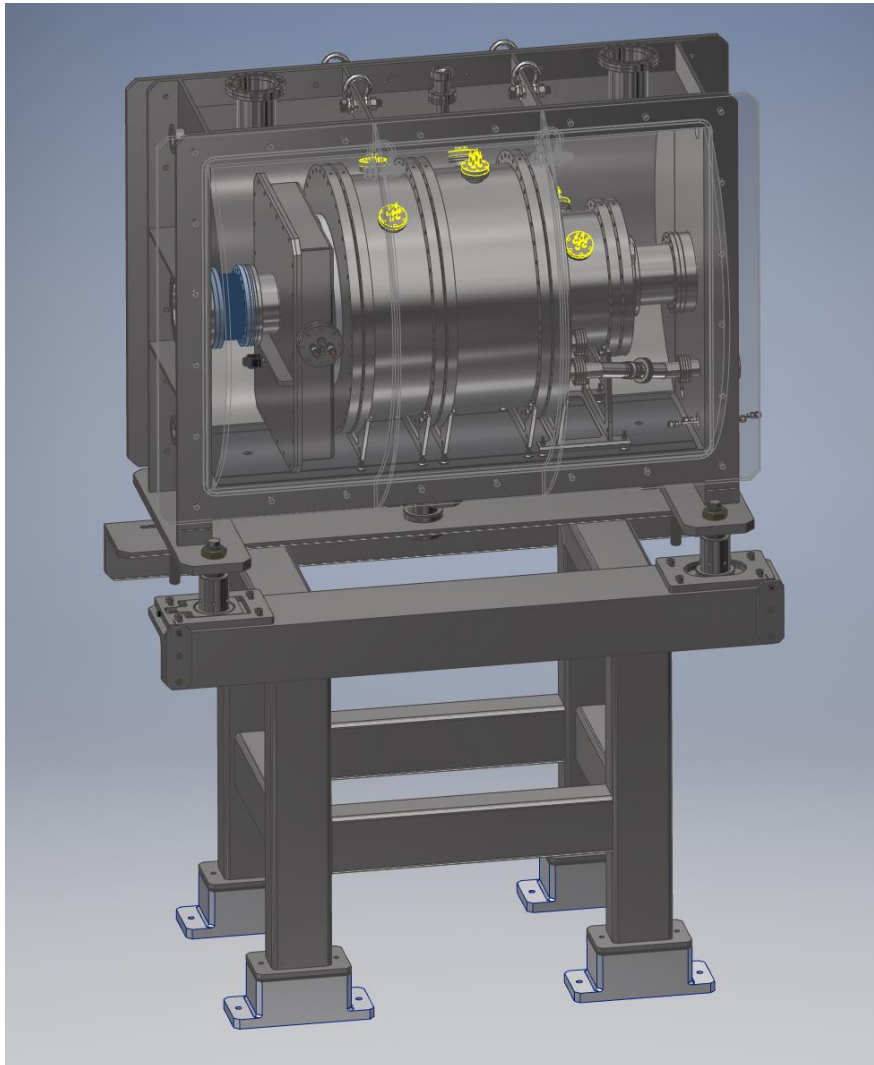


GAS CATCHER

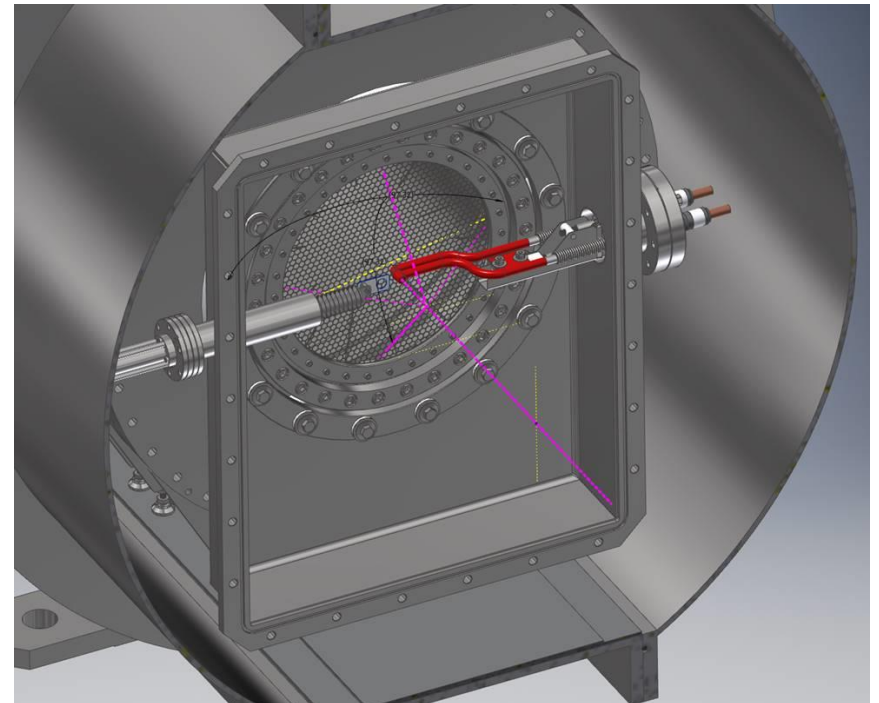
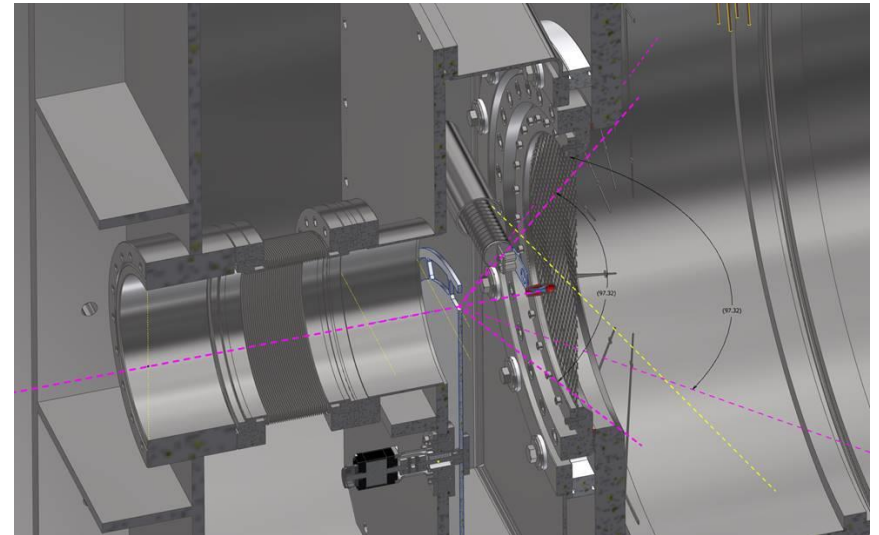


