

your name(s) _____

Physics 321 Quiz #9 - Friday, March 15 2018

25 points, all or none

You are scattering a projectile off a thin gold film. The density of the film is 1.0 mg/cm^2 . The mass of a gold nucleus is $3.27 \times 10^{-27} \text{ g}$. The number of projectiles that impinged on the film was 5.0×10^9 . You have a detector that records 50% of the scattered particles at any angle, i.e. the efficiency is 0.50, and records the number of counts for every 2 degrees. The number of recorded counts at each scattering angle is given in the table on the back page, or download from

<http://web.pa.msu.edu/people/pratts/phy321/programs/scatter/counts.csv>

- What fraction of the projectiles scattered?
- What is the total cross section? Express σ_{tot} in millibarns, $1 \text{ mb} = 10^{-27} \text{ cm}^2$.
- In a spreadsheet, make a third column, showing $d\sigma/d\Omega$. Test that

$$\int 2\pi \sin \theta d\theta \frac{d\sigma}{d\Omega} = \sigma_{\text{tot}}.$$

- Plot $d\sigma/d\Omega$ in mb/solid angle as a function of θ in degrees.

θ_s (deg.)	N_{counts}	$d\sigma/d\Omega$	θ_s (deg.)	N_{counts}	$d\sigma/d\Omega$
1.0	1.380e+06	4.716e+02	91.0	1.745e+06	1.041e+01
3.0	2.293e+06	2.613e+02	93.0	1.879e+06	1.122e+01
5.0	2.726e+06	1.865e+02	95.0	2.164e+06	1.295e+01
7.0	2.851e+06	1.395e+02	97.0	2.538e+06	1.525e+01
9.0	2.752e+06	1.049e+02	99.0	2.934e+06	1.772e+01
11.0	2.512e+06	7.850e+01	101.0	3.286e+06	1.996e+01
13.0	2.224e+06	5.896e+01	103.0	3.538e+06	2.166e+01
15.0	1.985e+06	4.573e+01	105.0	3.654e+06	2.256e+01
17.0	1.879e+06	3.833e+01	107.0	3.615e+06	2.254e+01
19.0	1.972e+06	3.613e+01	109.0	3.426e+06	2.161e+01
21.0	2.297e+06	3.823e+01	111.0	3.109e+06	1.986e+01
23.0	2.851e+06	4.352e+01	113.0	2.703e+06	1.752e+01
25.0	3.596e+06	5.074e+01	115.0	2.253e+06	1.482e+01
27.0	4.459e+06	5.858e+01	117.0	1.804e+06	1.207e+01
29.0	5.350e+06	6.581e+01	119.0	1.398e+06	9.532e+00
31.0	6.164e+06	7.138e+01	121.0	1.066e+06	7.420e+00
33.0	6.806e+06	7.452e+01	123.0	8.275e+05	5.885e+00
35.0	7.196e+06	7.483e+01	125.0	6.857e+05	4.992e+00
37.0	7.288e+06	7.222e+01	127.0	6.322e+05	4.721e+00
39.0	7.071e+06	6.701e+01	129.0	6.485e+05	4.976e+00
41.0	6.573e+06	5.975e+01	131.0	7.097e+05	5.608e+00
43.0	5.860e+06	5.124e+01	133.0	7.891e+05	6.434e+00
45.0	5.024e+06	4.237e+01	135.0	8.620e+05	7.270e+00
47.0	4.174e+06	3.403e+01	137.0	9.093e+05	7.951e+00
49.0	3.417e+06	2.700e+01	139.0	9.189e+05	8.353e+00
51.0	2.850e+06	2.187e+01	141.0	8.867e+05	8.403e+00
53.0	2.543e+06	1.899e+01	143.0	8.160e+05	8.086e+00
55.0	2.530e+06	1.842e+01	145.0	7.154e+05	7.439e+00
57.0	2.807e+06	1.996e+01	147.0	5.972e+05	6.539e+00
59.0	3.332e+06	2.318e+01	149.0	4.741e+05	5.489e+00
61.0	4.029e+06	2.747e+01	151.0	3.578e+05	4.401e+00
63.0	4.804e+06	3.215e+01	153.0	2.570e+05	3.376e+00
65.0	5.551e+06	3.653e+01	155.0	1.767e+05	2.494e+00
67.0	6.171e+06	3.998e+01	157.0	1.180e+05	1.801e+00
69.0	6.583e+06	4.205e+01	159.0	7.890e+04	1.313e+00
71.0	6.733e+06	4.247e+01	161.0	5.523e+04	1.012e+00
73.0	6.601e+06	4.117e+01	163.0	4.197e+04	8.562e-01
75.0	6.205e+06	3.831e+01	165.0	3.440e+04	7.927e-01
77.0	5.592e+06	3.423e+01	167.0	2.887e+04	7.654e-01
79.0	4.836e+06	2.938e+01	169.0	2.329e+04	7.278e-01
81.0	4.023e+06	2.429e+01	171.0	1.704e+04	6.497e-01
83.0	3.243e+06	1.949e+01	173.0	1.066e+04	5.219e-01
85.0	2.577e+06	1.543e+01	175.0	5.196e+03	3.555e-01
87.0	2.087e+06	1.246e+01	177.0	1.572e+03	1.792e-01
89.0	1.807e+06	1.078e+01	179.0	1.051e+02	3.591e-02

