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# Multinucleon Transfer in $^{40}\text{Ar} + ^{64}\text{Ni}$ at 15 MeV/nucleon Explored via Studies of Momentum Distributions

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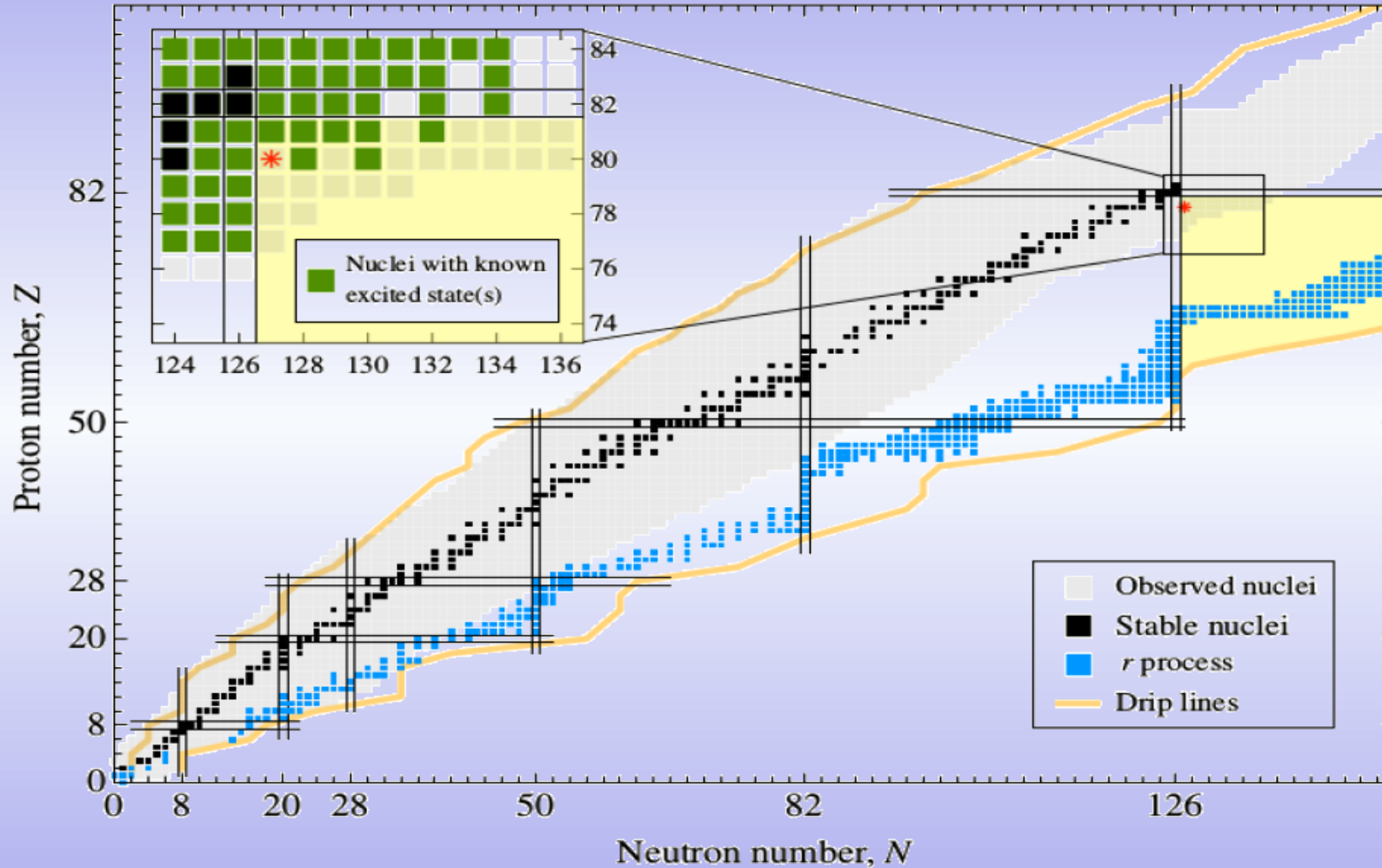
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# Overview

