

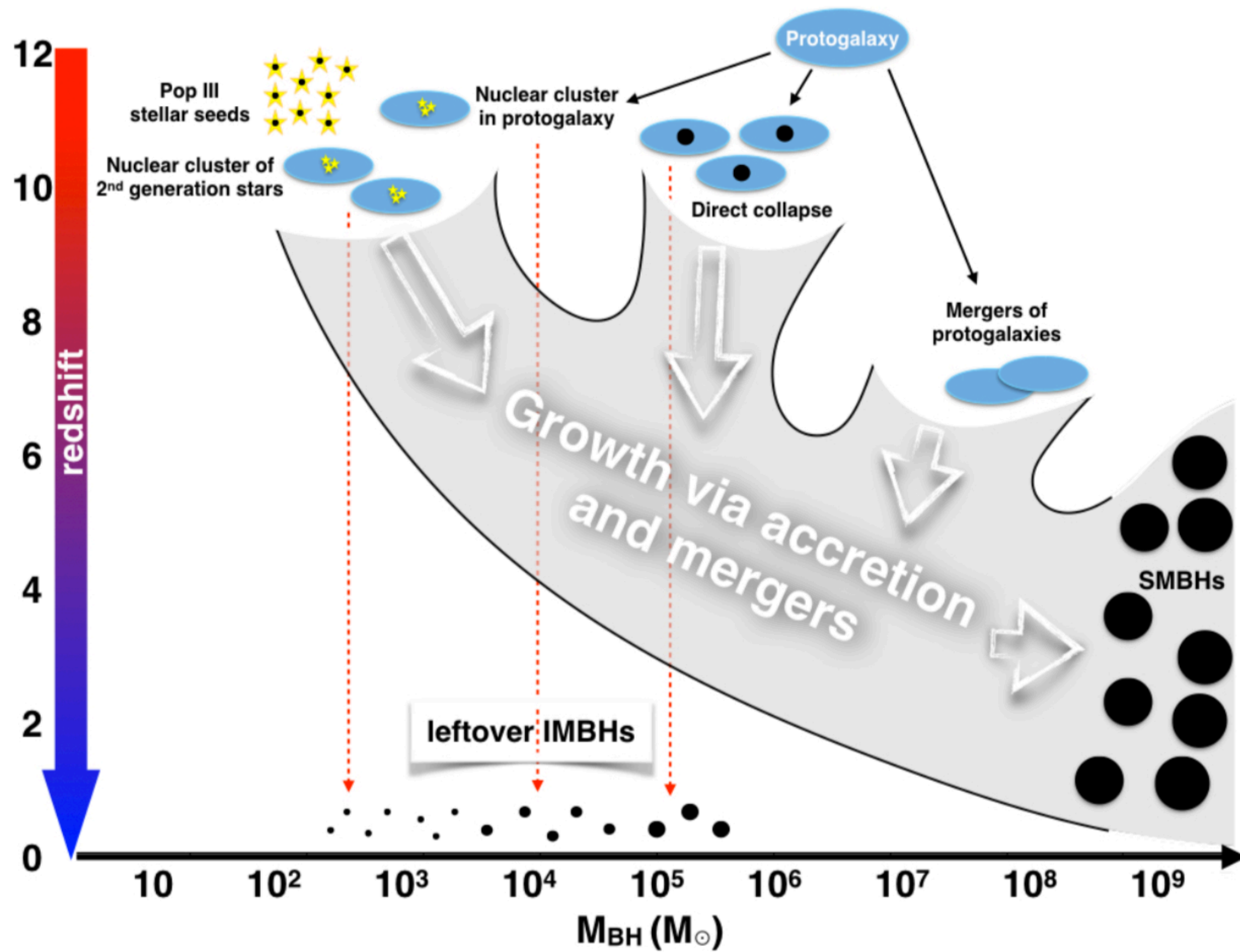


# **S**earch for **I**ntermediate-mass **B**Lack-holes **I**n **N**earby **G**alaxies: The **SIBLING** Survey

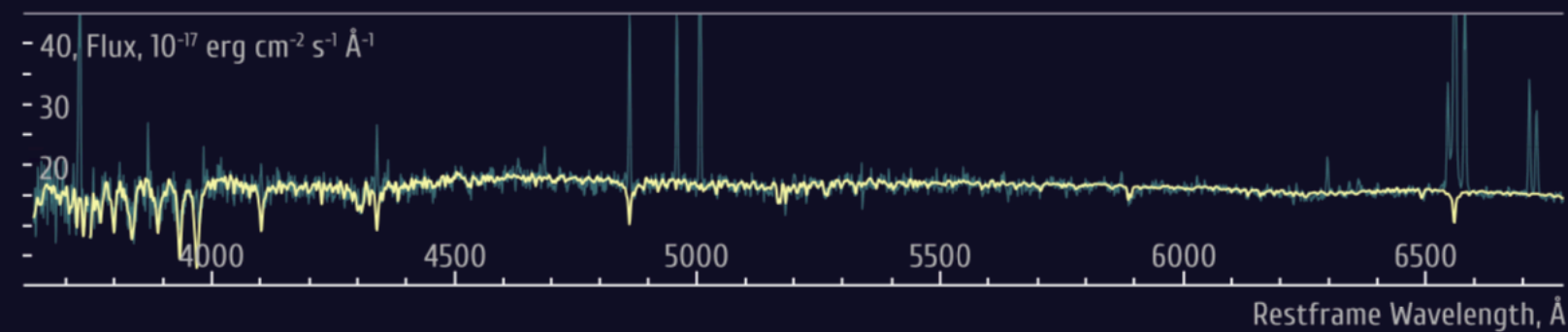
**Paulina Lira**  
**University of Chile**

J. Martínez-Palomera (Berkeley), I. Bhalla-Ladd (Yale), R. Plotkin (Nevada),  
L. Ho (KIAA), M. Graham (Caltech), F. Forster (UChile)

