The population of X-ray binaries in the Magellanic system detected during the eROSITA all-sky survey

Chandreyee Maitra

Frank Haberl, David Kaltenbrunner, Georgios Vasilopoulos,
Andrzej Udalski, David Buckley and many others

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cmaitra@mpe.mpg.de

The Magellanic stream system

A gaseous structure around the Magellanic Clouds spanning 200 degrees on the sky. Consists of Leading arm, **LMC, Bridge, SMC**, trailing stream

Credit:Nidever, et al., NRAO/AUI/NSF

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Low Z environment

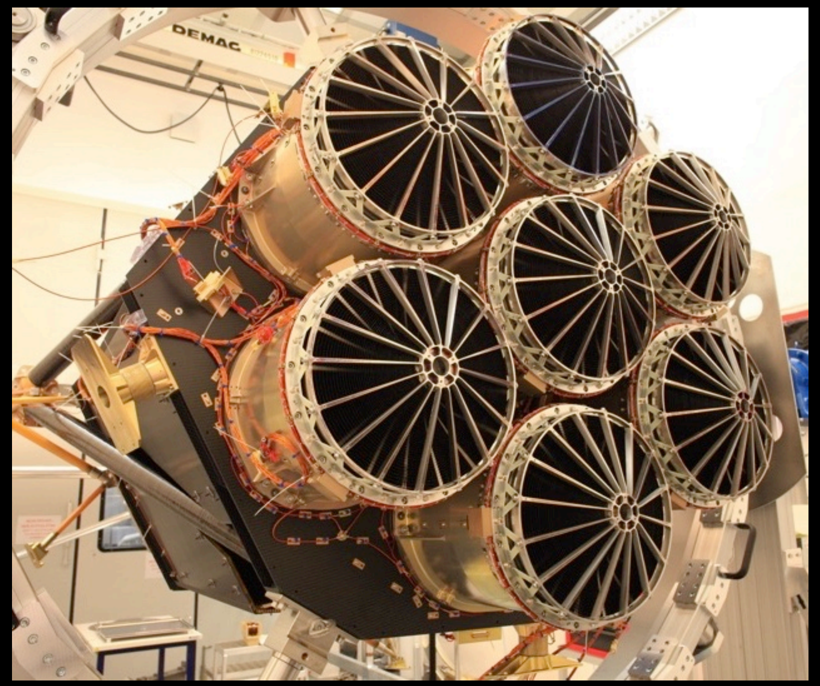
Well known moderately close (48-62 kpc)

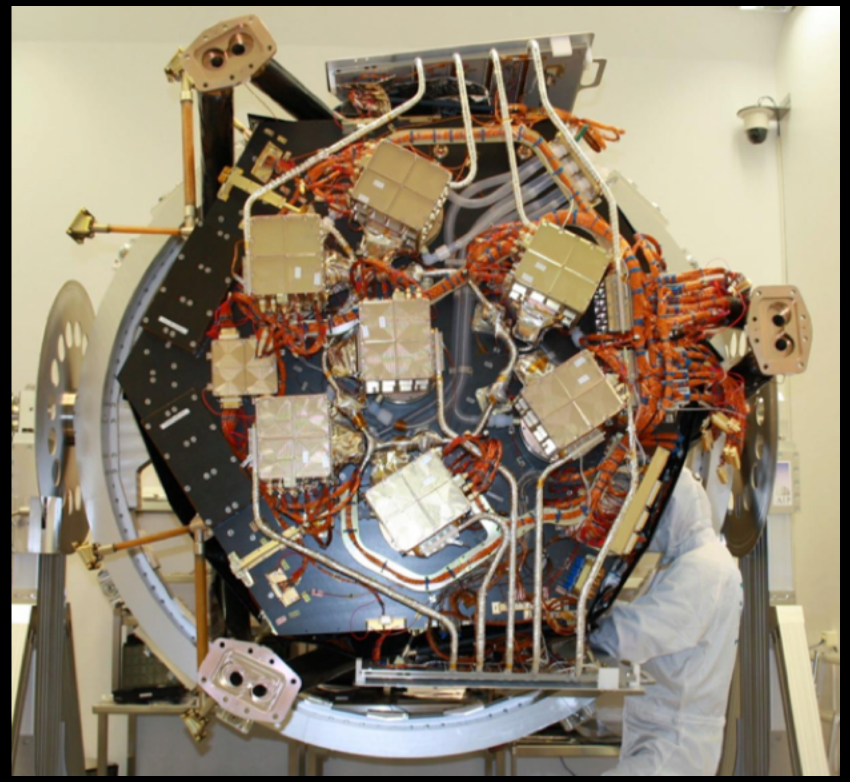
Low Galactic foreground absorption

eROSITA provides full X-ray coverage of the whole system combining the advantages of ROSAT (all-sky survey) and XMM-Newton (high sensitivity, wide energy band of 0.2-10 keV

