

The Heavy Ion Guide Gas Handling System: Calculations and Execution

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CYCLOTRON INSTITUTE
T E X A S A & M U N I V E R S I T Y

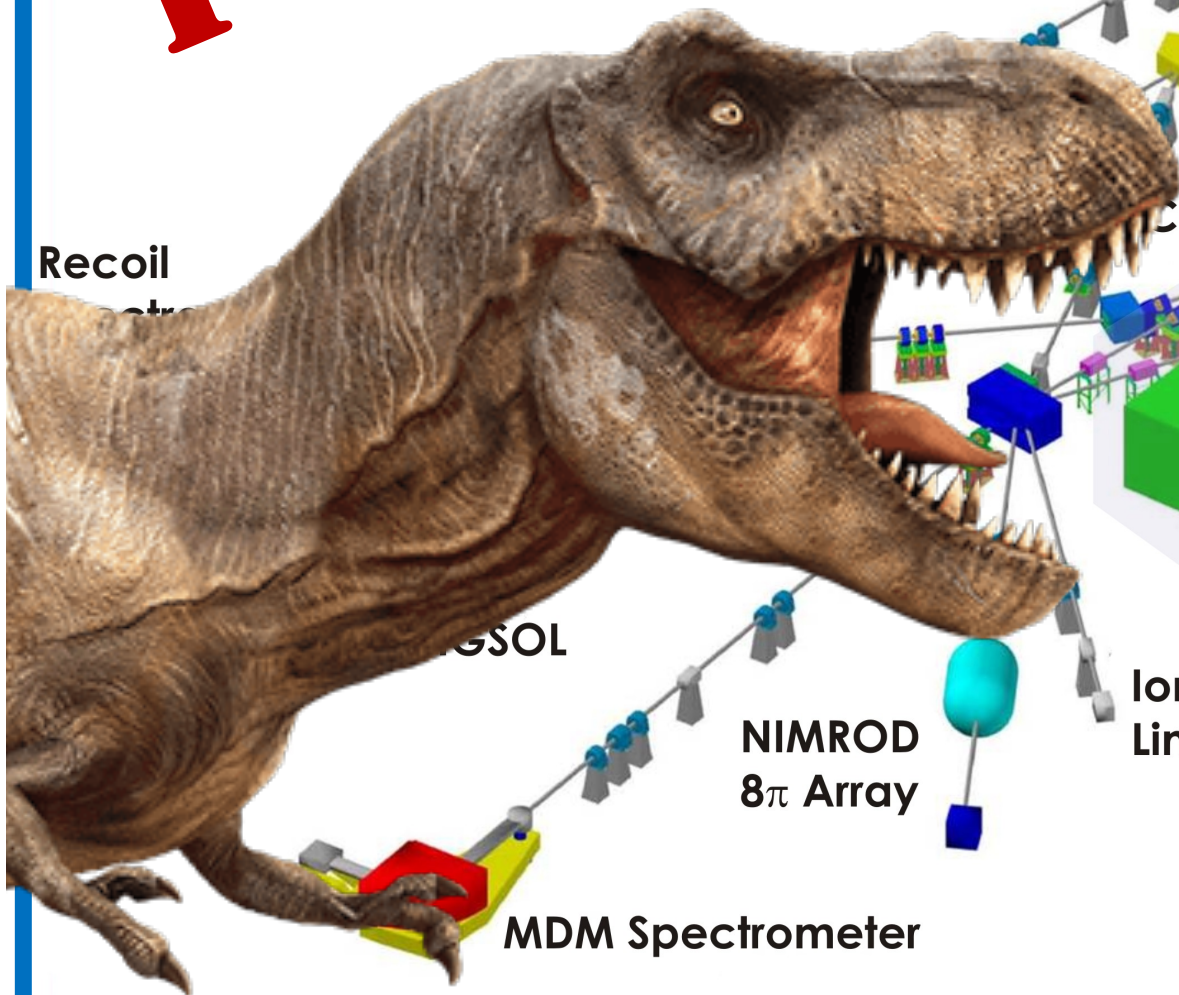


Texas A&M Cyclotron Institute



UPGRADE

T-REX



ECR 1

K500
Cyclotron

Light Ion
Guide

CB-ECR

Heavy Ion
Guide

BIGSOL

K150
Cyclotron

Ion Interactions
Line

NIMROD
 8π Array

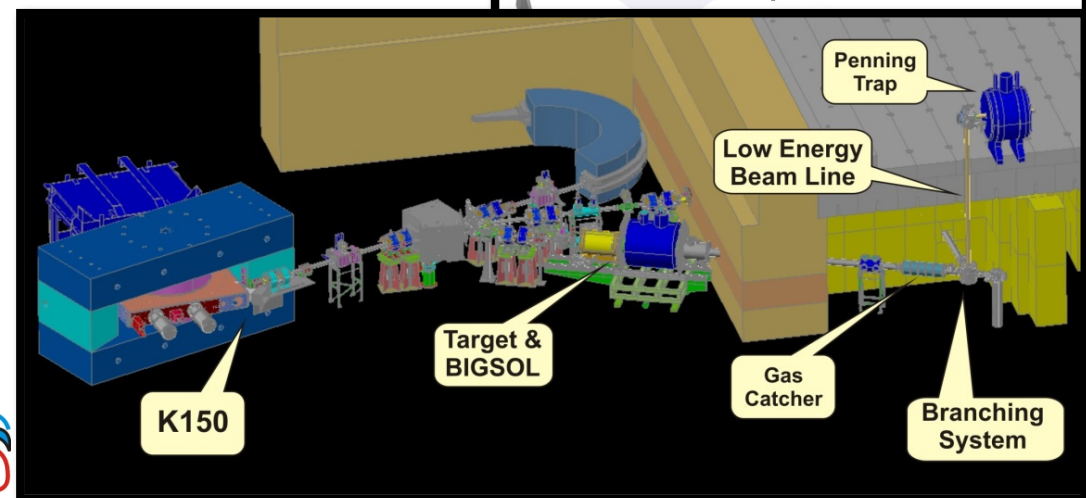
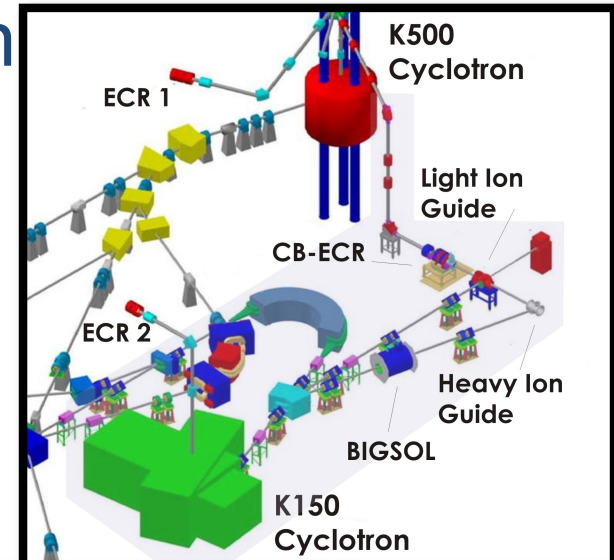
MDM Spectrometer