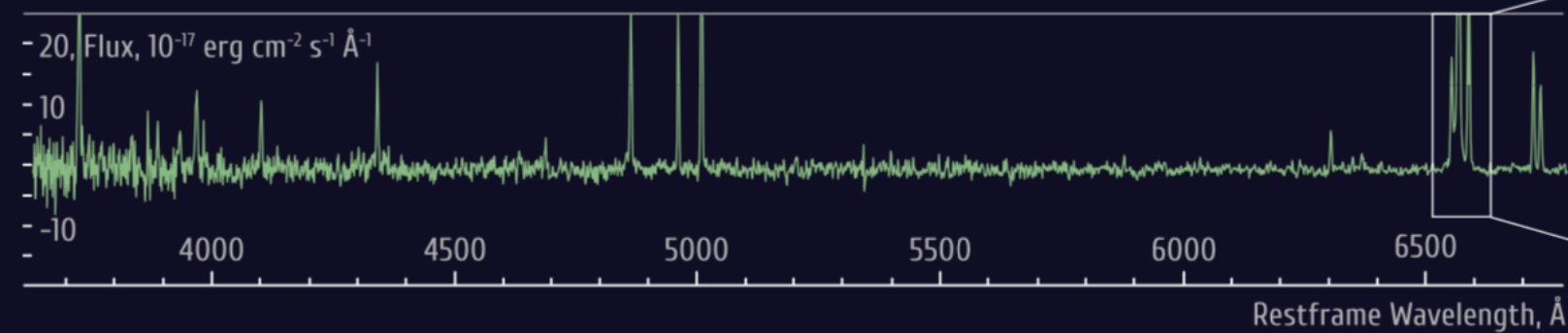




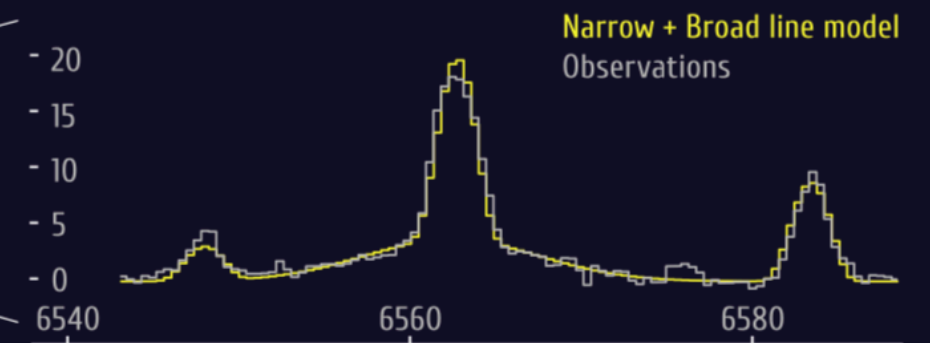
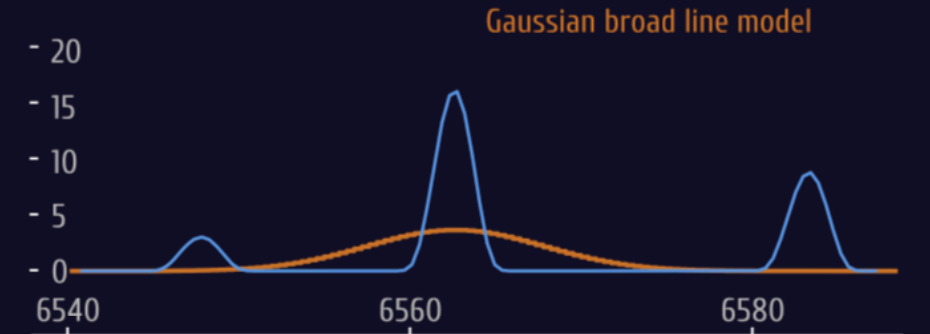
An optical spectrum of the galaxy centre and the galaxy starlight model



An optical spectrum of the galaxy centre with the galaxy starlight model subtracted



