Mining FIR data with SEDSTACK

Marco Viero — KIPAC/Stanford
w/
Lorenzo Moncelsi (Caltech), Ryan Quadri (Texas A&M),
Jason Sun (Caltech), and the HerMES Collaboration

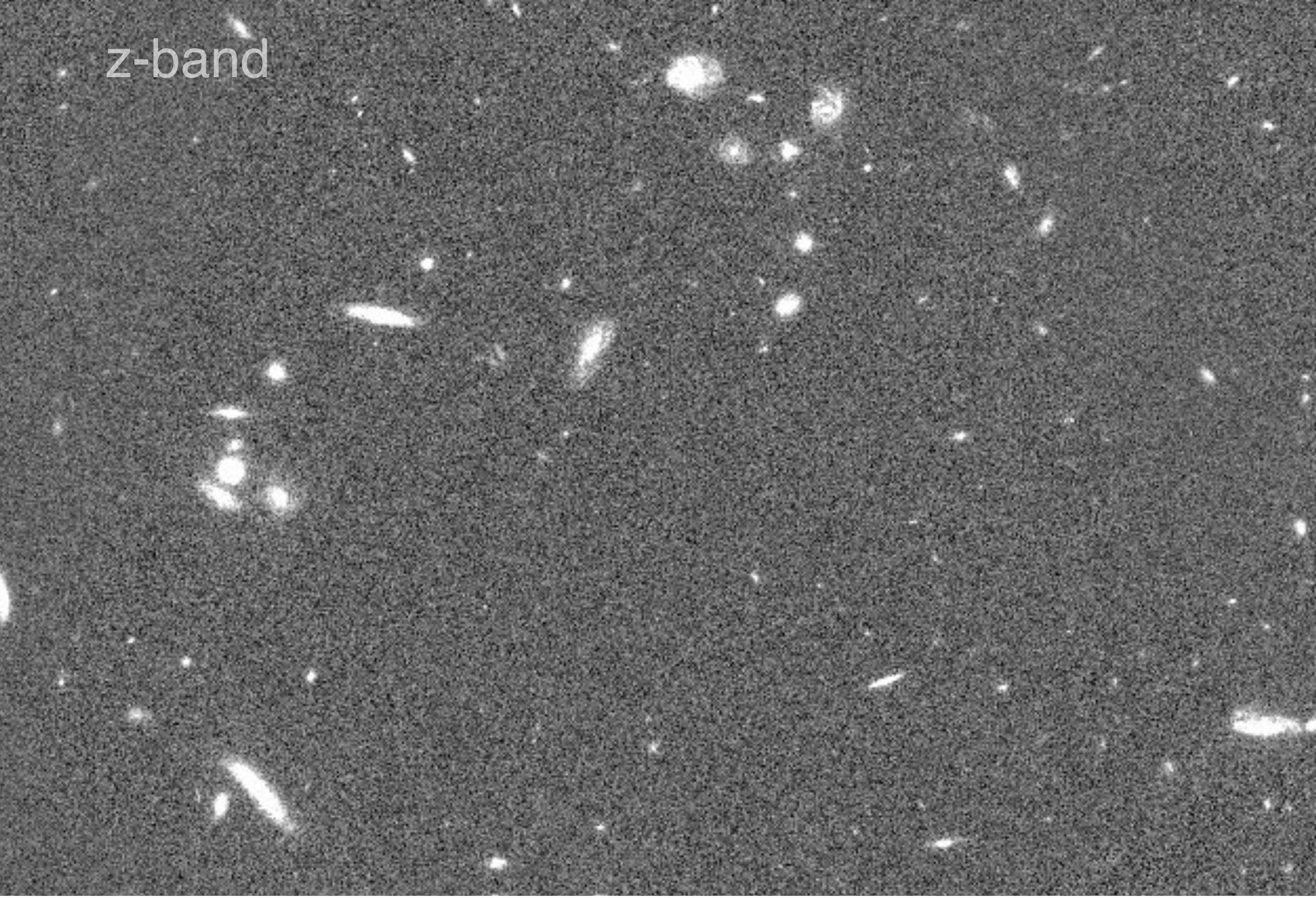
A workshop?

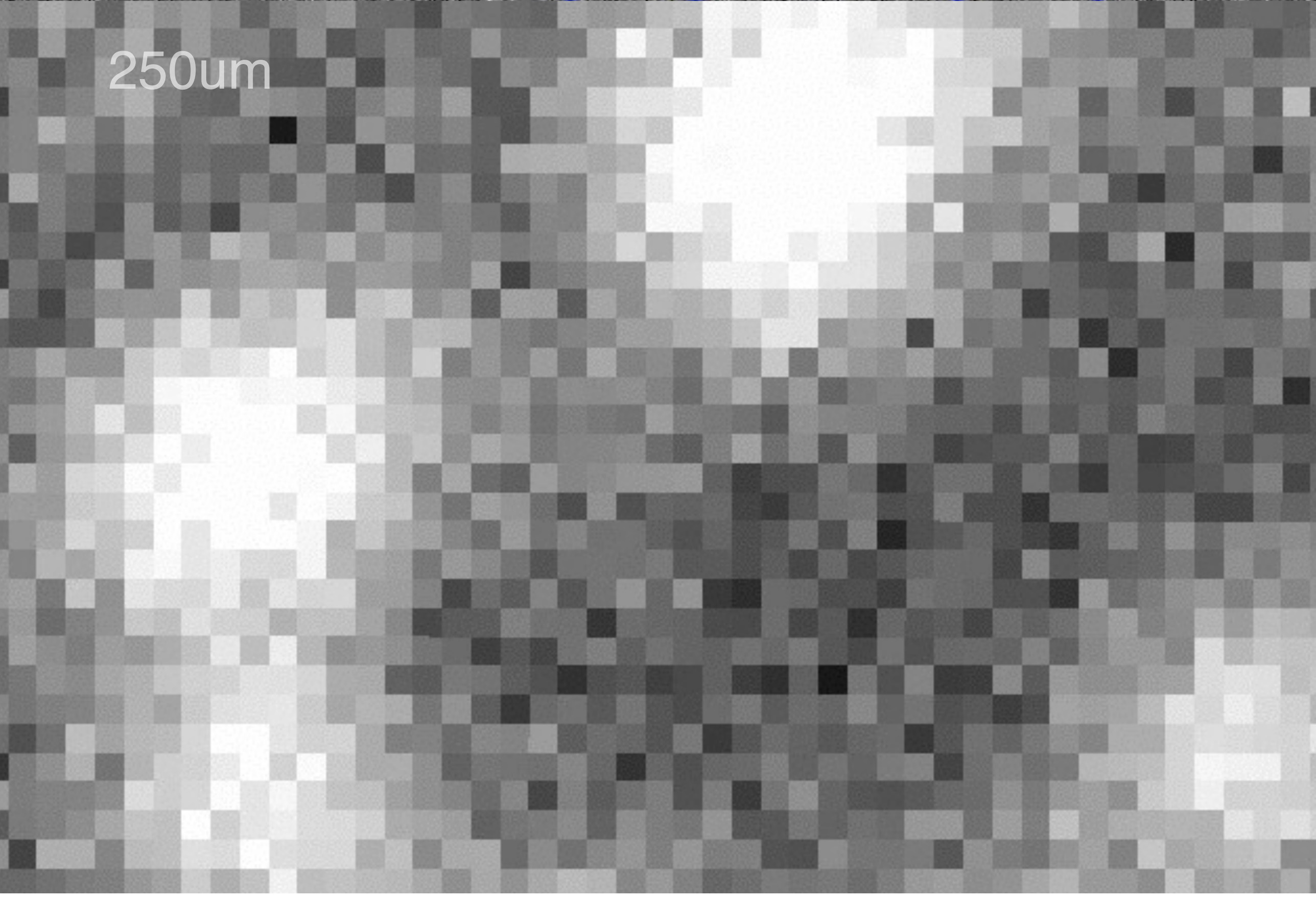
- Why are we here? I don't know. So I came up with three parts to this talk, or if you like, three questions:
  1. Moving beyond simple colors to divide galaxy samples, e.g.;
     - Model SEDs
     - AGN component, 24um flux, etc.,
  2. Moving beyond single field / single band treatment of stacking algorithms and into more sophisticated treatments, which I unfortunately named:
     - SEDSTACK
     - FLUCTFIT
  3. Explaining the weird behaviors that I have found in my stacking work, namely:
     - The extreme luminosities of high-redshift "quiescent" galaxies

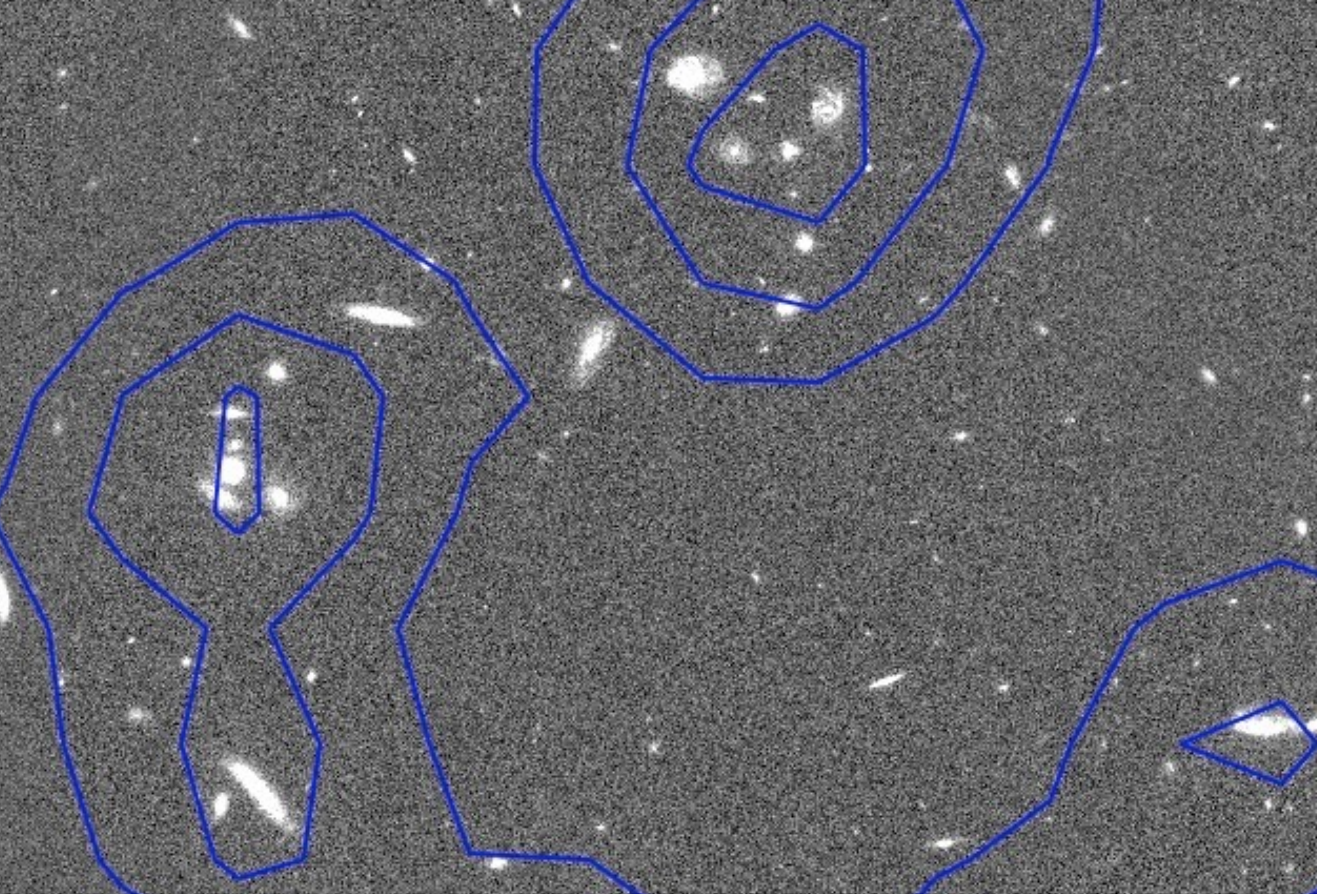
All codes are open-source, collaboration welcome!
Python (new) — https://github.com/marcoviero/simstack
[IDL (old) — https://web.stanford.edu/~viero/downloads.html]