10 m

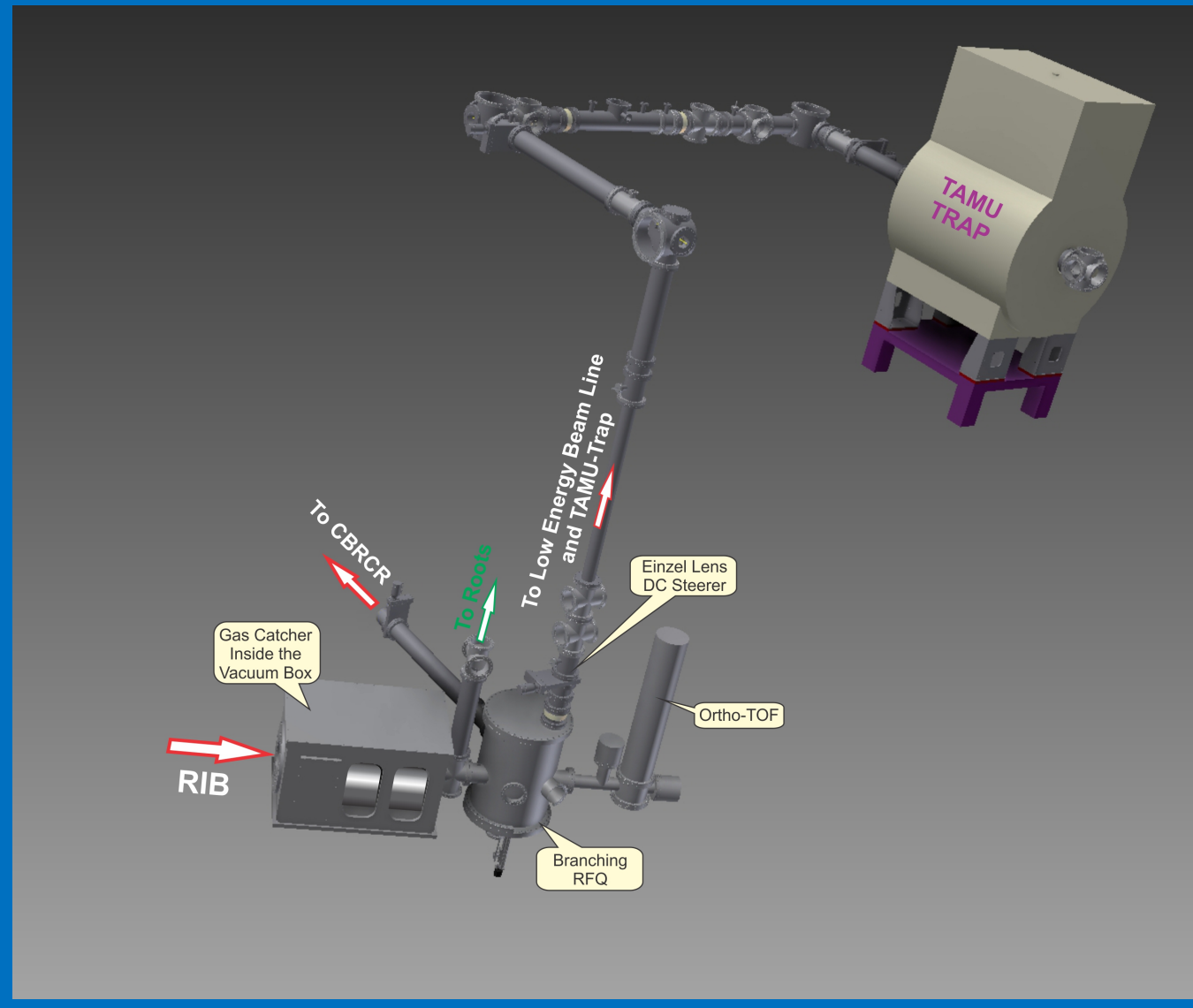


T-REX Upgrade Project

- Recommission K-150 Cyclotron
 - High-intensity beams
 - Secondary RIBs
 - Reacceleration by K-500 cyclotron
- Install ion guides
 - Heavy ion guide
 - Light ion guide



