

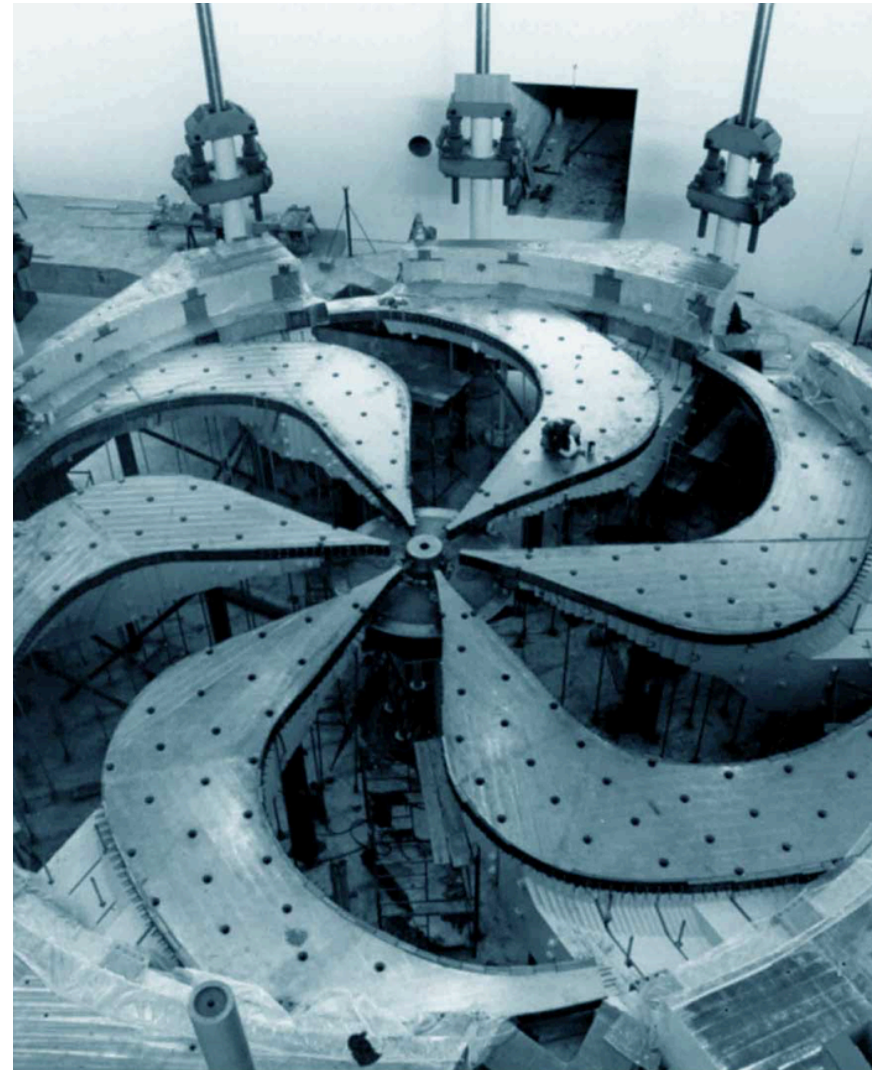


Approaching the $N = 20$ Island of Inversion

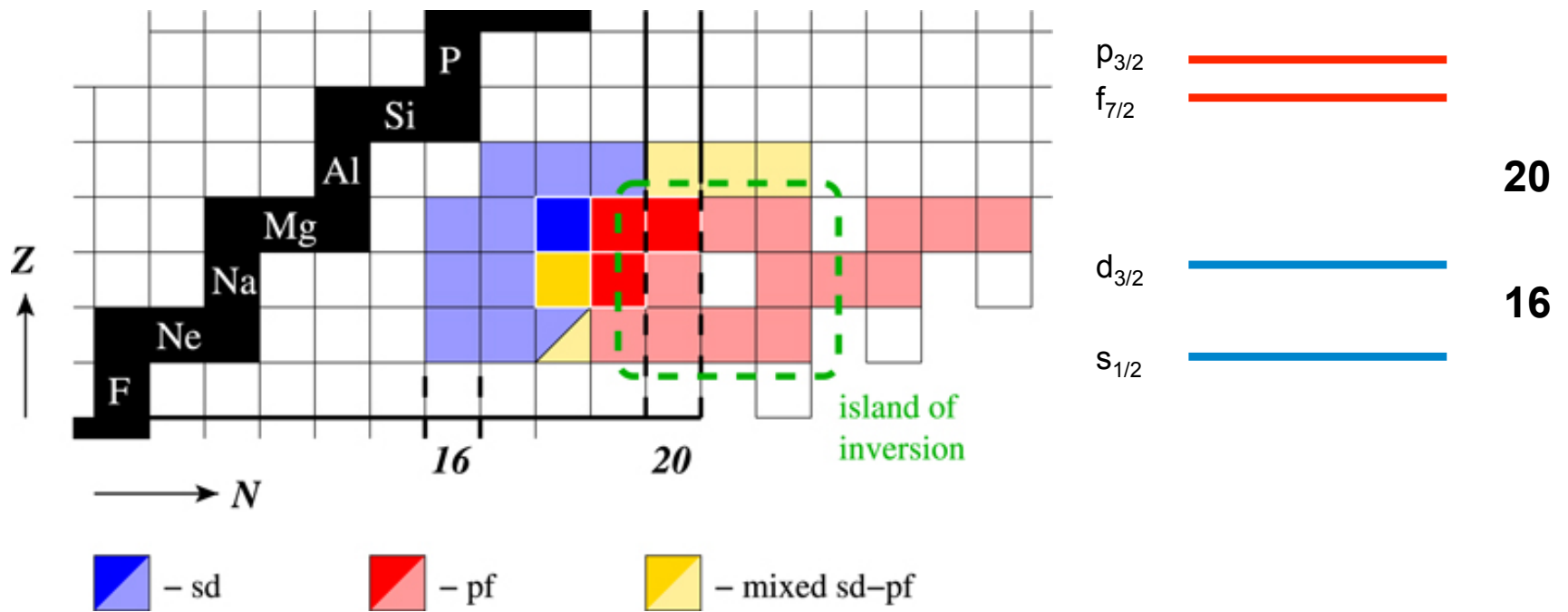
Andrew Jacobs

TITAN/University of British Columbia

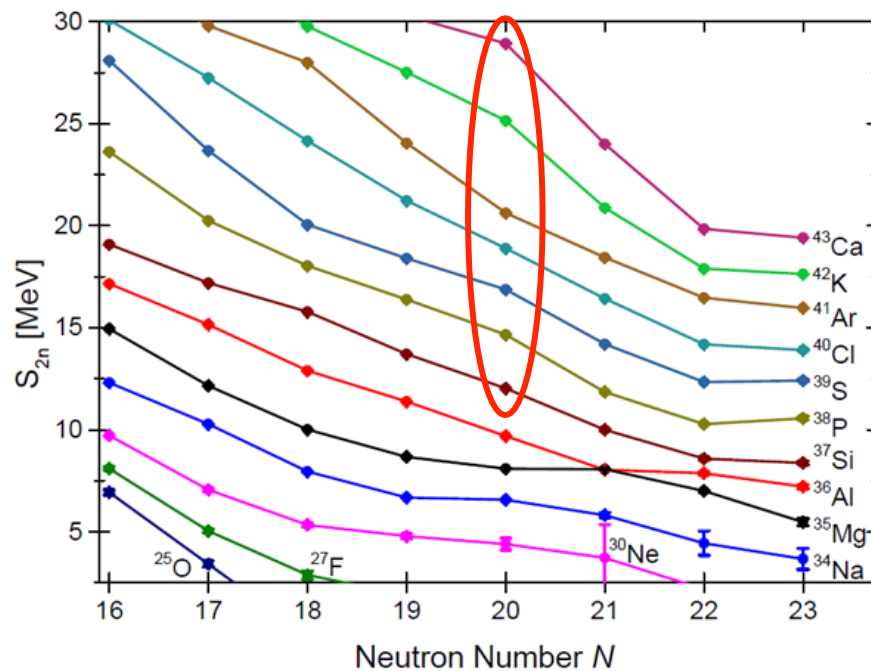
19-02-21



The Island of Inversion