$H_{\alpha}$  + [NII] emission lines

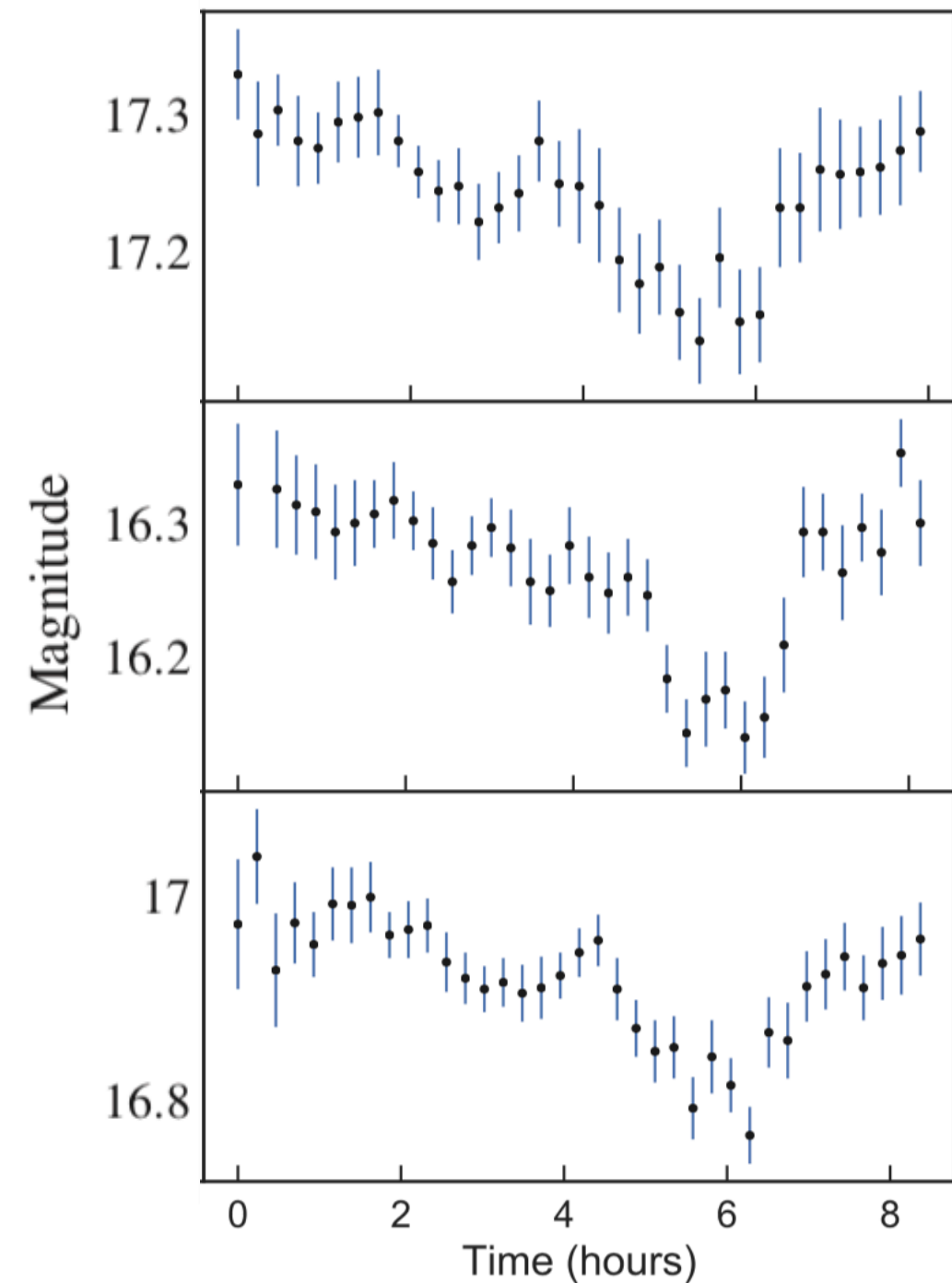


Liu et al. 2018

Chilingarian et al. 2018

# NGC 4395

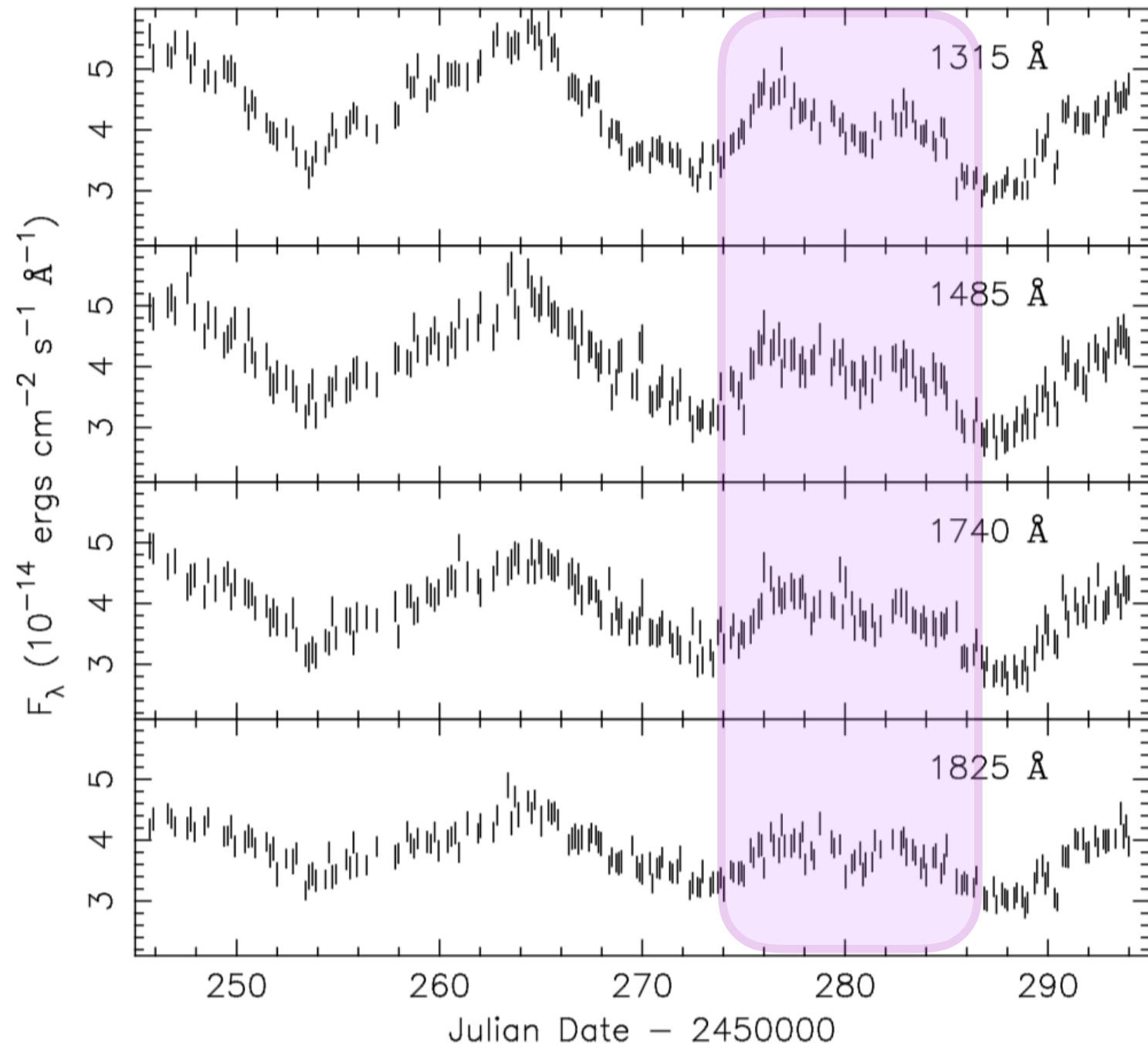
$$M_{\bullet} \sim 10^5 M_{\odot}$$



Edri et al., 2002

# NGC 7469

$$M_{\bullet} \sim 10^7 M_{\odot}$$



Wanders et al., 1997



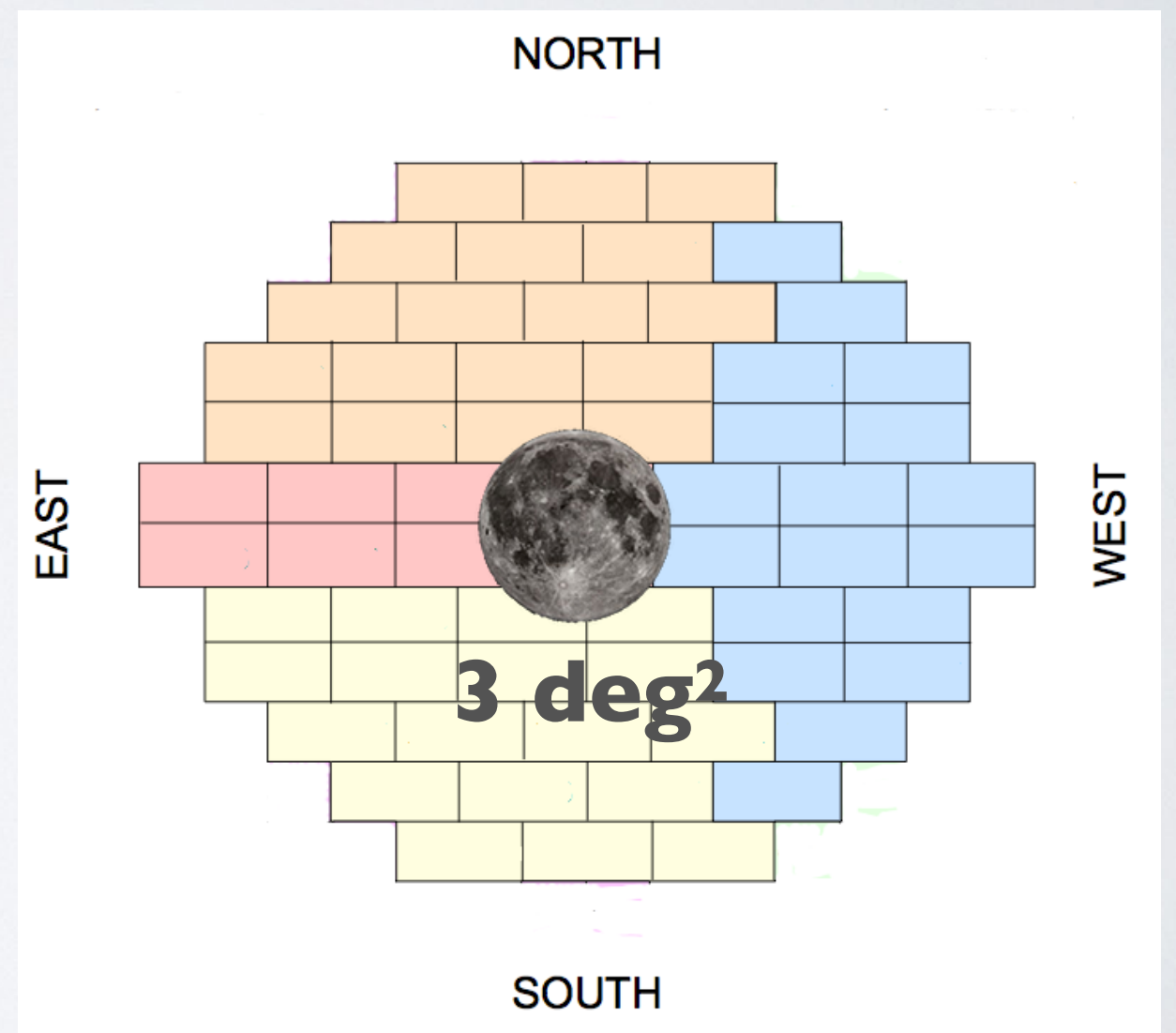
Cadence, depth, area.....