Heavy Ion Guide (HIG)



The Gas Catcher

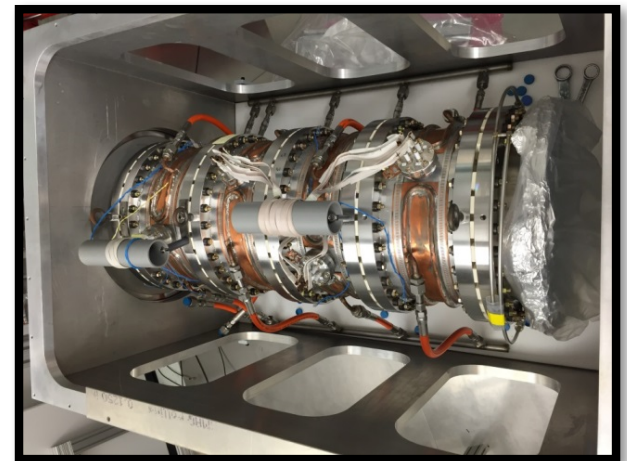
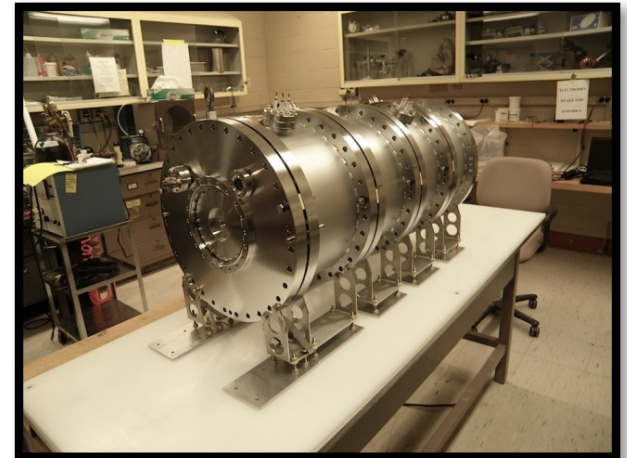
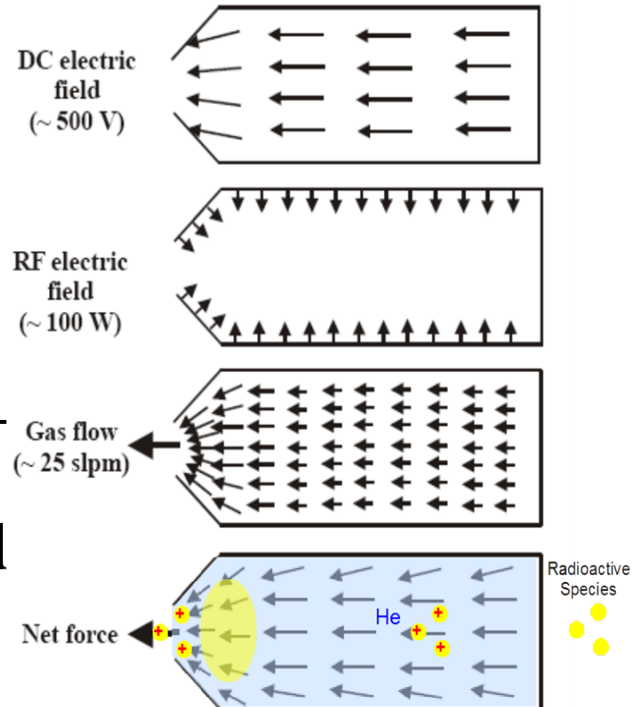
- Designed at ANL
- Central piece of HIG
- Al Degrader first