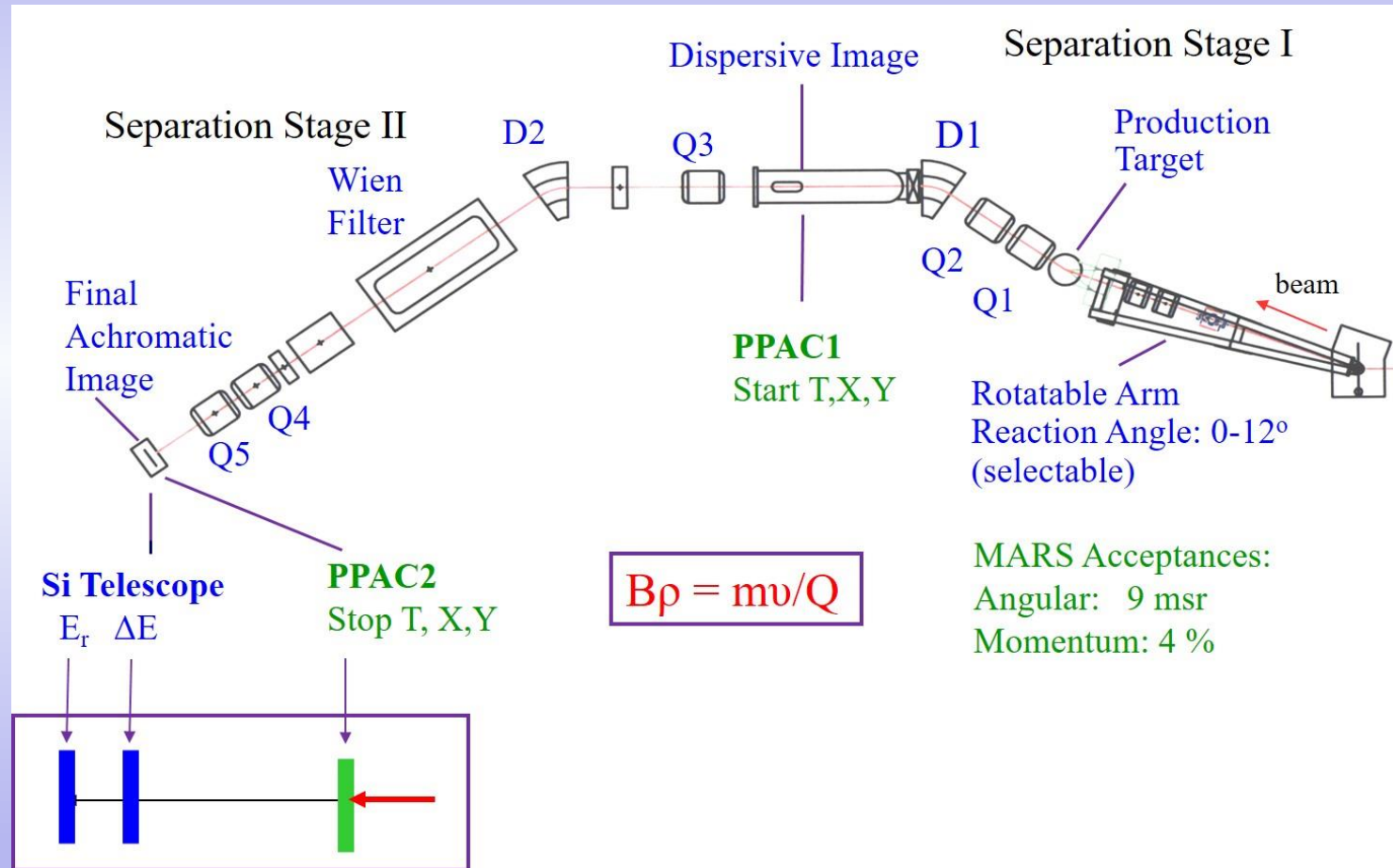
- Introduction
- MARS Experimental Setup
- Computational Models
- Results and Comparisons
- Summary

# Table of nuclides



- 288 stable
- $\sim 3300$  short-lived (radioactive) nuclei synthesized to date
- large region of neutron-rich nuclei is still unexplored ( $\sim 4000$  nuclei)

