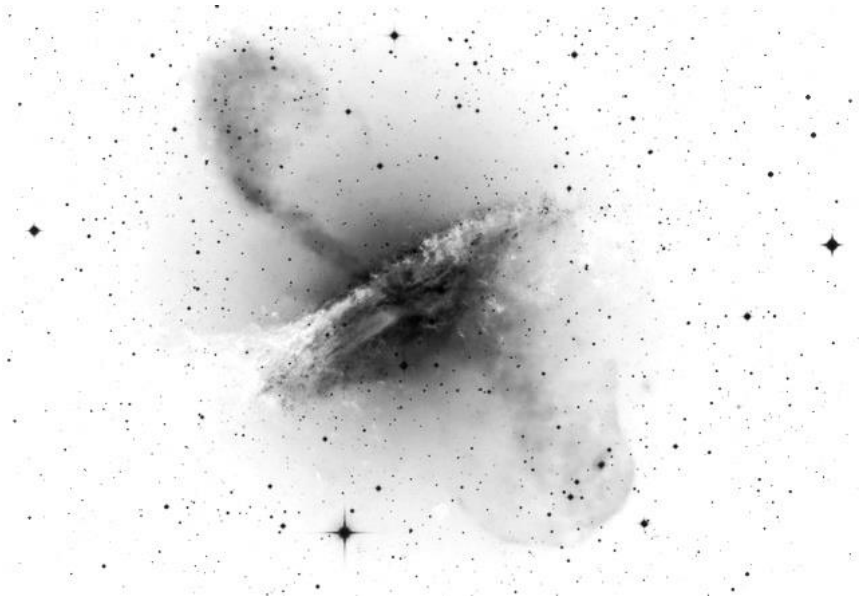
Searching for galaxies with active nuclei

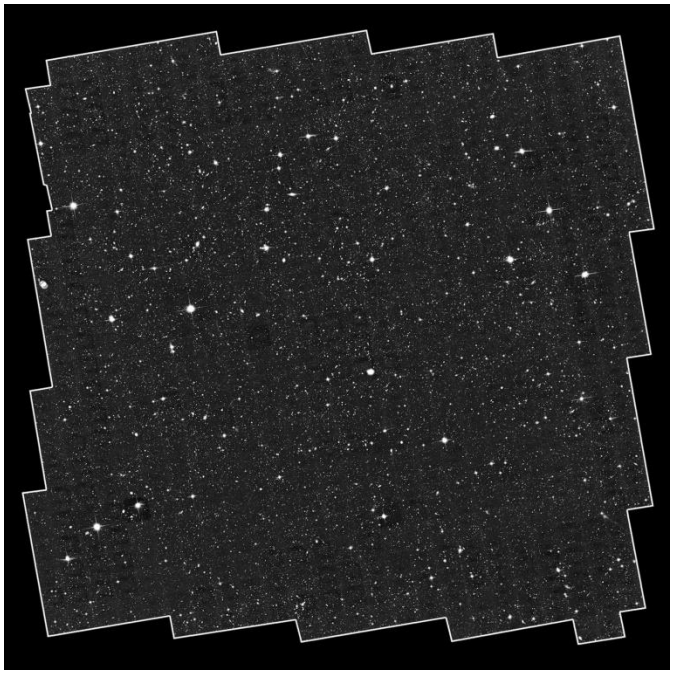
Kotov S.S., Dodonov S.N.

