Rutherford Scattering

PHYS 305 Final Project

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- Theory
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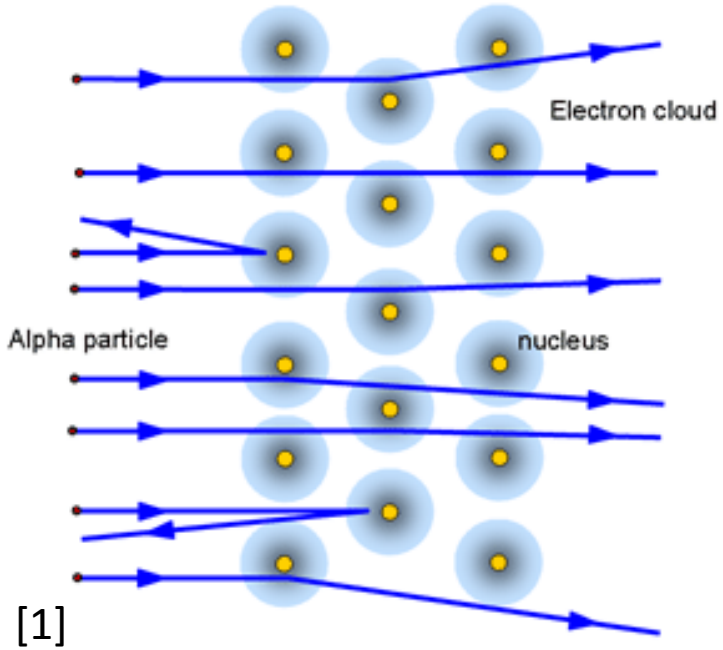
Introduction

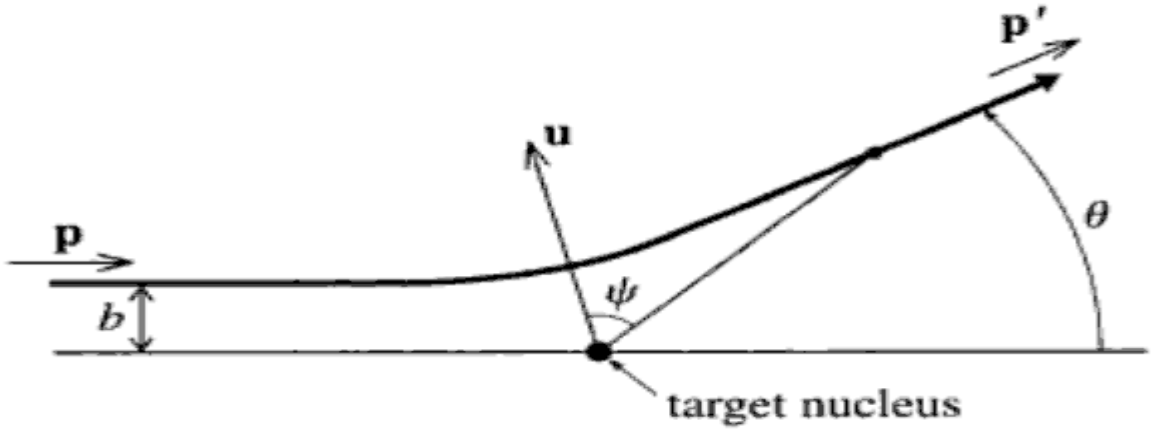
- Most famous collision experiment
- Thin Gold (Au) sheet & alpha particle
- Create atom model
- Different structure

  & thickness of metal
- Test & graph



[1]

Theory



[2]

