Changing-look AGN in the BAT AGN Spectroscopic Survey

arXiv:2211.04478

Matthew Temple

Universidad Diego Portales, Santiago, Chile

Matthew.Temple@mail.udp.cl

And the BASS collaboration:

Claudio Ricci, Mike Koss, Benny Trakhtenbrot, Franz Bauer, Alejandra Rojas etc.

The restless nature of AGN

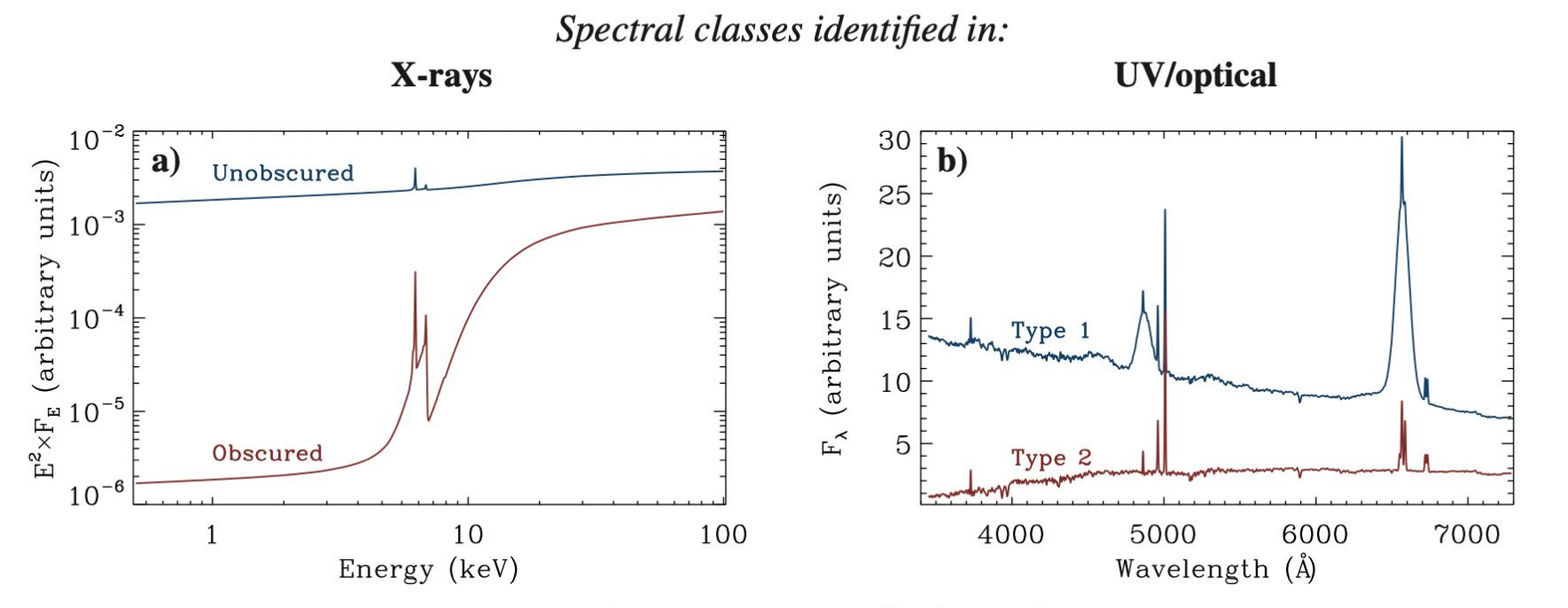
Naples, Italy

Thursday 29 June 2023

INSTITUTO DE ESTUDIOS ASTROFÍSICOS udp

FACULTAD DE INGENIERÍA Y CIENCIAS

Changing-look AGN



Ricci & Trakhtenbrot 2022

Changing-look AGN: some open questions

