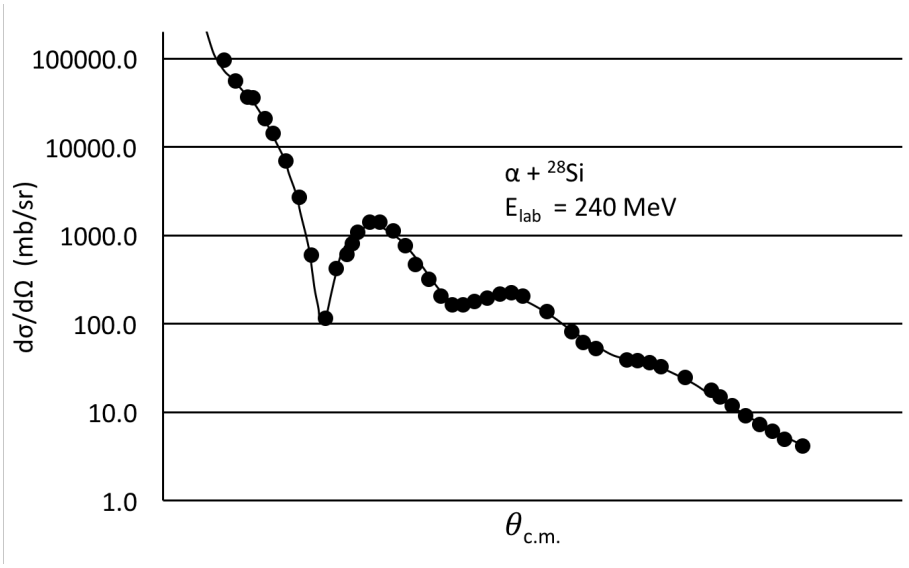
Name _____

Exam Advanced Nuclear Physics 16/01/2017 14:00

Question: Nuclear Reactions

These questions will be evaluated on 20 points. You require a minimum of 7/20 points on this part to pass the course. The points will be rescaled to a weight of 6 towards your final grade for the course. You are not allowed any book or notes. You may use a calculator and the given list of formulas for this part of the examination. Please use the attached sheets for your answer; any additional sheet will be discarded.

Consider the data in the figure, which refer to the elastic scattering of α particles on ^{28}Si at an incident energy $E_{\rm lab} = 240\,$MeV (data from D. H. Youngblood et al., PRC 65 (2002) 034302).
[α particle: $A = 4$, $Z = 2$; Si: $Z = 14$; for the interaction radius use $R = 1.6\,{\rm fm} \times (A_1^{1/3} + A_2^{1/3})$.]



- (3/20) Can you use a diffraction model to describe the behaviour of the data? Explain why and justify quantitatively which one.
- (4/20) Use the model that you discussed previously to add the expected values of $\theta_{\rm c.m.}$ on the x axis. Use the strong last visible maximum at $x = 11.6$.
- (5/20) The line in the figure represents a fit to the data. Which model or models can one use for such a fit? Which information can one expect to extract?
- (5/20) Use the sharp cut-off model to calculate the *reaction* cross section integrated on all angles (pay attention to the units).
- (3/20) If the beam intensity was $I = 10^8$ particles per second and the target thickness was $\rho\Delta x = 50\,\mu$g/cm^2, how many elastic scattering events would you measure in a minute, in a detector covering a solid angle $d\Omega = 0.01$ sr placed at $\theta_{\rm c.m.} = 5$ degrees.