B.J. Zabransky, G. Savard

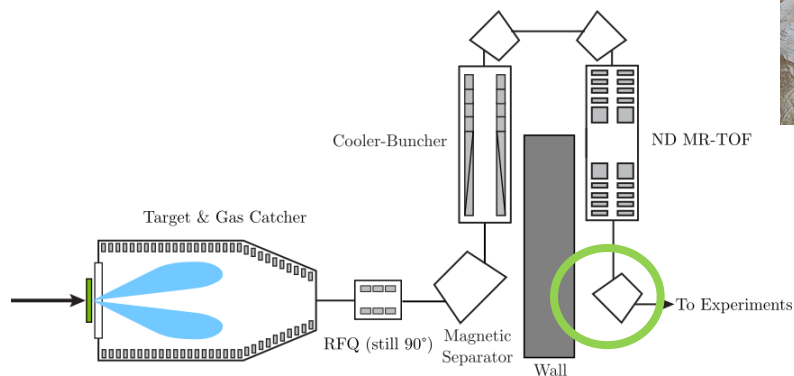
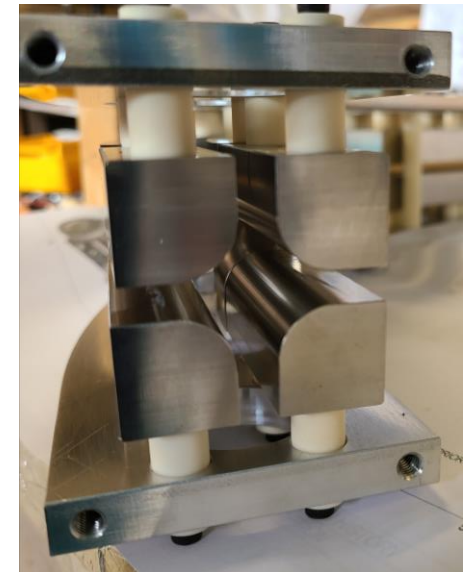
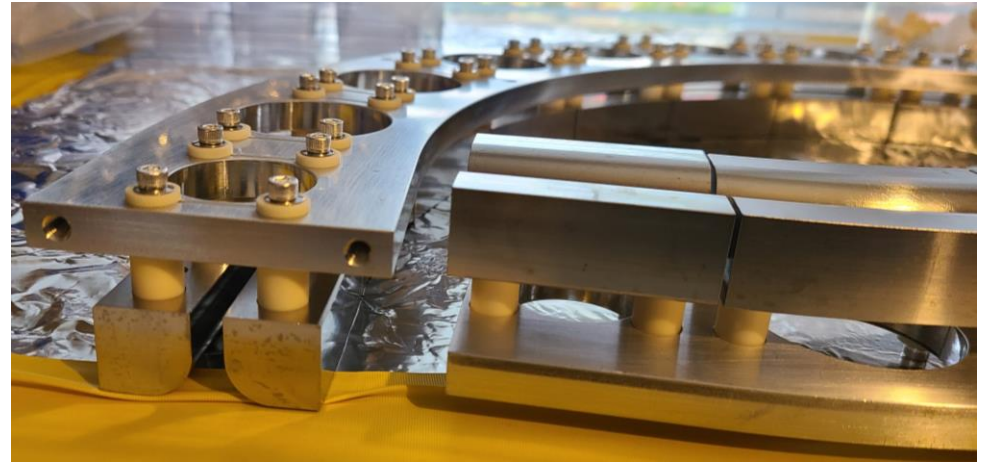
GAS CATCHER



