Optical spectroscopy of eROSITA AGN

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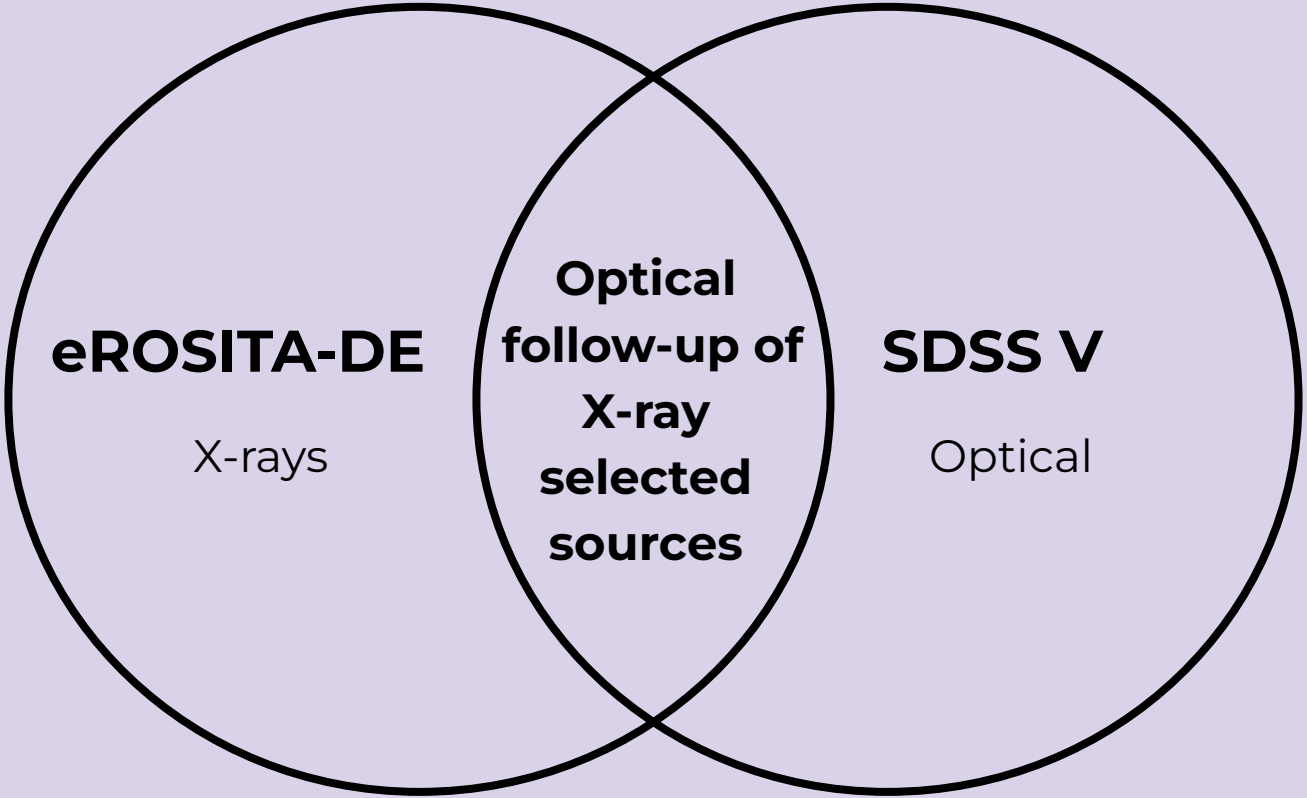
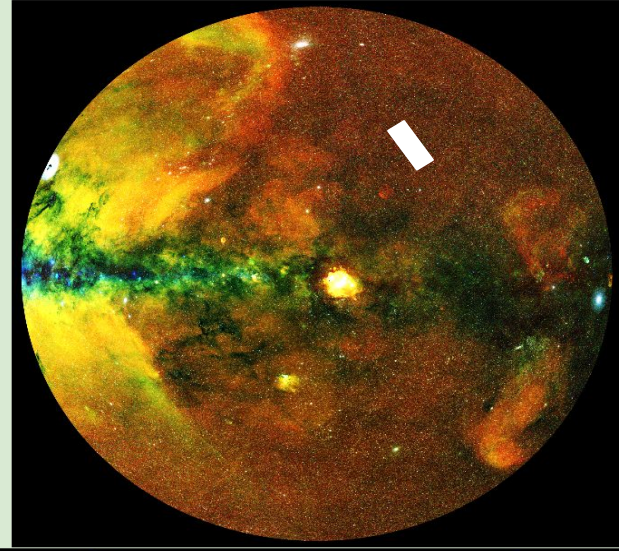

eROSITA-DE
X-rays
Optical follow-up of X-ray selected sources
SDSS V
Optical

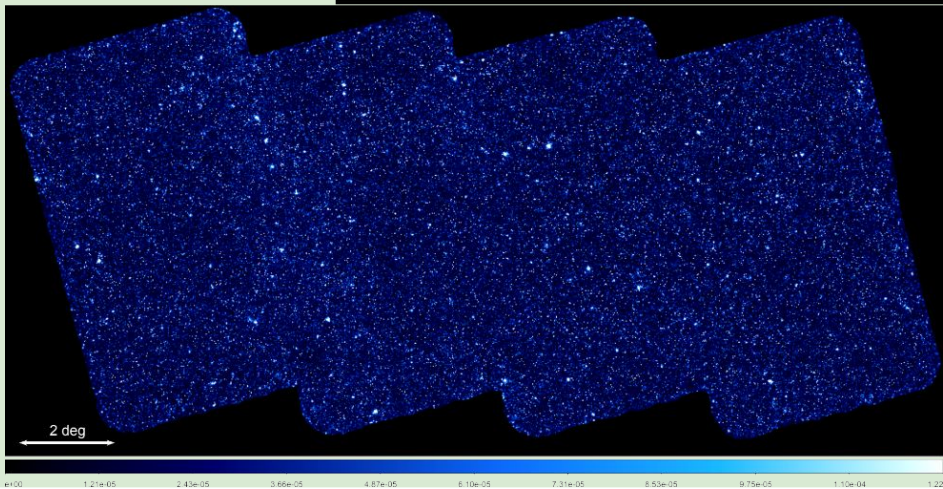
SPIDERS

- eROSITA & SDSS
  - **Sp**ectroscopic **Id**entification of X-ray selected sources from the **eR**OSITA All Sky **S**urvey
- AGN demographics
- Catalog of optical spectral analysis for X-ray emitting objects
  - Characterization of continuum, emission and absorption lines
  - Obtain physical quantities from optical spectra
  - Search for correlations between optical and X-ray features