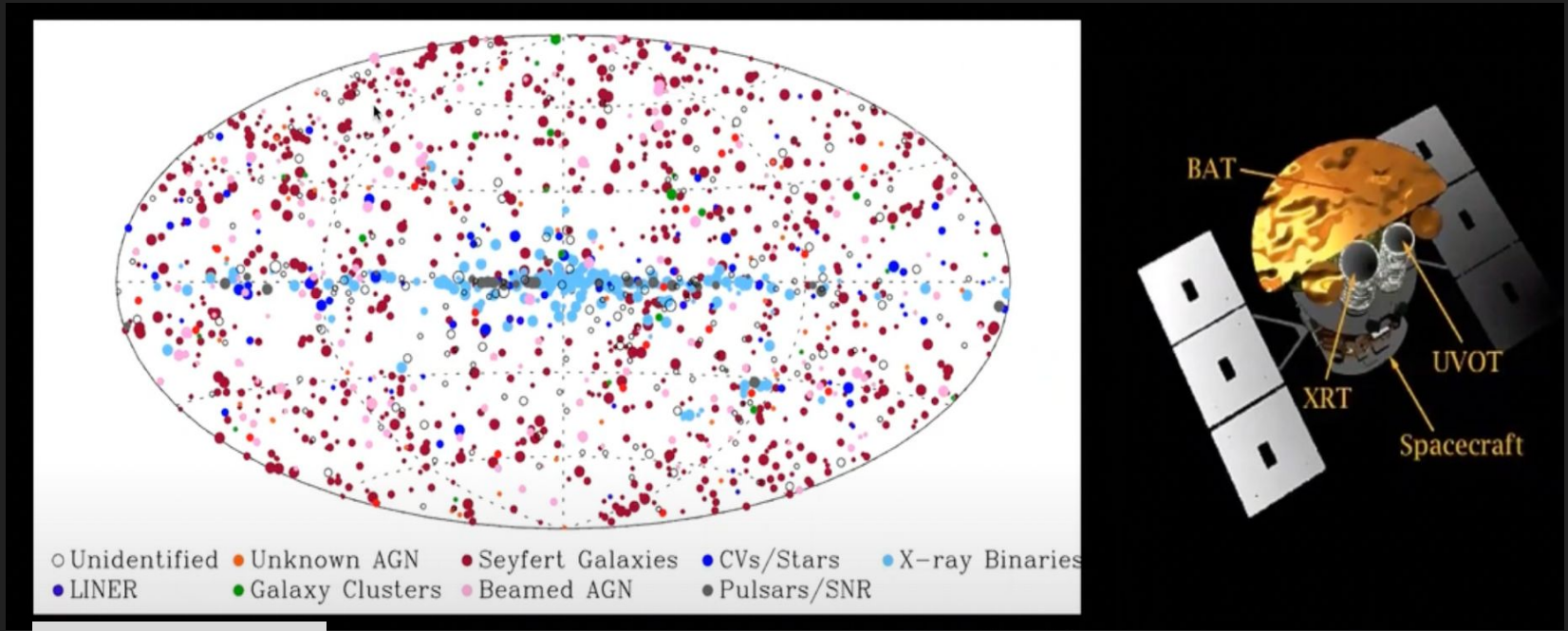
Changes in obscuration, or in accretion flow, or both (or neither)?

How common are CL events?

What are the timescales of changing state events?

How does the BLR link to the accretion flow? What drives CS events?

858 AGN from 70 months of Swift-BAT operations

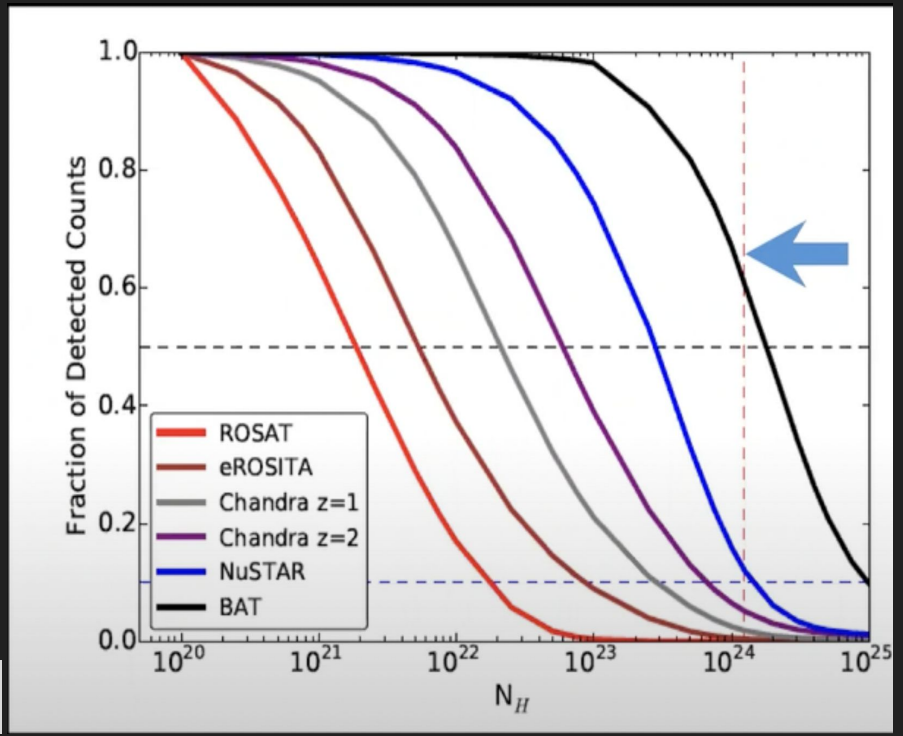


Oh et al. 2018

858 AGN from 70 months of Swift-BAT operations

Hard (14-195 keV) X-ray selection from Swift-BAT is sensitive to AGN up to $N_H \sim 10^{24}$

