Verification and validation of Geant4 Bertini cascade

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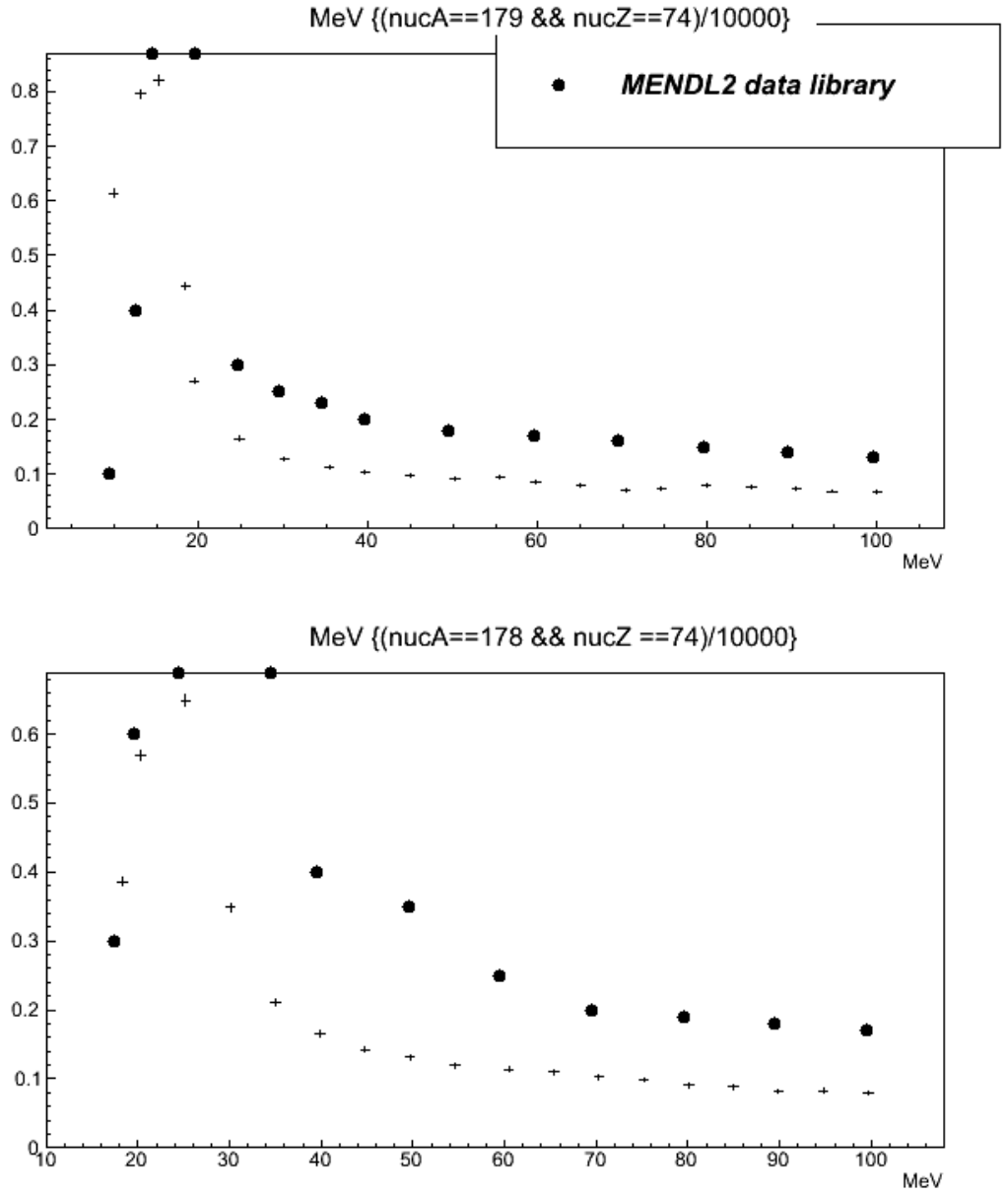
Outline

- Geant4 Bertini vs. MENDL2 data library
- Bertini vs. ABLA, GEM verification
- Pion multiplicity validation
- p(29MeV) + 54Fe submodel validation

