# Possible Science Projects
## with NEP 850μm survey

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JCMT Users meeting
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# What we have in hand

- mid-infrared photometry (2-24μm) over > 4deg$^2$

- (quite deep) optical photometry and (high-res) images
- optical spectra for r/R-band, MIR-selected sources

- 100, 160μm / 250, 350, 500μm
- radio fluxes (radio sources; WSRT)
- x-ray fluxes (x-ray sources; CXO, eROSITA?)
- FUV/NUV fluxes (GALEX)

# Strategies

- We can start working with the NEP-deep 850μm data (S2CLS) while the data coverage is expected to be widen by a factor of a few in 2018 summer.

- Previous works based on AKARI MIR data would be good starting points for new ideas.

# Expected papers

## who will lead each project?

- Data release (mosaics, catalog, number counts, ...)
- (Optical/MIR) identification of the submm sources
- Testing CIB fluctuation models
- Properties of red galaxies (DOGs, DRGs, EROs) – extinction, SFR, (stellar) mass, $T_{dust}$, …
- PAH-FIR correlation (evolution of the 8μm LF)
- Dust-obscured AGNs (selected in X-ray, selected in radio) and hidden star formation

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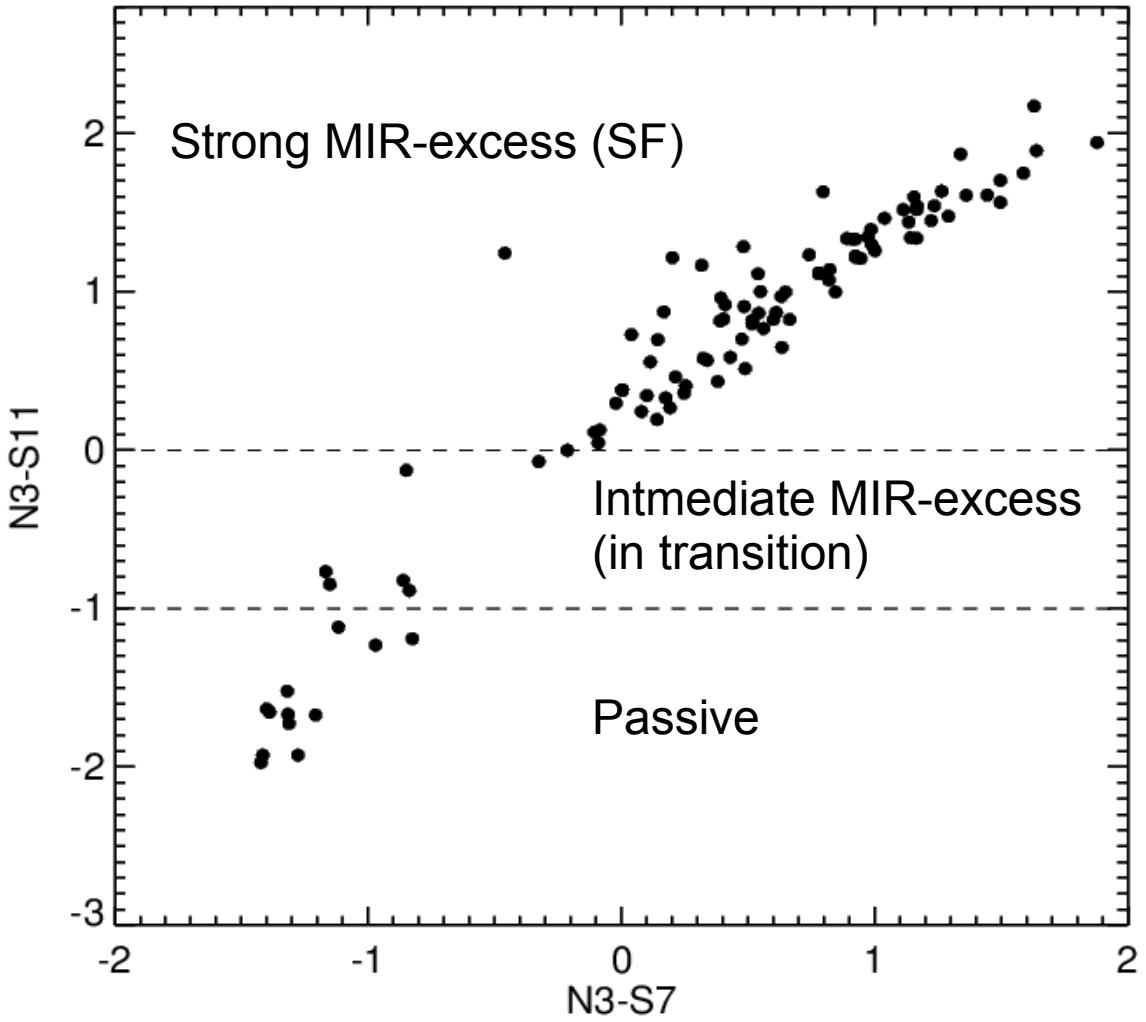
- Rare objects (e.g., z > 3-4 massive dusty starbursts)
- Clusters / proto-clusters around submm sources
- (angular, spatial) Clustering of the 850μm sources
- (average) dust properties of optically selected galaxies

