TUNL Program on PREEQUILIBRIUM PHENOMENOLOGY

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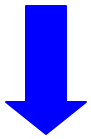
PROGRAM
(Model Development)

- Exciton preequilibrium model
- Studied with the code PRECO
- Additional models for reactions with complex particles
- Current version – PRECO-2006 (Released Spring 2007)

EFFECT OF FUNDING CUT

- Reduced level of effort
- More time on reviewing activities



- Delayed release of PRECO-2006
- Slowed model development work
- Facilitated 9 days in W. Africa translating at a rural medical clinic

WORK ON PRECO-2006

- Option for printing production cross sections
  (total or preeq.)
- Sample input/output files
- Cleaned up code
  - Remove dead coding
  - Update comments
  - Test for non-standard coding
  - Test for array boundary errors
- Tested at ORNL – RSICC
  - Different compilers and platforms

PROJECTILE BREAKUP

- Extend preliminary deuteron breakup model to He-3 and α-particles
- Absorbed fragment to initiate exciton model calculation in PRECO
- Work focusing first on centroid energies and peak widths

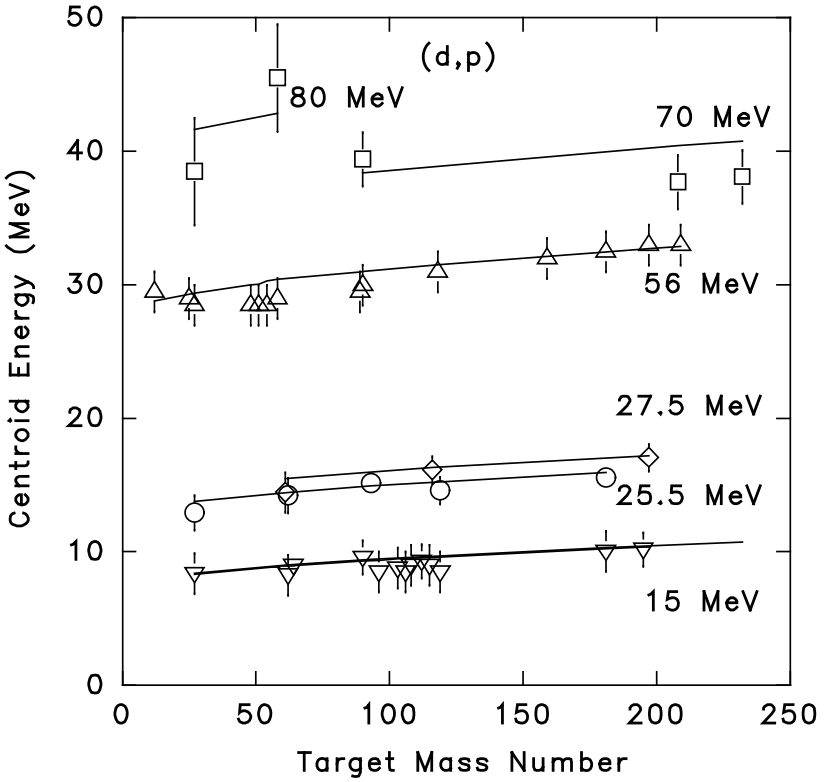
BREAKUP — Important Issues

- Mechanism
  - One fragment absorbed or not?
  - Multiple breakup modes for ^{3}He and α
    - ^{3}He: pd and ppn
    - α: dd, tp, hn, and dpn and ppnn
- "Background" subtraction
  - (normal preequilibrium cross section)
- Angular distributions
  - Limited & varied angular range in data
  - Must be studied before $\sigma_{BU}(E_{inc})$