NOTE: also high energy (E > 170 MeV) material is included in these slides

Geant4 Bertini vs. MENDL2 data library

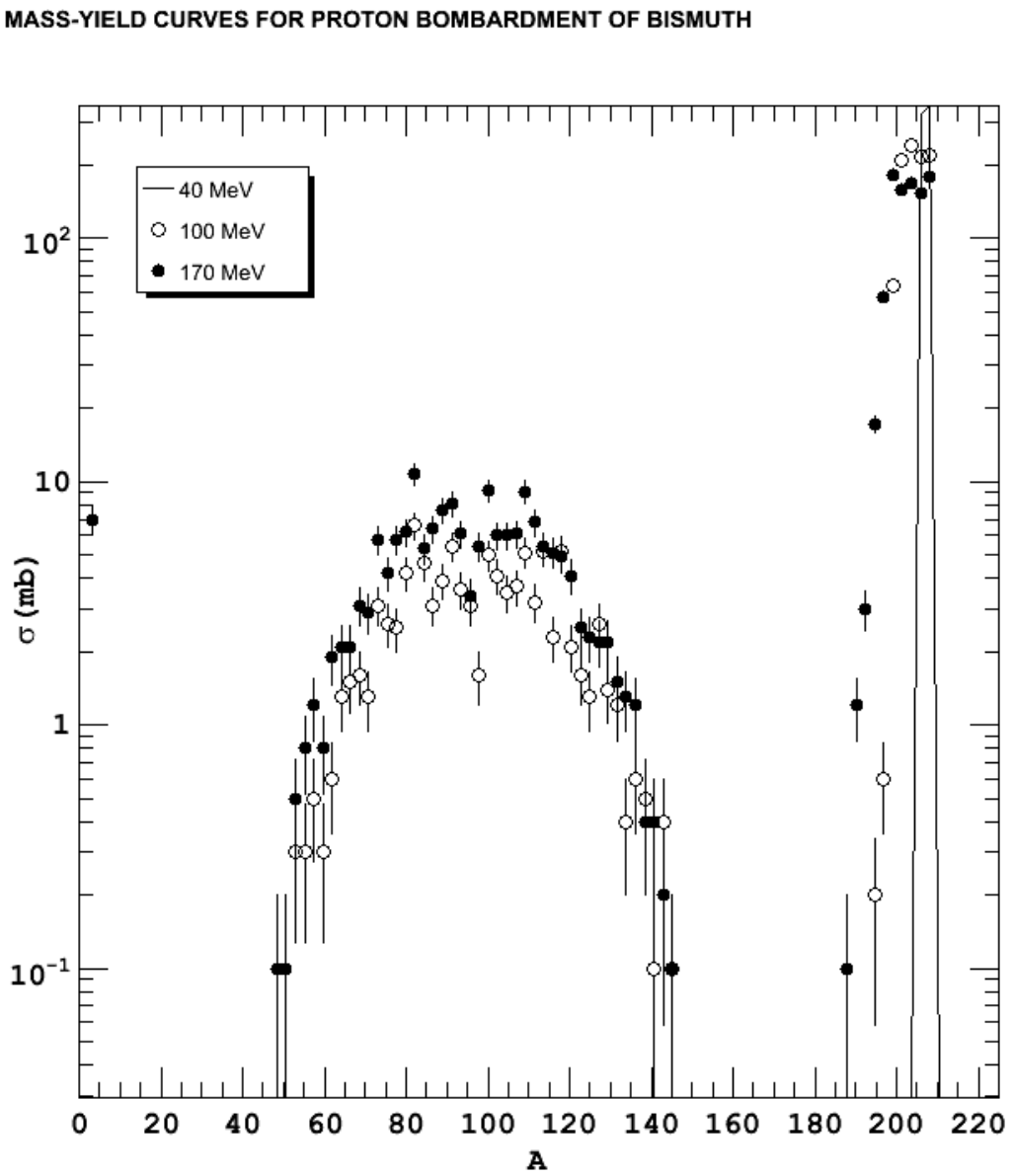


- 10-100 MeV neutrons on 180W target
- Comparing Geant4 Bertini isotope production cross-section (arbitrary scale) for W179 and W179 with MENDL2 data
- In general, Bertini produces general feature reasonably, but bad cases are frequent

