Near-Infrared Counterparts to ULXs

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Breaking the Limits. Arbatax, September 2016

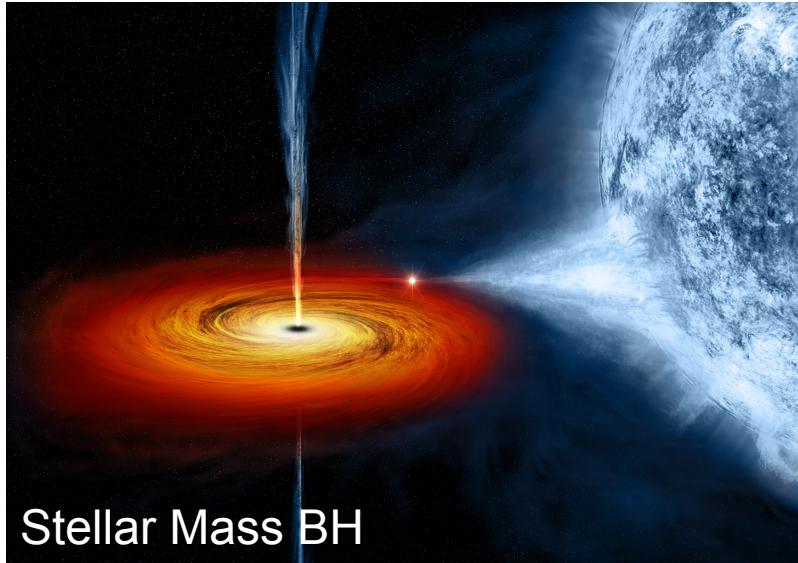# OUTLINE

- Introduction

- Near-infrared survey

- Astrometric correction

- Identifying NIR candidate counterparts

- What has to be done?

- Conclusions

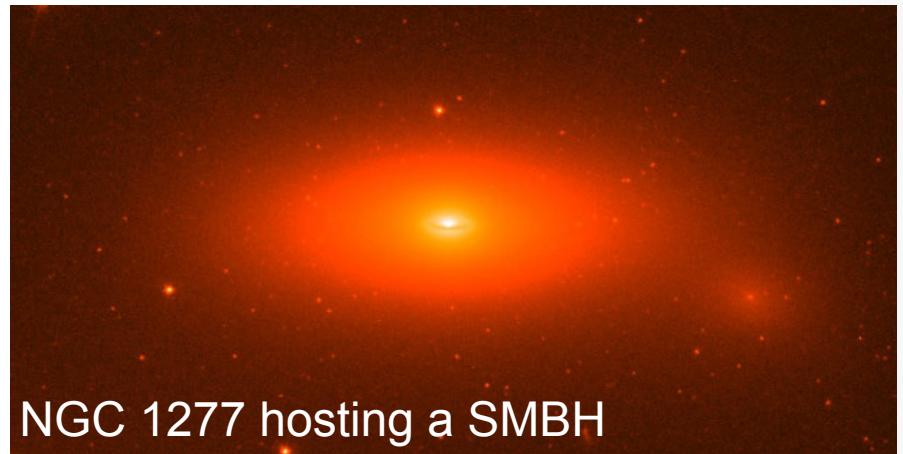We observed 123 ULXs in 49 galaxies and identified 35 NIR candidate counterparts, of which 21 are RSG candidates.