DC Field

RF Field

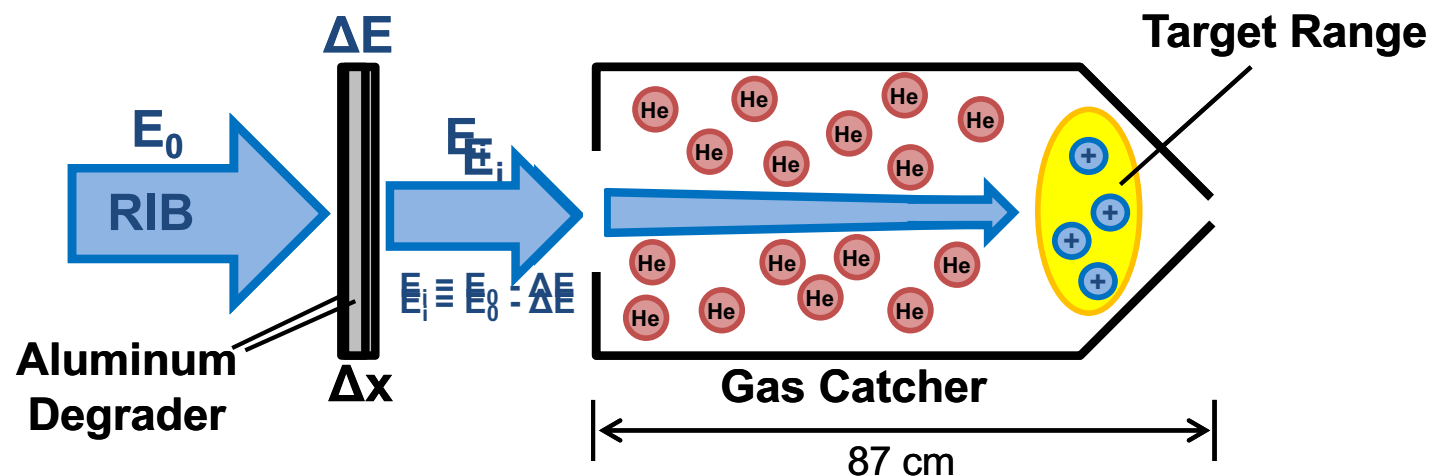
+ Helium Gas Flow

= Most Ions Captured



Pressure Effects

- Need to know pressure's effect on:
 - Ability of gas to stop ions
 - Required thickness of Al degrader
- How? – Use SRIM simulations to:
 - Find energy of ions that can be absorbed (E_i)
 - Calculate corresponding Al thickness (Δx)
 - Simulate system to find energy and space distributions