(e.g., NUV/u/B-dropouts, galaxies with $z_{phot}$ > 3)

- NEP supercluster environments and galaxies

# NEP superclusters




Ko et al.(2012)

$0.07 < z_{spec} < 0.1$

191 sources (in 2016 spec-z catalogs)

132 sources in IRC catalogs

# NEP superclusters

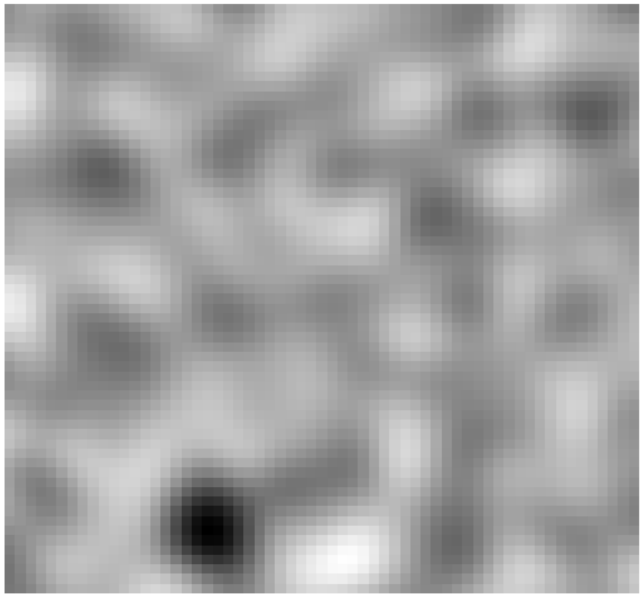
**Table 4**
Galaxy Classification

| Galaxy Type (1) | Optical Color (2) | IR Color (3) | log(SSFR ($yr^{-1}$)) (4) | Morphology Fraction (5) | Comments |
|---|---|---|---|---|---|
| Weak-MXG | Red | $N3 - S11 < -1$ | $-11.2$ | Early type (>90%) | Passively evolving galaxies |
| Intermediate-MXG | Red | $-1 < N3 - S11 < 0$ | $-10.8$ | Early type (>71%) | Transition populations |
| Weak-SFG | Red | $N3 - S11 > 0$ | $-10.3$ ($-10.7 \sim -10.0$) | Late type (>67%) | Transition populations |
| Dusty-SFG | Red | $N3 - S11 > 0$ | $-9.7$ ($-10.0 \sim -9.0$) | Late type (>88%) | SF galaxies |
| Blue-SFG | Blue | $N3 - S11 > 0$ | $-9.5$ ($-10.2 \sim -8.9$) | Late type (>93%) | SF galaxies |

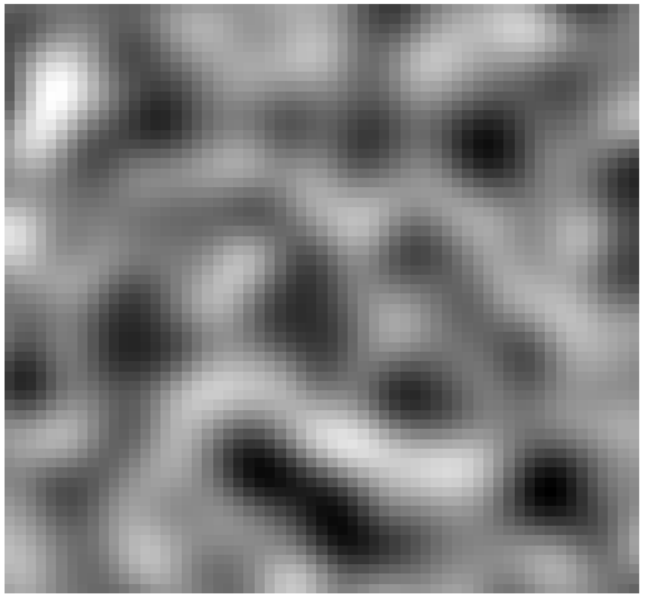
**Notes.** Column 1: classified galaxy type; Column 2: first, the optical color–magnitude relation (CMR) is used to separate *red* from *blue* galaxies; Column 3: second, the *red* galaxies are subdivided by NIR−MIR (N3 − S11) color; Column 4: the mean values of specific star formation rate (SSFR) in units of dex. For SF populations, the range of SSFR is enclosed in brackets; Column 5: the dominant morphology from visual classification, and the fractions of early types: 0, 1 and late types: 2, 3, 4 (see the caption in Figure 16).

