

Andy Lawrence Leiden July 2018

## Normal AGN variability



3C273 Turler et al 1999



### Extreme AGN variability



- Weird Supernovae?
- Accretion disc instabilities?
- Tidal Disruption Events?
- Microlensing?



# Microlensing



### many tens of candidates from PS1 and CRTS

Lawrence et al 2016 Graham et al 2017



 $\begin{array}{l} typical \ fits \\ z_{lens} \sim 0.2 \\ M_{lens} \sim 1 \ M_{sun} \end{array}$ 



#### claimed by Meusinger et al 2010 as TDE



quasar at z=2.1

fit by Bruce et al in prep  $D_{lens} \sim 0.67 \ Mpc \\ M_{lens} \sim 1 \ M_{sun}$ 

stars in M31



### Microlensing issues

- Disc sizes / BLR structure
- Find early: risers
- Get spectroscopy over the peak

# Tidal Disruption Events

**PS1-10jh:** Gezari et al 2012, 2015



87 TDEs claimed at <u>https://tde.space</u>

are they really single star disruptions?





HeII only: must be single unnusual star?





Arcavi et al 2014

### Energy problem

cf Stone and Metzger 2016, Kochanek 2016

 $E \sim 10^{51} \text{ erg}$ M<sub>acc</sub> = 0.01 Msun if  $\mu$ =0.1

maybe really SNe??

### but TDEs prefer same kind of galaxies as AGN



and seem to be at  $\sim L_{Edd}$ 



- partial disruptions?
- mostly ejected?
- low efficiency?
- scraps of ISM?
- outbursts in cold discs?

how will we know??



nagging worry... could PS1-10jh be a background AGN?

# Intrinsic AGN Changes



### We can distinguish CLQ from microlensing events



### HUGE He II variability

### Thirty years of MKN 110



CLQ not a distinct class really examples of *extreme variability* 



### Viscosity crisis

Lawrence 2018

 $\alpha \sim 0.1$  needed to explain luminosity

 $\begin{array}{l} t(UV) \sim 200 \ yrs \\ t(opt) \sim 1600 \ yrs \\ t(obs) \sim 2 \ yrs \end{array}$ 

 $\alpha \sim \lambda \! / \! H$ 

no viscous disc model can work

the other problem with discs

 $T(exp) \sim 100,000$  $T(obs) \sim 30,000$ 

ditto TDEs



c.f. Lawrence 2012



# Non-AGN nuclear transients?



# developed a jet

E=1.1 x 10<sup>52</sup>

Dong et al 2016 : SLSN Leloudas et al 2016 : TDE?

E=2.3 x 10<sup>52</sup> NLS1? SLSN?



E=1.5 x 10<sup>52</sup> in IR no spectrum available TDE? AGN outburst?



#### Bruce PhD



any offers from the floor?





 $\begin{array}{ll} E=7 \ x \ 10^{52} \\ broad \ MgII ?? & AGN \\ MgII >> H\beta?? & nope \end{array}$ 











Dong et al 2016



E=1.1 x 10<sup>52</sup> SLSN in large red galaxy

Leloudas et al 2016 ... TDE?

PS1-10adi

Kankare et al 2018



E=2.3 x 10<sup>52</sup> interaction with CSM? line profiles evolve

does look rather like a NLS1 ...