Majority of AGNs obscured.

Swift BAT gives penetrating power and lack of confusion with stellar sources.

HET and XMM-Newton follow-up.
HET Follow-Up of BAT AGNs

Expect ~ 450 AGNs in 36-month BAT catalog.

Effective 8-meter aperture

Covers -10 to +72 declination. Can access ~ 250 BAT AGNs.

Queue scheduled

25% of time owned by Penn State
HET Follow-Up of BAT Sources

HET already used for some Swift BAT follow-up work effectively.

HET well matched to BAT sources in terms of

- Sky separation – queue scheduling
- Expected magnitudes – $R \sim 15-20$
- Line properties

Plan to put in HET proposal for 2007 June 15 deadline.
Complex X-ray Spectra of Obscured AGNs

Swift XRT effective at identification, but short exposures and small effective area limit photon statistics and understanding.

NGC 6240
Vignati et al. (1999)

Tololo 0109-383
Matt et al. (2001)
XMM-Newton Follow-Up of BAT Sources

XMM-Newton exposures of 10-20 ks can give:

- Level and nature of complex X-ray absorption
- Iron K line and Compton-reflection continuum (with BAT)
- Circumnuclear starburst activity and scattered low-energy emission
- X-ray variability

Tololo 0109-383
Matt et al. (2001)
Expected XMM-Newton Targets

Have ~ 120 BAT AGNs presently with reasonable X-ray spectra.

In future need to focus on important subsets enabling new science.

• Representative sample pushing to faintest BAT fluxes possible.

• Most-luminous obscured sources.

• Highest-redshift BAT sources.

• Objects not previously identified as AGNs at any wavelength.

• Unusual objects.
Active Galaxy Variability Studies with Swift

2-3 examples briefly – many more possibilities!

1. Luminous radio-quiet quasars at $z \sim 1-5$
2. Stellar tidal disruptions and other X-ray outbursts
3. Absorption-variability monitoring in local Seyferts
Changes in X-ray Variability with Redshift?

Little is known about X-ray variations of radio-quiet AGNs at moderate-to-high redshift, during main growth phase of SMBHs.

Significant X-ray variations, by a factor of ~ 2 or more, appear common among z ~ 4 quasars.

Some claims that AGNs (of matched luminosity) are more X-ray variable at high redshift. Changes of emission-region size, accretion rate, variability mechanism?
Swift + Chandra + XMM-Newton Variability Study

Swift + Chandra + XMM-Newton program can dramatically improve variability studies for luminous quasars at z ~ 1-5.

Observe ~ 10-12 luminous quasars for several years (~ 20 epochs), sampling range of timescales.

Flexible scheduling.

UVOT for optical-to-X-ray SED.

Utilize archival X-ray data for longest timescales possible.

Four approved for Swift AF-4.

Combine with X-ray variability in Chandra Deep Fields to probe full luminosity-redshift space.

Three Swift targets (PG 1247+267, PG 1634+706, HS 1700+6416), being reverberation mapped to get SMBH masses.
Stellar tidal disruptions (transient fueling) should be inevitable in crowded galactic centers.

Should lead to X-ray / UV flares of AGN-level luminosities over month-to-year timescales.

Evidence for such events, mainly from ROSAT and GALEX.
IC 3599: Example X-ray Outburst from the ROSAT All-Sky Survey

1990-1992 ROSAT Light Curve

X-ray variability by factor of ~ 60+. Peak $L_X \sim 5 \times 10^{43}$ erg s$^{-1}$.

X-ray bright.

Very soft X-ray spectrum. Dominant $kT \sim 90$ eV blackbody.

X-ray outburst induced optical variability.

IC 3599 has a weak AGN. Other outbursts seen from non-AGN.
Catching Outbursts in Progress

Current outbursts only recognized after they were largely over (and faint).

Ideally want to catch them in progress and study intensively with Swift and at other wavelengths (e.g., emission and absorption lines).

Ongoing and new surveys should deliver outbursts in progress:

- Supernova surveys
- Wide-field optical surveys
- GALEX surveys
- Chandra cluster survey

Swift Key Project on stellar tidal disruptions – waiting for event to trigger.
## Rapid-Response X-ray Outburst Searches

### Zwicky 1953

### MCS J0329.7-0212

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Problems with Classical AGN Obscuration Model

Unified AGN models have had great success, but classical “torus” is problematic:

Vertical-support problem
(e.g., Krolik & Begelman 1988)

Failure to match resolved infrared measurements implies clumping
(e.g., Elitzur 2006)

X-ray absorption variability on timescales down to hours implies small size
(e.g., Risaliti et al. 2002)

Much still to be learned!
One Revised AGN Obscuration Model

Best current models propose that “torus” is a dynamic, clumpy structure.

Related to ubiquitous AGN winds that provide feedback to galaxies.

Current X-ray measurements of absorption variability suffer from
• Limited time sampling
• No complete sample studied systematically

Swift monitoring of a bright, well-defined sample of absorbed AGNs on wide range of timescales.

Constrain frequency, timescale, and level of absorption changes.
• Number of clouds along line of sight.
• Radial absorption profile – X-ray vs. infrared constraints.

Object-to-object variations
• Orientation effects
• Luminosity effects