# The High Cadence Transient Survey (HiTS)

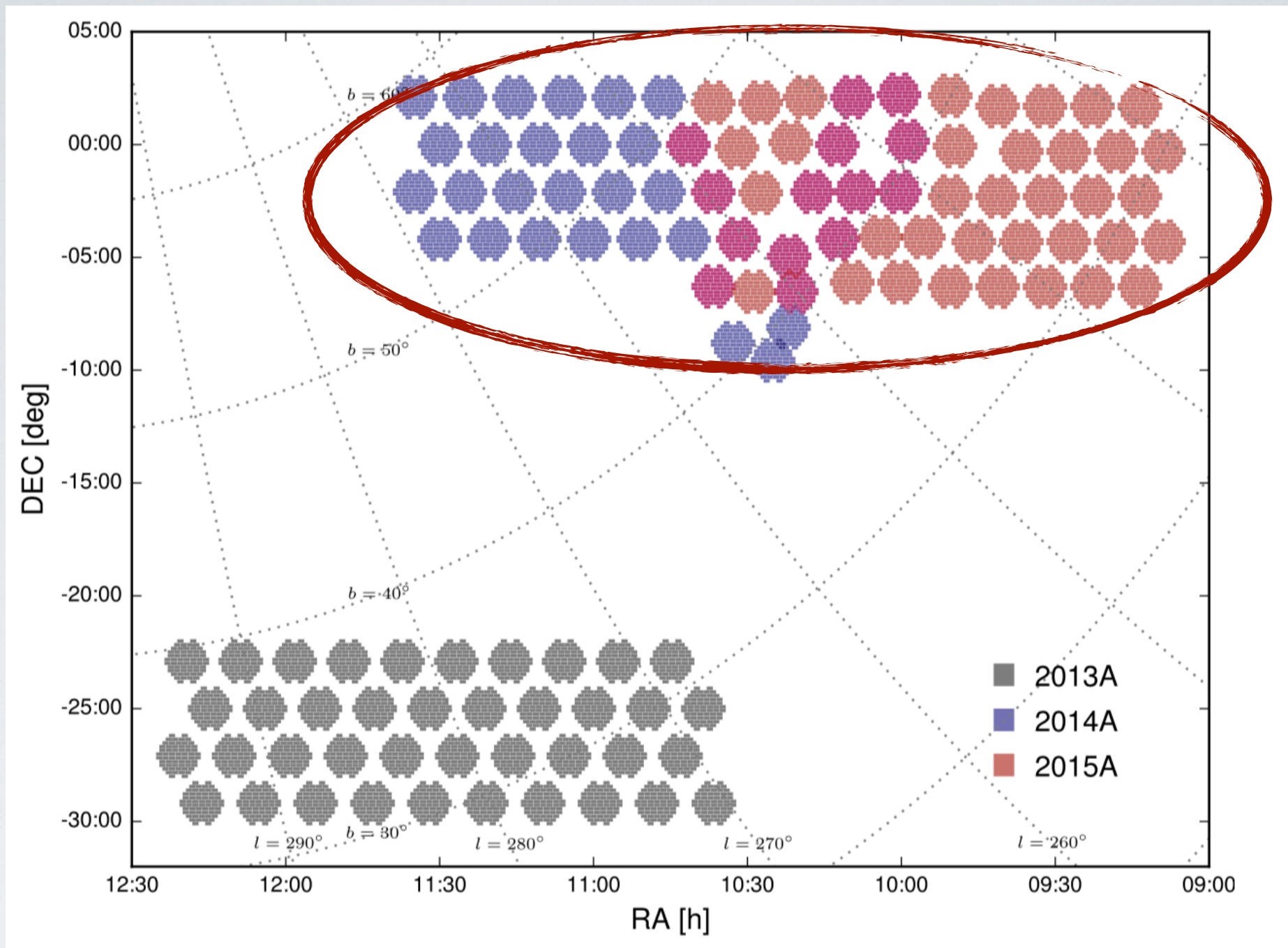
PI: Francisco Forster



Blanco 4m Telescope



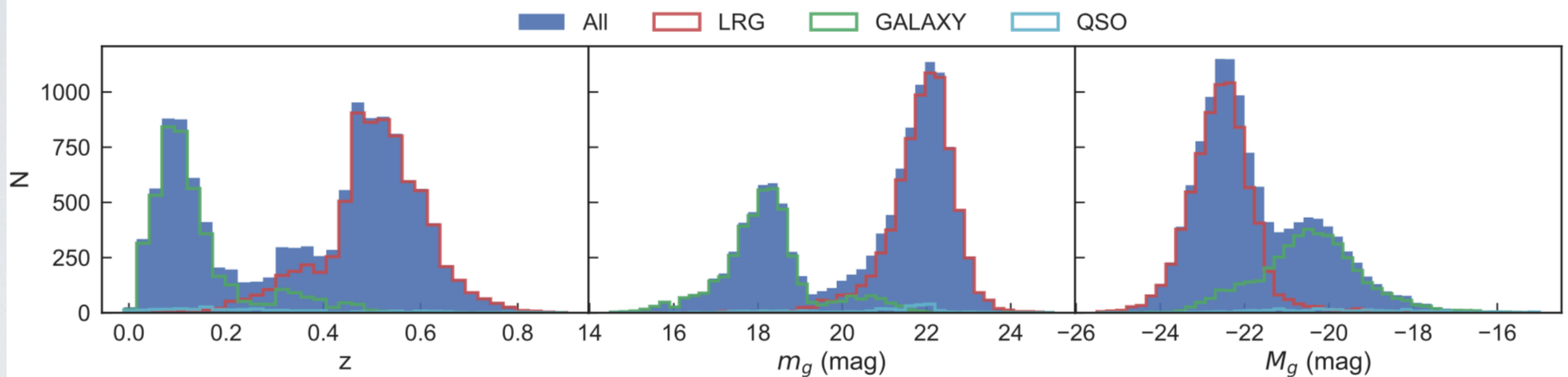
Dark Energy Camera



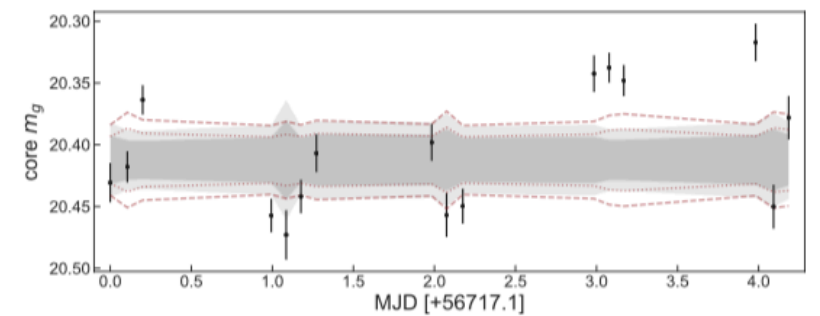
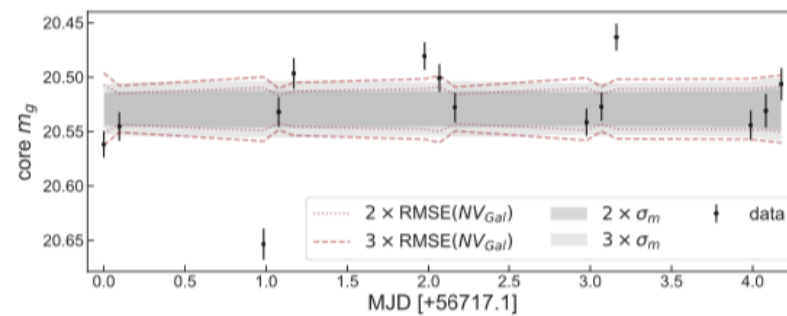
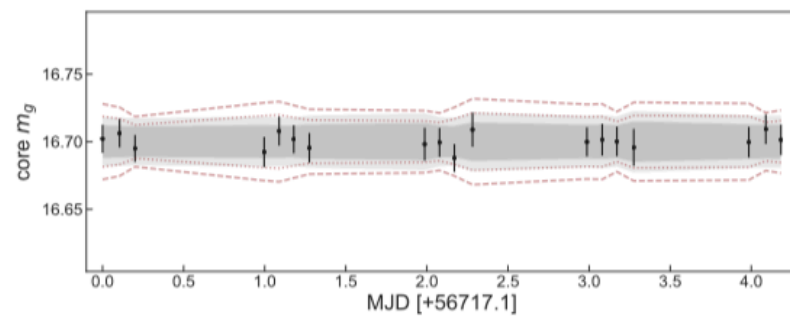
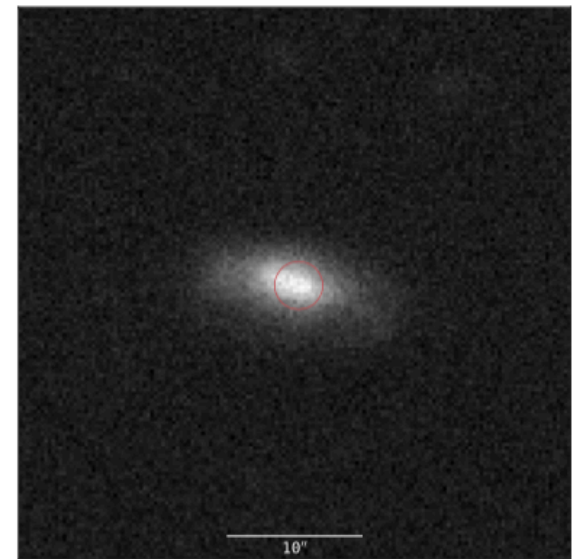
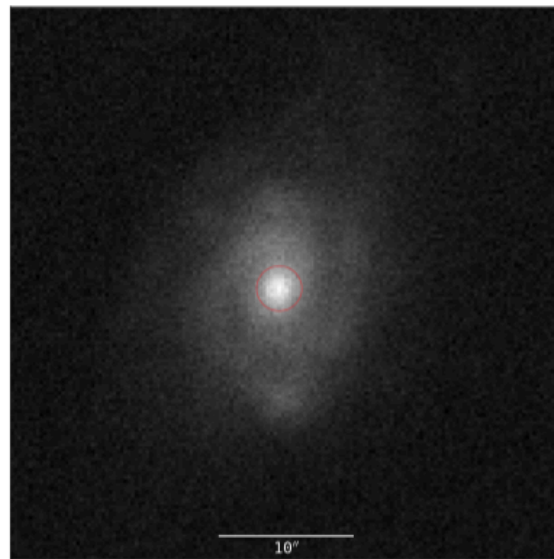
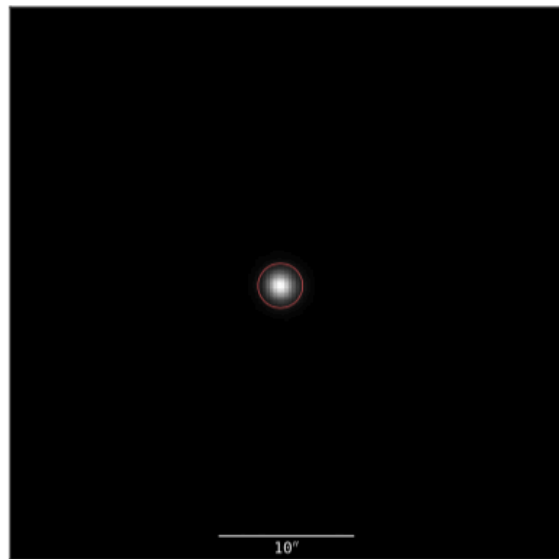
- Cross-match with SDSS Main Galaxy Catalog (**2014**+**2015**)
- Take all epochs to the same PSF
- Light-curve production from aperture photometry of nuclei



