

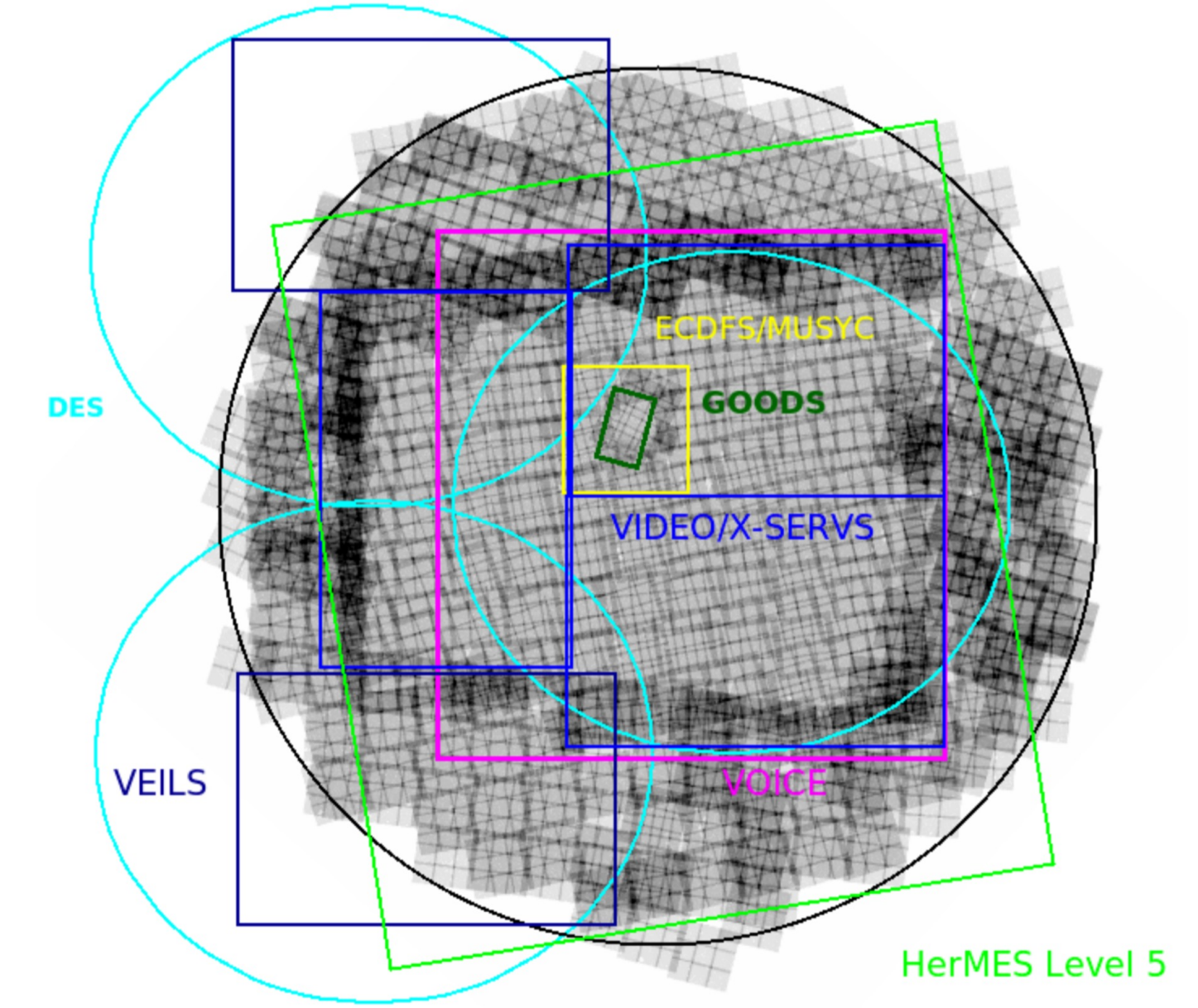
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Graduate Student

Three Million SEDs in Three LSST Deep-Drilling Fields: Source Classification and Galaxy Properties

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(arXiv: 2206.06432)

The Rubin LSST Deep-Drilling Fields (DDFs)

