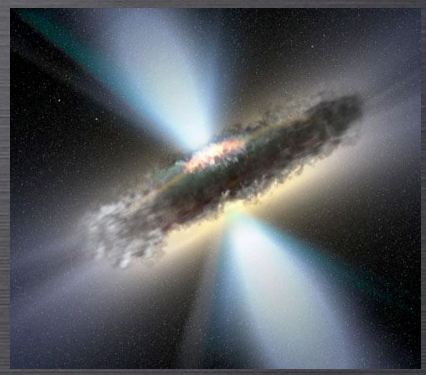
A Supernovae / AGN connection?



Sarah Hutton, Martin Ward, Chris Done
Durham University

Seppo Mattila, Rubina Kotak and the QUB Pan-STARRS Transient Team,
Jonathon Gelbord (Swift)

OUTLINE

- Motivation behind the project
- Brief Introduction
- PS1-10adi
- Similar objects
- Extending the search
- Further work
- Summary

MOTIVATION

- Use Pan-STARRS surveys to look for and characterise general variability of AGN

- Focusing on extreme events

Pan-STARRS

INTRODUCTION

- AGN variability known but often poorly understood
- Disc variability seen in BHB scale to timescales of 100+ years in AGN
- Must result from other processes

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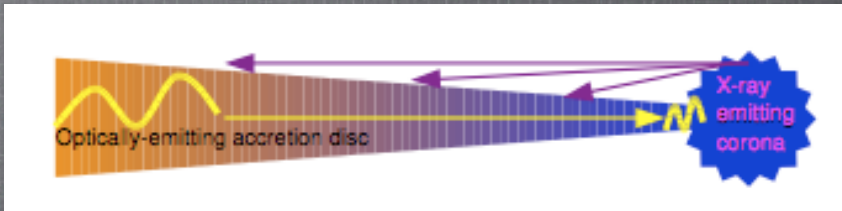
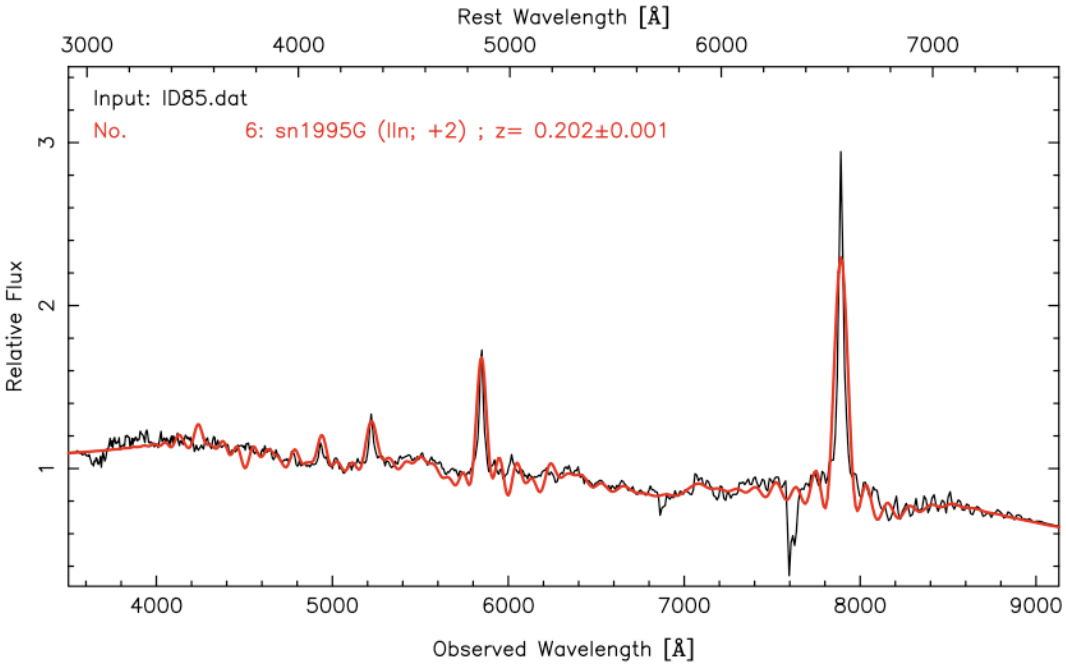
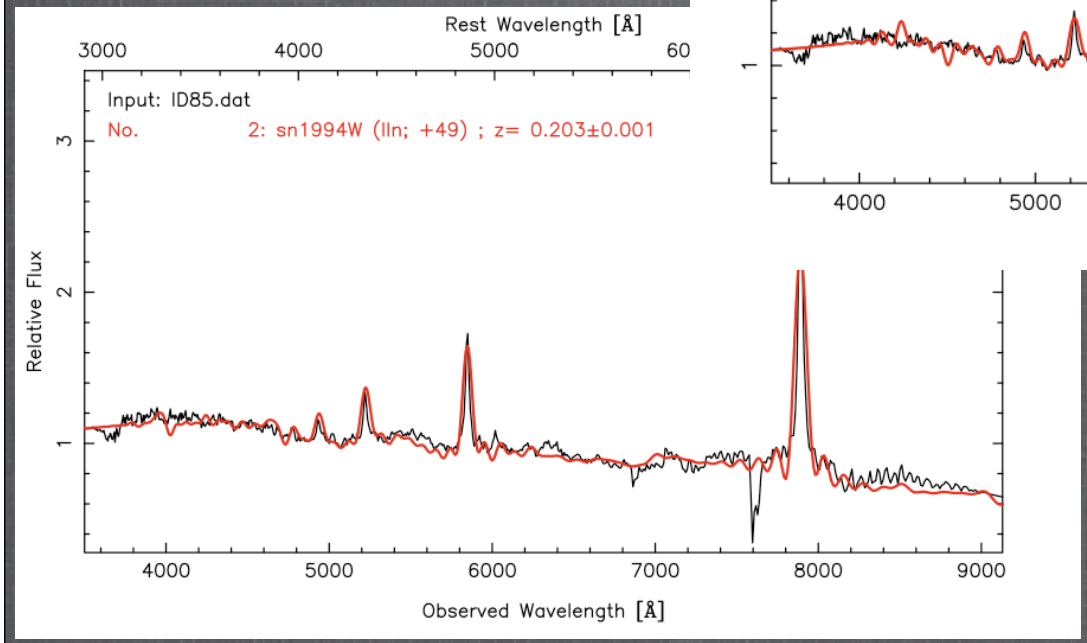