Measure of coronal X-ray emission gives clean probe of accretion power

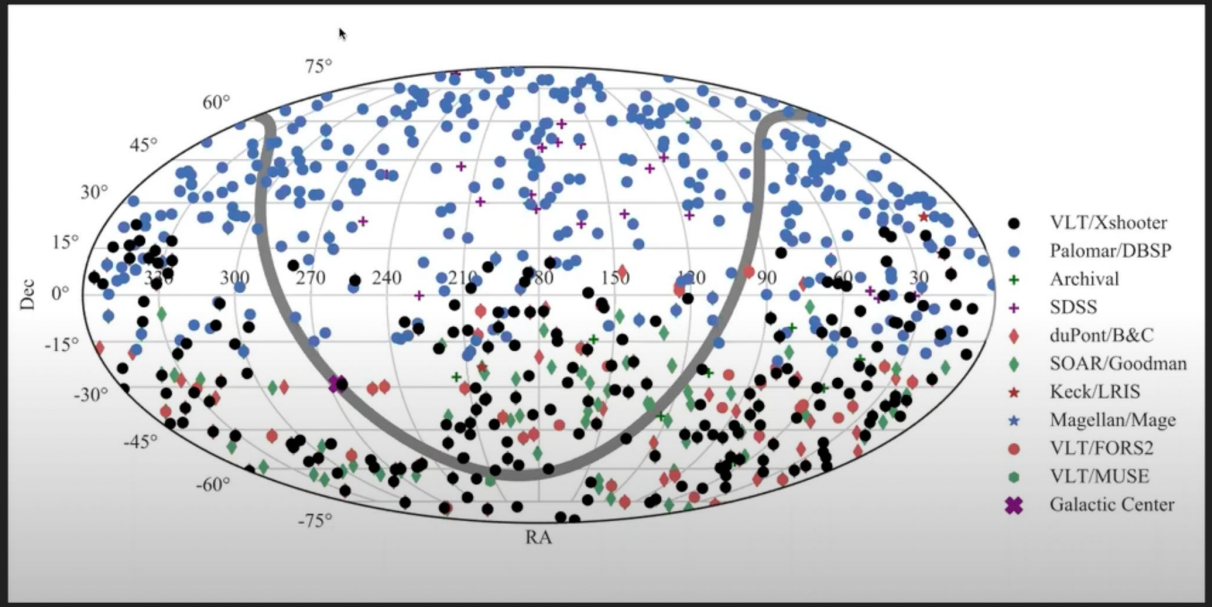


Koss et al. 2016b

BAT AGN Spectroscopic Survey (BASS)

Multi-wavelength follow-up of
858 BAT detected sources

- DR2: 1449 spectra
- M_{BH}, L/L_{Edd}, N_H, etc.