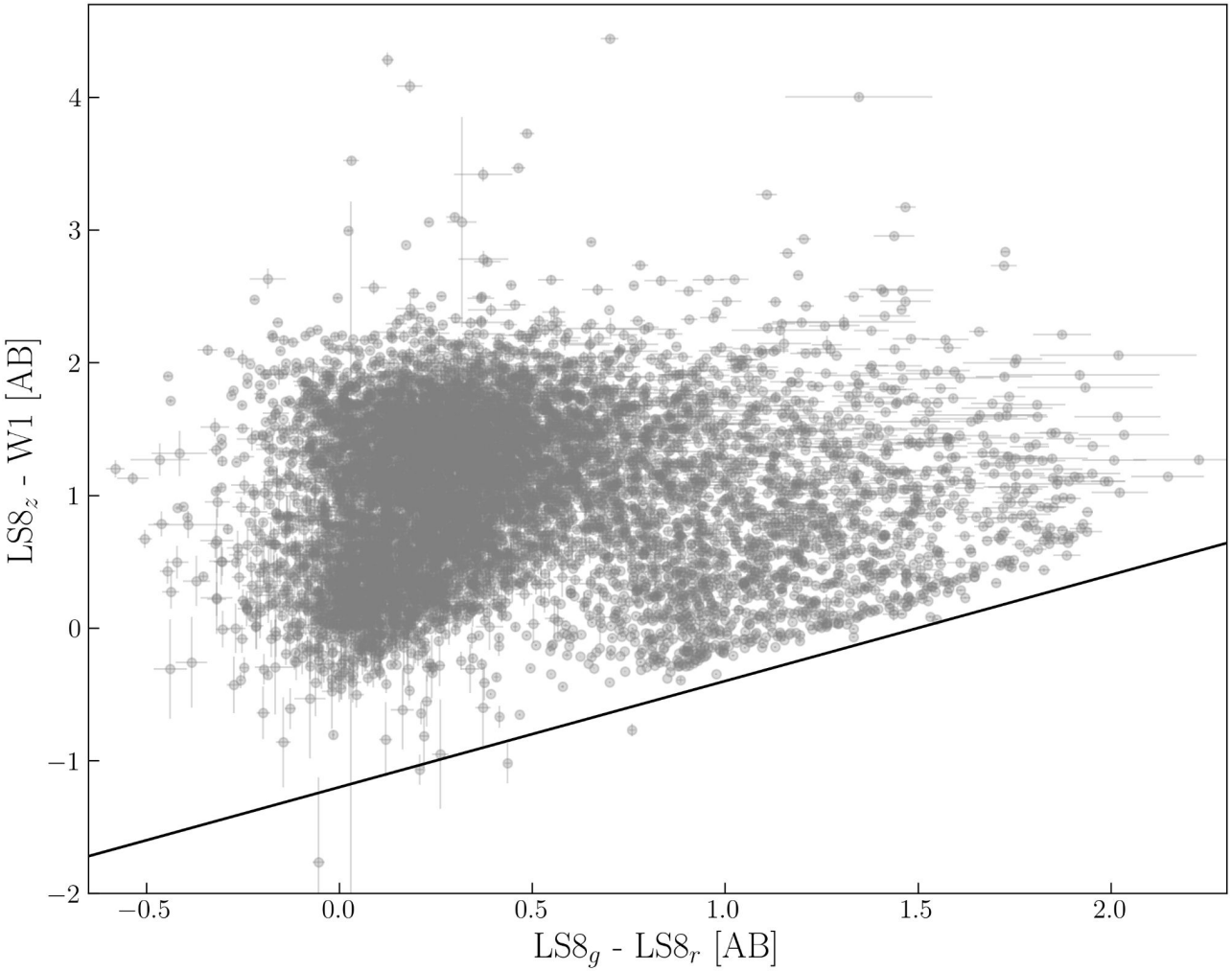
eFEDS Sample

- eROSITA Final Equatorial-Depth Survey
  - ~28k X-ray sources
  - ~13k SPIDERS sources (with redshifts)
  - Brunner et al. 2022; Salvato et al. 2022
- Reliable visually inspected redshift
- Exclude cluster members and Galactic objects
- Automatize spectral fits
  - 10 404 spectra





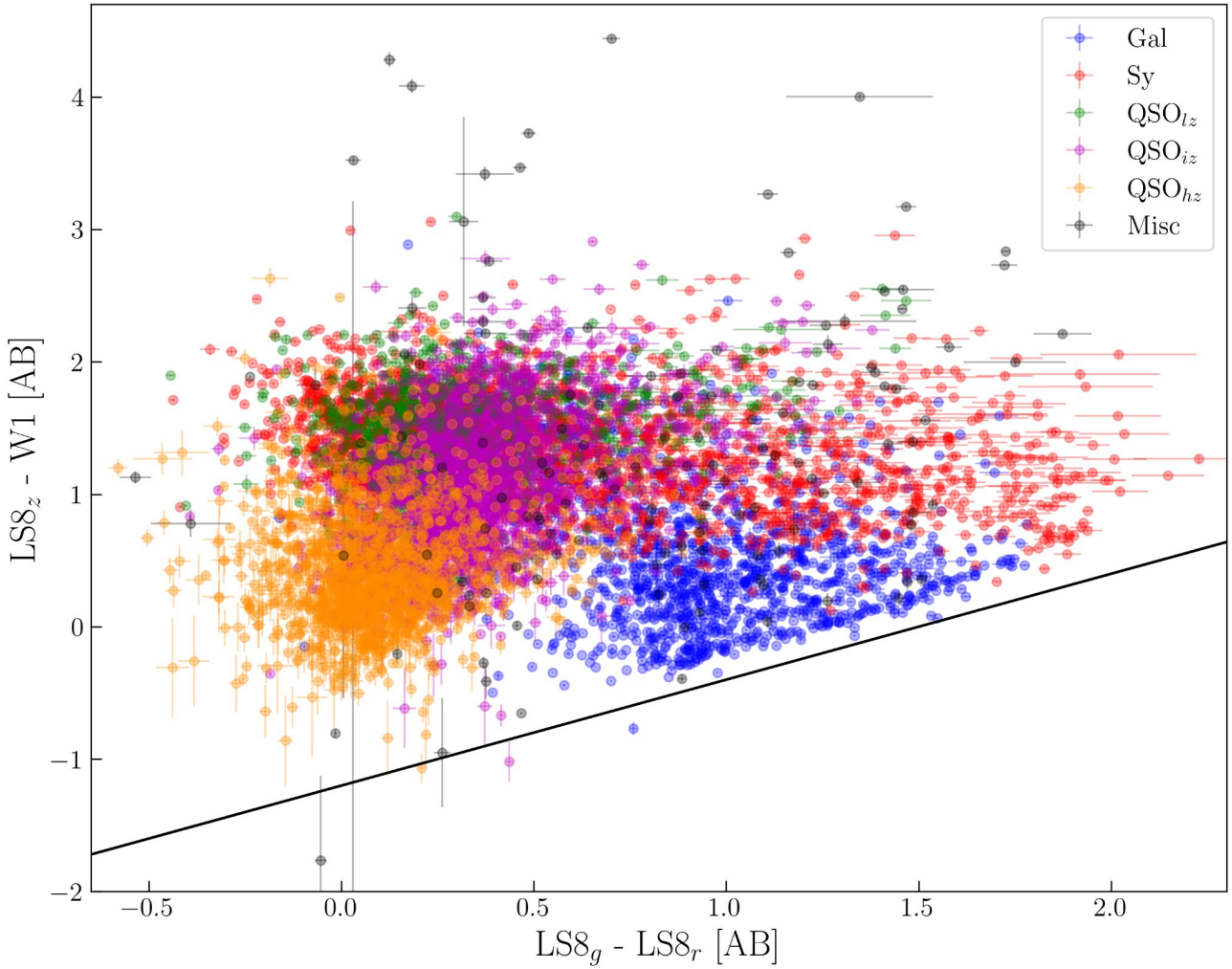
General properties



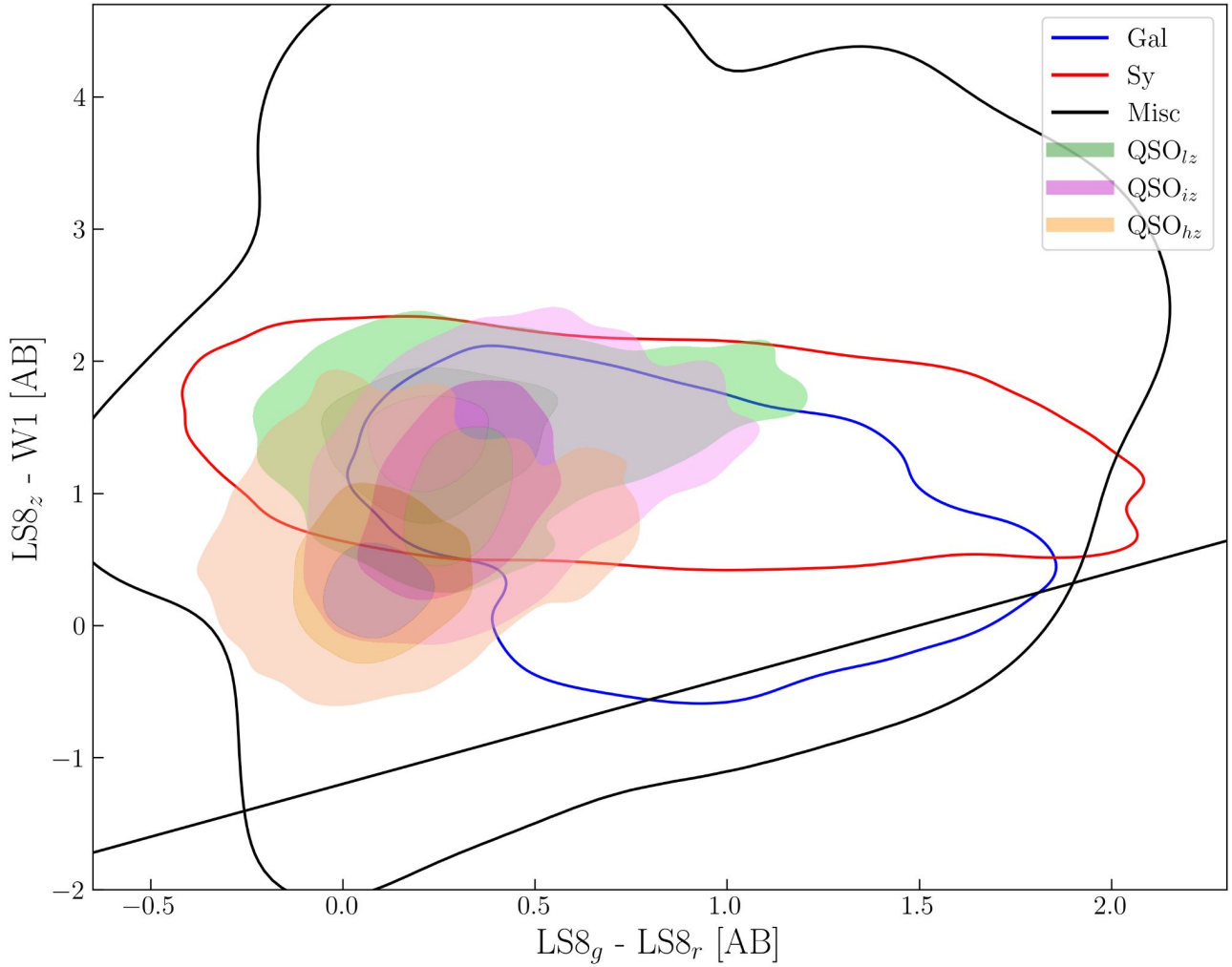
Clustering via STAREX (Shashwat Tiwari) to distinguish populations