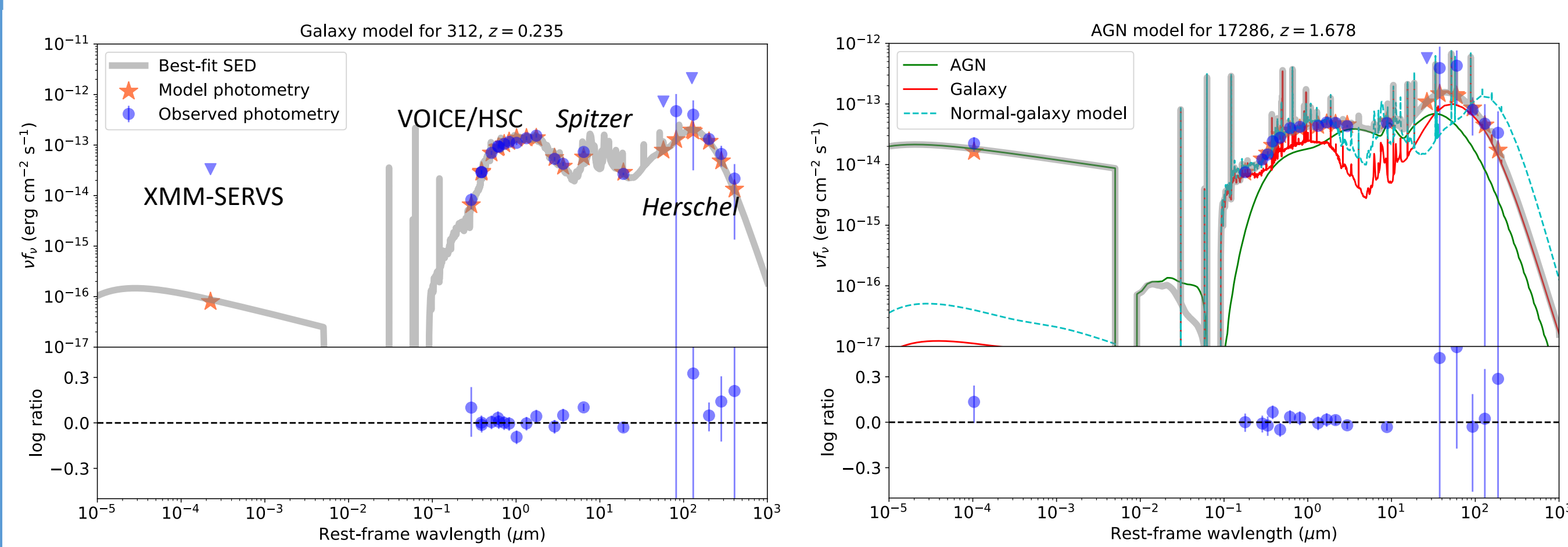
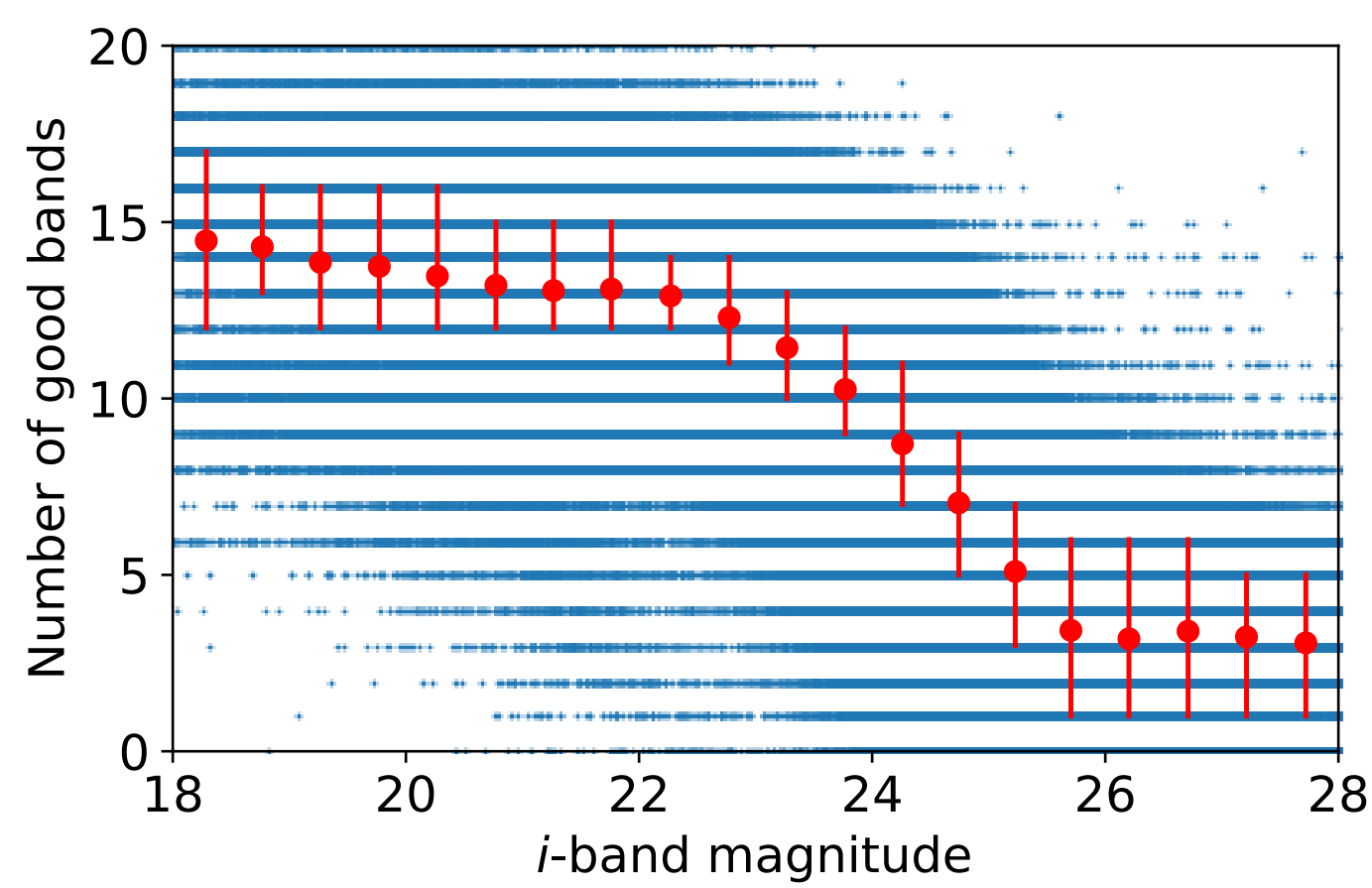
- LSST DDFs currently include the COSMOS, W-CDF-S, ELAIS-S1, XMM-LSS, and EDF-S fields, which will be observed by LSST with deeper imaging and a higher cadence compared to the wide LSST survey.
- Sources in COSMOS have already been intensively cataloged and explored, and the current multi-wavelength data in EDF-S are still limited. The remaining three fields (W-CDF-S, ELAIS-S1, and XMM-LSS) already have superb archival data, and thus systematic cataloging of the source properties in these three fields is possible and important for future science.
- We have compiled and refined the multi-wavelength photometry from X-rays to far-infrared and measured photometric redshifts in W-CDF-S, ELAIS-S1, and XMM-LSS. **We then fit spectral energy distributions (SEDs) to do source classification and measure galaxy properties for 2.8 million sources in these fields.**