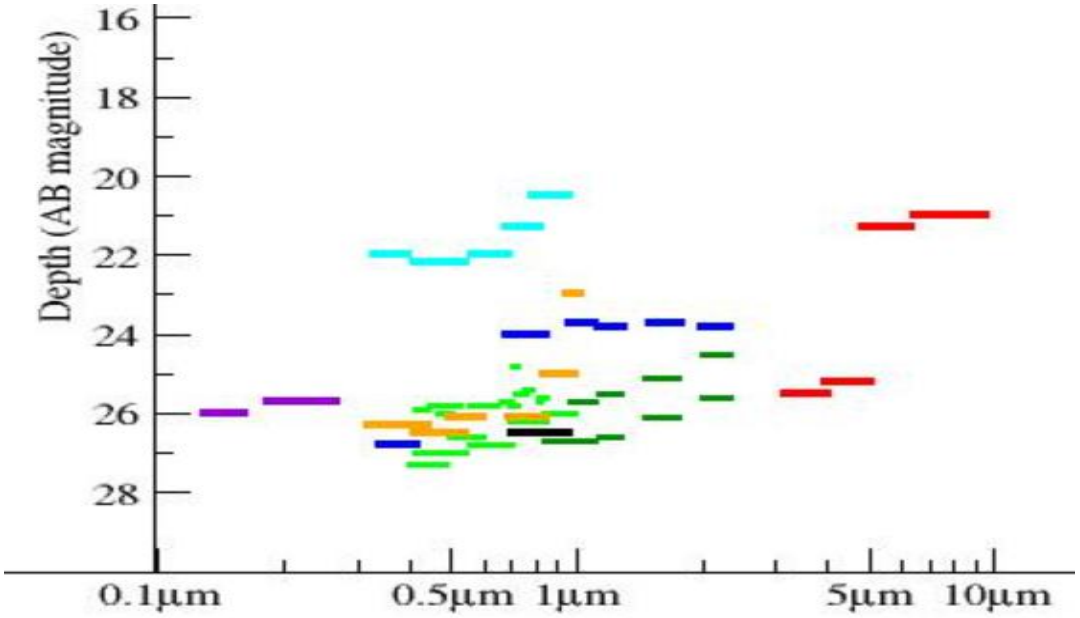


Active galaxies at different scales and wavelengths
Nizhniy Arkhyz 2024

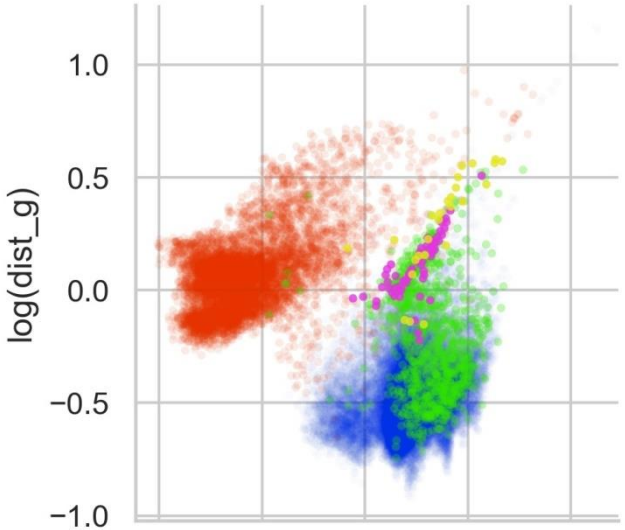
COSMOS survey

- 2 sqare degrees
- Optical photometry up to 27m
- NIR photometry up to 26m
- Spitzer IR photometry up to 25.5m
- 4016 Chandra x-ray sources
- HST morphology data in F814W filter up to 27.2m
- Optical spectroscopy of 20689 sources





Main idea

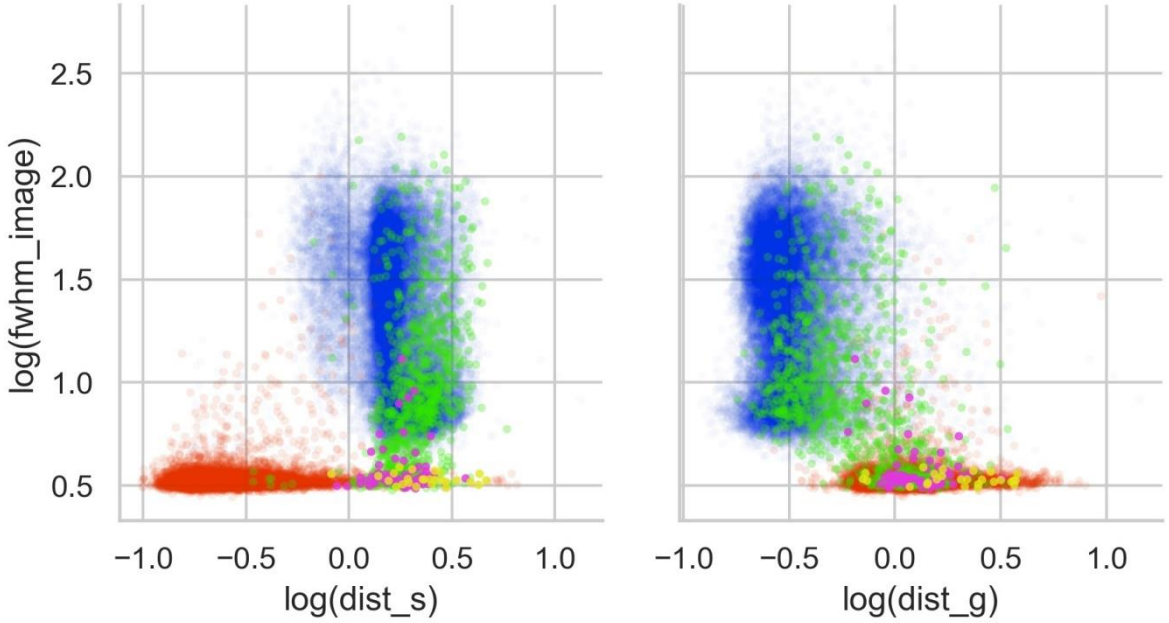


Red – stars
Blue – galaxies
Green – X-ray sources
Yellow – COSMOS QSO
Purple – QSO candidates

Colorspace u-g-r-i-z-J-H-K-CH1.