INTRODUCTION

ULXs as IMBH candidates

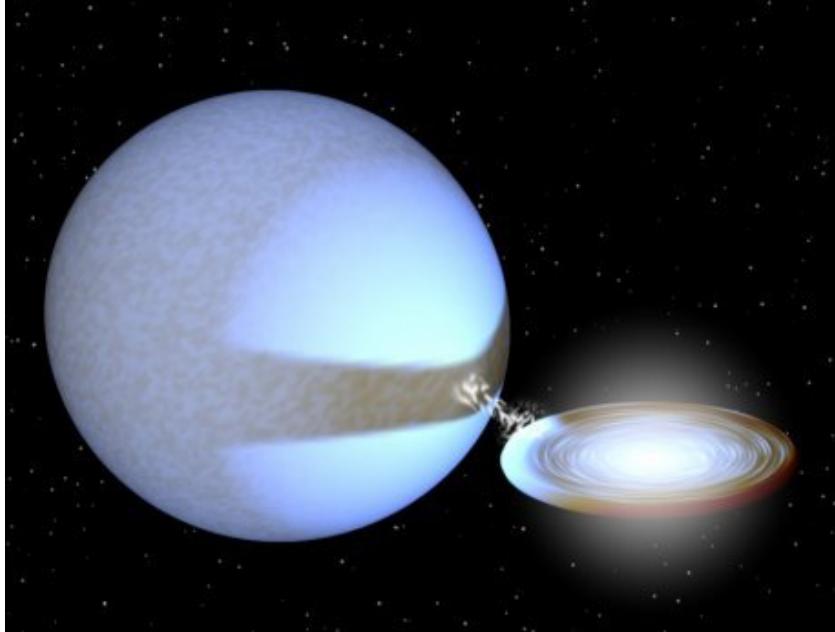Stellar Mass BH

Credit: Image by NASA/CXC/M. Weiss.

NGC 1277 hosting a SMBH

Credit: Image by NASA/ESA
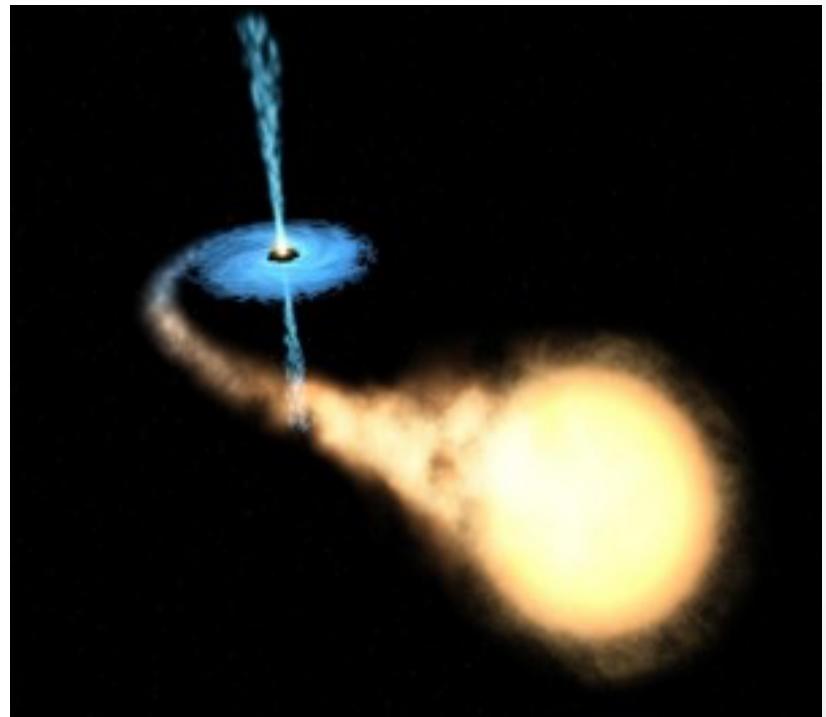
$$10^2 M_{SUN} < M_{IMBH} < 10^5 M_{SUN}$$

Determining their true nature

Credit: Image by Tom Russell (ICRAR) using the software created by Rob Hynes (Louisiana State University)

Red supergiants (RSGs)

Credit: Image by NASA.