SIMSTACK

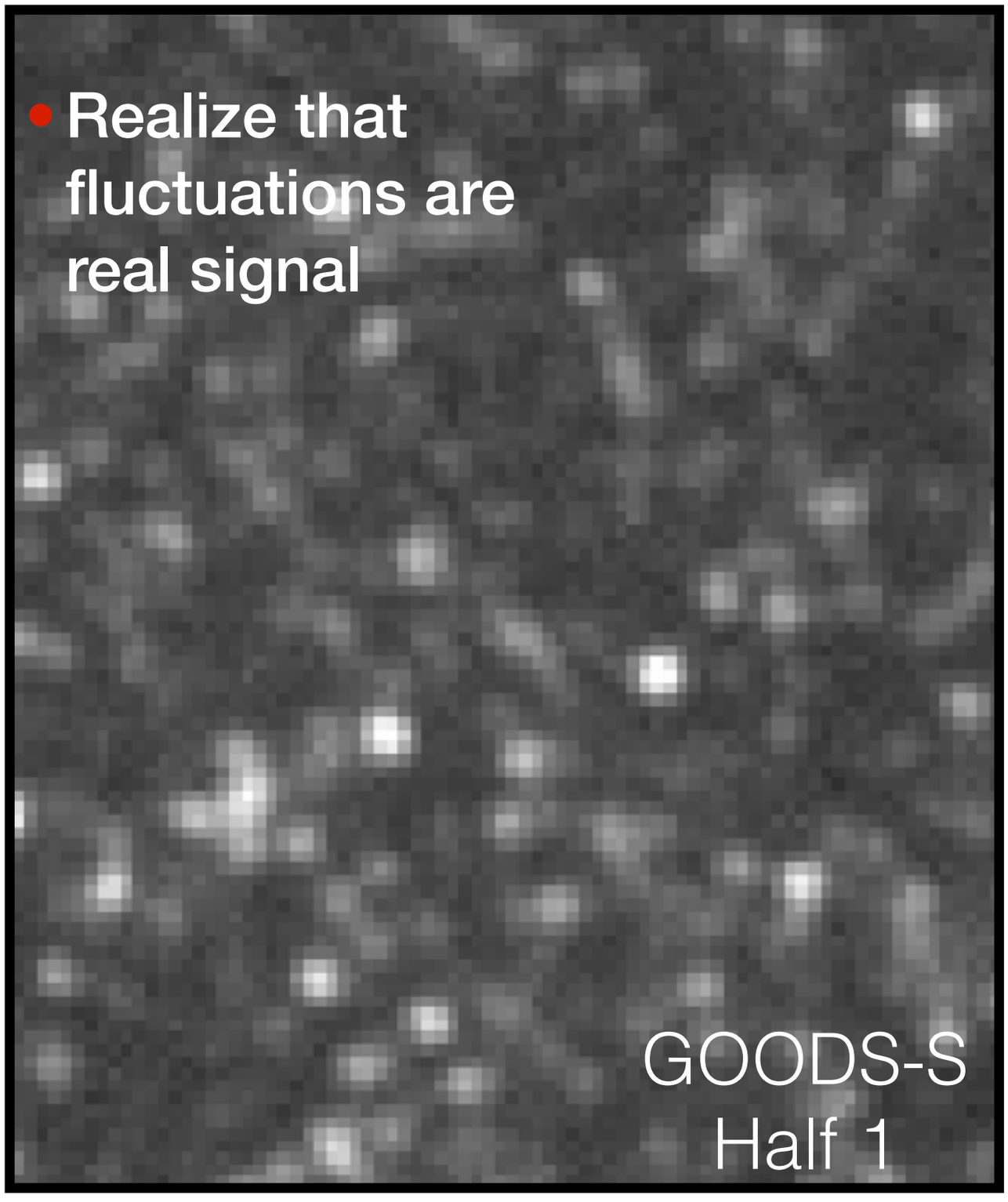
First, an introduction

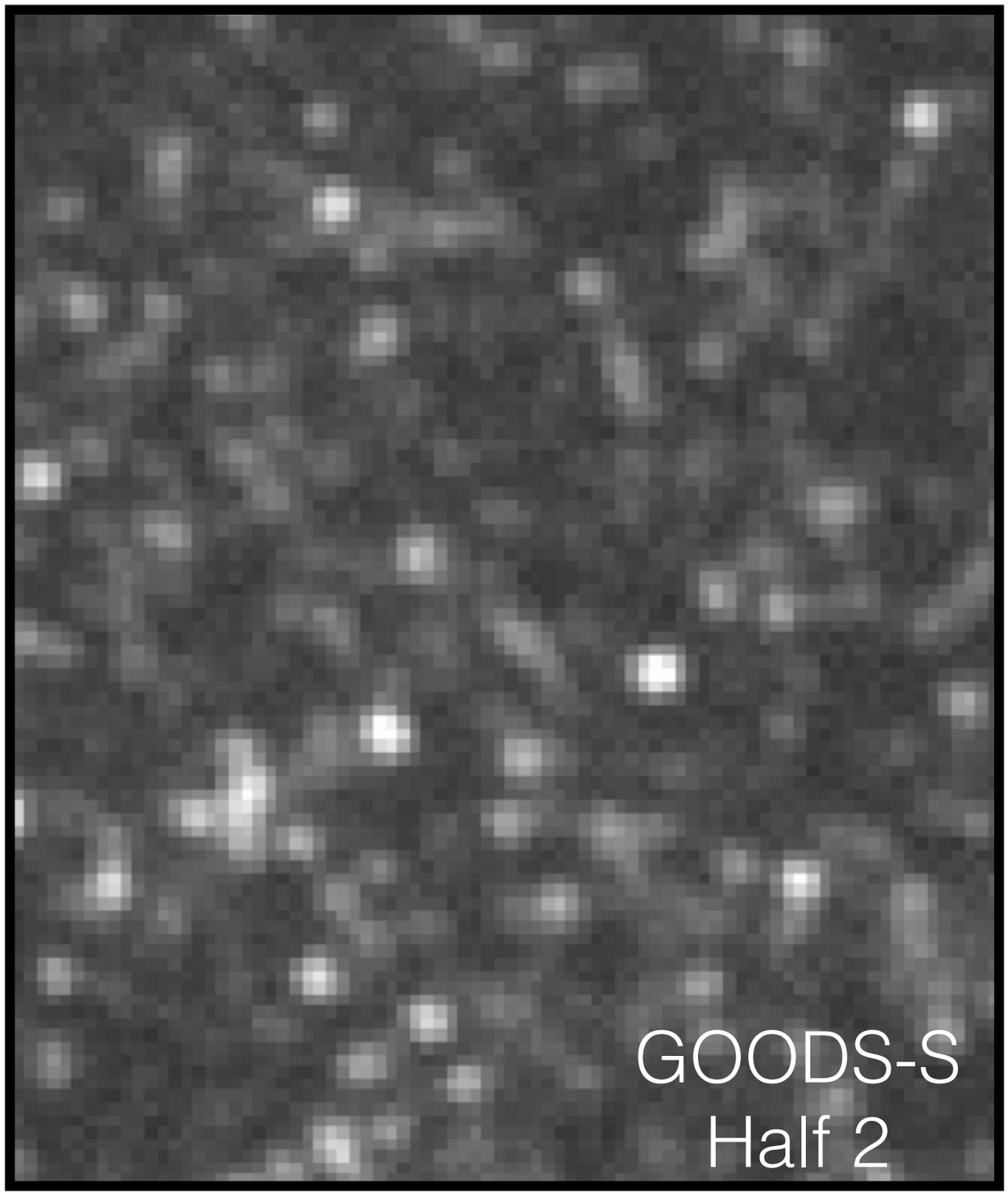

z-band


250um



- Realize that fluctuations are real signal





SPIRE Contour

SPIRE 250μm
18” Beam

- Difficult to attribute an individual submillimeter “source” to any single galaxy

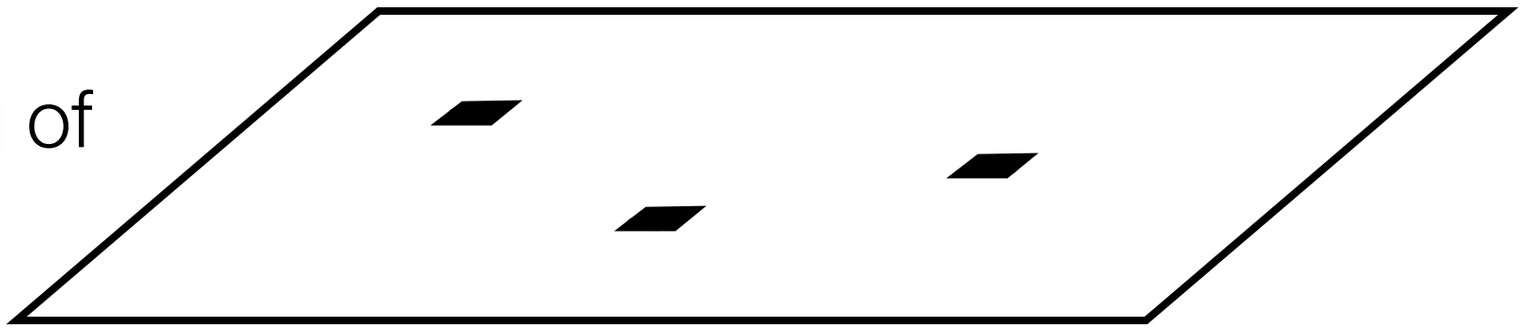
SPIRE Contour

SPIRE 250μm
18” Beam

- Key is to identify galaxies with similar *physical* properties, and then rely on ***statistics*** *to fit* ***fluctuations***

SIMSTACK: Synthetic Intensity Fitting Algorithm

make hits map from catalog of similar objects



Formalism developed w/ Lorenzo Moncelsi (Caltech);
also see Kurczynski & Gawiser (2010), Roseboom et al. (2010)

SIMSTACK code publicly available (see arXiv:1304.0446):
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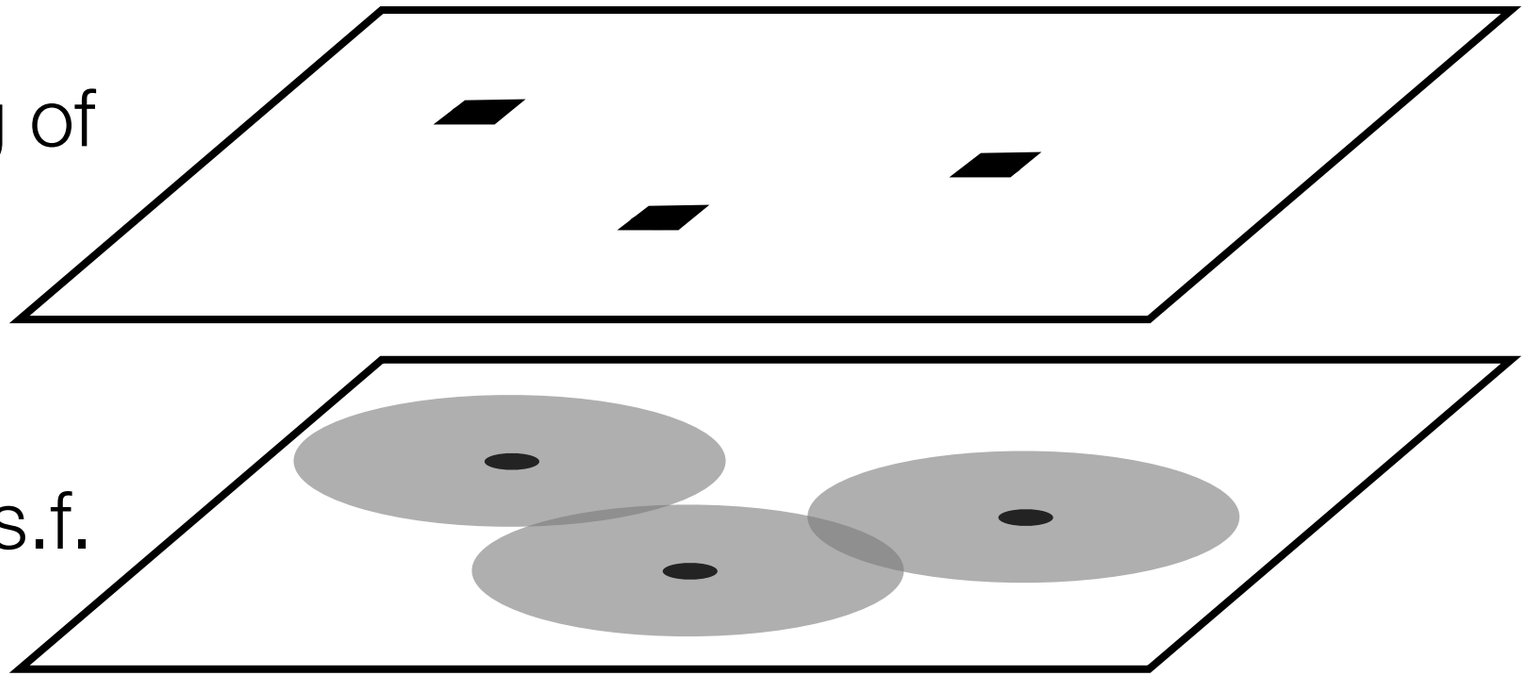
convolve with instrument p.s.f.



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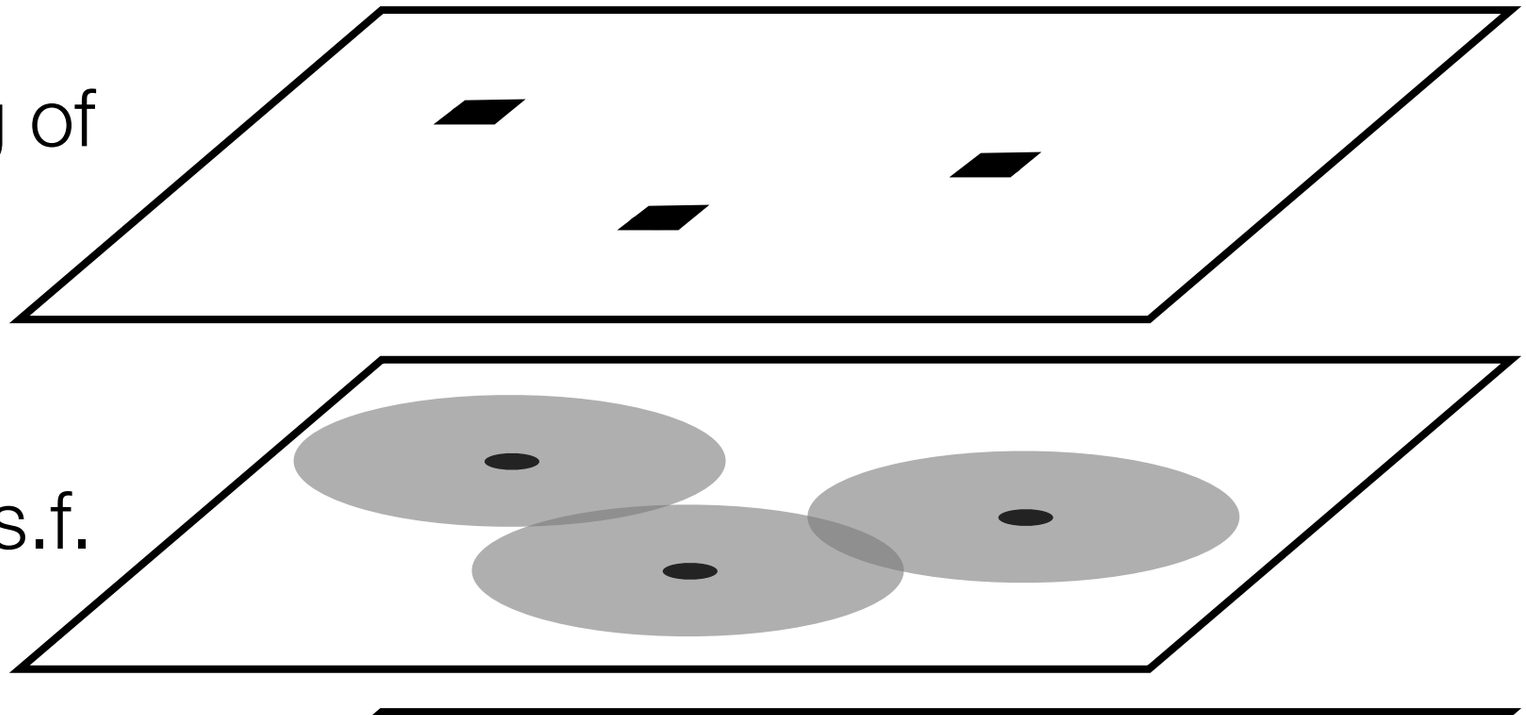
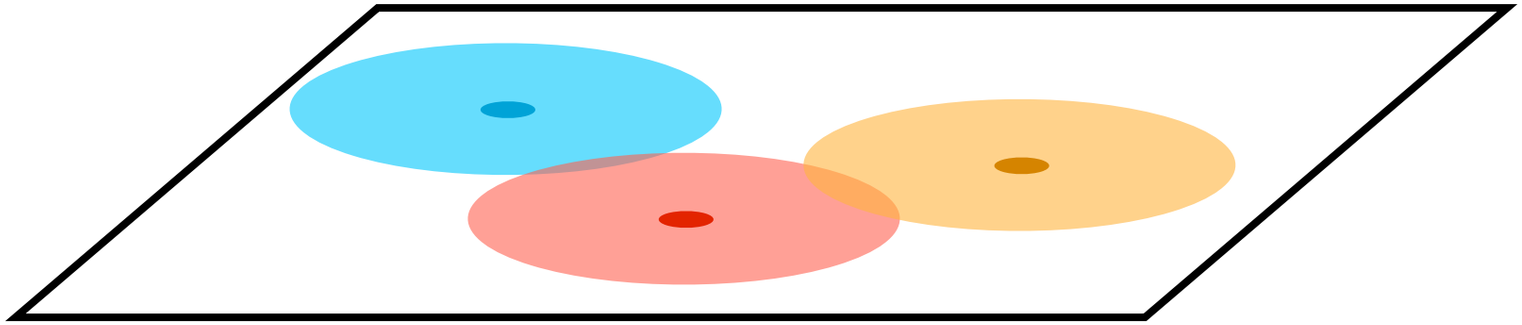


convolve with instrument p.s.f.

regress to find *mean* flux density



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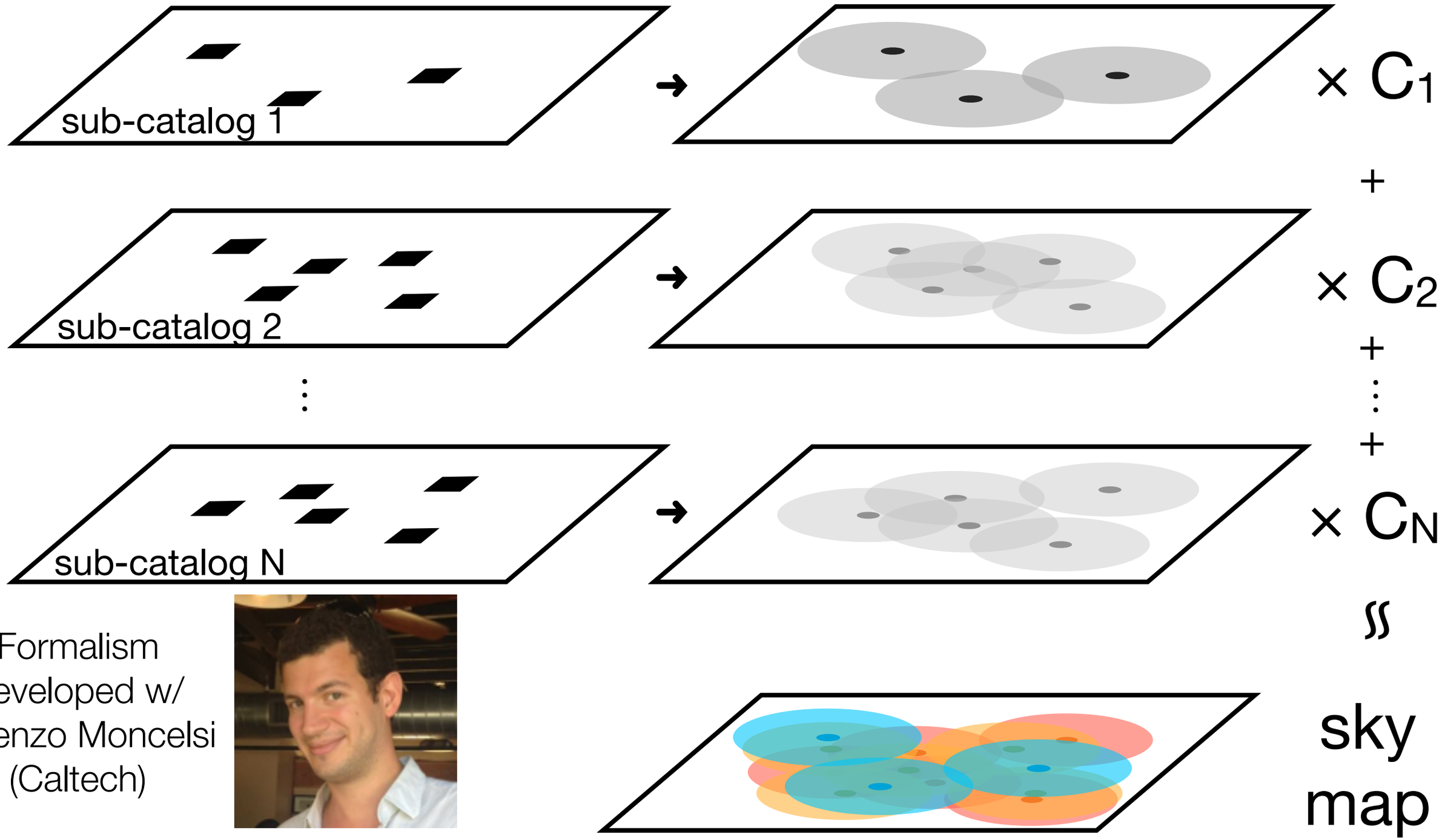