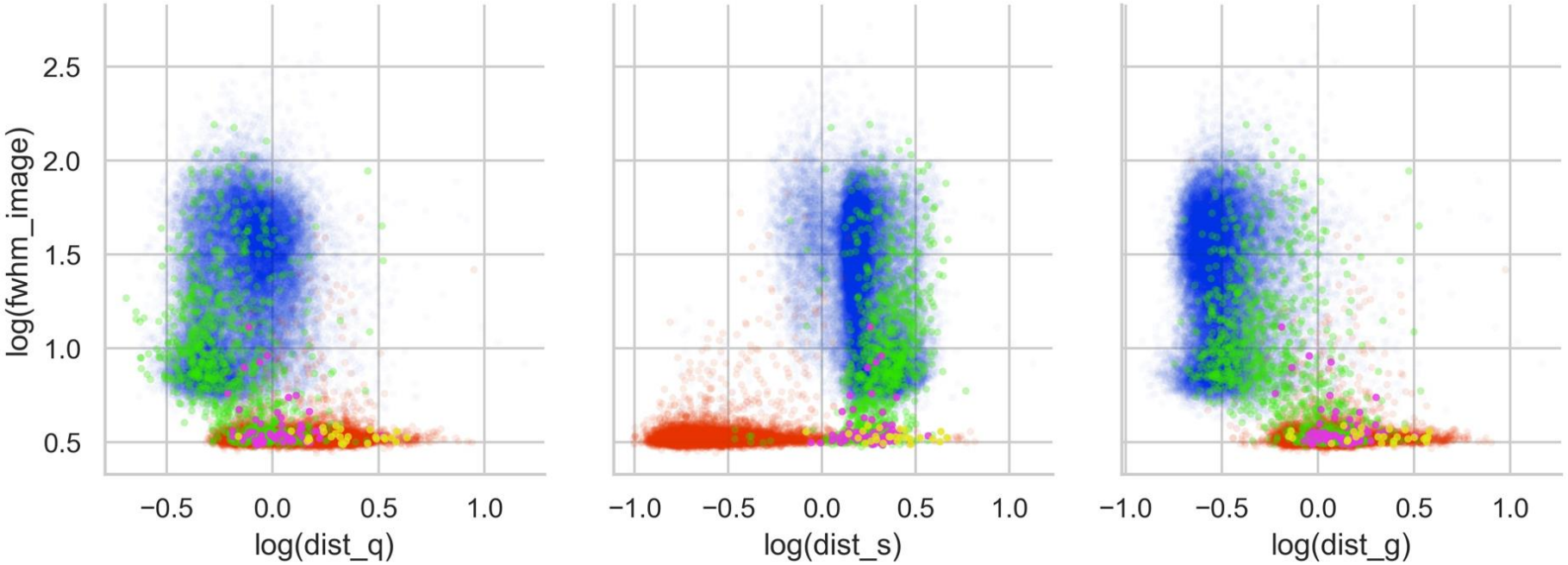
Dist_g – mean distance to the nearest 10 galaxies in colorspace.

Dist_s – mean distance to the nearest 5 stars in colorspace.



We can see continuous trail of x-ray sources between QSO and galaxies!

