Observation Planning GC

Preface and Context

The concept of observation planning is useful when observing multiple targets; for example, a Messier Marathon. A similar idea is used to plan out overnight observations at scientific observatories, like in the IITB-operated GROWTH-India telescope at Hanle, Ladakh, except that it is automated and optimized.

This GC will involve a similar task, involving teams of up to 4 people.

For our purposes, there are broadly 4 kinds of targets

1. Naked eye
2. Small Aperture
3. Large Aperture
4. Astrophotography only

1. Naked eye targets include constellations/asterisms etc. which are too big to be seen with magnification, yet bright enough to be visible without the extra aperture that telescopes provide
2. Small aperture targets are those with high surface brightness, that can easily be viewed through a small (say 4.5 inch) telescope
3. Large aperture targets are generally very low surface brightness, such as galaxies, and very faint nebulae, which are best suited to high aperture telescopes (at the cost of price and mobility, so assume that if a target is reasonably visible with small apertures, the observer prefers that). Large apertures also come with better resolution, so these would be preferred for crowded fields such as globular clusters.
4. Astrophotography targets involve very faint objects that are exceedingly difficult to view with the eye (aided or otherwise) and require long exposures to resolve details, which is usually possible with a specialized motorized mount.

During the scheduling of the targets, you must also classify targets into these 4 categories. Also, assume that the astrophotography targets can be photographed parallel to the telescope observation (this is in general not possible, but we have separate telescopes for photography).
GC Task

Given a list of objects from all 4 categories (which can be found here), plan out an observation session.

The location of observations is assumed to be a dark site at 20 degrees latitude. The instruments available are:

- 4.5 inch F/7 Alt-Azimuth Telescope (Newtonian)
- 8 inch F/6 Dobsonian Telescope (Newtonian)
- 6 inch F/5 Equatorial Newtonian Telescope, mounted on a motorized mount.

Keep in mind the following while planning out the observation:

1. The rise and set times of the objects (which in general, vary with time of the year)
2. The surface brightness of the objects, which shall be used to select the telescope.
3. For targets of Category 2 and 3, allow for a slew time, i.e. time to find the object given a sky-map. This would depend on several factors, including closeness to bright stars/recognisable patterns in the sky, and how bright the object itself is. A brief justification will receive **bonus** points.
   eg: M13 in Hercules would take the observer about 2 minutes to slew to.
4. For the astrophotography targets, you are to allot times based on the position in the sky and the brightness of the object. Longer exposures are required in general for fainter targets. A point to ponder: What if there is a bright star right next to a faint object. How can it be imaged?
   a. Exact times to image will require knowledge of the sensitivity of the detector being used to image the source. Instead, provide arguments justifying why one target will require more time than another, i.e. a relative comparison to allot times.
5. It is possible to have a target in more than one category, for example, an object in Category 3 that you also want to image. In these cases, please justify why time has been given to that particular object.
6. It may not be possible to observe the complete list of objects in one night.
Judging Criteria and Submission Guidelines

1. There shall be 100 points divided as follows:
   a. 40 points for scheduling the targets. This includes points for including as many targets as possible
   b. 20 points for classification into the 4 categories, along with proper justification for each object (or group of objects)
   c. 10 points for calculation/estimation of slew times for Category 2 and Category 3 objects. (Justification shall be provided upto 10 bonus points)
   d. 10 points for calculation/estimation of exposures for Astrophotography targets, with proper justification.
   e. 20 points for overall documentation (including citations), and presentation of the final solution.

2. Submission Guidelines:
   a. Send your solutions to krittika.club@iitb.ac.in with a CC to gsectech@iitb.ac.in on or before the deadline of 23:59 on 29th September, with the subject as Team Name Hostel {xx} Observation Planning GC
   Late submissions shall not be graded
   b. The solution should be in the form of a PDF document, named TeamName_Hostel_xx. If the team wishes, they may add supporting documents as well, accessible in the form of a link provided in the final solution. Only one solution document per team shall be allowed. In case more than one solution is sent, the first one to be received shall be considered for grading.
   c. The solution document must contain the Team Name, and the names and roll numbers of each team member.