See Salvato+22

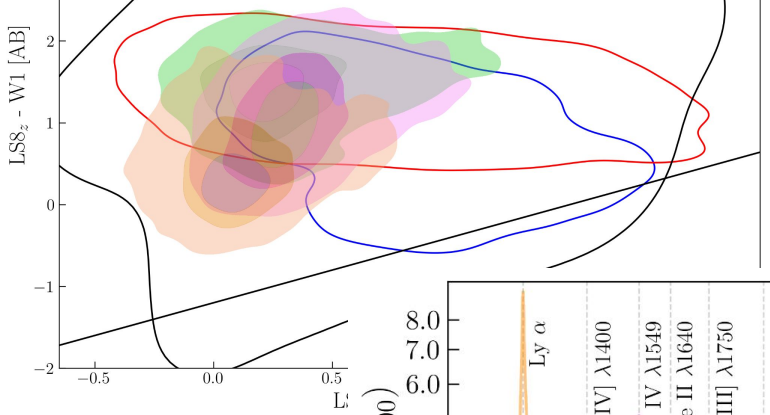
General properties



Classification based on redshift and color

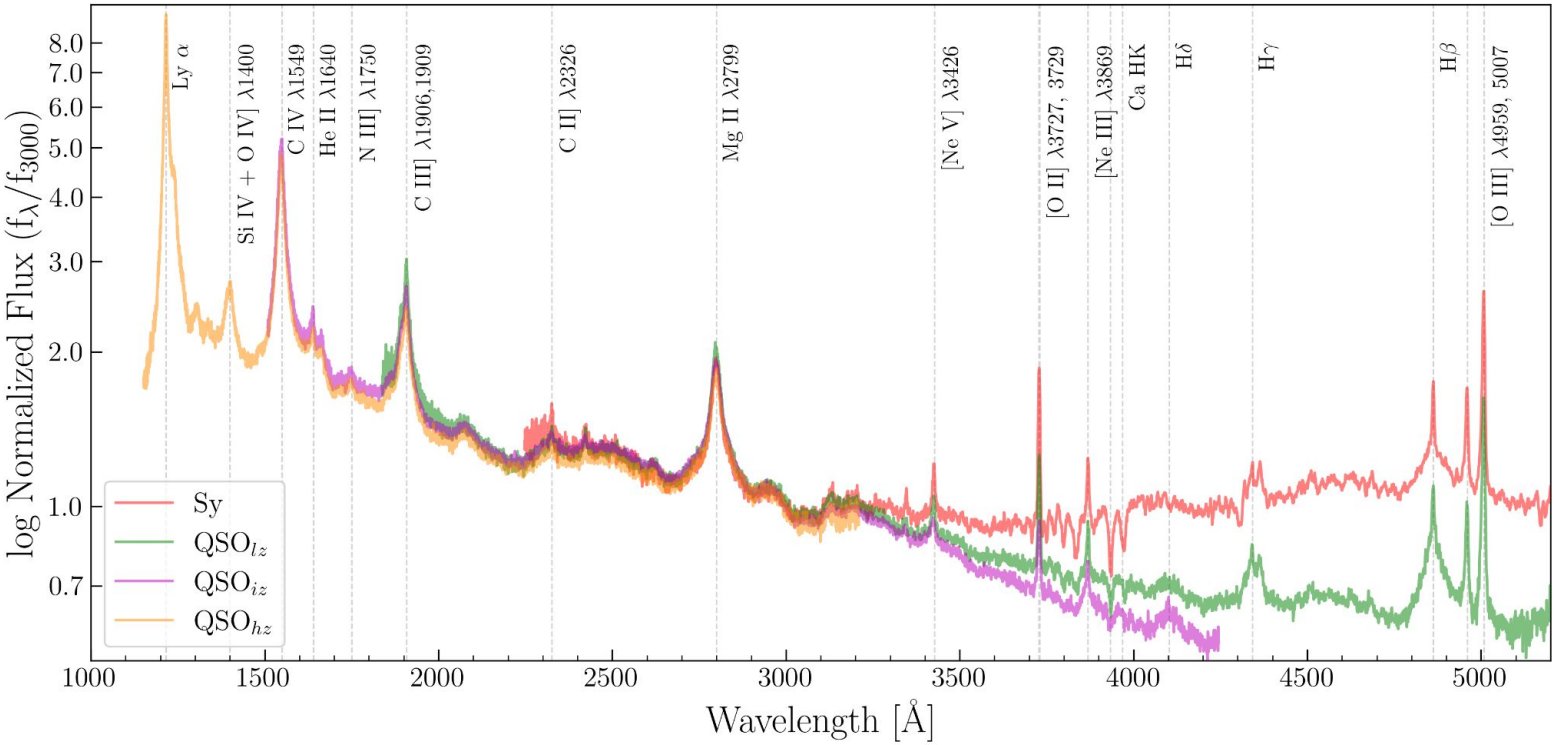


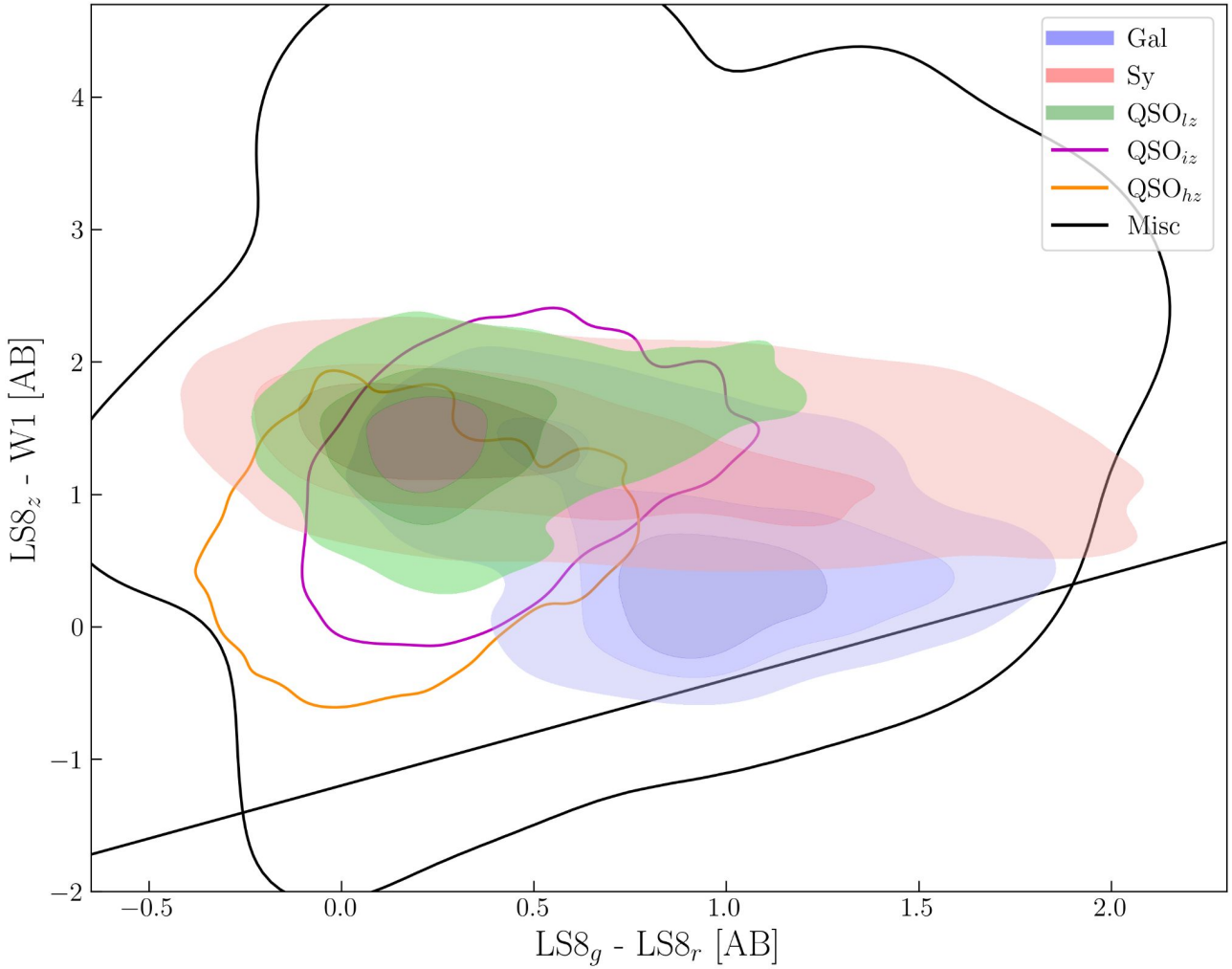
Higher redshift



Higher redshift

Stacking of the spectra with similar redshift and colors

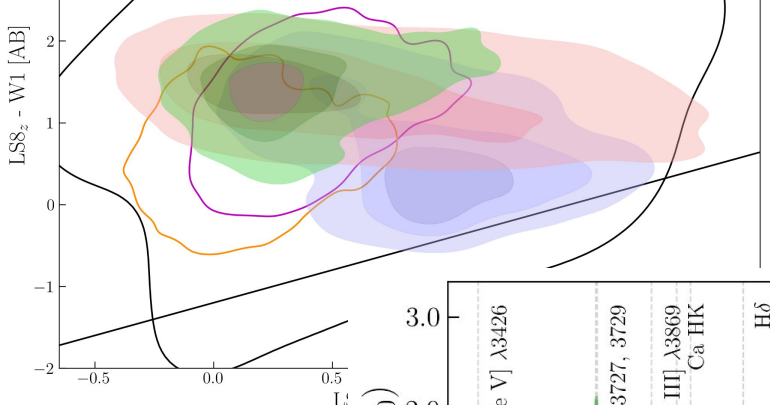




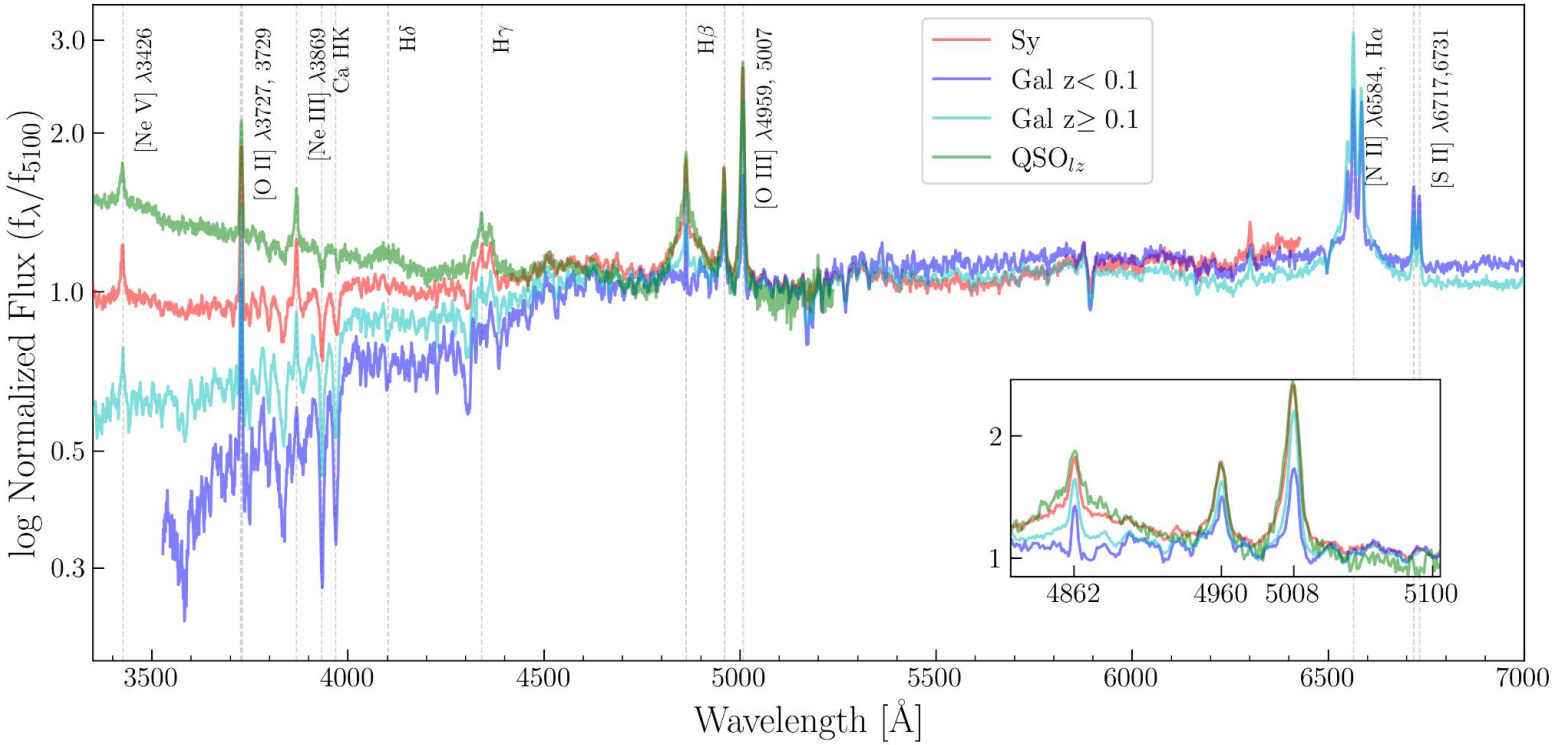
Lower redshift

Aydar et al. (in prep)