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SIMSTACK: Measurement Data

HERMES

Catalogs

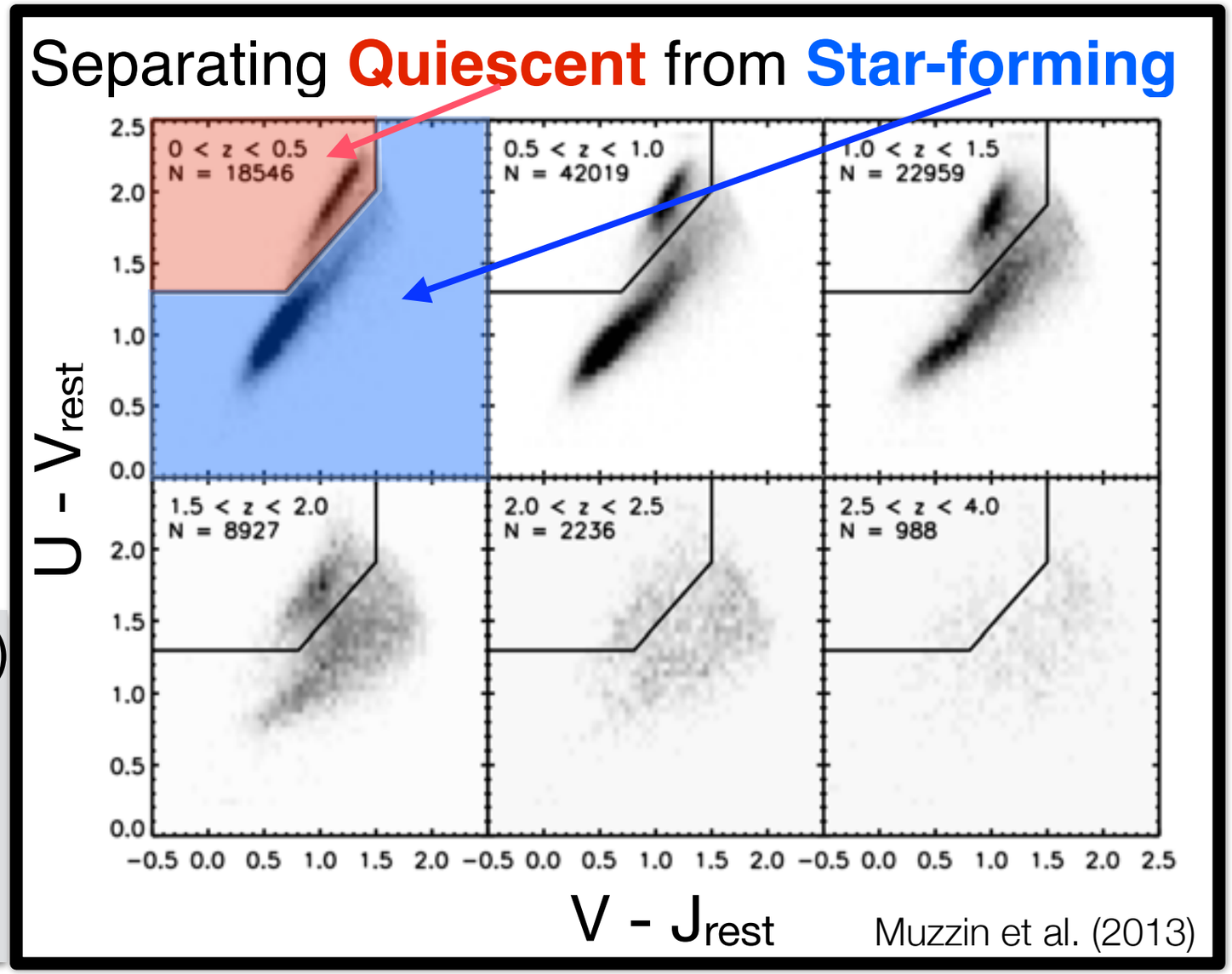
- UKIDSS/UDS [2/3 deg^2] / COSMOS [1.6 deg^2]

  uBVRizJHK + IRAC ch1234

  K-band cut 23.4 / 24 AB

  80,000 / 120,000 sources

- **Redshifts** - EAZY (Brammer 2008)
- **Masses** - FAST (Kriek 2009)
- **Colors** - UVJ (Williams 2009)



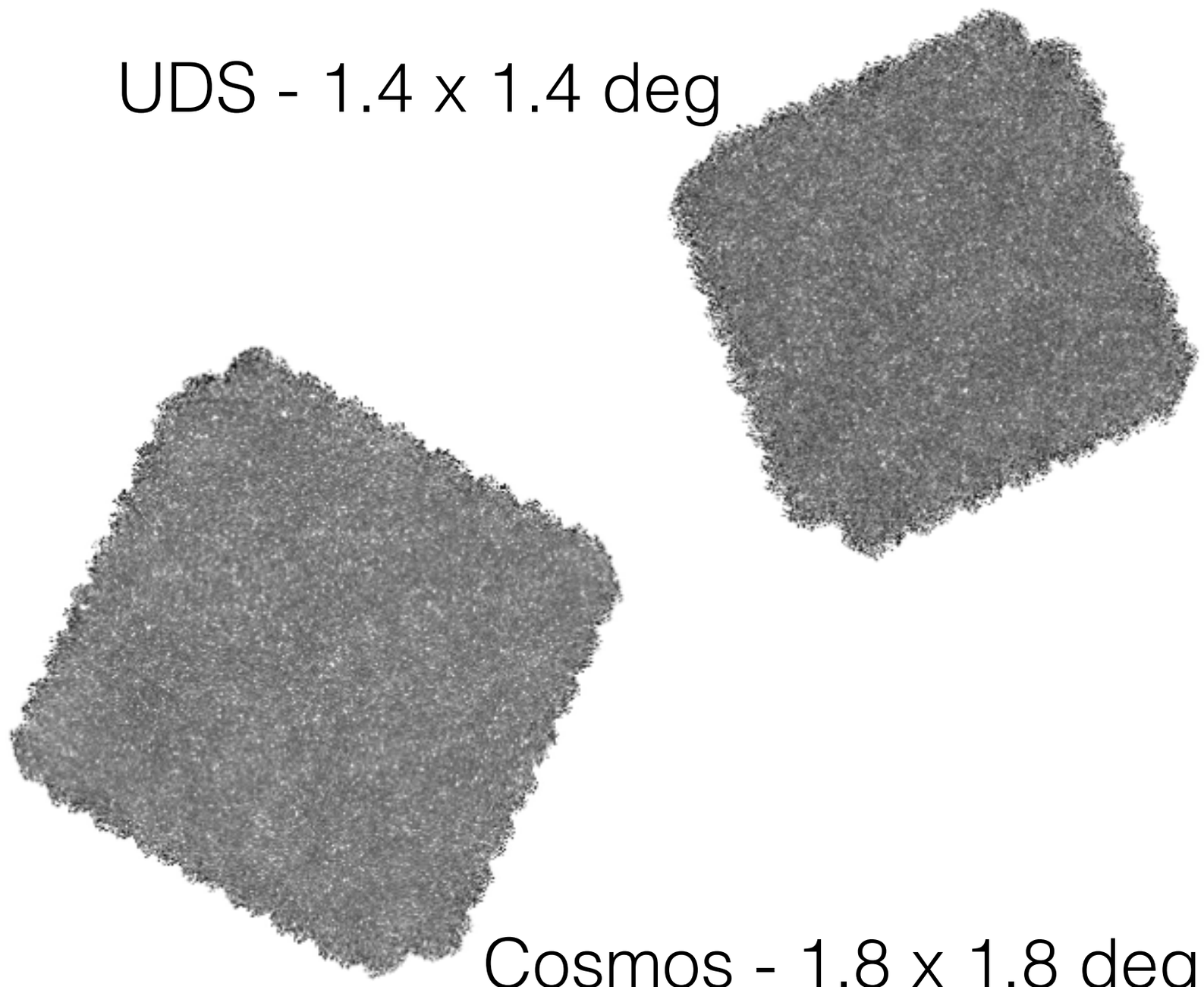
SIMSTACK: Measurement Data

HERMES

Maps

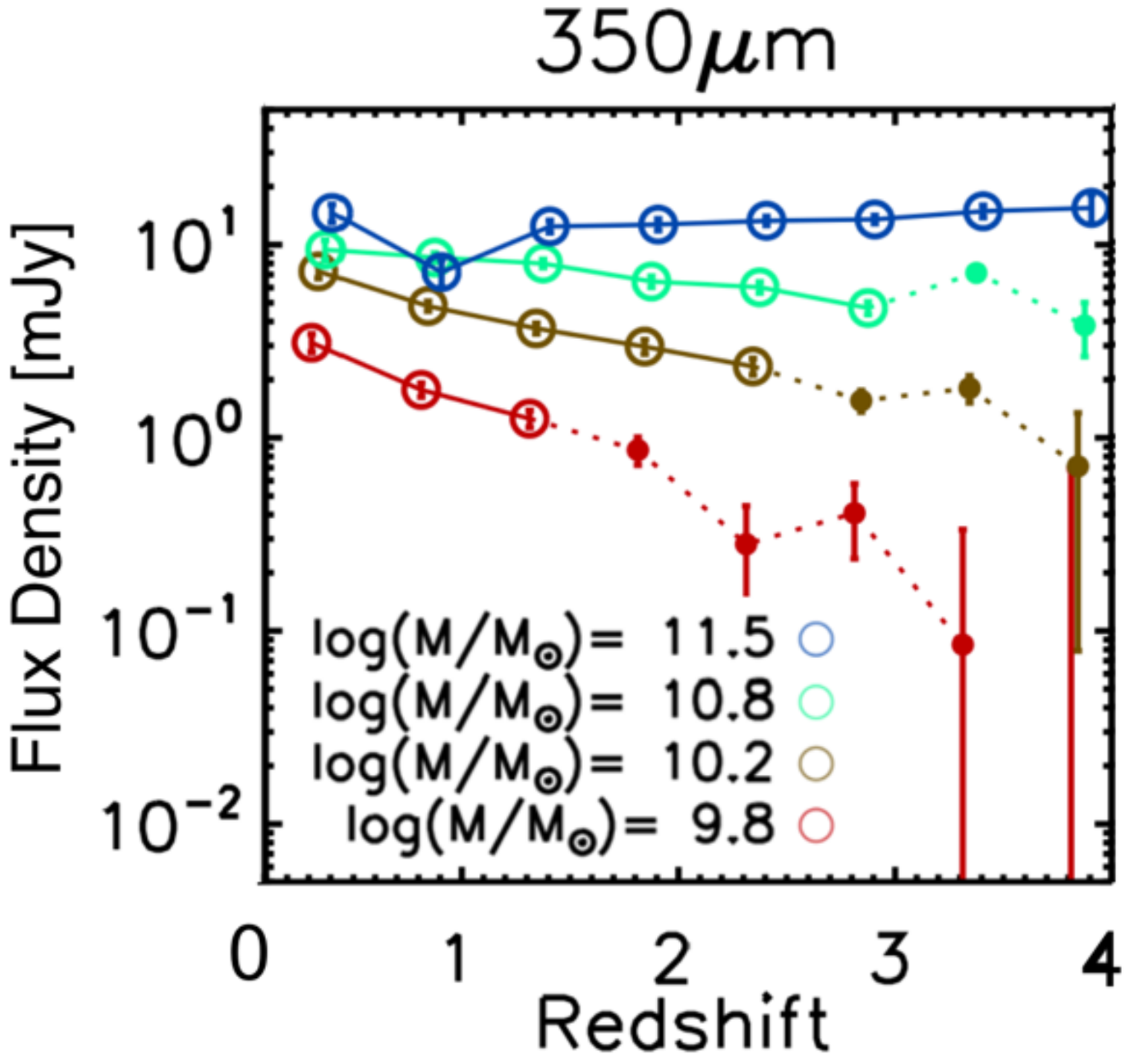
- *Spitzer*/MIPS
  - 24, 70μm
- *Herschel*/PACS
  - 100, 160μm
- *Herschel*/SPIRE
  - 250, 350, 500μm
- ASTE/AzTEC
  - 1100μm

UDS - 1.4 x 1.4 deg



Cosmos - 1.8 x 1.8 deg

SIMSTACK: Flux Densities (M,z)



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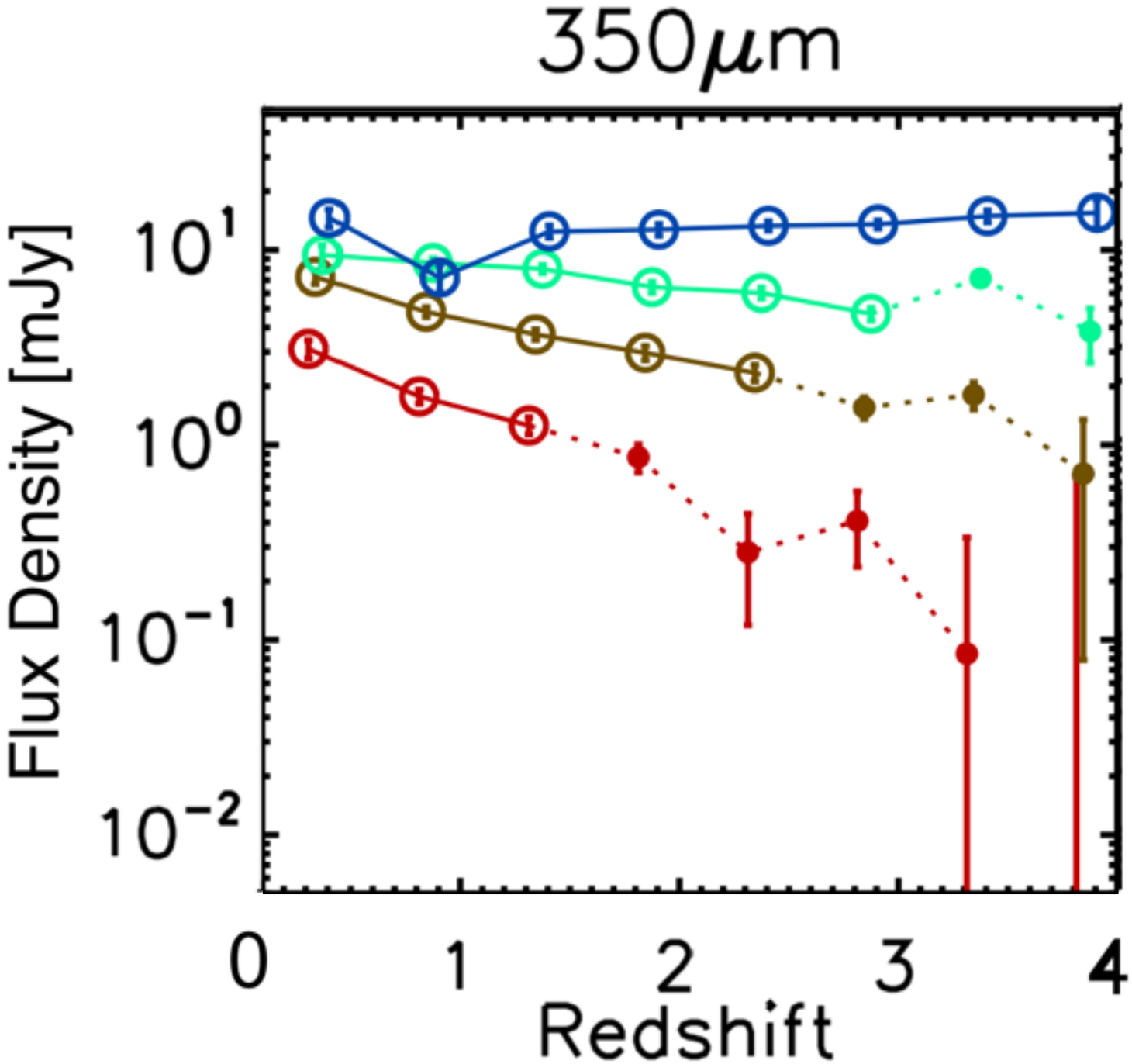