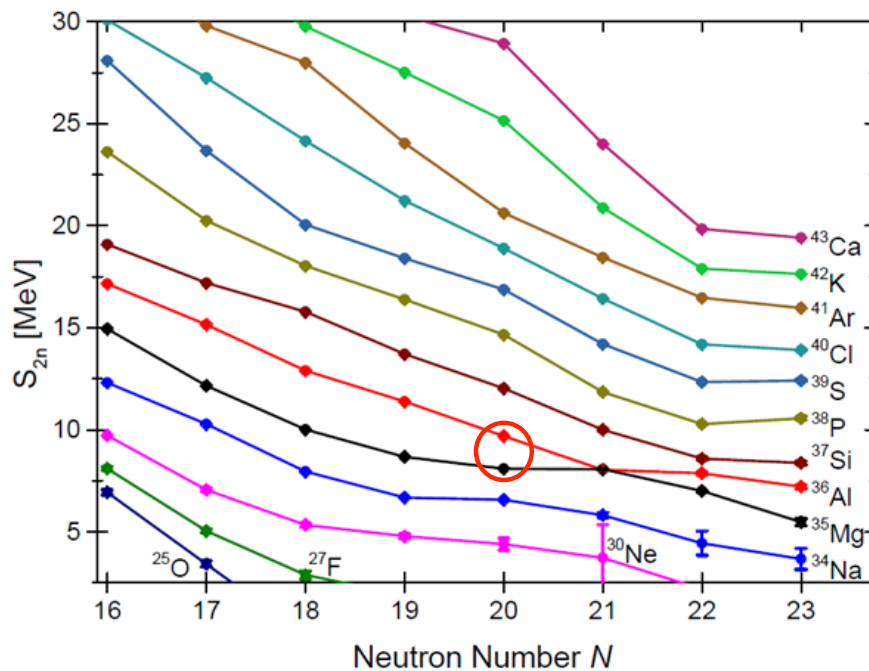
The N = 20 Shell Closure



- **Kink at N = 20 indicates shell closure**
- Shift occurs for Al indicating the upper limit of the Island of Inversion
- Still need more accurate Ne measurements for lower limit