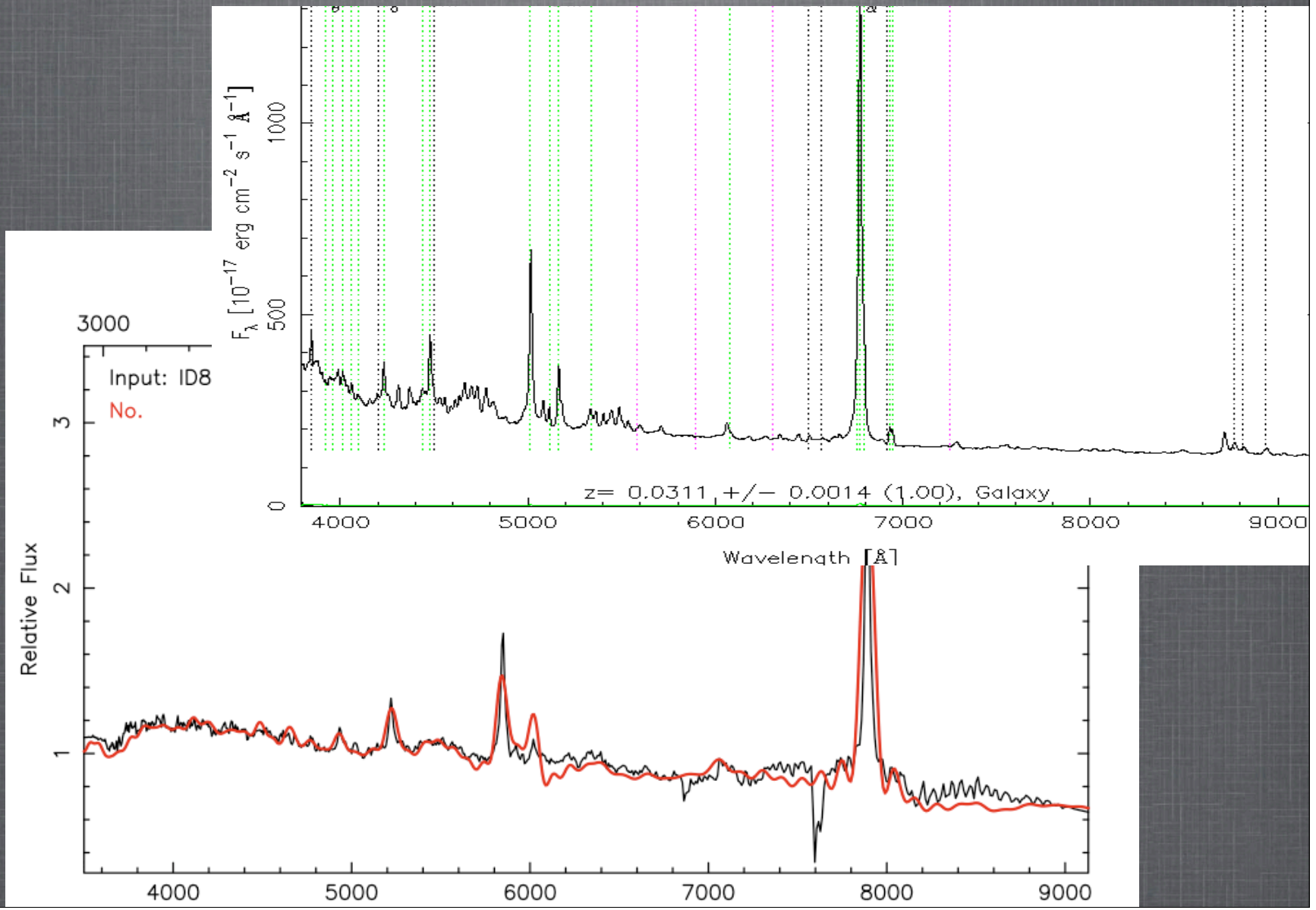
Thermal reprocessing of X-rays into optical emission on the surface of the disc.

