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**Problem 29.15 (RHK)**

*Space vehicles travelling through the Earth's radiation belts collide with trapped electrons. Since in space there is no ground, the resulting charge build-up can become significant and can damage electronic components, leading to control circuit upsets and operational anomalies. A spherical metallic satellite* 1.3 m *in diameter accumulates* 2.4 $\mu$C *of charge in one orbital revolution. We have to find* (a) *the surface charge density;* (b) *the resulting electric field just outside the surface of the satellite.*

**Solution:**

It is given that a spherical metallic satellite of 1.3 m in diameter accumulates 2.4 $\mu$C of charge in one orbital revolution. Surface area of the satellite is

$A = \pi d^2 = \pi \times 1.3^2 \text{ m}^2 = 5.309 \text{ m}^2.$

It is also given that in each orbital revolution the satellite accumulates 2.4 $\mu$C of charge.

Therefore, the surface charge density on the satellite (after one orbital revolution)

$$\sigma = \frac{q}{A} = \frac{2.4\times10^{-6}}{5.309}\ \text{C m}^{-2} = 452\ \text{nC m}^{-2}.$$

The electric field just outside the surface of the satellite, which is a conductor as it is made out of metallic material,

$$E = \frac{\sigma}{\varepsilon_0} = \frac{0.452\times10^{-6}}{8.85\times10^{-12}}\ \text{N C}^{-1} = 51\ \text{kN C}^{-1}.$$