$$S_{2n}(Z, N) = M(Z, N-2) + 2m_n - M(Z, N)$$

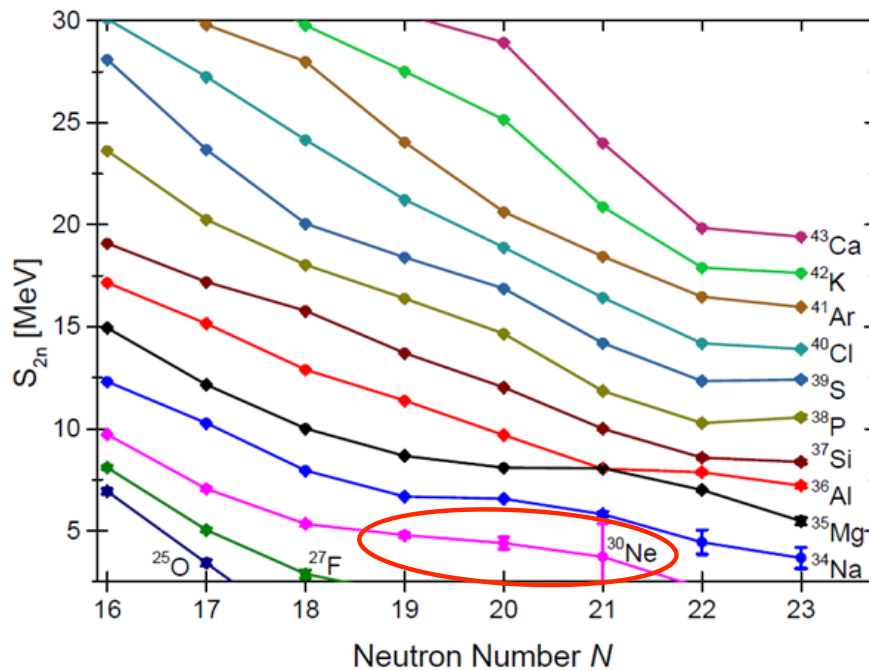
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The N = 20 Shell Closure



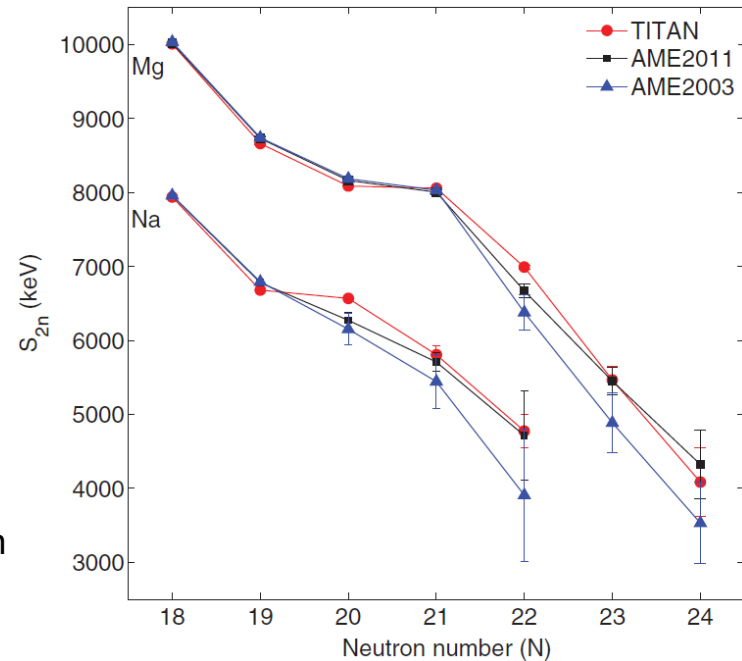
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$$S_{2n}(Z, N) = M(Z, N-2) + 2m_n - M(Z, N)$$

Previous TITAN Exploration of the Island of Inversion

²⁹ Si	³⁰ Si	³¹ Si	³² Si	³³ Si	³⁴ Si	³⁵ Si	³⁶ Si	³⁷ Si	³⁸ Si	³⁹ Si	⁴⁰ Si	⁴¹ Si	⁴² Si
²⁸ Al	²⁹ Al	³⁰ Al	³¹ Al	³² Al	³³ Al	³⁴ Al	³⁵ Al	³⁶ Al	³⁷ Al	³⁸ Al	³⁹ Al	⁴⁰ Al	⁴¹ Al
²⁷ Mg	²⁸ Mg	²⁹ Mg	³⁰ Mg	³¹ Mg	³² Mg	³³ Mg	³⁴ Mg	³⁵ Mg	³⁶ Mg	³⁷ Mg	³⁸ Mg	³⁹ Mg [#]	⁴⁰ Mg
²⁶ Na	²⁷ Na	²⁸ Na	²⁹ Na	³⁰ Na	³¹ Na	³² Na	³³ Na	³⁴ Na	³⁵ Na	³⁶ Na [#]	³⁷ Na	Sodium Z=11	
²⁵ Ne	²⁶ Ne	²⁷ Ne	²⁸ Ne	²⁹ Ne	³⁰ Ne	³¹ Ne	³² Ne	³³ Ne [#]	³⁴ Ne	Neon Z=10			
²⁴ F	²⁵ F	²⁶ F	²⁷ F	²⁸ F [#]	²⁹ F	³⁰ F [#]	³¹ F	Fluorine Z=9					
²³ O	²⁴ O	²⁵ O	²⁶ O	²⁷ O [#]	²⁸ O	Oxygen Z=8							
²² N	²³ N	²⁴ N [#]	²⁵ N [#]	Nitrogen Z=7									
²¹ C [#]	²² C	²³ C [#]	Carbon Z=6										
²⁰ B [#]	²¹ B [#]	Boron Z=5											