BREAKUP

Deuteron Peak Energies

Tentative results
(several schemes work)



$$E_0 = 0.5\,(E_{inc} - C) + C$$

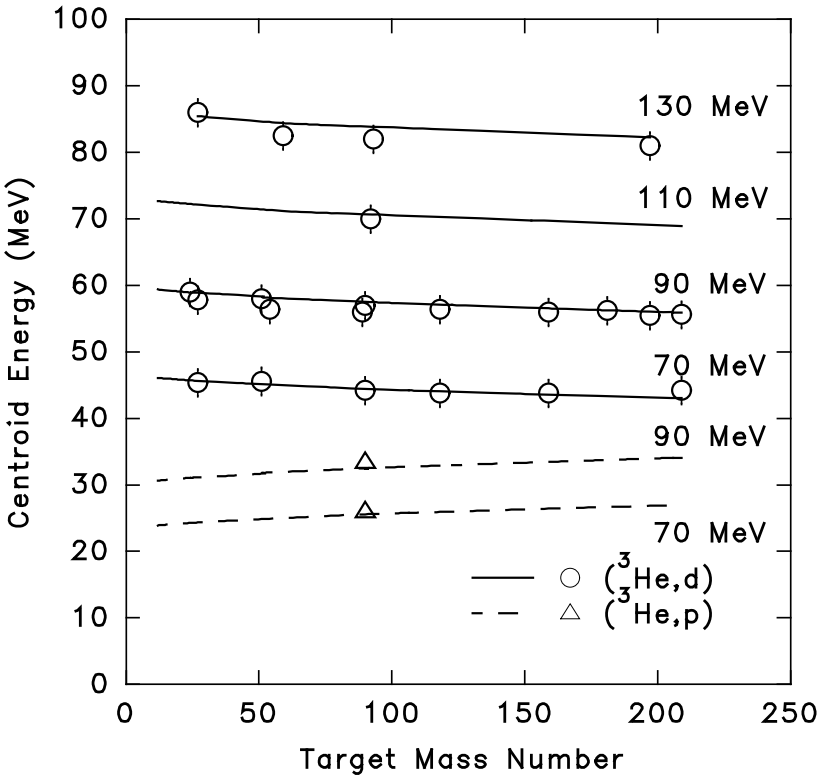
$$C = 1.44\,Z_A / D_{eff}$$

$$R_{eff} = \{1.2 + 5[1+\exp(E_{inc}/30)]^{-1}\}\,A_A^{1/3} + 1.2$$

BREAKUP

^{3}He Peak Energies

Tentative results
(several schemes work)



$$E_0 = (A_b/3)\,(E_{inc} - 2C) + C$$

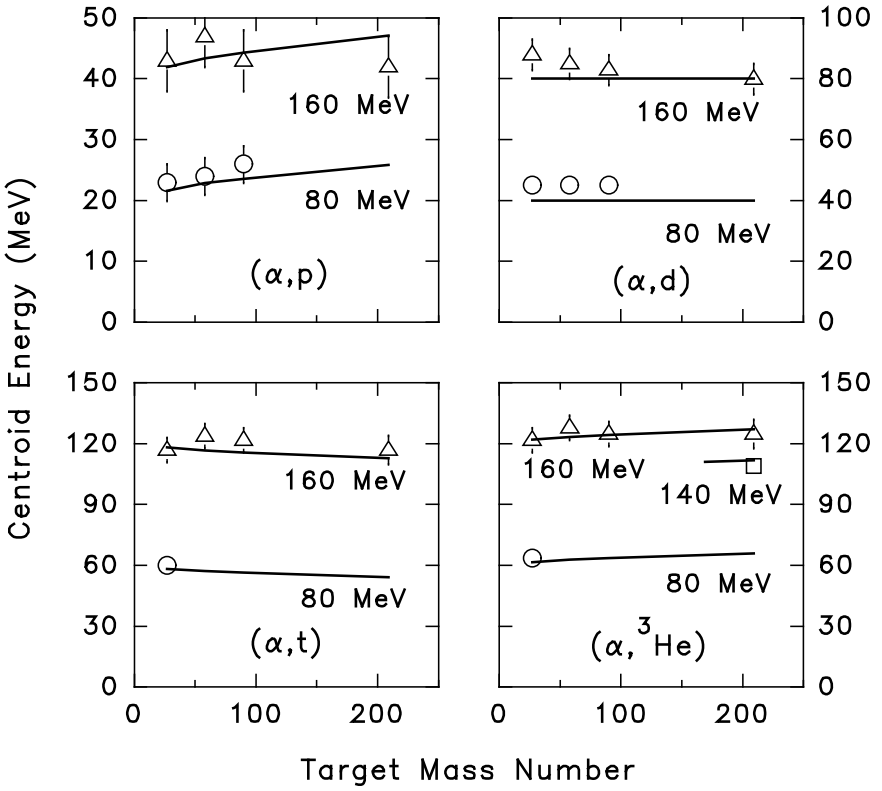
$$C = 1.44\, Z_A / D_{eff}$$

$$D_{eff} = \{1.2 + 5[1+\exp(E_{inc}/30)]^{-1}\}\, A_A^{1/3} + 1.2$$

BREAKUP

α-particle Peak Energies

Tentative results
(several schemes work)



