William Elder

Research Proposal

Astronomy 100

Nebular emission

**HII Region Spectroscopy**

**Abstract:**

We will collect spectral data on the Horsehead Nebula(possibly other candidates), and use this data, to calculate nebular physical conditions such as temperature and chemical abundances.

**Scientific Justification:**

HII Regions are interstellar gas clouds, mostly composed of ionized hydrogen (HII). Within these zones, young, hot, stars ionize the surrounding hydrogen through UV emission, while simultaneously driving gas outwards with their powerful stellar winds. During the HII region’s lifetime, its rapidly expanding boundary collides with adjacent, slow-moving interstellar clouds. This shockwave compresses the slower moving gas and induces dense pockets of the gas to collapse into protostars. However, this process eventually destroys the HII region after a few million years.

These relatively volatile systems provide insight on stellar formation, the galactic chemical composition , and the evolution of our universe. Several radiative processes (Recombination, particle collision, forbidden transitions) take place within HII regions. Since HII regions produce their own light, we can derive nebular properties such as temperature and chemical abundances by analyzing the cloud’s spectrum.

**Experimental Design:**

Since HII regions’ most prominent emission lines are within the visible spectrum, we will observe the Horsehead Nebula using B and V filters(?).

|  |  |
| --- | --- |
| HII region | Exposure Time |
| Horsehead Nebula | 810 s |
| Sharpless Nebula | 810 s |
| NGC 1579 | 810 s |

First, I calculated the exposure times that we would need if we used the MMTO spectrograph. To estimate the exposure time for the 1.5 m Tillinghast telescope, I then multiplied the exposure times by the ratio between the area of the MMTO telescope and the 1.5 m Tillinghast telescope.

Once we gather spectroscopic data, we will perform a series of calibrations to ensure that the light that we are analyzing originated from the nebula. These will first include telescopic calibrations (flatfield corrections, cosmic ray removal, bias, etc.). We will also need to adjust our observed spectrum for interstellar reddening and remove the background continuous spectrum from starlight and other foreign sources.

**Technical Description:**

**List of Target Objects:**

|  |  |  |
| --- | --- | --- |
| Object | Position(RA, Dec) | Visible at observatory at midnight |
| Horsehead Nebula | (5h 40m 59s, -2d 27′ 30″) | **Yes** |
| Sharpless Nebula | (00h 01m08.58s, +67d 25’ 17.0’’) | **Yes** |
| NGC 1579 | (4h30min9.5s, +35d 16’19’’) | **Yes** |

I determined visibility by the determining local sidereal time at midnight in Arizona and comparing it to each object’s right ascension.

During our time at the observatory, the Moon’s declination will remain around -20 degrees and its right ascension will range from 18 to 20 hours. The noise from the moon should be sufficiently small, given the large angular distances between each target and the moon.

References:

<http://www.rpi.edu/dept/phys/observatory/obsastro6.pdf>

Peimbert et al., Nebular Spectroscopy: A Guide on HII Regions and Planetary Nebulae