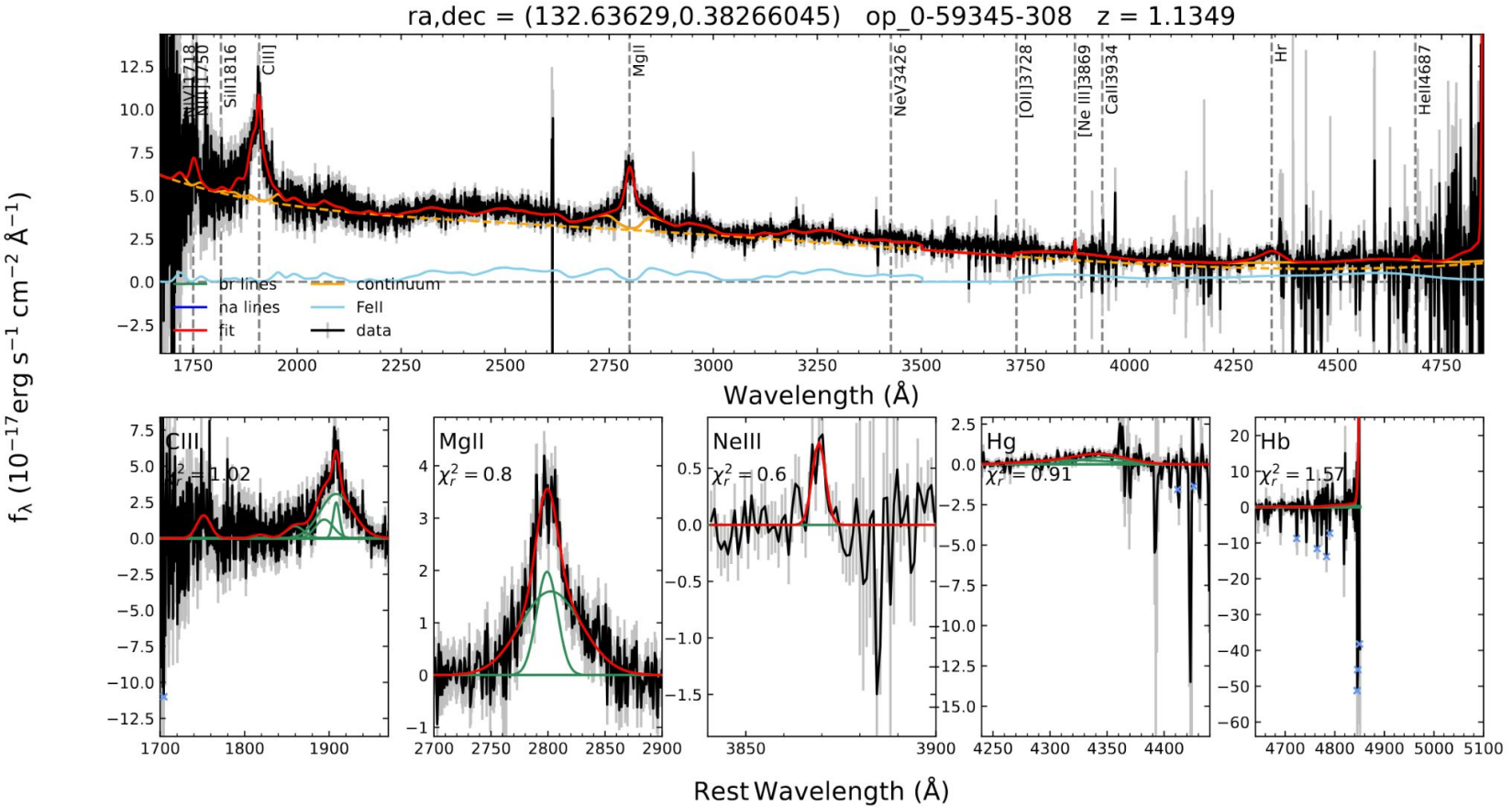
Lower redshift



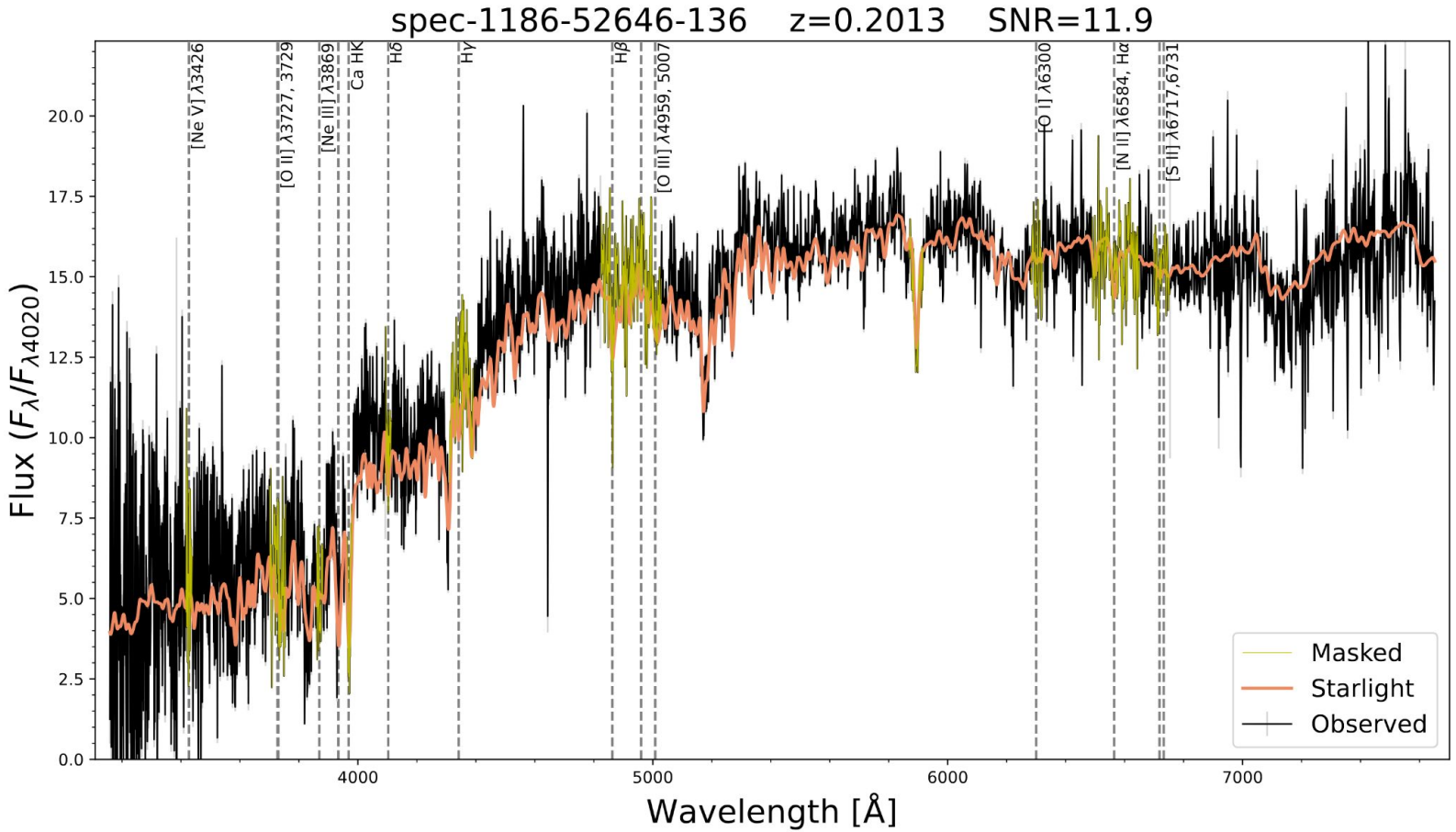
Stacking of the spectra with similar redshift and colors



Individual spectra - QSO dominated

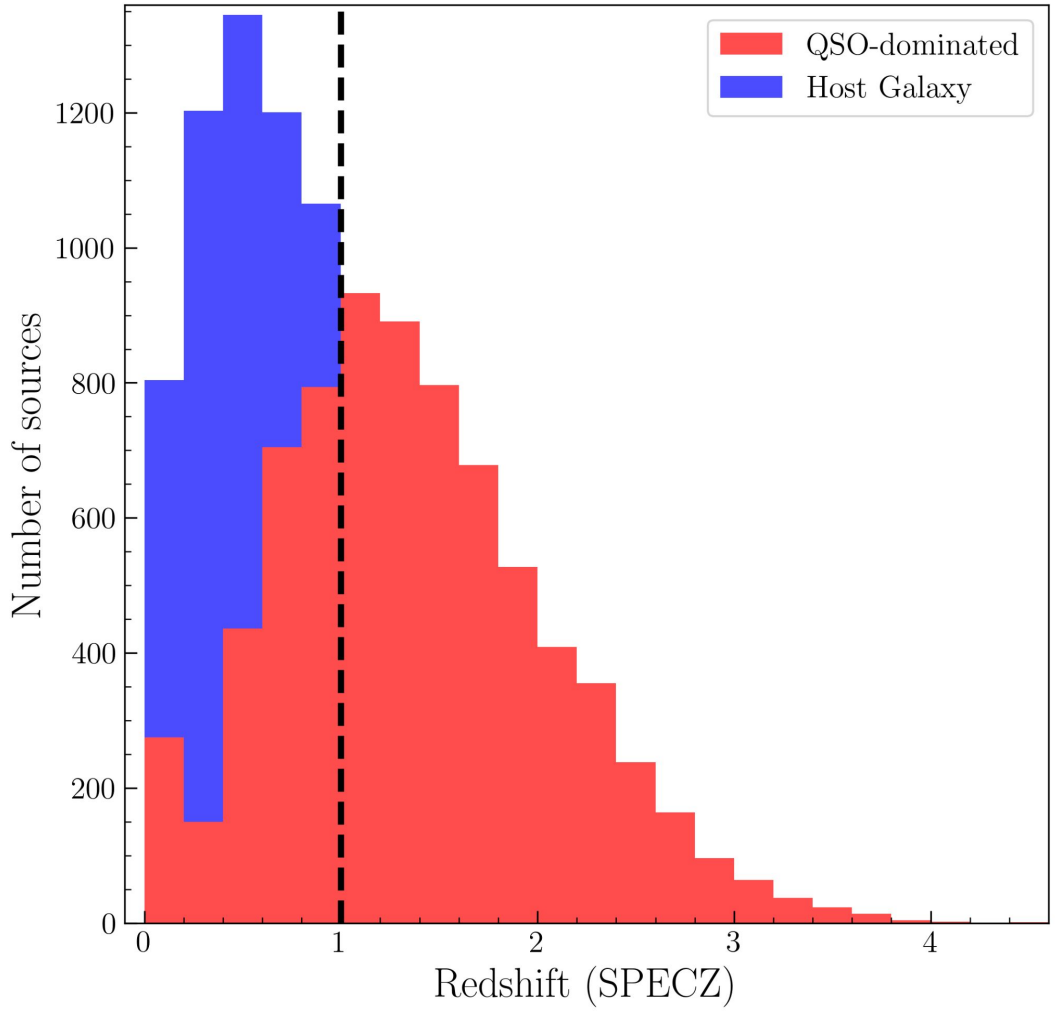