# NEP superclusters

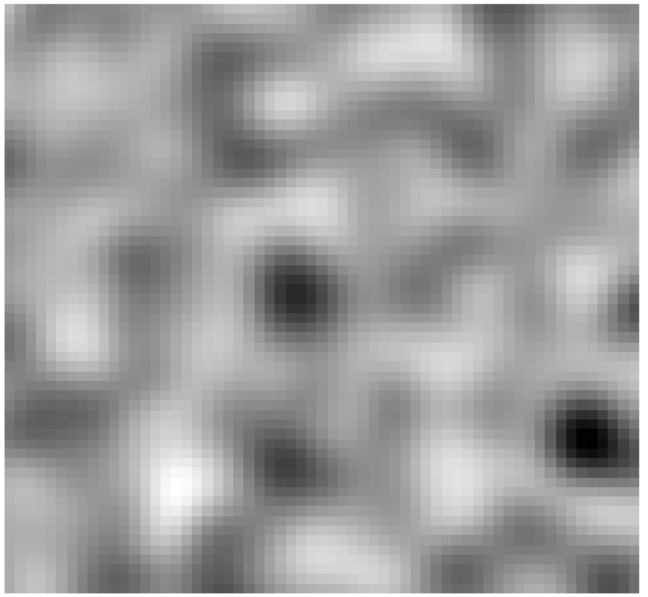
850μm stacking results



Weak MXG



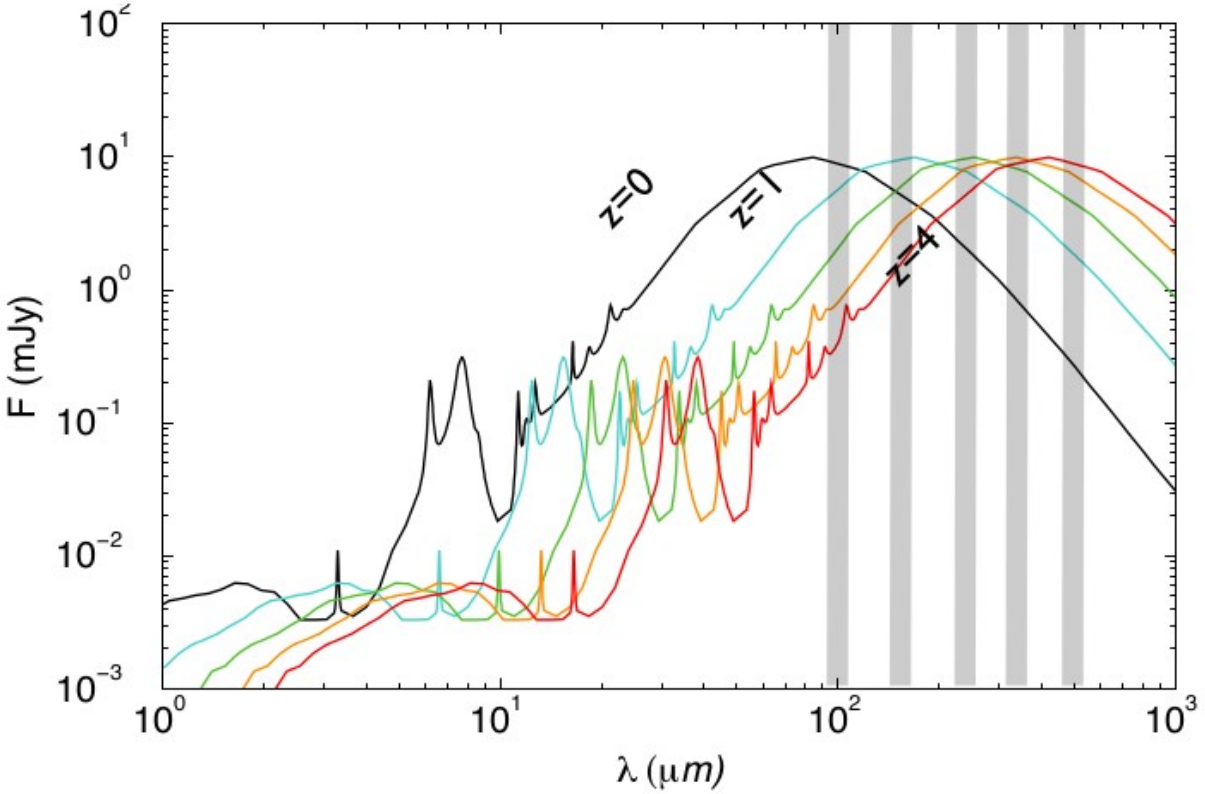
intermediate MXG



SFG

# High-z massive star-forming galaxies

## : search using SPIRE color-color diagram




Naive expectation based on sub-mm SED