$$b = \frac{kqQ}{mv^2}\cot\left(\frac{\theta}{2}\right) \qquad [2]$$

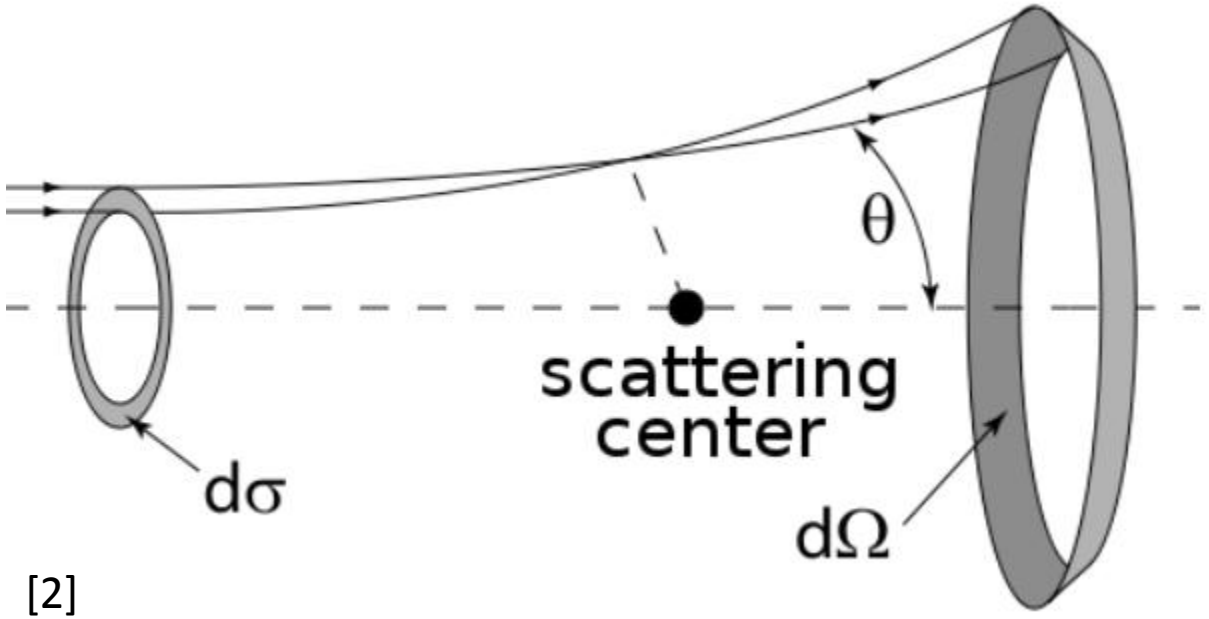
Where k=8.99*10^9 (Nm^2/C^2),

Q =charge of target,

q = charge , m = mass , v= speed of projectile

$$\frac{d\sigma}{d\Omega} = \left(\frac{kqQ}{4E \sin^2(\theta/2)} \right)^2$$ [2]

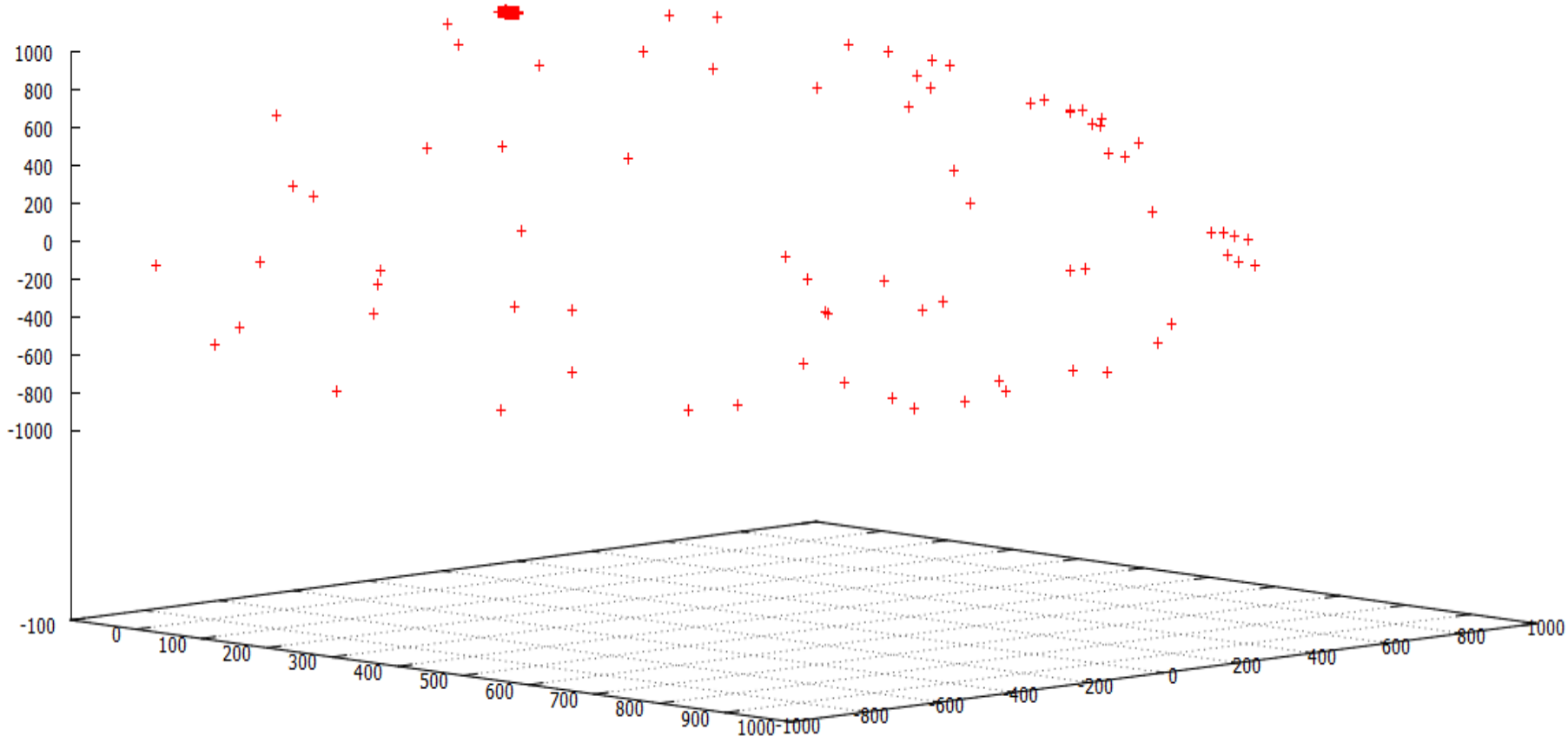
Where E = the energy of the projectiles



[2]