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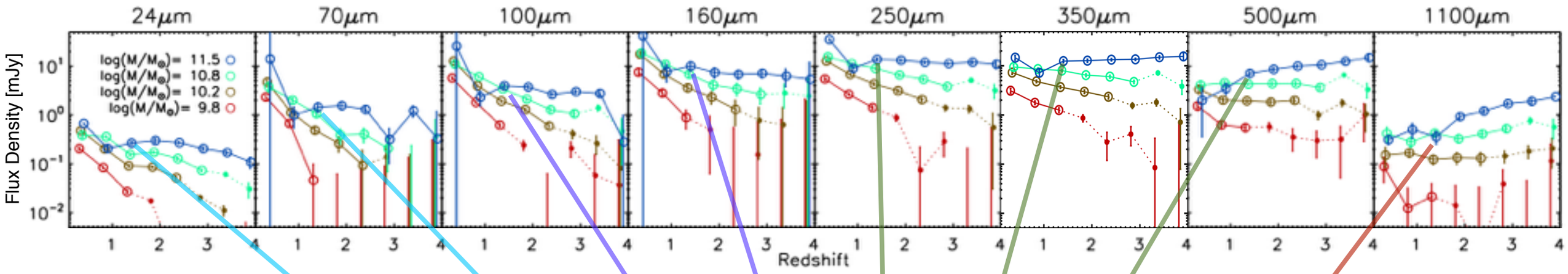
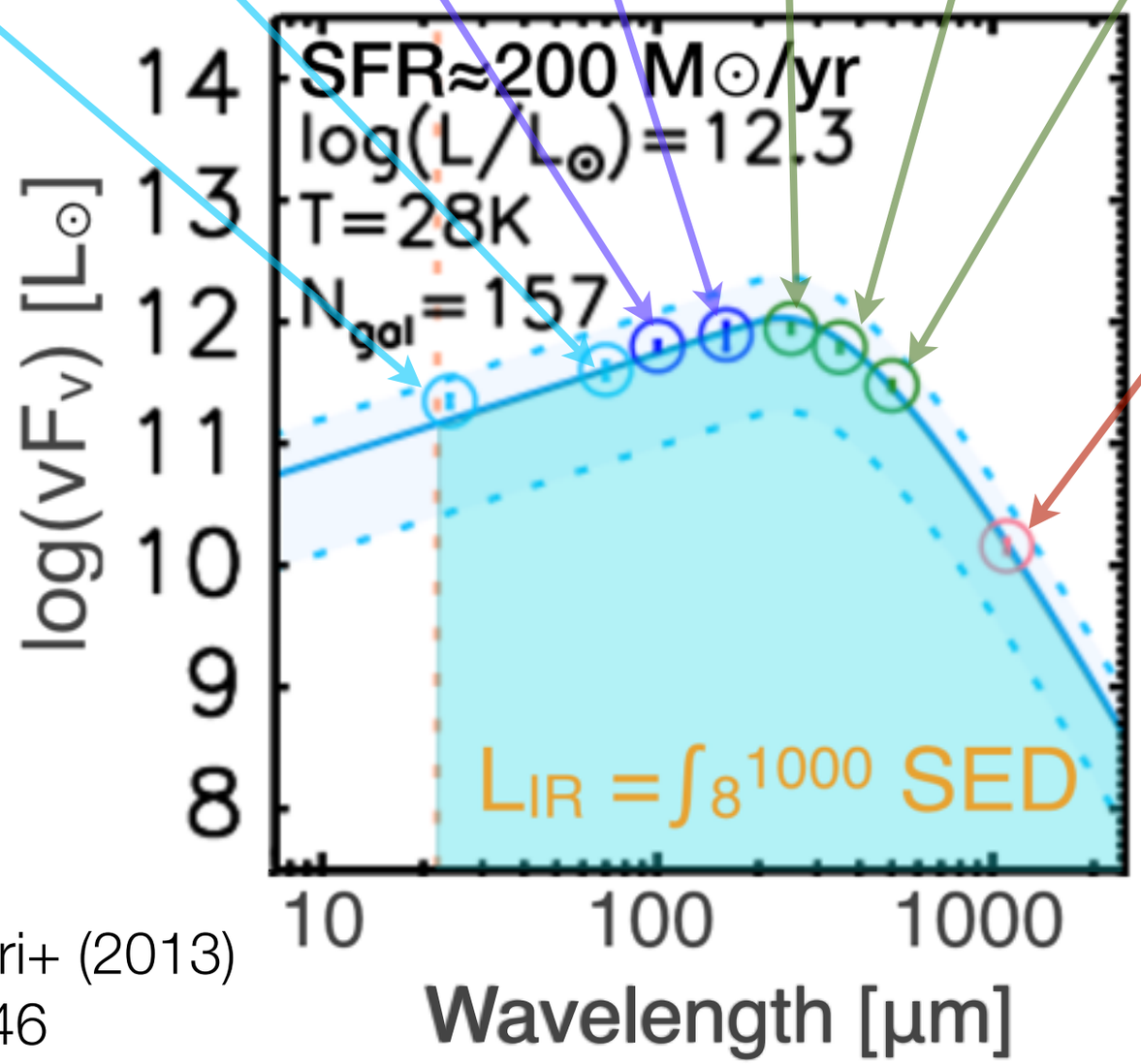


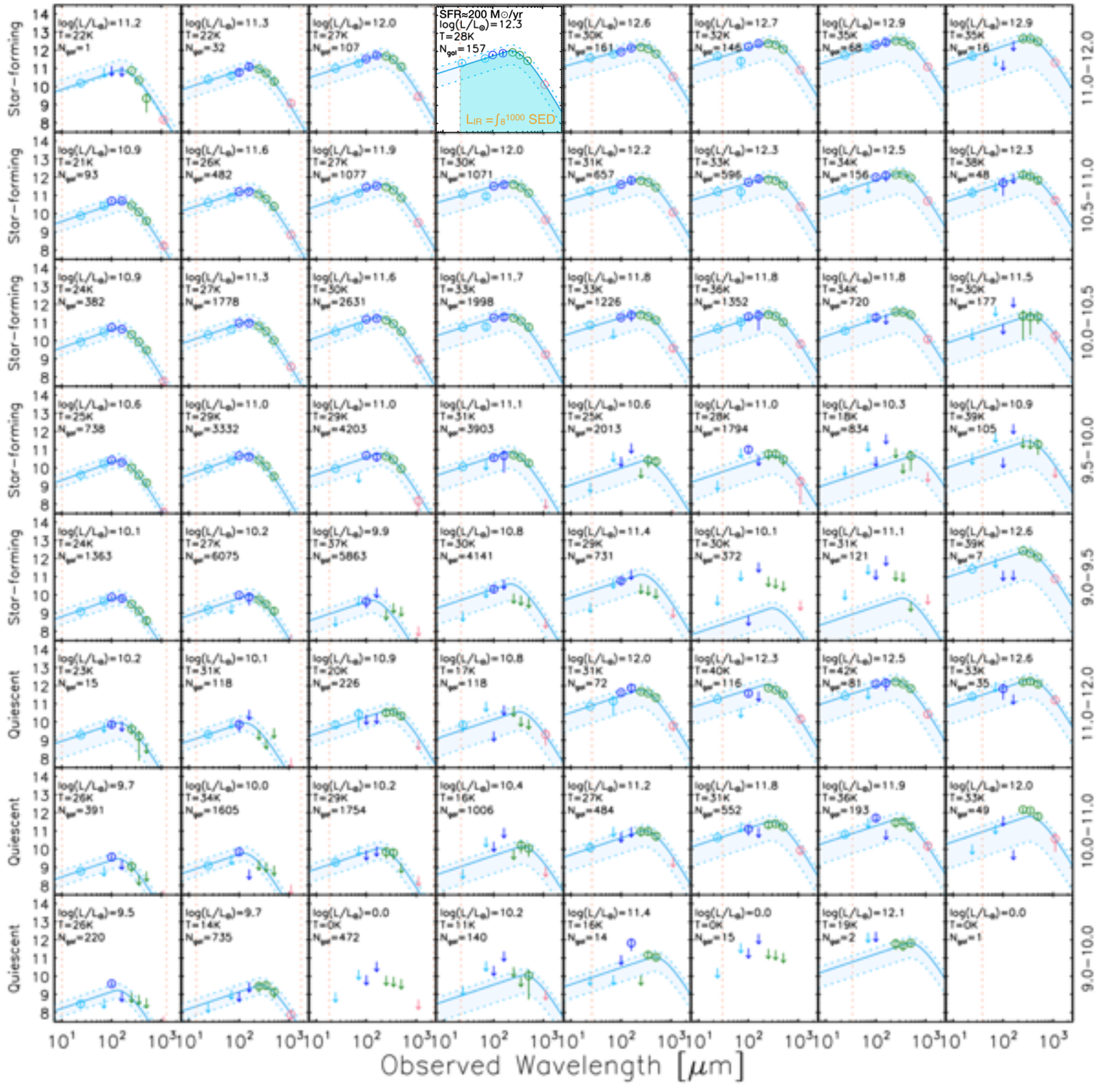


Viero, Moncelsi, Quadri+ (2013)
arXiv:1304.0446

SIMSTACK: SEDs

redshift slices

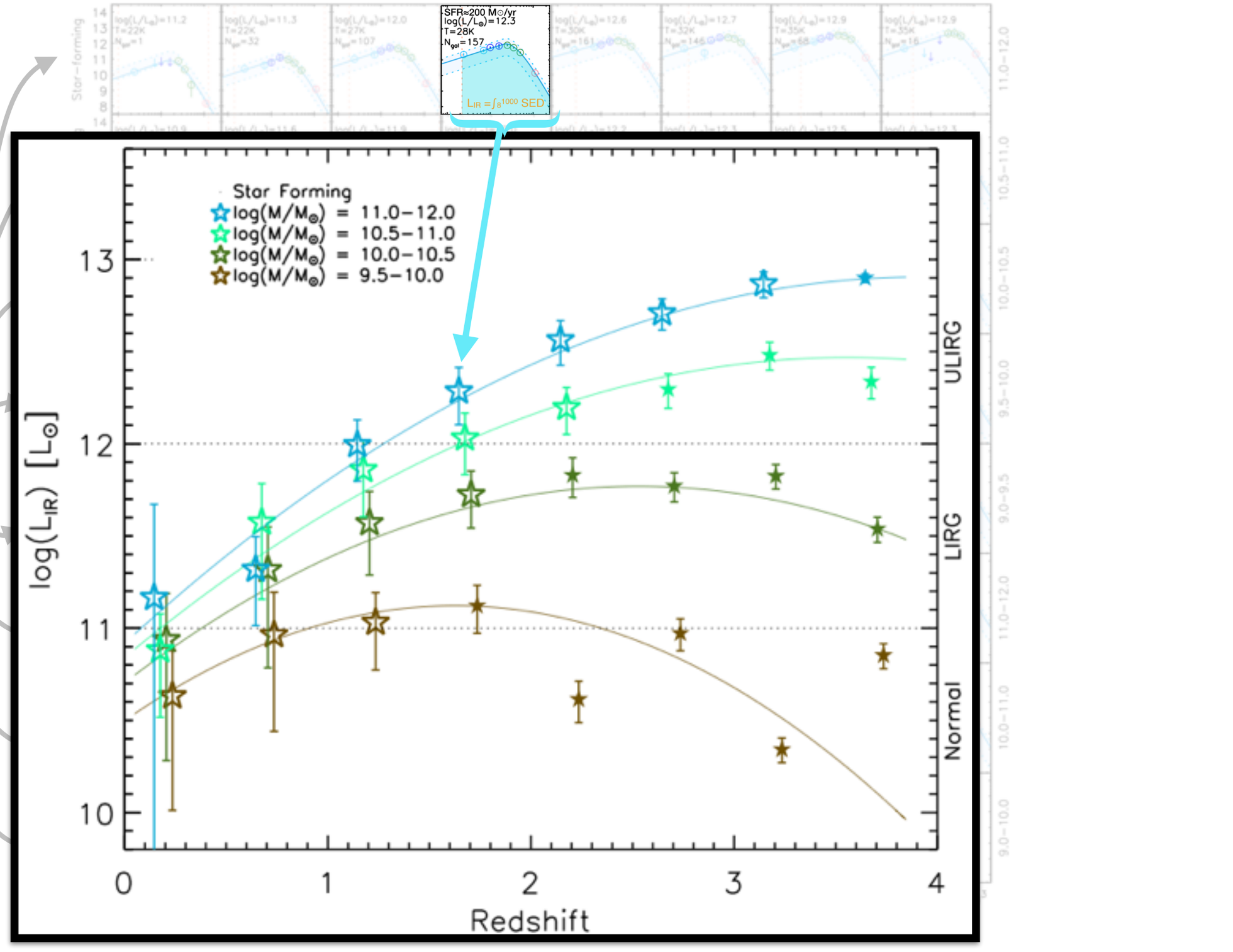
stellar mass slices



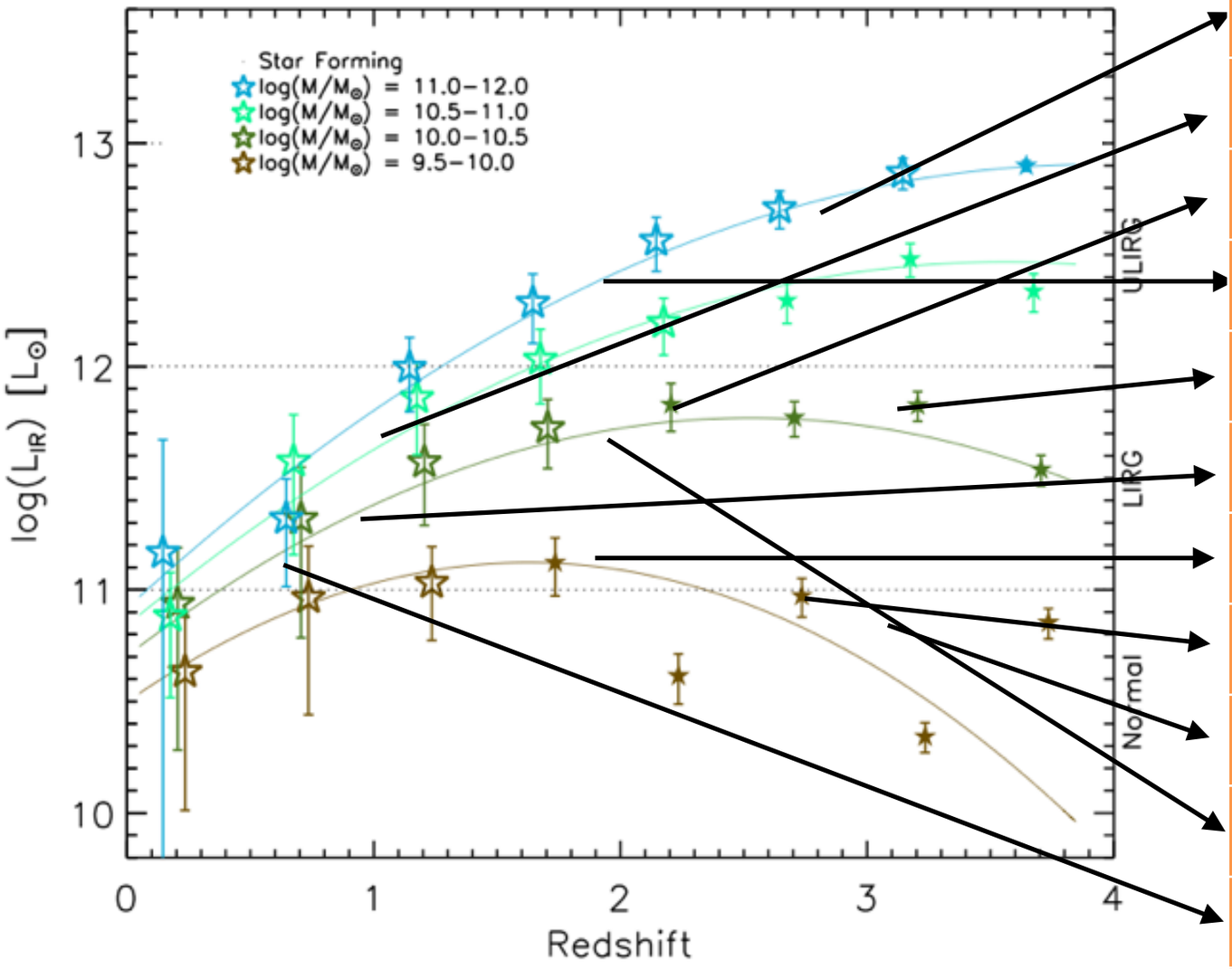
SIMSTACK: $L_{IR}(M,z)$

redshift slices

stellar mass slices



SIMSTACK: coming full circle



Flux	RA	DEC
41.4	149.853	2.608
3.5	149.854	2.258
4.4	149.752	2.584
16.7	149.832	2.724
22.5	149.275	2.196
3.6	149.262	2.966
5.8	149.915	2.206
3.1	149.546	2.564
2.3	149.824	2.047
4.0	149.453	2.278
2.1	149.863	2.788
…	…	…

