First Constraints on Black Hole Spin in Broad Iron Line AGN

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1. Introduction

Black holes (BHs) can be completely defined by their mass and spin alone. But whereas the mass of a BH is fairly simple to calculate through any number of methods, spin has proven much more challenging to constrain. One of the most promising and robust methods for measuring this quantity relies on modeling the relativistically altered shape of the Fe-K spectral line emitted from the accretion disk around a BH. Employing this technique, I have expanded on previous methods to create a new relativistic emission line model which allows the BH spin to be fit as a free parameter. This allows us to robustly constrain the angular momentum of a BH for the first time. Herein I present the results of spectral fitting of this model to several AGN with robustly observed broad iron lines in an effort to perform the very first statistically robust study of BH spin distribution in these types of sources. This is a crucial first step toward taking a census of the spin in both AGN and BHGs. This project is ongoing, and will be presented as a dissertation talk at the summer 2007 AAS meeting in Hawaii.

2. The kerrdisk Model

![Graphs and plots showing various models for the kerrdisk.

3. Results of Spectral Fitting to Several Seyfert AGN

![Graphs and plots showing results of spectral fitting.

<table>
<thead>
<tr>
<th>AGN</th>
<th>Fe-K Absorber</th>
<th>MgK Absorber</th>
<th>Fe-Lya Absorber</th>
<th>Fe-Lamina Absorber</th>
<th>Fe-llka Absorber</th>
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</thead>
<tbody>
<tr>
<td>MCG-6-30-15 (z=0.008)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>MCG-5-30-15 (z=0.008)</td>
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<td>Yes</td>
<td>Yes</td>
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4. Conclusions

- A close examination of XMM-Newton data of several Seyfert-1 AGN has confirmed the presence of broad iron lines in these objects.
- Using a careful, step-wise spectral analysis of these data, we have accounted for the effects of absorption and continuum curvature in these sources and have conclusively found a significant improvement in fit when ionized disk spectra are smeared with relativistic effects as per our new model kerrcom.
- A new generation of models such as kerrdisk and kerrline are now enabling us to use broad iron lines of sufficient resolution and count number to robustly constrain black hole spin, providing we employ reasonable physical constraints for the other disk parameters (e.g., emissivity index, radial extent).
- MCG-6-30-15 harbors a rapidly-spinning black hole: a non-spinning hole is strongly ruled out. Preliminary results for several other Seyfert-1 AGN with broad iron lines are shown here, and future work in the coming months will increase the sample size to ~10 AGN in which we attempt to constrain black hole spins.