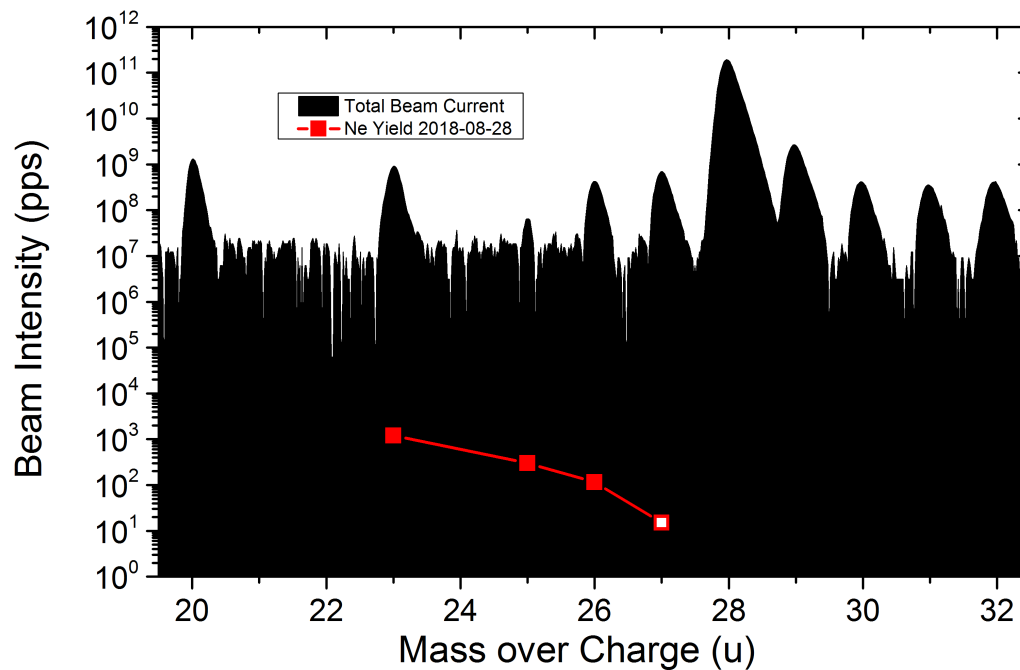
Cannot surface ionize Ne, need a different ion source



A. Chaudhuri, C. Andreoiu, T. Brunner, U. Chowdhury, S. Ettenauer, A.T. Gallant, G. Gwinner, A.A. Kwiatkowski, A. Lennarz, D. Lunney, T.D. Macdonald, B.E. Schultz, M.C. Simon, V.V. Simon, J. Dilling, Phys. Rev. C 88 (2013) 054317.

New Challenges with Neon

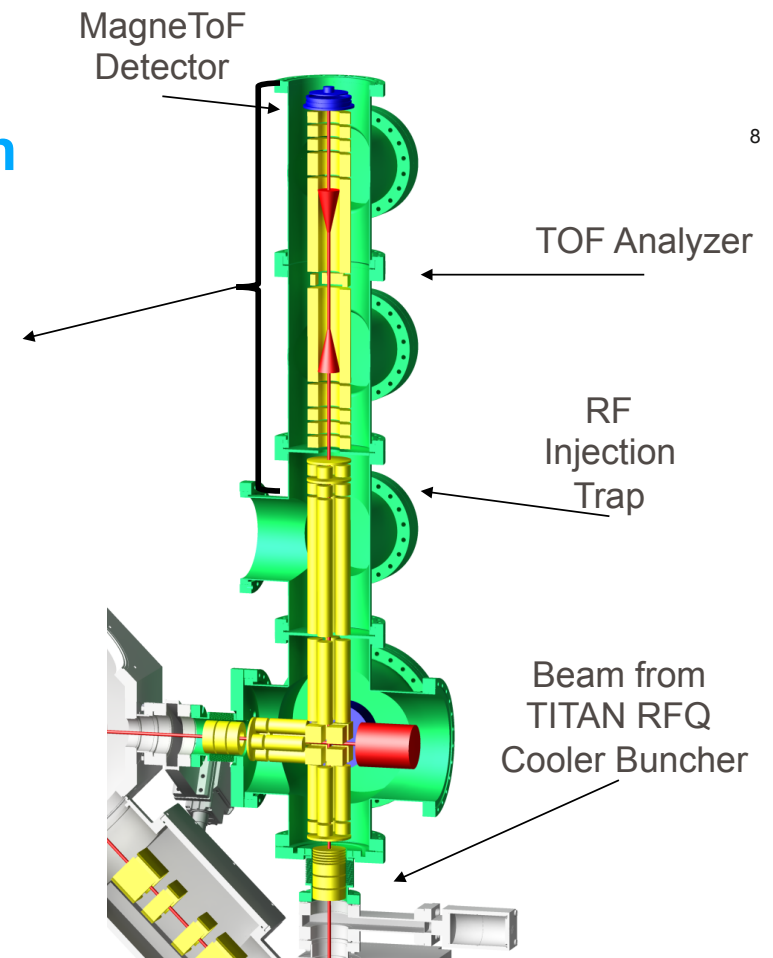
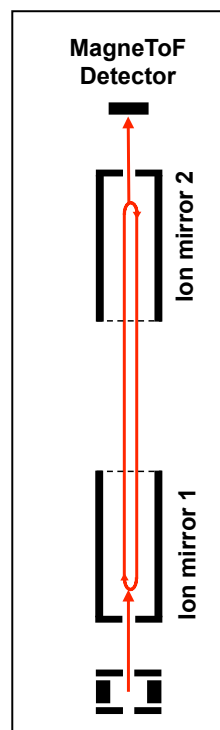
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- Forced electron beam induced arc discharge (FEBIAD) ion source is the only option for Ne
- Very high background contamination obscuring ion of interest
- Need a technique for cleaning the beam

