Indian Institute of Science Education and Research, Mohali

Astronomy and Astrophysics (IDC201)

(January – April, 2021)

Problem Set 1

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1. Using IISER Mohali as the location of an observer, calculate the range of declinations that are visible to you. What is the range of declinations for circumpolar objects?

2. Calculate duration of the shortest and the longest day for an observer at IISER Mohali. Repeat for an observer at IISER Pune. Discuss.

3. Study the data for the Sun given at http://astropixels.com/ephemeris/sun/sun2020.html. Use this to do the following. Note, you do not need to process date for each day in order to find the solution: do one in ten days or even longer. You may find it easier to write a program for this.

   (a) Plot the right ascension for the Sun as a function of Julian Date (JD) (Column 2). Use the end points to plot the progression of the Mean Sun as a function of JD. Compare the difference of the two curves with the equation of time.

   (b) Compute and plot the time at Sunrise and Sunset at your location (nearest available position) as a function of JD. Find out the day with the earliest sunrise, the latest sunset, the latest sunrise, and, the earliest sunset.

   (c) On which day of the year is the Earth closest to the Sun?

   (d) On which day of the year is the Earth farthest from the Sun?

4. The Hanle Optical Telescope is situated at $32^\circ\ 47'$ N and $78^\circ\ 58'$ E. Due to mechanical constraints, the antenna cannot point at an altitude below 10°. Calculate the range of declinations that can be observed using this telescope. Calculate the duration for which sources at a given declination are visible. Make a plot to illustrate this.

5. A telescope with a field of view $5'$ is pointed to a star at equator. Due to rotation of the Earth, the star drifts out of the field of view. If the star crosses the field of view along the diameter then calculate the time taken by the star to drift from one edge of the field of view to the other edge.

6. The same telescope is now pointed to a star at declination $\delta = 30^\circ$. If the star crosses the field of view along the diameter then calculate the time taken by the star to drift from one edge of the field of view to the other edge.

7. There are two stars close to each other with coordinates h_1, δ_1, and, h_2, δ_2. Derive an expression for the angle between the two stars.

8. Consider two stars with coordinates $h_1 = 0^\circ$, $\delta_1 = 75^\circ$, and, $h_2 = 0.6^\circ$ and $\delta_2 = 75.2^\circ$. Can both the stars be seen simultaneously with a telescope that has a field of view $30'$?