# MARS Experimental Setup



# Computational Models

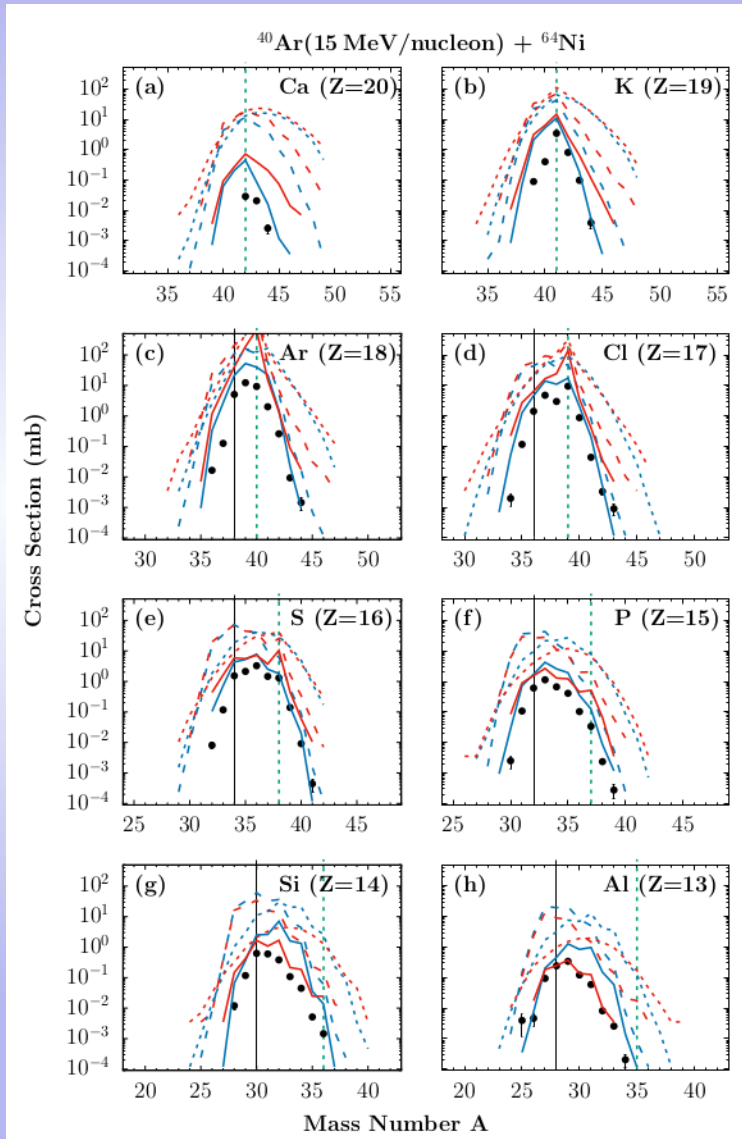
- DIT (Deep-Inelastic Transfer) model<sup>1</sup>
  - Phenomenological model
  - Di-nuclear configuration of the system
  - Stochastic exchange of nucleon through a “window” in the potential
- CoMD (Constrained Molecular Dynamics) model<sup>2</sup>
  - Microscopic model
  - Quantum molecular dynamics
  - Gaussian wavepackets – Skyrme-type effective interaction
  - Compressibility:  $K = 9\rho_0^2 \frac{\partial^2}{\partial \rho^2} \left( \frac{E}{A} \right)$
- GEMINI<sup>3</sup>
  - Deexcitation code – Binary-decay/”Evaporation”

<sup>1</sup>L. Tassan-Got, C. Stephan, Nucl. Phys. A 524, 121 (1991)

<sup>2</sup>M. Papa, A. Bonasera et al., Phys. Rev. C 64, 024612 (2001)

<sup>3</sup>R. Charity et al., Nucl. Phys. A 483, 371 (1988)