PAN-STARRS VARIABLE AGN

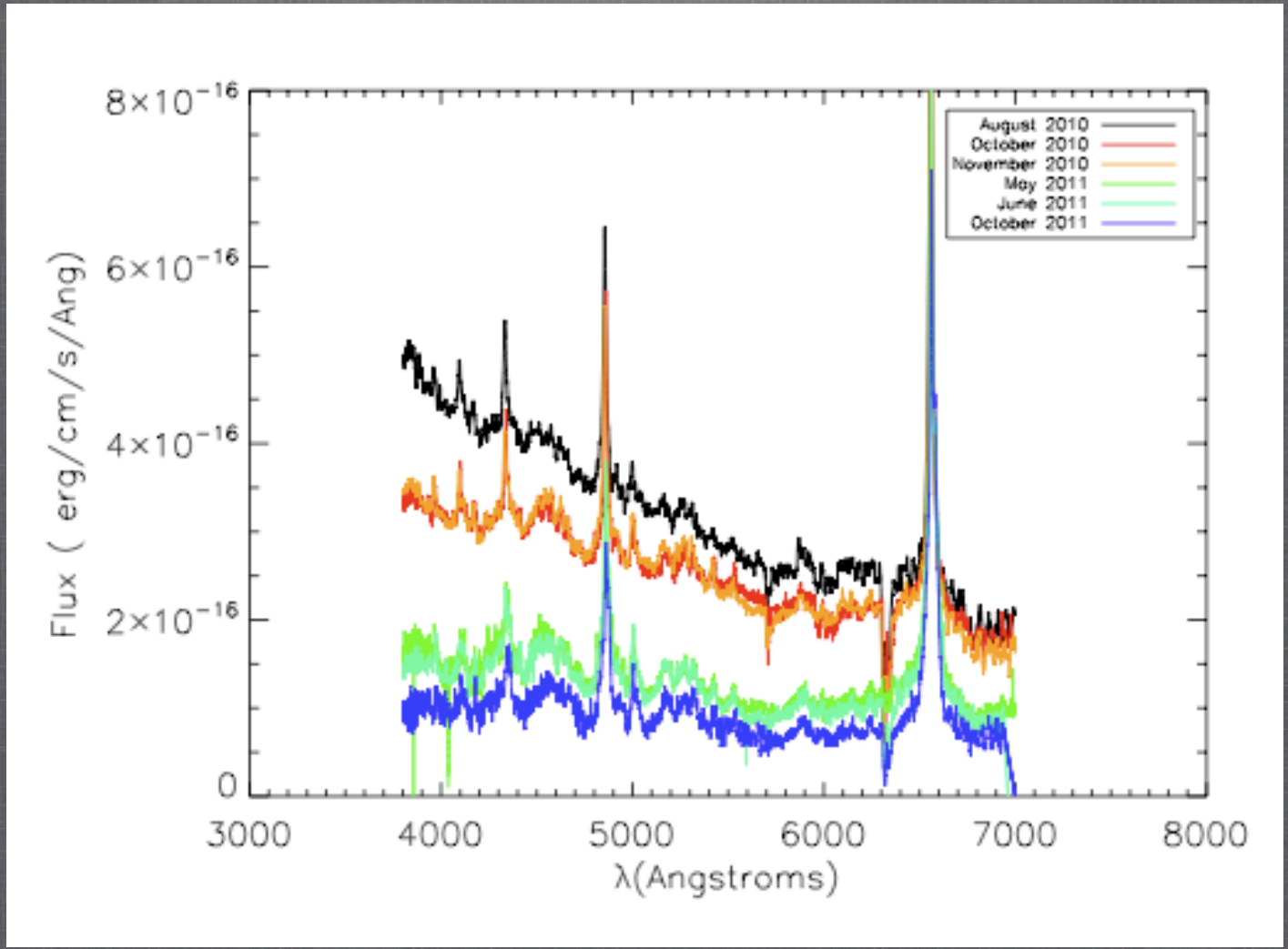




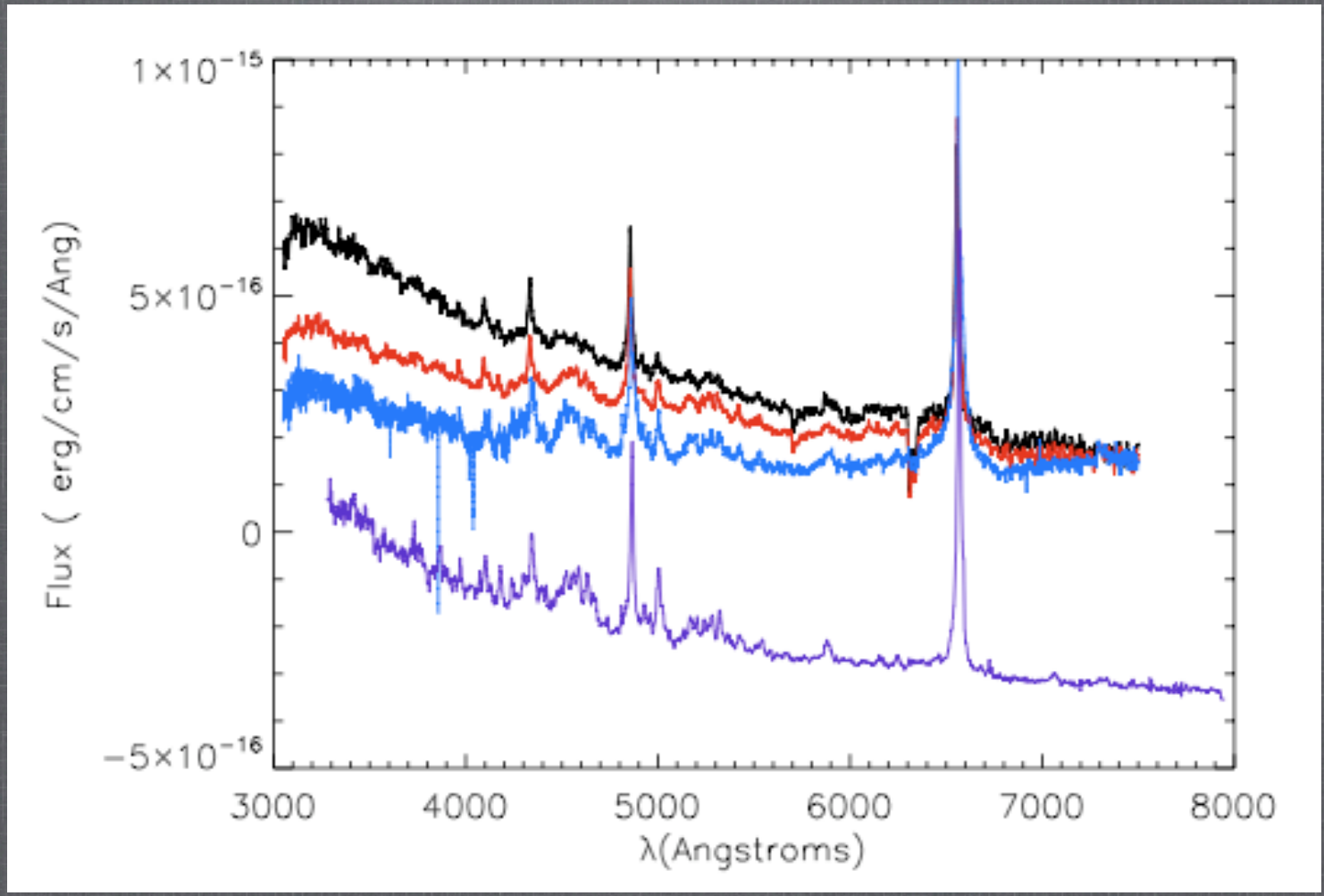
PS1-10ADI


3000
Input: ID8
No.
Relative Flux
1
2
3
4000
5000
6000
7000
8000
9000
F_λ [10^{-17} erg cm^{-2} s^{-1} Å^{-1}]
0
500
1000
z= 0.0311 +/- 0.0014 (1.00), Galaxy
Wavelength [Å]

