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Monitoring AGNs with H-beta Asymmetry: Markarian 841

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Introduction

As part of the MAHA[1,2] reverberation mapping campaign, new spectroscopy was obtained for Markarian 841. We report high fidelity reverberation mapping results, including mass determination, continuum and Hβ light curves, and a velocity-resolved time delay graph. Although Mrk841's Hβ profile is not very asymmetric now, it has a past of both red[3,4] and blue[5] asymmetries.

Materials and Methods

These data were taken using the 2.3m Wyoming InfraRed Observatory (WIRO) utilizing a 900 line/mm diffraction grating. Gaps in the continuum data were filled using ASASSN data. Fluxes were calculated by finding the area under the spectrum of that section.

Results and Analysis

$$M_\bullet = f\frac{c\tau\Delta V^2}{G} \qquad (1)$$

From Equation 1, the mass of Markarian 841 was determined as $10^{8.15}$ solar masses (where ΔV=4763 km/s and f=1.12[6]). Note that ΔV is the FWHM of the Hβ broad line in the spectrum at the right.

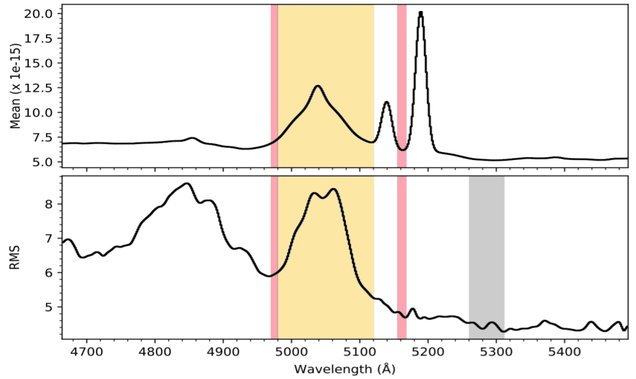

Figure 1. Continuum (5100 Å) and Hβ light curves for Mrk841. By comparing these two curves, we can find τ, the time lag between flux changes in the continuum and changes in the Hβ broad line. Fluxes were calculated by integrating under each respective portion of the AGN's spectrum. For Mrk841, τ=27±5 days. This time lag gives us the size of the broad line region.

Figure 2. Velocity-resolved time delay graph (top) found by binning the Hβ broad line into velocity bins of equal integrated flux (bottom). The top graph displays shorter time lag portions having a largely redshifted velocity, indicating that the broad line region of Mrk841 is likely undergoing infall.

Conclusions

The MAHA campaign has produced robust reverberation mapping results for Mrk841, including a first ever mass determination via optical reverberation mapping. In addition, the velocity-resolved time delay graph gives us key insight into the structure of the broad line region of Mrk841, indicating an infall of material. In the future, the MAHA campaign aims to continue producing high fidelity reverberation mapping results for Mrk841 and other AGNs.

Literature cited

[1]Du et al. 2018.
[2]Brotherton et al. 2020.
[3]De Robertis 1985.
[4]Boroson & Green 1992.
[5]Barth et al. 2015.
[6]Woo, J. et al. 2015.

Acknowledgments

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Further information

Please see the MAHA[1,2] series of papers for more specific information on the contents of this poster. For questions or comments, contact me at sjschonsberg@gmail.com.