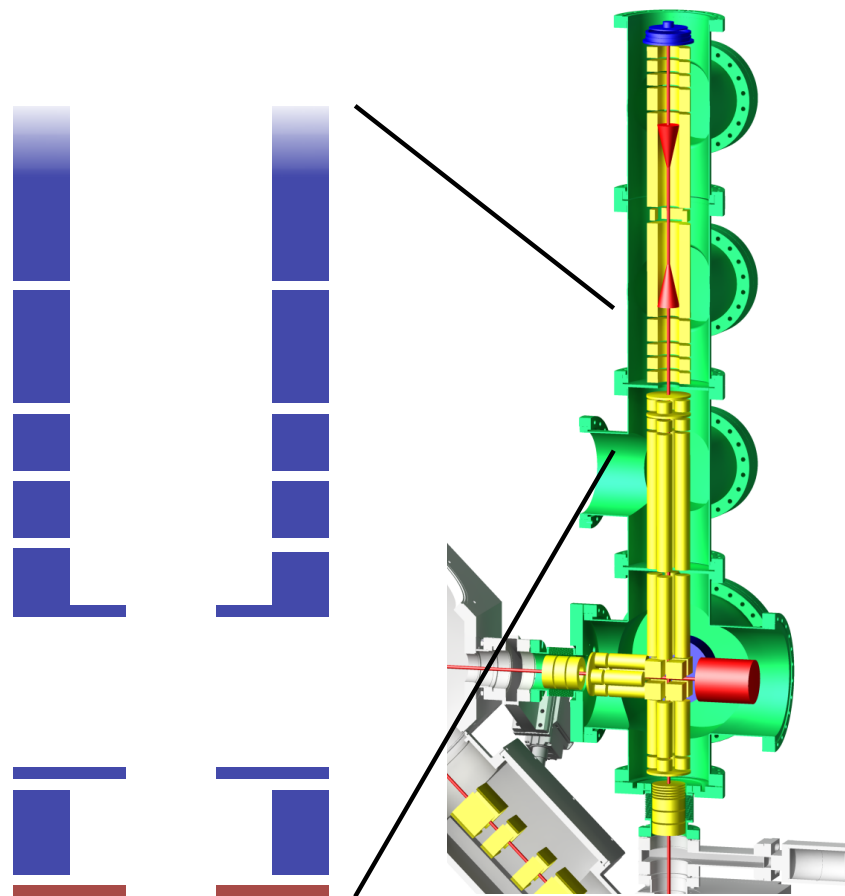
Review of Mass Measurements with MR-ToF

- Mass Measurement mode:
 - Ions ejected from Injection Trap
 - Fly in the Time of Flight Analyzer
 - Hit MagneToF Detector after opening of Ion mirror 2