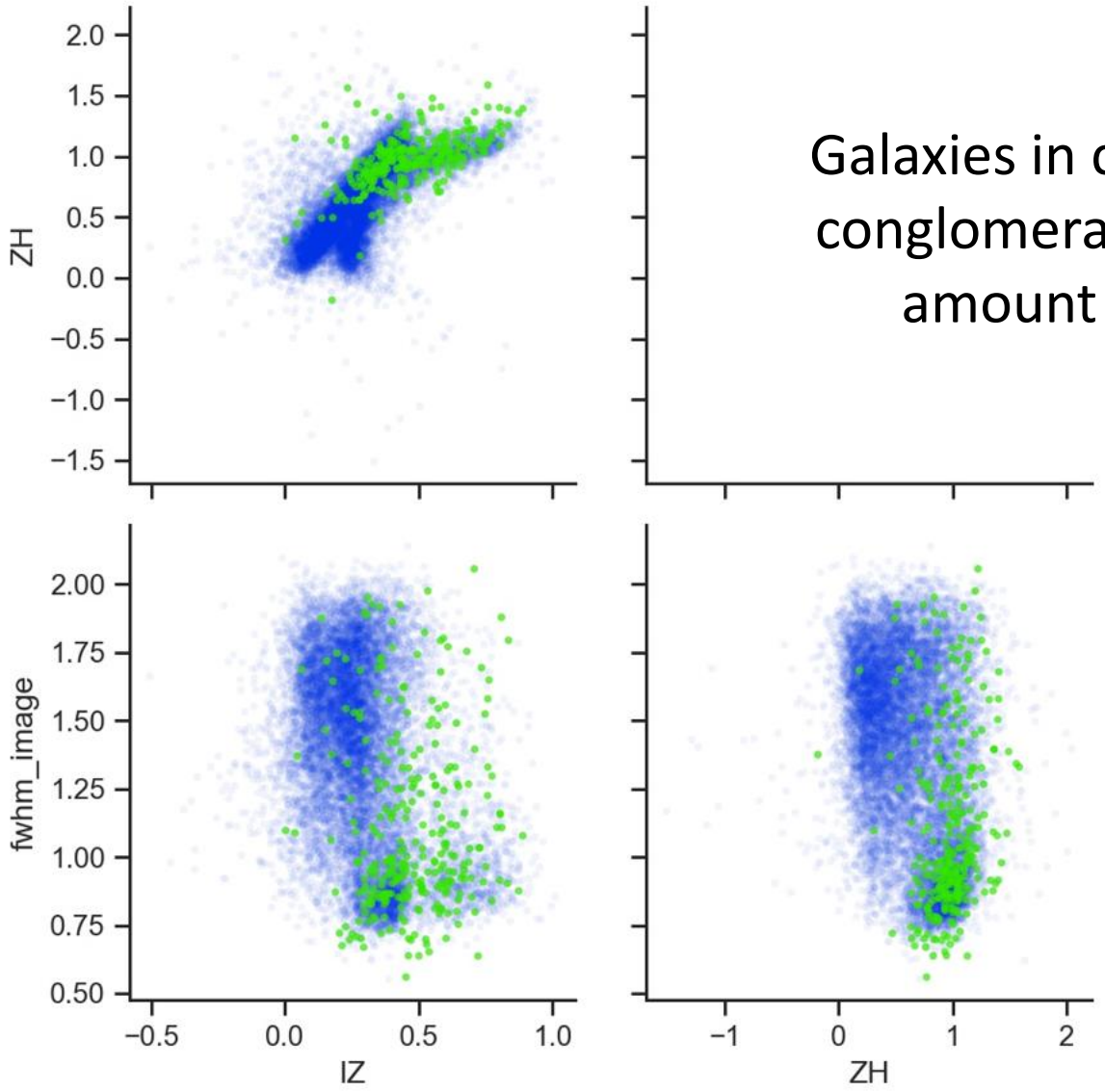
Galaxies and x-ray sources



Dist_q – mean distance to the nearest 3 x-ray sources

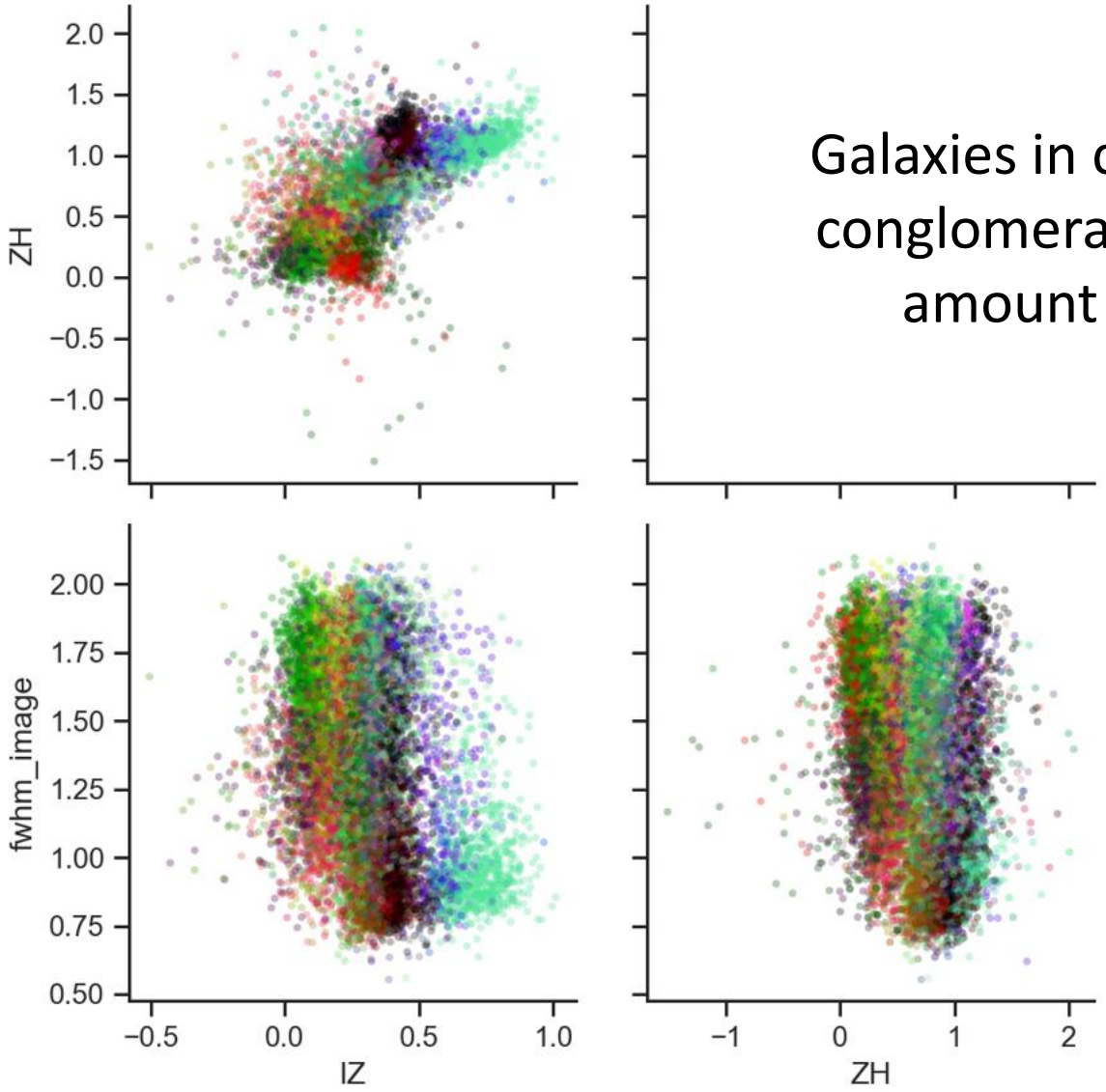
We can not clearly separate galaxies and x-ray sources!