R. Knaack



90-DEGREE RFQ & ACCELERATING SECTION

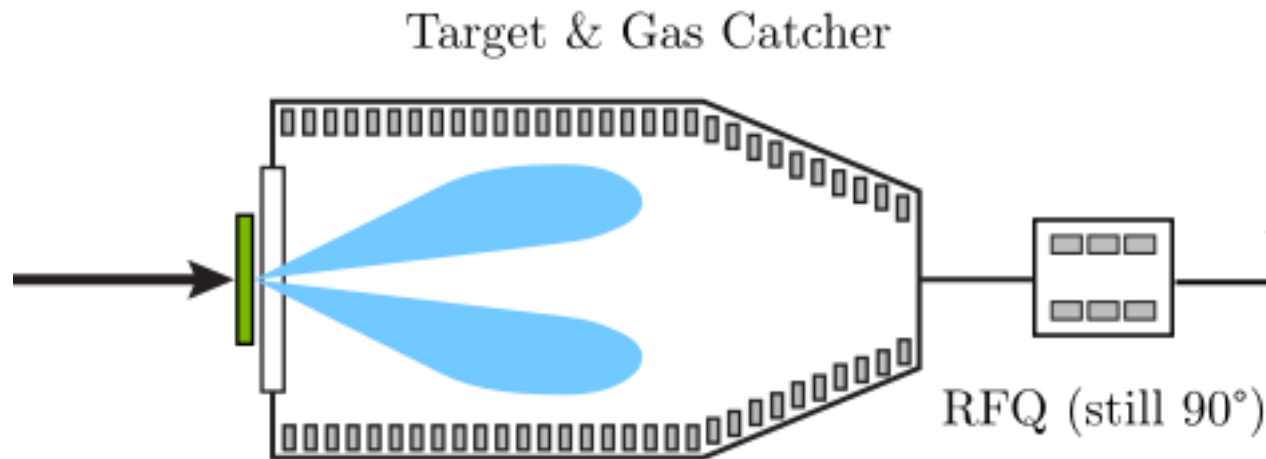


N=126 BEAM

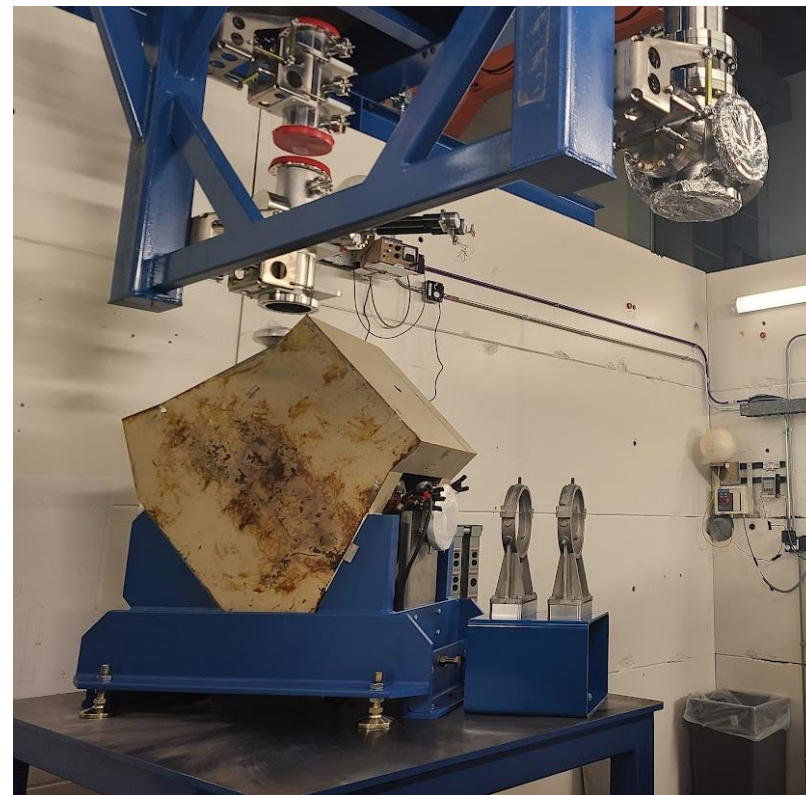
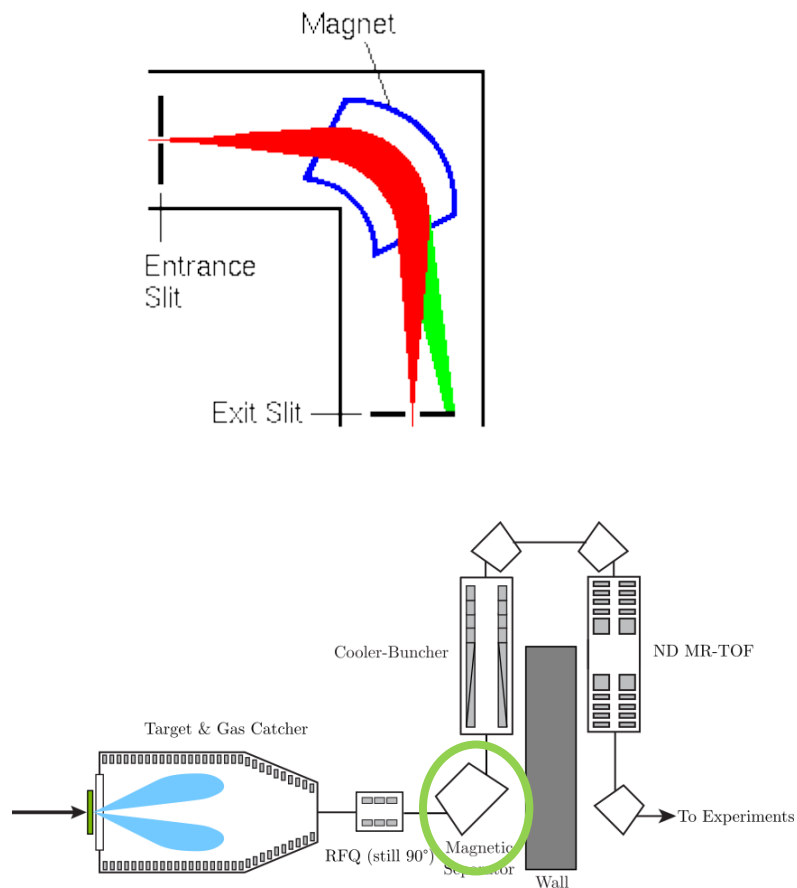
- Continuous, isotopically mixed, high-emittance beam