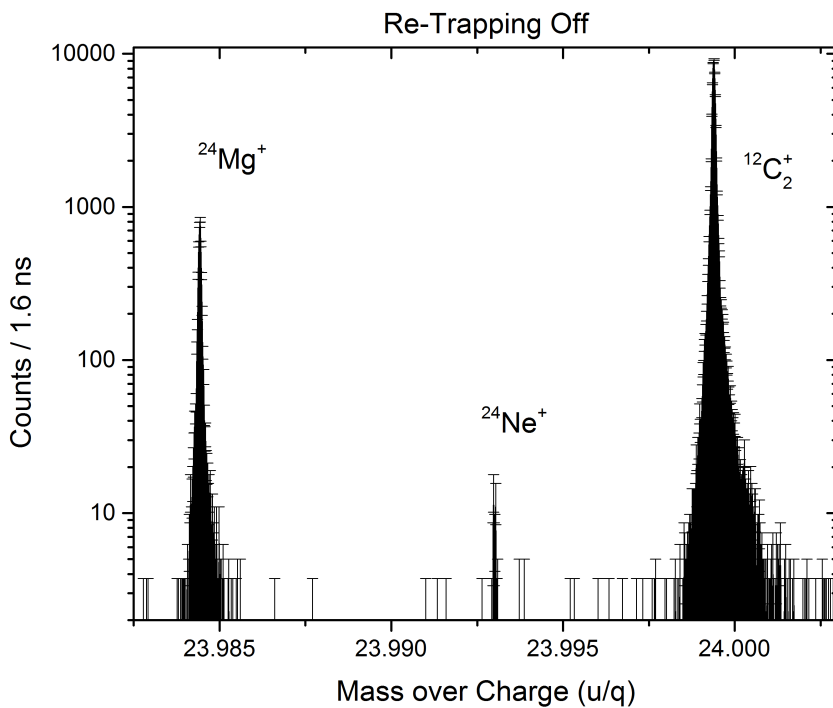
Introduction to Re-Trapping

- Re-Trapping Mode:
 - Inject and fly in Time of Flight Analyzer
 - Open Ion mirror 1
 - Close trap when ion of interest is inside
 - Re-inject purified beam in mass measurement mode



Re-Trapping in Action

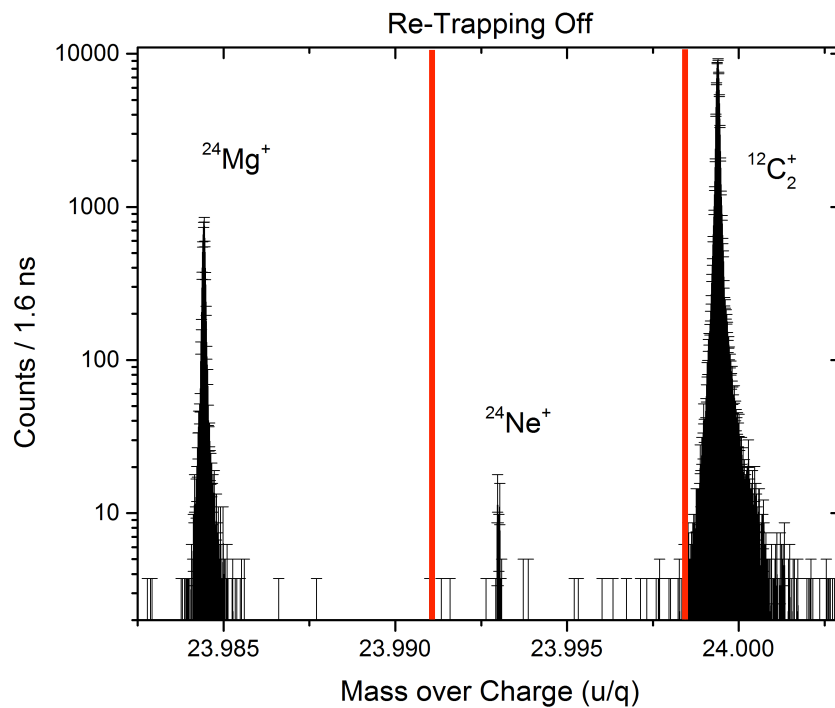
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- Take initial spectra to identify desired window
- Set window to capture Ne
- However, still need a calibrant in the spectrum