Galaxies classification



Galaxies in colorspace can form conglomerations with different amount of x-ray sources

Galaxies classification

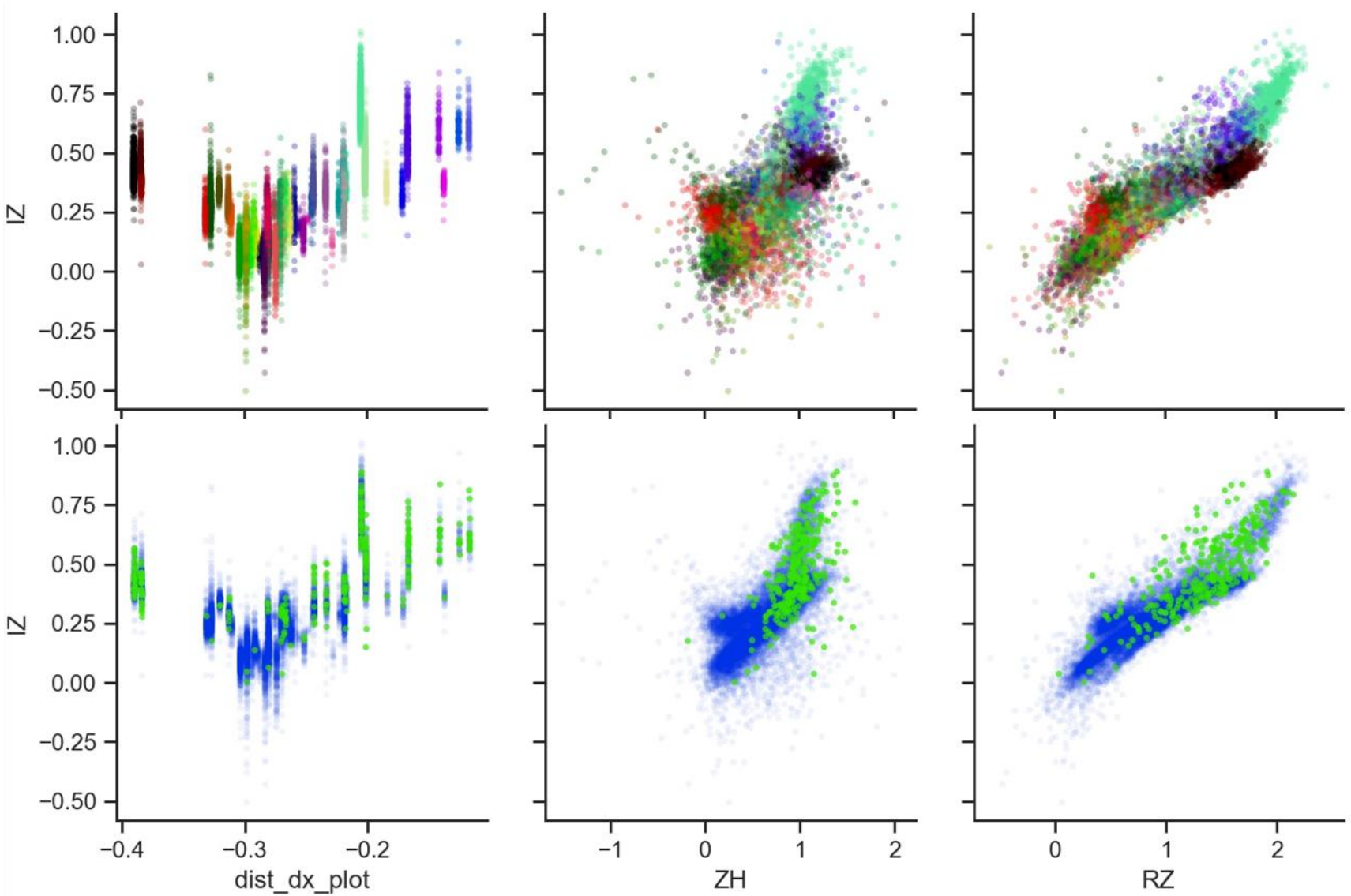


Galaxies in colorspace can form conglomerations with different amount of x-ray sources