Multi-wavelength coverage in W-CDF-S; Brandt et al. (2018)

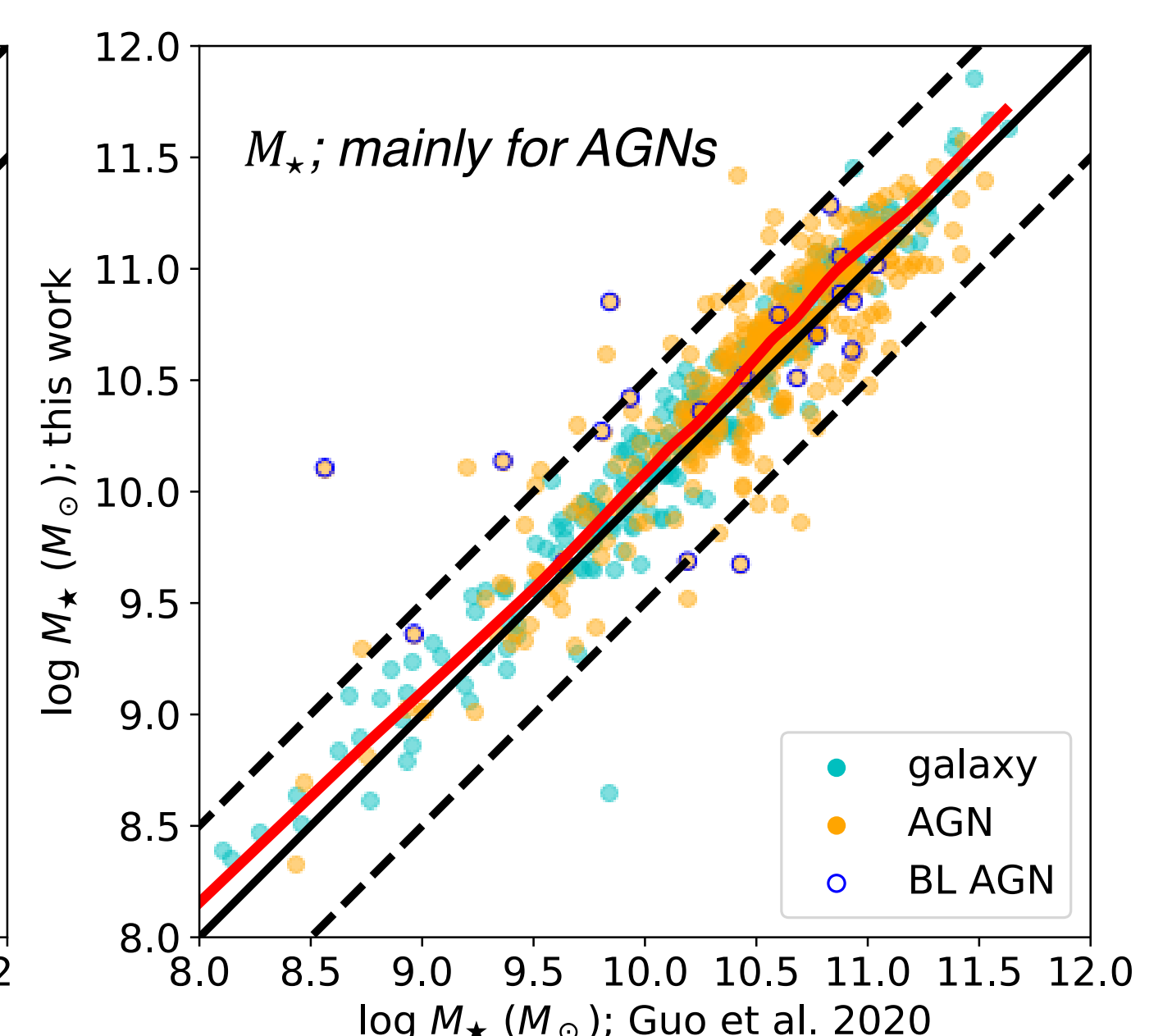
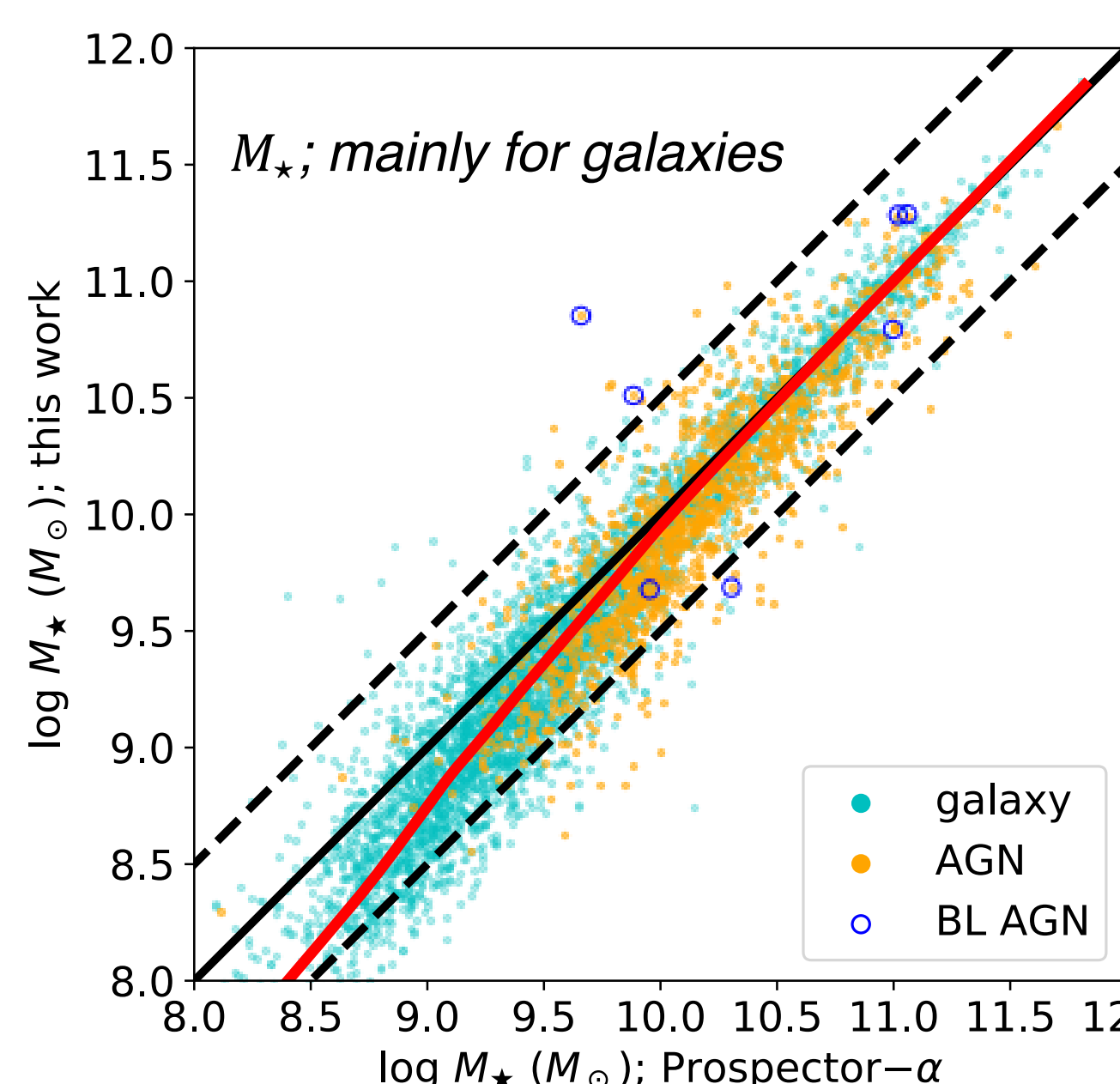