Credit:Nidever, et al., NRAO/AUI/NSF

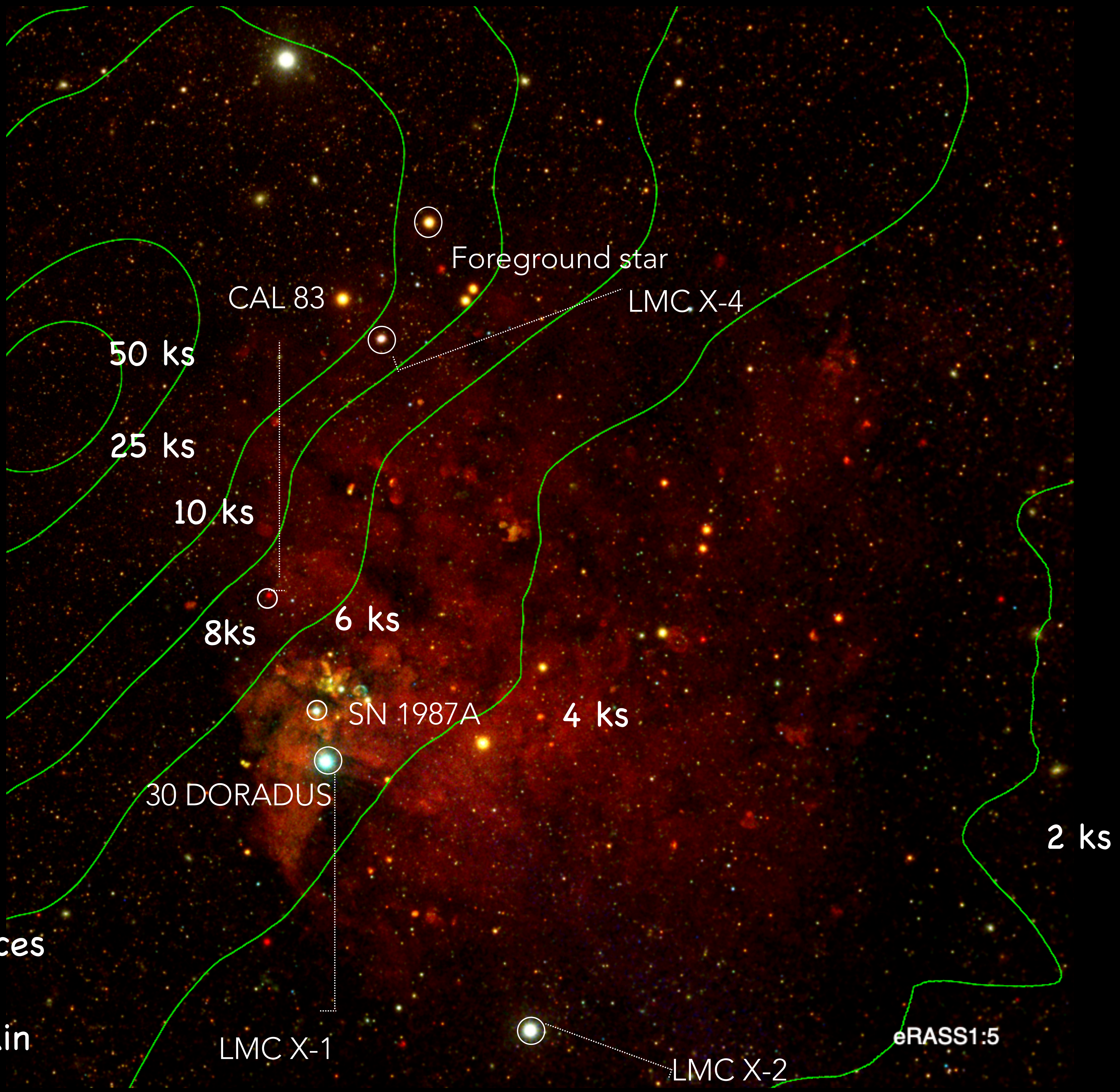
SRG/eROSITA survey - proximity to SEP





MPE/IKI

Mapping the LMC eRASS:4



R=0.2-1.0 keV
G=1.0-2.0 KeV
B=2-4.5 KeV

11x11 deg
~ 6300 'clean' sources detected in eRASS:4 in the main body of the LMC

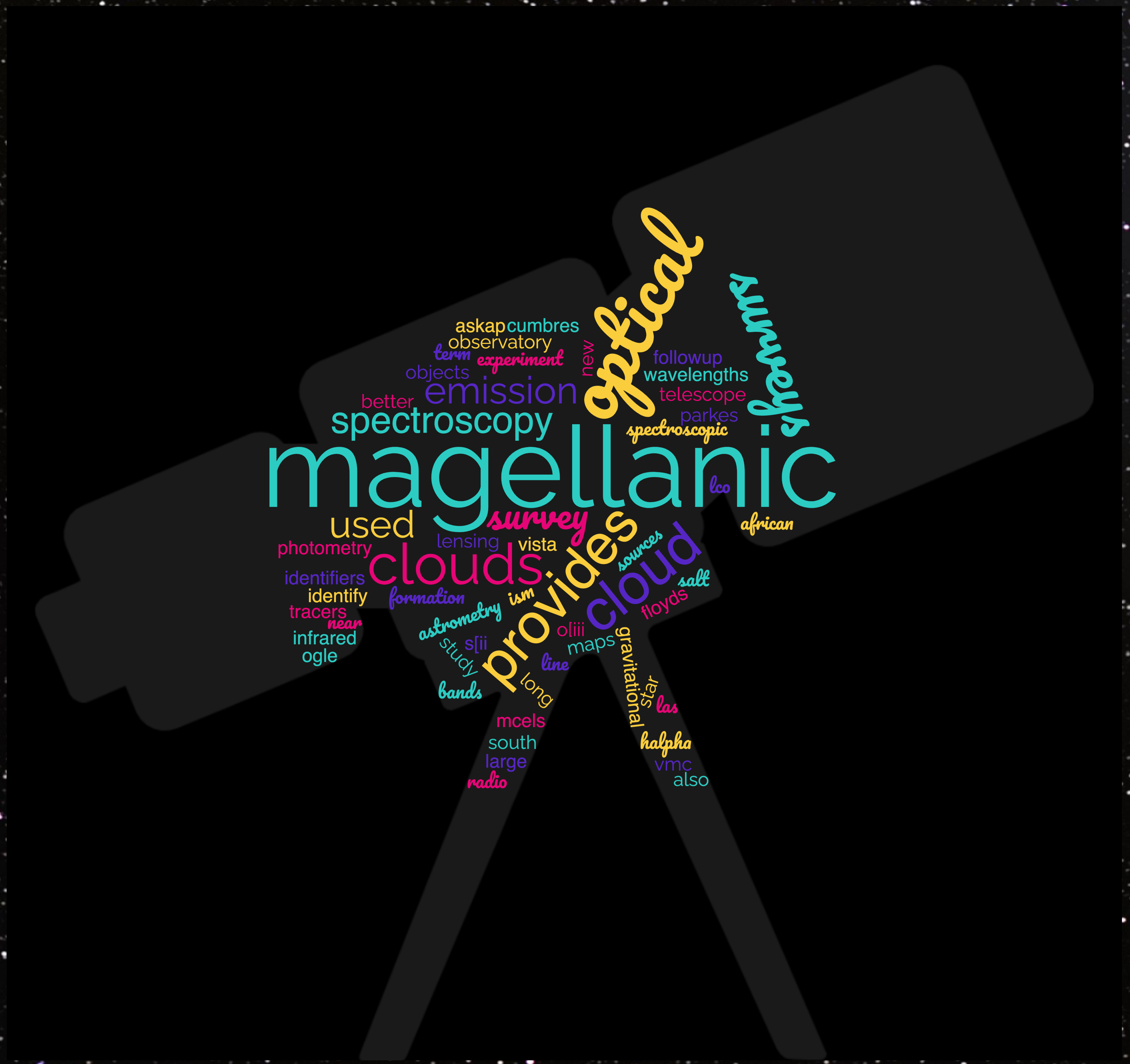
+ wealth of Multi-wavelength information

Current surveys/facilities

Magellanic Cloud Emission Line Survey

OGLE

S·A·L·T

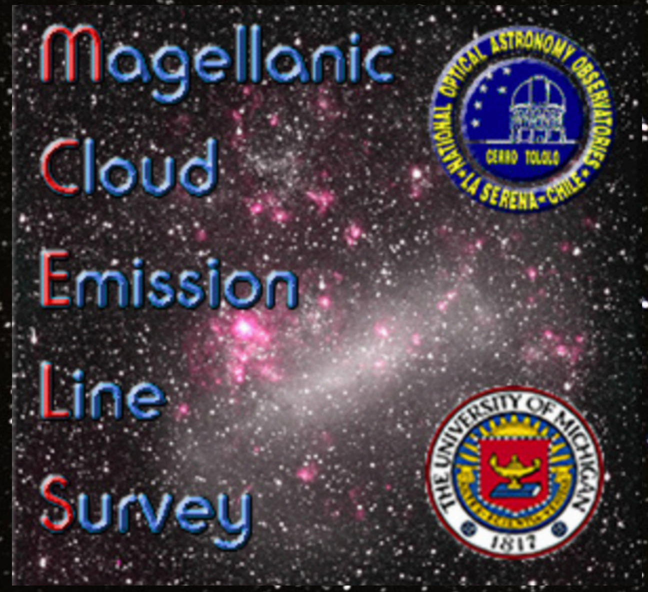


VMC

DESI Legacy Imaging Surveys

+ wealth of Multi-wavelength information

Current surveys/facilities



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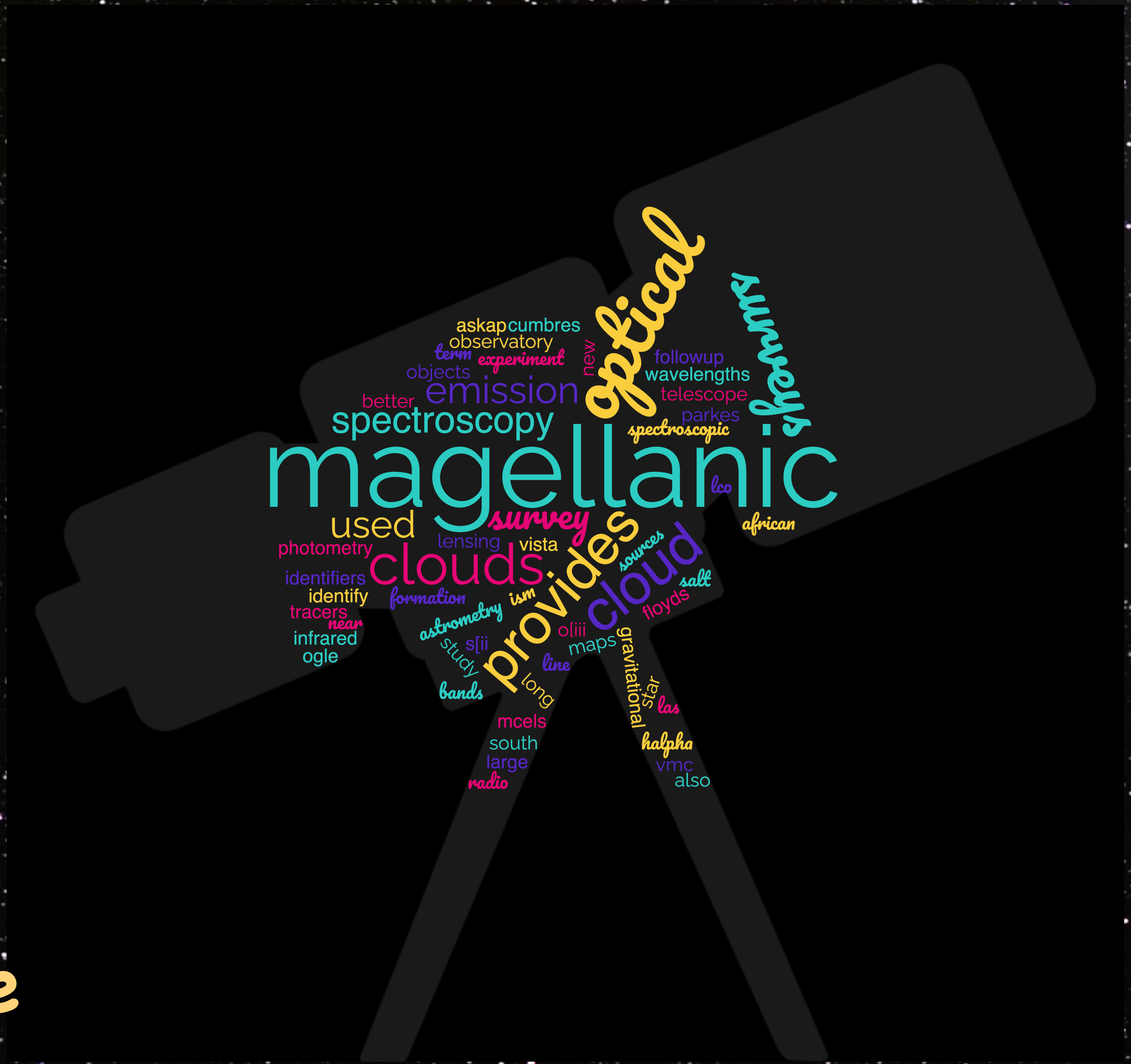
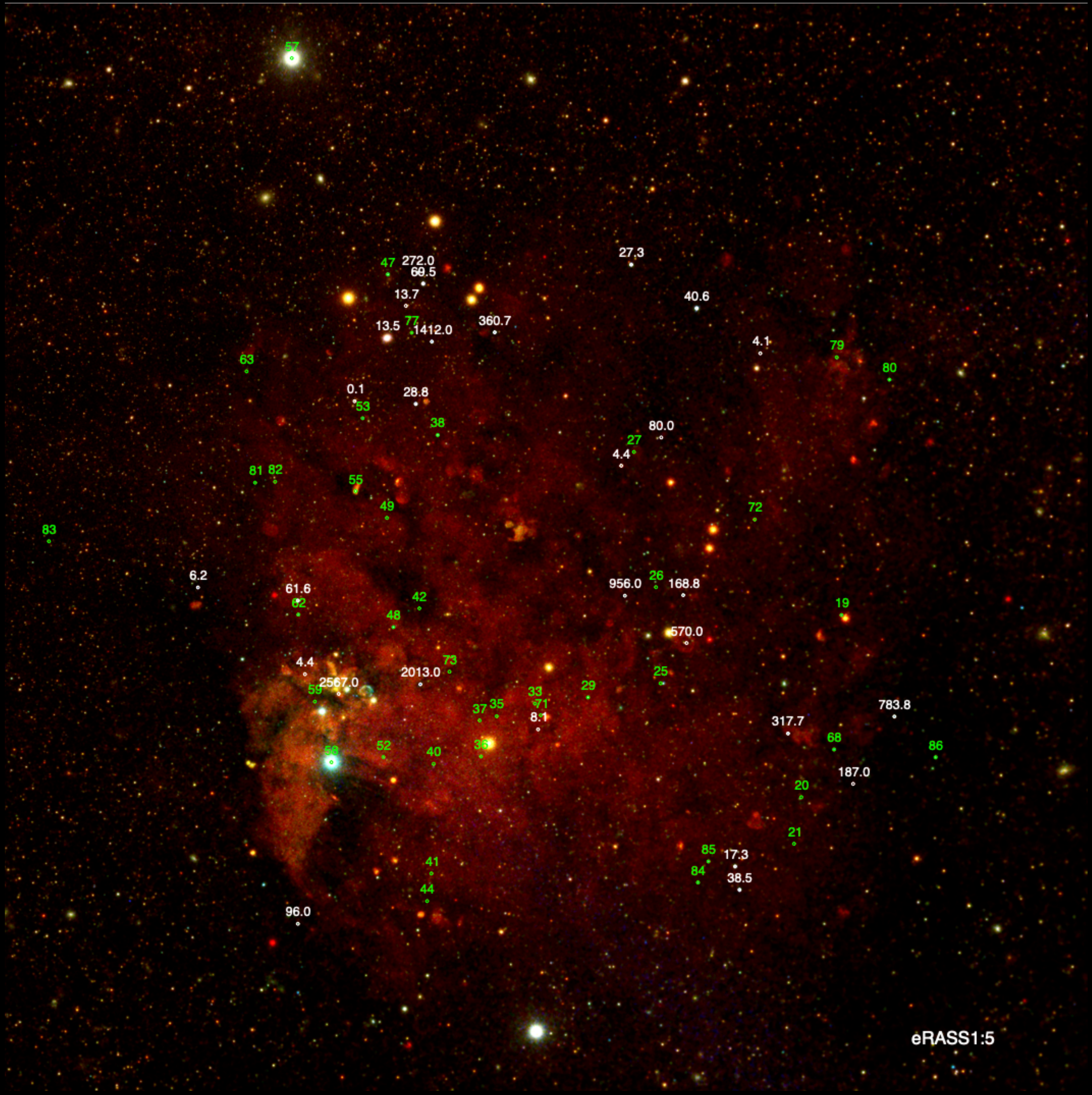