$S_{250} > S_{350} > S_{500}$: $z < 2$

$S_{250} <\sim S_{350} > S_{500}$: $z \sim 2$ to 3

$S_{250} < S_{350} < S_{500}$: $z > 4$

Exceptions: AGNs, Galactic sources, .....

*sub-mm colors as a mechanism to select z > 2 galaxies*

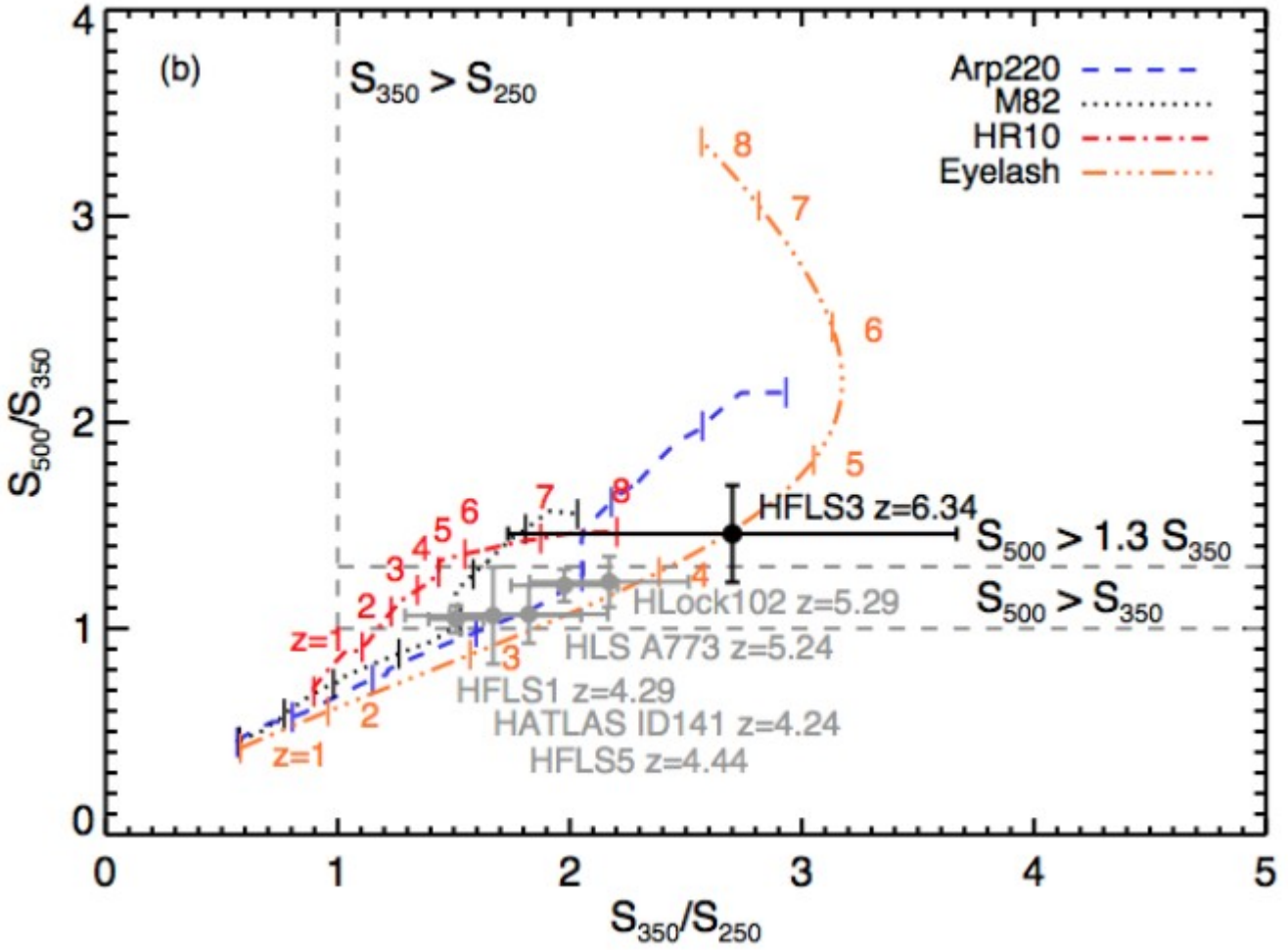
Cooray et al.(2013), Dowell et al.(2013)