Koss et al. 2022a

Searching for CL AGN in BASS

412 BAT AGN with >1 optical spectrum → Change in Broad Balmer lines?

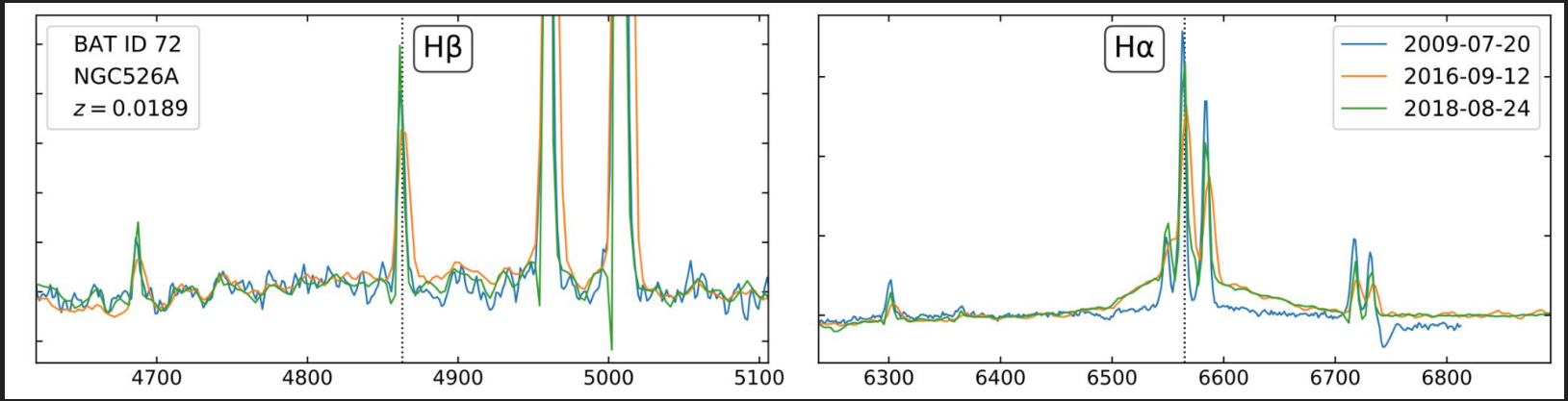
$z < 0.5$

$L_{Bol} \sim 10^{42\text{-}47}$ erg/s

$M_{BH} \sim 10^{6\text{-}9.5} M_{sol}$

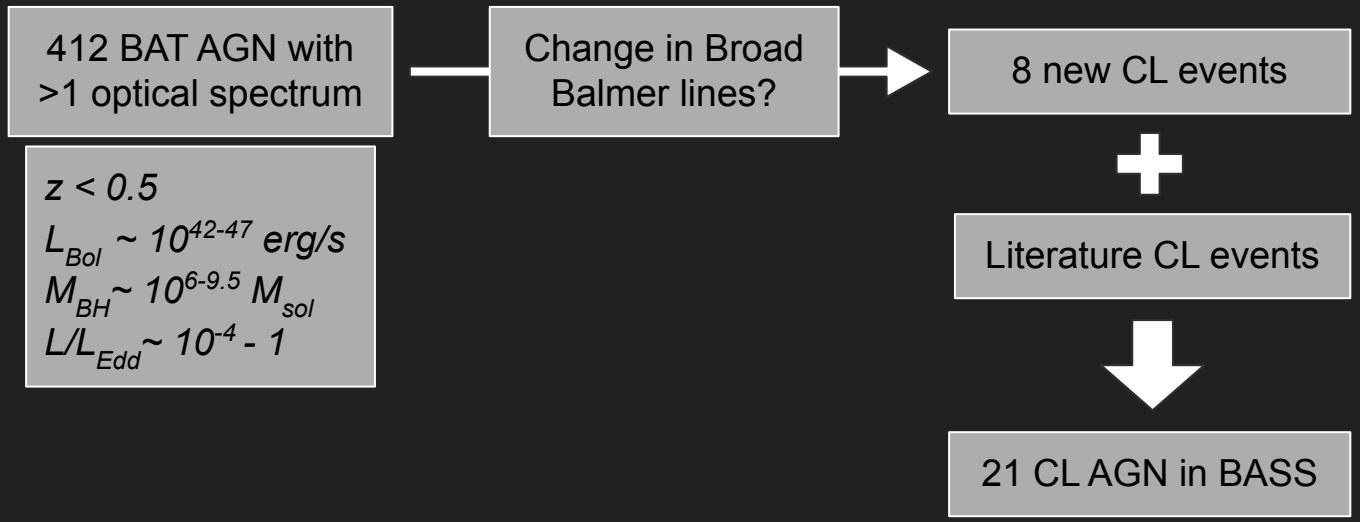
$L/L_{Edd} \sim 10^{-4} - 1$

Searching for CL AGN in BASS



Temple et al. 2023a

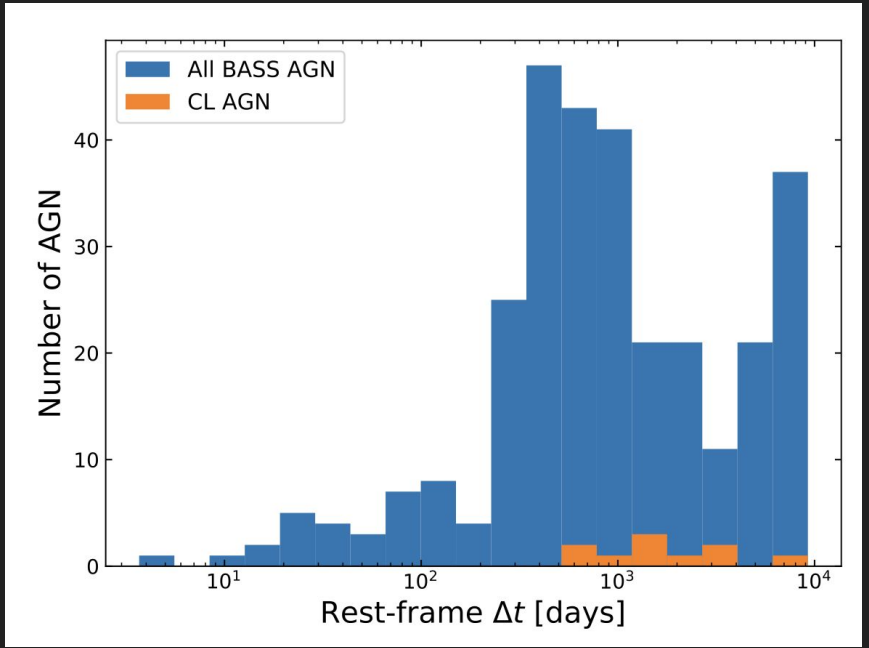
Searching for CL AGN in BASS



CL AGN timescales and rates

We find ~3% (0.7-6.2%) of local AGN displaying complete BL-NL (or NL-BL) changes on ~15yr timescales

CL events are temporally unresolved - potentially missing fast events which turn both off+on within ~1yr



Temple et al. 2023a

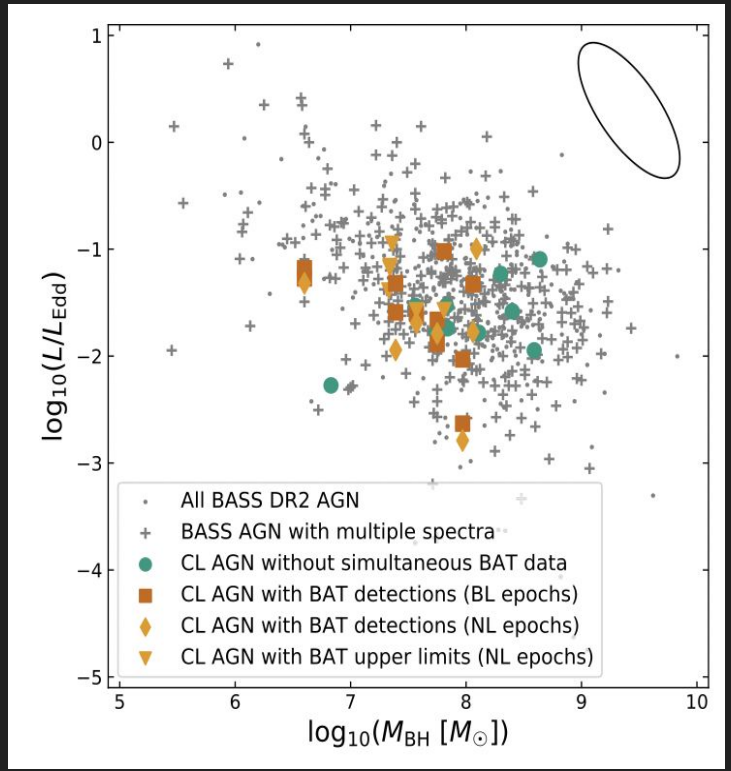
CL AGN timescales and rates

We find ~3% (0.7-6.2%) of local AGN displaying complete BL-NL (or NL-BL) changes on ~15yr timescales