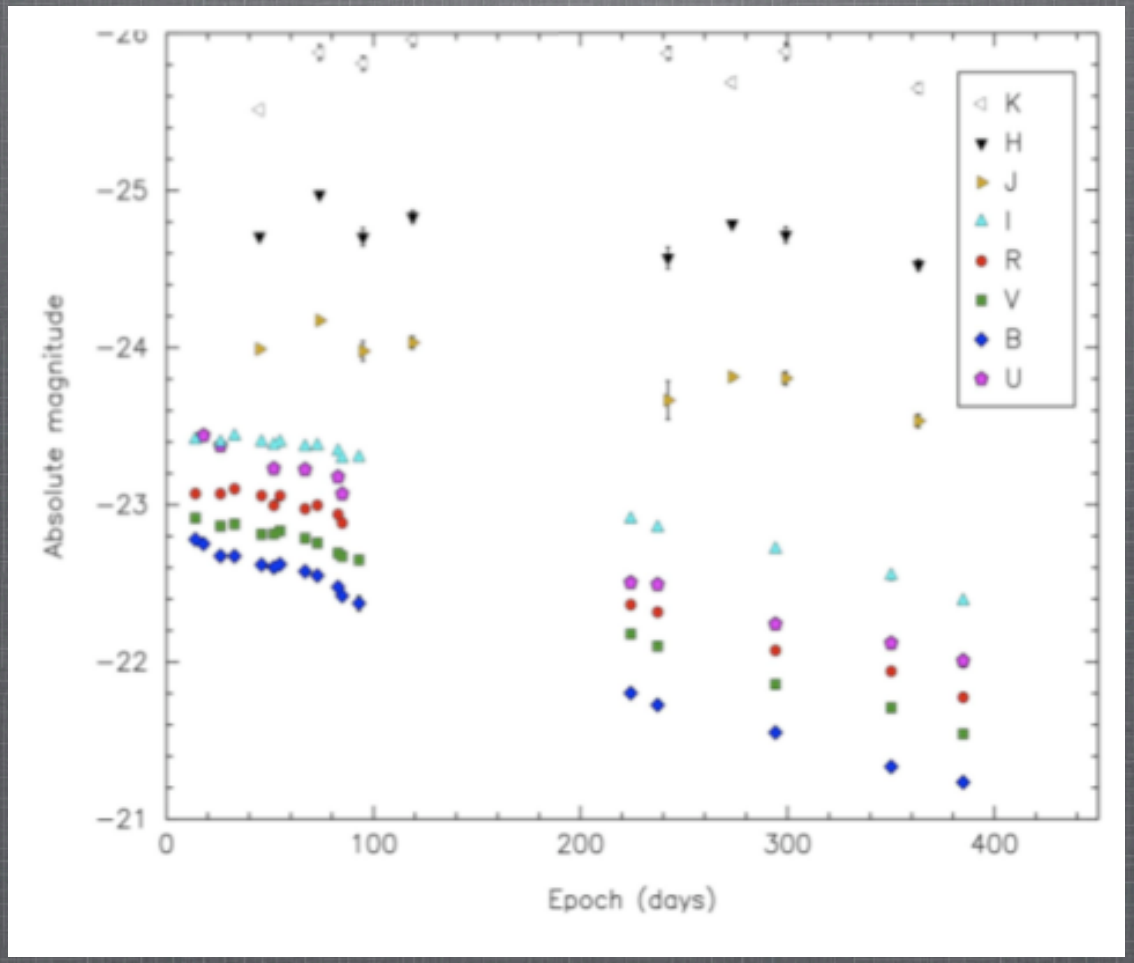
PS1-10ADI


August 2010
October 2010
November 2010
May 2011
June 2011
October 2011
Flux (erg/cm/s/Ang)
8×10⁻¹⁶
6×10⁻¹⁶
4×10⁻¹⁶
2×10⁻¹⁶
0
3000
4000
5000
6000
7000
8000
λ(Angstroms)

PS1-10ADI

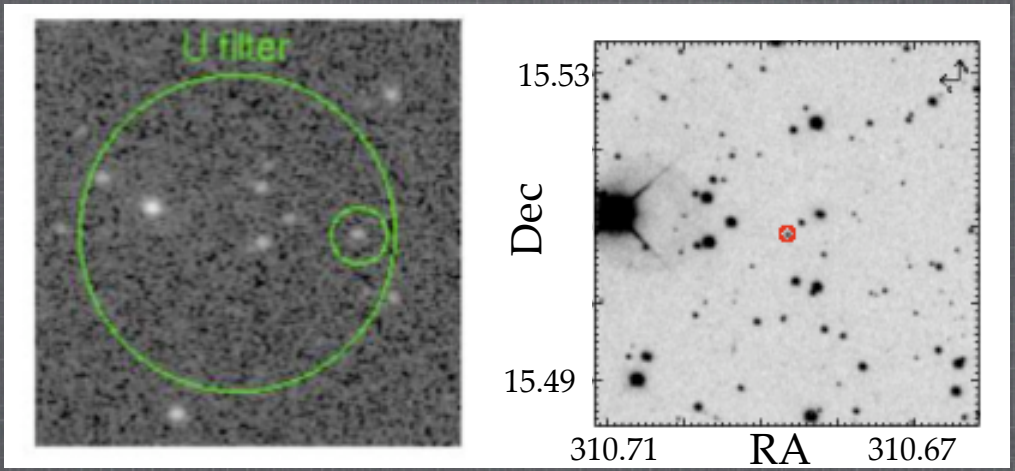

1×10⁻¹⁵
5×10⁻¹⁶
0
−5×10⁻¹⁶
Flux (erg/cm/s/Ang)
3000
4000
5000
6000
7000
8000
λ(Angstroms)

PS1-10ADI

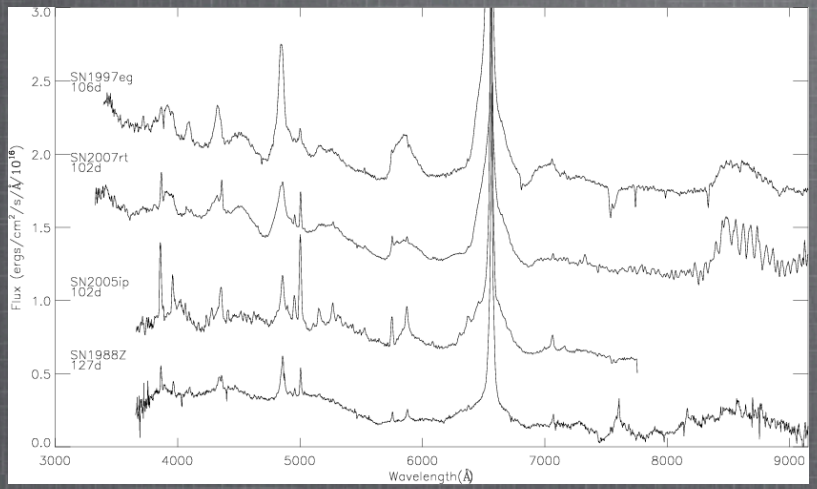

K
H
J
I
R
V
B
U
−25
−24
−23
−22
−21
0
100
200
300
400
Absolute magnitude
Epoch (days)

PS1-10ADI - SWIFT OBSERVATIONS

- Awarded 2 sets of SWIFT ToO time totaling 20 ks.
- Detection in all UVOT filters, but no X-ray detection
- X-ray upper limit: 3.6×10^{-14} ergs cm^{-2} s^{-1}
- $\alpha_{ox} > 2.6$ - one of the most extreme objects found