Re-Trapping in Action

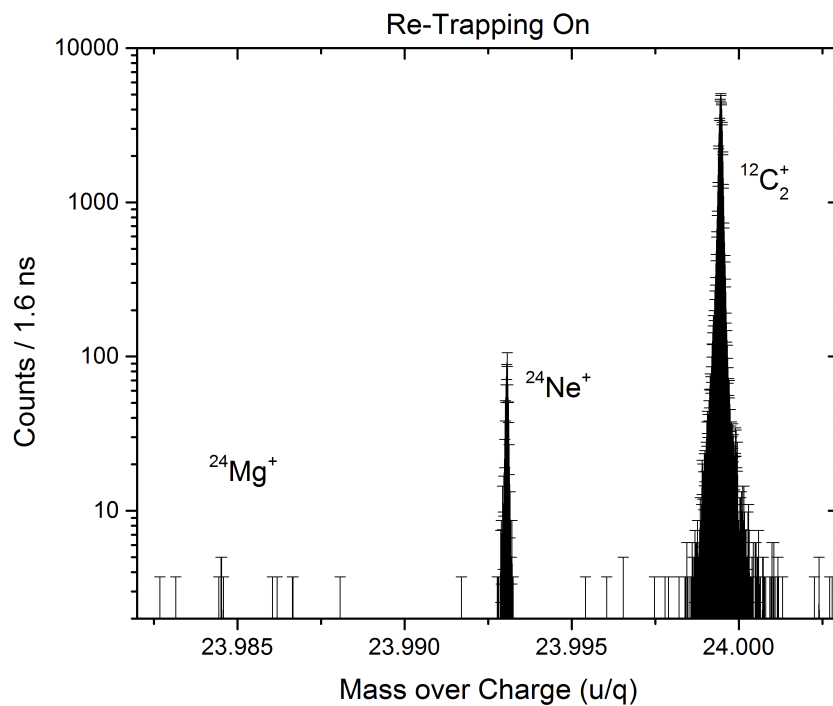
11



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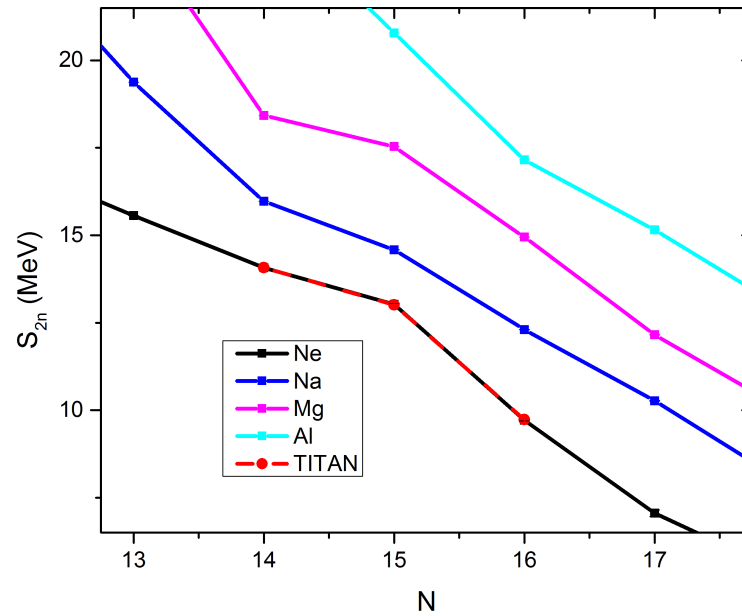
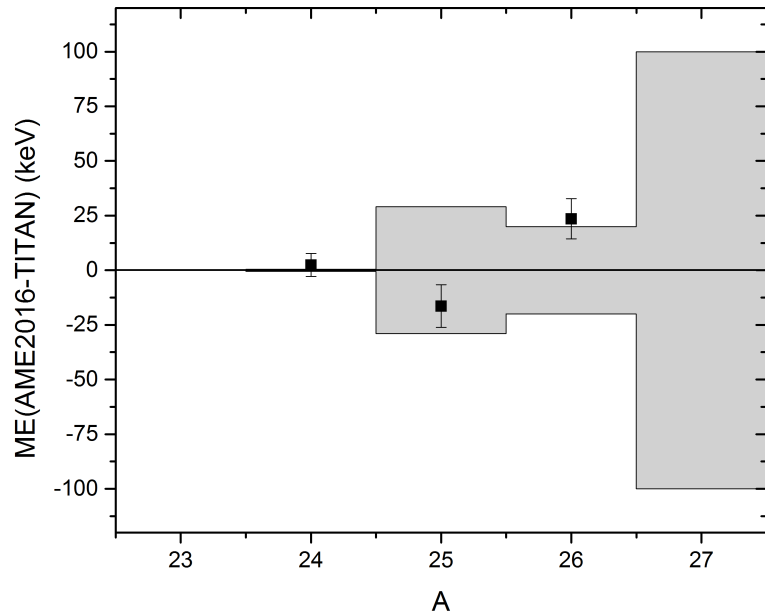
Re-Trapping in Action

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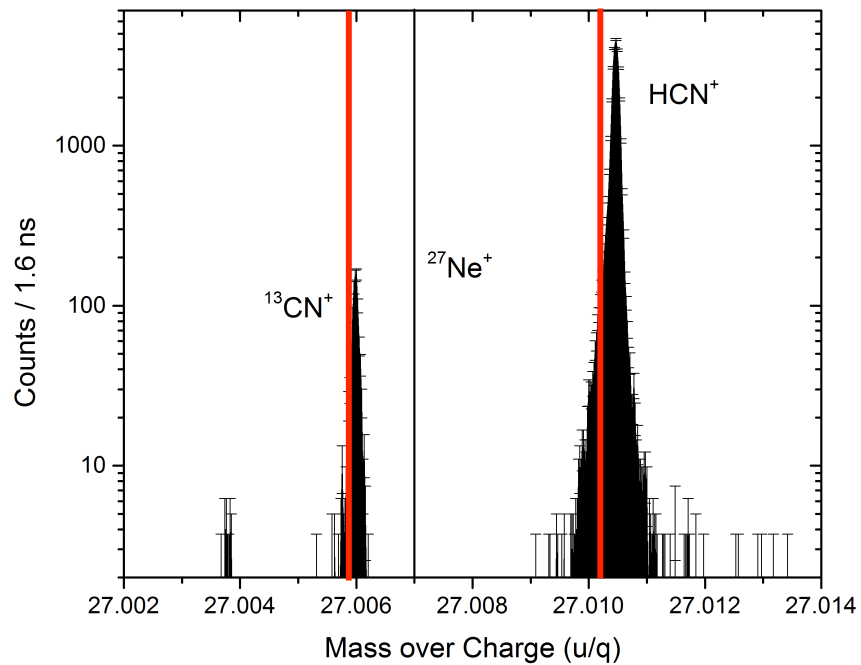
- Mg^+ suppressed $\approx 10^4$
- C_2^+ suppressed $\approx 10^1$
 - Still plenty of counts for calibration

