NGC 5548 Revisited: The Lean Years

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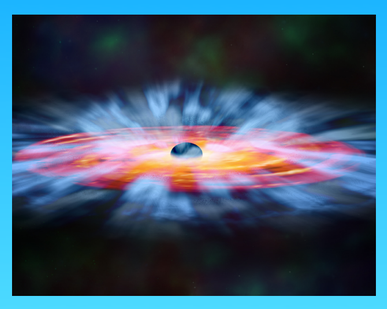
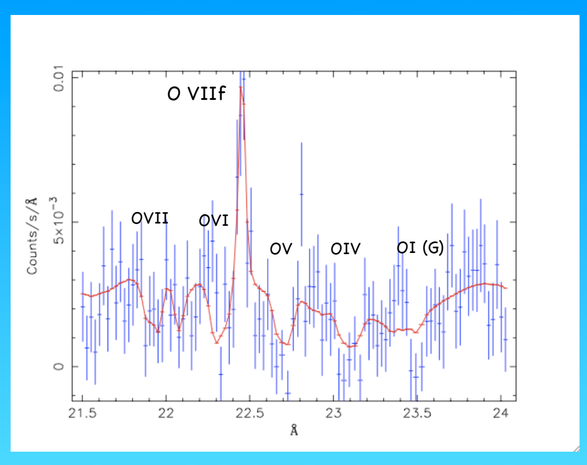
Introduction

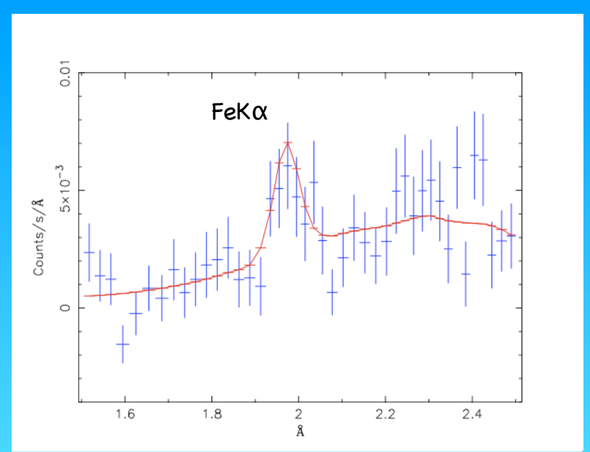
The presence of outflows in AGN has long been known in the form of radio jets or BAL AGN's. Only recently UV and X-ray observations have shown that the majority of Seyfert Galaxies have outflows in the form of a wind or clouds of gas showing up as blue-shifted absorption in the spectrum.



It is important to study these outflows carefully, since they provide information of the dynamics and physics of the inner-most region of AGN's.
We present the results of an observation of NGC 5548 taken in 2005 with the Chandra LETGS X-ray spectrometer. The source was in a very low state for the first time, allowing us to determine changes in the spectral features when compared to previous observations.