Viero, Moncelsi, Quadri et al. (2013)
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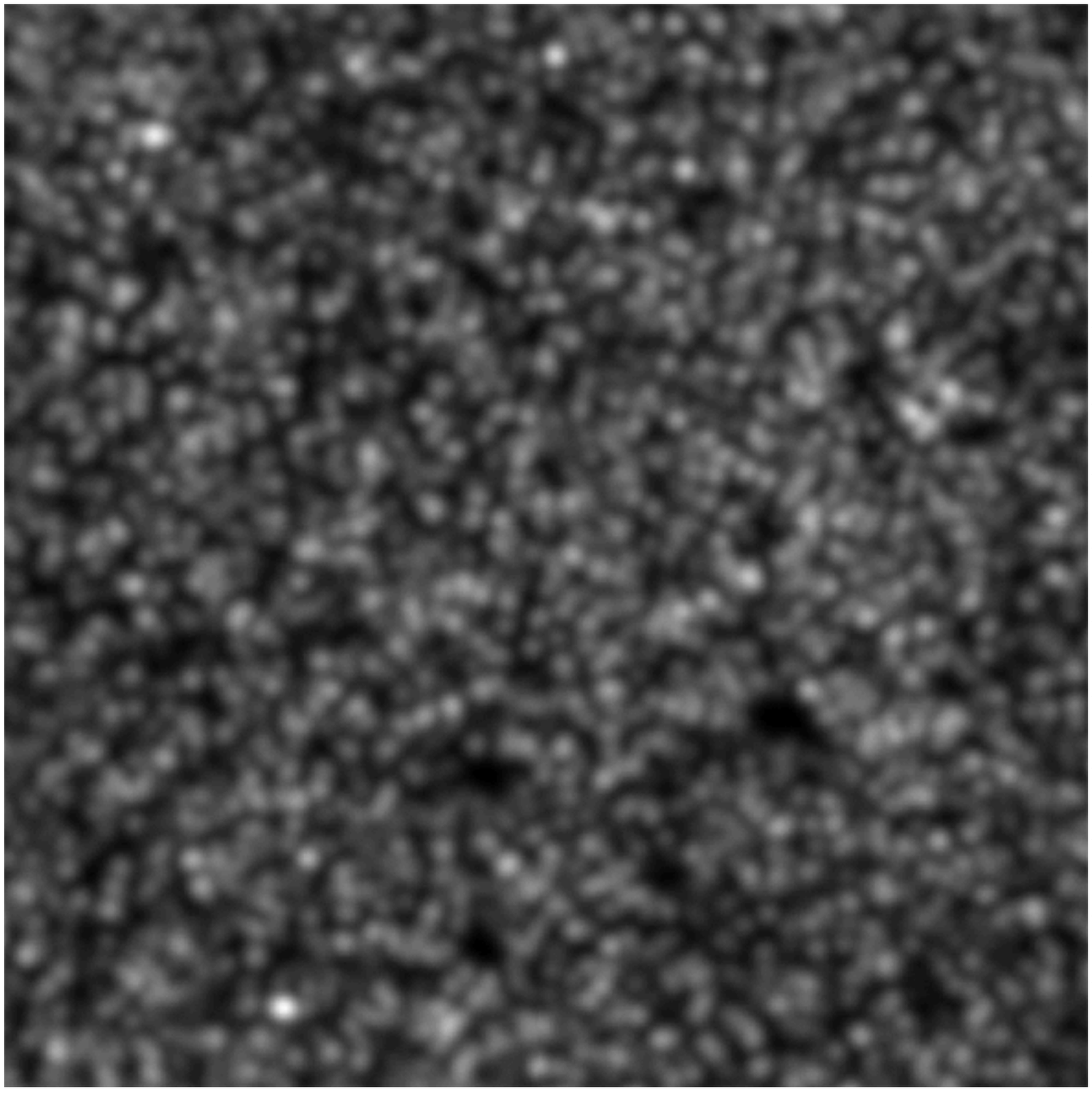
SIMSTACK: simplest results



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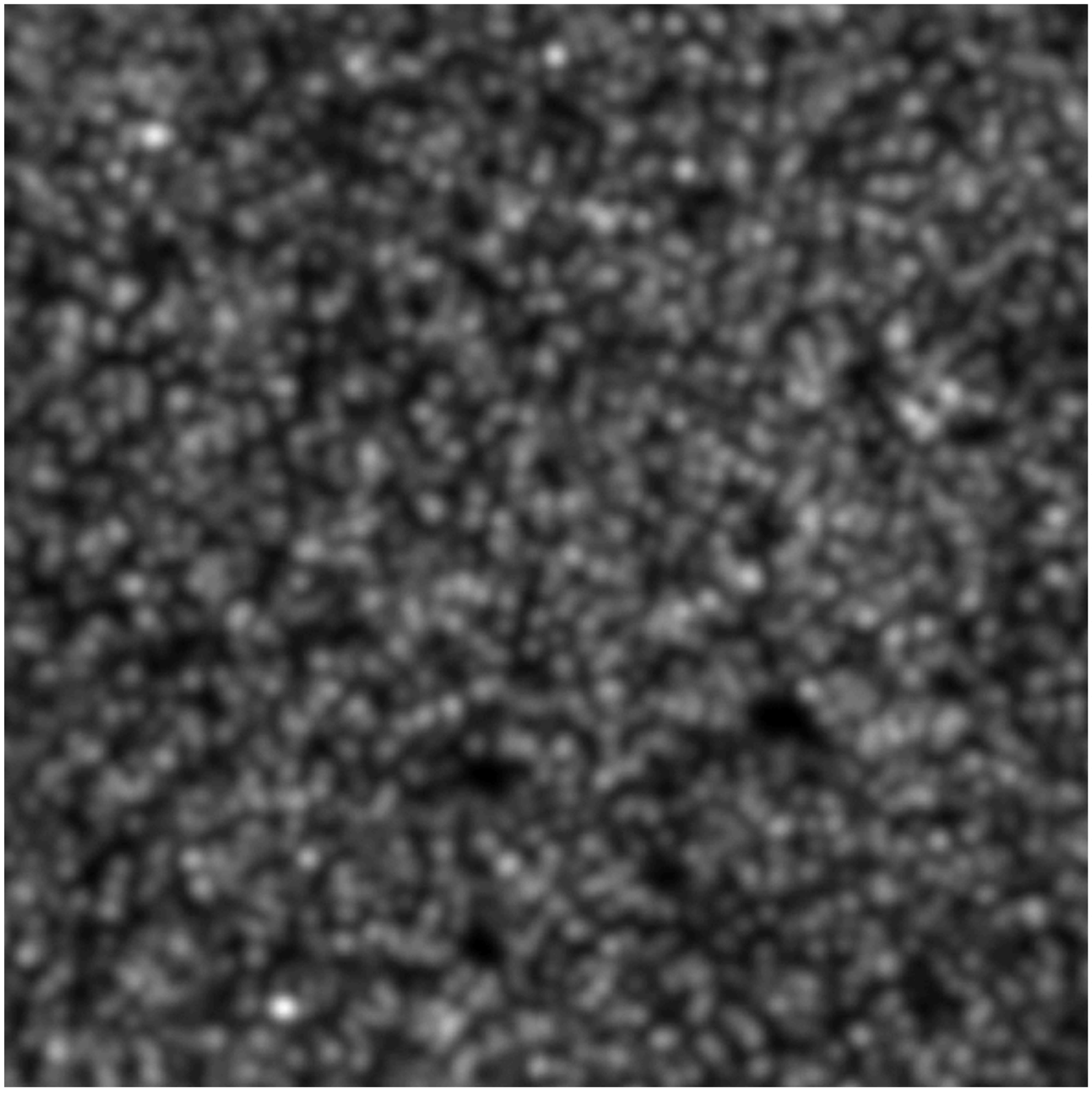

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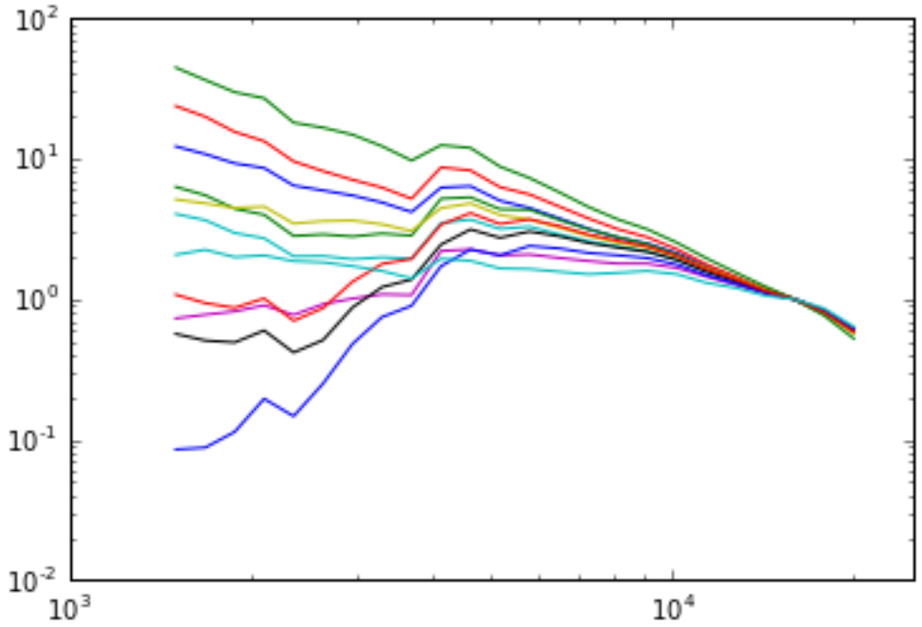
Model SEDs

Towards taking full advantage of SIMSTACK

SIMSTACK: Beyond Colour

- Full SED Categorization
  - ➡map physical features to FIR flux



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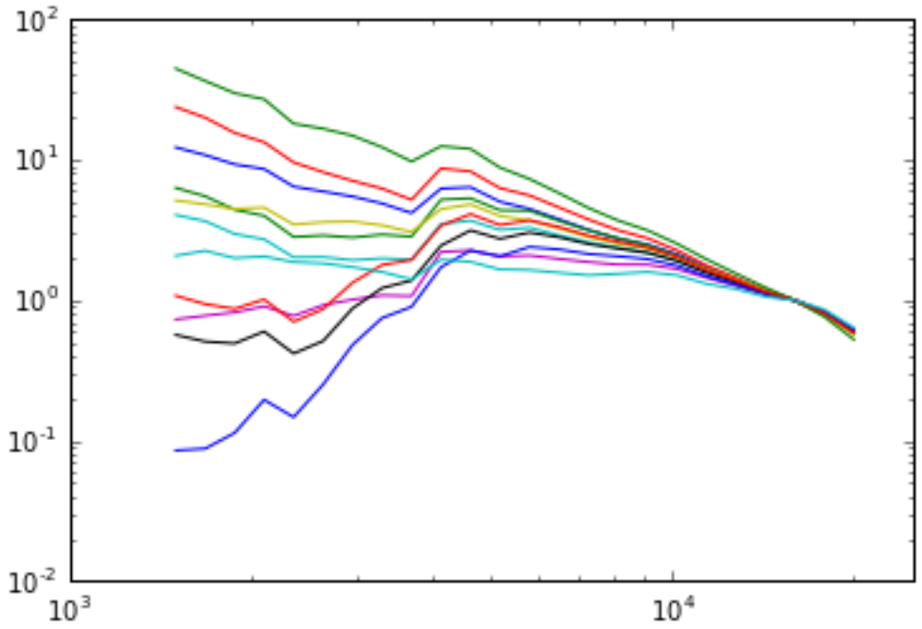
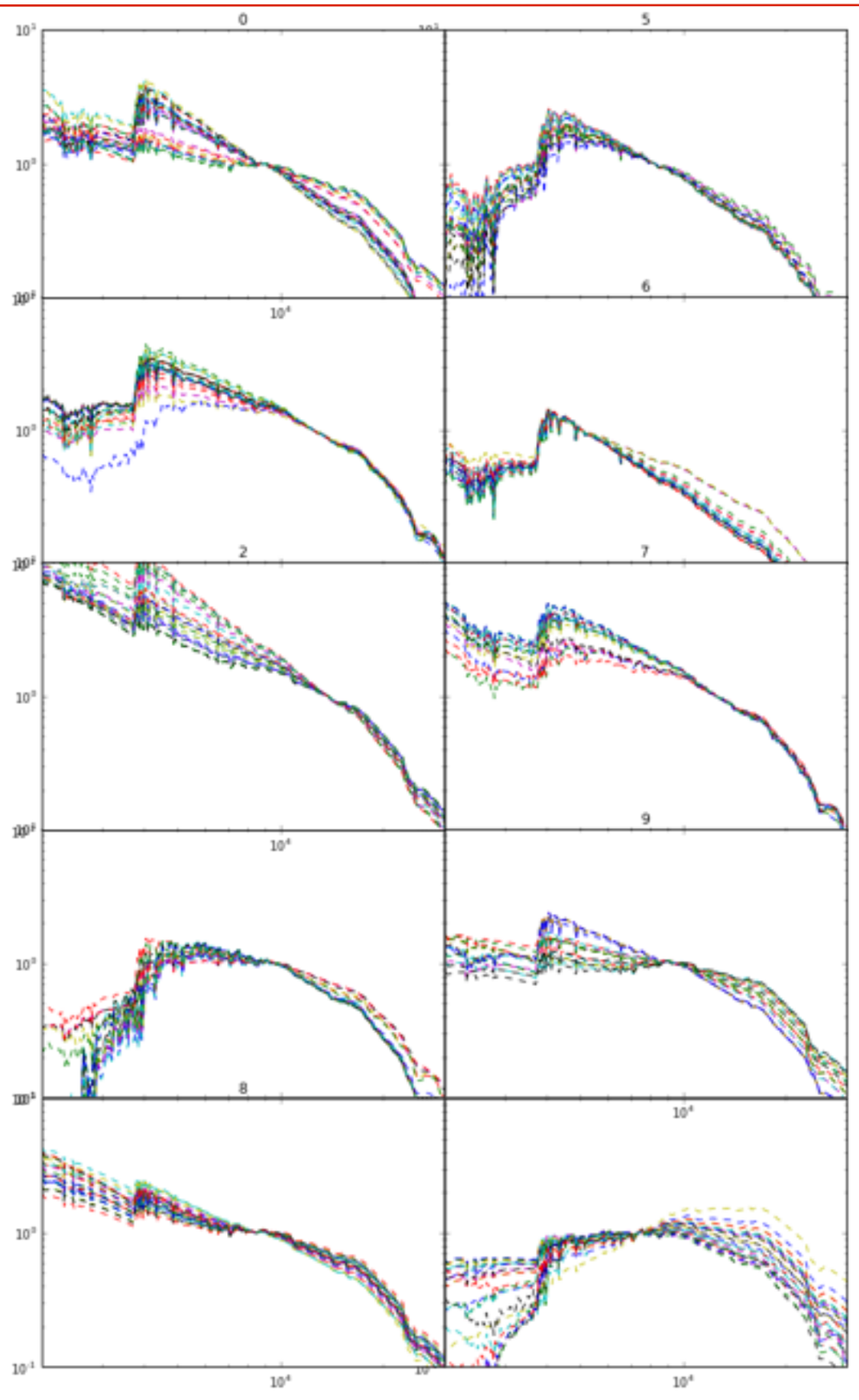


