Variability in Active Galactic Nuclei (AGN)

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Introduction

The purpose of this project was to determine the variability in selected Active Galactic Nuclei (AGN). By taking several images per night, as well as throughout the summer, in both the Infrared and Red filters, it was determined that of the two AGN observed—Markarian 501 (MKN 501) and BL Lacertae (BL Lac)—BL Lac had intraday variability, as well as interday variability. No variability was observed in MKN 501.
AGN Model

(Credit: C.M. Urry and P. Padovani)
Method

Observations were made on June 9, July 7, 10, 11, 12, 17, 23, 24, 26, and 30 as well as August 3, and 4. However, only data from July 7, 11, 23, 24, and 26 was able to be used. Data collected on the 23, 24, and 26 showed significant variability. Dark images and flat fields were taken on each night of observation. The object images were dark subtracted and flat fielded. The Photom II program was used for data reduction and analysis. Microsoft Excel was used to determine the variability of the objects and to perform the F-test.
F-test

The F-test was used to determine whether or not one could reject the null hypothesis that the star is not variable. It also produced a method of determining the percent confidence level of variability.
BL Lacertae (I Filter) on July 23, 2003

Time elapsed approximately 1.5 hours
BL Lacertae (R Filter) on July 23, 2003

Time elapsed approximately 1.5 hours
BL Lacertae (R Filter) on July 24, 2003

Time elapsed approximately 4.5 hours
BL Lacertae (I Filter) on July 24, 2003

Time elapsed approximately 4.5 hours
BL Lacertae (I Filter) on July 26, 2003

Time elapsed approximately 5 hours
BL Lacertae (R Filter) on July 26, 2003

Time elapsed approximately 5 hours
BL Lac (I Filter) All Nights

Time elapsed approximately 3 days
BL Lac (R Filter) All Nights

Time elapsed approximately 3 days
F-test Results

<table>
<thead>
<tr>
<th>Night</th>
<th>% Confidence of variability</th>
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<tbody>
<tr>
<td>July 23, 2003</td>
<td>99%</td>
</tr>
<tr>
<td>July 24, 2003</td>
<td>95%</td>
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<td>July 26, 2003</td>
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Markarian 501 Field
BL Lacertae Field
Conclusion

The results of this project show that BL Lac can vary in short (<1 hour) periods of time. This proves that BL Lac cannot be more than 1 lighthour across.

There are no significant results with regard to Mkn 501.