Conducting sphere in a uniform electric field (Griffiths Ex. 3.6)

It is better to plot the electric field in the y-x plane. To convert the field in (r, θ) coordinates to (y,z), use

$r=\sqrt{y^2+z^2}$, $\cos(\theta) = \frac{z}{r}$, $\sin(\theta) = \frac{y}{r}$,

$u_r=\cos(\theta)u_y+\sin(\theta)u_z$, $u_\theta=\cos(\theta)u_y-\sin(\theta)u_z$

where the u's indicate unit vectors

The y and z components of the electric field are given below. The electric field is normalized by Eo and y and z are normalized by R, so the sphere has unit radius

> *restart*;

> $Ey := \frac{3\cdot y\cdot z}{r^5}; Ez := \frac{1}{r^2}\cdot(y^2+z^2) + \frac{1}{r^5}\cdot(2\cdot z^2-y^2);$

$$Ey := \frac{3\,y\,z}{r^5}$$

$$Ez := \frac{y^2+z^2}{r^2} + \frac{2\,z^2-y^2}{r^5} \qquad \textbf{(1)}$$

> $r := \sqrt{y^2+z^2};$

$$r := \sqrt{y^2+z^2} \qquad \textbf{(2)}$$

> *Ey*; *Ez*;

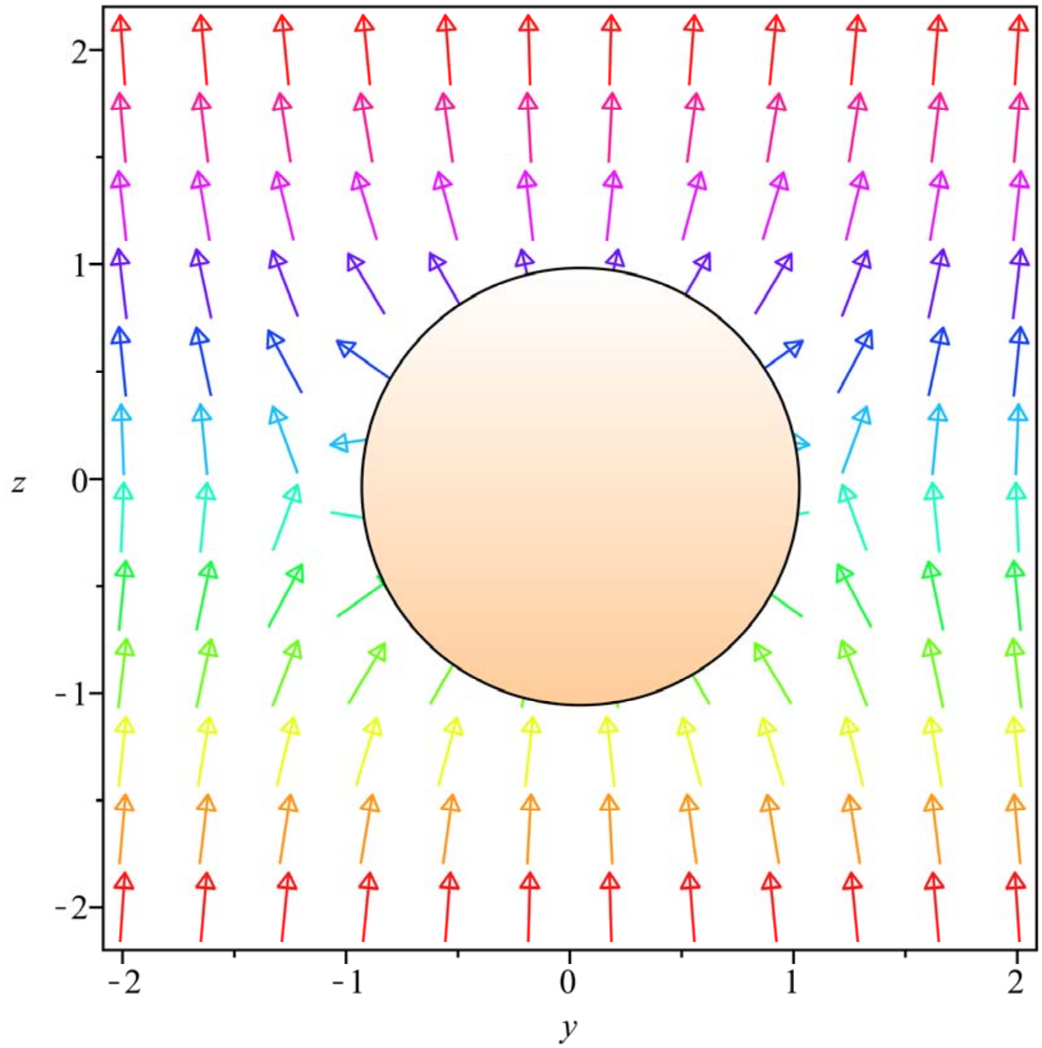
$$\frac{3\,y\,z}{(y^2+z^2)^{5/2}}$$

$$1 + \frac{2\,z^2-y^2}{(y^2+z^2)^{5/2}} \qquad \textbf{(3)}$$

> *with*(*plots*) :