Split into layers



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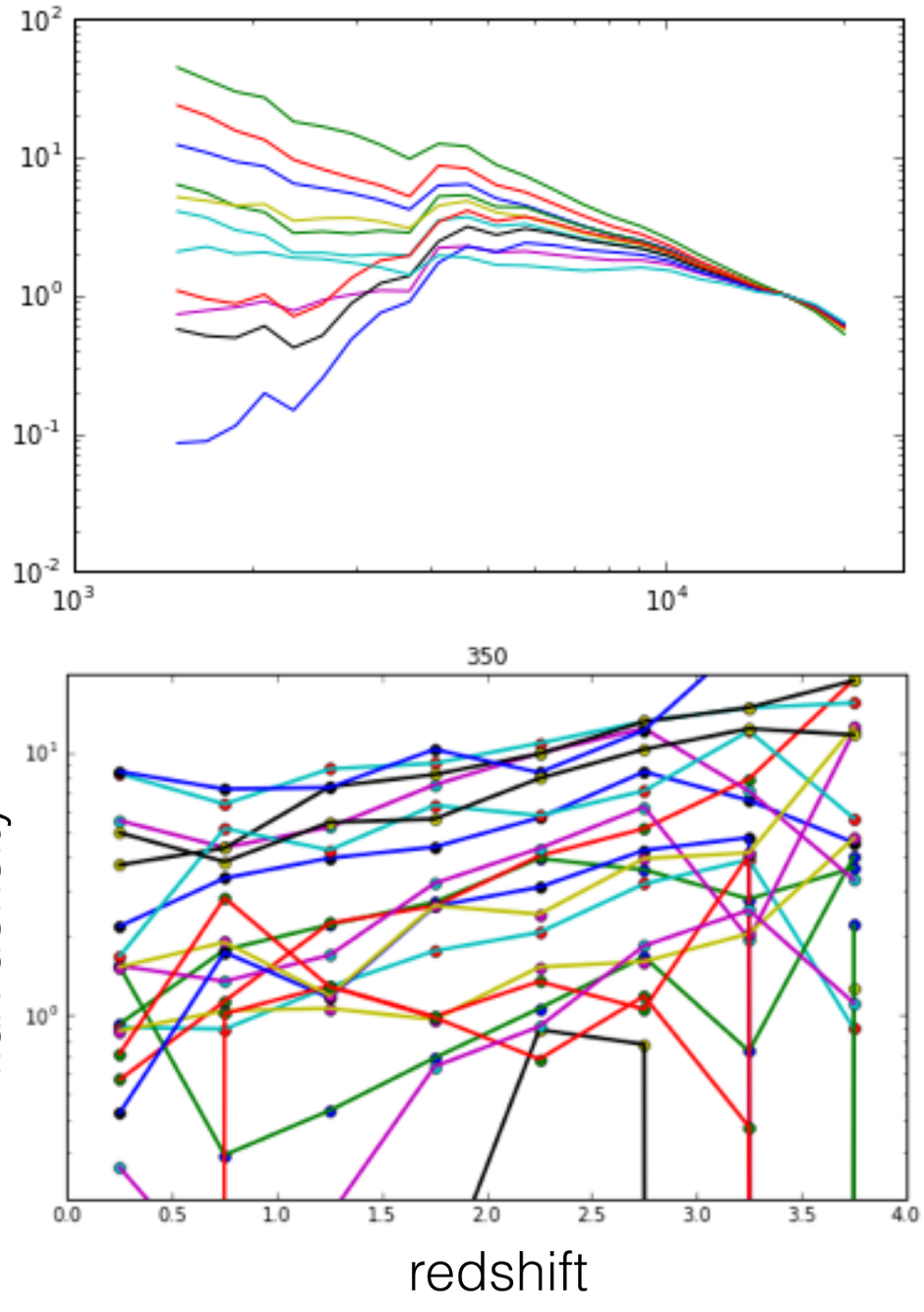
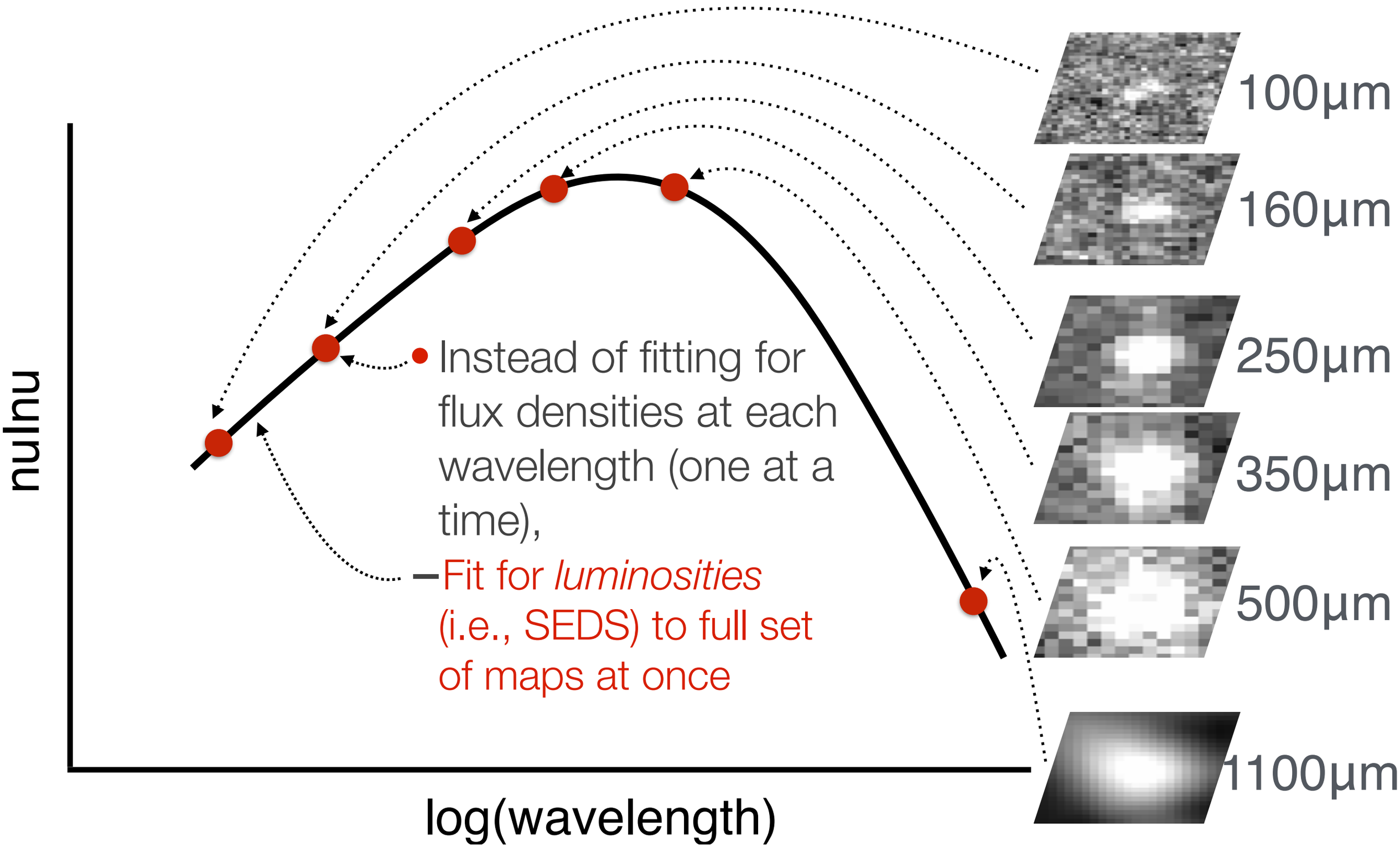


SEDSTACK

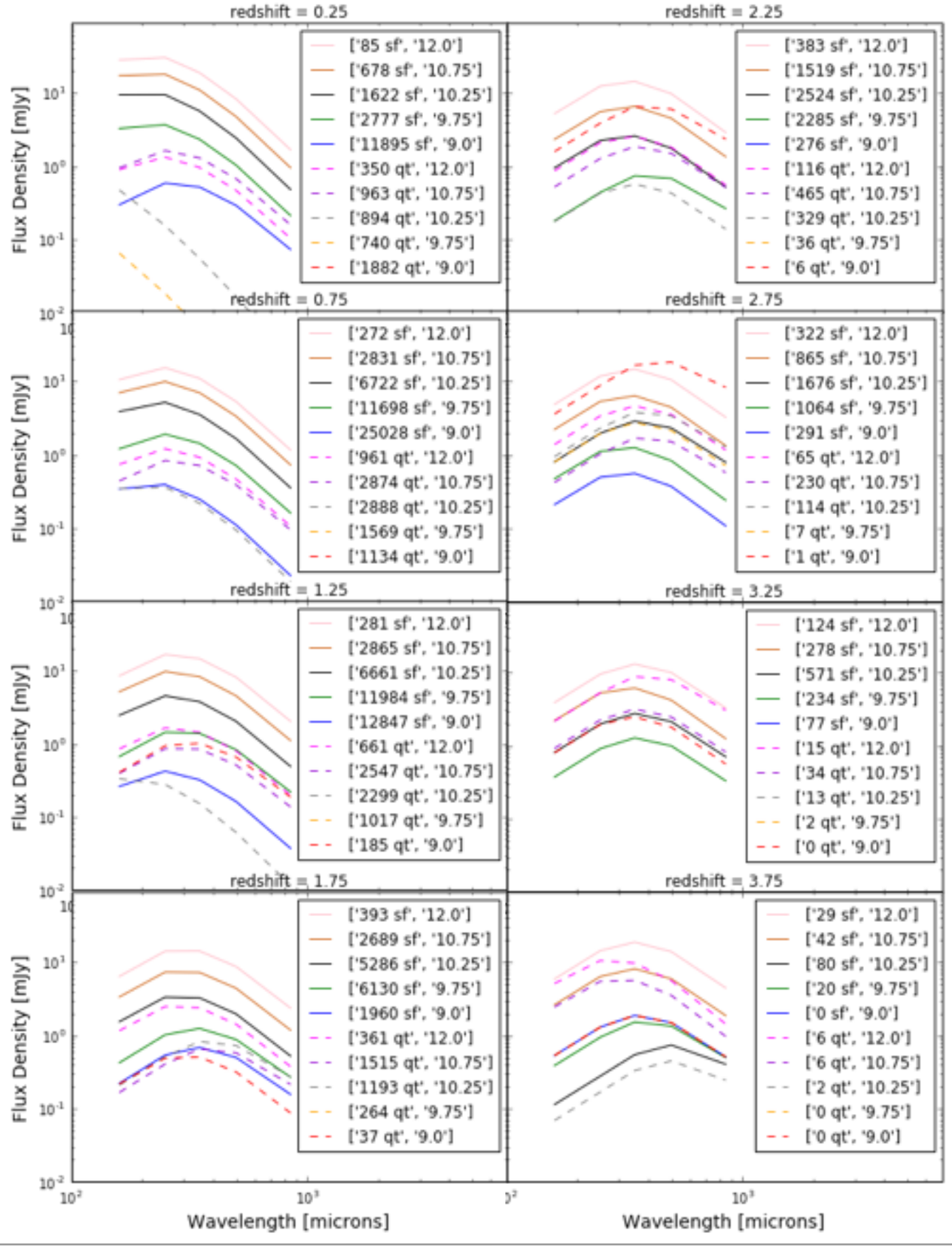
An extension of SIMSTACK

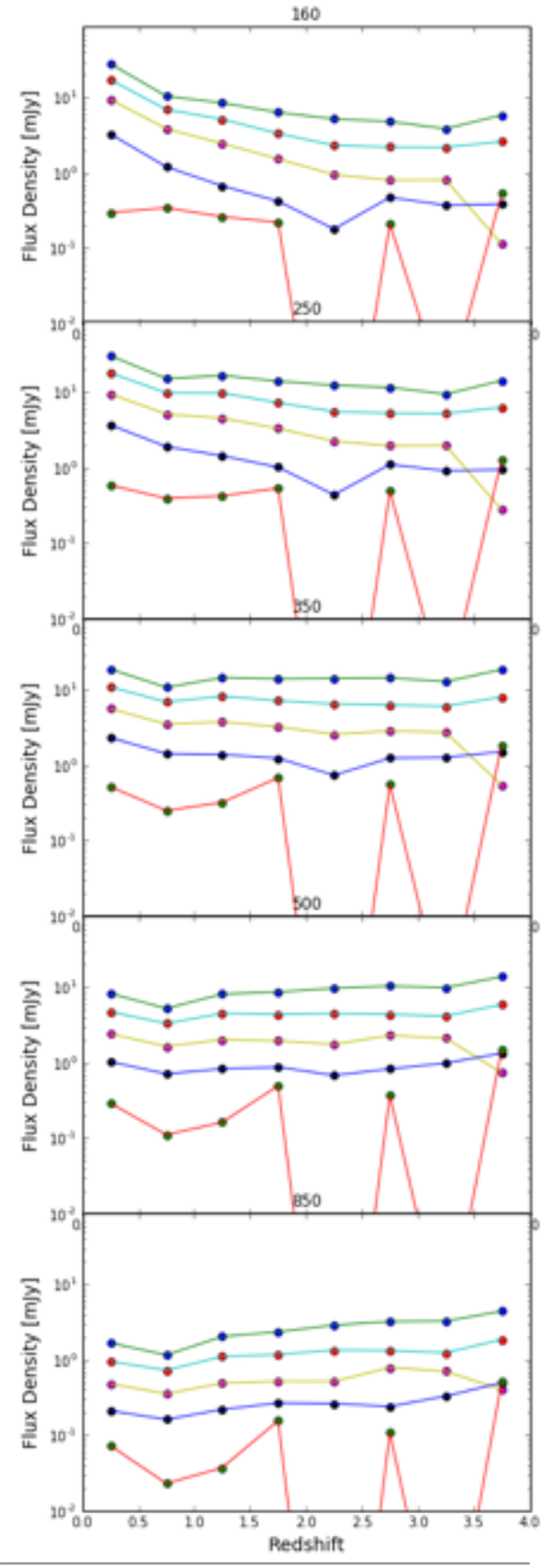
SEDSTACK: Beyond Flux



SEDSTACK in z - M - QT/SF bins

- Advantages:
  - ➡ leverage high S/N components to better constrain faint-end
- To-do:
  - ➡ quantify improvement
  - ➡ speed up
  - ➡ Emcee to measure full posterior





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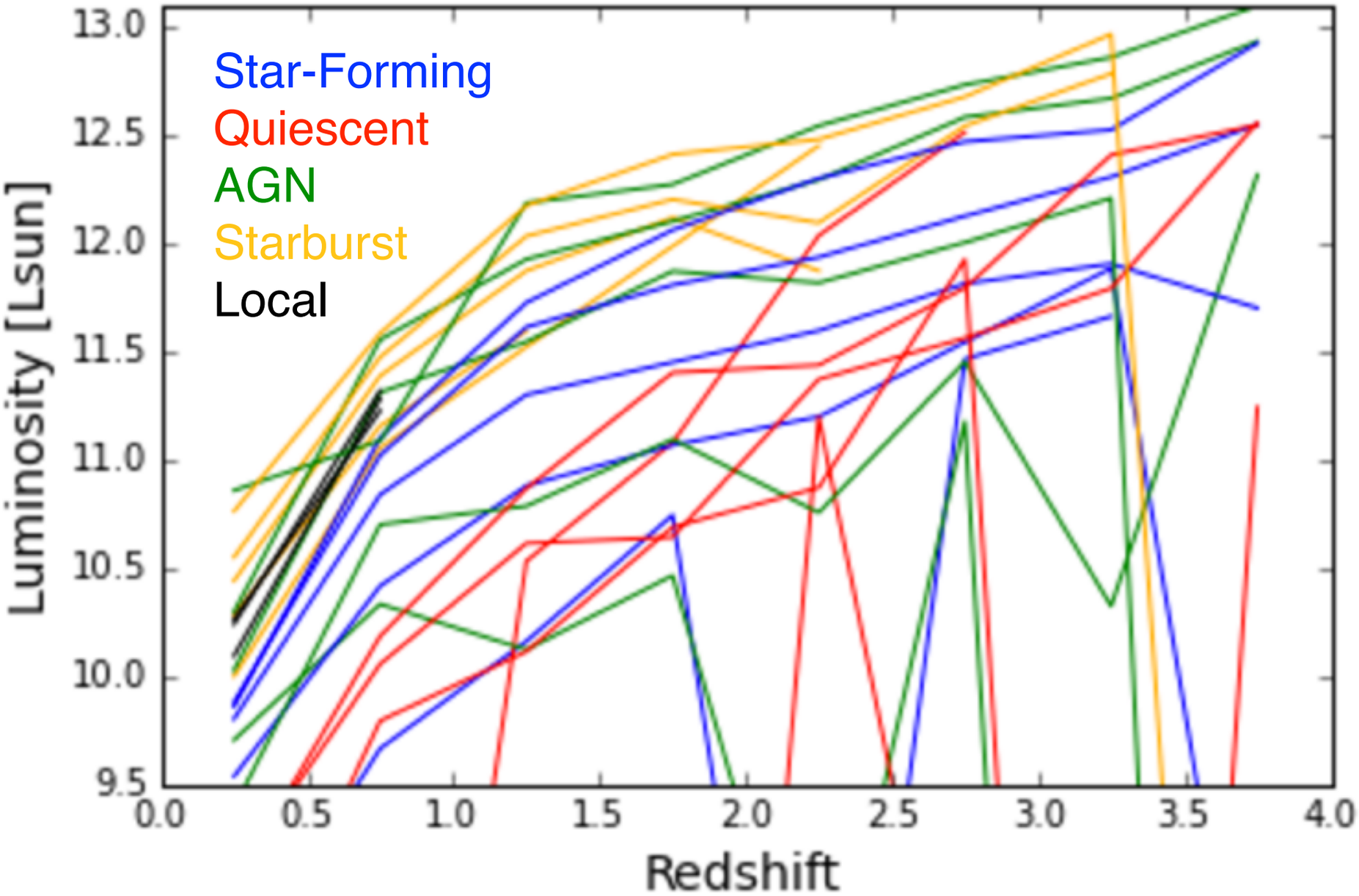

