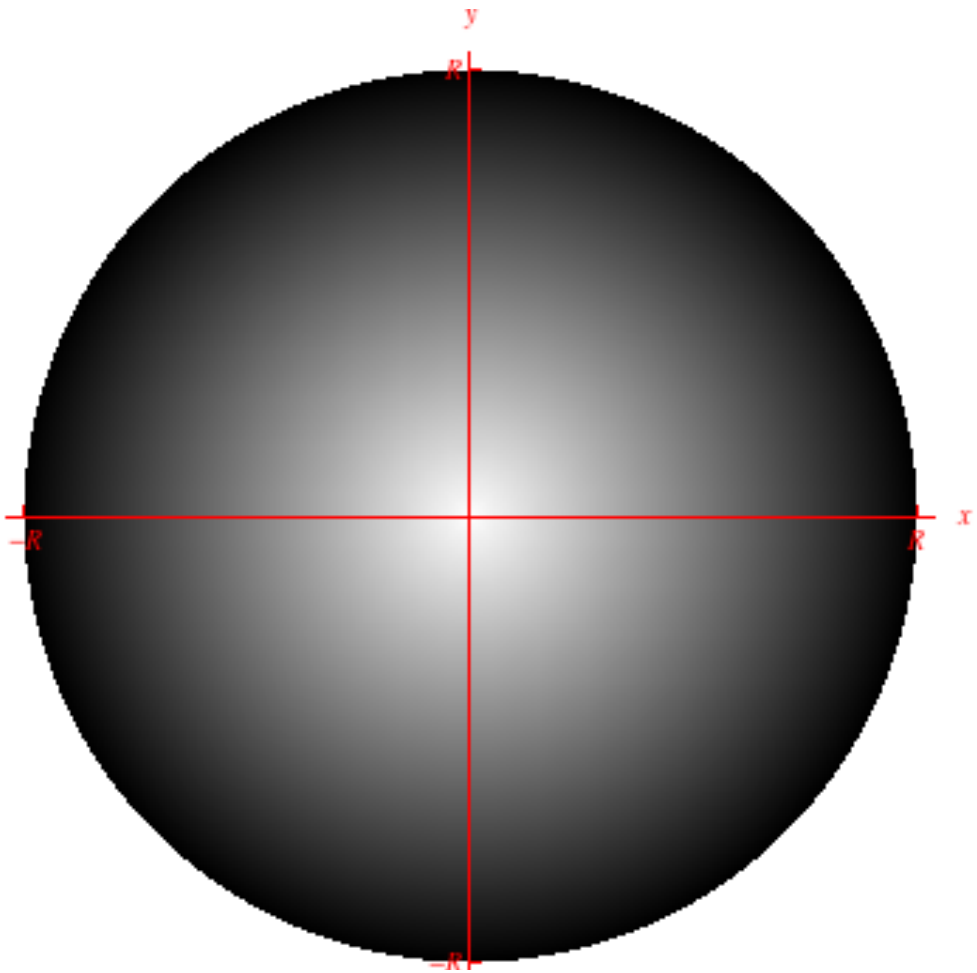
# Total from area density

**Problem:** Charge is distributed on a disk of radius $R$ so that the area charge density is proportional to the distance from the center, reaching a maximum value $\sigma_0$ at the far edge. Compute the total charge.




Area charge density example 2

# Total from area density

$$
\begin{aligned}
Q &= \iint_{\text{disk}} \sigma \, dA \\
&= \int_a^b \int_c^d \sigma(x, y) \, dy dx \\
&= \int_{-R}^{R} \int_{-\sqrt{R^2-x^2}}^{\sqrt{R^2-x^2}} \sigma(x, y) \, dy dx \\
&= \int_{-R}^{R} \int_{-\sqrt{R^2-x^2}}^{\sqrt{R^2-x^2}} \frac{\sigma_0}{R} \sqrt{x^2 + y^2} \, dy dx \\
&= \text{not fun to evaluate}
\end{aligned}
$$

Turn to a different coordinate system: polar coordinates.