Total of 12 306 unique galaxies across 140 deg<sup>2</sup>



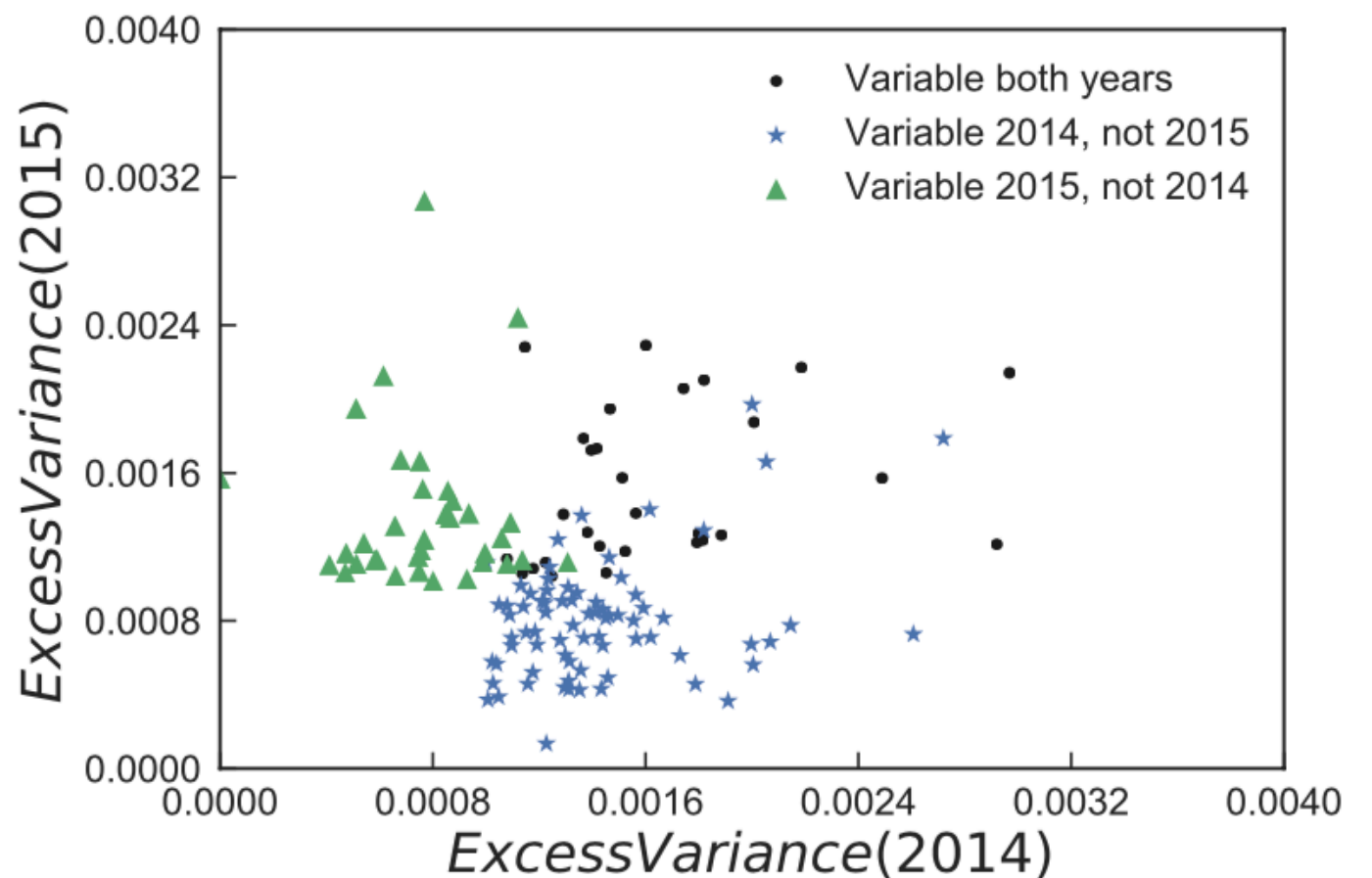
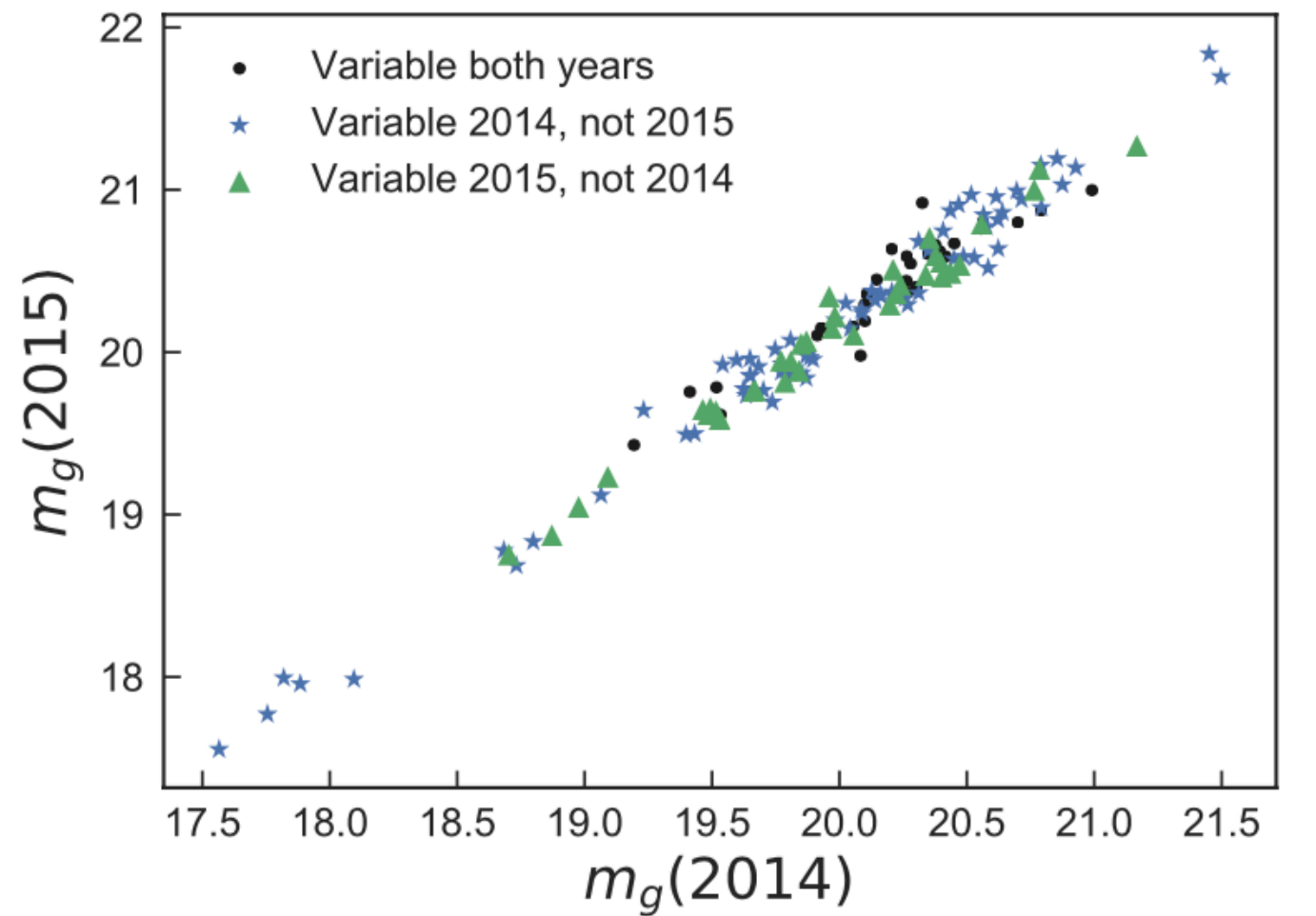
# Short time-scale variable galaxy nuclei