Preliminary Results



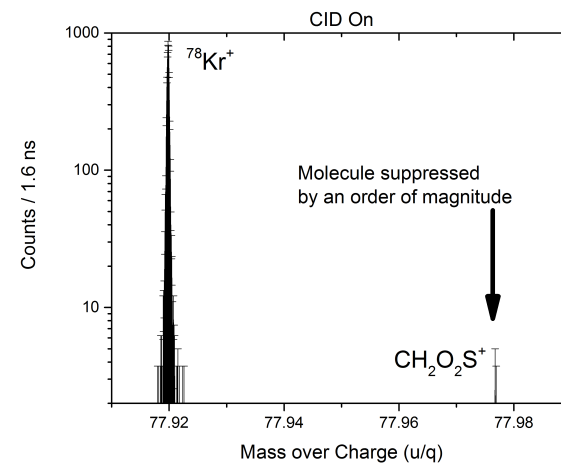
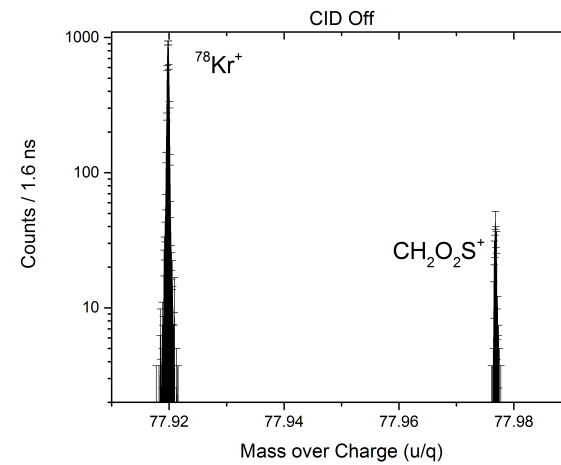
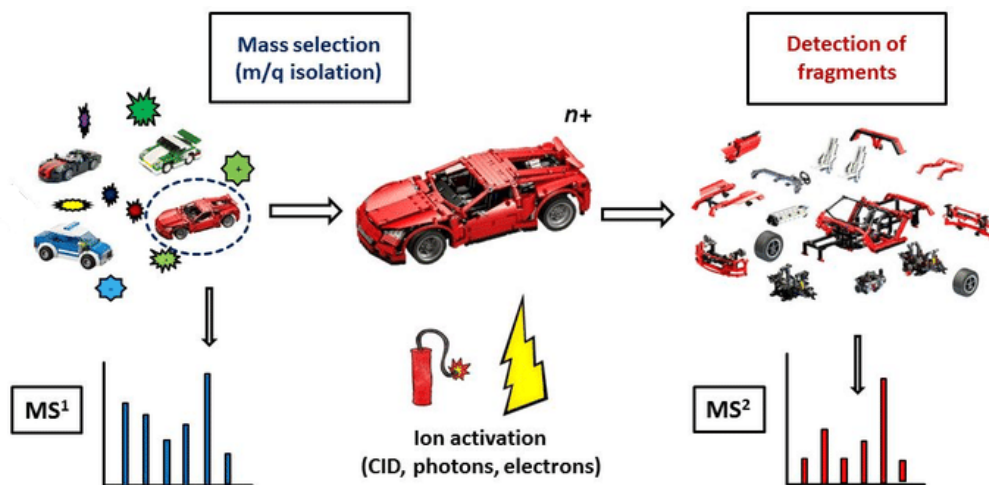
Is Re-Trapping Enough?

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- Re-trapping window cannot single out ion of interest
- For heavier Ne beams, 10^4 suppression will not be enough

Collision Induced Dissociation



Ranković, Miloš. (2016). Photon and electron action spectroscopy of trapped biomolecular ions - From isolated to nanosolvated species. 10.13140/RG.2.2.20901.91365.

Summary and Outlook

²⁷ Si	²⁸ Si	²⁹ Si	³⁰ Si	³¹ Si	³² Si	³³ Si	³⁴ Si	³⁵ Si	³⁶ Si	³⁷ Si
²⁶ Al	²⁷ Al	²⁸ Al	²⁹ Al	³⁰ Al	³¹ Al	³² Al	³³ Al	³⁴ Al	³⁵ Al	³⁶ Al
²⁵ Mg	²⁶ Mg	²⁷ Mg	²⁸ Mg	²⁹ Mg	³⁰ Mg	³¹ Mg	³² Mg	³³ Mg	³⁴ Mg	³⁵ Mg
²⁴ Na	²⁵ Na	²⁶ Na	²⁷ Na	²⁸ Na	²⁹ Na	³⁰ Na	³¹ Na	³² Na	³³ Na	³⁴ Na
²³ Ne	²⁴ Ne	²⁵ Ne	²⁶ Ne	²⁷ Ne	²⁸ Ne	²⁹ Ne	³⁰ Ne	³¹ Ne	³² Ne	³³ Ne [#]
²² F	²³ F	²⁴ F	²⁵ F	²⁶ F	²⁷ F	²⁸ F [#]	²⁹ F	³⁰ F [#]	³¹ F	

- High precision mass measurements of ²⁴⁻²⁶Ne agrees with literature
- MR-ToF's beam purification has been improved with suppressions of:
 - Re-Trapping: 10⁴
 - CID: 10¹
- These tools allow us to reach Ne isotopes in the Island of Inversion



Thank you
Merci

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