VMC

Optical/IR colors magnitude
Signature of Be disc
Optical variability - orbital period

DESI Legacy Imaging Surveys

Mapping the HMXBs in the LMC

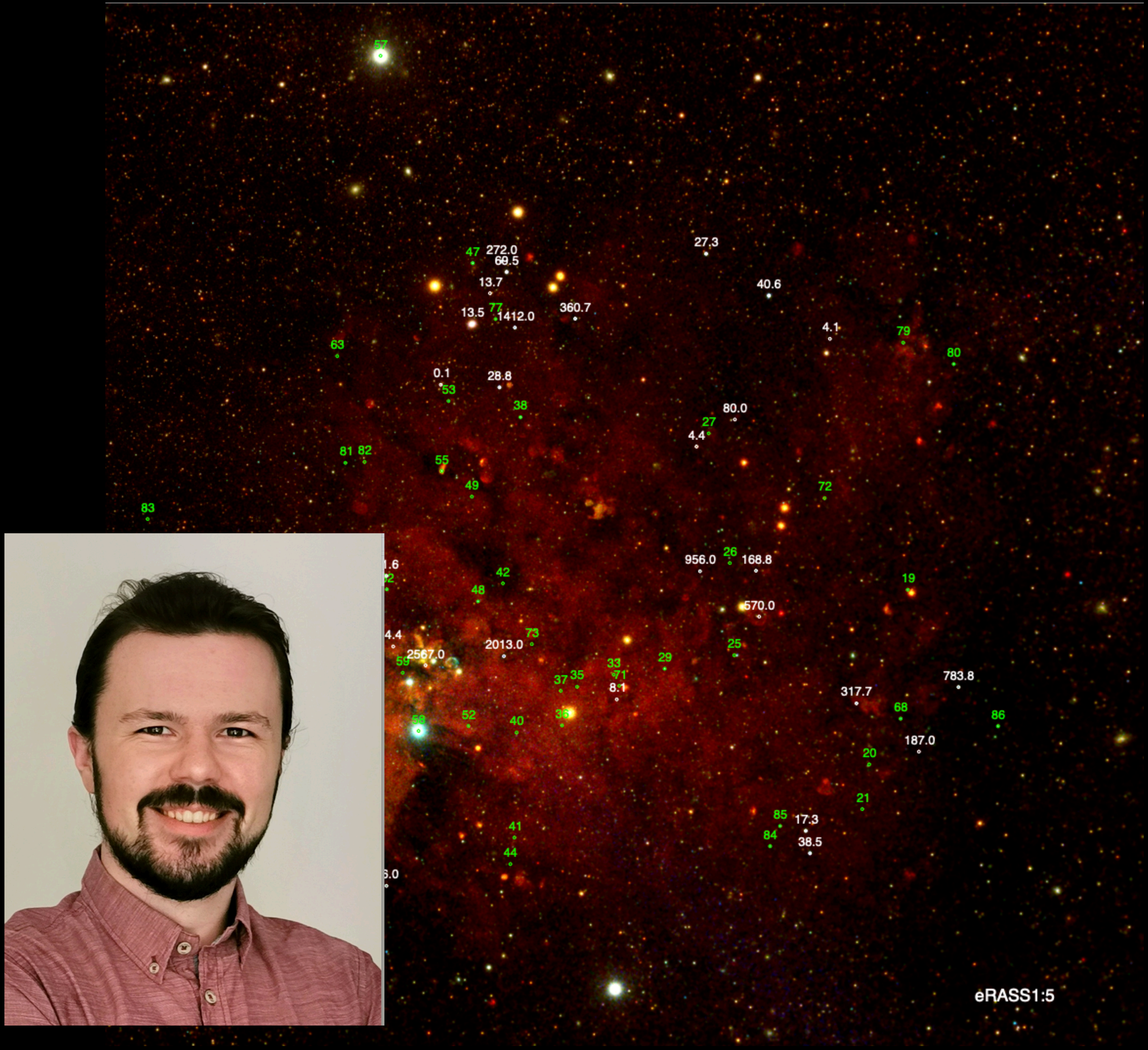


28 pulsars, total 73 HMXBs

- eROSITA will provide the complete and systematic study of the X-ray sources down to **Lx ~10^{33} erg/s** (near SEP) for the first time in the LMC
- The high observation cadence of the MCS provided by eROSITA will allow the study of long-term X-ray variability of these systems to probe the physics of accretion on massive stars
- Explore the relation between the HMXBs and the star formation history to systematically explore the differences in the stellar content of the clouds

# eRASS1	Source
19	Pulsars
7	Candidates
23 (10)	New*

Mapping the HMXBs in the LMC



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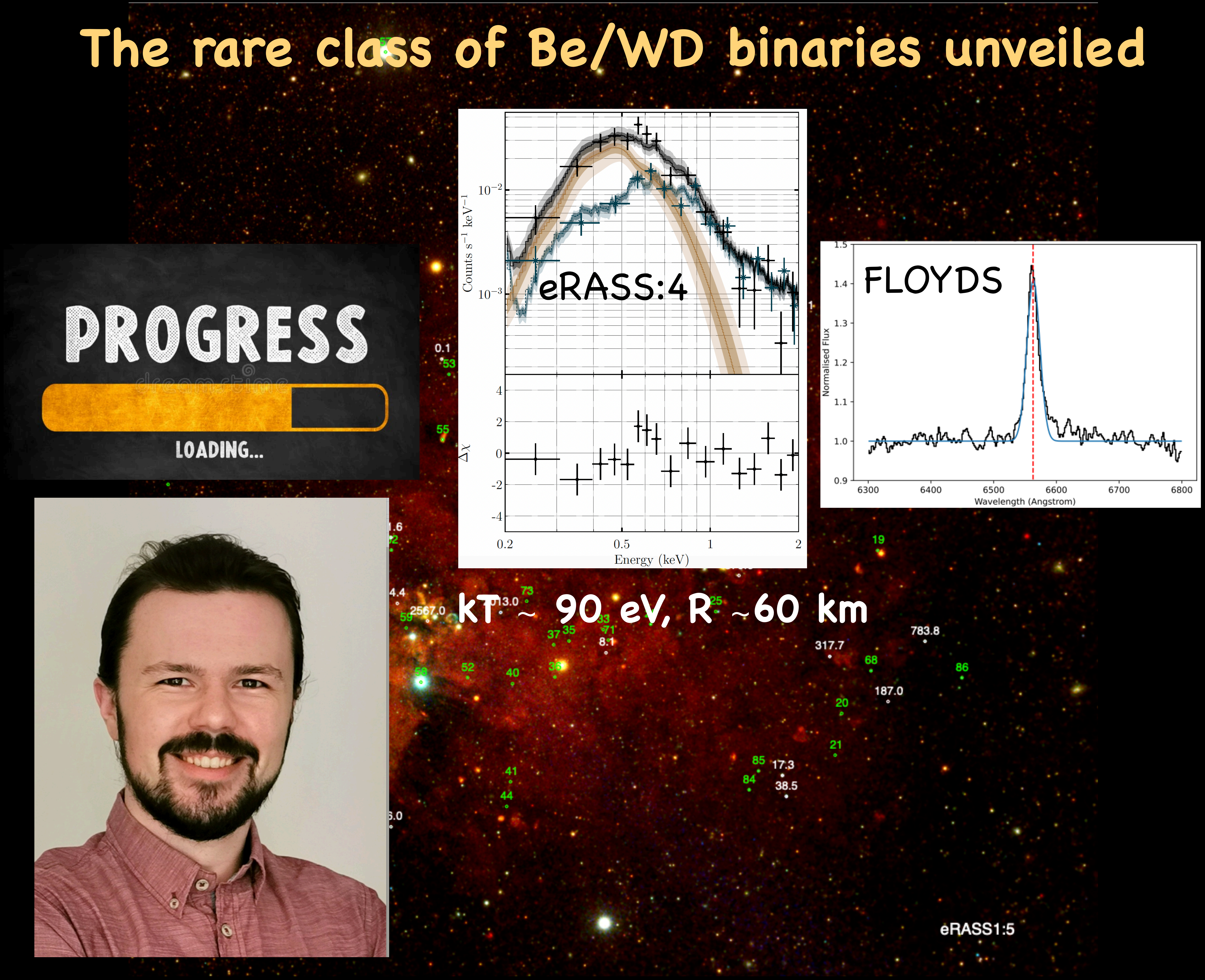
Kaltenbrunner, Maitra , Haberl et al, in prep