A. Heikkinen: Verification and validation of Geant4 Bertini cascade for E < 170 MeV

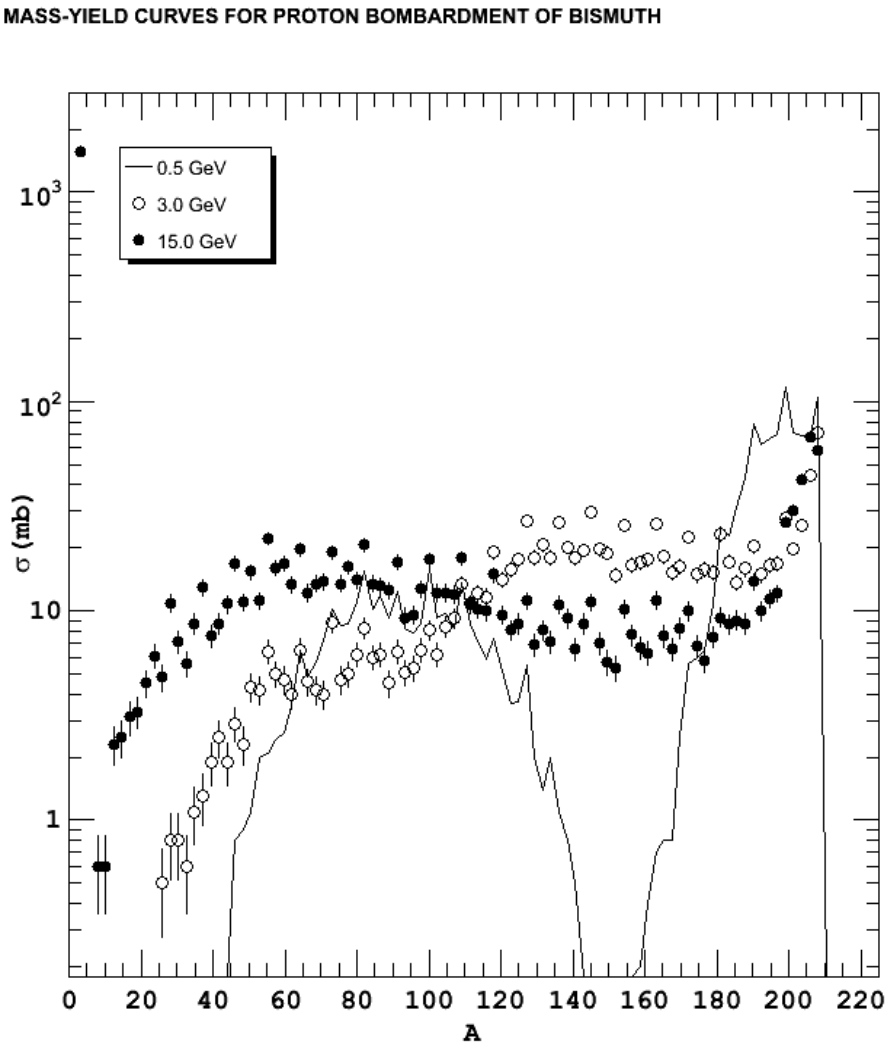
Geant4 Verification and Validation Workshop, CERN, July 17-19, 2006.

Bertini vs. ABLA, GEM verification



- As bullet energy increases, we see a expected change in a mass-yield curve …

- Additional Bertini model (in INUCL code) comparisons vs. CEM, LAHET, CASCADE, YIELDX are documented in arXiv:nucl.ex/ 9908012



- .. even for energies up till 15 GeV.