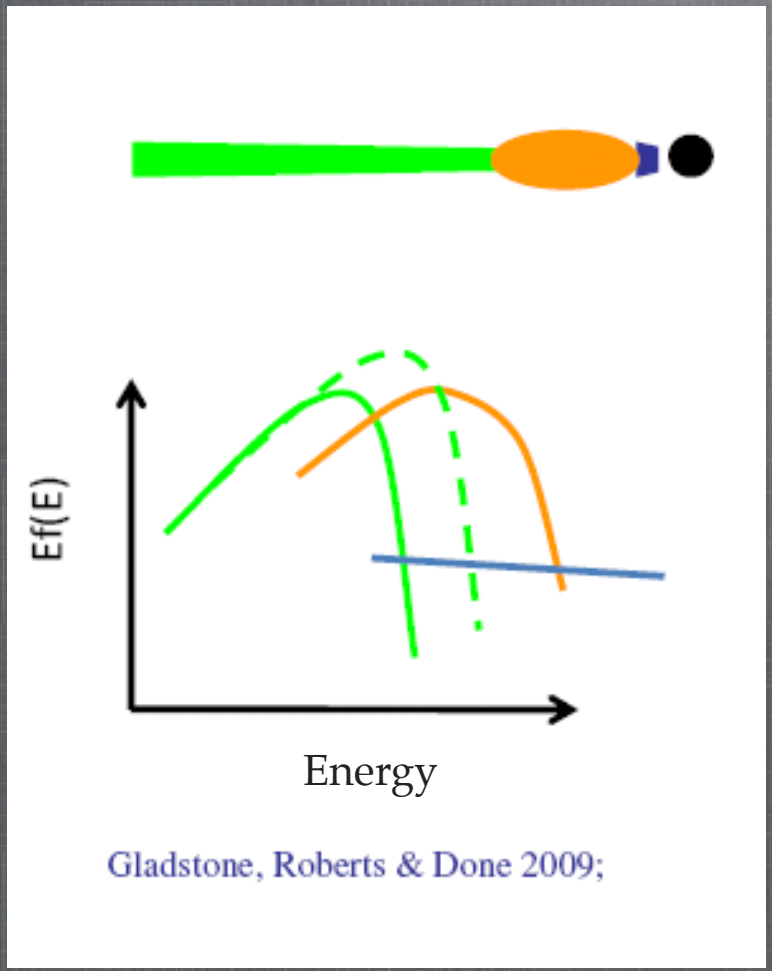


POSSIBLE SNE?



- Typical SNe power output ~10^{51} ergs
- Similar UV luminosity in both Swift observations
- Total power output ~ 5 x 10^{53} ergs
- Too bright for SNe alone

MODELING AGN SEDS

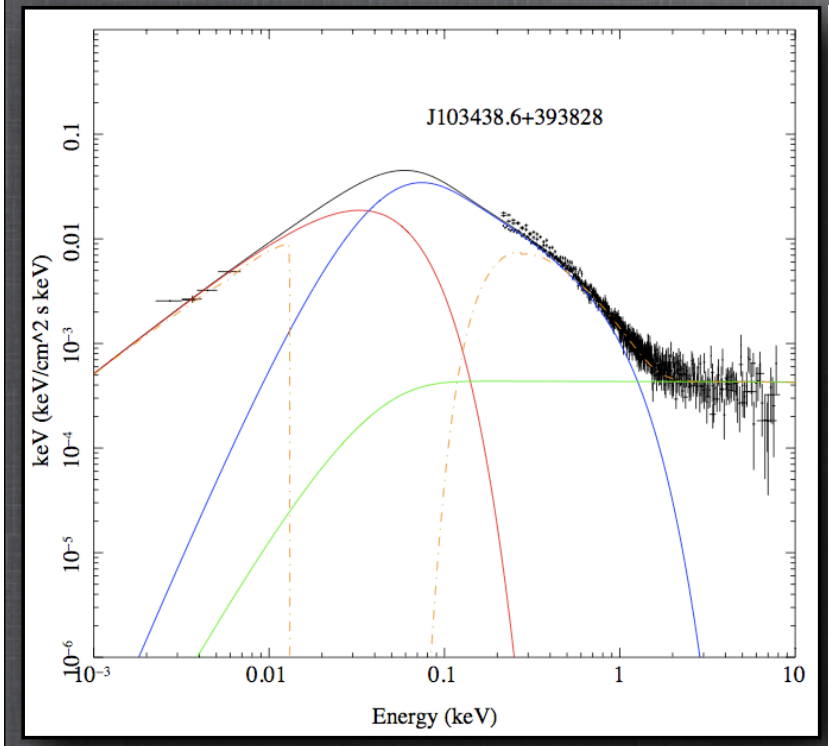


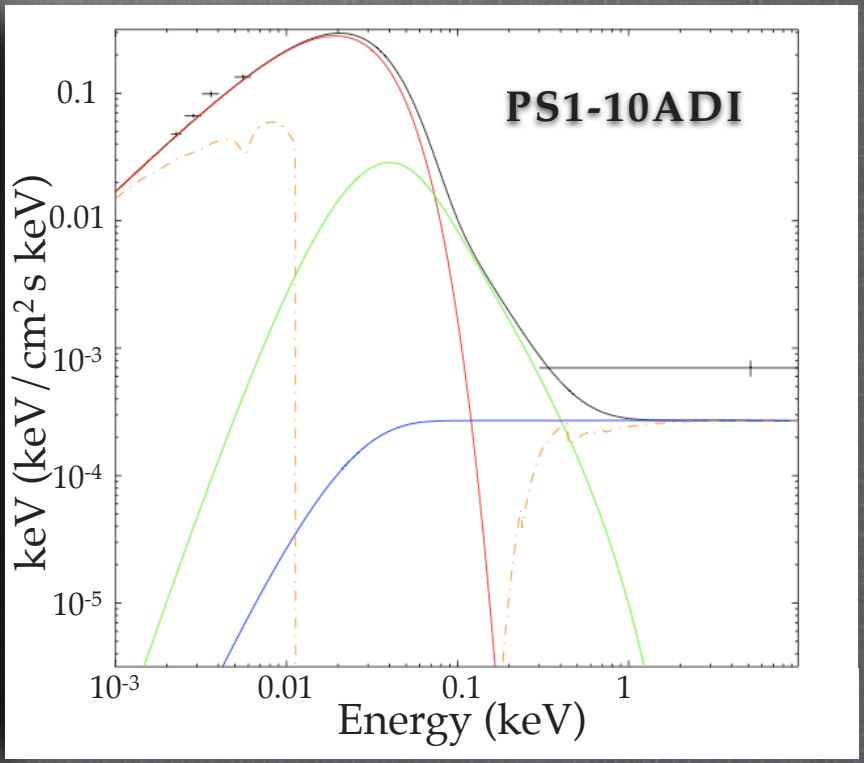
Gladstone, Roberts & Done 2009;