- Bunched, isotopically pure, low-emittance beam

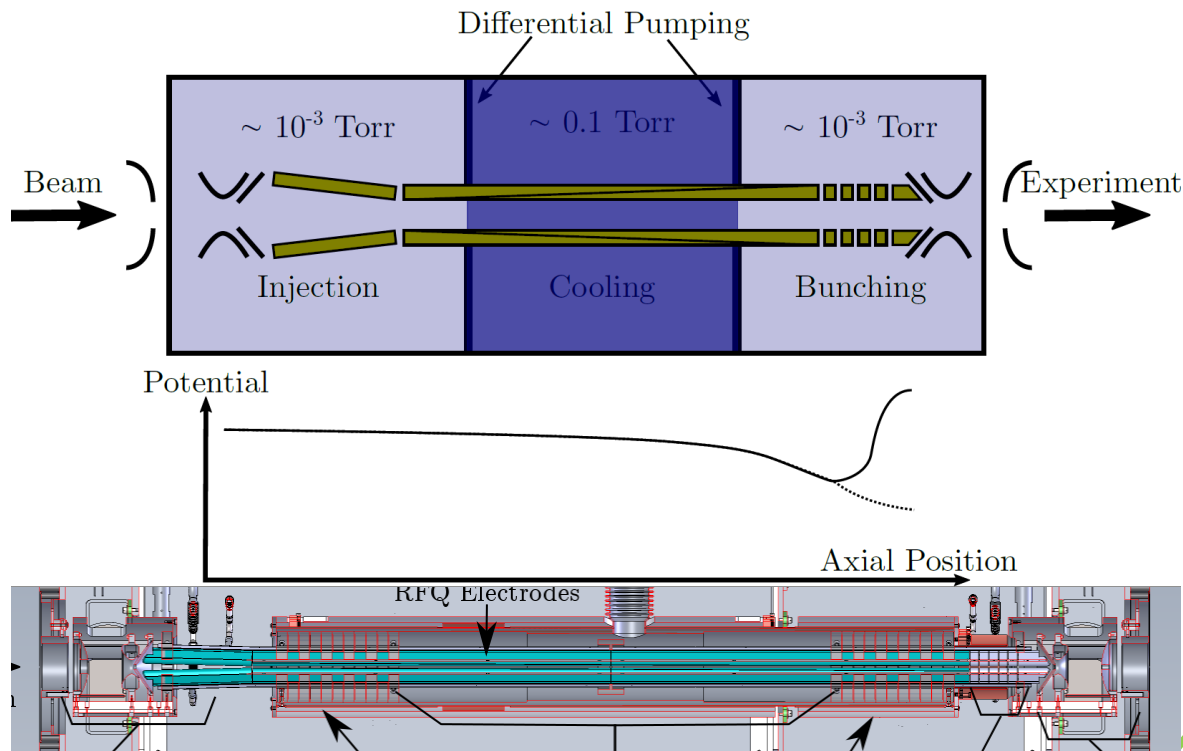


ISOBAR SEPARATING MAGNET

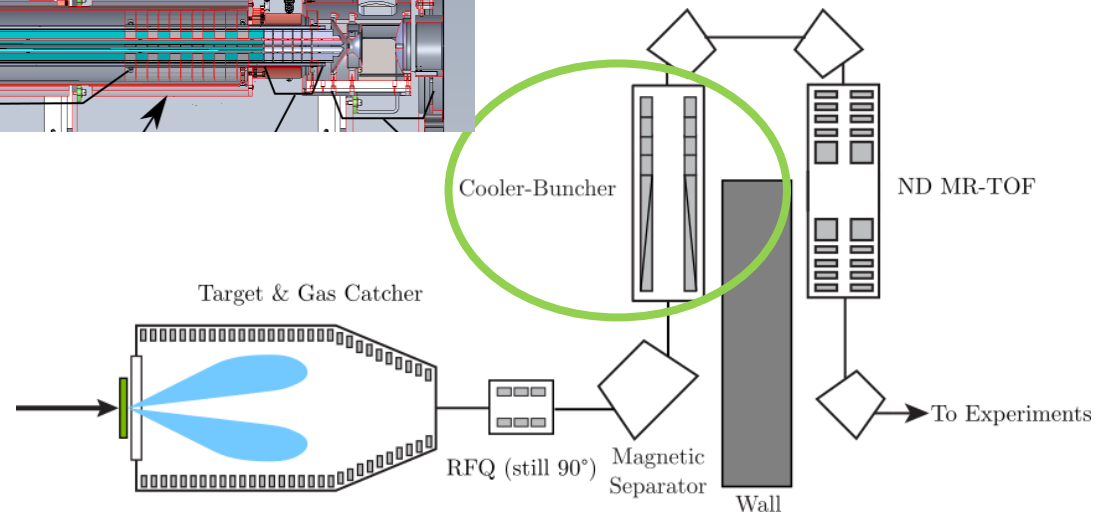


- Resolution high enough ($M/\Delta M \sim 1000$) to separate into isobars

COOLER-BUNCHER



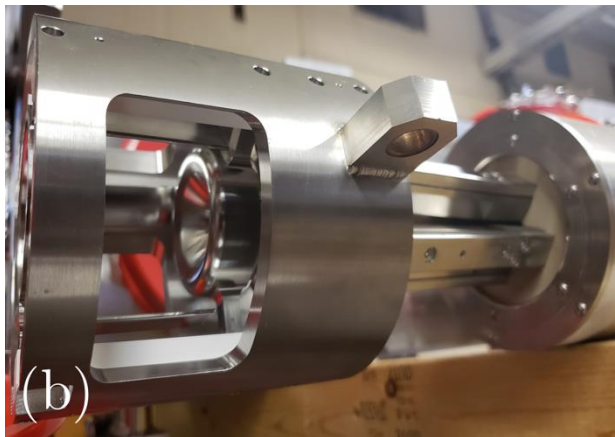
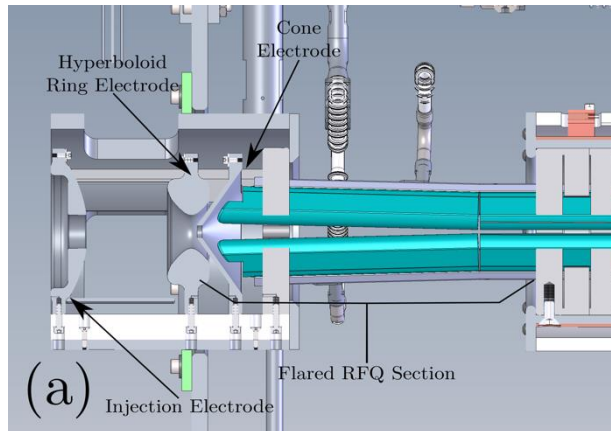
- Separated cooling and bunching sections, simplified electrode construction, optimized injection optics
- Design used for NSCL EBIT Cooler-Buncher