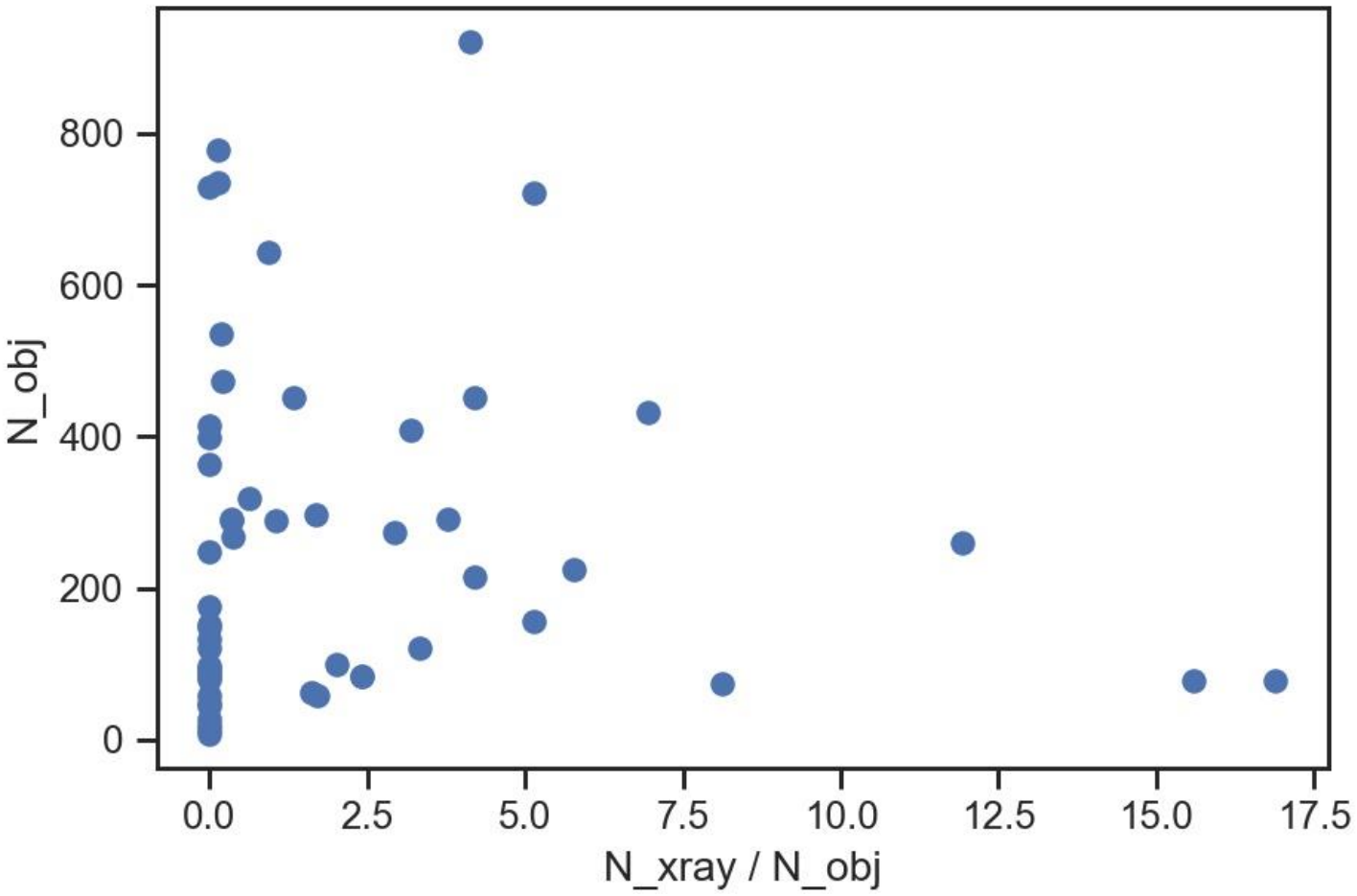
Classification method

1) Calculate the surrounding density for each galaxy, using mean distance to the nearest N neighbors as a criteria
2) For each galaxy:
    * Find the nearest K neighbors
    * Find the neighbor with highest surrounding density
    * For that neighbor also find the neighbor with highest density
    * Repeat previous step several times
    * You have found the central object of conglomeration!
3) Find all unique central objects
4) Create groups around central objects using references from step 2.