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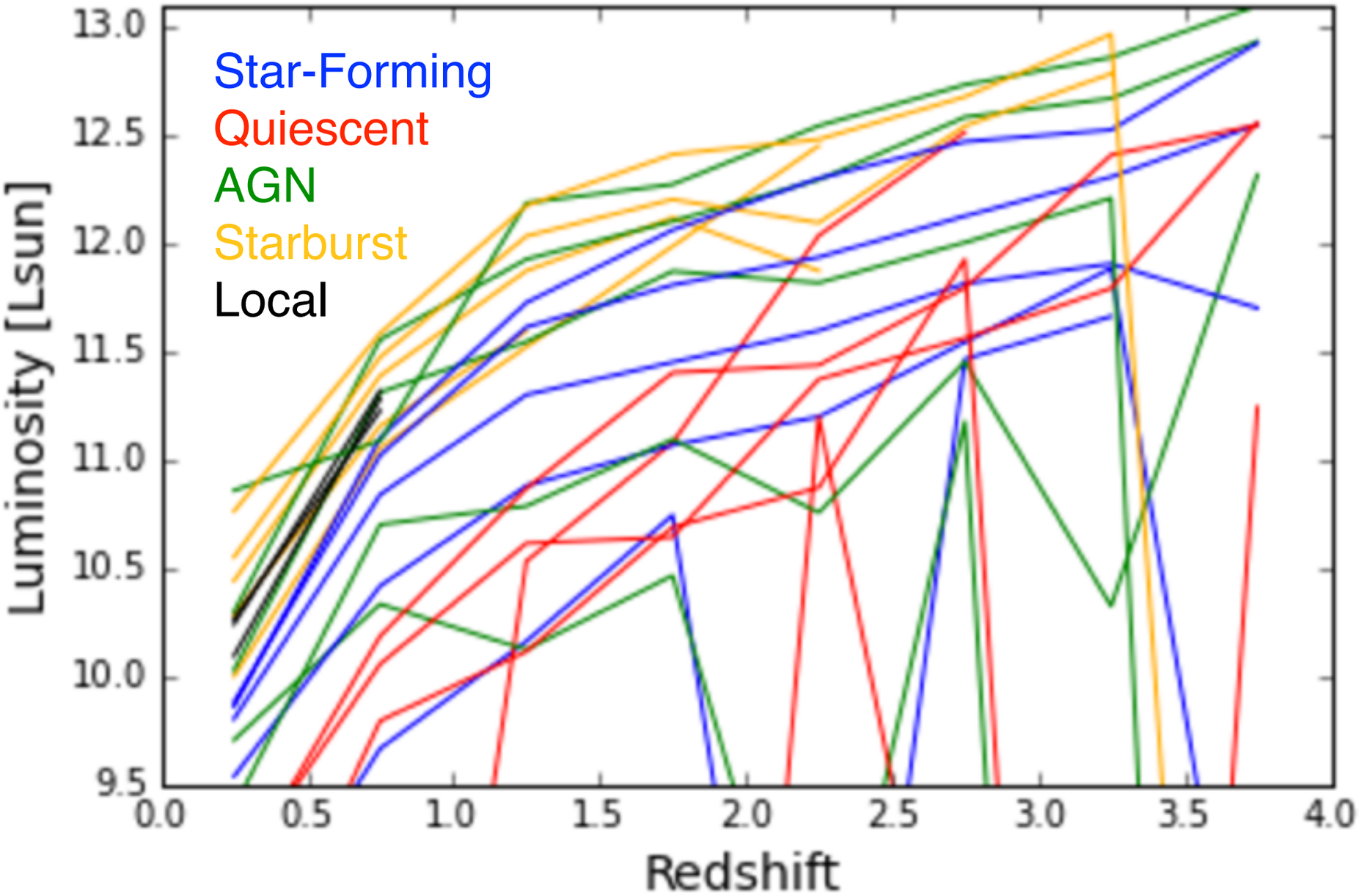

- SEDSTACK lets us explore more layers (e.g, here 25)

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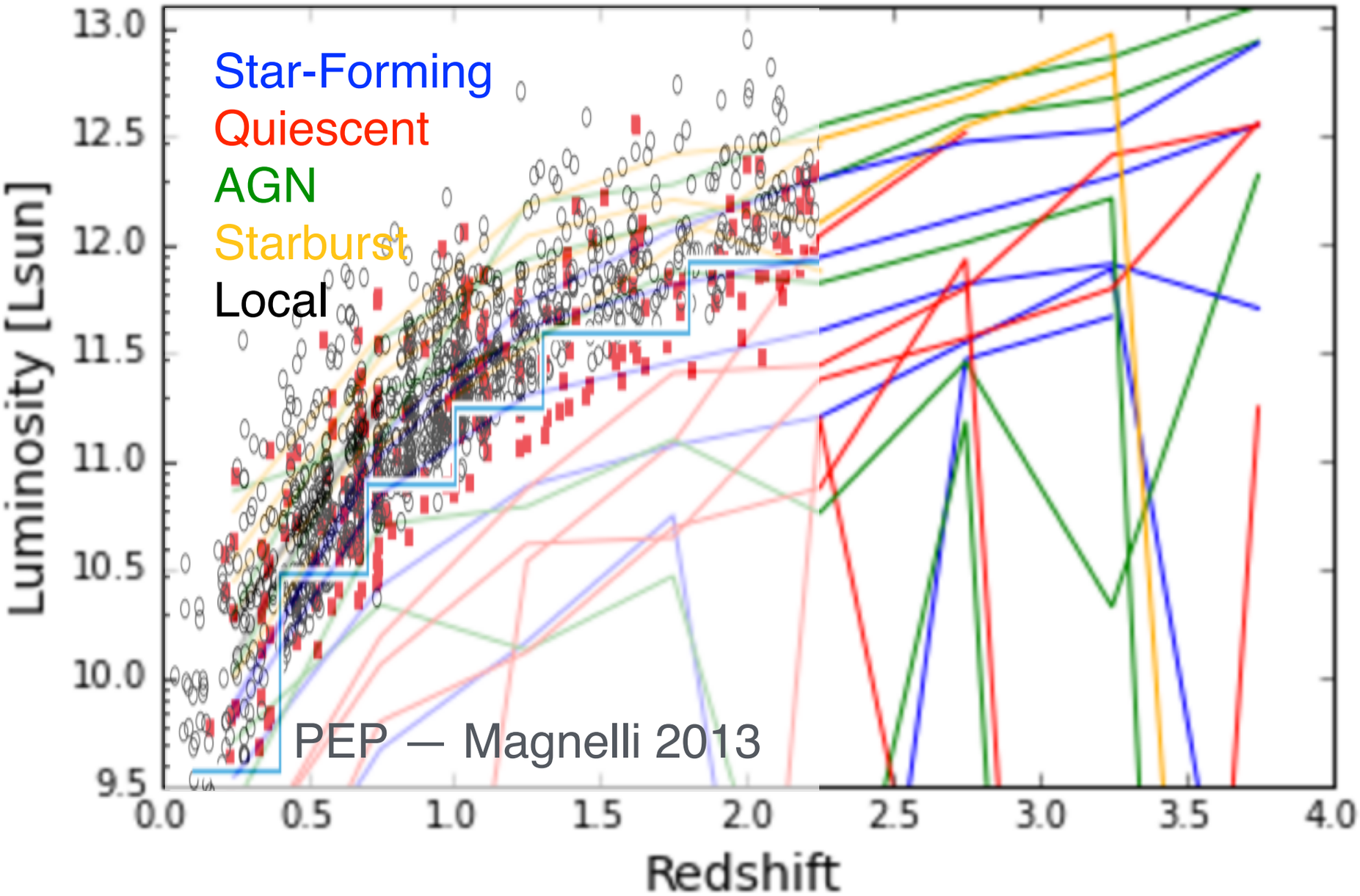


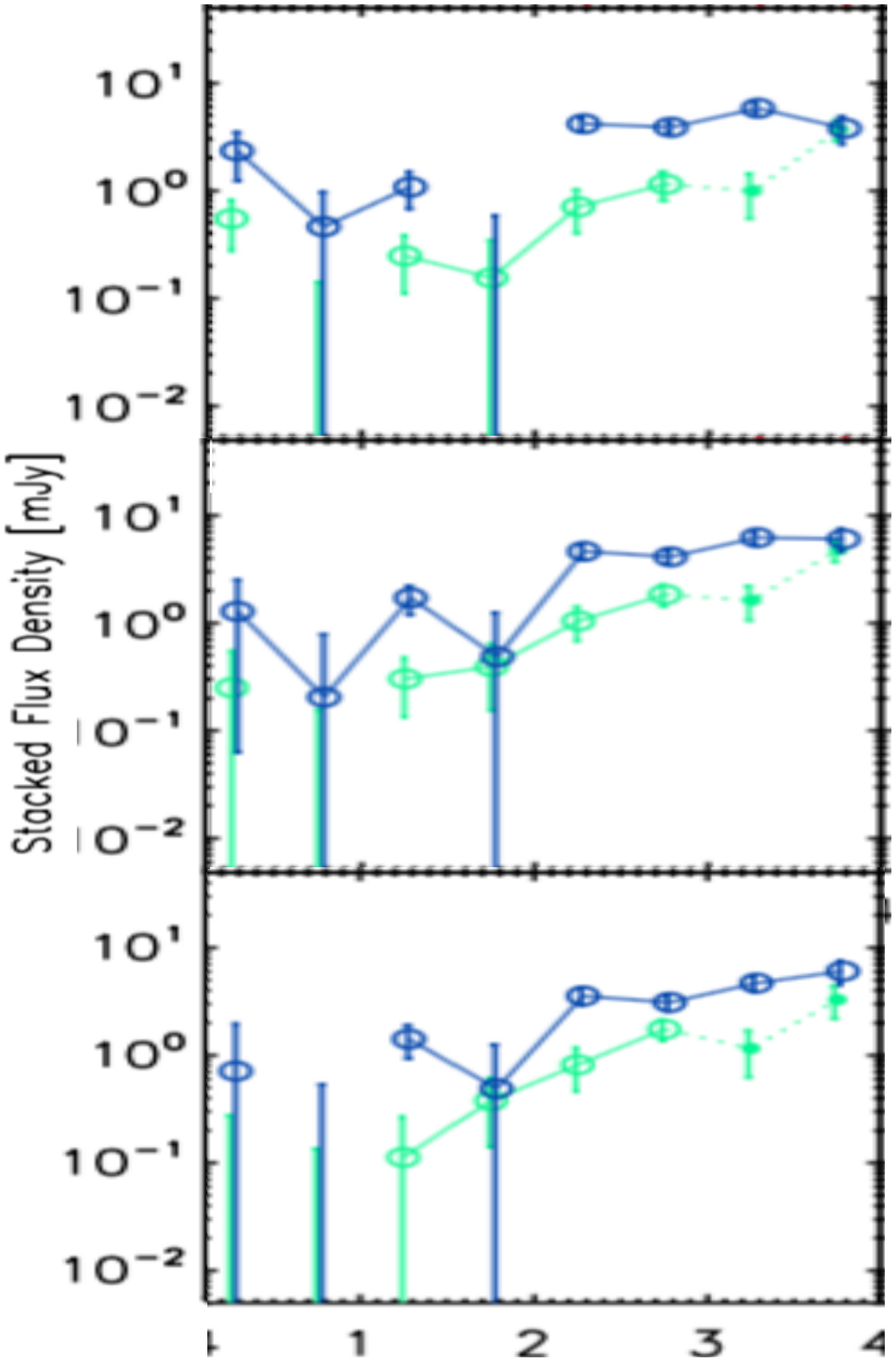
- SEDSTACK lets us explore more layers (e.g, here 25)
- Similar behavior to that found in Magnelli (2013)

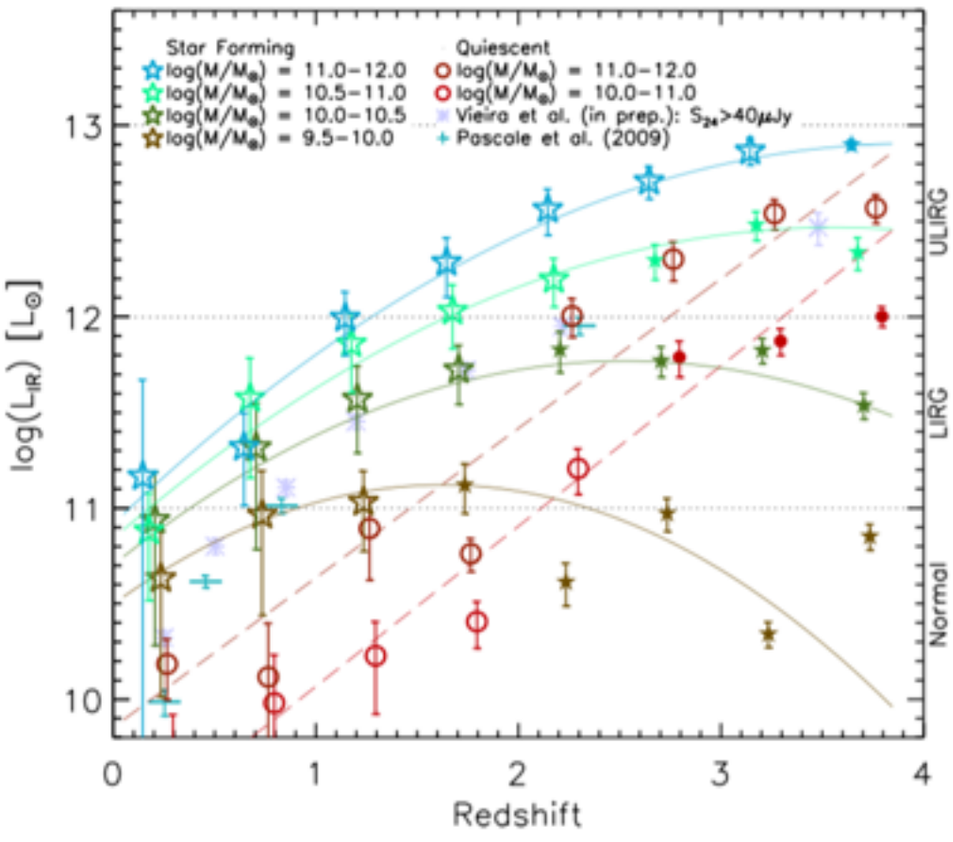
What is this?

Weird results from SIMSTACK

Luminous High-z Quiescent Galaxies? UVJ failure?

- High-z "quiescent" (UVJ) sources in UDS very luminous!
- Confirm this behavior with alternative catalogs and maps (UVISTA/ COSMOS)





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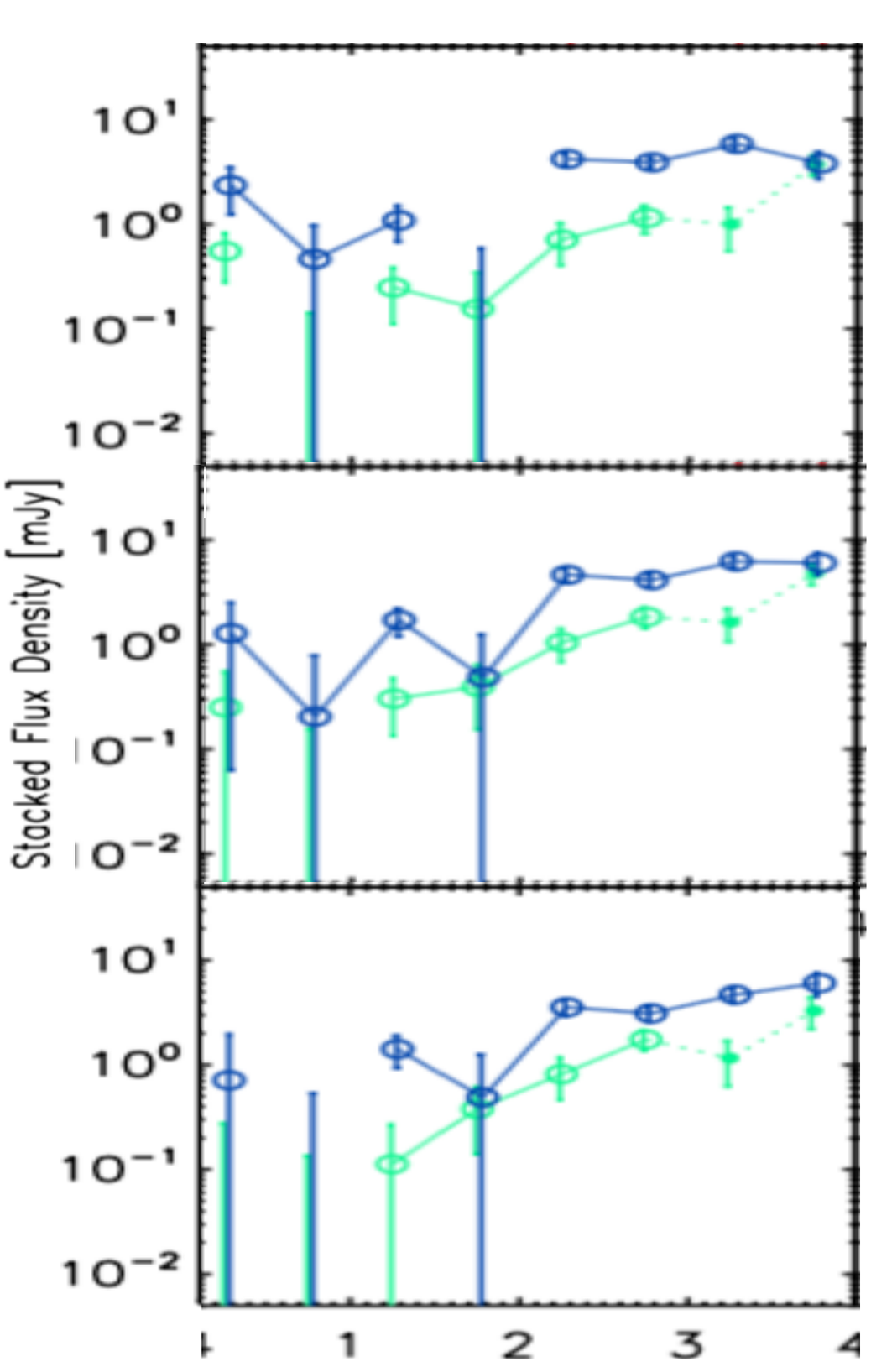