Bertini vs. ABLA, GEM verification

p(2.5 GeV)+ Au:

ABLA <n> 18.0, <p> 6.7
Bertini <n> 24.5, <p> 8.8

p(1.0 GeV)+ 208Pb:

GEM <n> 15.4, <p> 4.5
Bertini <n> 17.4, <p> 3.8

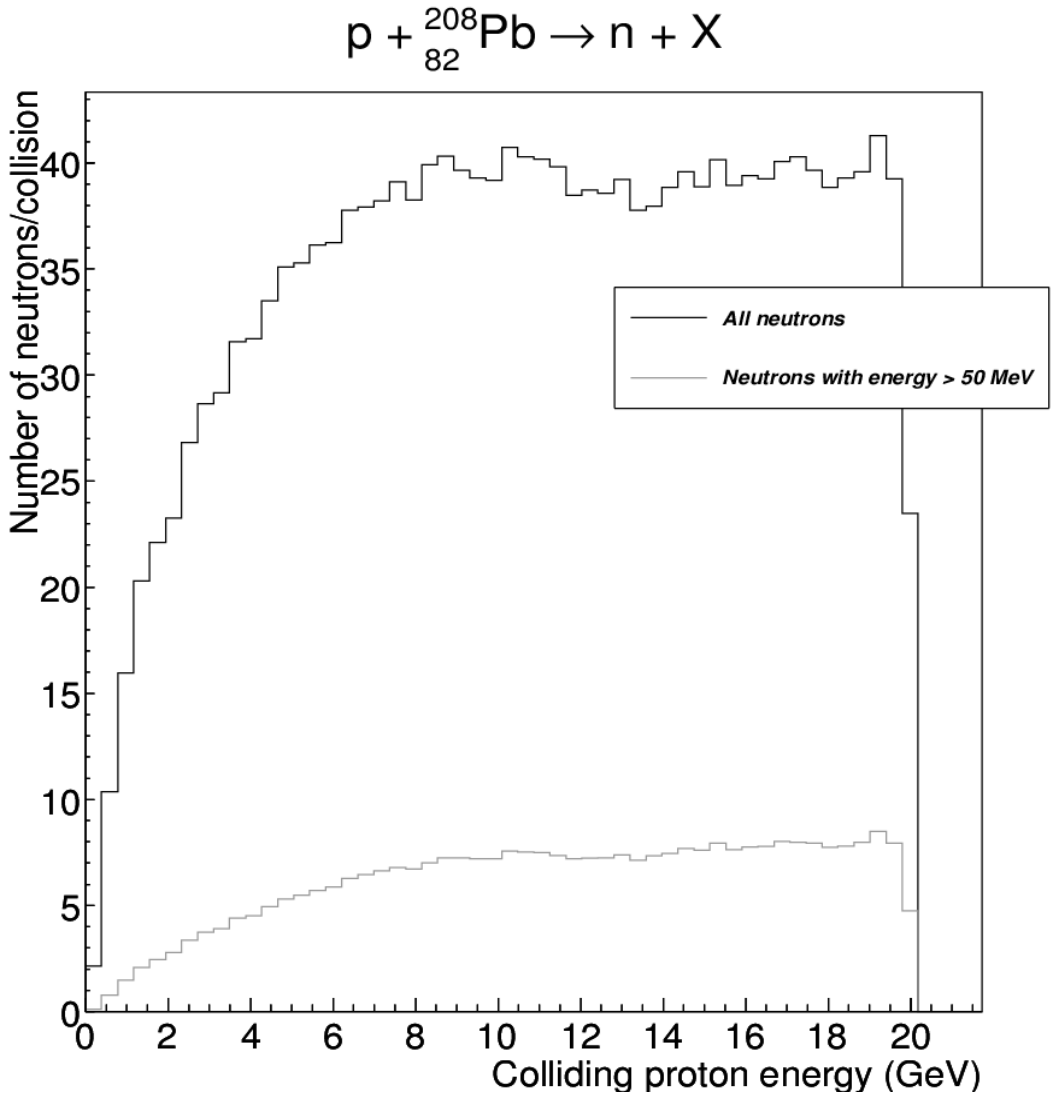
p(1.2 GeV)+ 208Pb:

ABLA <n> 16.6, <p> 4.9
Bertini <n> 19.0, <p> 4.4

- Using Bertini as event generator, we count the total number of produced neutrons n and protons p per event
- Verification is done against ABLA and GEM codes

A. Boudard et al., Nuclear Physics A 740 (2004) 195-210.

Looking neutron producton



- Brief verification of continuous neutron production behaviour above typical application upper limit 3 GeV
- Number of neutrons coming from evaporation is indicated

