HELIUM I $\lambda$10830 OBSERVATIONS OF SEYFERT 2 GALAXIES

Ross D. Cohen, Richard J. Rudy, George S. Rossano, R.C. Puetter, and Scott D. Chapman
The Center for Astrophysics and Space Sciences, UCSD
La Jolla, CA 92093
and
Space Sciences Laboratory, The Aerospace Corporation
M2/266 P.O. Box 92957
Los Angeles, CA 90009

1. INTRODUCTION

Because of the metastability of the $2^3S$ level of He I, a variety of effects can change the line strengths from pure recombination values in Seyfert galaxies (see Feldman and MacAlpine 1978). This occurs because the population which builds up in the $2^3S$ level can be collisionally excited to the $2^3P$ level, enhancing $\lambda$10830. The expected ratios of $\lambda$10830/$\lambda$5876 can be altered by internal or external reddening and vary with temperature, density and optical depth.

Previous observations of $\lambda$10830 in AGN were mostly of Seyfert 1 galaxies (LeVan et al. 1984 and references therein). We have measured the $\lambda$10830/$\lambda$5876 ratio in 12 Seyfert 2 galaxies and NGC 1275.

2. OBSERVATIONS AND RESULTS

Infrared observations were made with the Lick Observatory 3m Shane Telescope and the University of Minnesota/UCSD 1.5m Telescope at Mt. Lemmon. The observations were made either at a resolution of $\Delta \lambda/\lambda = 0.02$ and an aperture of 12.0" or a resolution of $\Delta \lambda/\lambda = 0.0033$ and an aperture of 7.5". The detector was a single germanium photodiode. Published results were used to scale $\lambda$5876 and $\eta$ $\beta$ to the flux of [O III] measured in an 8.0" aperture.

Measured ratios of $\lambda$10830/$\lambda$5876 ranged from 5 to 28, while case B recombination values may range from 2.4 to 3.6. For $n_e > 600$, collisions dominate the production of $\lambda$10830, producing $\lambda$10830/$\lambda$5876 up to 15. Because several of the $\lambda$10830/$\lambda$5876 ratios are greater than that, and because $H\alpha/H\beta > 3.0$, the recombination value, we know that there is reddening affecting the line ratios. We have corrected the $\lambda$10830/$\lambda$5876 ratios for reddening derived from the Balmer lines, and find a range from 1 to 12.

3. DISCUSSION

While the high values are within the range produced by collisional enhancement of $\lambda$10830, the low values cannot be explained unless the density is very low. We...
consider two methods for depopulating $2^3S$ and one for destroying $\lambda 10830$.

We consider the intensity that the continuum source must have to photoionize the $2^3S$ level and thus decrease the strength of $\lambda 10830$. For typical luminosities and densities, this mechanism is important only within a few pc of the nucleus, a region which probably does not contain the bulk of the material.

For regions of high optical depth in Ly$\alpha$, resonant scattering of Ly$\alpha$ could increase the flux of Ly$\alpha$ to where photoionization by Ly$\alpha$ could be a significant destruction mechanism for the $2^3S$ level. We find that for column depth of $10^{21}\text{cm}^{-2}$ and neutral fraction $10^{-4}$, the destruction of $2^3S$ by Ly$\alpha$ is negligible compared to other destruction mechanisms. In addition, any dust in the region will destroy the Ly$\alpha$ photons, further decreasing the importance of this mechanism.

A similar process of resonant scattering in a dusty medium could act to destroy $\lambda 10830$ photons. Again, we find that extremely large column depths are necessary before this mechanism can have a large effect. Only an ad hoc model where scattering takes place through dusty regions between clouds will work.

4. BROAD $\lambda 10830$ IN NGC 1068

The $\lambda 10830$ profile in NGC 1068 appears to show a broad component under the strong narrow component. A rough comparison with the broad component of $H\beta$ (Antonucci and Miller, 1985) yields $\lambda 10830/H\beta \approx 4$, considerably greater than the average of 0.6 found for Seyfert 1 galaxies by LeVan et al. (1984). This may yield clues to the nature of the occulting disk or scattering medium in NGC 1068.

Figure 1 shows the broad component of the $\lambda 10830$ line in NGC 1068.

5. REFERENCES