=> **a relatively common phenomenon**

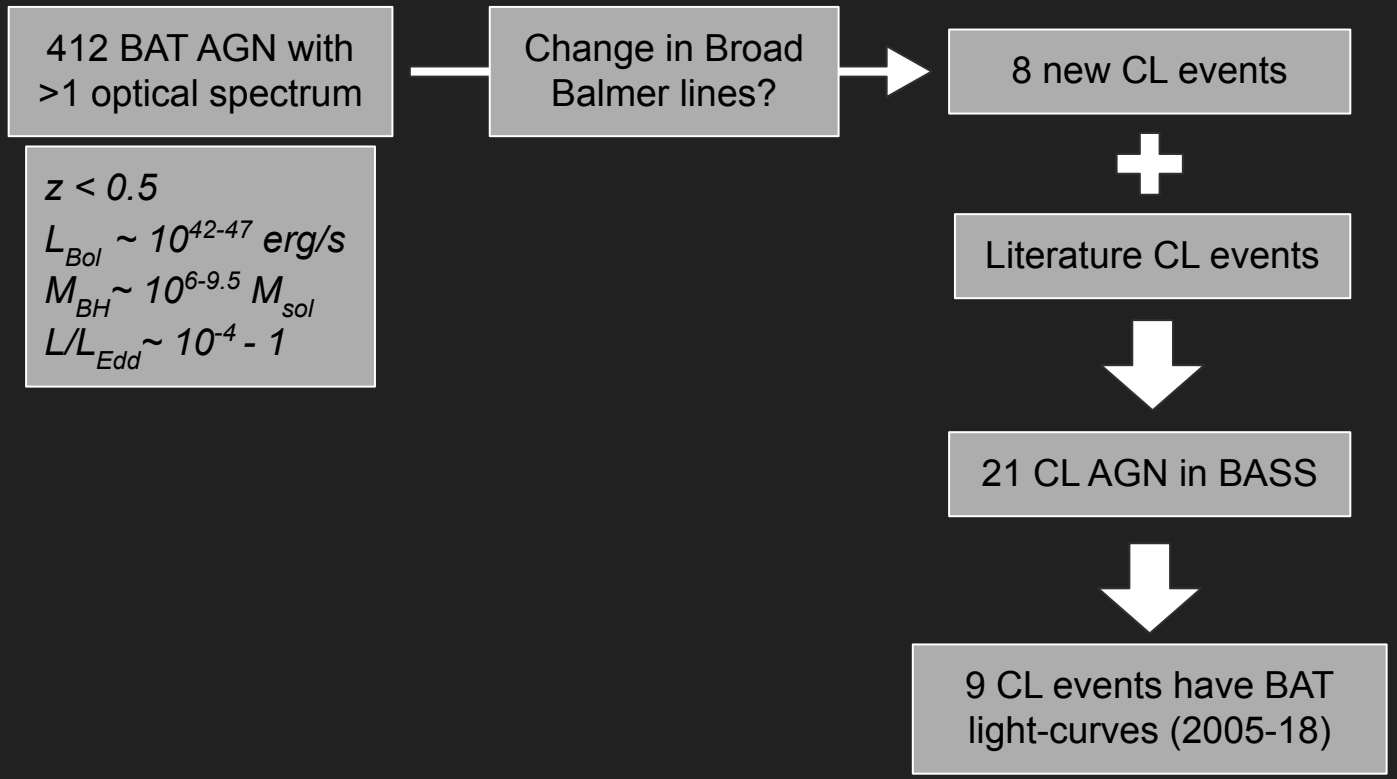
CL rates much higher than in SDSS quasars