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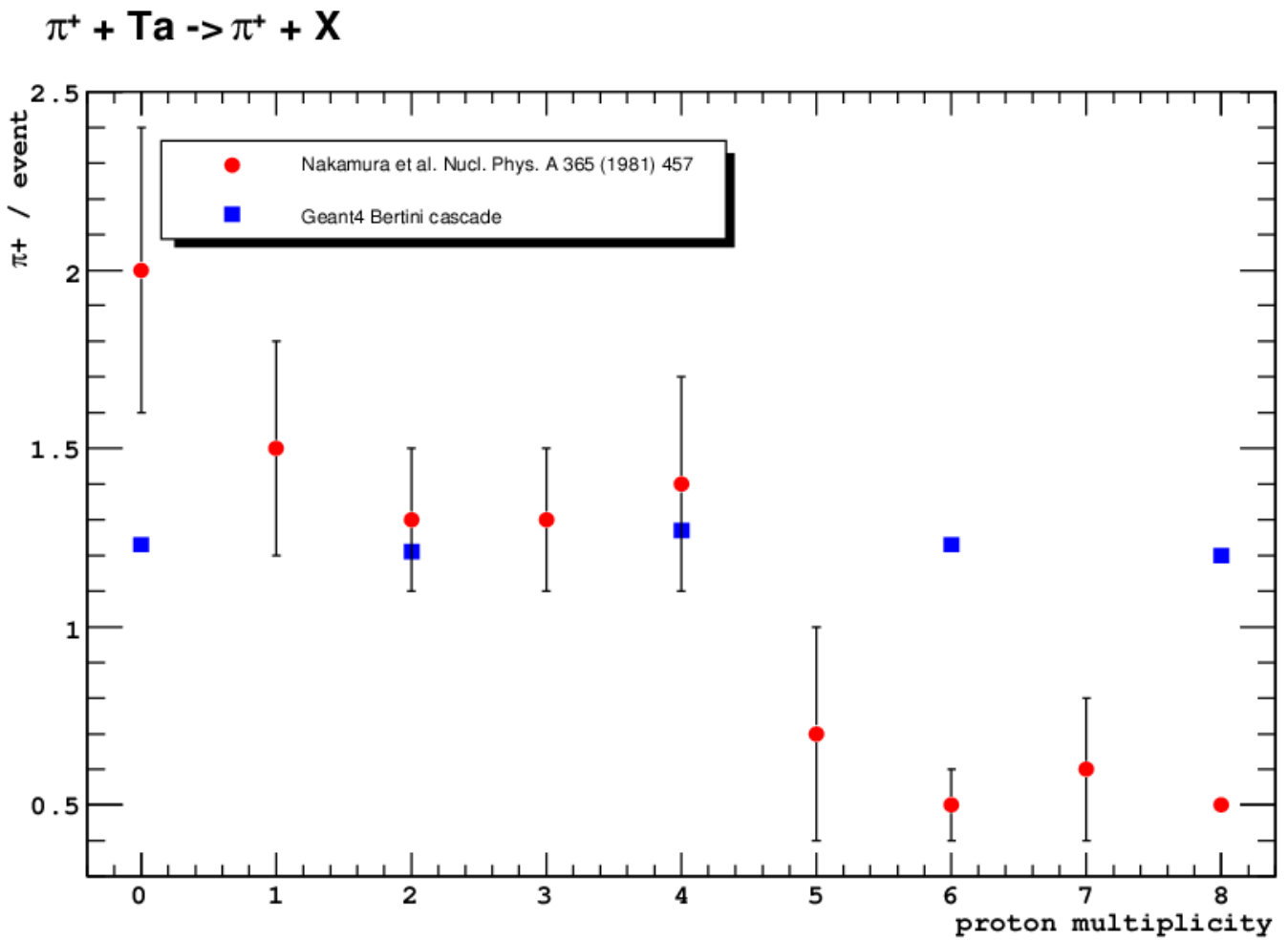
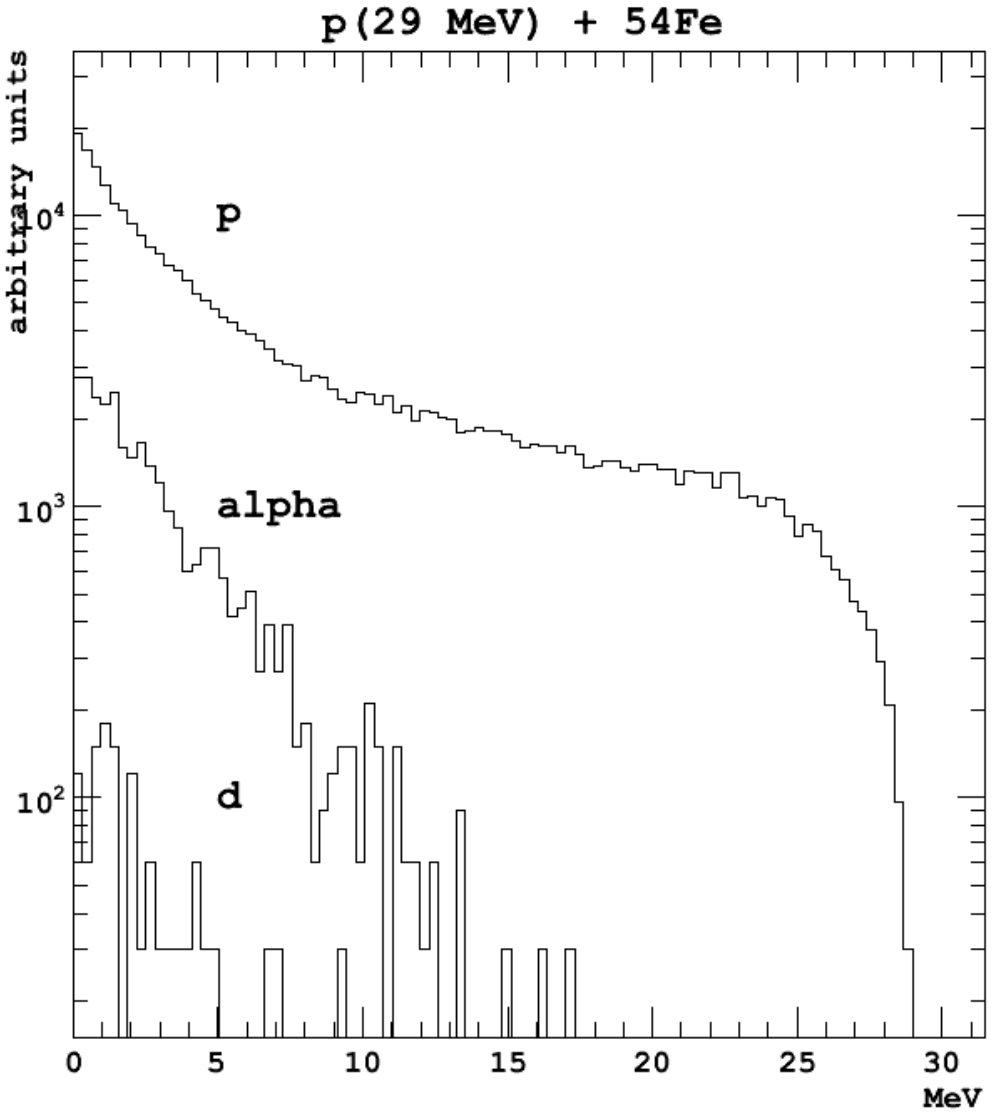
Pion multiplicity validation



- Again we use Bertini as a event generator
- Now we validate pion vs. proton multiplicity correlation for 4 GeV pion iduced collisions on a Ta target. Notice constant pion production for Bertini.
- (Multiplicities 1,3,5,7 are not simulated)

K. Ackerstaff et al., NIM A 491 (2002) 492-506.

p(29MeV) + 54Fe Bertini submodel validation



- An example of low energy production cross-sections to be studied in more detail
- We develop new validation tools to indicate what specific submodel created particles

C. Kalbach, Z. Physik A 283, 401-411 (1977).