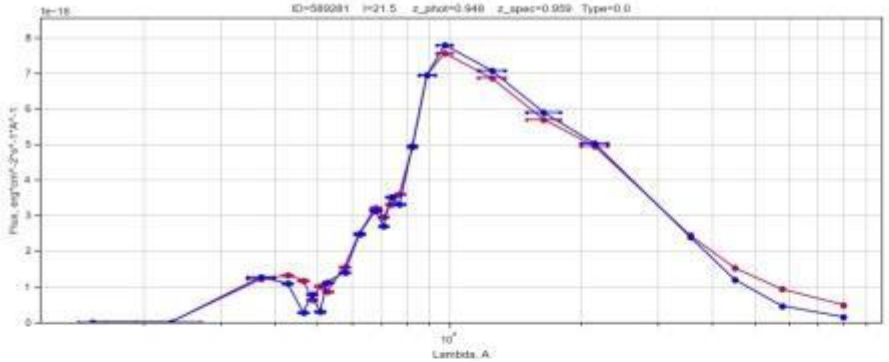
Classification results

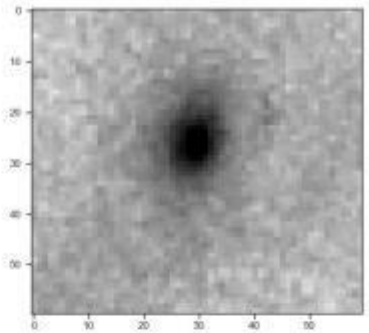


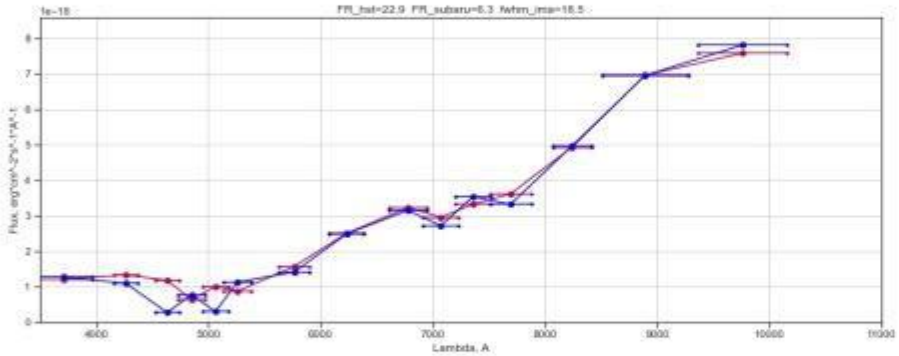
Classification results

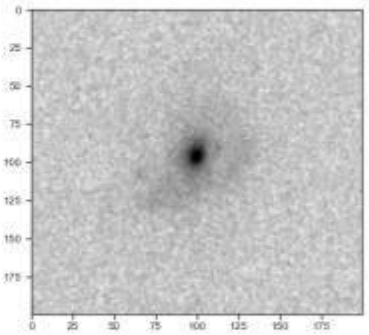


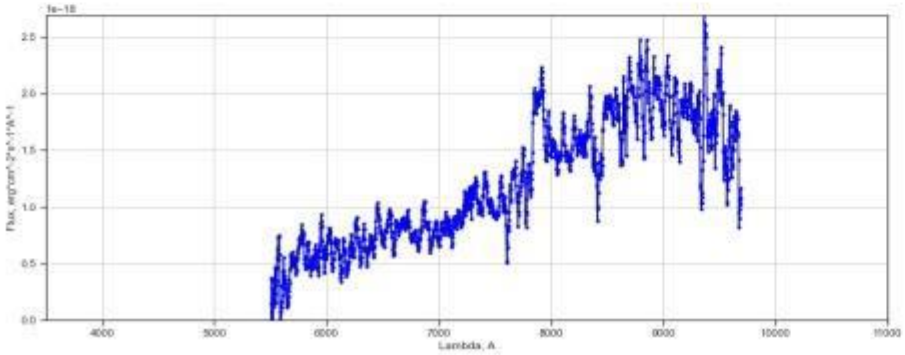
Galaxies from high x-ray group

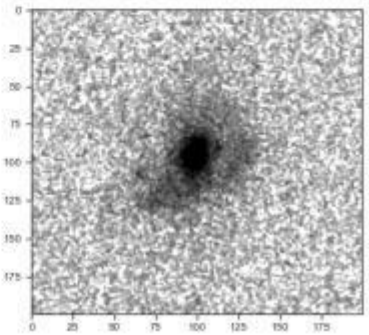




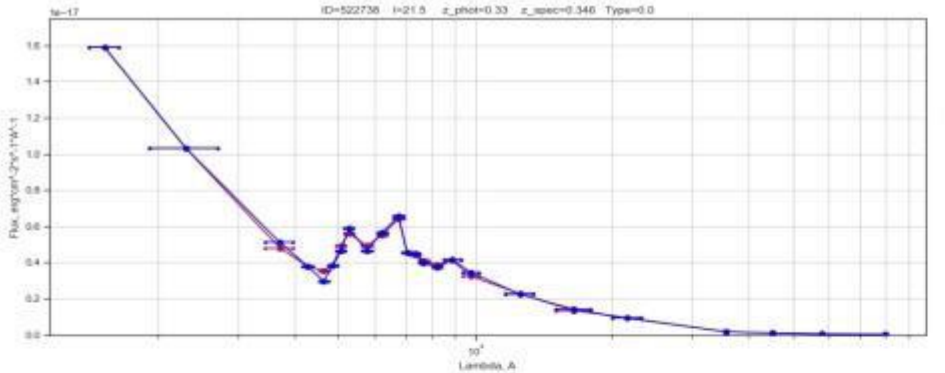


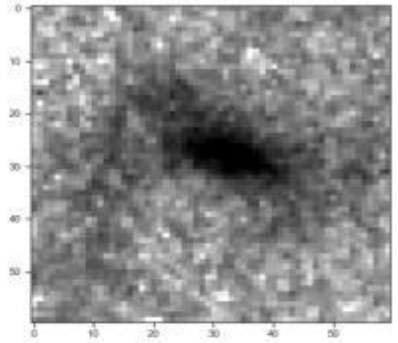


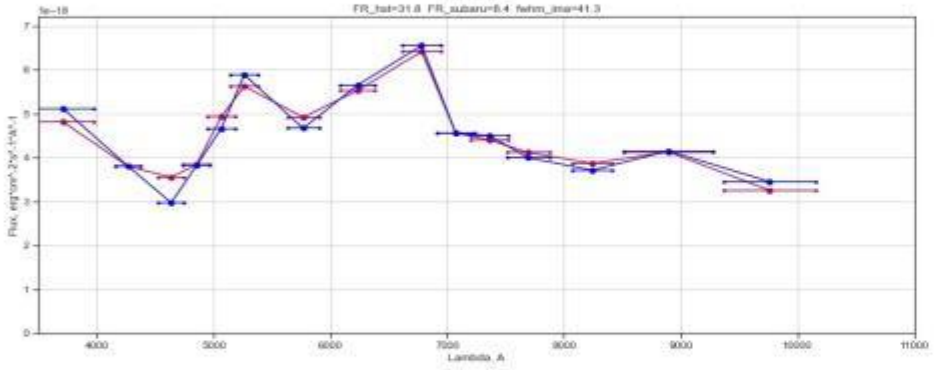


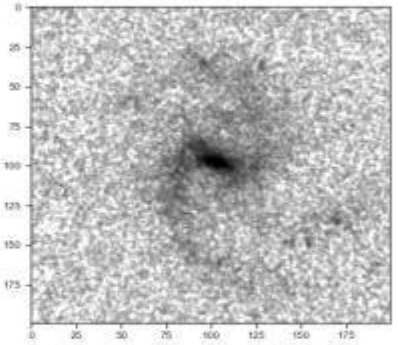