Individual spectra - Host-galaxy dominated



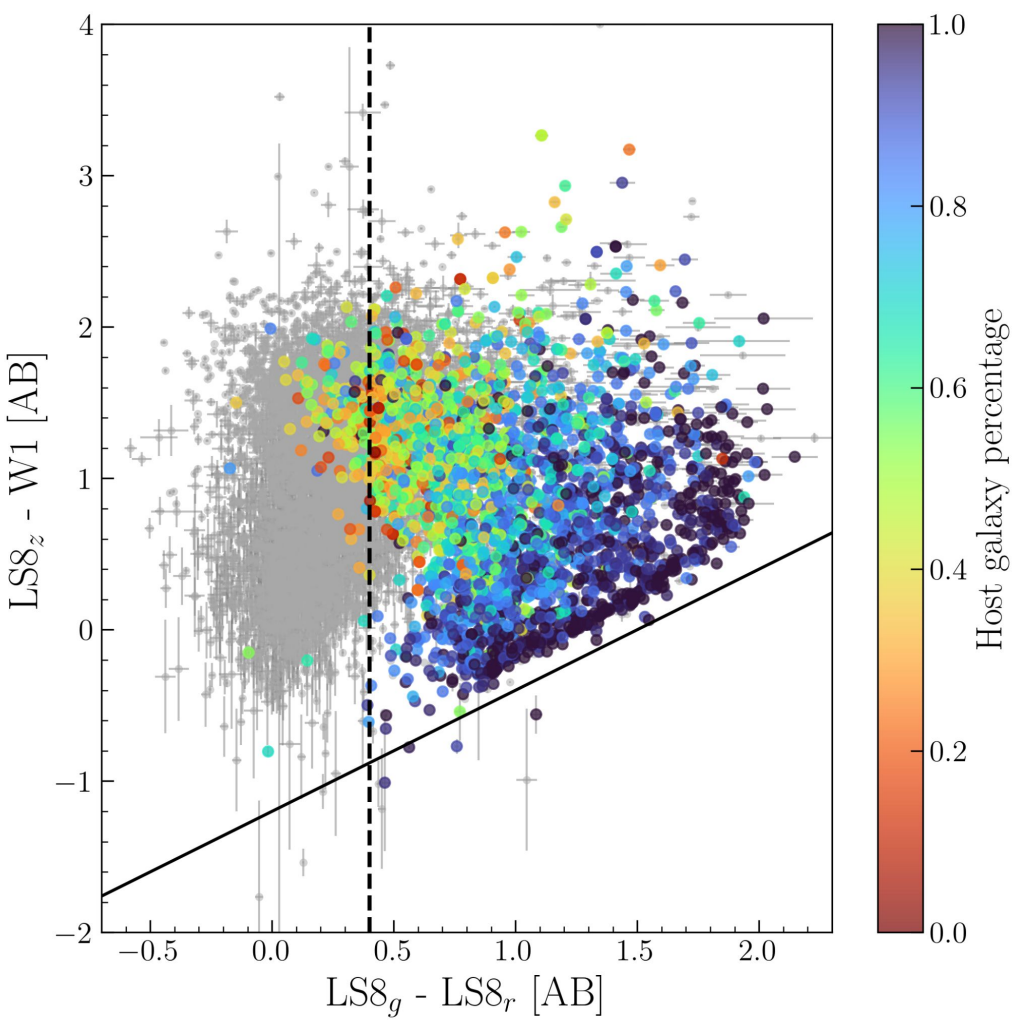
Individual spectral properties

- **QSO-dominated spectra**
  - **z>1**
  -
  - 7 226 spectra
  - PyQSOFit
- **Host galaxy**
  -
  -
  - 3 178 spectra
  - STARLIGHT+PyQSOFit