Mapping the HMXBs in the LMC

The rare class of Be/WD binaries unveiled



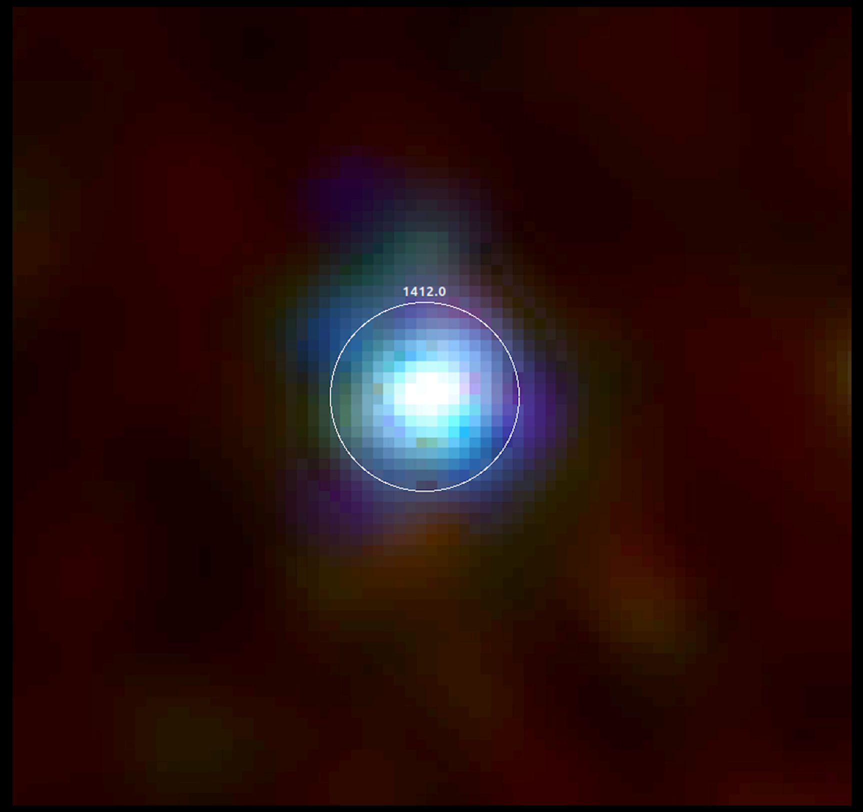
kT ~ 90 eV, R ~60 km

- 70% of Be stars are expected to have a WD companion (Raguzova 2001)
- Very few detected observationally
- Super-soft X-ray spectrum may be absorbed by circumstellar Be disk
- Handful of candidates in the Magellanic Clouds, 2 from eROSITA (Haberl et al 2021, ATel 13789)

