

CHAPTER 6

SUMMARY

6.1 Conclusion

There are many features can be studied from M-type red giant stars. These stars are late type, very luminous, great in size but cool in temperature. Their temperature and evolution stage make them unique since they already produce and still producing a lot of heavier element atoms and molecules. These characteristics can be studied by using astronomical spectroscopy technique.

Instrumentation involved is the 20 inch Ritchey–Chrétien optical system telescope attached with ST-7E CCD camera and a slit type Self Guided Spectrograph. IRAF is the most important software in this study especially during the image reduction process and the data analysis part.

One of the features that have been studied is the $H\alpha$ $\lambda 6563$ Å line profiles. These profiles show that the abundance of hydrogen in M-type red giants is relatively less. This is because of the amount of hydrogen is decreasing since it has been fused by the star. Another factor is the temperature of the stars is cool so that the energy needed for this element to get excited is not sufficient enough.

The study on radial velocity on these stars also showing that the observed stars are validating the expansion of universe at a certain acceleration rate. However, there are two stars having blue shifted due to the existence of stellar wind that approaching toward us.

Another characteristics seen in the M-type red giants are two famous photospheric line which are Fe I $\lambda 6546 \text{ \AA}$ and Ca I $\lambda 6572 \text{ \AA}$. The presence of these two lines in the stellar spectrum shows the existence of these elements thus proving the existence of heavier elements in these cool type stars.

One of the most important things related to M-type is the presence of titanium oxide (TiO) molecular bands which dominates the spectrum. The molecular band can be detected as early as M1.5/2 especially at $\lambda 7055 \text{ \AA}$ spectral region. This molecule appearance shows that the M-type stars have suitable temperature to produce molecules compared than other hot stars.

6.2 Suggestion on future works

In order to improve the achievement and to upgrade the quality of this study, here are some suggestions for future works:

1. With the intention of studying the M-type red giants, higher magnification telescope is the ultimate must especially to detect dim stars since cool stars are already transferring its maximum energy towards the end of visible spectrum.
2. When doing comparison of the same type, it is better to have a large number of data and focus with some spectral characteristics. Hence, it is easier to see a pattern or a variation of stars within the same type.
3. Most of the study is being done in high resolution which is best to look at a particular spectral line property. However, it is good also to use low

resolution and capturing the whole spectrum into one frame. This could be done in order to find the temperature of the stars and hence, can be used to compare on the arrangement of the stars within the subclasses since the arrangement are according to the stellar effective temperature. By doing high resolution and combining frame by frame is not suitable since each frame has different relative flux or exposure time.

4. Since M-type red giants are cool stars, their strength already transferring to the infrared region. This part especially, contains a lot of information on molecules. Hence, the later subclass in M-type can be observed in this region. Another bonus of doing infrared study is that the observation is not limited by clouds and water vapour particularly when Malaysia is a equatorial climate country with lots of clouds and high humidity. It is the time to actually develop something in that in order to develop the astronomy knowledge and bringing it into another paradigm.