The structure of AGNs from X-ray eclipses

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Method: XMM long look of Mrk 766
No absorption, “standard” model

$N_H \sim 10^{23}\text{cm}^{-2}$, C.F. $\sim 80$

No continuum spectral variation
Ubiquitous Variability of $N_H$ in Seyfert Galaxies

Eclipses on short time scales are common! (~10 sources with confirmed occultations in hours-days)

Table 1. List of sources with $N_H$ variations on short time scales

<table>
<thead>
<tr>
<th>Name</th>
<th>$\Delta(N_H)^a$</th>
<th>$\Delta(T)^b$</th>
<th>Method$^c$</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGC 1365</td>
<td>$&gt;10^{24}$</td>
<td>&lt; 2 days</td>
<td>Snapshot</td>
<td></td>
</tr>
<tr>
<td>NGC 1365</td>
<td>$3 \times 10^{23}$</td>
<td>10 hours</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>NGC 4388</td>
<td>$2 \times 10^{23}$</td>
<td>15 hours</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>NGC 4151</td>
<td>$2 \times 10^{23}$</td>
<td>20 hours</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>NGC 4151</td>
<td>$10^{23}$</td>
<td>&lt;2 days</td>
<td>Snapshot</td>
<td></td>
</tr>
<tr>
<td>NGC 7582</td>
<td>$10^{23}$</td>
<td>20 hours</td>
<td>Snapshot</td>
<td></td>
</tr>
<tr>
<td>Mrk 766</td>
<td>$3 \times 10^{23}$</td>
<td>10 to 20 hours</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>MCG-6-30-15</td>
<td>$10^{23}$</td>
<td>10 hours</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>UGC 4203</td>
<td>$3 \times 10^{23}$</td>
<td>&lt; 15 days</td>
<td>Snapshot</td>
<td></td>
</tr>
<tr>
<td>NGC 3227</td>
<td>$7 \times 10^{22}$</td>
<td>1 day</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>NGC 4395</td>
<td>$3 \times 10^{23}$</td>
<td>10 hours</td>
<td>Continuous</td>
<td></td>
</tr>
</tbody>
</table>

(Risaliti et al. 2010)
Finding more sources with eclipses in ~hours-days

NGC 4388
\[ \Delta N_H \sim 2 \times 10^{23} \text{ cm}^{-2} \]
\[ \Delta T \sim 15 \text{ hours} \]

NGC 4151
\[ \Delta N_H \sim 10^{23} \text{ cm}^{-2} \]
\[ \Delta T \sim 2 \text{ days} \]

UGC 4203
\[ \Delta N_H \sim 3 \times 10^{23} \text{ cm}^{-2} \]
\[ \Delta T < 15 \text{ days} \]

NGC 7582
\[ \Delta N_H \sim 10^{23} \text{ cm}^{-2} \]
\[ \Delta T \sim 20 \text{ hours} \]

(Bianchi et al. 2009)
Future IXO observations of AGN eclipses

• 1) Structure and properties of X-ray absorber:
  → “Cometary” shape of clouds
  → distribution of cloud velocities

• 2) A possible experiment of “disc tomography”
  → probing general relativistic effects through iron line variations during an eclipse
1) Structure of the absorber

NGC 1365 Suzaku

Maiolino et al. 2010
1) Structure of the absorber

NGC 1365 \text{Suzaku}

Maiolino et al. 2010

\[ V_c > 2000 \text{ km/s} \]

\[ R_{\text{head}} \]

\[ R_x \]

\[ L_{\text{tail}} > 2 \times 10^{13} \text{ cm} \]

\[ \theta < 2.4^\circ \]
Assumptions:

1) It is really a relativistic line
2) Long look (>300 ks)
3) Source in Compton-thin state
4) Complete 10-hours C-thick eclipse during obs.
Simulation: IXO observation of the eclipsing iron line
IXO observation of the already observed eclipses
Simulation: XMM observation of the eclipsing iron line