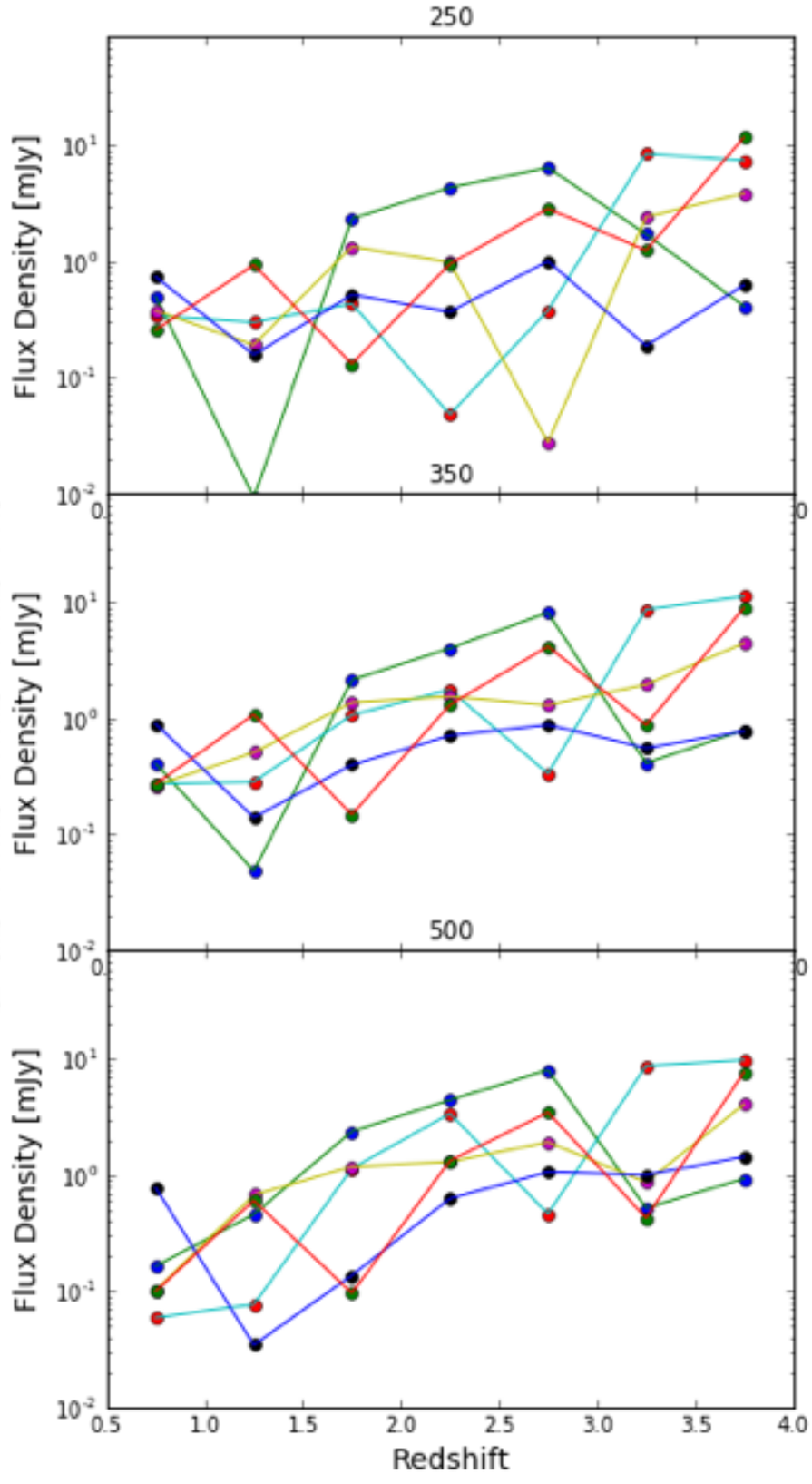

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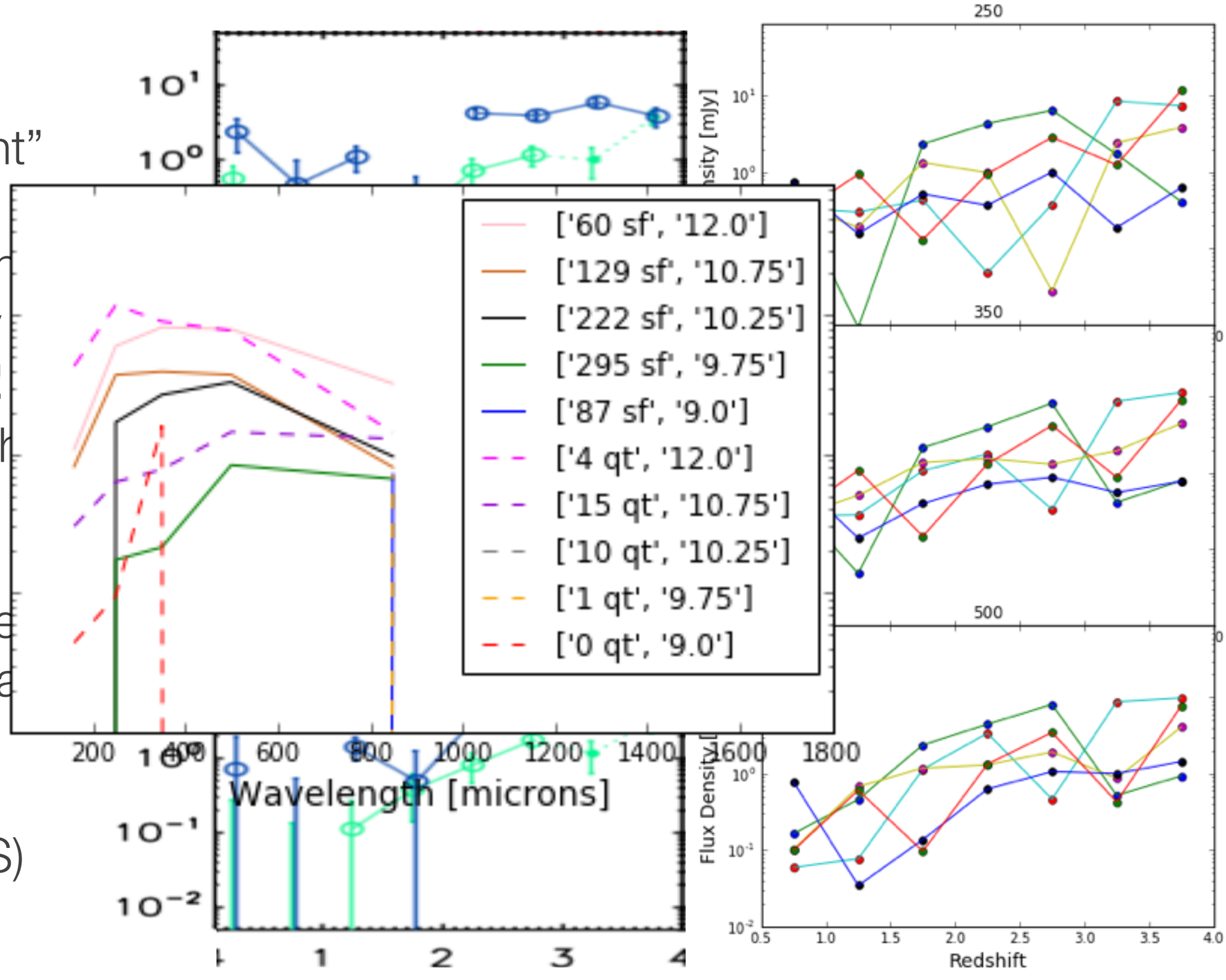


HeLMS / HerS

The Herschel Surveys in Stripe 82

HERMES

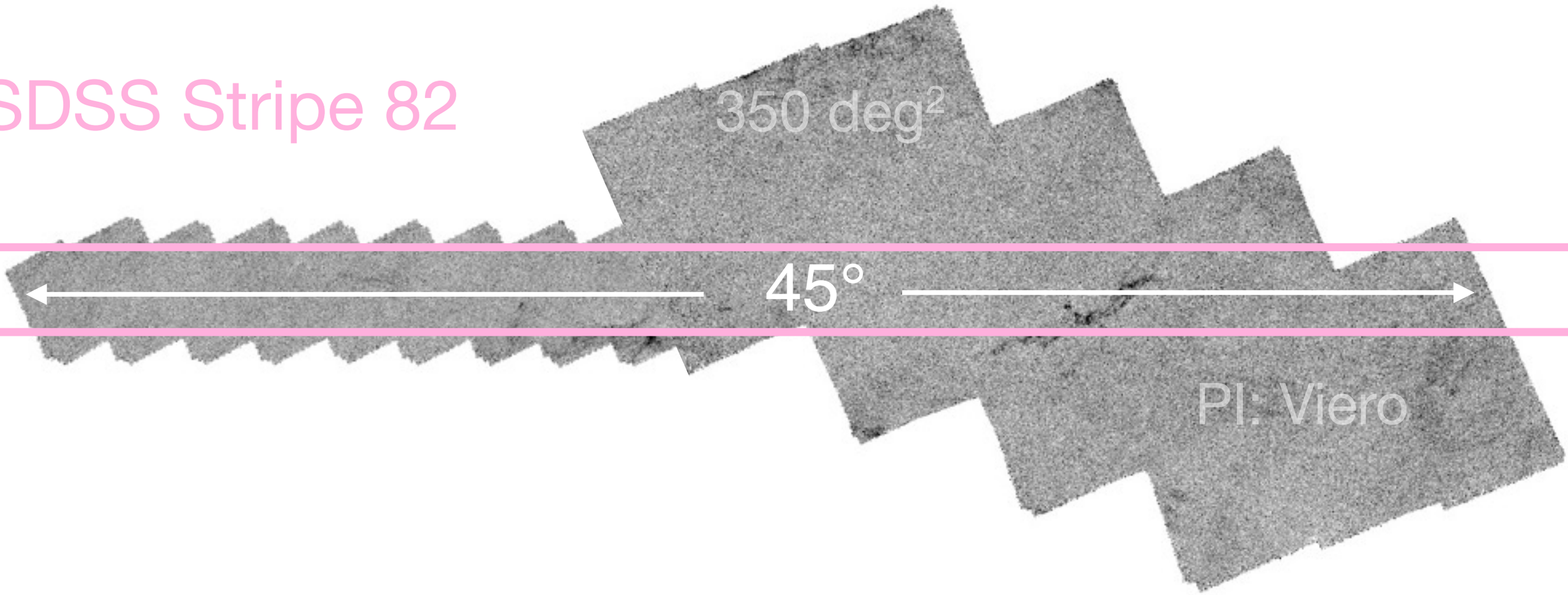
HeLMS

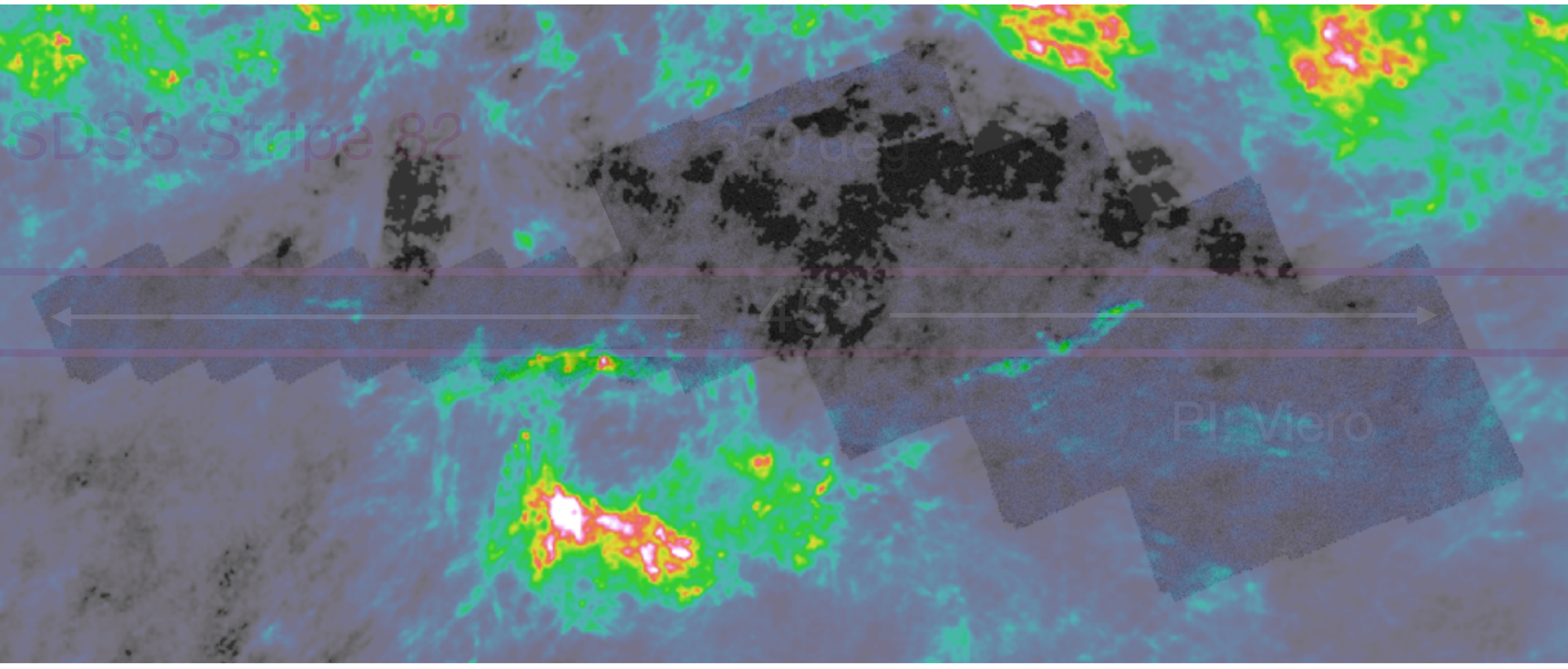
SDSS Stripe 82

HerS

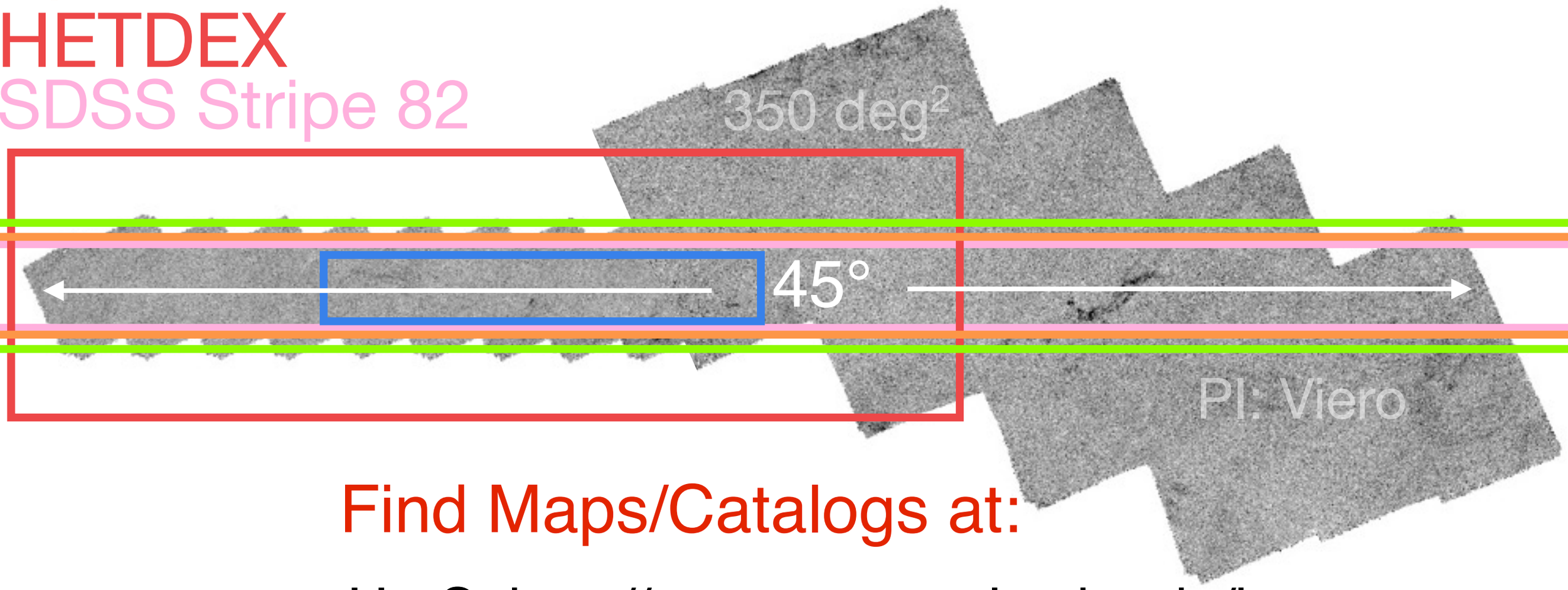
herschel stripe 82 survey

SDSS Stripe 82




SDSS Stripe 82
350 deg
45°
PI: Viero

ACT
SHELA
SpIES
HETDEX
SDSS Stripe 82



Find Maps/Catalogs at:

HerS: http://www.astro.caltech.edu/hers

HeLMS: http://hedam.lam.fr/HerMES/