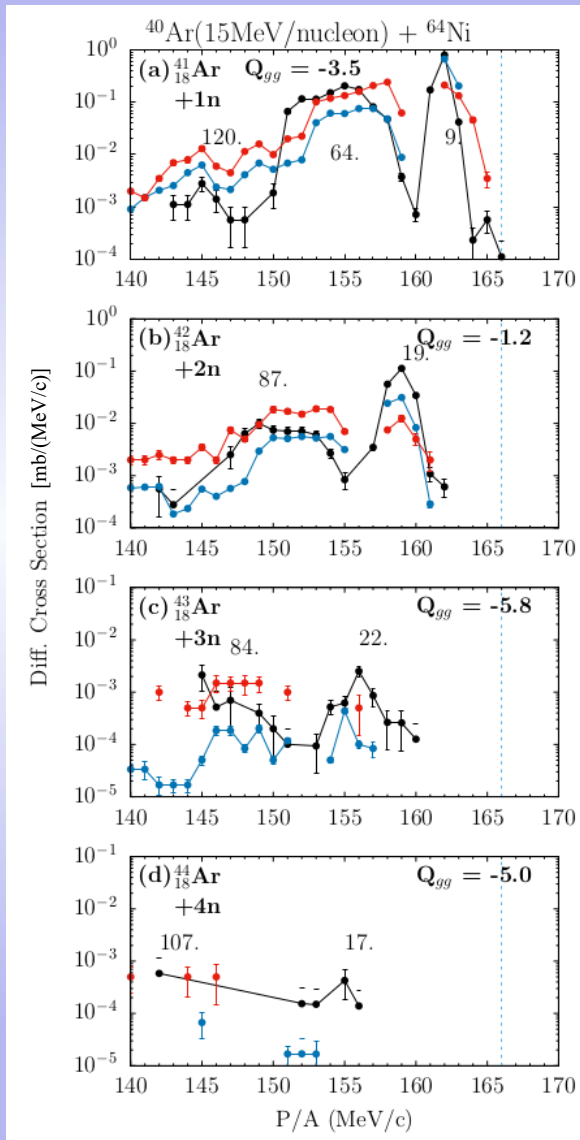
# Results – Mass Distributions



- : Experimental Data
- ⋯ : DIT/GEMINI primaries
- : DIT/GEMINI totals
- : DIT/GEMINI filtered
- ⋯ : CoMD/GEMINI primaries
- : CoMD/GEMINI totals
- : CoMD/GEMINI filtered