OPTXAGN

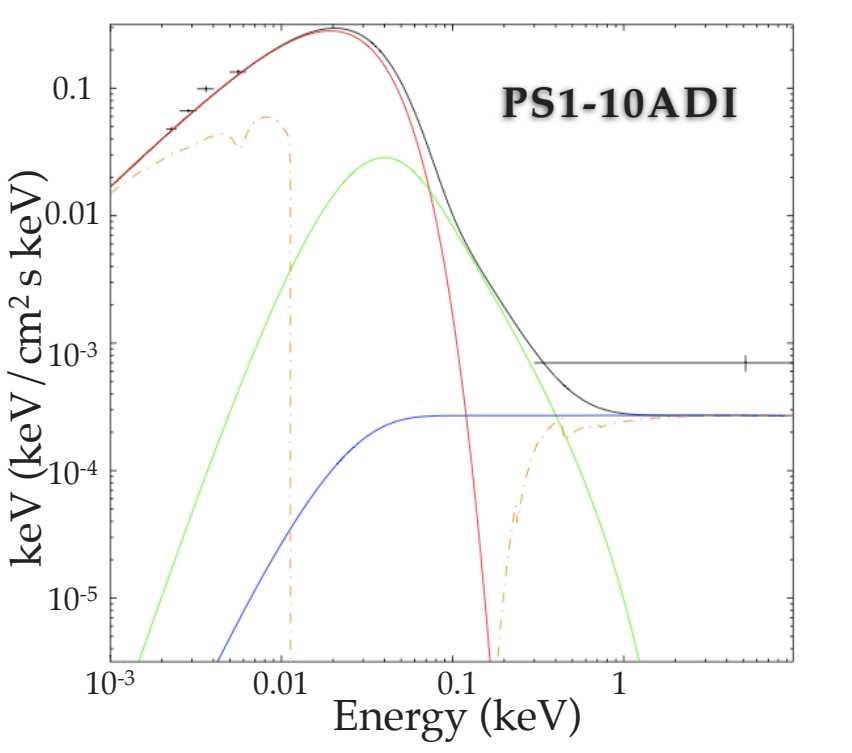
- Conservation of energy from optical to soft X-rays
- Breaks down for super-Eddington objects
- Allows M_{BH} to be a free parameter

MODELING AGN SEDS



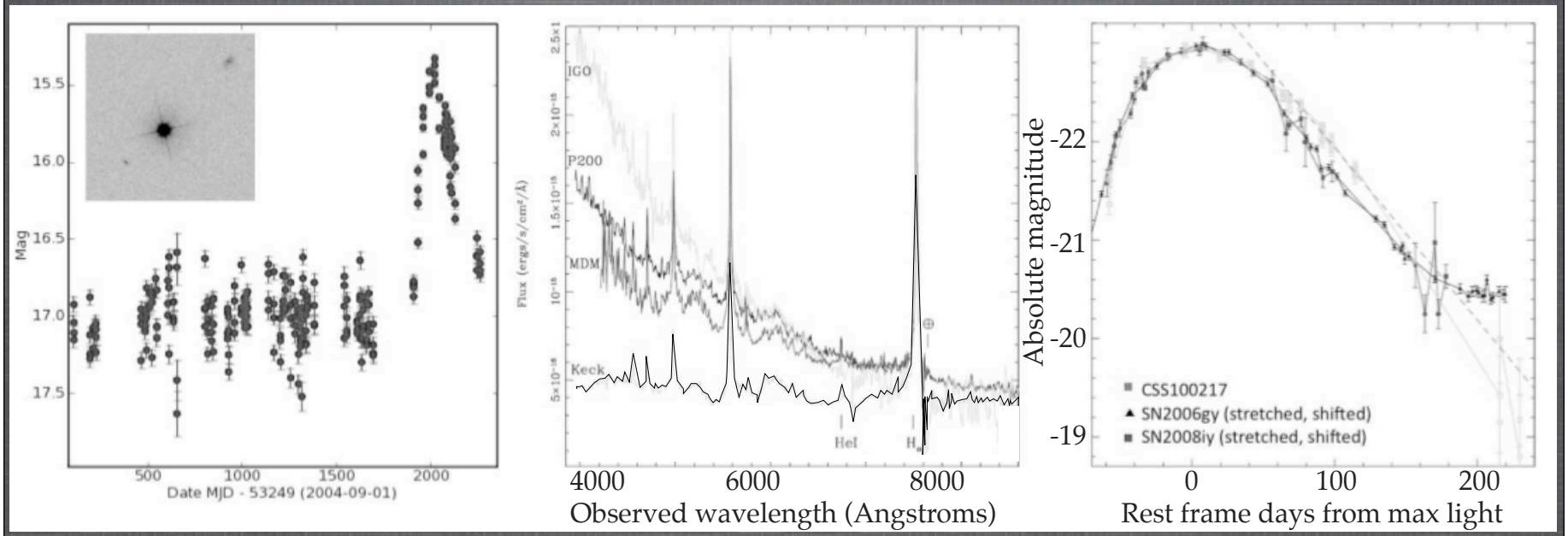


EDDINGTON RATIO



- Adapt model for conservative L_{BOL} estimate
- $L_{BOL} \sim 10^{47}$ erg/s
- From Hβ line fitting:
- $M_{BH} \sim 10^{7}\ M_{\odot}$
- Eddington ratio ~ 4

SIMILAR OBJECTS



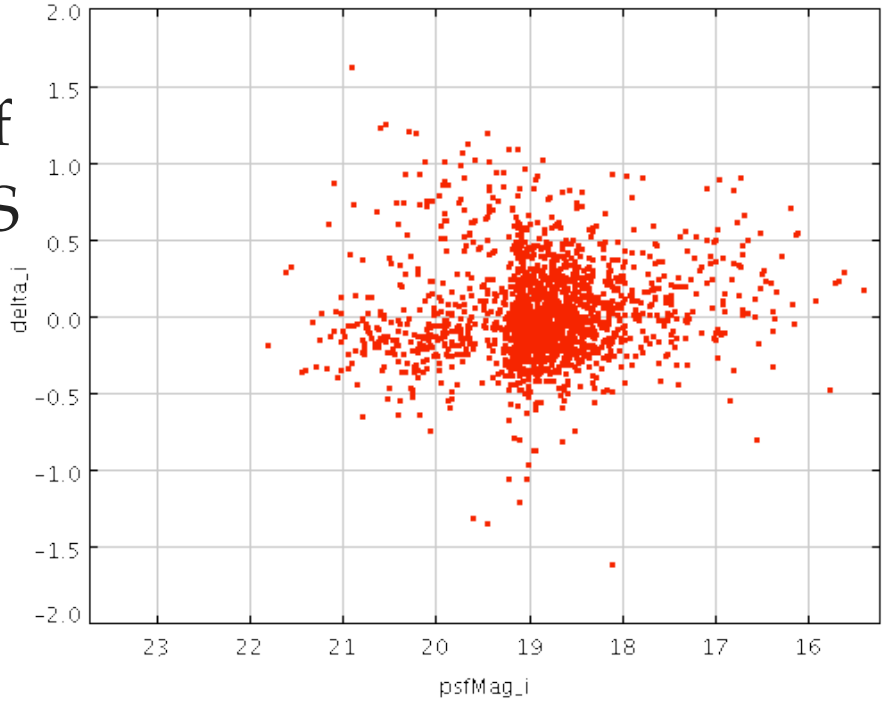
- Catalina Transient survey
- Discovered 27th February 2010
- Pre-outburst spectrum and monitoring
- z~0.147