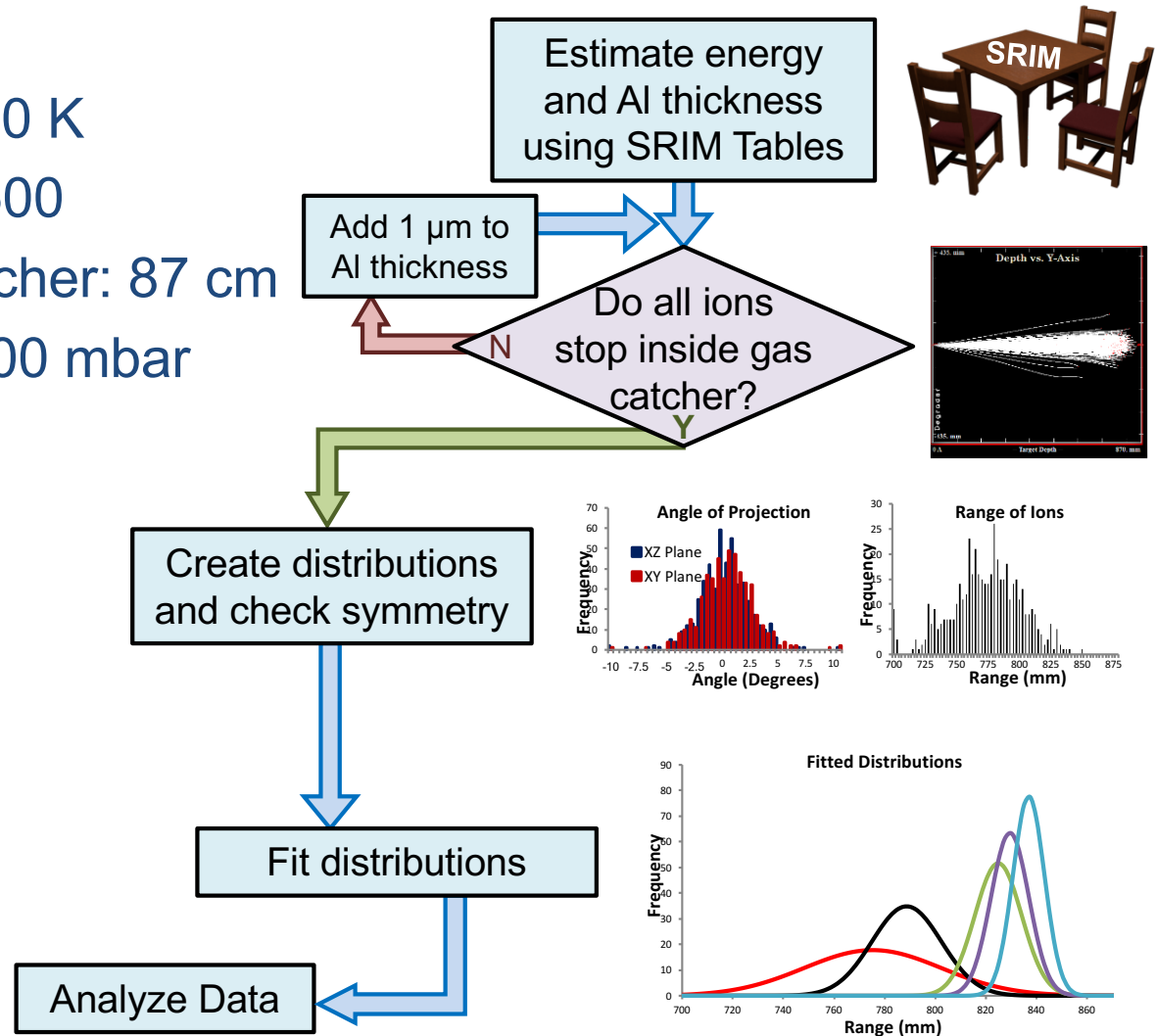
SRIM/TRIM Simulations

- Conditions:

- Temperature: ~300 K
- Number of ions: 500
- Length of gas catcher: 87 cm
- Pressures: 100-500 mbar