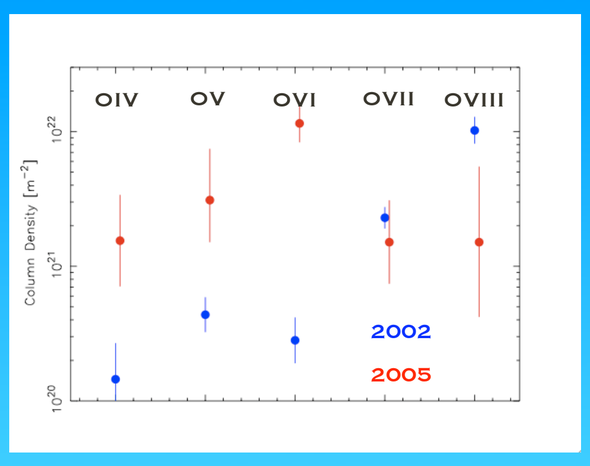
X-ray Spectral Fit





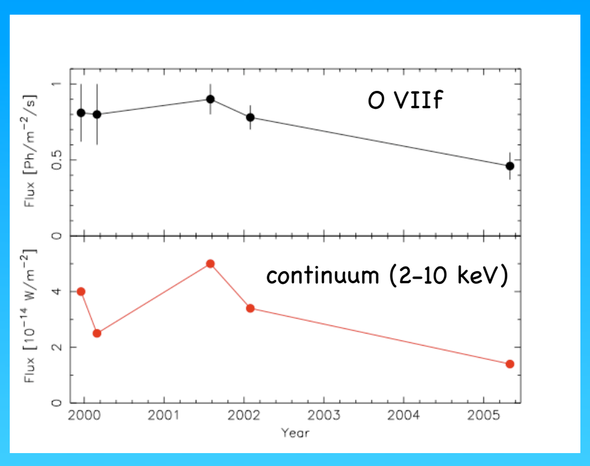
The spectral fit of NGC 5548, showing the two most important regions: the Fe K emission line and the region around the OVIIf emission line. We have modeled the continuum with a spline model, so we make no a priori assumptions about the continuum shape. The outflow is modeled with 3 seperate absorbers, each with a different outflow velocity and with adjustable ionic column densities. For each ion all lines are fitted.

Oxygen Column Densities



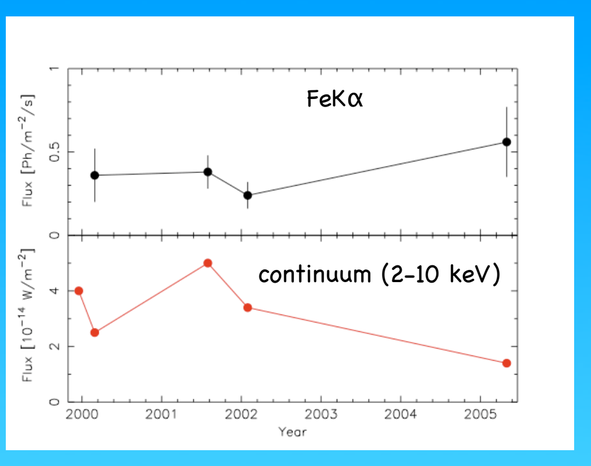
The oxygen column densities of the outflow in NGC 5548 for this observation and the previous one.
It is clear that the gas has started to recombine to a lower ionized state.
This allows us to determine an upper limit to the location of the gas using the upper limit of 3 years on the recombination timescale (i.e. the time it takes for the gas to recombine).
We can constrain the location of the absorber to within 35 pc of the central source.

OVIIf emission line



The OVIIf emission line flux (upper plot) and the continuum flux (lower plot) for several observations taken from 1999 to 2005.
The OVIIf line flux follows the drop in continuum flux observed in 2005, allowing us to constrain its location to within 1 pc of the central source.

Fe K emission line



The Fe K emission line flux (upper plot) and the continuum flux (lower plot) for several observation taken in the period of 1999 to 2005.
Although the continuum flux in 2005 was the lowest ever recorded for NGC 5548, we did not detect a drop in the line flux. From the measured FWHM of 7300 ± 2700 km/s, the detected line is formed close to the central source, so should have responded to the lower continuum flux in 2005.
The most likely explanation for this result is that the line is actually a blend of multiple lines formed further away from the central source.

Conclusions

- The gas in the warm absorber has recombined to a lower ionized state --> location constrained to within 35 pc from the central source.
- The O VIIf emission line has decreased in flux --> location constrained to within 1 pc from the central source.
- The gas emitting the Fe K line has not changed --> most likely due to blending of multiple components of the Fe K line.

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More to read

- Steenbrugge, K. et al, A&A, 2005
- Kaastra, J. et al, A&A, 2002
- Pounds, K. et al, MNRAS, 2003
- Yaqoob, T. et al, ApJ, 2001