=> **consistent with most CL events occurring at lower L/L_{Edd}**



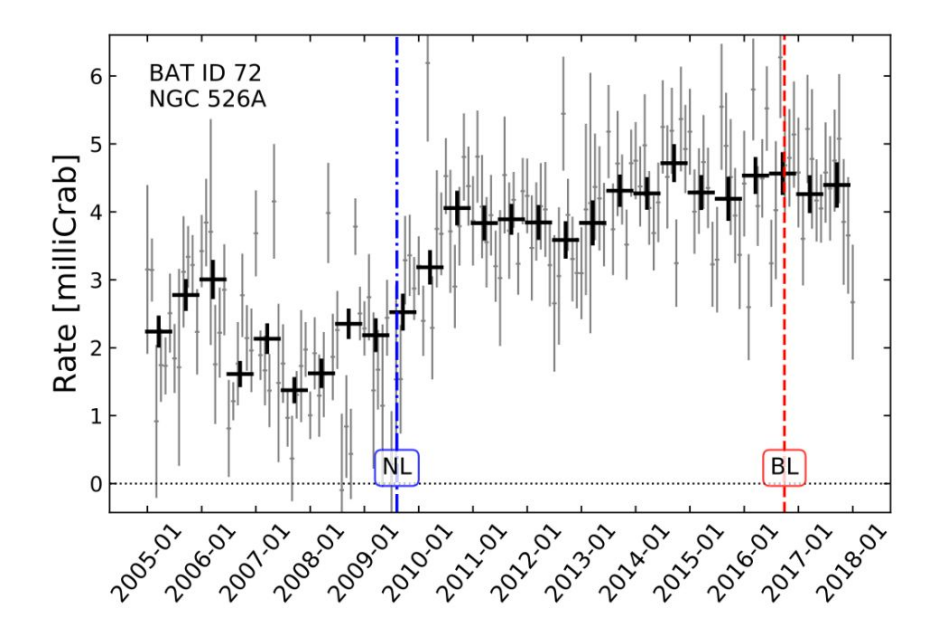
Temple et al. 2023a

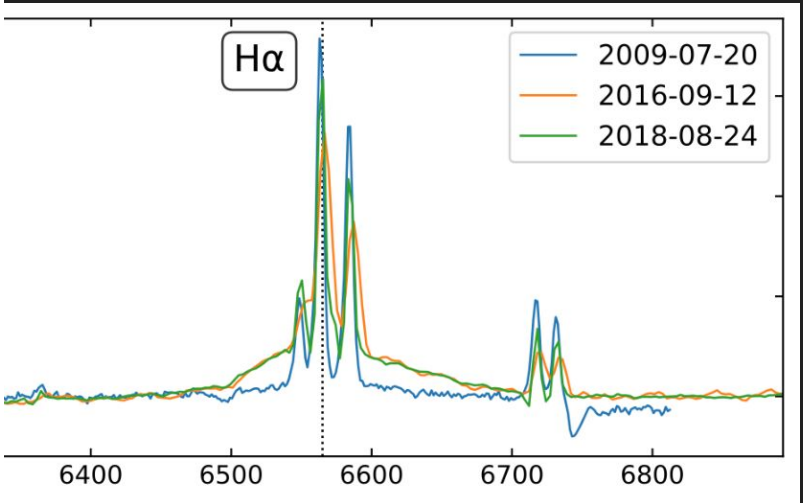
Understanding CL AGN in BASS



Swift-BAT provides 14-195 keV light-curves for 9 CL events

- Six of these CL events show significant changes in their X-ray emission

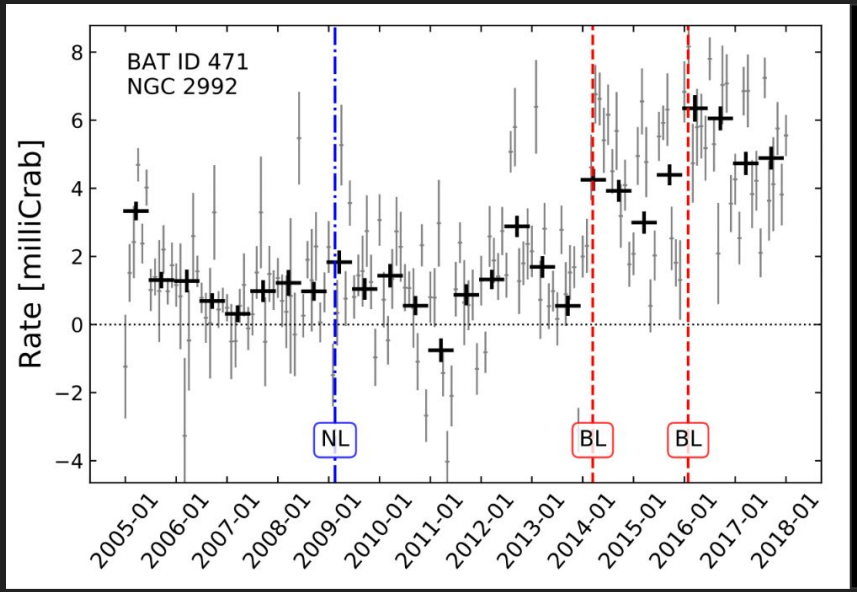


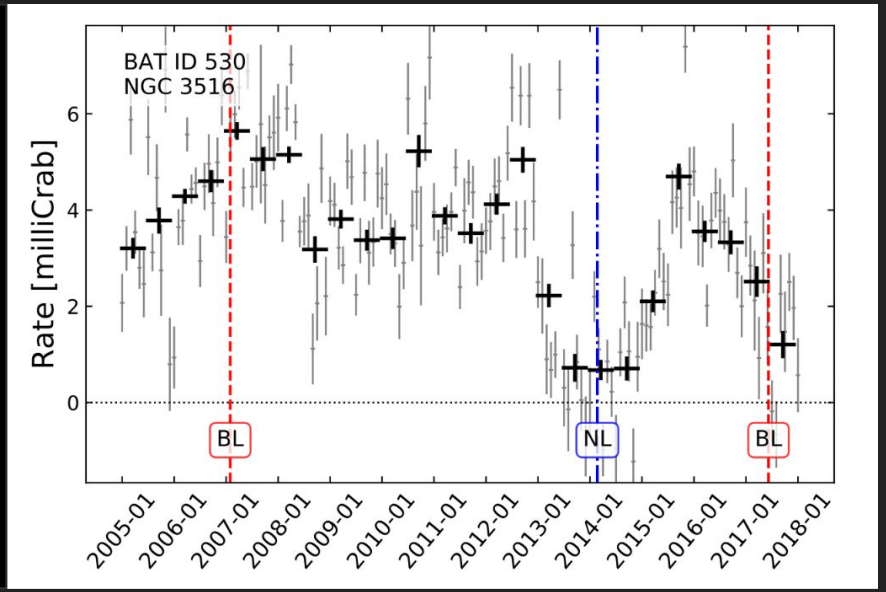


Temple et al. 2023a

Swift-BAT provides 14-195 keV light-curves for 9 CL events

- Six of these CL events show significant changes in their X-ray emission