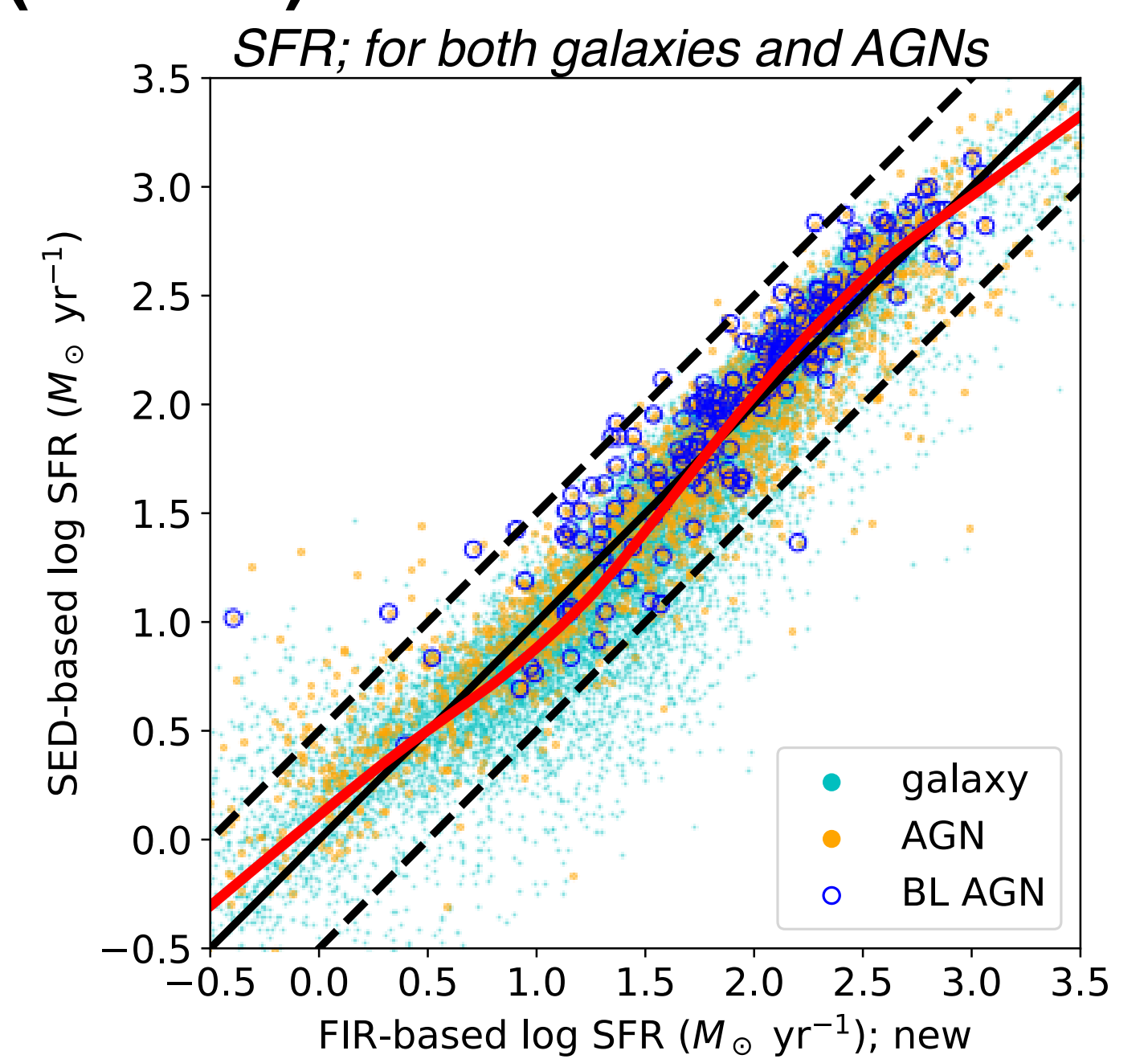
SED fitting

