

(1) A star like the sun is just about visible to the naked eye if it is 50 light years away. If you want to put up an Earth satellite in the form of a reflecting sphere that can be seen as it passes over at night, what is the smallest diameter it may have?

Imagine the satellite, of radius a , at height h above the observer, and still in sunlight. A reflecting sphere is an isotropic scatterer. The fraction of the sun's radiation scattered by our satellite is $\pi a^2 / 4\pi R^2$, where R is its distance from the sun. To make it appear as bright as a star like the sun at a great distance D we require that $h^2 / D^2 = a^2 / 4R^2$, or $a = 2hR / D$. Let's assume $h = 1000$ km. Then with $R = 1.5 \times 10^{11}$ m and $D = 5 \times 10^{17}$ m, the satellite's diameter must be $2a = 4hR / D \approx 1$ m. Remember Echo?