Proton-Proton Elastic Collision with Coulomb Repulsion

(Force is assumed to be $c \frac{\hat{r}}{r^2}$)

Various constants (masses assumed equal):

Function for distance between the protons:

Equations of motion in 2 dimensions ($ma = c \frac{\hat{r}}{r^2}$):

Initial conditions:

$y_1[0]$ is impact parameter - increase for more glancing collisions

$x_2[0] = +10, x_2^[0] = -1$ for CM collision
Solve for trajectories numerically: get coordinates as function of t

(Local) In[98]:=
    eq2 = Join[eq1, init] /. val;

(Local) In[99]:=
    sol = NDSolve[eq2, {x1, y1, x2, y2}, {t, 0, 20}][[1]];

Define a plot of the proton positions as a function of t
and tabulate it for ten t values from 0 to 20

(Local) In[100]:=
    Clear[coord1plot];
    coord1plot[t_] :=
        ListPlot[{{x1[t], y1[t]}} /. sol, PlotStyle -> {PointSize[0.03], RGBColor[0, 0, 1]},
        GridLines -> Automatic, Frame -> True, PlotRange -> {{-10, 10}, {-5, 5}}]

(Local) In[102]:=
    Clear[coord2plot];
    coord2plot[t_] :=
        ListPlot[{{x2[t], y2[t]}} /. sol, PlotStyle -> {PointSize[0.03], RGBColor[1, 0, 0]},
        GridLines -> Automatic, Frame -> True, PlotRange -> {{-10, 10}, {-5, 5}}]

(Local) In[104]:=
    plotarray = Table[{coord1plot[tp], coord2plot[tp]}, {tp, 0, 20, 2}];

Combine the ten plots into one plot

(Local) In[105]:=
    Show[plotarray];