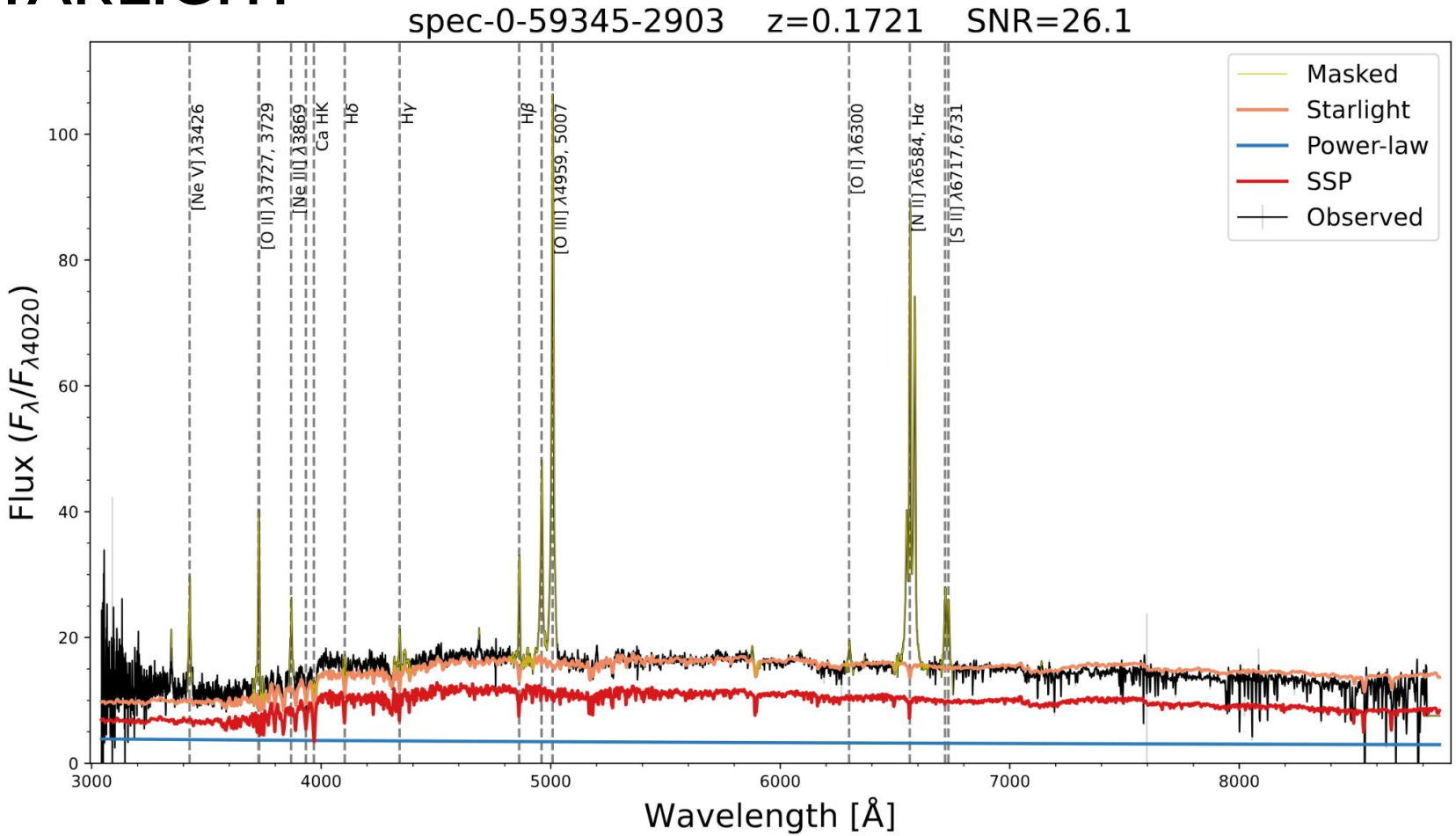


Individual spectral properties

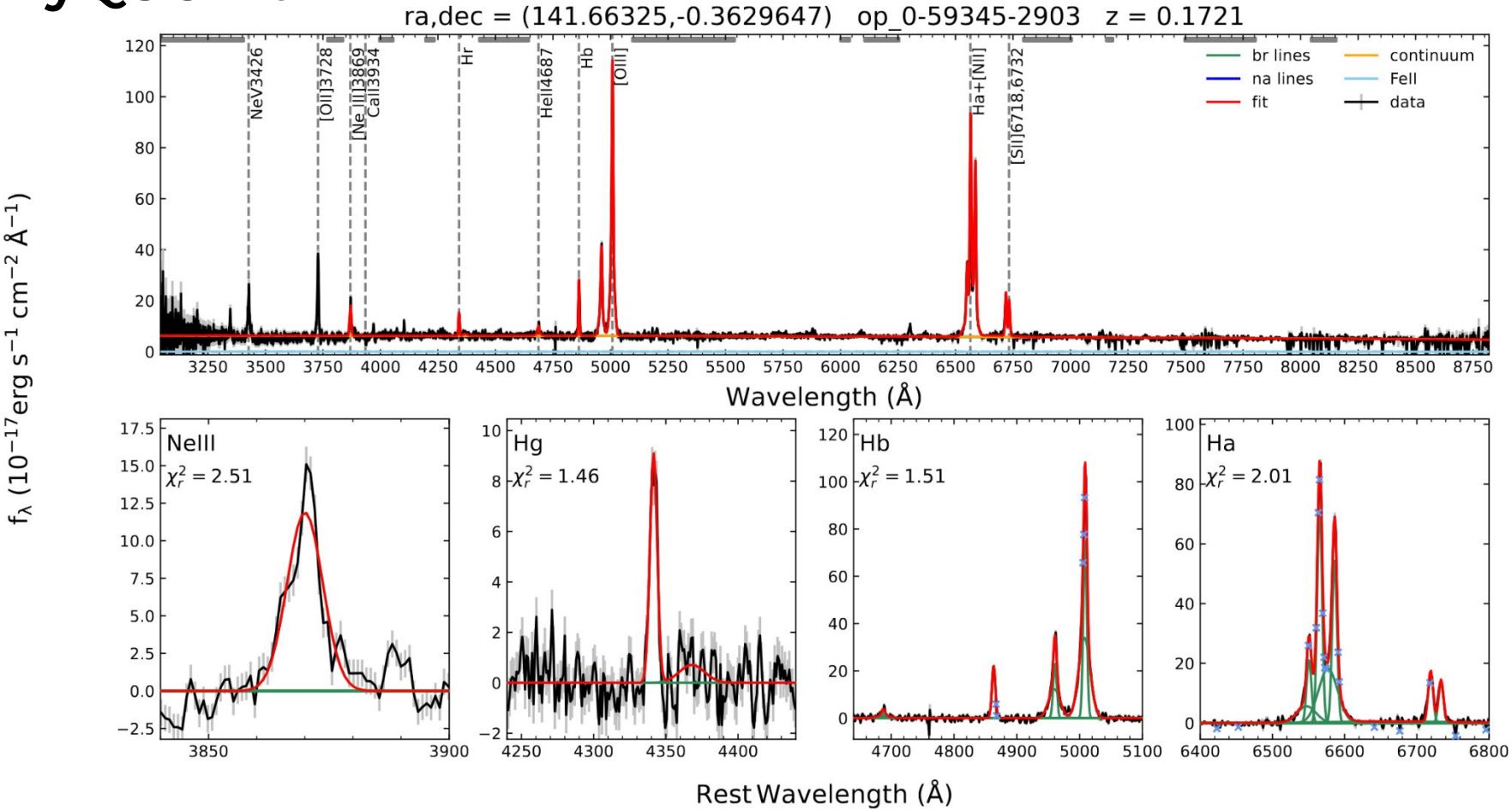
- **QSO-dominated spectra**
  - z>1
  - **Point-like sources with g-r<0.4**
  - 7 226 spectra
  - PyQSOFit
- **Host galaxy**
  - **Extended sources (LS8)**
  - **Point-like sources with g-r>0.4**
  - 3 178 spectra
  - STARLIGHT+PyQSOFit