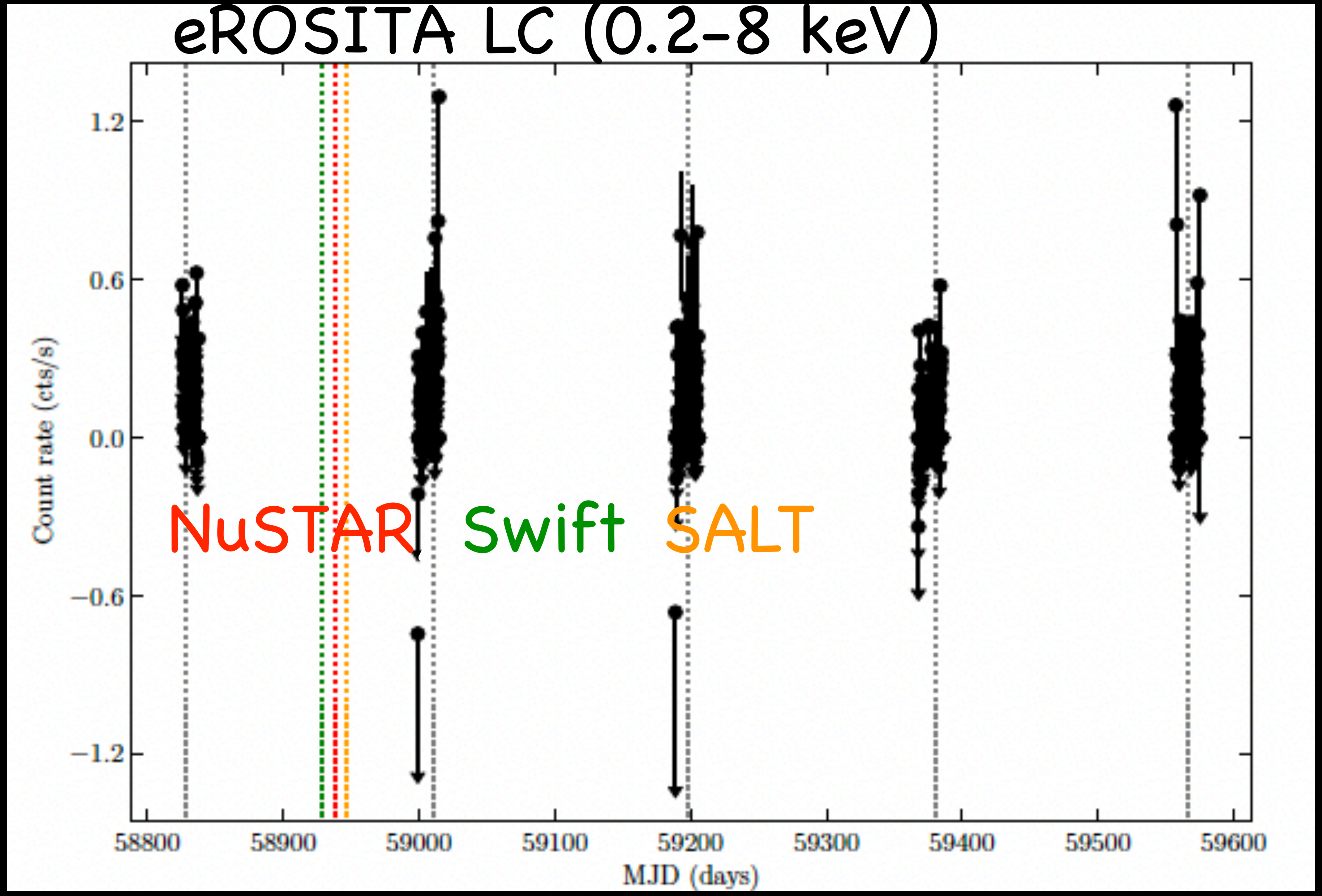
Poster #61

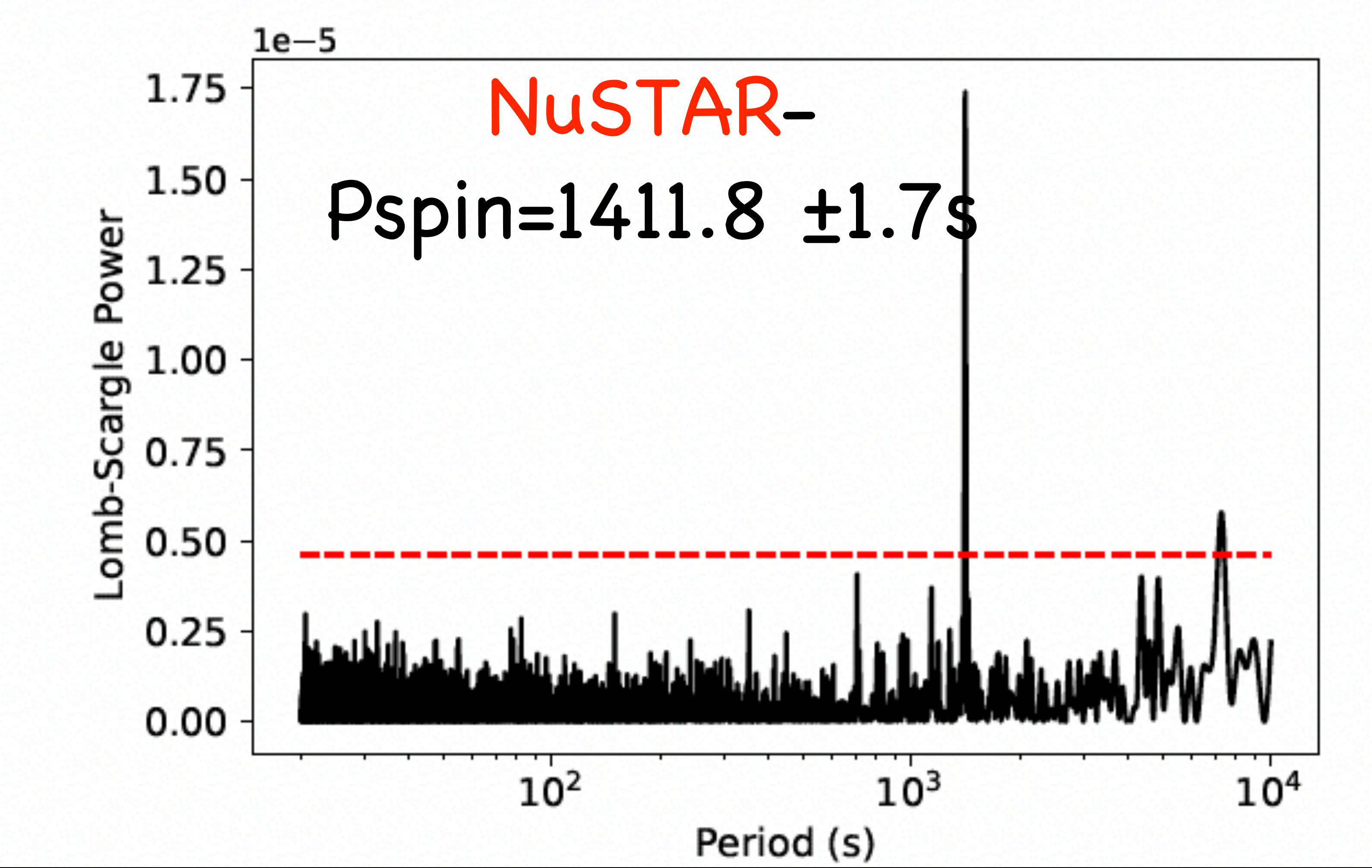
Kaltenbrunner, Maitra , Haberl et al, in prep

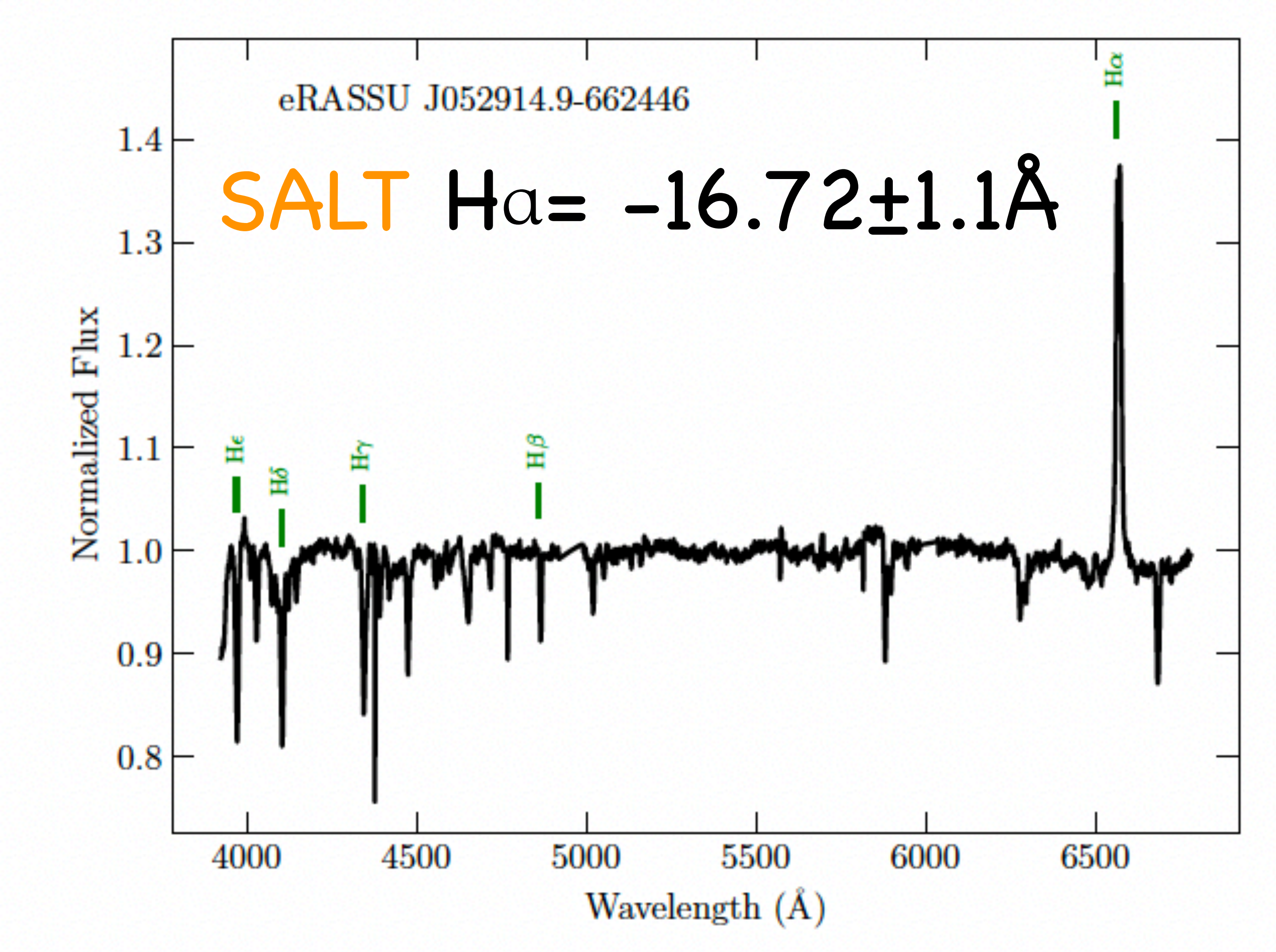
eRASSUJ052914.9-662446: a new BeXRB in the LMC