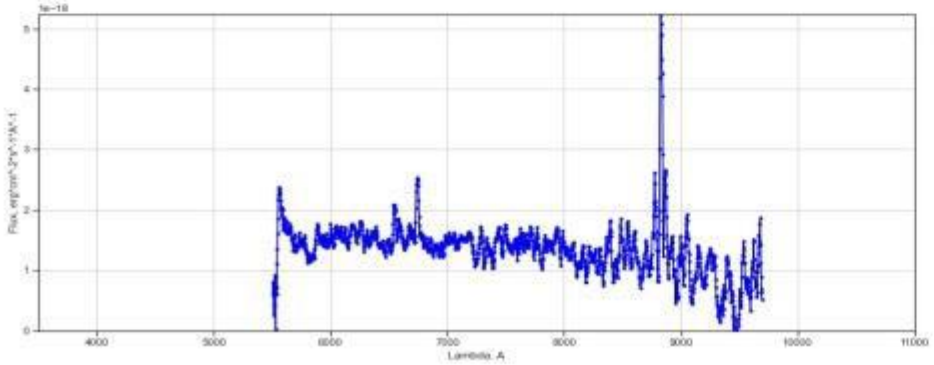
Galaxies from low x-ray group

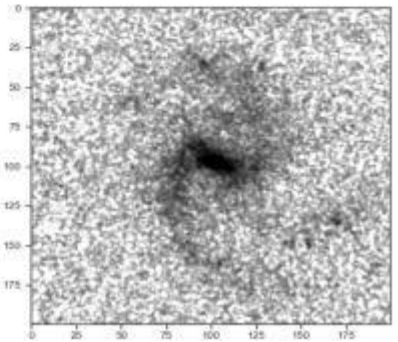












Summary

- Automatic classification of galaxies in broadband photometric colorspace can be used as a preselection criteria for AGN search
- Method could be applied to poor-calibrated data or photometric data with unique filter set
- Method could be used to classify any types of objects in the sample, i.e. galaxies, stars or QSOs

Thank you for your attention!