During 2014 we detected **~75%** of “available” sources

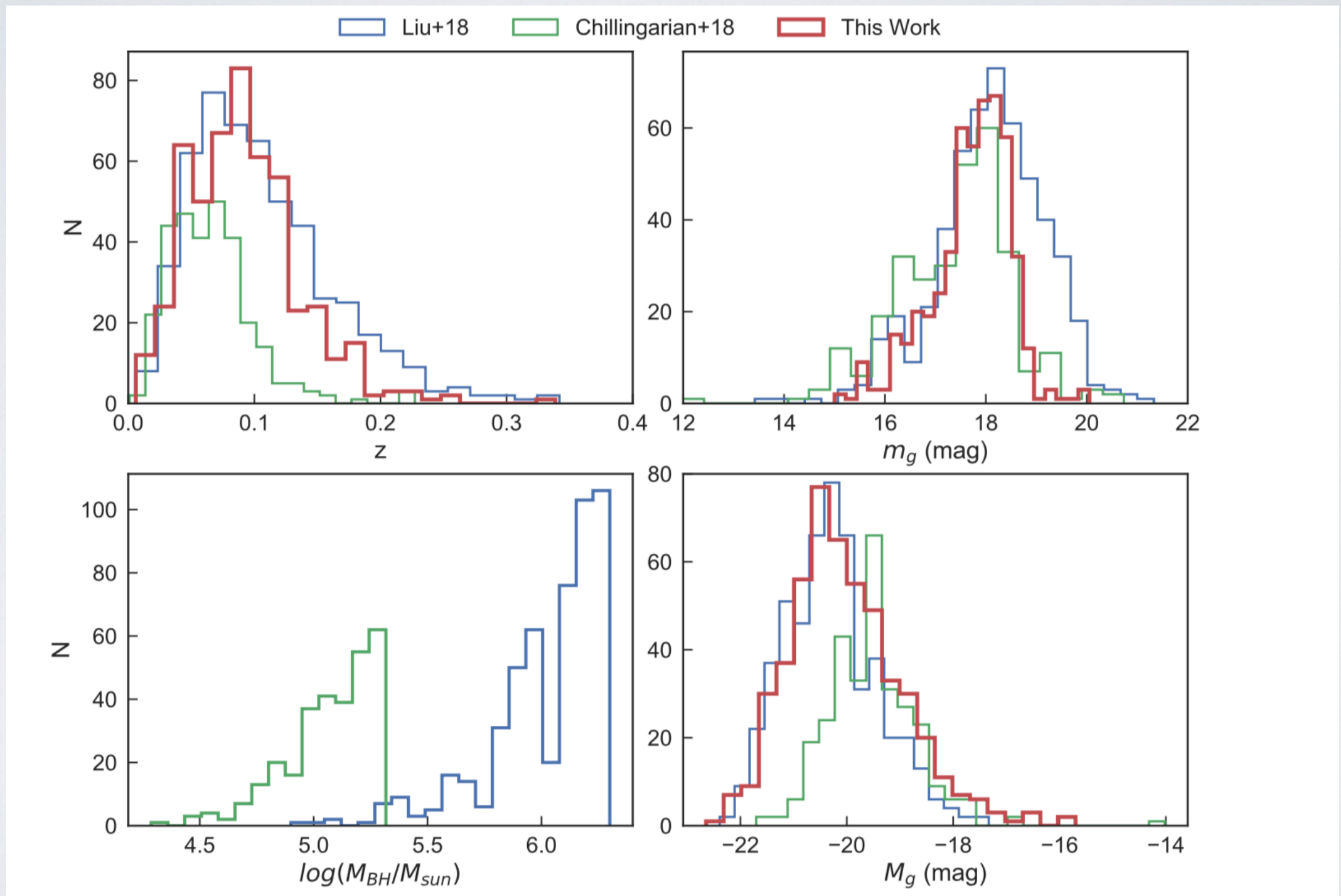
During 2015 we detected **~50%** of “available” sources



Other works searching for IMBH measuring broad  $H\alpha$  emission lines:

**Liu+18** & **Chilingarian+18**

with  $\sim 500+300$  candidates each from full SDSS searches

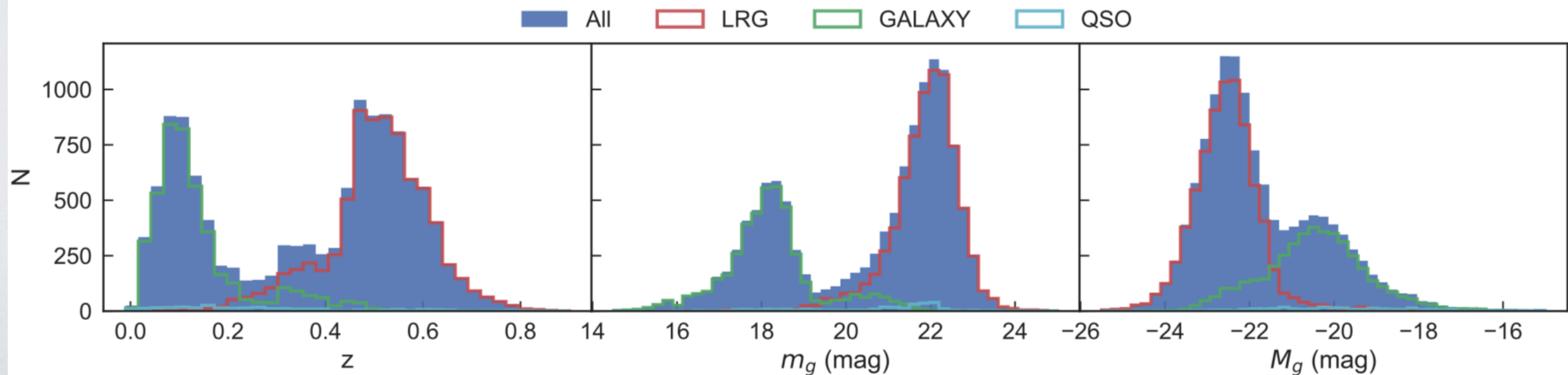
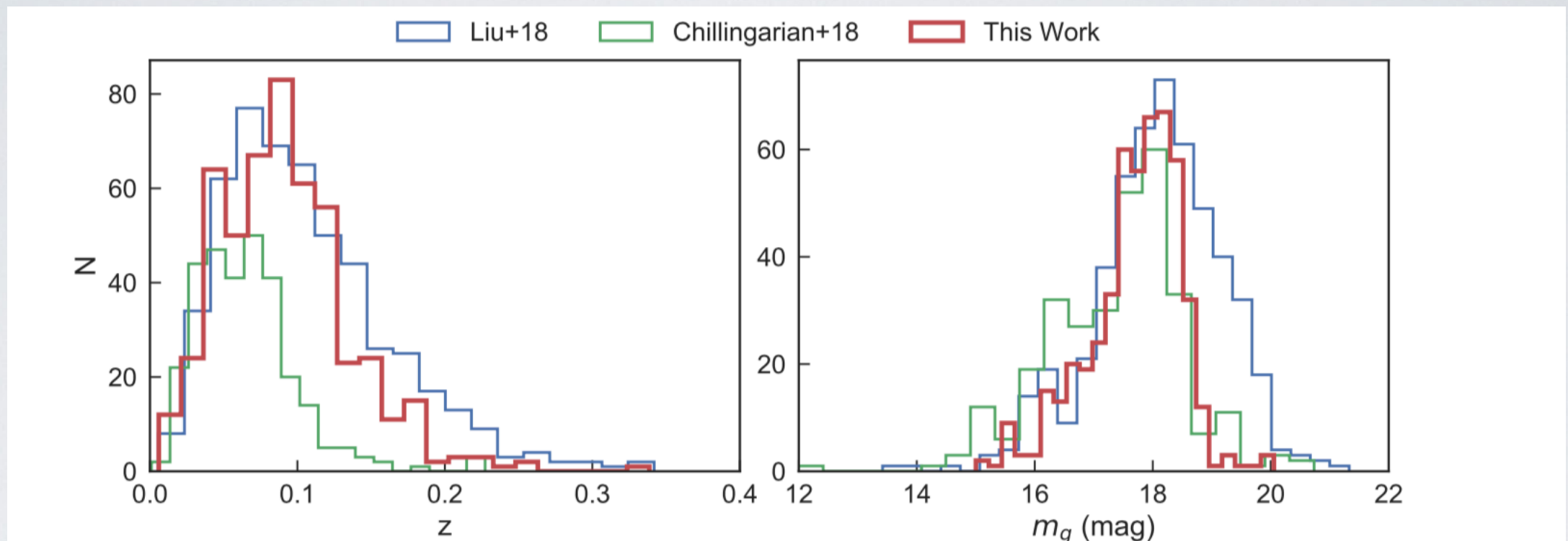