NEAR-INFRARED SURVEY

NIR Counterparts to ULXs – Kristhell López – K.M.Lopez@sron.nl

Catalogues

$$L_X > 10^{39} \text{ erg/s}$$

- J. Liu & Bregman, 2005
- Q.Z. Liu & Mirabel, 2005
- Winter, Mushotzky & Reynolds, 2006
- Walton, Roberts, Mateos & Heard, 2011
- Swartz, Ghosh, Tennant & Wu, 2004
- Swartz, Soria, Tennant & Yukita, 2011
- J. Liu, 2011
- Roberts & Warwick, 2000
- Burke, Kraft, Soria et al. 2013 (for NGC 5128)
- Ptak, Colbert, Van der Marel, Roye & Towne, 2006
- Colbert, Heckman, Ptak, Strickland & Weaver, 2004
- Earnshaw, Roberts & Middleton in prep.
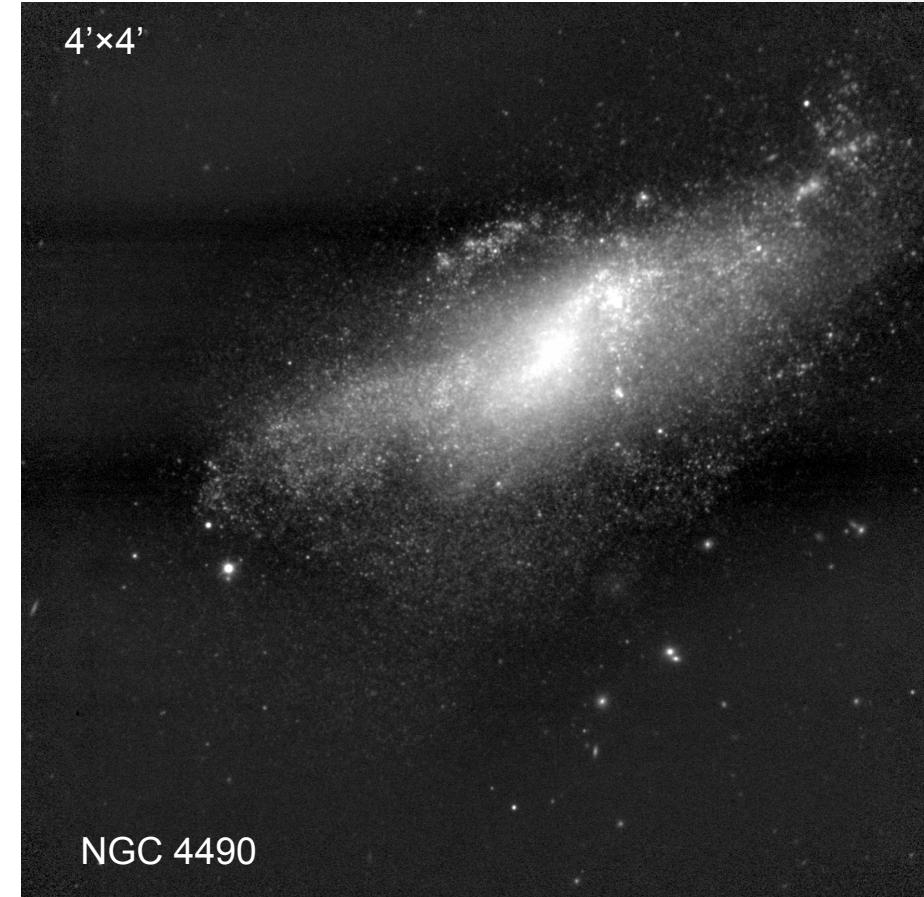
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Imaging campaign

10 Mpc

49 galaxies

123 ULXs

35 candidates

21 RSG

4'×4'

NGC 4490

- 17 candidate counterparts (Heida et al. 2014)
- 18 candidate counterparts (López et al. in prep)

