

Keck laser guide star observations of 11 GOODS-South Chandra sources at $z \sim 1$

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Abstract. The Center for Adaptive Optics (CfAO) Treasury Survey (CATS) has observed 11 Chandra sources (10 AGN) at $z \sim 1$ in the GOODS-South field with the laser guide star adaptive optics (LGS AO) system at Keck Observatory. We combine this K band imaging with ACS imaging in the B, V, I, and z bands to obtain multi-color imaging at a spatial resolution better than 100 mas in all bands. We attempt to remove central optical point sources from AGN using the GALFIT (Peng *et al.* 2002) routine. We fit Bruzual & Charlot (2003) tau-models to the residuals and find young, dusty stellar populations in the central 1-2 kpc (the mean central optical depth at rest-frame 500 nm is 4-5).

Keywords. instrumentation: adaptive optics, galaxies: active, galaxies: stellar content

1. Introduction

The nature of AGN circumnuclear starbursts has been the focus of many low-redshift studies (Ho *et al.* 2003, Cid Fernandes *et al.* 2003, Kauffmann *et al.* 2003 with SDSS photometry, Joquet *et al.* 2001, Storchi-Bergmann *et al.* 2001, Heckman 1997). Generally, at $z < 0.3$ it is seen that AGN with strong optical emission tend to be more associated with nuclear ($0 < r < 2$ kpc) starbursts and early-type systems than either weak AGN or nonactive systems, supporting the notion that black hole growth and bulge formation are simultaneous and triggered by similar processes. Kauffmann *et al.* 2006 hypothesizes that these AGN possess low-mass reservoirs of cold gas, which would be a necessary condition for both star formation and AGN fueling. Galaxy interactions (e.g., Gunn 1979, Hernquist 1989) or bars (Shlosman 1992) must then be invoked to funnel this gas to the nucleus.

The CfAO Treasury Survey (CATS) has observed 11 AGN with LGS AO to determine if circumnuclear starbursts are associated with AGN at higher redshift ($z \sim 1$). We focus on infrared data with good spatial resolution in regions where HST optical data is abundant to constrain stellar populations.

2. Results & Conclusions

We have observed the following AGN from Mainieri *et al.* 2005: XID 15, 30, 32, 56, 61, 83, 155, 266, 532, 536, and 594. Bruzual & Charlot (2003) tau-model grids are interpolated across dust extinction, age, and tau and fit to the photometry as a function of radius. All the systems show a rise in the fraction of old populations with radius, with younger ($t < 100$ Myr) star formation dominating in the central 2 kpc; this may support the claim that AGN at $z \sim 1$ are associated with circumnuclear star formation. Figure 1

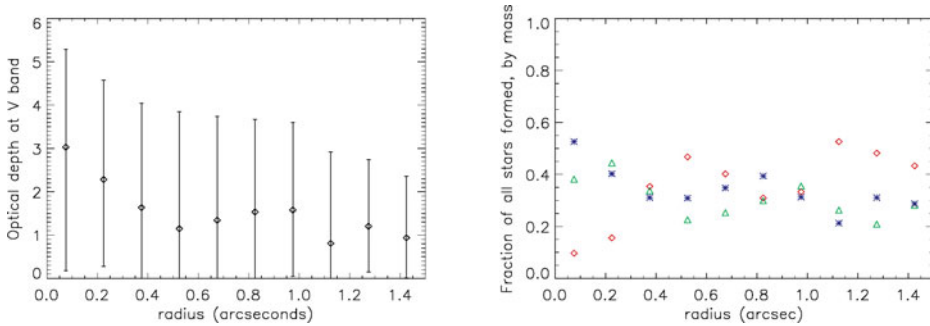


Figure 1. (Left) average fitted dust extinction (error bars denote range of values); (right) fractions of stars formed, split by age (blue: $t < 100$ Myr, green: $0.1 < t < 1.0$ Gyr, red: $t > 1$ Gyr)

plots the fraction of stars formed against radius, differentiated by age, averaged over all Chandra sources. Also plotted is the fitted rest-frame optical dust extinction as a function of radius. Note that younger, dustier stellar populations dominate in the central regions ($r < 2$ kpc).

Two systems (XID 155 and 594) display bar-like residuals after the subtraction of a sersic bulge + exponential disk + central point source model. Two display prominent spiral arms (XID 83 and XID 266). Two are obvious mergers (XID 56 and XID 536 - see Melbourne *et al.* 2005). Two others are dominated by a central point source and are accompanied by distinct structures (XID 532 has a set of star-forming knots 6 kpc to the north; XID 15 has a ring of young material at a projected radius of 3-4 kpc). The remaining three systems are central point sources with a diffuse, radially symmetric structure overlaid (e.g., XID 61, 30, and 32). The infrared images are smooth in all cases.

Concluding, 9 of 11 AGN display positive age gradients, with younger populations in the central regions ($r < 2$ kpc) compared to the outer regions. 10 of 11 AGN display increased dust extinction in the inner 2 kpc relative to the outer regions.

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