

UNIVERSITY OF KANSAS
Department of Physics and Astronomy
Physical Astronomy (ASTR 391) — Prof. Crossfield — Fall 2025

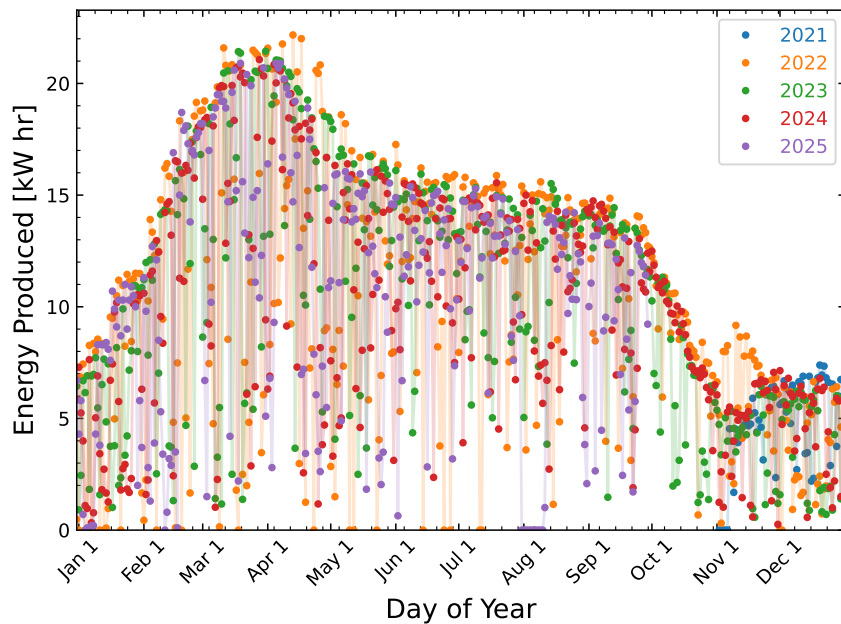
Problem Set 7

Due: Friday, Oct 31, 2025, 12pm Kansas Time
This problem set is worth **42 points**.

As always, be sure to: show your work, circle your final answer, and use the appropriate number of significant figures.

1. Solar Energy [16 pts]

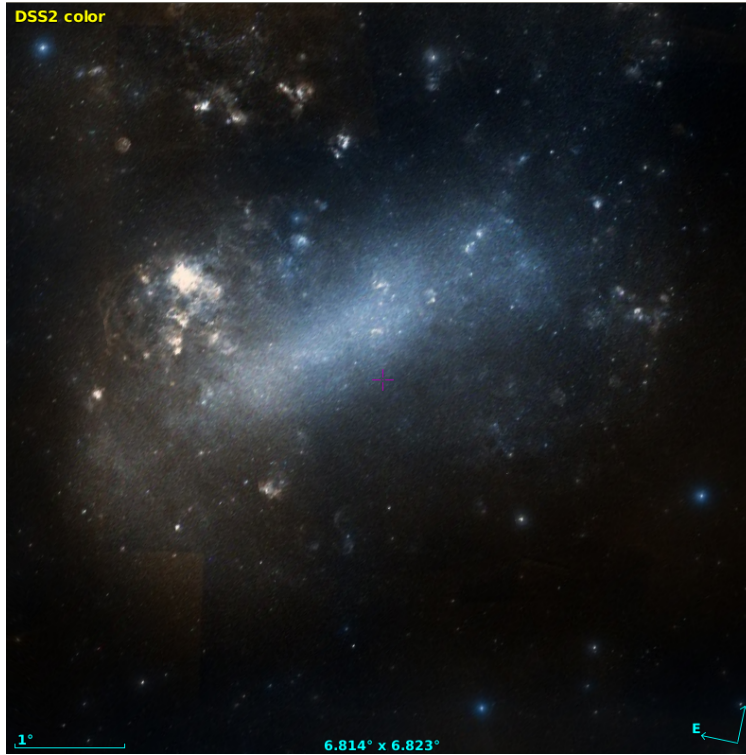
Figure 1 below shows the daily energy produced by Prof. Crossfield's rooftop solar panels over the past few years.



- Describe the general trends you observe in this plot. [4 pts]
- Calculate the Solar Constant, the typical flux of sunlight incident on the Earth, in W/m^2 . [3 pts]
- Prof. Crossfield's solar panel system has a total collecting area of roughly 20 m^2 . Estimate the maximum power (in W) that you might expect the panels to produce. [2 pts]
- Using your estimate of the maximum power, estimate the total energy (in kW-hr, kilowatt-hours) that might be produced in a day. [3 pts]
- In fact, the system never produces more than about 5 kW of power at peak, and rarely more than $\sim 20 \text{ kW-hr}$ of energy per day, at maximum. Describe why these numbers are significantly lower than your rough estimates. [4 pts]

2. A Galaxy (not so) Far, Far Away [26 pts]

The Large Magellanic Cloud (LMC) is a dwarf/irregular galaxy fairly near to the Milky Way. Here is its selfie, in Figure 2:



- The total apparent brightness of the LMC at visible wavelengths is a visual magnitude of ~ 0.1 , corresponding to roughly 10^8 photons/sec/m²/nm. Assume that all these photons are visible-wavelength, and then estimate the observed flux density, F_λ , from the LMC in W/m²/nm. [5 pts]
- Assume further that all energy from the LMC is radiated at visible wavelengths, and then estimate the total flux observed from the LMC, in W/m². [4 pts]
- The parallax to the LMC is roughly $20 \mu\text{as}$. Estimate the distance to the LMC, in pc. [2 pts]
- Use your value for the distance to estimate the total luminosity of the LMC, in both W and L_\odot . [4 pts]
- Given the image of the LMC, estimate its angular diameter (in deg), physical diameter (in pc), and angular area (solid angle, in square degrees — \square°). [6 pts]
- Use your estimate of the LMC's solid angle to estimate its average surface brightness, I_λ , in W/m²/nm/ \square° . How does this compare to the value of $\sim 10^{-13}$ W/m²/nm/ \square° that we estimated for M31 (the Andromeda Galaxy) in class? [5 pts]