- We use CIGALE v 2022.0 to do the SED fitting.
- SEDs cover X-ray to far-infrared with typically 5-12 bands.
- SEDs are decomposed into AGN components and galaxy components for AGNs and AGN candidates.



Host-galaxy stellar mass (M_*) and star-formation rate (SFR)

The SED fitting returns galaxy M_* and SFR, and we compare our measurements with others. Examples:

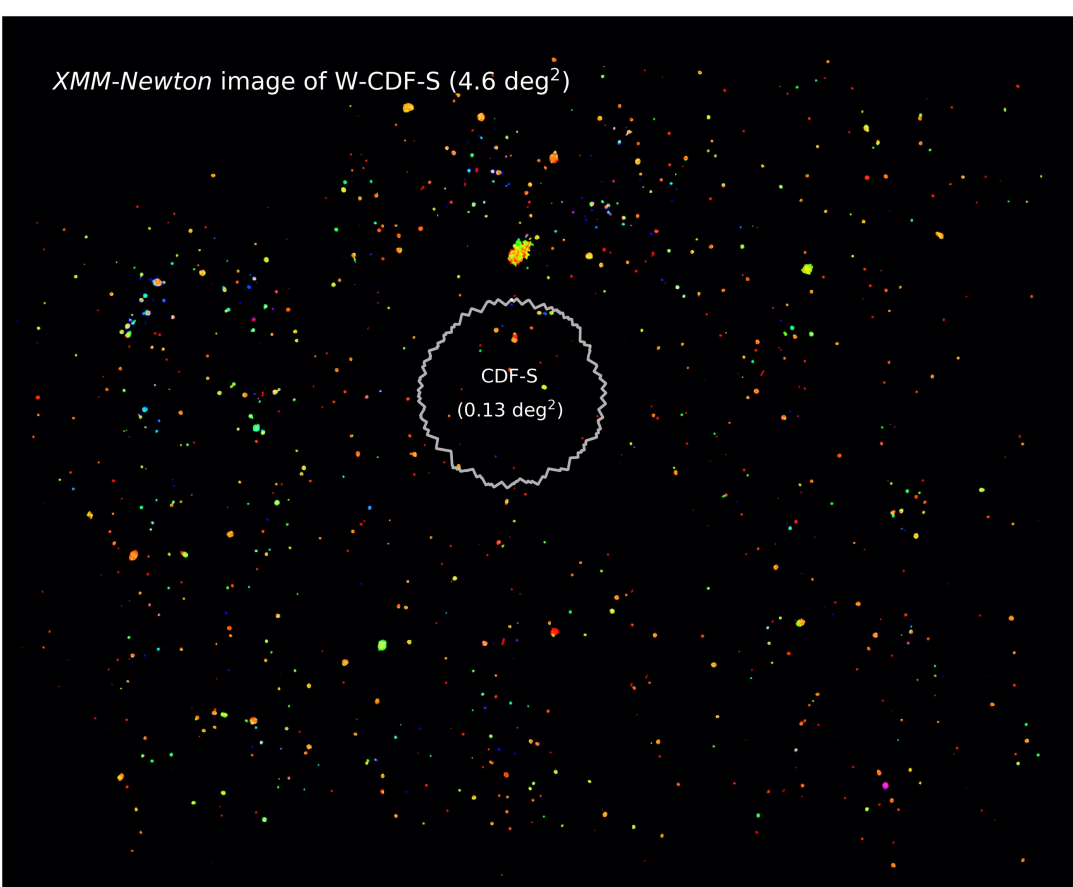


Source classification

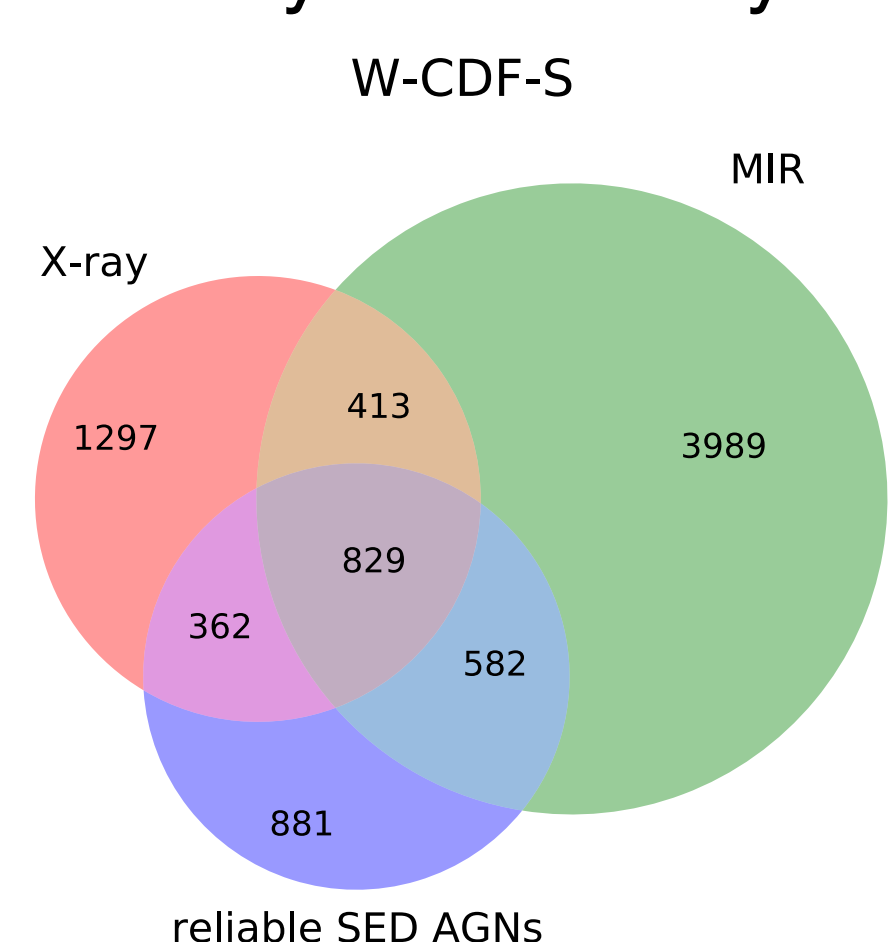
Star selection: stars are selected based on their morphology, SEDs, colors, and proper motions.