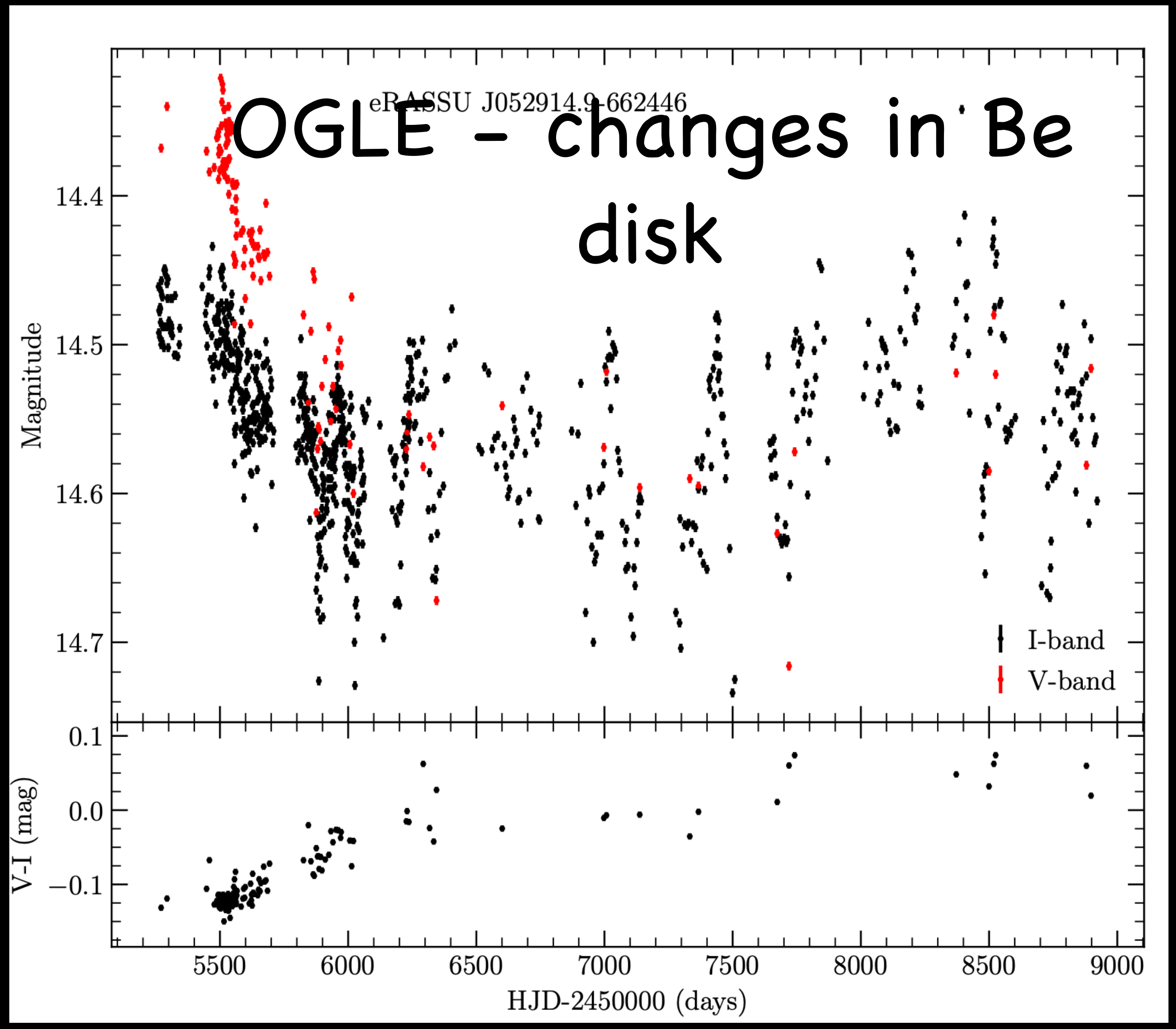


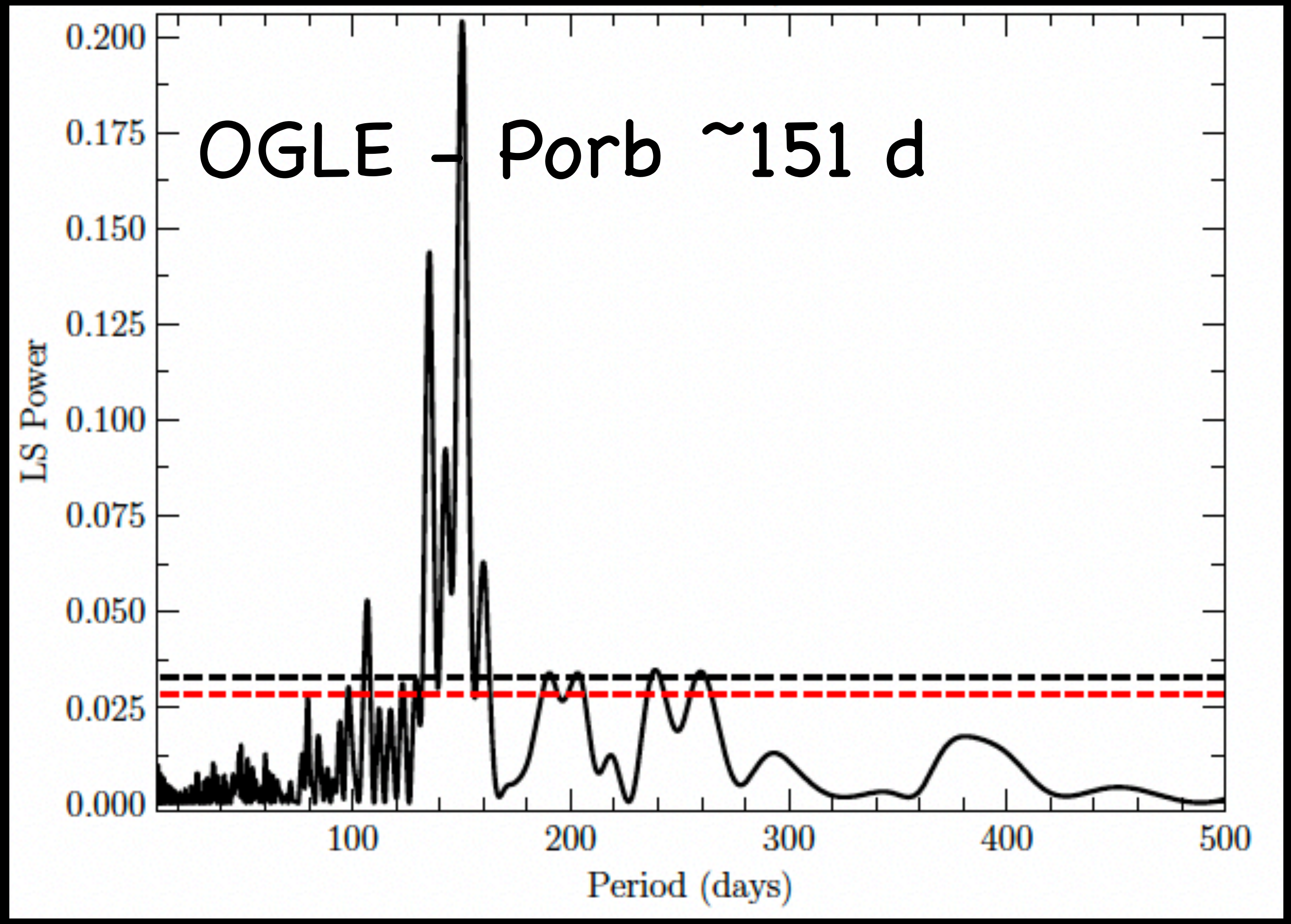
Scanned 13 days, 6 scans/day in each eRASS – 5.5 ks total