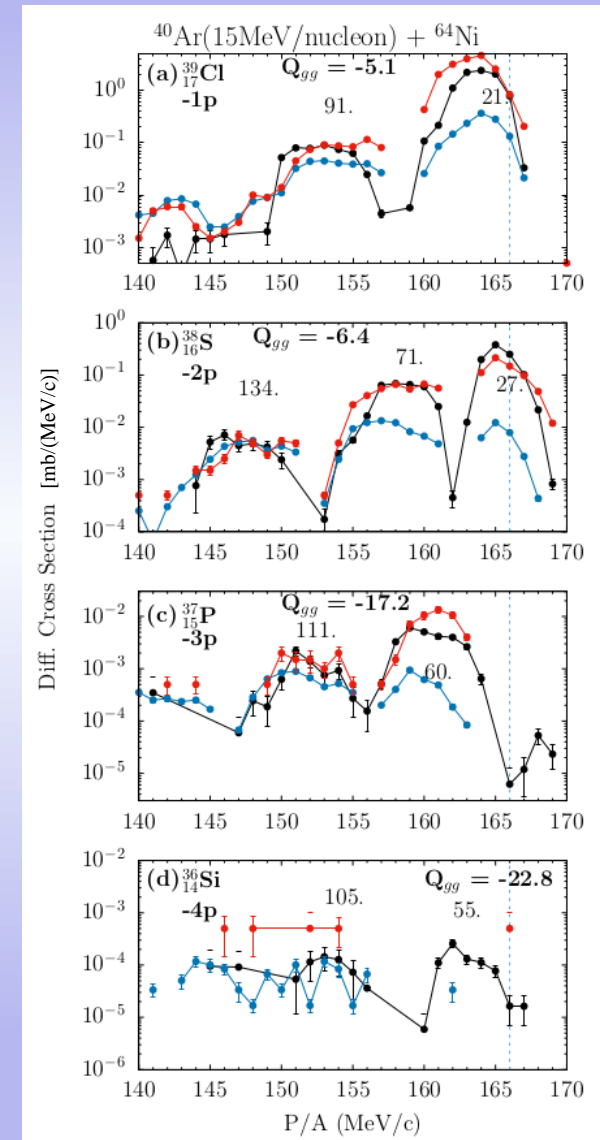
Compressibility: **K=254 MeV**

# Results – Momentum Distributions of Projectile Fragments

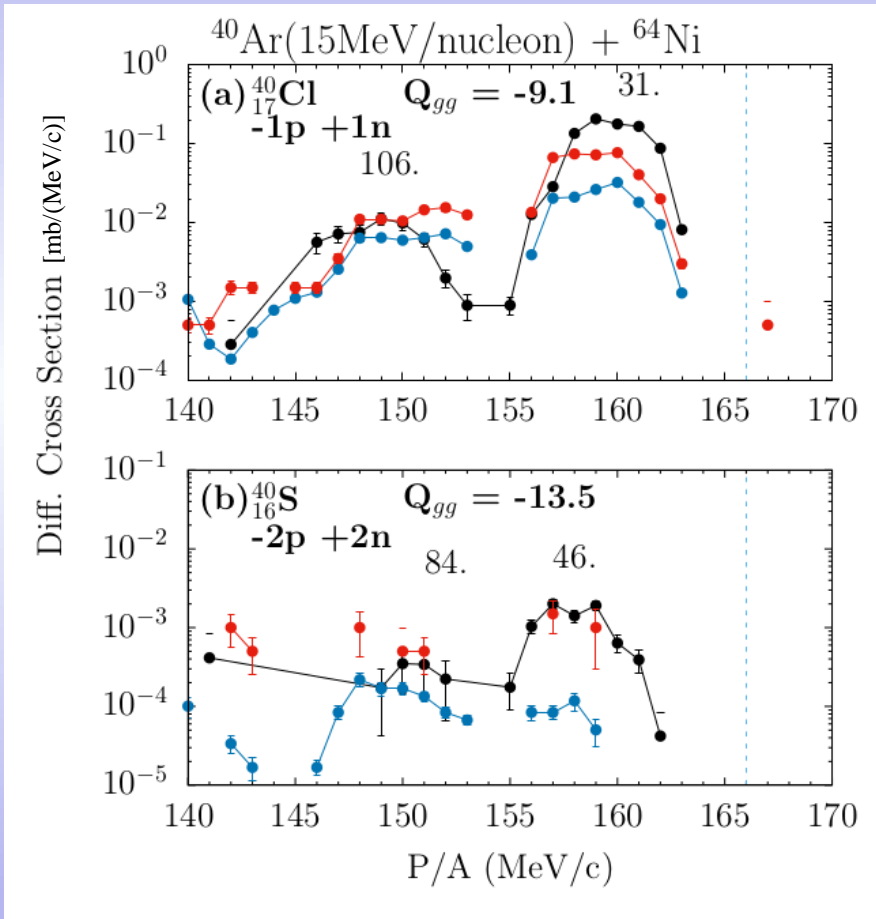


- : Experimental Data
- : DIT/GEMINI filtered
- : CoMD/GEMINI filtered  $K=254$

$$E_{tot}^* = Q_{gg} - Q$$



# Results – Momentum Distributions

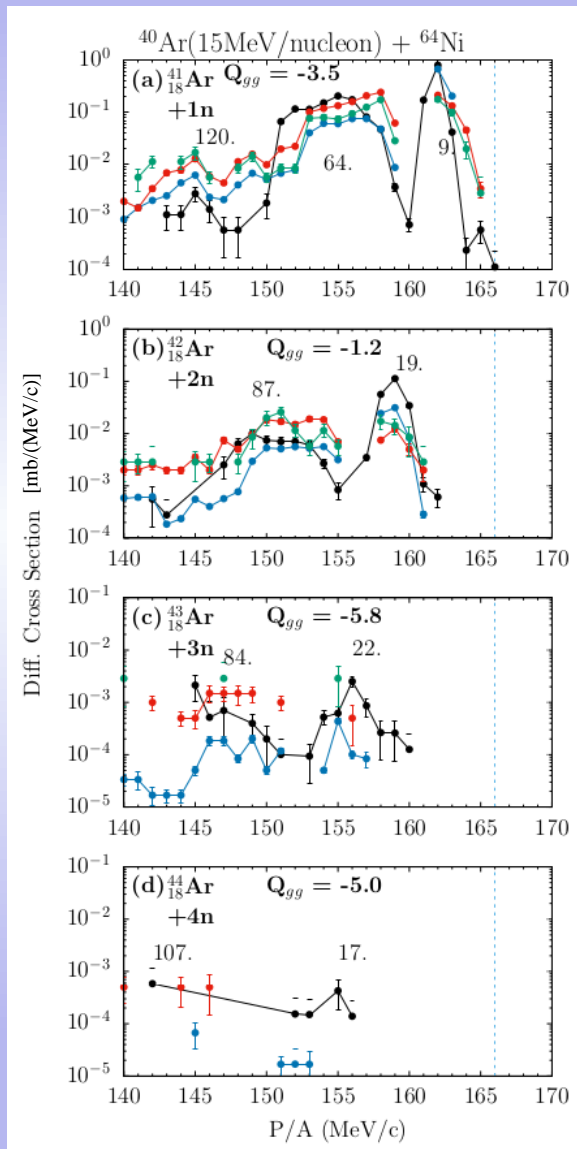


