**On the relation between X-ray absorption and optical extinction in AGN**

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**ABSTRACT**

According to the Unified Model of Active Galactic Nuclei (AGN), an X-ray unabsorbed AGN should appear as unobscured in the optical band (the so-called type-1 AGN). However, there is an important fraction (10–30%) of AGN whose optical and X-ray classifications do not match. To provide insight into the origin of this apparent discrepancy, we have conducted two types of analysis: 1) a detailed study of the UV-to-near-IR emission of two X-ray low-absorbed AGN with high optical extinction drawn from the Bright Ultra-Soft XMM-Newton Survey (BUXS); 2) a statistical analysis of the optical obscuration and X-ray absorption properties of 159 type-1 AGN drawn from BUXS to determine the distribution of dust-to-gas ratios in AGN over a broad range of luminosities and redshifts.

We have determined the impact of contamination from the AGN hosts in their optical classification (detection or lack of detection of rest-frame UV-optical broad emission lines). This is an on-going project, but our preliminary results, reported below, are very promising.

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**The BRIGHT ULTRA-HARD XMM-NEWTON Survey (BUXS)**

The AGN analyzed in this work were selected from the Bright Ultra-Soft XMM-Newton Survey (BUXS; Mattei et al. 2012). This is a flux-limited sample of 260 AGN detected at 4.5-10 keV energies with the XMM-Newton observatory. It is based on 35% high Galactic latitude (E(B-V)>0.5) observations. The objects have large X-ray fluxes f_X\_unabs\_3-8 keV>10^{-14} erg/cm^2/s, and were detected in a total sky area of 44.43 deg^2.

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**Low X-ray absorption in 2 AGN**

![X-ray spectra](image)

Table 1: X-ray information of the selected objects and optical properties of the sources from public surveys.

<table>
<thead>
<tr>
<th>Object</th>
<th>J2000.04-00.0</th>
<th>J2000.00-00.71</th>
<th>J2000.60-00.71</th>
<th>Redshift</th>
<th>Conuty (MC/ps)</th>
<th>N_{H,O} (cm^{-2})</th>
<th>Optical classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>J0041.24-040711.3</td>
<td>42.76</td>
<td>0.1107</td>
<td>3212</td>
<td>\geq4.710^{-26}</td>
<td>Type-1 (SDSS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J2051.40-000711.3</td>
<td>41.25</td>
<td>0.026</td>
<td>1534</td>
<td>\geq1.7\times10^{-26}</td>
<td>Type-2 (2-2E2F Survey)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Av/Nv in the type-1 sample**

![Histogram of Av/Nv](image)

Table 2: Results for the dust absorption to gas ratio Av/Nv.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>log(10^{2} kpc)</td>
<td>42-45</td>
</tr>
<tr>
<td>N_{F} objects</td>
<td>0.05-3.18</td>
</tr>
<tr>
<td>N_{absorbed}</td>
<td>31-36</td>
</tr>
</tbody>
</table>

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**CONCLUSIONS**

The 10–20% of AGN with optical and X-ray extinction are still an important challenge to the Unified Model of AGN. This is why we conducted this study with an unbiased sample like BUXS. From the detailed study of two low X-ray absorbed AGN with high optical extinction we concluded that AGN with a decoupled X-ray and optical classification do not represent an homogeneous sample, as the course of the optical extinction and the X-ray emission are interrelated. We also studied a statistical sample of 159 type-1 AGN from BUXS to determine the distribution of dust-to-gas ratios in AGN over a broad range of luminosities and redshifts.

The statistical study shows that in the majority of the objects in our sample, the dust-to-gas ratio is compatible with the Galactic or lower. In comparison with the Maiolino et al. (2001) sample, whose AGN shows values normally between 3 and 100 times below the Galactic relation, we obtain a wider range of ratios. Dust-to-gas ratios of AGN are not well known in the past and play an important role in understanding AGN.