$$E_0 = (A_b/4)\,(E_{inc} - 2C) + Z_b C$$

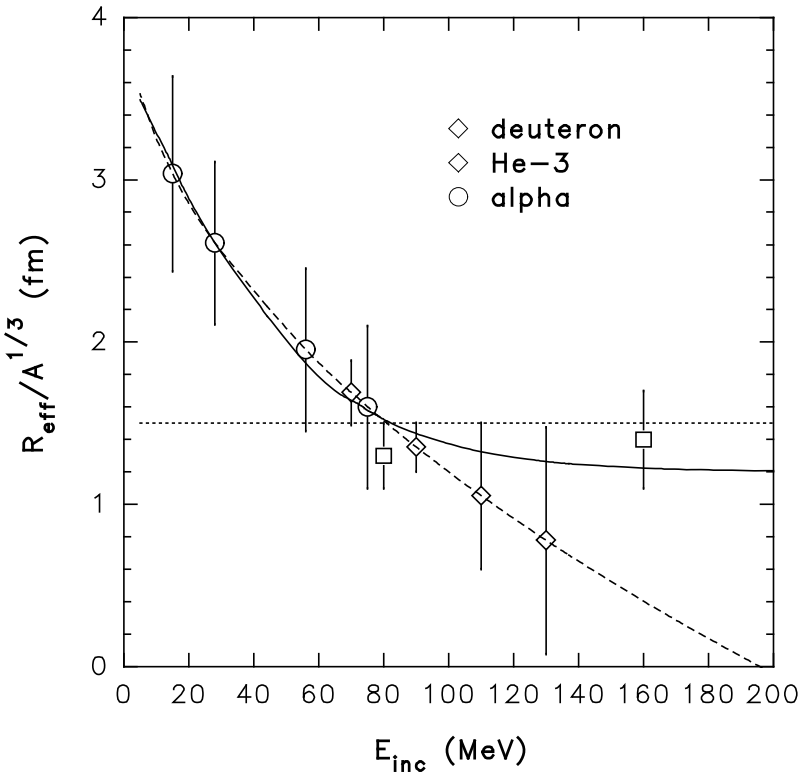
$$C = 1.44\, Z_A \,/\, D_{eff}$$

$$D_{eff} = \{1.2 + 5[1+\exp(E_{inc}/30)]^{-1}\}\, A_A^{1/3} + 1.2$$

BREAKUP

Distance of closest approach

Heavy targets ($Z \approx 80$)