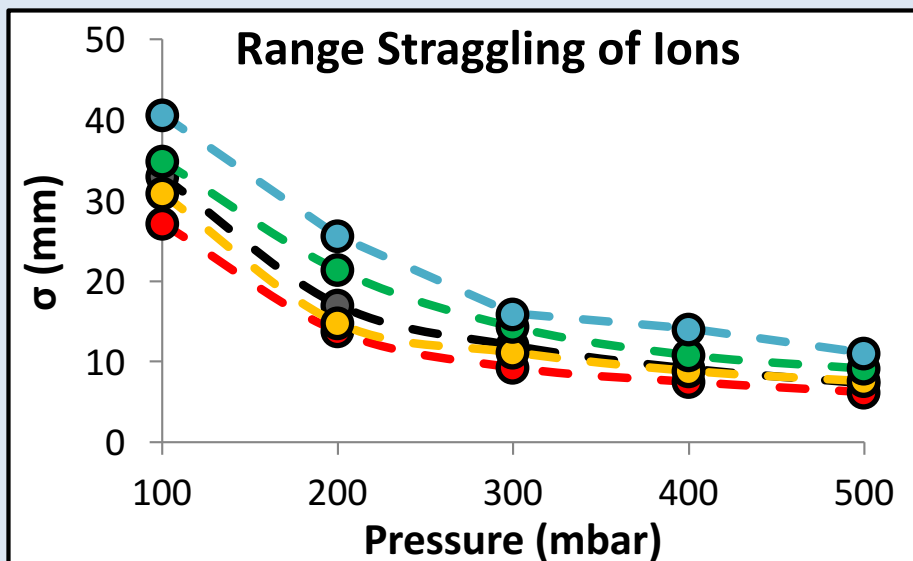
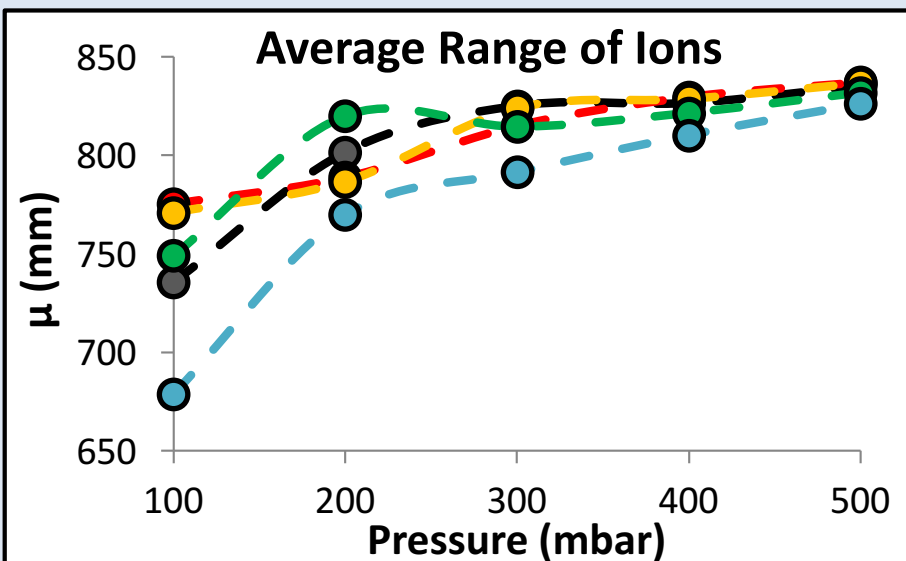
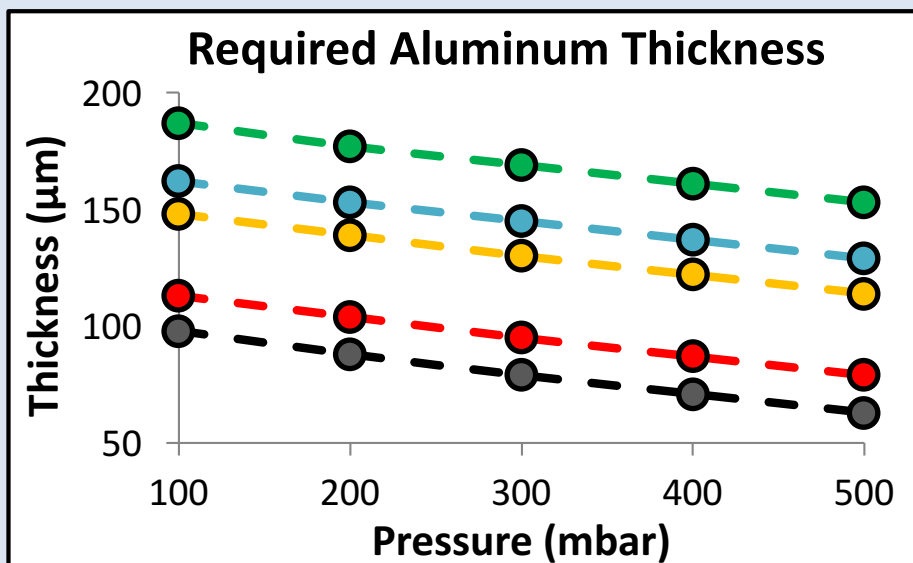
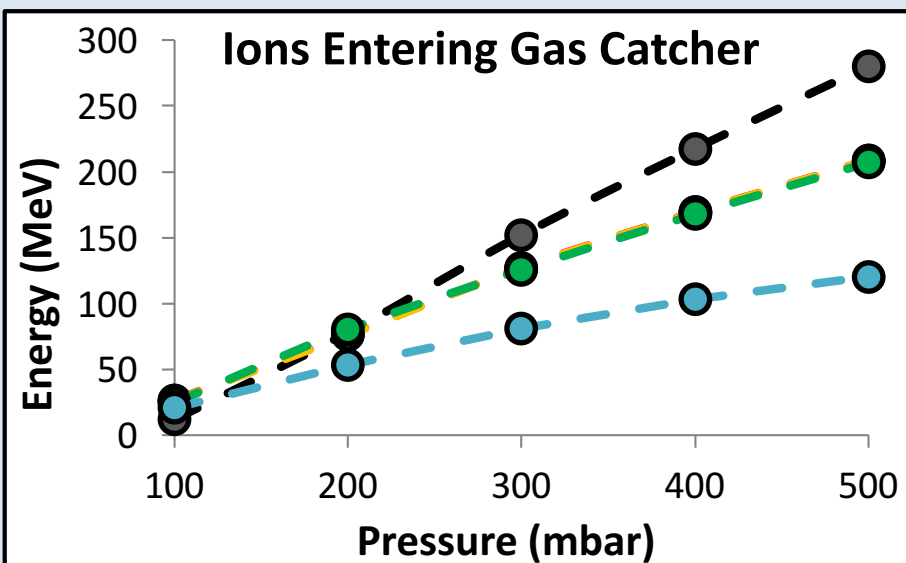
- Ions:

- ^{50}Ca at:
 - 10 MeV/u
 - 12 MeV/u
 - 14 MeV/u
- ^{68}Ni at 10 MeV/u
- ^{24}Si at 14 MeV/u



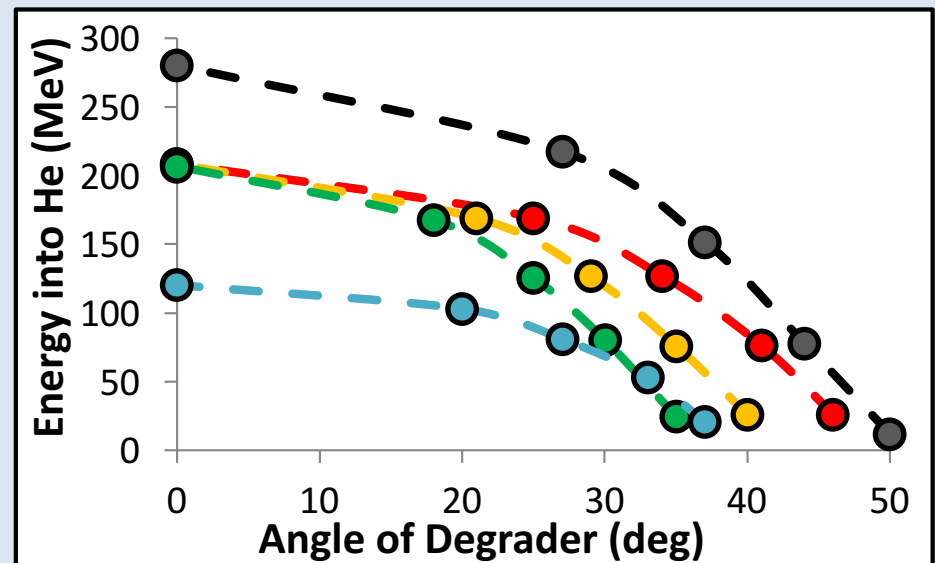
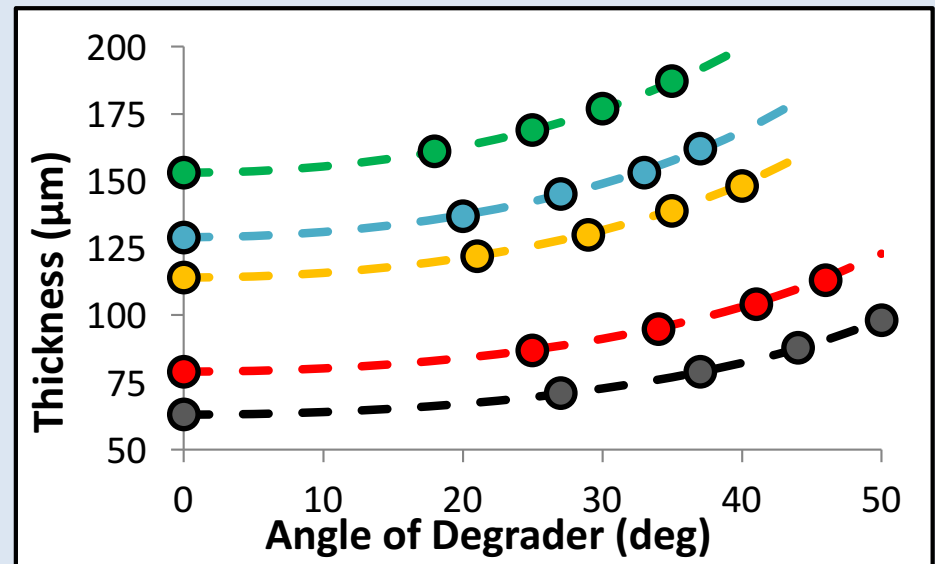
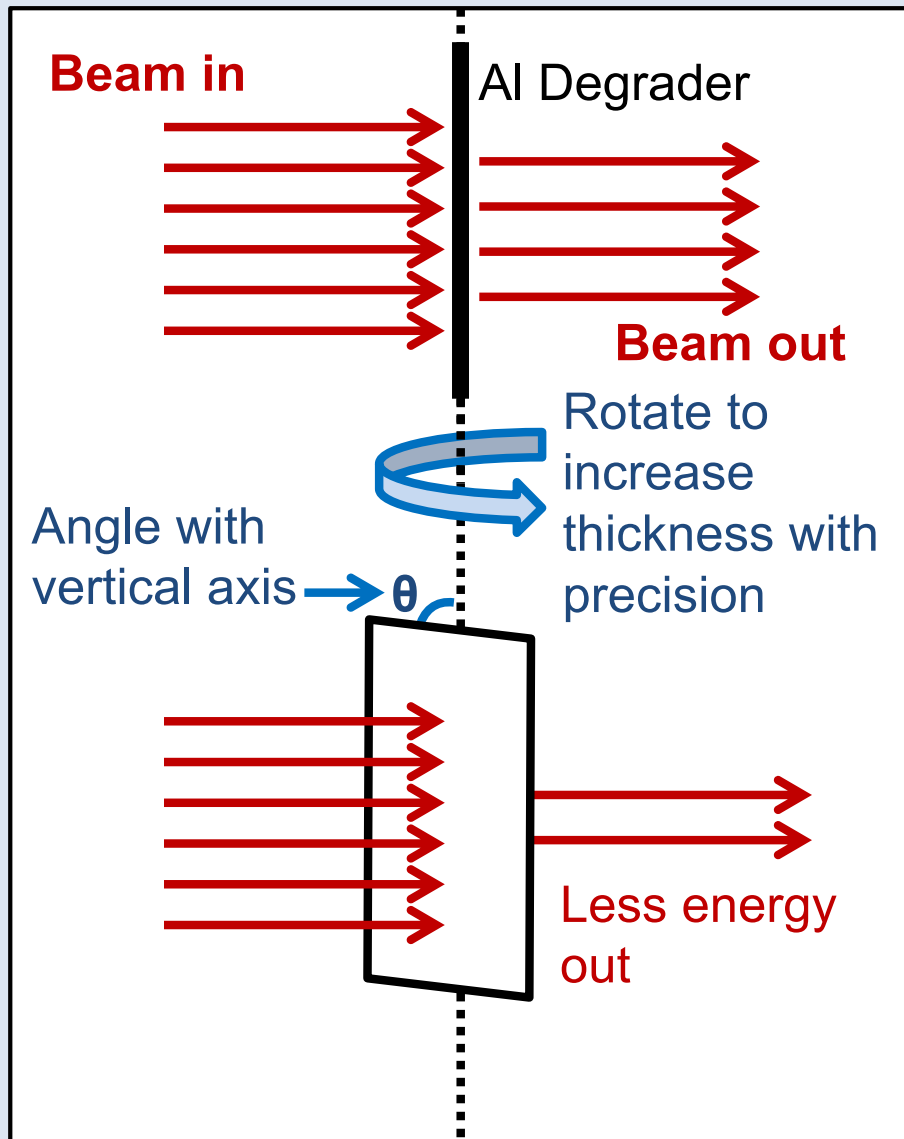
Results of Simulations

■ ^{50}Ca , 10 MeV/u ■ ^{50}Ca , 12 MeV/u ■ ^{50}Ca , 14 MeV/u ■ ^{68}Ni , 10 MeV/u ■ ^{24}Si , 14 MeV/u