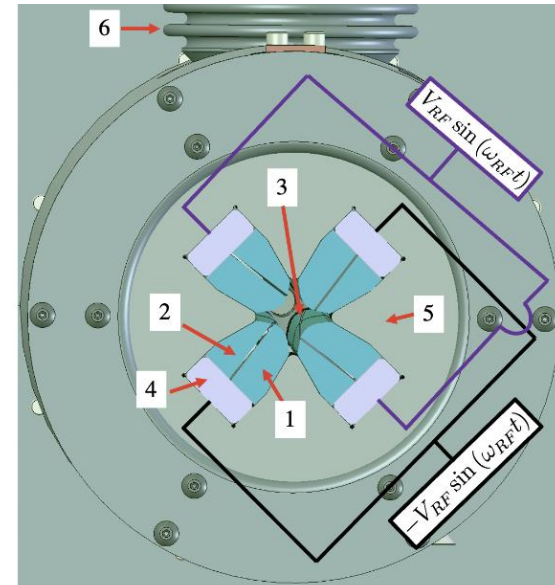
A. A. Valverde

COOLER-BUNCHER

- Flared entrance section for larger acceptance



- High-power RF applied on backbone
- Cross-cut DC electrodes



A. A. Valverde

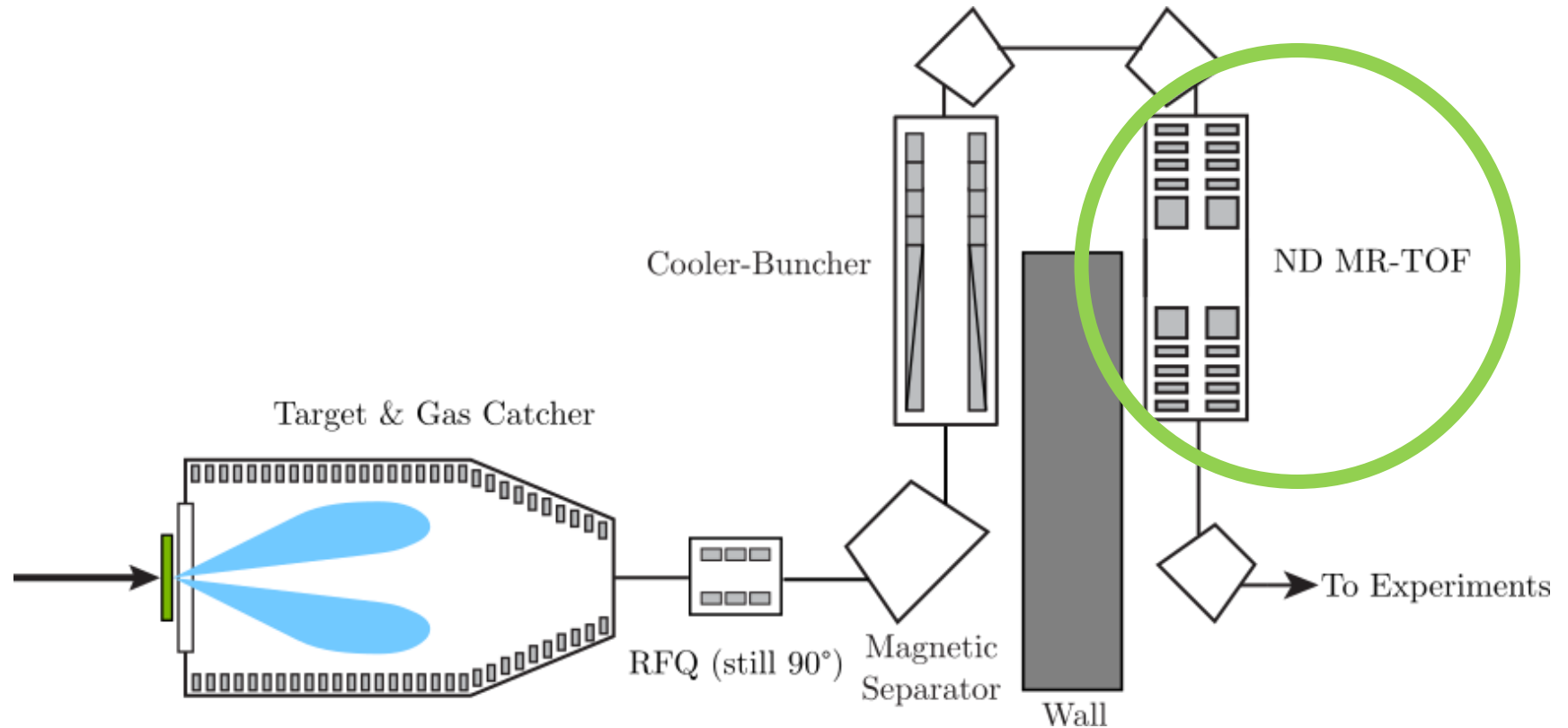
COOLER-BUNCHER



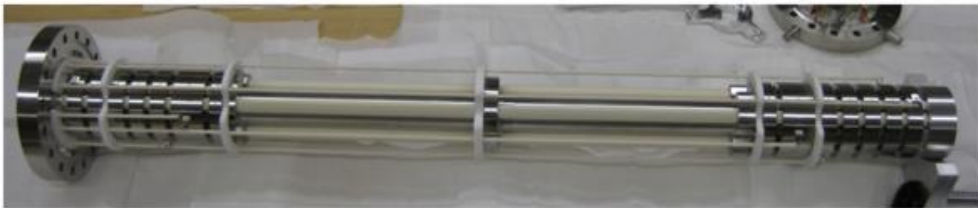
A. A. Valverde

NOTRE DAME MR-TOF

- Mass Resolution in $M/\Delta M > 10^5$
- Deliver isotopically pure beams to experiments



~~NOTRE DAME MR-TOF~~ MSGR-TOF



M. Brodeur, B. Liu

AREA 1 STOPPED BEAMS

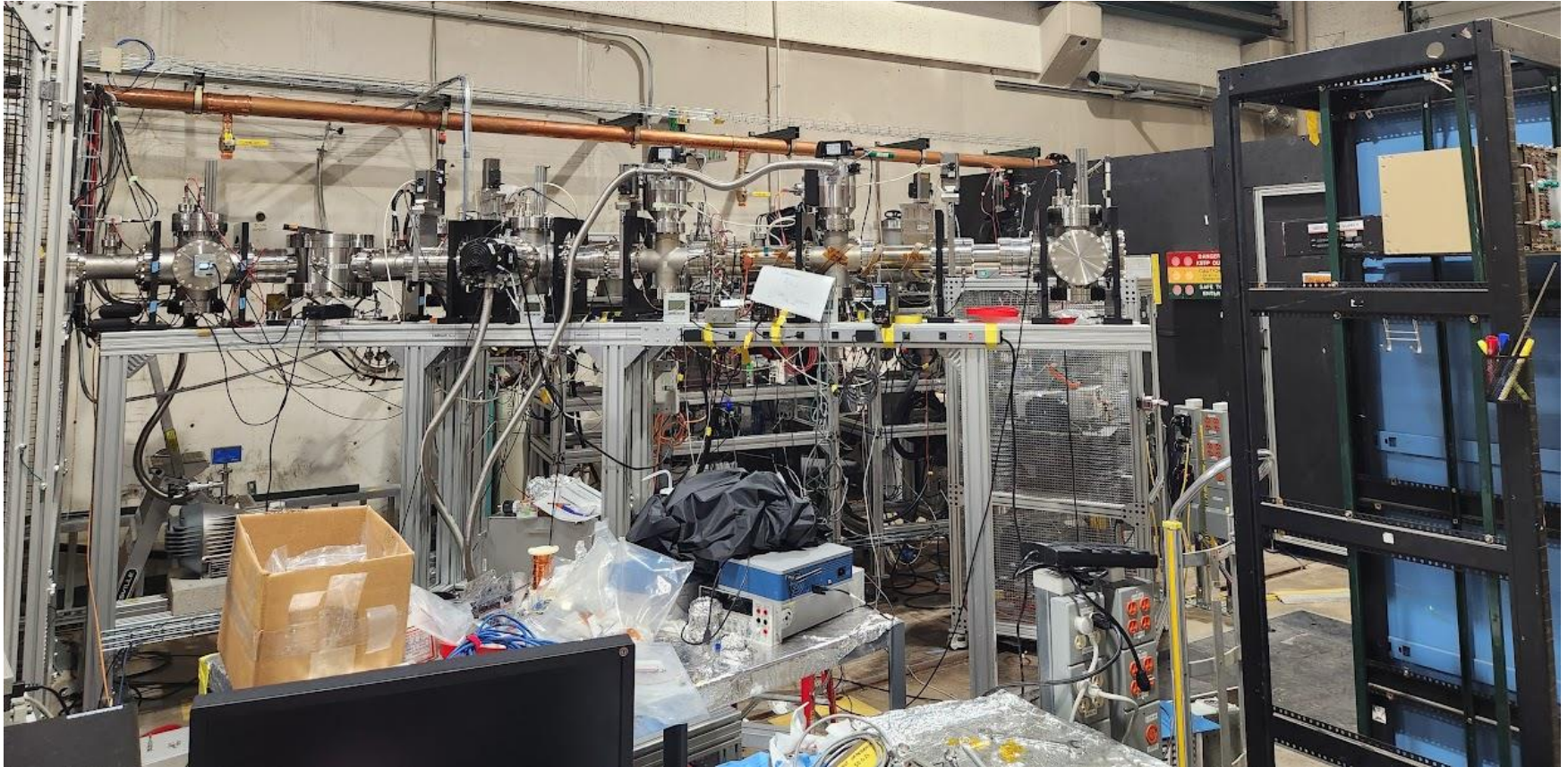
- Stopped, bunched beams needed in CARIBU Low-energy Area (Area 1)
- One of three bunchers
- Used in A1 for ATLANTIS (B. Maaß, after lunch) and BEARtrap (Poster by D. Burdette)
- Currently being used for commissioning of MSGR-TOF



