correspond to 3 different initial energies E_x : 0 MeV (reseparation), 8 MeV (fusion) an 3.385 MeV leading right to the saddle point. Two dashed lines represent trajectories with stochastic force and E_x=3.385 MeV. In Fig 2 excitation function (probability of fusion) is shown. In the box inside there is a part of the function in the small probabilities region. The dashed line corresponds to direct calculations and the full line to calculations where our method was used.

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PL9900021

2.3 Radiative and Nonradiative Electron Capture by Relativistic $^3He^{++}$ Ions

by D.Chmielewska, P.Rymuza, Z.Sujkowski, Y.Fujita[1], H.Akimune[2], M.Fujiwara[2], T.Inomata[2], A.Tamii[3], M.Tanaka[4]

A fast ion traversing a solid undergoes multiple electron stripping and capture processes. The capture to a vacant electron shell in the projectile proceeds mainly via two mechanisms: the non-radiative electron capture [1], NREC, occurring mainly at the velocity matching condition $v_{projectile} \approx v_{te}$, where v_{te} is the velocity of the bound target electron, and the radiative electron capture, REC, in which the excess energy is carried away by a photon.

Measurements of the REC for He^{++} and very light targets correspond in principle to measuring the photo-electric effect for singly ionized He, provided that the target electrons can be considered as free. No such data exist.

A 450 MeV $^3He^{++}$ beam extracted from the the ring cyclotron of the RCNP Osaka was used to bombard thick targets ranging from Be through Pb. The typical beam intensity was 20 nA.

Singly ionized $^3He^+$ ions together with tritons from the (^{3}He,t) reaction were detected in the focal plane of the magnetic spectrometer Grand Raiden, set at 0^0 with respect to the beam, with vertical and horizontal opening of 40 mrad each. The $^3He^{++}$ beam was fully intercepted by a Faraday cup placed in the first dipole magnet of the spectrometer.

The present data have been obtained as a by-product of the systematic study of the Gamov-Teller strength distribution in the (^{3}He,t) charge exchange reactions.

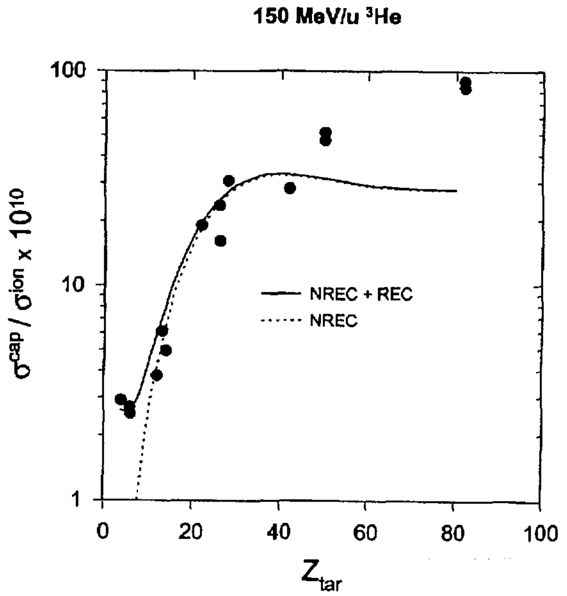

Fig.1 Measured and calculated ratios of the electron capture cross section for bare $^3He^{++}$ ions to the cross section for electron stripping from $^3He^+$ions as a function of the atomic number of the target.

We have analyzed the measured yields, $Y(^3He)$, in terms of the yield ratio

$$\frac{Y(^3He^+)}{Y(^3He^{++})} = \frac{\sigma_{EC}}{\sigma_{stripping}}$$

valid at equilibrium, where $\sigma_{EC} = \sigma_{REC} + \sigma_{NREC}$ is the sum of radiative and nonradiative electron capture cross sections, $\sigma_{stripping}$ is the cross section for stripping of the single electron from the $^3He^+$ ions and $Y(^3He^{++})$ is the beam intensity. The targets used were a few mg/cm^2 thick which means that the charge equilibrium condition was safely fulfilled.

Fig.1 shows the results together with the calculated yield ratios. No fitting has been done. For high Z targets the capture is dominated by the nonradiative process. The decreasing trend of the calculated curve in this region is preasumably mainly due to the approximations used in calculating the $\sigma_{stripping}$ function (see below). The excess of the capture yield for low Z targets is only explainable if the radiative capture is included.

The cross sections σ_{REC} *and* σ_{NREC} were calculated using the high energy approximations [1] with corrections for relativistic kinematics [2]. The ionization cross sections, $\sigma_{stripping}$, were obtained with semiempirical formulae [3] in high energy Born approximation. This method describes well the ionization cross sections of He in collisions with low Z targets but overestimates those for high Z targets. This explains the deviation of the calculated curve for high Z. Experimental results on the $\frac{\sigma_{EC}}{\sigma_{stripping}}$ ratios have earlier been obtained [3] for He ions with energies below 200 MeV. At these energies the NREC process dominates even for light targets. No evidence for REC could be seen.

Information on REC for relativistic He ions is of direct astrophysical interest [4].

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PL9900022

2.4 Compressibility of Nuclear Matter Nuclear and Astrophysical Evidence

by Z.Sujkowski

The nuclear incompressibility modulus, K_∞, is the primary ingredient of the Equation - Of - State of nuclear matter, EOS. This is still poorly known. In fact only the values of the coordinates of one point on the energy per nucleon versus the density plane are known, that is the saturation density, ρ_0=0.16 fm^{-3}, and the binding energy per nucleon at this density, E_0=-16MeV. Known also, though with much inferior accuracy, is the curvature at this point, i.e. K_∞.

The present constraints on the value of K_∞ stem from the nuclear physics data on cold, finite nuclei as well as from the data on unequilibrated and/or very dense systems, e.g. on the nucleus-nucleus collisions, the neutron stars and supernovae explosions [1]. The intuitively most promising information on K_∞ is that obtainable from data on the breathing mode in finite nuclei (the Giant Monopole Resonances, GMR), [2].

Recently [3] a simple relationship has been proposed between the incompressibility moduli, K_{AZ} and K_∞, and the binding energy per nucleon, E_{AZ} and E_0, for the finite nuclei and for the nuclear matter, respectively. For uncharged finite nuclei the relationship is

$$K_{AZ} / K_\infty = E_{AZ} / E_0$$

The resonance energies given by this formula (Coulomb corrected) are overestimated and the deviations increase with A decreasing. A two mode model proposed in [4] predicts two energy solutions for the GMR due to the coupling of the surface mode to the bulk mode. The low energy solution, corresponding to the observed resonance concentration, is pressed down inreasingly with lower mass values. The high energy component escapes observation. The main lesson of the coupled mode analysis is a warning: the identification of the ***observed GMR centroid*** with the unperturbed energy may lead to false results for the deduced K_∞ value.

A possible recipe [5] to obtain the range of allowed K_∞ values is to calculate K_∞ microscopically, e.g. with a good Gogny or Skyrme force [2]; to use this value as an input to the Coupled Mode Model and deduce corrections to $E_{GMR}(AZ)$ from a fit to the data; to compare the *corrected* $E_{GMR}(AZ)$ values with microscopic calculations; to iterate.

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