- 11 RSG candidates (Heida et al. 2014)
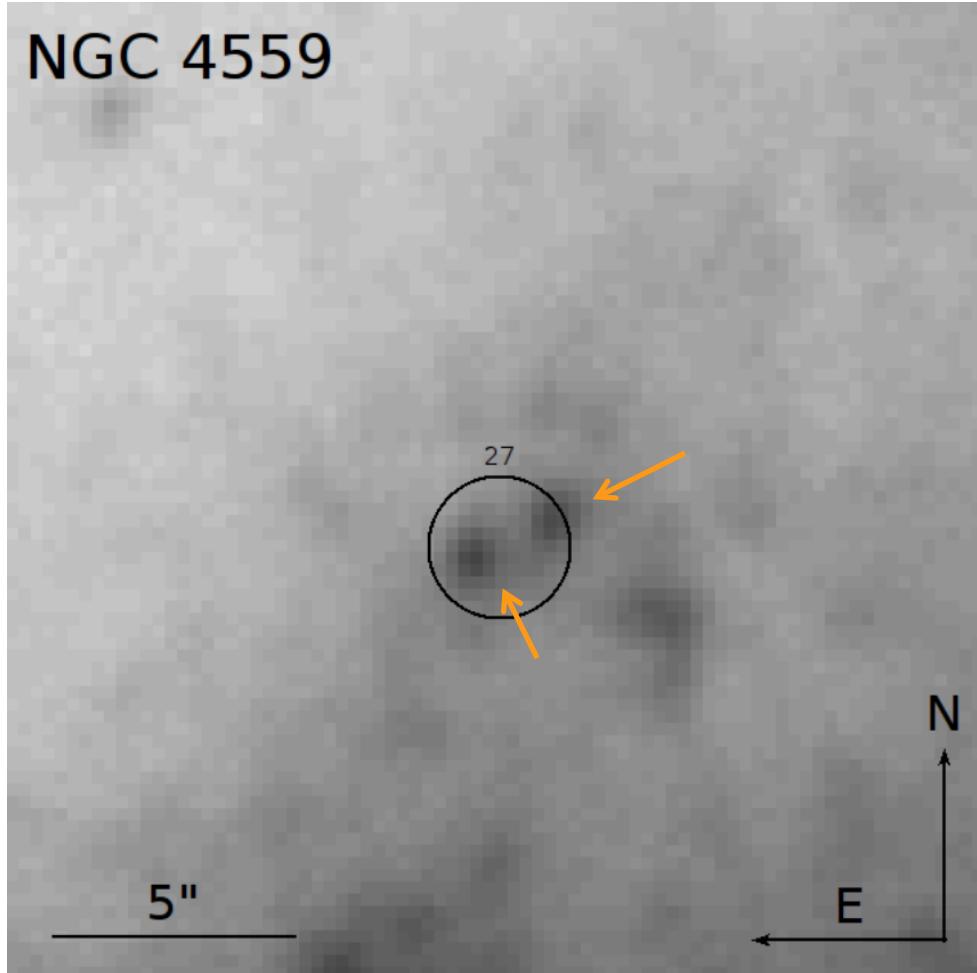- 10 RSG candidates (López et al. in prep)