A. Barcikowski, D.P. Burdette, N. Callahan, J. Clark, B. Maass, P. Mueller, A.A. Valverde

NEXT STEPS: COMMISSIONING MSGR-TOF

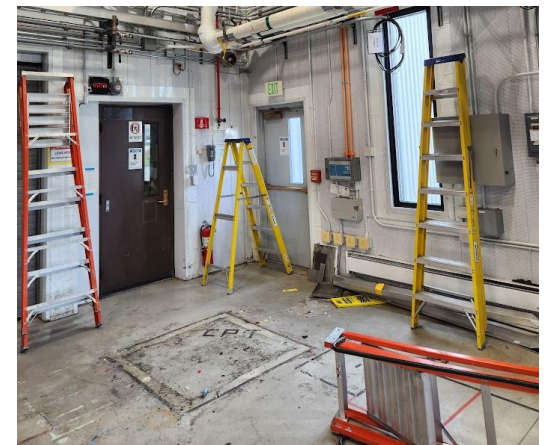
- Offline commissioning done at Notre Dame
- Online commissioning within the month on BEARtrap line



B. Liu, D.P. Burdette, B. Maass, A.A. Valverde

NEXT STEPS: MOVING THE CPT

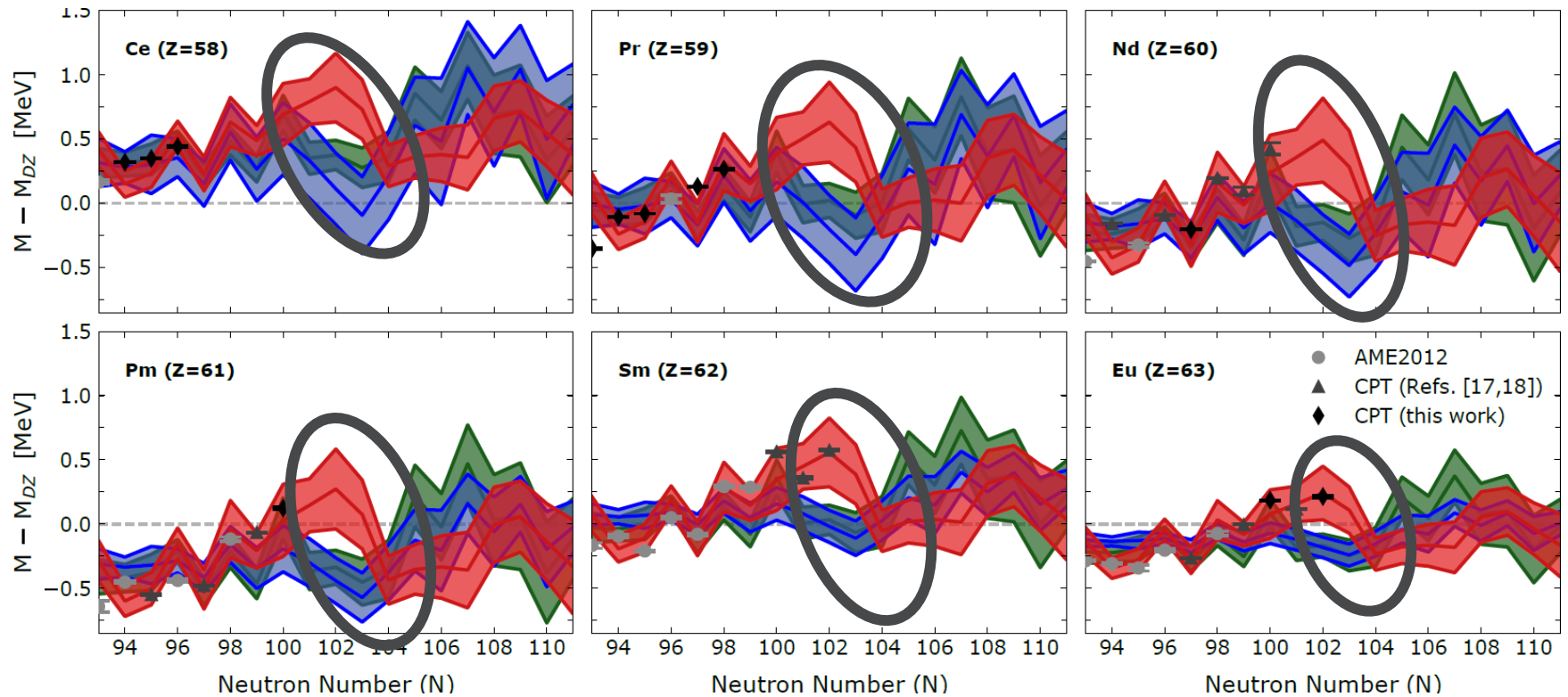
- CPT must leave CARIBU to make room for nuCARIBU and move to the N=126 Factory to make measurements there.
- CPT has left CARIBU, is waiting to move into Area 126