$R_{eff} = 1.5\ A^{1/3}$

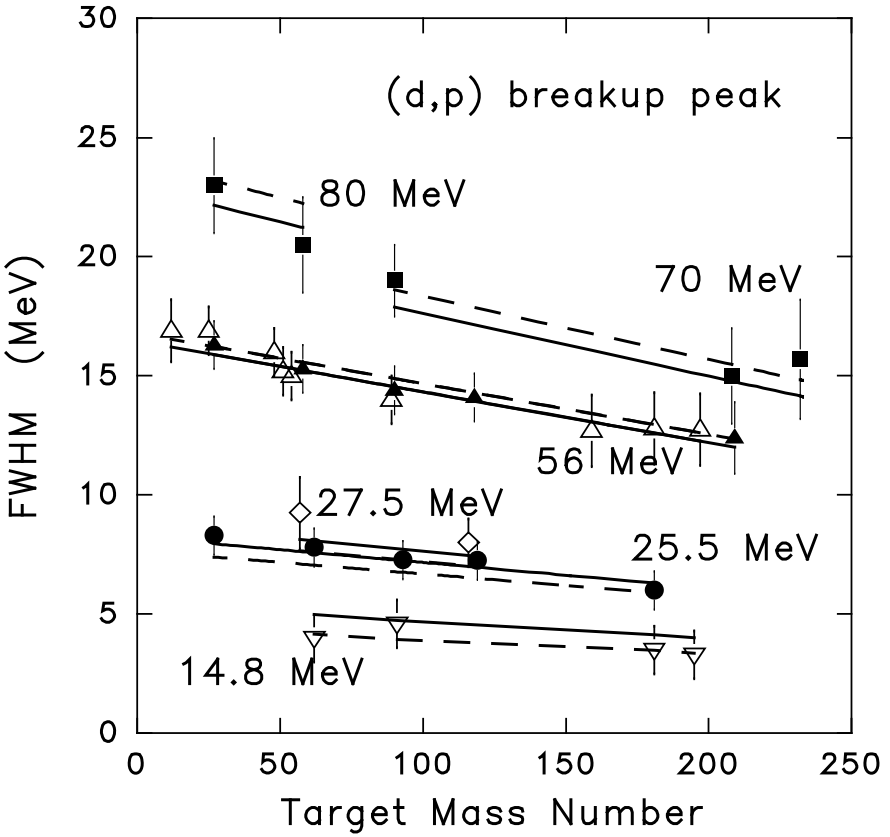
$R_{eff} = 1.5(1-E^{1/2}/14)\ A^{1/3}$

$R_{eff} = \{1.2 + 5[1+\exp(E/30)]^{-1}\}\ A^{1/3}$ fm

BREAKUP

Deuteron Peak Widths

Tentative



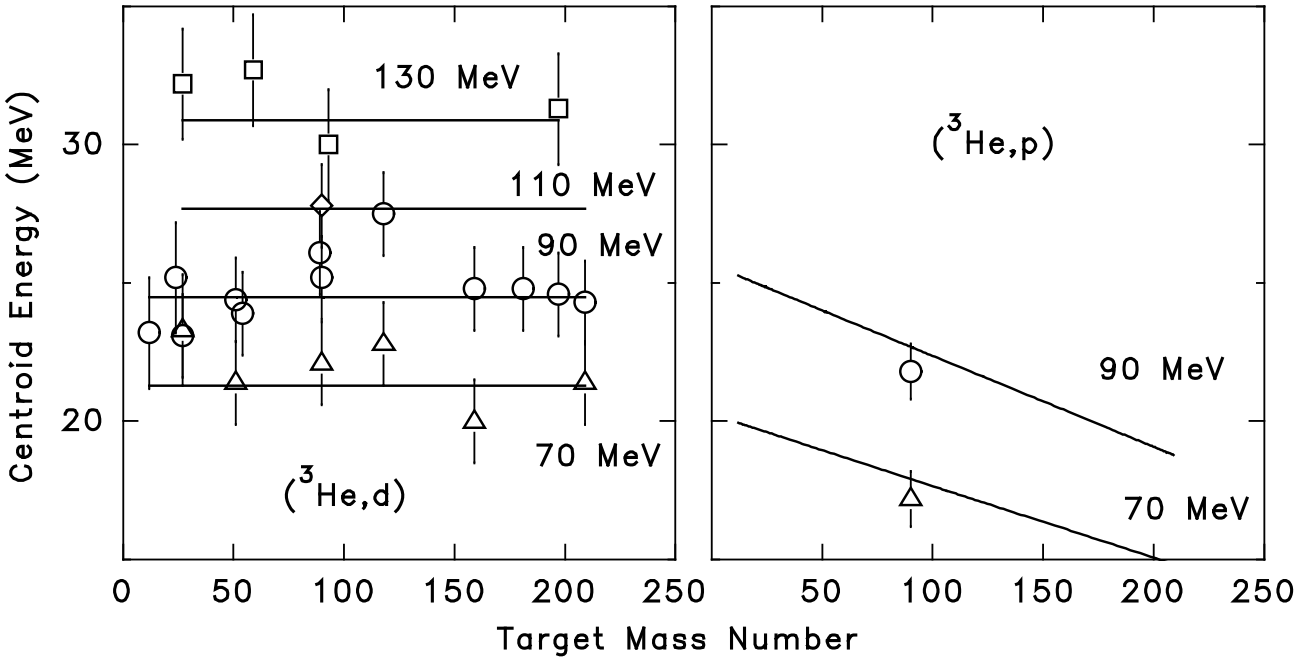
- – FWHM = 0.30 E_{inc} (1−A/790)