Other works searching for IMBH measuring broad  $H\alpha$  emission lines:

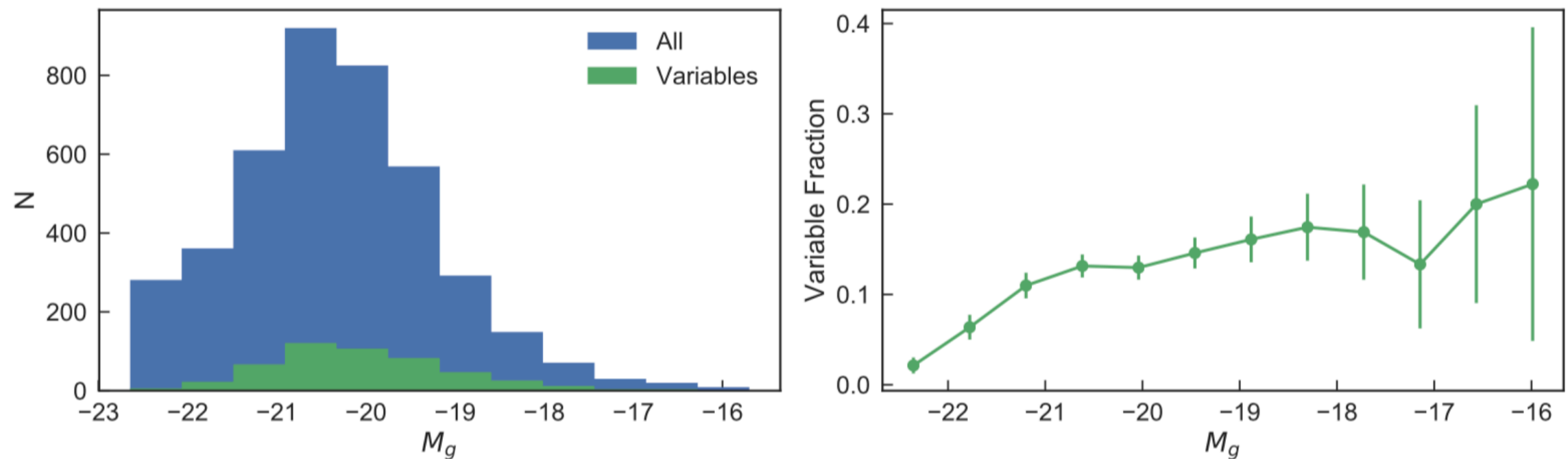
**Liu+18** & **Chilingarian+18**

with  $\sim 500+300$  candidates each from full SDSS searches



# IMBH Candidates

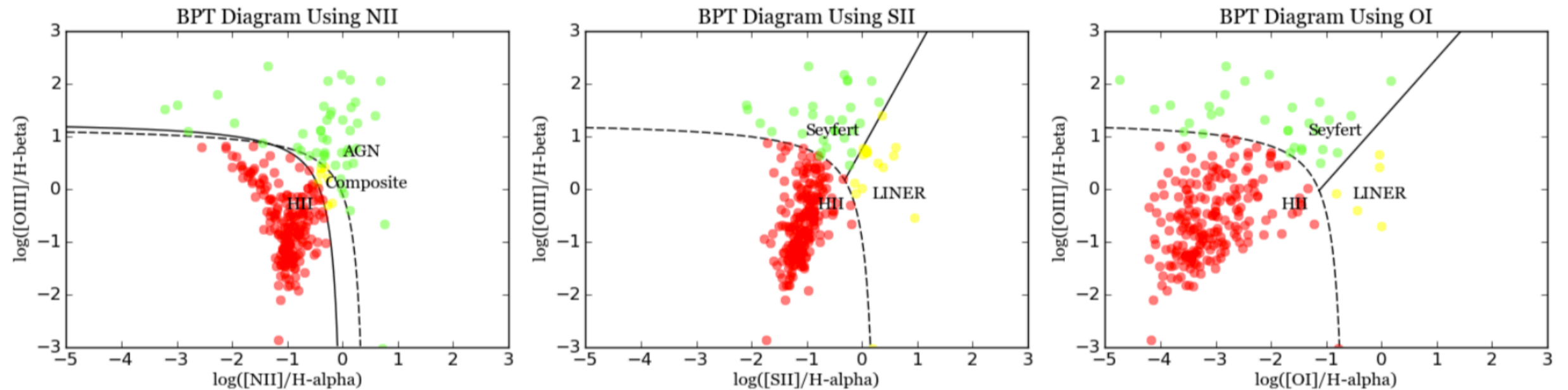
- IMBH occupancy fraction is  $\sim 4\%$  and the surface density is  $3.1 \text{ deg}^{-2}$



GZ Type	Visual Inspection				
	Spiral	Elliptical	Irregular	Merger	Uncertain
Spiral	213	1	2	0	0
Elliptical	1	15	0	0	0
Uncertain	167	49	27	4	3
No Data	10	3	1	2	1
Total	391	68	30	6	4



