

(3) If all the starlight falling on the State of New York could be directed into Yankee Stadium, would there be enough light for a night game?

The area to be illuminated is about $2 \times 10^4 \text{ m}^2$ and the area of New York State must be roughly 10^5 km^2 . If we estimate the area ratio as 5×10^6 , we can hardly be off by more than a factor of 2 either way. How bright is starlight relative to sunlight? Suppose we remember only that there are something like 10^{10} or 10^{11} stars in the Galaxy, and that the Sun, a fairly typical star, is $1.5 \times 10^8 \text{ km}$ away from us, and 10 kpc (or 30 000 light years) from the center of the Galaxy. If our starlight came from 10^{10} "suns" at the Galactic center, it would be dimmer than sunlight by $10^{10} \times (1.5 \times 10^{11} \text{ m} / 3 \times 10^{20} \text{ m})^2$, a factor of 2.5×10^{-9} . But visible light from the Galactic center never reaches us—if it did, we would see one brilliant spot in the night sky. Stars more than 2 or 3 kpc away are obscured by interstellar dust. In a more realistic model, our starlight would come from fewer stars closer to the Sun. Perhaps 10^8 stars at 1 kpc ($3 \times 10^{19} \text{ m}$) scattered over the whole sky would be more like it. With those numbers, the ratio of starlight to sunlight received by the whole Earth remains at 2.5×10^{-9} , but the starlight is spread over the whole sphere, lowering its local intensity, relative to that from the Sun at zenith, by a further factor of $\frac{1}{4}$. So we will guess that a horizontal surface receives about 10^{-9} times as much energy in starlight as in light from a high sun. Concentrating it by the factor of 5 million would bring the illumination up to 1/200th of a summer noon. And we are somewhat better off when the Milky Way is overhead. Is this light enough? Probably—but the uncertainties in our estimates make it too close to call with confidence.¹

¹By the way, if you should, for some serious purpose, really need to know the intensity of starlight, consult C. W. Allen, *Astrophysical Quantities* (Athlone, Dover, NH, 1973), 3rd ed., p. 134. Every physicist, whether astronomically inclined or not, should make the acquaintance of that superb handbook.