- : Experimental Data
- : DIT/GEMINI filtered
- : CoMD/GEMINI filtered **K=254**

$$E_{tot}^* = Q_{gg} - Q$$

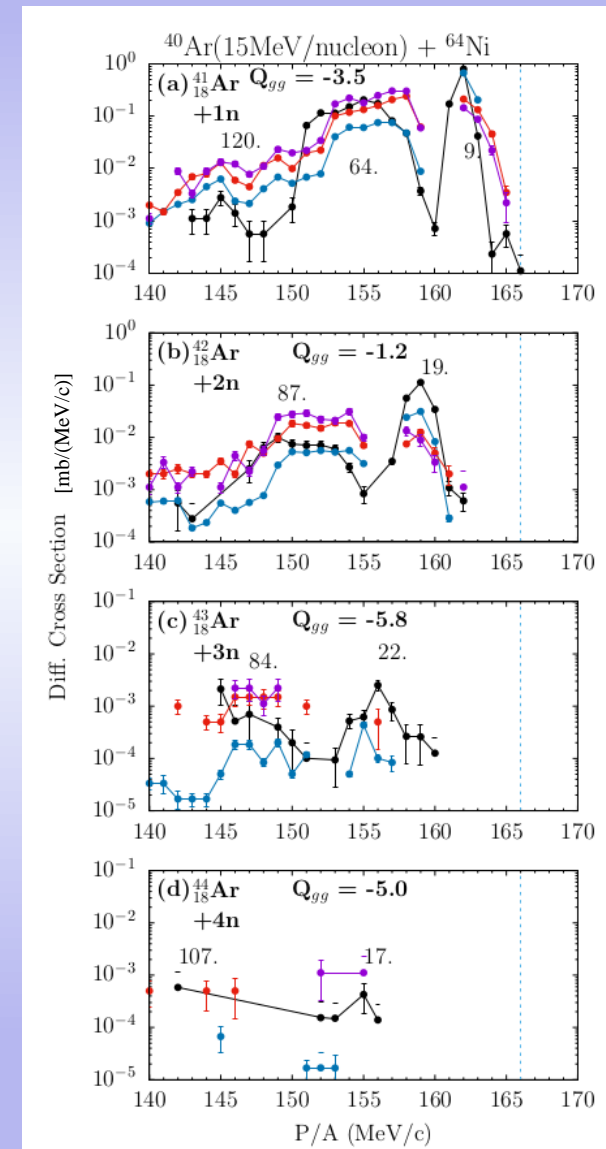


# Results – Momentum Distributions

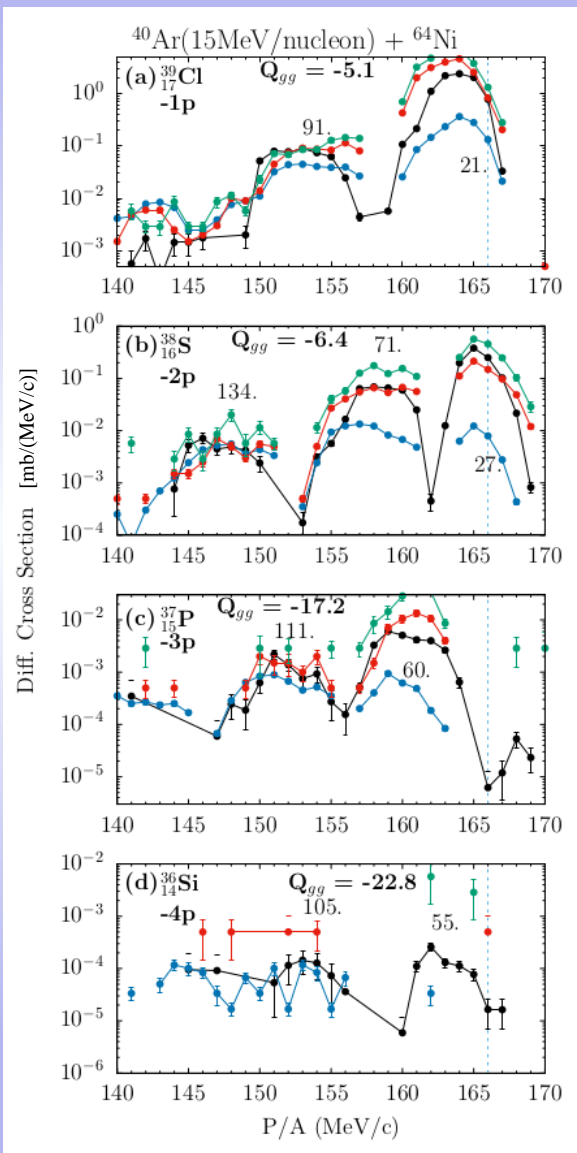


- : Experimental Data
- : DIT/GEMINI filtered
- : CoMD/GEMINI filtered  $K=254$
- : CoMD/GEMINI filtered  $K=200$
- : CoMD/GEMINI filtered  $K=308$