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■ ^{50}Ca , 10 MeV/u ■ ^{50}Ca , 12 MeV/u ■ ^{50}Ca , 14 MeV/u ■ ^{68}Ni , 10 MeV/u ■ ^{24}Si , 14 MeV/u

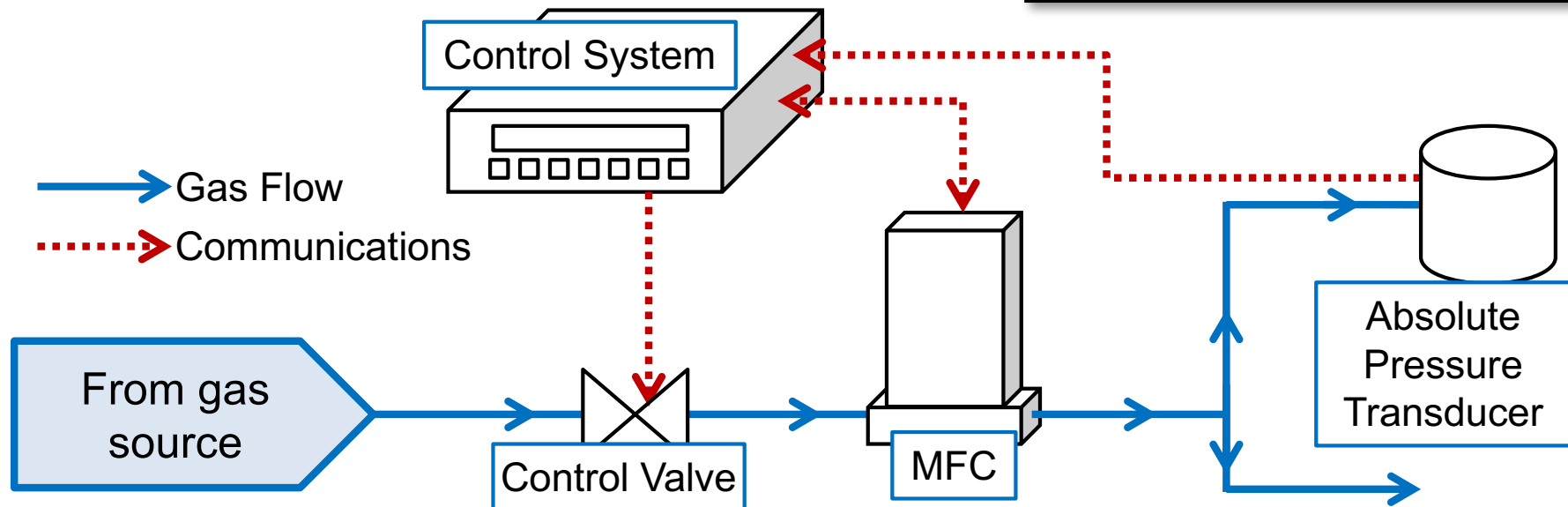


Gas Handling System

- Need to control pressure and gas flow
- How? – MKS Type 146C Control System
 - Use MFC, control valve, and Baratron Pressure Transducer with control system
 - Program digital interface using LabVIEW
 - Allow user control of pressure and flow rate through interface

Equipment

- MKS Type 146C Control System
 - MKS Type 1479A MFC
 - MKS Type 148J Control Valve
 - MKS Baratron Type 626A Absolute Pressure Transducer
- Absolute Pressure Transducer



Digital Interface

The screenshot displays the MKS Type 146C Control System software interface. The interface includes a menu bar (File, Edit, View, Project, Operate, Tools, Window, Help), a toolbar, and a search bar. The main display area is divided into several sections:

- Pressure (mbar) Plot:** A graph showing a steady pressure reading of 1009.67 mbar. A red dashed box and arrow point to this plot with the annotation "Obtain current readings".
- Flow Rate (sccm) Plot:** A graph showing a fluctuating flow rate. A red dashed box and arrow point to this plot with the annotation "Obtain current readings".
- Pressure Control Parameters:** A section with input fields for Setting (mbar) (1017), Lead (5), and Gain (1000). A red dashed box and arrow point to this section with the annotation "Choose control parameters".
- Flow Rate (sccm) Parameters:** A section with input fields for Setting (sccm) (110), Lead (5), and Gain (1000). A red dashed box and arrow point to this section with the annotation "Choose control parameters".
- Communication Settings:** A section with dropdown menus for Channel Numbers (MFC: 1, Pressure Sensor: 2), Serial Port (COM7), and Output Messages (@0211:OK). A red dashed box and arrow point to this section with the annotation "Set up communications".
- Mode of Operation:** A section with radio buttons for Close Valve (0%), Open Valve (100%), Pressure Control, and MFC Control. A red dashed box and arrow point to this section with the annotation "Choose mode of operation".
- STOP Button:** A large red button labeled "STOP" is located at the bottom right of the interface.

Outcomes

- General idea of degrader thickness
 - Angle rotation for precision
- Good starting point for in-beam measurements
 - Simulation results can be normalized to experimental data later
- Digital interface ready for use

Acknowledgements

I would like to thank Dr. Greg Chubaryan for taking me on as an REU student this summer and mentoring me through this project.

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References

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