SIMILAR OBJECTS: SUMMER PROJECT

1000 NLSy1s with SDSS spectra

g, r, i data

strong variability > 0.5 mag diff between SDSS and Pan-STARRS data



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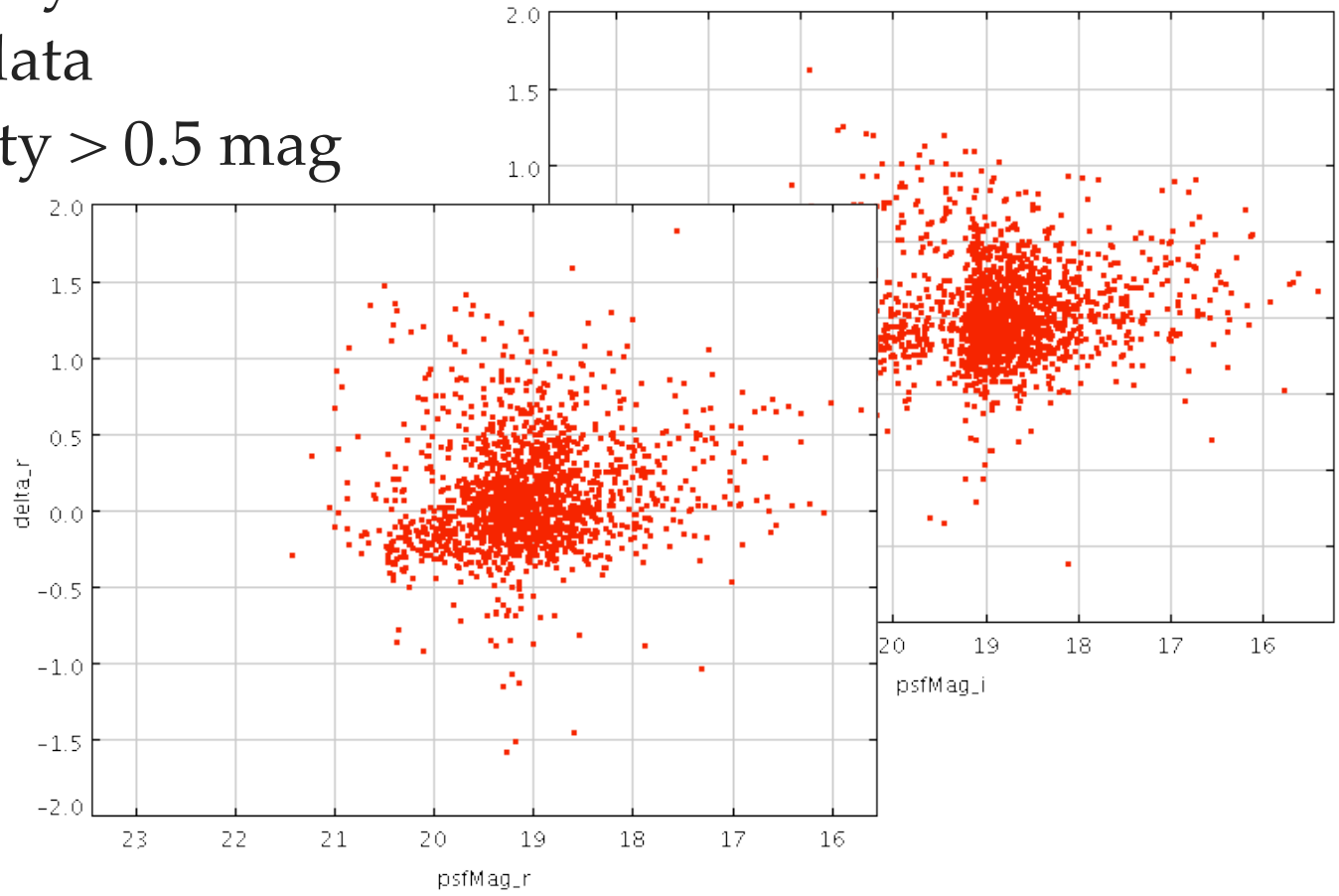