- (One AGN, NGC 3516, has two CL events)

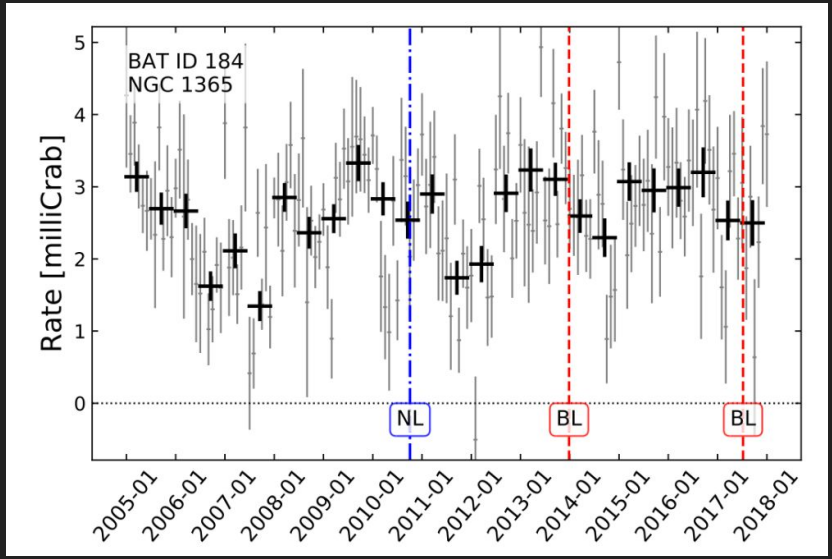




Temple et al. 2023a

Swift-BAT provides 14-195 keV light-curves for 9 CL events

- Three of these CL events could be due to variable obscuration
- For example, NGC 1365 is a well-known CO AGN:



Temple et al. 2023a

Summary

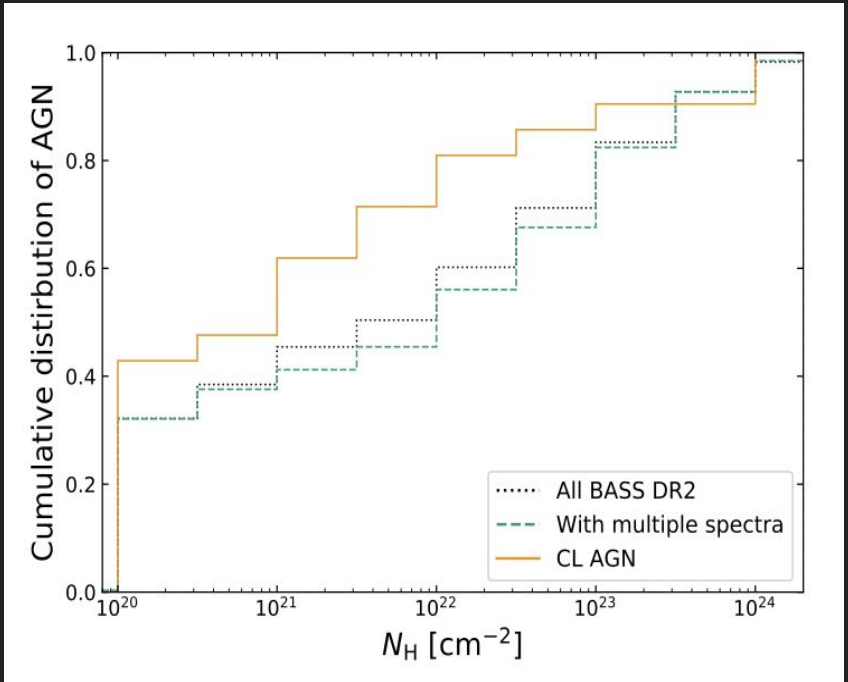
The BASS sample is an ideal test-bed to better understand the physics of highly variable and changing-look AGN, with rich multiwavelength data available