STARLIGHT


spec-0-59345-2903 z=0.1721 SNR=26.1
Masked
Starlight
Power-law
SSP
Observed
[Ne V] λ3426
[O II] λ3727, 3729
[Ne III] λ3869
Ca HK
Hδ
Hγ
Hβ
[O III] λ4959, 5007
[O I] λ6300
[N II] λ6584, Hα
[S II] λ6717,6731
Flux ($F_\lambda/F_{\lambda 4020}$)
Wavelength [Å]
0
20
40
60
80
100
3000
4000
5000
6000
7000
8000

PyQSOFit


ra,dec = (141.66325,-0.3629647) op_0-59345-2903 z = 0.1721
br lines
na lines
fit
continuum
FeII
data
NeV3426
[OII]3728
[NeIII]3869
CaII3934
Hr
HeII4687
Hb
[OIII]
Ha+[NII]
[SII]6718,6732
Wavelength (Å)
NeIII
$\chi_r^2 = 2.51$
Hg
$\chi_r^2 = 1.46$
Hb
$\chi_r^2 = 1.51$
Ha
$\chi_r^2 = 2.01$
Rest Wavelength (Å)

Our data

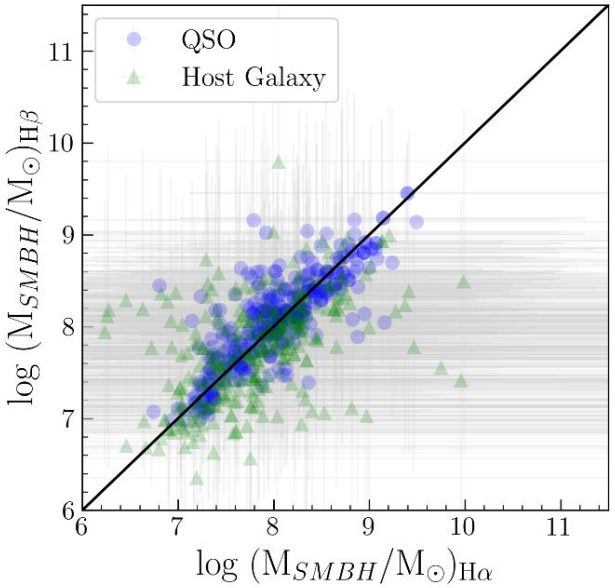
Work in progress

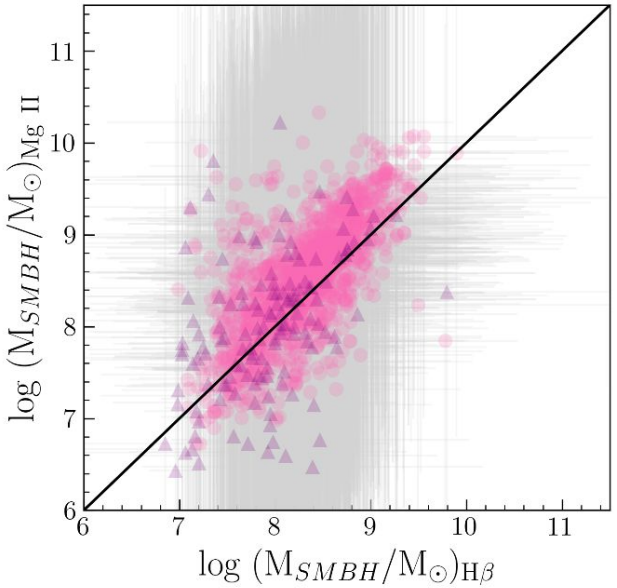
- eROSITA (Brunner+22; Liu+22)
  - **X-ray data** (column density, photon index, luminosity, outflows)
- NWAY (Salvato+22)
  - **Photometric counterparts** (redshift, colors, morphology)
- SDSS
  - STARLIGHT
    - **Stellar continuum** (stellar mass, luminosity, stellar populations' age and metallicity)
    - **Stellar absorption lines** (dynamics, velocity dispersion)
  - PyQSOFit
    - **Narrow lines** (AGN classification, metallicity, density, ionization parameter, ionized outflows, NLR)
    - **Broad lines** (SMBH mass, accretion rate, fast outflows, BLR)
    - **AGN continuum** (luminosity, power-law and polynomial components)

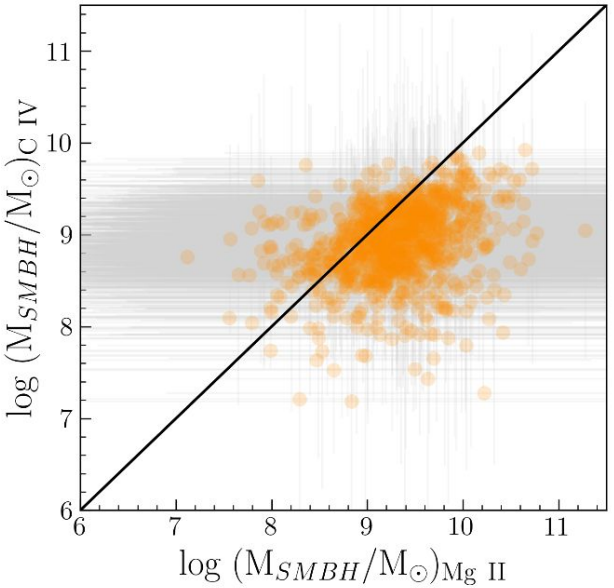
Comparing methods of Single-epoch SMBH mass

$$\log\left(\frac{\mathrm{M_{SE}}}{\mathrm{M_\odot}}\right) = \alpha\,\log\left(\frac{\mathrm{L}}{\mathrm{erg\ s^{-1}}}\right) + \beta\,\log\left(\frac{\mathrm{FWHM}}{\mathrm{km\ s^{-1}}}\right) + \gamma$$