AGN selection

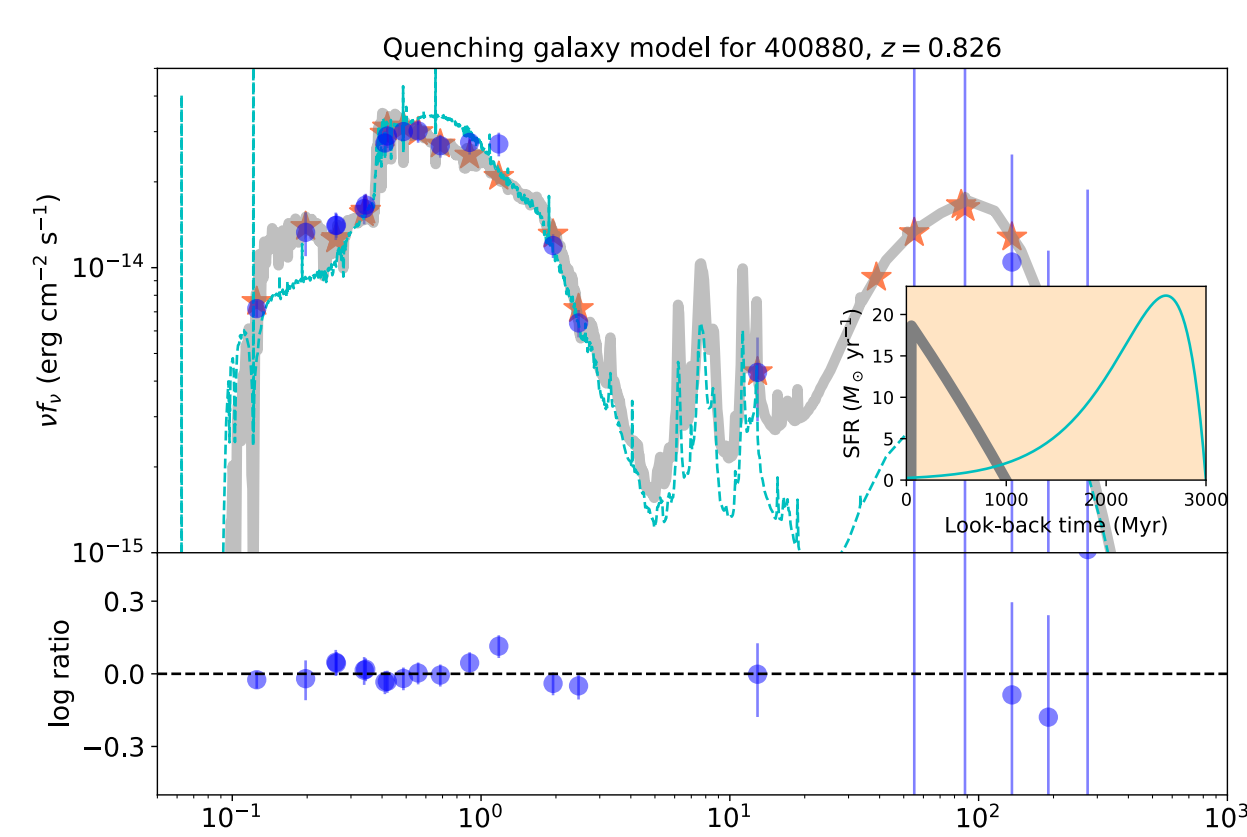
- AGN candidates are selected in three ways: X-ray (from the XMM-SERVS survey), mid-infrared color, and SED.
- SED AGN selection and calibration
 - Sources whose fitting is greatly improved after adding an AGN component are selected as SED AGN *candidates*.
 - The selection is then calibrated using X-ray AGNs in small regions with high X-ray exposures in our fields (e.g., 7 Ms *Chandra* Deep Field-South) to construct a reliable criterion.
- Most reliable SED AGNs can be selected by either X-ray or MIR.



XMM-Newton image in W-CDF-S; Ni et al. (2021)



Bursting/quenching galaxy selection: sources whose SEDs favor recent rapid changing star-formation histories are selected as bursting/quenching galaxy candidates.



All the other sources are classified as normal galaxies.

Data release

- Zenodo repository:
<https://zenodo.org/communities/ddfddata/>
Including catalogs recording the SED-fitting results, best-fit decomposed SED models, and photometric catalogs.
- XMM-SERVS website:
<https://personal.psu.edu/wnb3/xmmservs/xmmservs.html>
Including X-ray catalogs, multi-wavelength photometry, and photometric redshifts produced by the Penn State XMM-SERVS team in these three LSST DDFs and some relevant papers.

Future prospects

- Many more photometric and spectroscopic datasets are constantly being generated in our fields, which will further improve the source characterizations. Especially, the LSST DDF observations will provide deep optical data with hundreds of observation epochs.
- Our catalogs will provide direct information for sources in the LSST DDFs and help source classifications (e.g., AGN selection) in the LSST era by serving as a calibration sample.
- Our work enables exciting science studies now underway, e.g., supporting characterizing Compton-thick AGNs, radio AGNs, and active dwarf galaxies in these LSST DDFs and systematically probing the coevolution of supermassive black holes and galaxies.

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