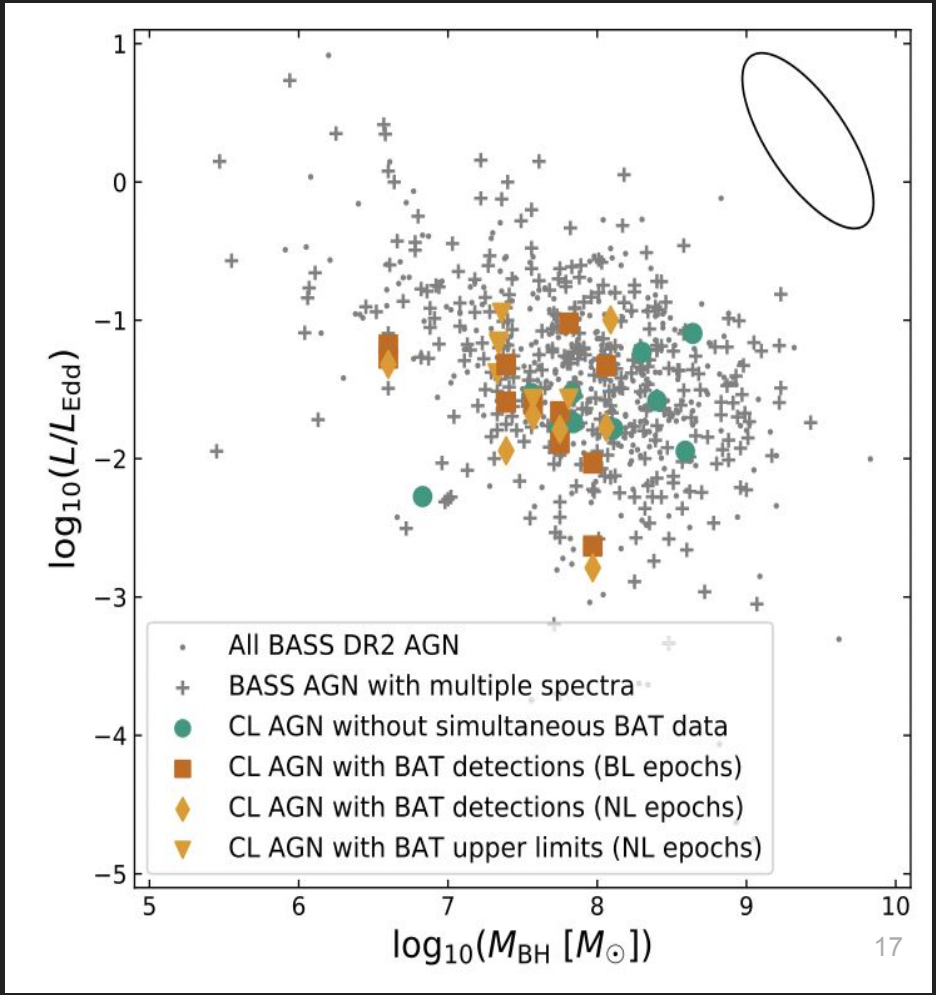
- see also poster by Priscilla Behar

~3% of Swift-BAT AGN show complete BL-NL transitions on ~15yr timescales

Over half of these changing-look events show simultaneous changes in their X-ray emission, which are unlikely to be due to changes in obscuration: changes in the accretion flow must be driving many CS events

CL AGN are typically less obscured (X-ray NH) and show lower accretion rates (L/L_Edd~<0.1) compared to the wider BASS sample





Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

MNRAS **518,** 2938–2953 (2023)
Advance Access publication 2022 November 12

https://doi.org/10.1093/mnras/stac3279

BASS XXXIX: *Swift*-BAT AGN with changing-look optical spectra

Matthew J. Temple [1★] Claudio Ricci [1,2] Michael J. Koss [3,4] Benny Trakhtenbrot [5] Franz E. Bauer,[4,6,7] Richard Mushotzky,[8] Alejandra F. Rojas [1,9] Turgay Caglar,[10] Fiona Harrison,[11] Kyuseok Oh,[12,13] Estefania Padilla Gonzalez,[14,15] Meredith C. Powell,[16] Federica Ricci,[17,18] Rogério Riffel [19] Daniel Stern[20] and C. Megan Urry[21]

[1]*Núcleo de Astronomía de la Facultad de Ingeniería, Universidad Diego Portales, Av. Ejército Libertador 441, Santiago 22, Chile*

ABSTRACT

Changing-look (CL) AGN are unique probes of accretion onto supermassive black holes (SMBHs), especially when simultaneous observations in complementary wavebands allow investigations into the properties of their accretion flows. We present the results of a search for CL behaviour in 412 *Swift*-BAT detected AGN with multiple epochs of optical spectroscopy from the BAT AGN Spectroscopic Survey (BASS). 125 of these AGN also have 14–195 keV ultra-hard X-ray light curves from *Swift*-BAT which are contemporaneous with the epochs of optical spectroscopy. Eight CL events are presented for the first time, where the appearance or disappearance of broad Balmer line emission leads to a change in the observed Seyfert type classification. Combining with known events from the literature, 21 AGN from BASS are now known to display CL behaviour. Nine CL events have 14–195 keV data available, and five of these CL events can be associated with significant changes in their 14–195 keV flux from BAT. The ultra-hard X-ray flux is less affected by obscuration and so these changes in the 14–195 keV band suggest that the majority of our CL events are not due to changes in line-of-sight obscuration. We derive a CL rate of 0.7–6.2 per cent on 10–25 yr time-scales, and show that many transitions happen within at most a few years. Our results motivate further multiwavelength observations with higher cadence to better understand the variability physics of accretion onto SMBHs.