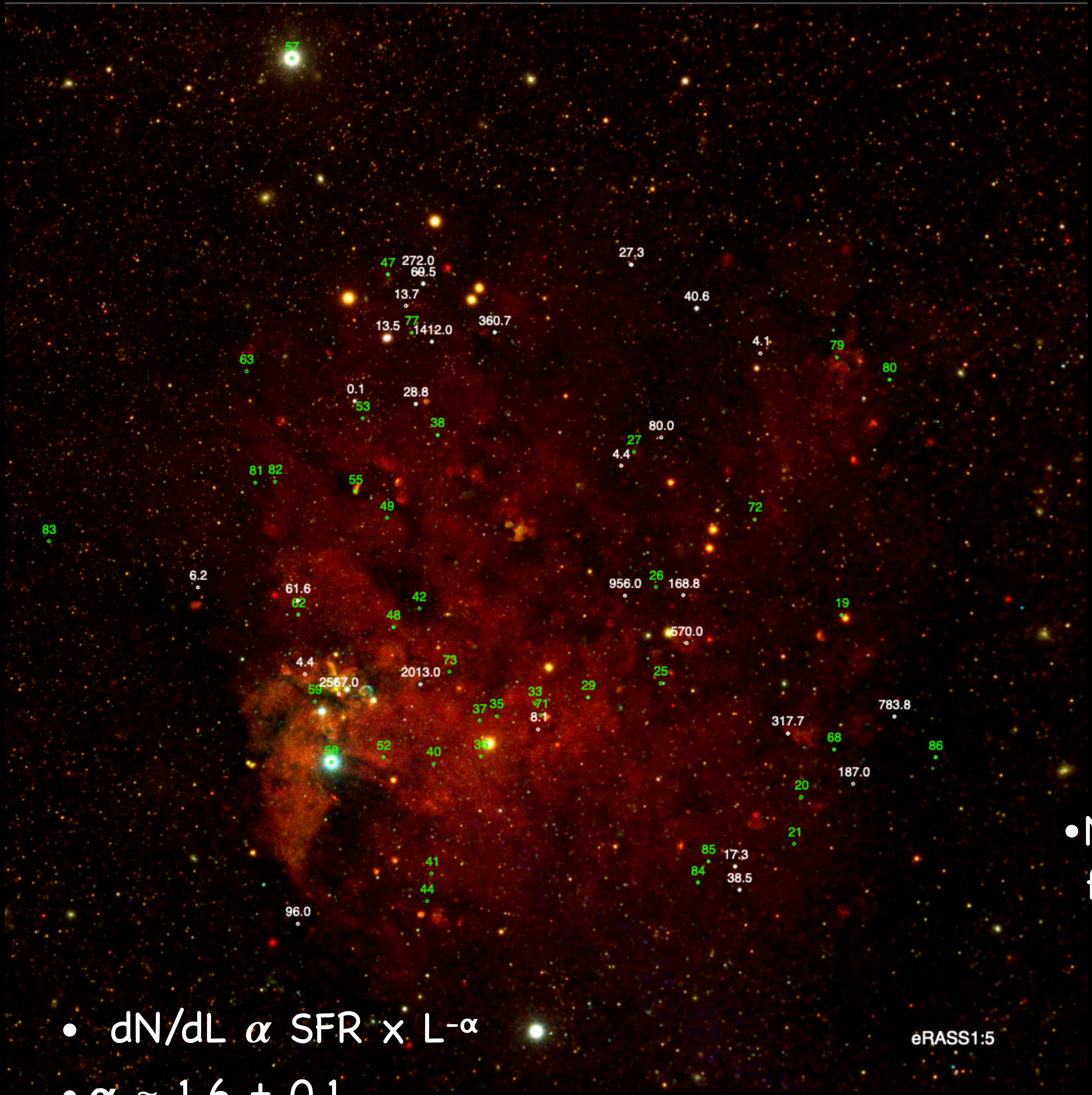


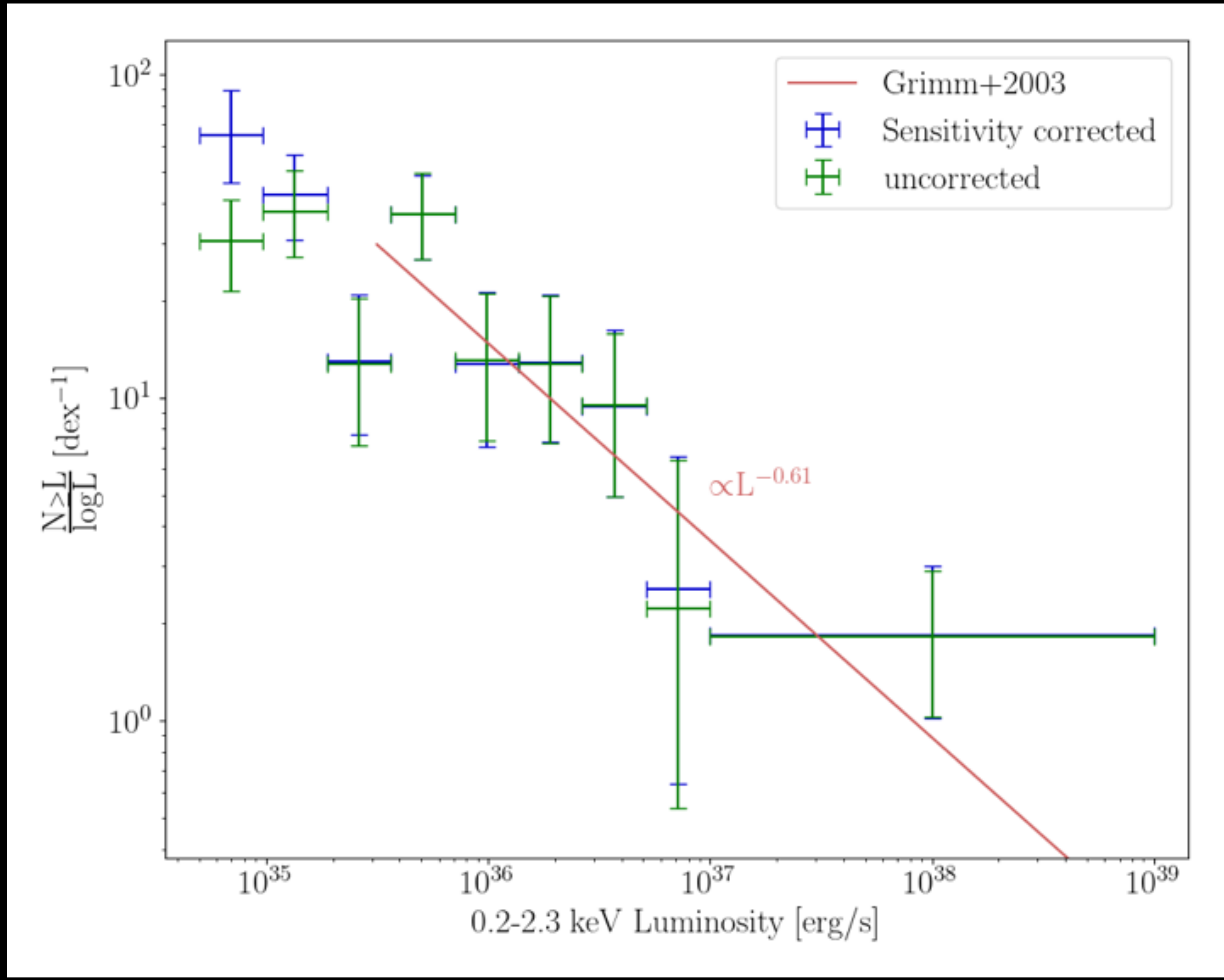




Maitra et al. 2023, A&A, 669, A30

Population studies - Luminosity function





- dN/dL α SFR x $L^{-\alpha}$
- $\alpha \simeq 1.6 \pm 0.1$

- Normalization proportional to the star formation rate (Grimm+2003)

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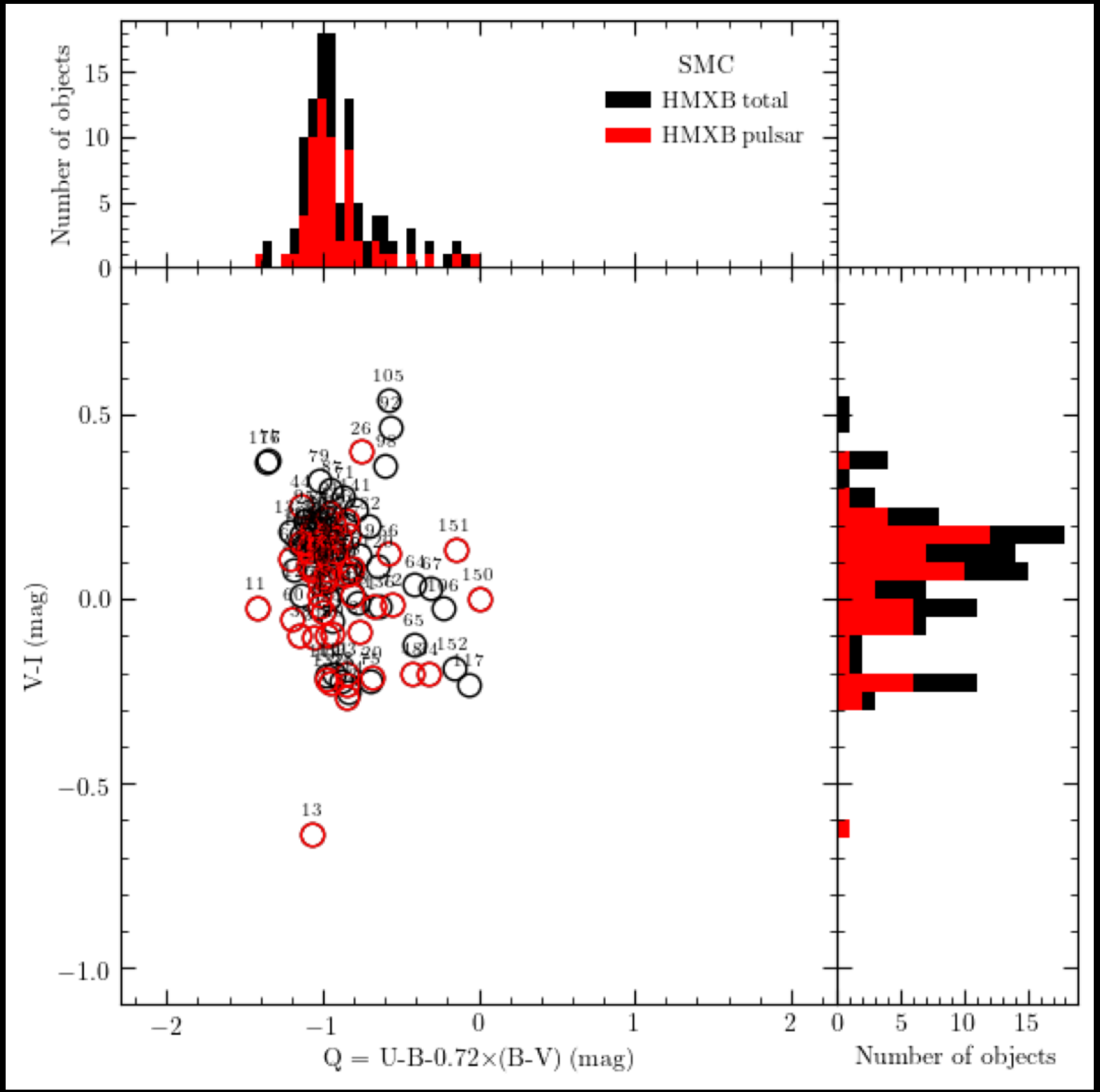
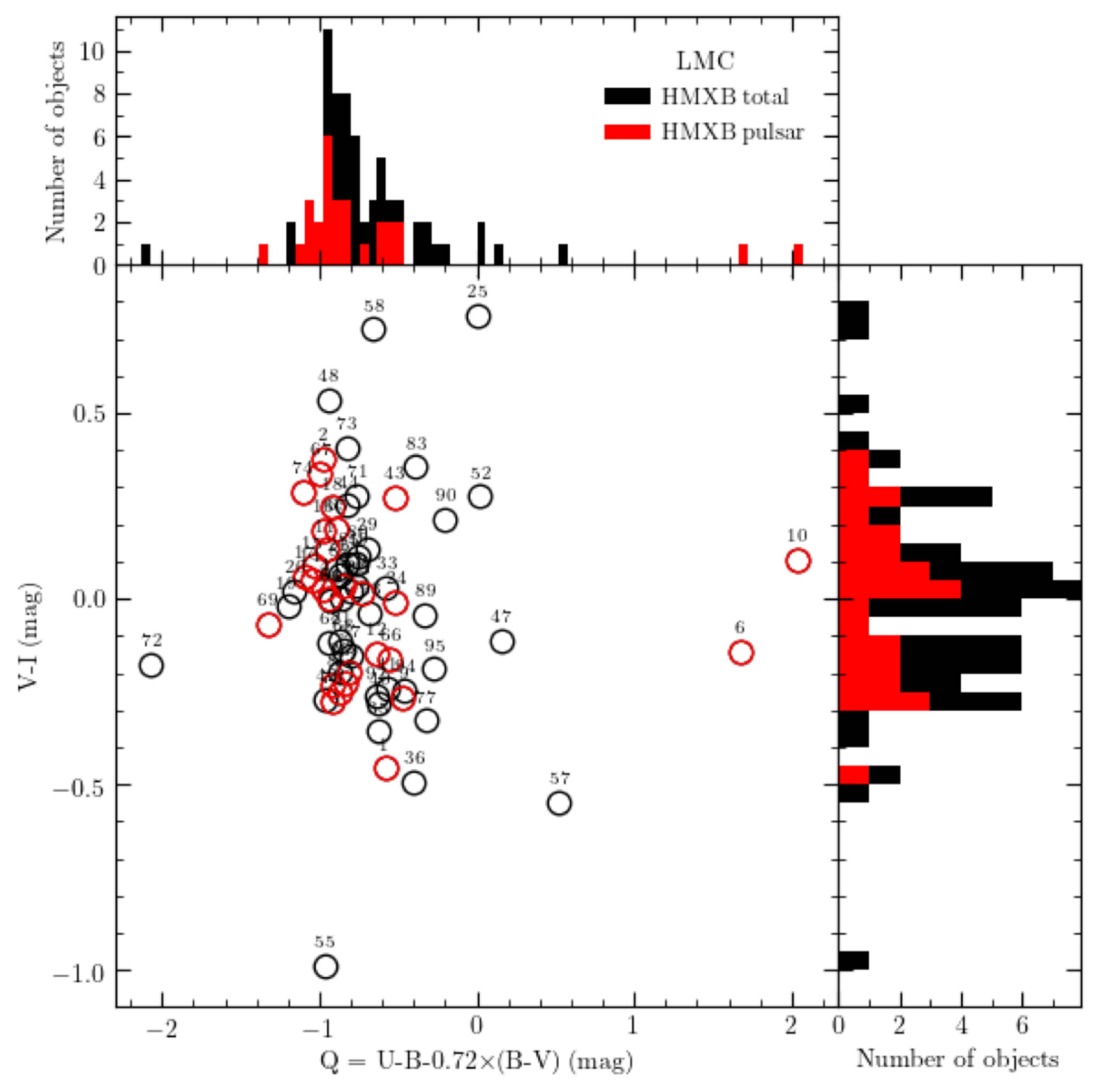
HMXB population comparison between SMC & LMC