See Shen+24

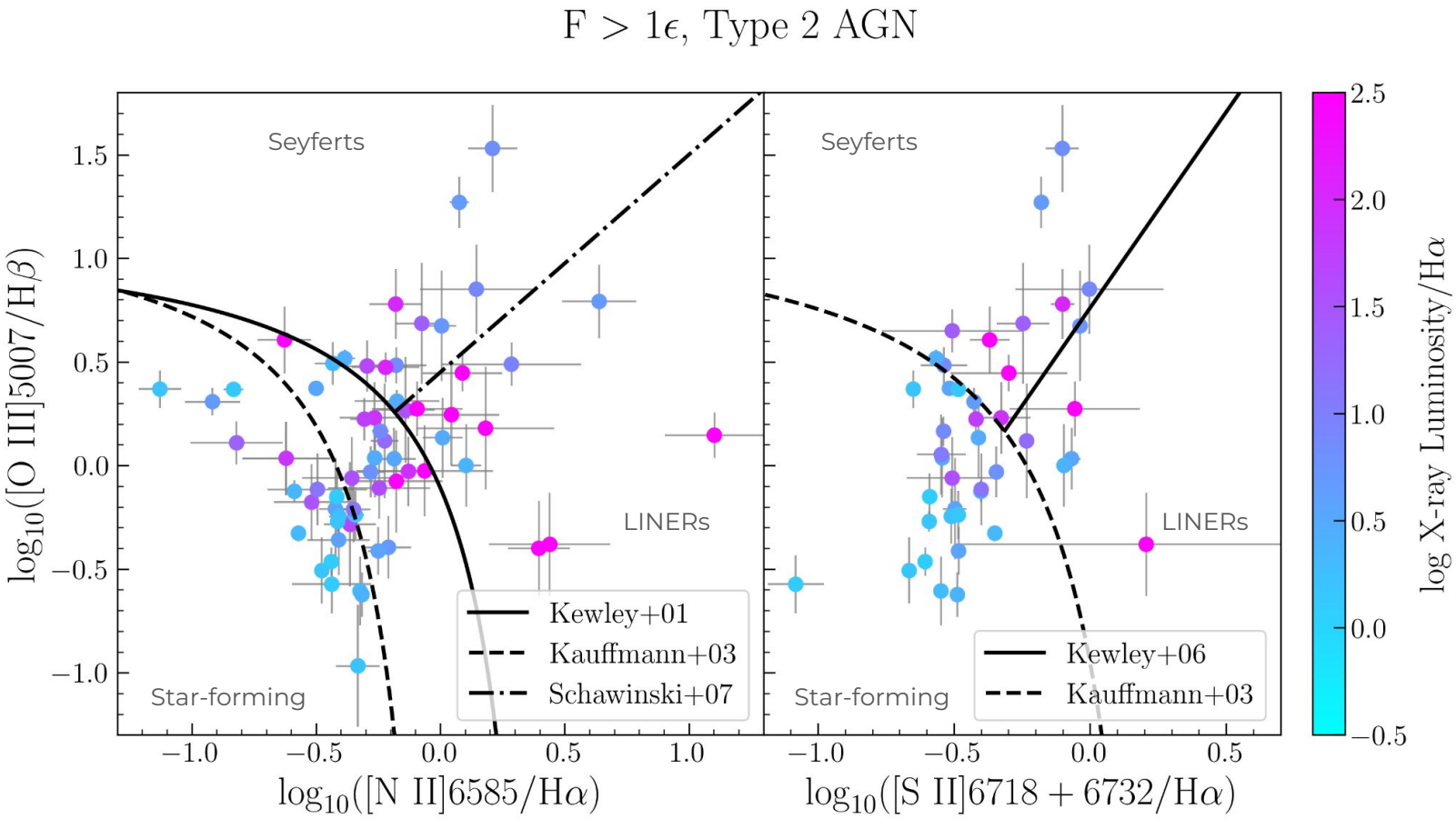




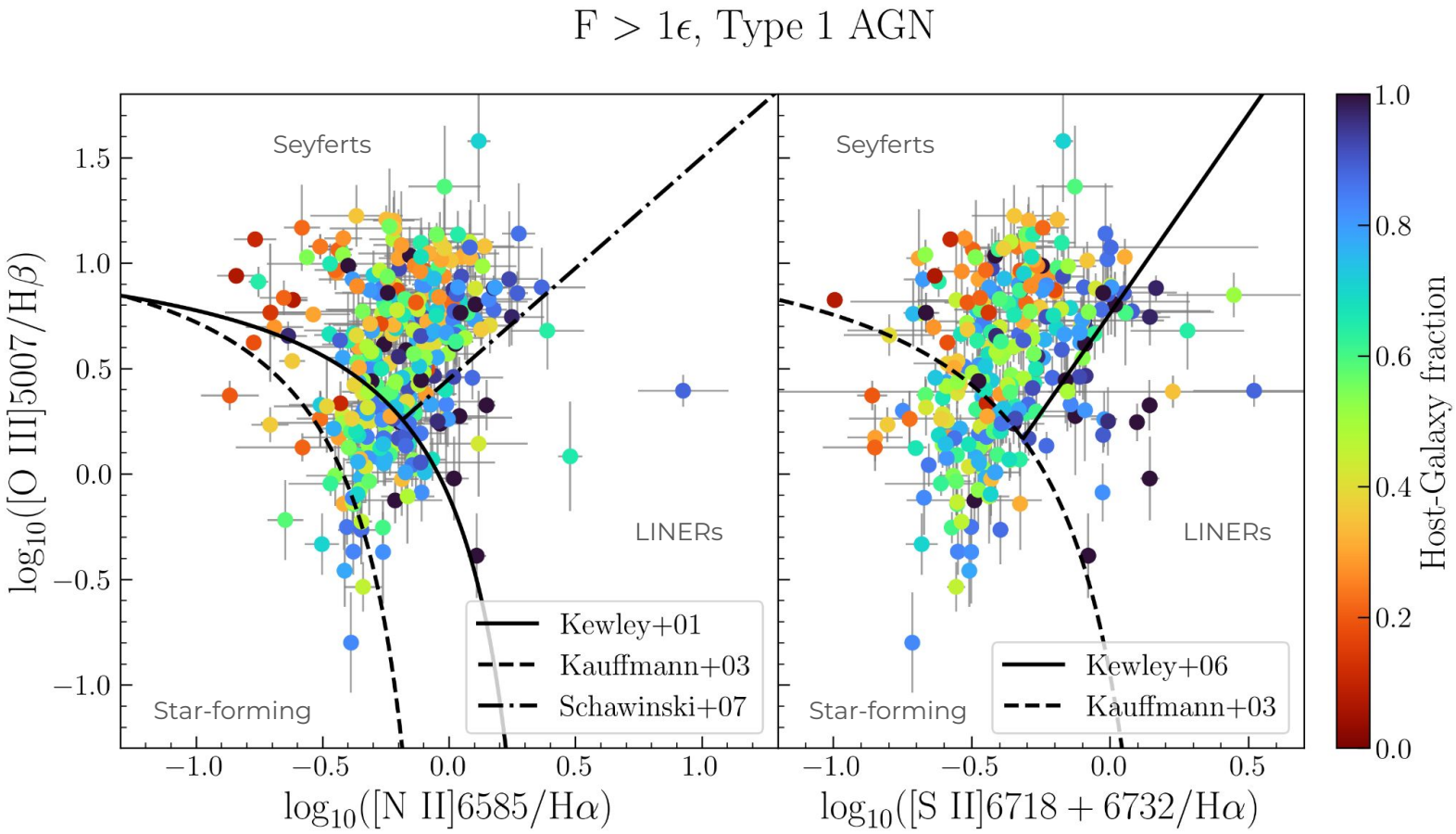


BPT diagrams

See Pulatova+24



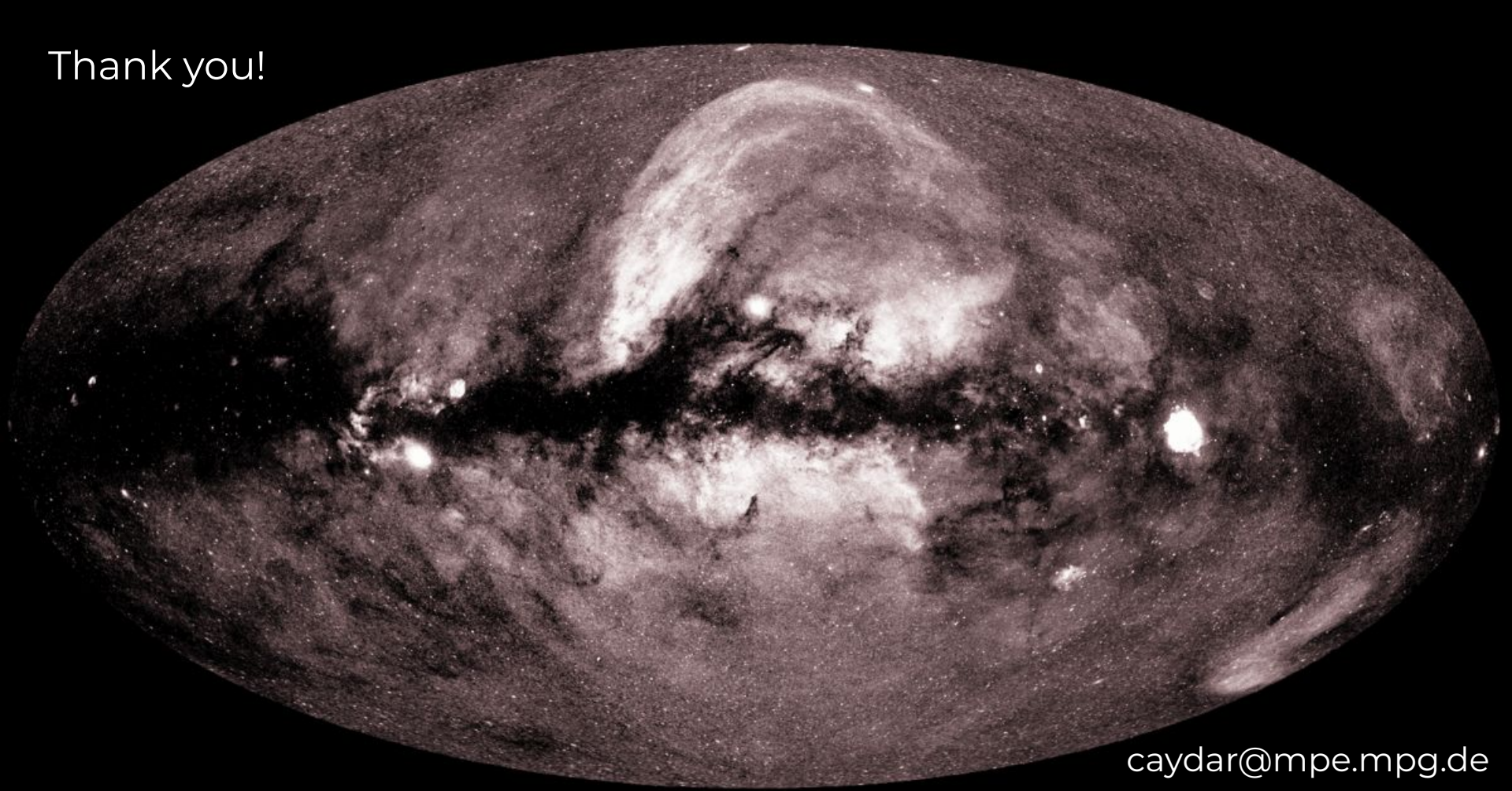
BPT diagrams



Summary and future perspectives

- SDSS+eROSITA
  - Unprecedented large and uniform sample of optical spectra of AGN
- Global stacked spectral analysis reveal a wide variety of spectral type
- Method to separate host galaxy from AGN emission
  - Public script for fitting SDSS AGN
- Catalog: optical classification, and measurement of host and AGN parameters (stellar mass, ages, emission and absorption lines fluxes and shapes, BH masses, etc.)
- Extend to the full SDSS-V/BHM sample of >250k X-ray selected AGN

Thank you!



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