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ASTROMETRIC CORRECTION

GAIA's "Fit-to-star" tool

Sources observed by *Chandra* – CIAO software, bore-sight correction

Sources observed by XMM-*Newton* – SAS software, catcorr task

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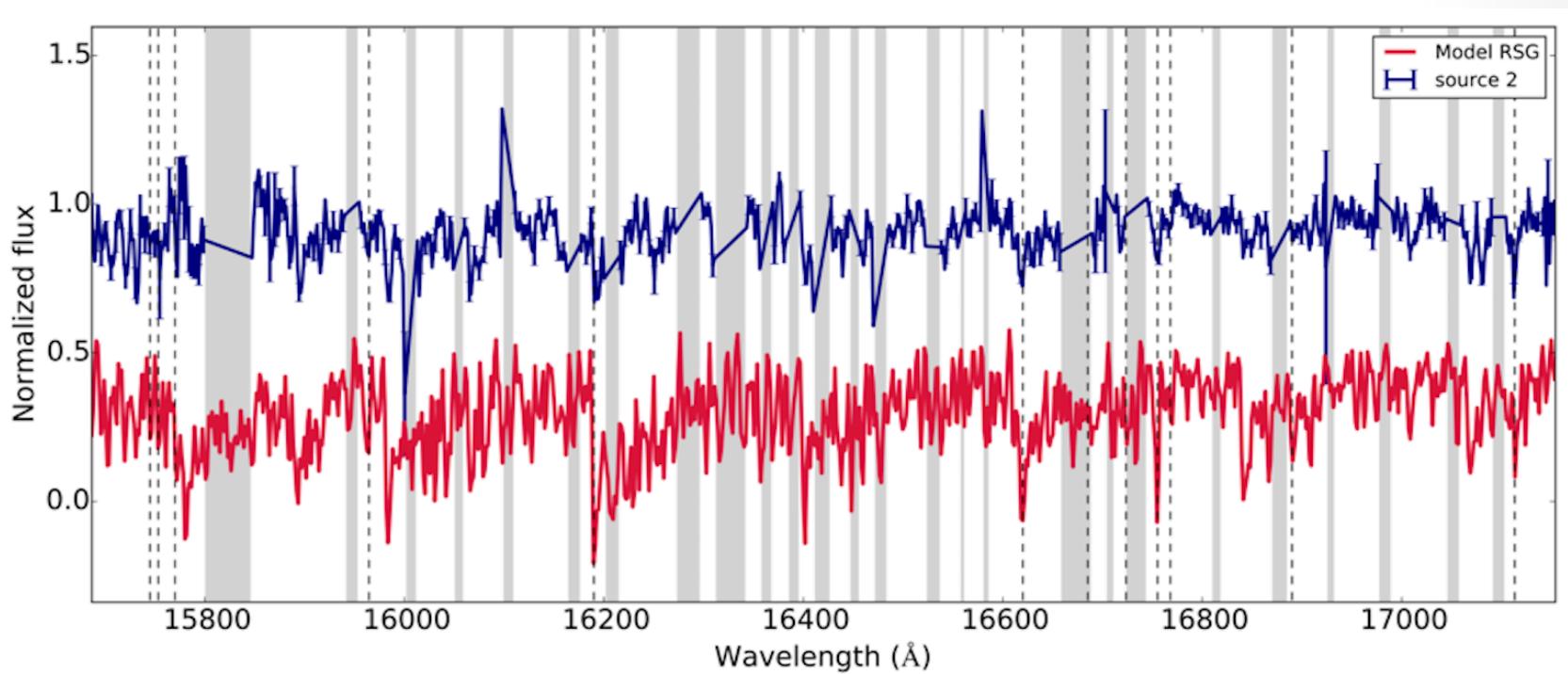
IDENTIFYING NIR CANDIDATES

99.7% confidence radius = 1.47"

17.3 mag in H-band (-13.6 mag)

WHAT HAS TO BE DONE?

- Finish imaging survey on January 2017.

- Applied for time on WHT spectroscopic mode for brightest 10 objects (14.5 mag < H < 18.4 mag).

- Applying for time on Gemini-North and/or Keck to take spectra of the remaining 8 candidates.

H-band Keck/MOSFIRE spectrum of J0022, in NGC 925
3500 K model, Lancon et al. 2007
Taken from Heida et al. 2016

CONCLUSIONS

- We have done an imaging survey in 49 galaxies within 10 Mpc, observing 123 ULXs in the NIR.

- Observing a ULX field in the NIR allows us to identify candidate counterparts. We have identified 35 candidate counterparts, of which 21 are RSG candidates.

- After identifying the candidate counterparts, spectra have to be taken to determine whether they are RSG or not. Within these spectra, we search for radial velocity variations of the RSG.