Optical counterparts of HMXBs - spectral types



Narrow distribution of Q value in SMC (Haberl & Sturm 2016) - Result of small range of spectral types (McBride et al. 2008). Except one, all SMC counterparts are Be stars



#10 - IGR J05007-7047, O9Ve, Q=2.04

#6 -LMC X-4, O8III, Q=1.67

#72 -eRASSU J050213.8-674620, Be/WD

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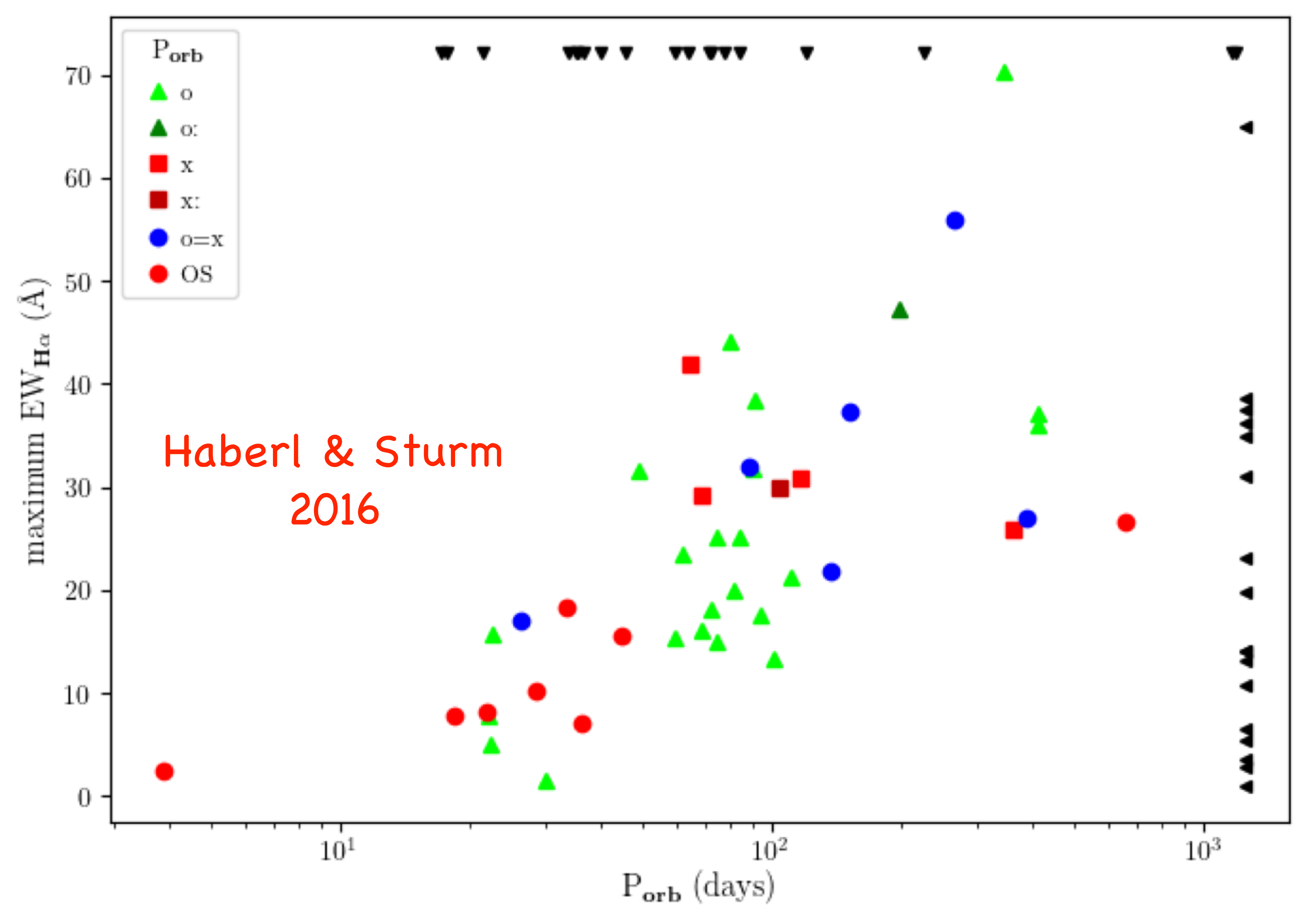
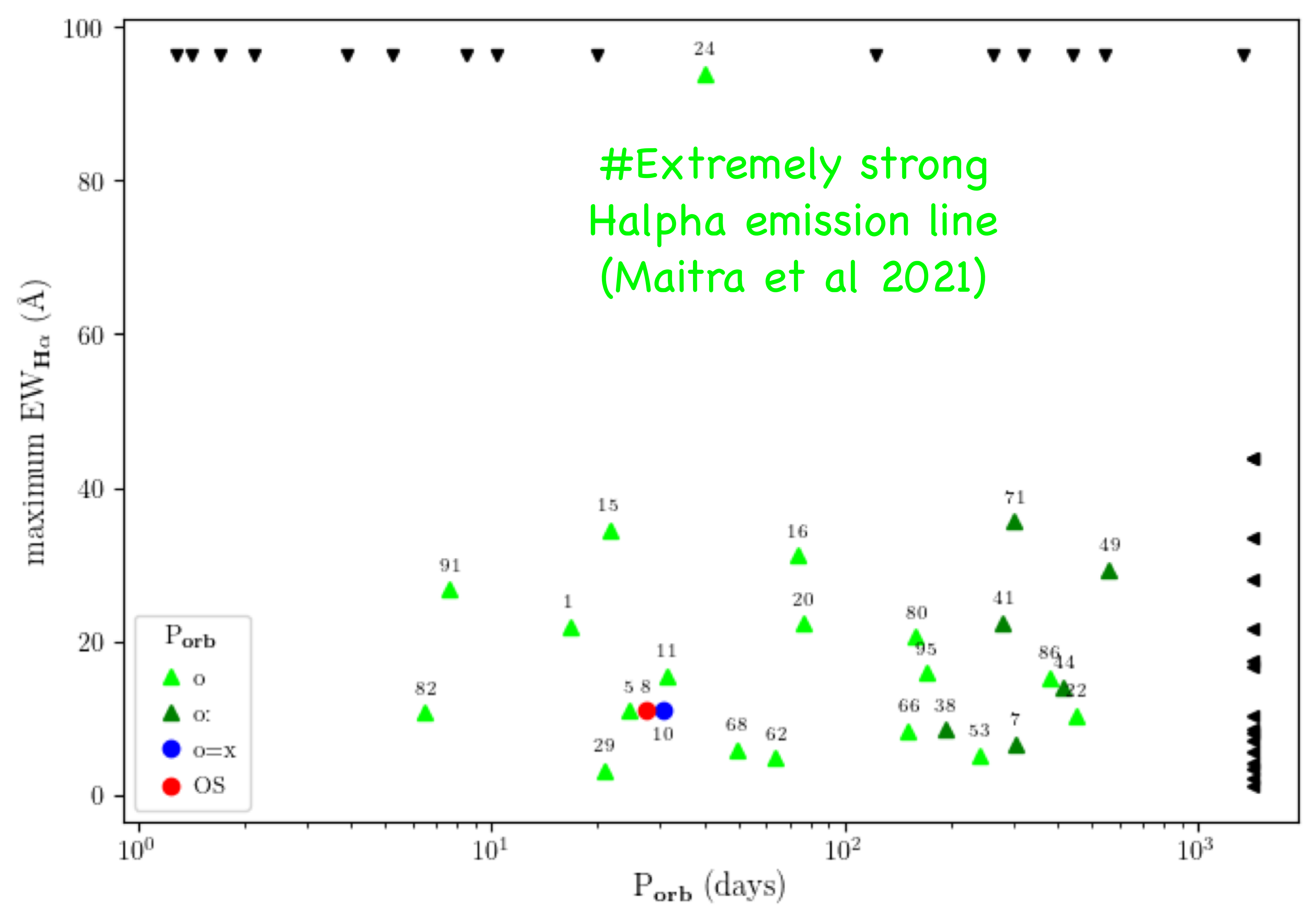
HMXB population comparison between SMC & LMC

Optical counterparts of HMXBs –disc truncation





Correlation between the orbital period and the strength of the Hα line in Galactic & SMC Be/X-ray binaries.

The neutron star appears to prevent the formation of an extended disk in systems with short orbital period (Reig et al. 1997).

Correlation also present in the SMC: Coe & Kirk (2015), Haberl & Sturm (2016)

Kaltenbrunner, Maitra , Haberl et al, in prep

eRASS view of the XRBs in the Magellanic Clouds

eRASS:4

Median Lx ~ 8×10^{33} erg/s

Minimum flux ~ x10 lower

Probing low Lx, quiescent XRB population, constraining the XLF especially at faintest end

Population studies

Correlation with star formation history & determination of formation efficiency of XRBs

Key science questions

Comparison LMC – SMC – Milky Way
spectral types, Be-disc/ Orbits, spin period

Serendipitous discoveries

THANK YOU
Questions, suggestions?

cmaitra@mpe.mpg.de