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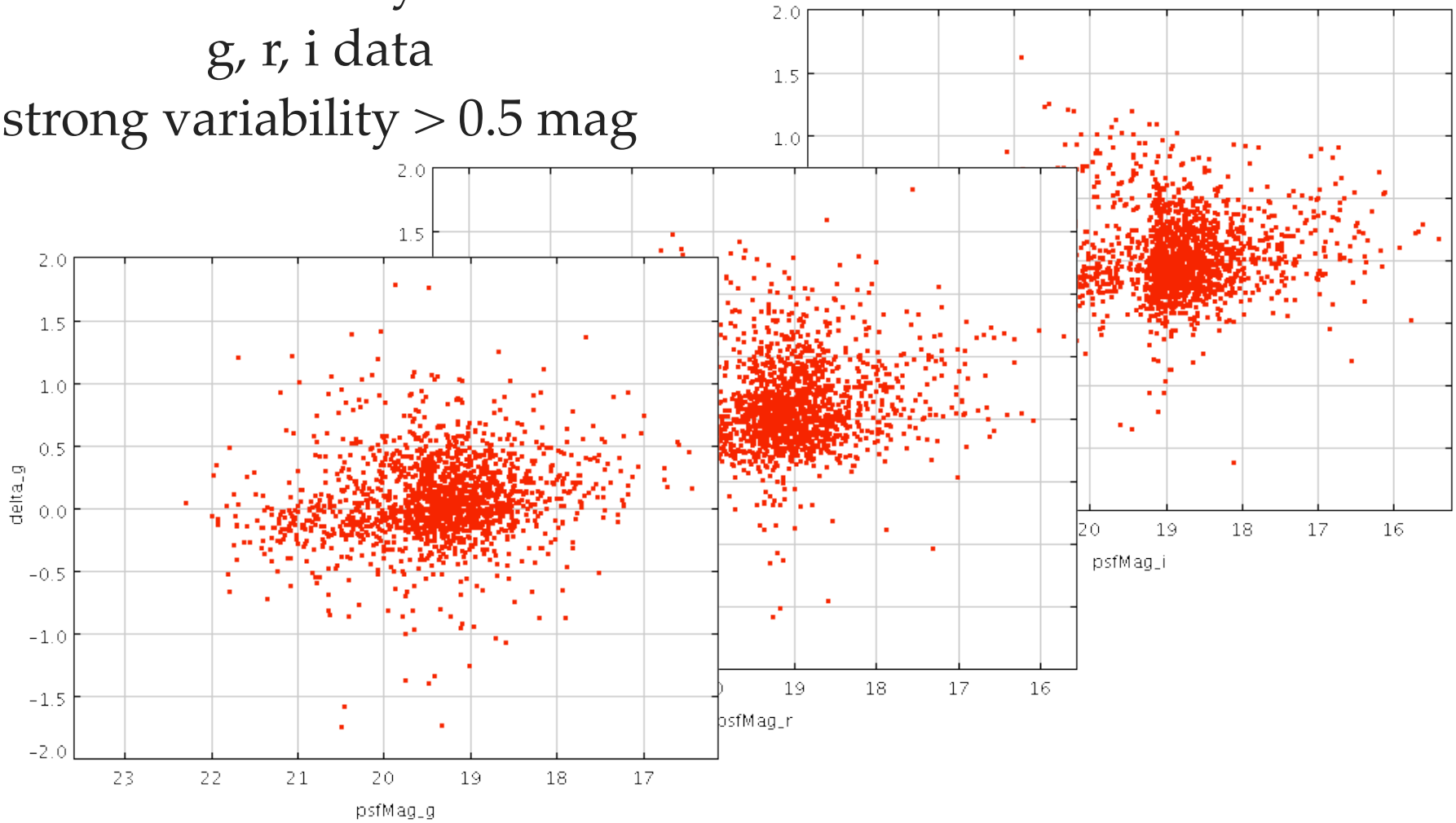

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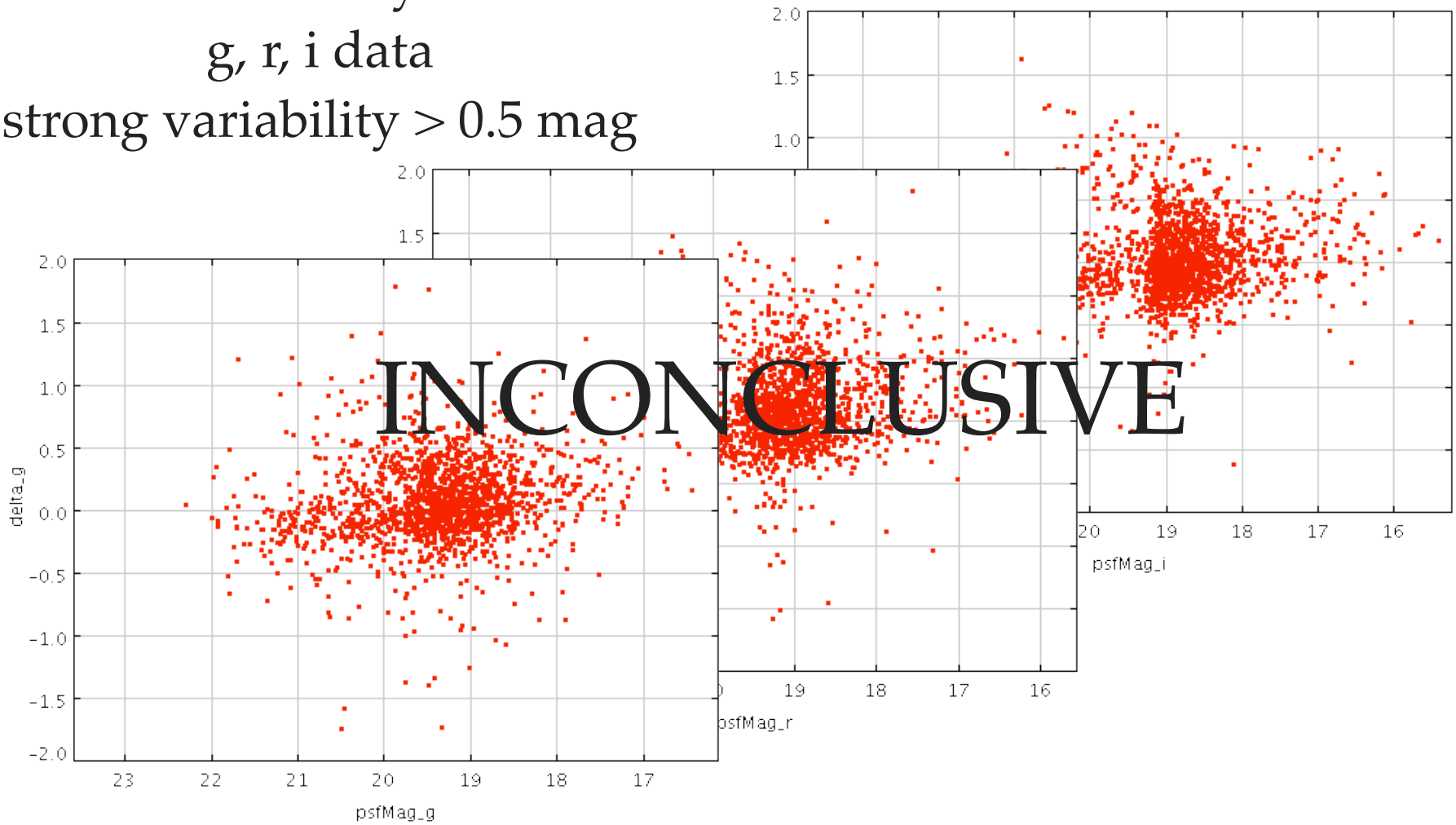

INCONCLUSIVE

FURTHER WORK

PS1-QUB TRANSIENT SEARCH

SUMMARY

- Using Pan-STARRS to look for variable AGN
- Found one object and have completed an extensive follow-up campaign
- When compared to similar objects it doesn't appear to be a SNe, therefore most like due to corona/disc interactions
- Summer project in a larger sample proved inconclusive
- Further work will extend this to work directly with the transient database for more lightcurve information