SCIENCE AT THE N=126 FACTORY

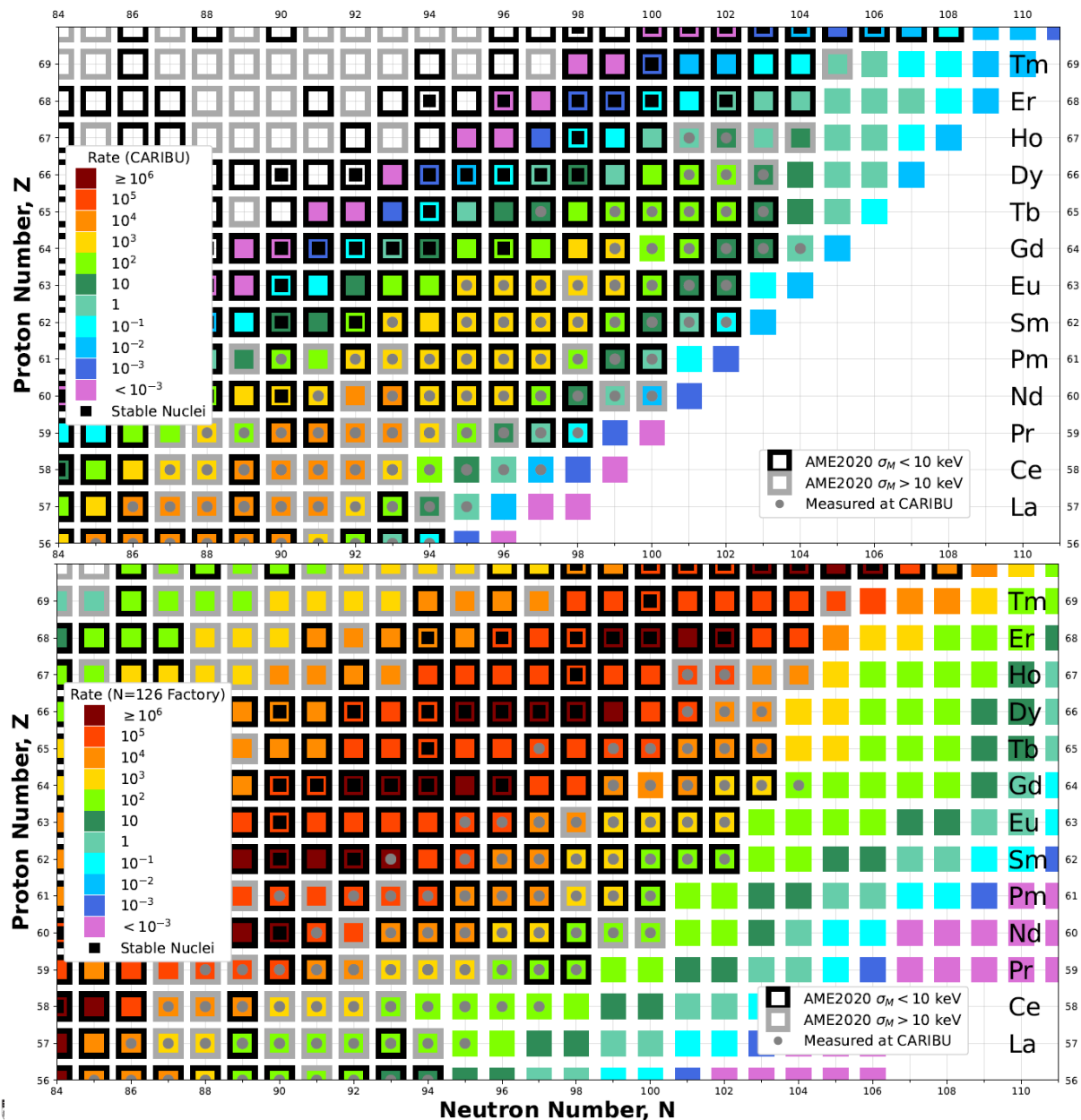
- Alongside mass measurements, the plan is to deploy a small decay station to allow for half-life measurements of these isotopes both for science cases and for better identification
- A collinear laser spectroscopy setup is also planned
- Eventually these beams will also be delivered to other parts of ATLAS

N=126 FACTORY REACH



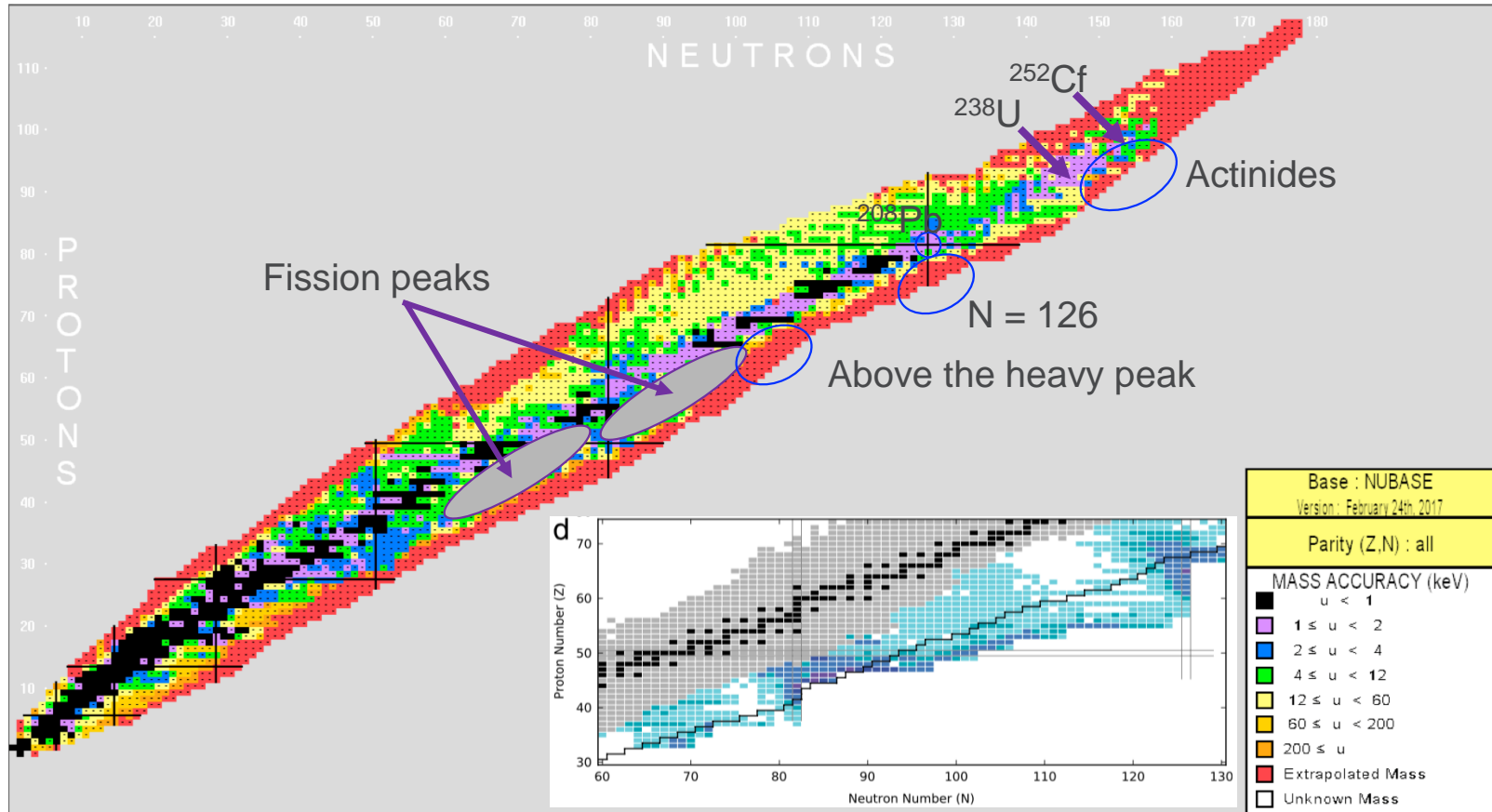
R. Orford, N. Vassh, *et al.*, in prep.