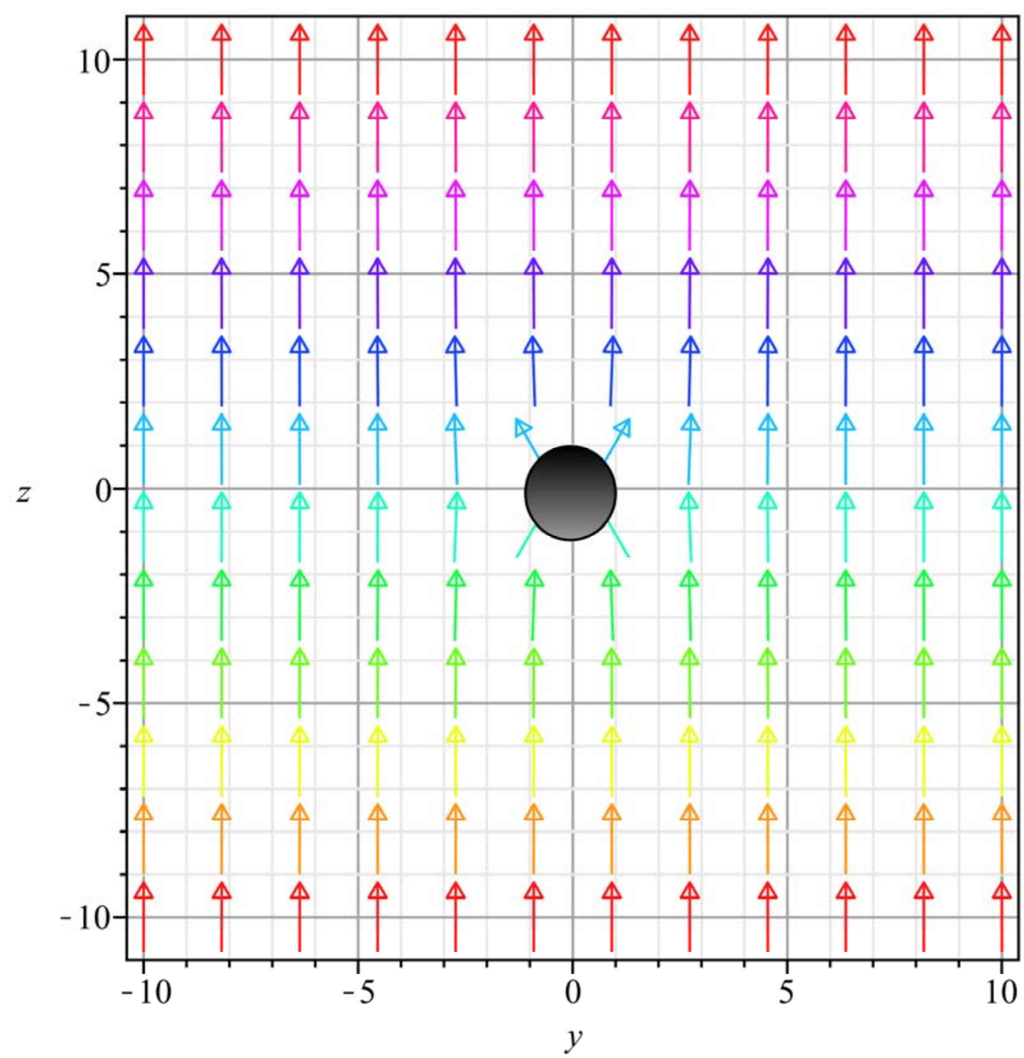
The fieldplot will be given with vectors of constant length so that the directions can be more easily seen
The first plot is on a scale -2 to +2, the sphere has a unit radius. Note that the electric field is VERTICAL
in these plots. Notice that at the surface, the electric field is perpendicular to the sphere.

> *fieldplot*([*Ey*, *Ez*], *y* =−2 ..2, *z* =−2 ..2, *fieldstrength* = *fixed*, *arrows* = *SLIM*, *grid* = [12, 12], *color* = z);



This plot is on a much larger scale (-10 to +10) so that the uniform nature of E is clear at large distances

> *fieldplot*([*Ey*, *Ez*], *y* = -10 ..10, *z* = -10 ..10, *fieldstrength* = *fixed*, *arrows* = *SLIM*, *color* = *z*, *grid* = [12, 12]);


10
5
0
-5
-10
z
-10
-5
0
5
10
y