—— FWHM = 0.27 (E_{inc}+5) (1−A/780)

BREAKUP

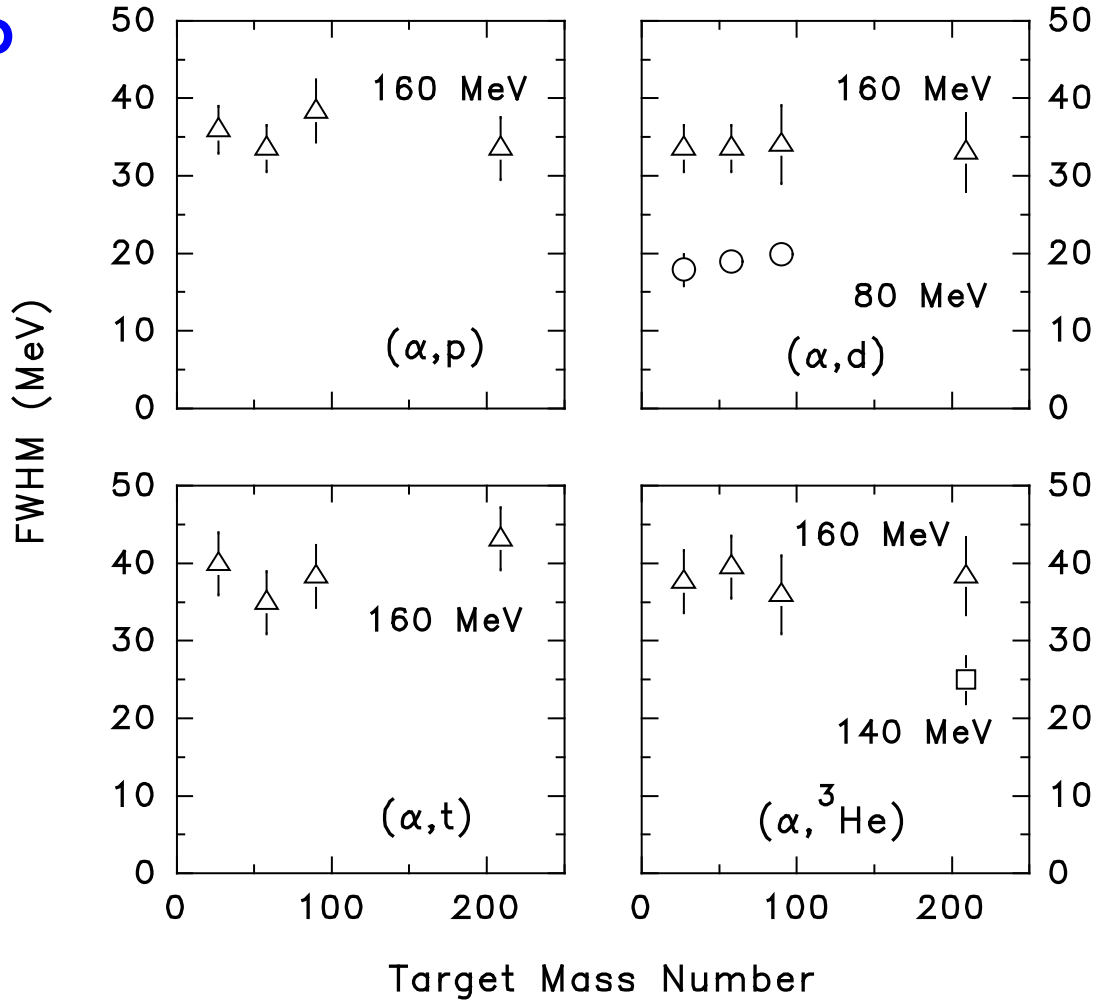
(d,p) systematics

He-3 Peak Widths



BREAKUP

α-particle
Peak Widths



POSSIBLE FUTURE WORK

- Complete description of projectile breakup
- Include projectile breakup in PRECO
  Absorbed fragment initiates exciton model calculation
- Benchmark models / code for
  (N,N) rxns at E_{inc} = 90 to 200 MeV