RARE EARTH FACTORY



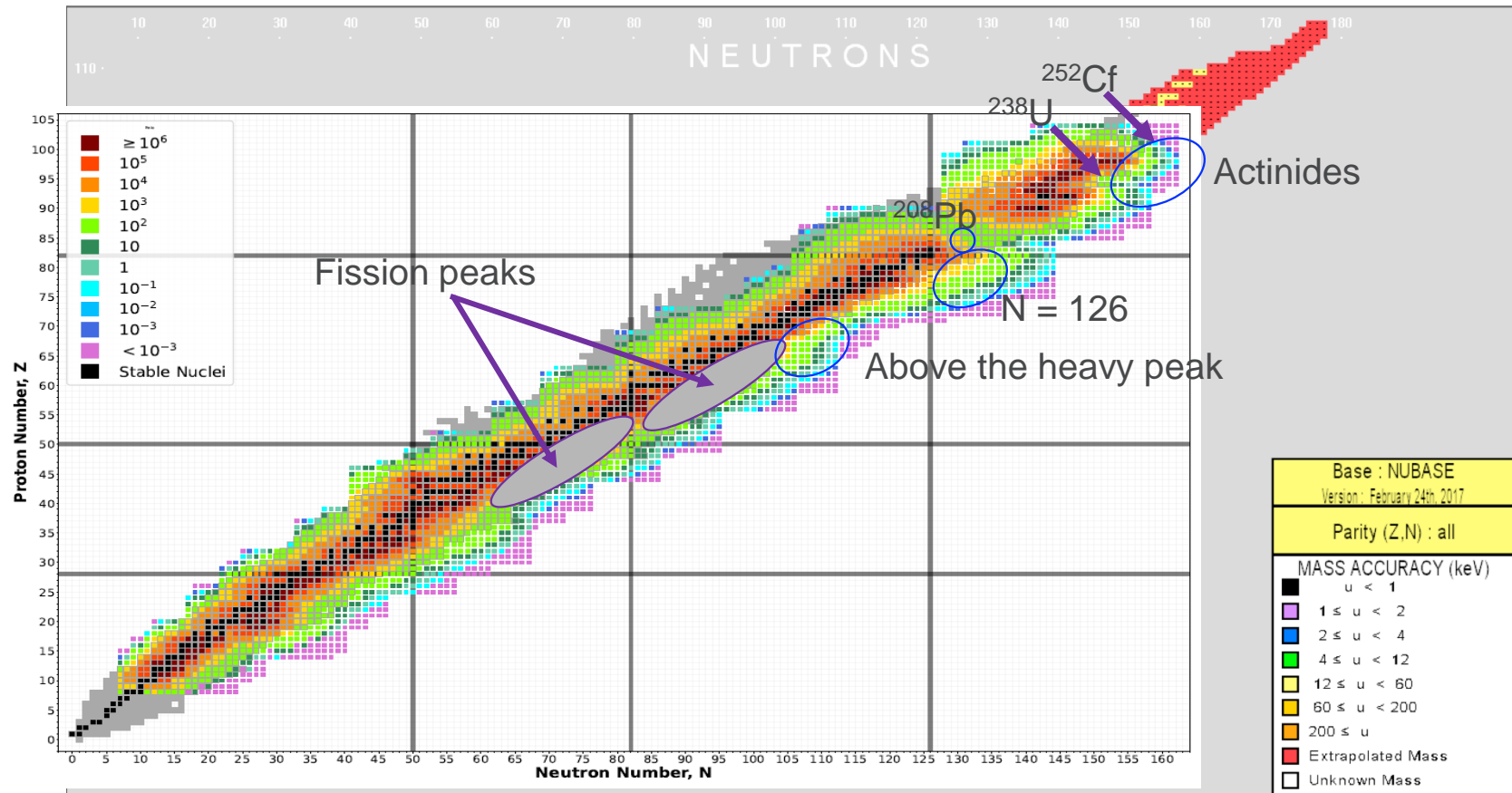
N=126 FACTORY REACH

What regions can it cover?



N=126 FACTORY REACH

What regions can it cover?



→ longer term, insight into fissionability of heaviest neutron-rich nuclei

CONCLUSION

- The N=126 Factory at ANL's ATLAS Facility will use MNT reactions to produce nuclei in regions we cannot currently reach at the N=126 peak, in the rare earth region above the fission peaks, and other regions
- The N=126 Factory is currently under assembly. The Gas Catcher is undergoing final assembly with the box already installed, the extraction RFQ has been assembled, the Cooler-buncher has been installed, and the MR-TOF is currently commissioning.
- Assembly of the N=126 Factory should finish this fall, with commissioning to begin by the end of 2023
- The CPT will be moved in by the end of the year to begin a mass measurement campaign, with other experimental devices also expected.

ACKNOWLEDGEMENTS



D.P. Burdette,
J.A. Clark,
R.A. Knaack,
J. Rohrer,
G. Savard,
A.A. Valverde,
B.J. Zabransky



M. Brodeur,
A.M. Houff,
B. Liu,
W.S. Porter



K.S. Sharma

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