$$E_{tot}^* = Q_{gg} - Q$$

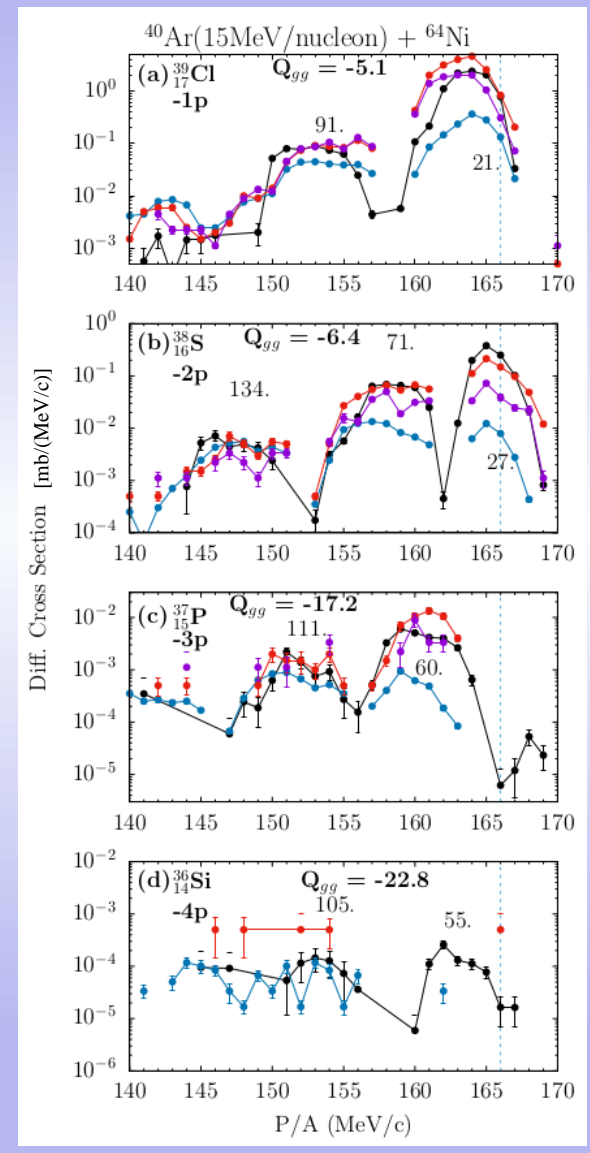


# Results – Momentum Distributions

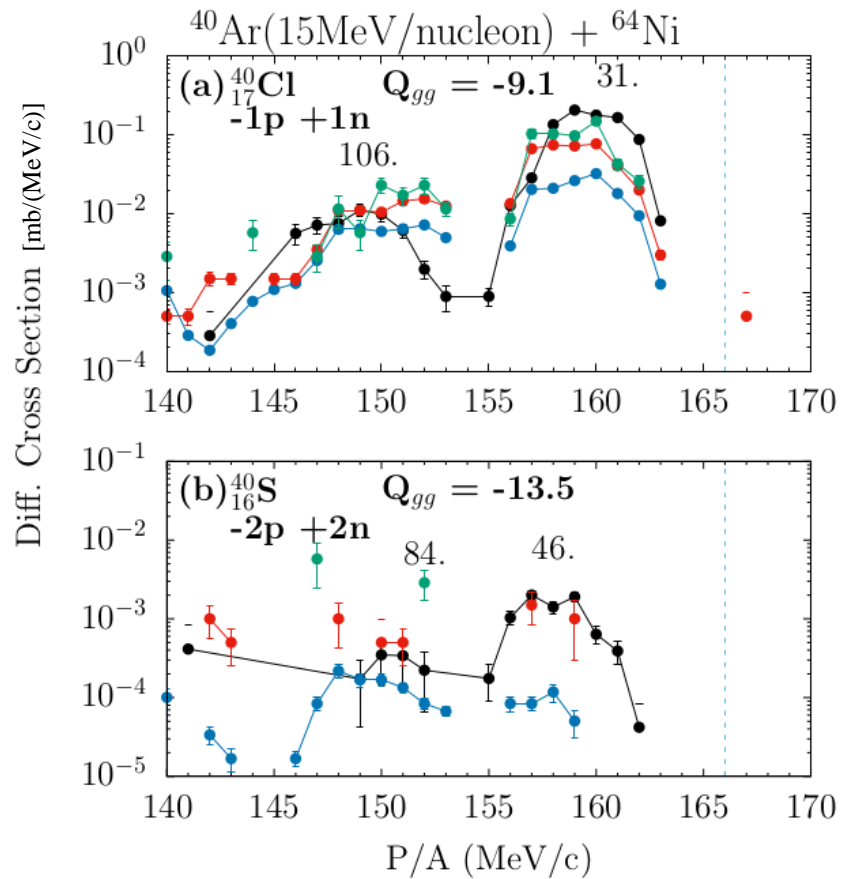


- : Experimental Data
- : DIT/GEMINI filtered
- : CoMD/GEMINI filtered  $K=254$
- : CoMD/GEMINI filtered  $K=200$
- : CoMD/GEMINI filtered  $K=308$

$$E_{tot}^* = Q_{gg} - Q$$

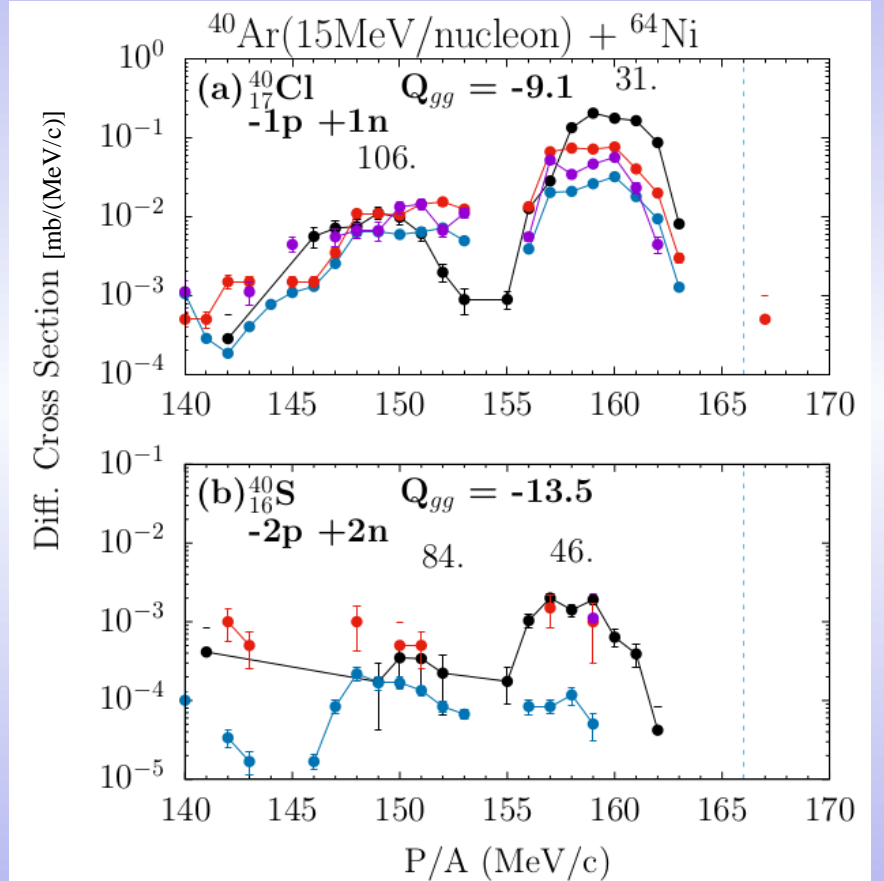


# Results – Momentum Distributions



- : Experimental Data
- : DIT/GEMINI filtered
- : CoMD/GEMINI filtered  $K=254$
- : CoMD/GEMINI filtered  $K=200$
- : CoMD/GEMINI filtered  $K=308$

$$E_{tot}^* = Q_{gg} - Q$$



# Summary

- We presented experimental data and theoretical calculations of mass distributions and momentum distributions of several channels of the reaction  $^{40}\text{Ar} + ^{64}\text{Ni}$  at 15 MeV/nucleon.
- The experimental data were obtained with the MARS Spectrometer.
- They were compared with the two theoretical models, DIT and CoMD.
- Different compressibilities were tested. ( $K=254,200,308$  MeV)
- We are in the state of further investigating the CoMD results and understand their tendencies.

# Future Work

- We plan to increase the statistics of our CoMD calculations on channels that are of very low cross sections.
- Further experiments with other combinations of projectile and target may contribute to our systematics and to our understanding of nuclear reactions in this energy regime, below the Fermi energy (10-35 MeV).

**Thank you!**

# Results – Mass Distributions