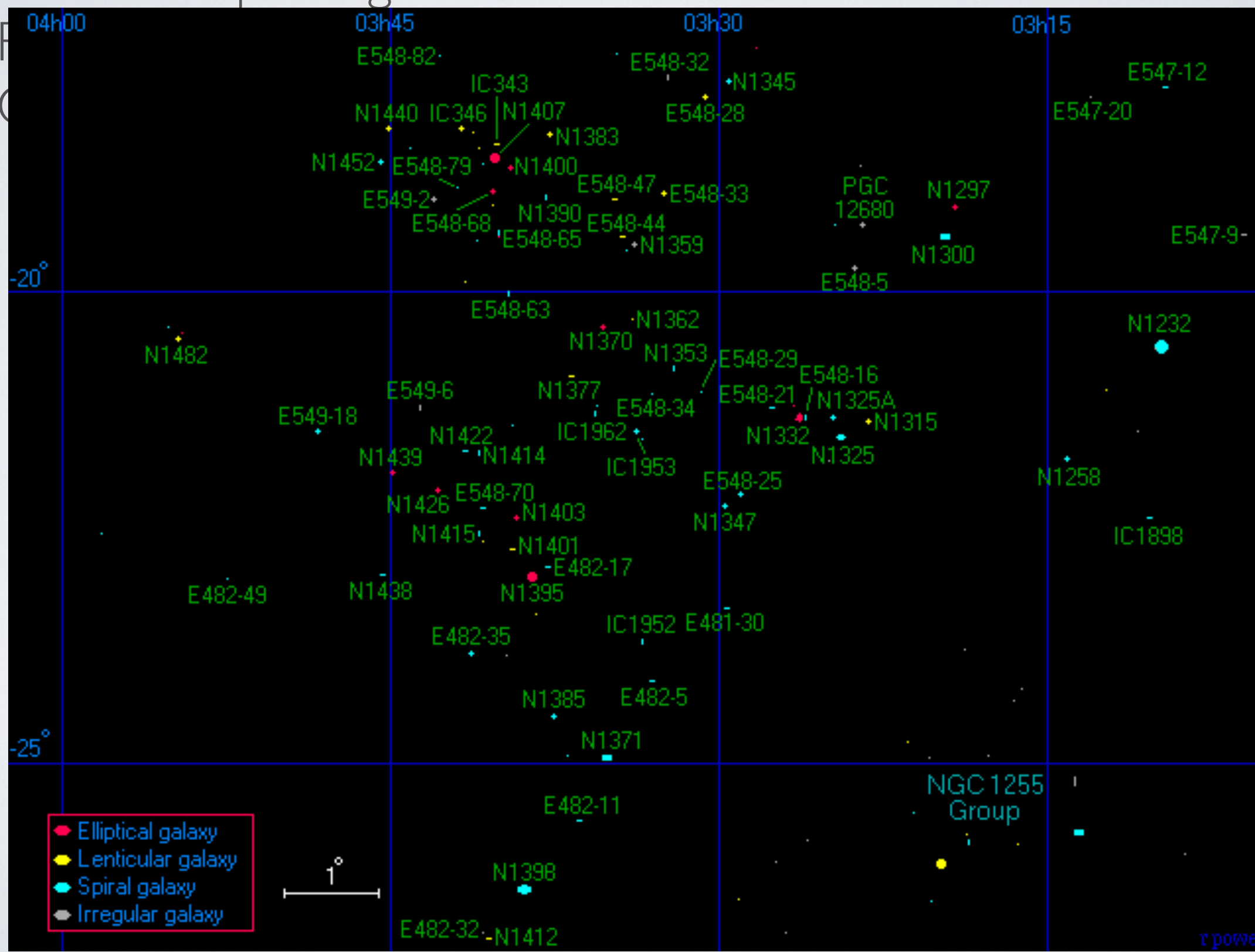
# BPT Diagnostic Diagrams



BPT Diagram	AGN-Seyfert	Composite-LINER	HII-Starforming
NII	43	8	199
SII	25	14	211
OI	27	6	217

# Next Steps

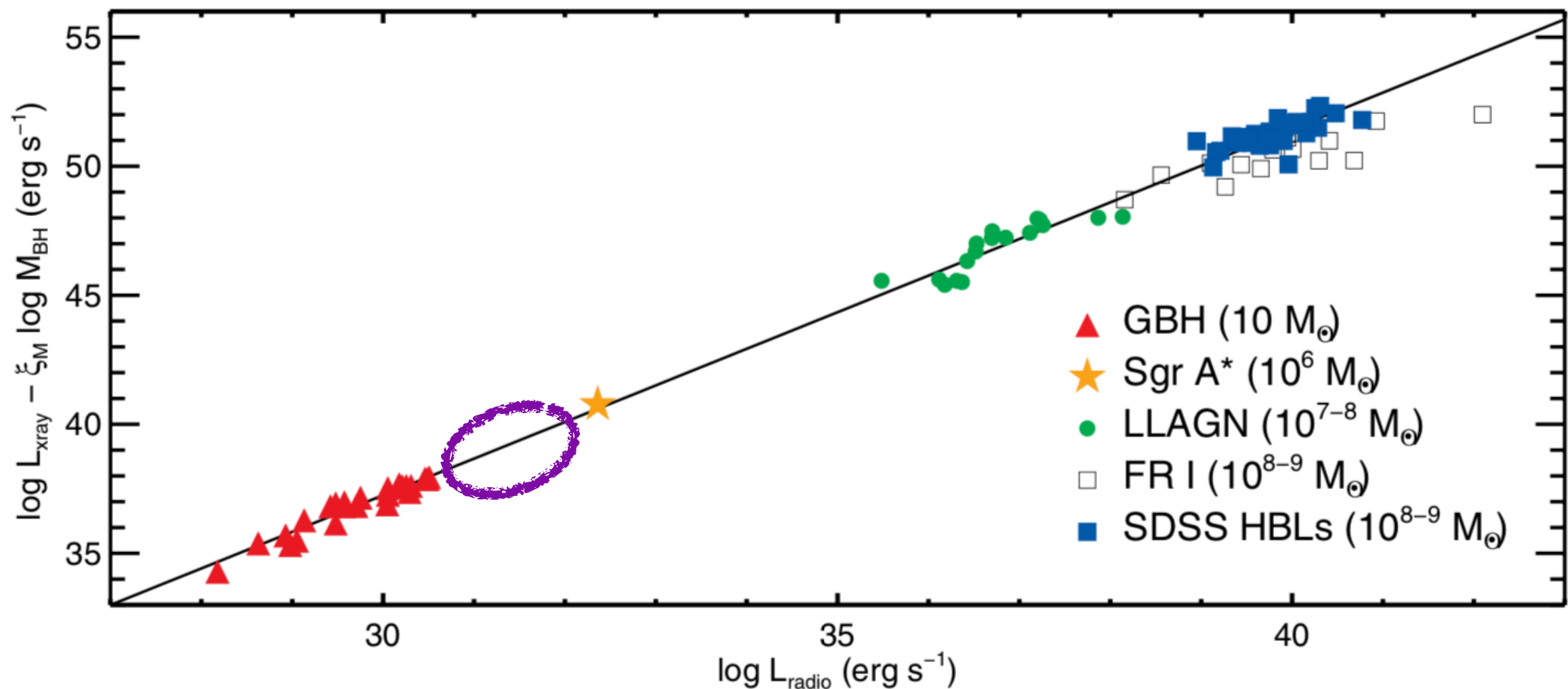
- Better sampled light curves





# Next Steps

- Better sampled light curves
- Radio and X-ray follow up (VLA, Chandra, eROSITA)
- Ground based spectroscopy, HST, JWST, dynamical studies



## Summary:



We have conducted a search for IMBHs using variability:

### **The SIBLING Survey**



SIBLING is  $\sim 30$ -50 times more efficient than searches of broad components to Balmer lines



It is found that  $>4\%$  galaxies harbor an IMBH candidate



The host galaxies span  $M_g \sim -18$ :-22 and morphological types are mostly Spirals



Follow up is underway



# Two Announcements





## Calan Postdoctoral Fellowship 2020

### ▼ Submission Information

**Publish Date:** Wednesday, August 7, 2019

**Archive Date:** Wednesday, September 11, 2019

To event remaining 33 days

### ▼ Job Summary

**Job Category:** Post-doctoral Positions and Fellowships

**Institution Classification/Type:** Large Academic

**Institution/Company:** Universidad de Chile

**Department Name:** Department of Astronomy

**Street Line 1:** Camino El Observatorio #1515

**City:** Las Condes

**State/Province:** Santiago

**Country:** Chile

### ▼ Announcement

#### **Job Announcement Text:**

The Department of Astronomy ([DAS](#)) at Universidad de Chile invites applications for a two-year postdoctoral position in observational, theoretical, and/or computational astrophysics, as well as astronomical instrumentation. The selected fellow will be expected to conduct an ambitious and independent research program, and collaborate with members of the department. The position, based at the DAS in Santiago, Chile, is sponsored by the [CATA](#) grant and should be started in early 2020.





# International Astronomy Meetings

## Formation and Growth of Supermassive Black Holes

Date	Monday, 7 December 2020 - Saturday, 12 December 2020
Location	Pucon
Contact	Dominik Schleicher
Address	Astronomy Department, Universidad de Concepción, Concepción, Chile
Phone	+56976550770
URL	
Email	<a href="mailto:dschleicher@astro-udec.cl">dschleicher@astro-udec.cl</a>

**14 December 2020**