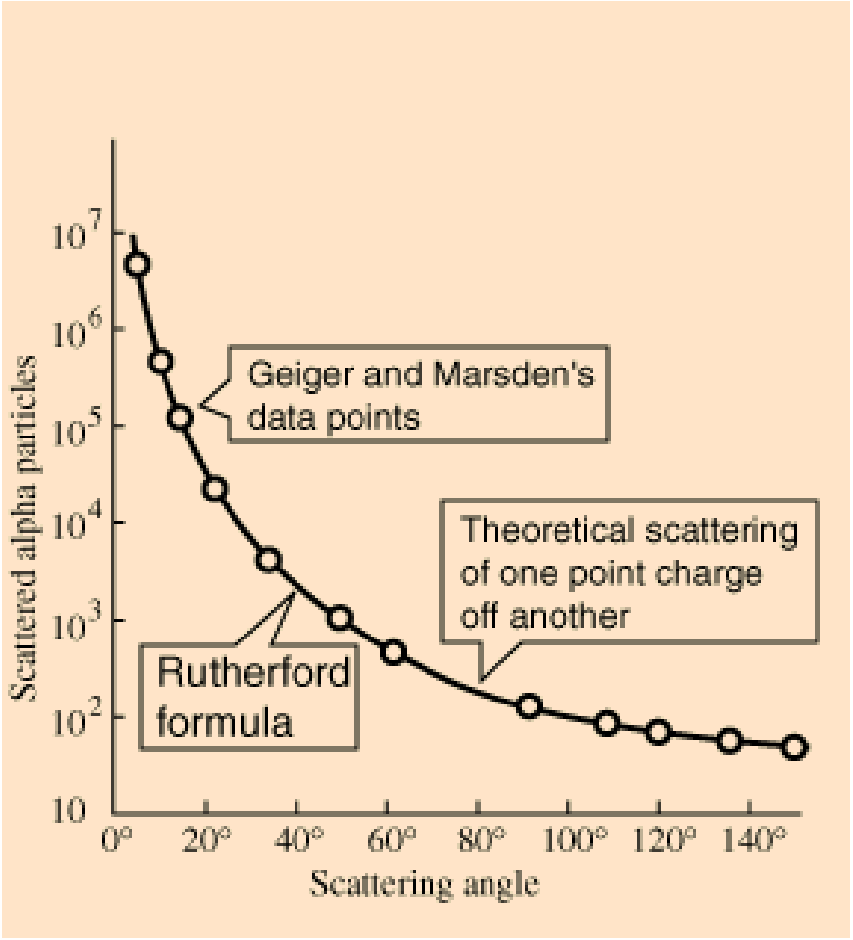
Kernel Description

```
main(){
    double Radius_gold, radius, Alpha_x, Alpha_y, Target,k,c,q,Q,m,b,v,x,y,z;
    double R,theta,phi,angle;

    k=8.988*pow(10.0,9);
    q=2.0*1.602*pow(10.0,-19);
    Q=79.0*1.602*pow(10.0,-19);
    m=6.645*pow(10.0,-27);
    Radius_gold=1.441*pow(10.0,-8);
    v=1.77*pow(10.0,7);
    c= k*Q*q/m/pow(v,2);
    R=1000.0;


for (int i=0; i<= 1000000; i++){
    x=(double (rand())/RAND_MAX-0.5)*20.0;
    y=(double (rand())/RAND_MAX-0.5)*20.0;
    theta= atan(y/x);
    b= pow( pow(x,2)+pow(y,2),0.5);

    if (b > 0.1){
        z=pow(pow(1000.0,2)-pow(b,2),0.5);
        fout<< x<<"   "<<y<<"   "<<z<<endl;
    }
    else if (b <= 0.1){
        phi=acos(b/0.1)*2.0;
        x=R*sin(M_PI-phi)*cos(theta);
        y=R*sin(M_PI-phi)*sin(theta);
        z=R*cos(M_PI-phi);
```



3D plot with a simple model.
1,000,000 projectiles were incented with small area

Another expected result



[3]

Rutherford differential cross section as a function of angle.

Status

- Simulate with simple model

4/25	4/26	4/27	4/28	4/29	4/30	5/1	5/2
FINISHING CODING (CREATE ATOM MODEL)			TESTING		PREPARE PRESENTATION	CONTINUE CODING (DIFFERENT STRUCTURE)	
5/3	5/4	5/5	5/6	5/7	5/8	5/9	5/10
CONTINUE CODING (DIFFERENT THICKNESS)				FINISH REPORT & PREPARE PRESENTATION			

Reference

- [1]http://tap.iop.org/atoms/rutherford/index.html
- [2] John R. Taylor \Classical Mechanics",University Science Books, 2005, page 557
- [3] http://hyperphysics.phy-astr.gsu.edu/hbase/nuclear/rutsca2.html