# High-z massive star-forming galaxies

## : search using SPIRE color-color diagram

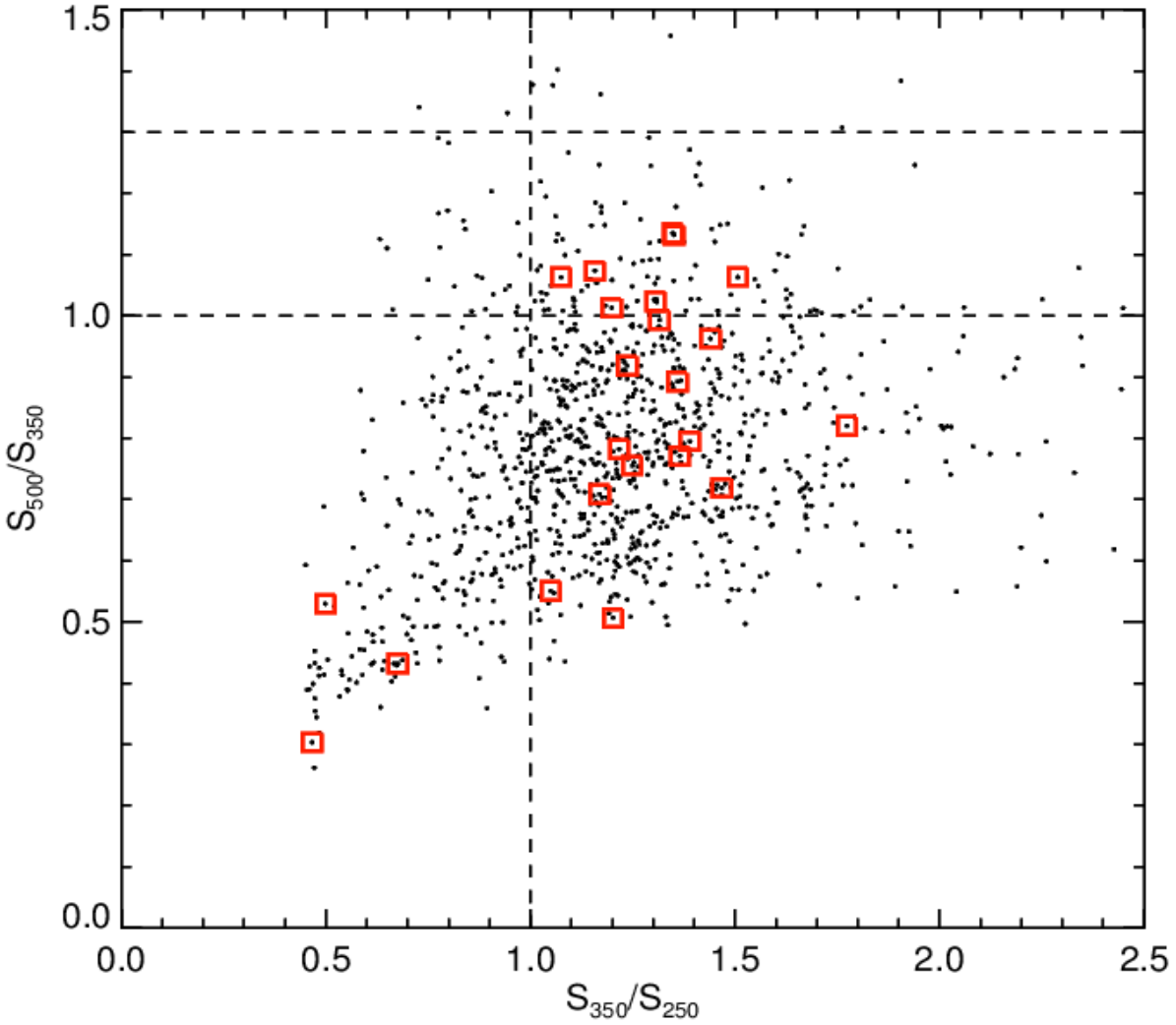
Peres-Fournon et al.(2013)

SPIRE colors are useful to select z>4 dust galaxies, but Herschel/SPIRE resolution is very poor. Spatial resolution of the SCUBA-2 850μm image is better than that of the Herschel FIR images.



# High-z massive star-forming galaxies

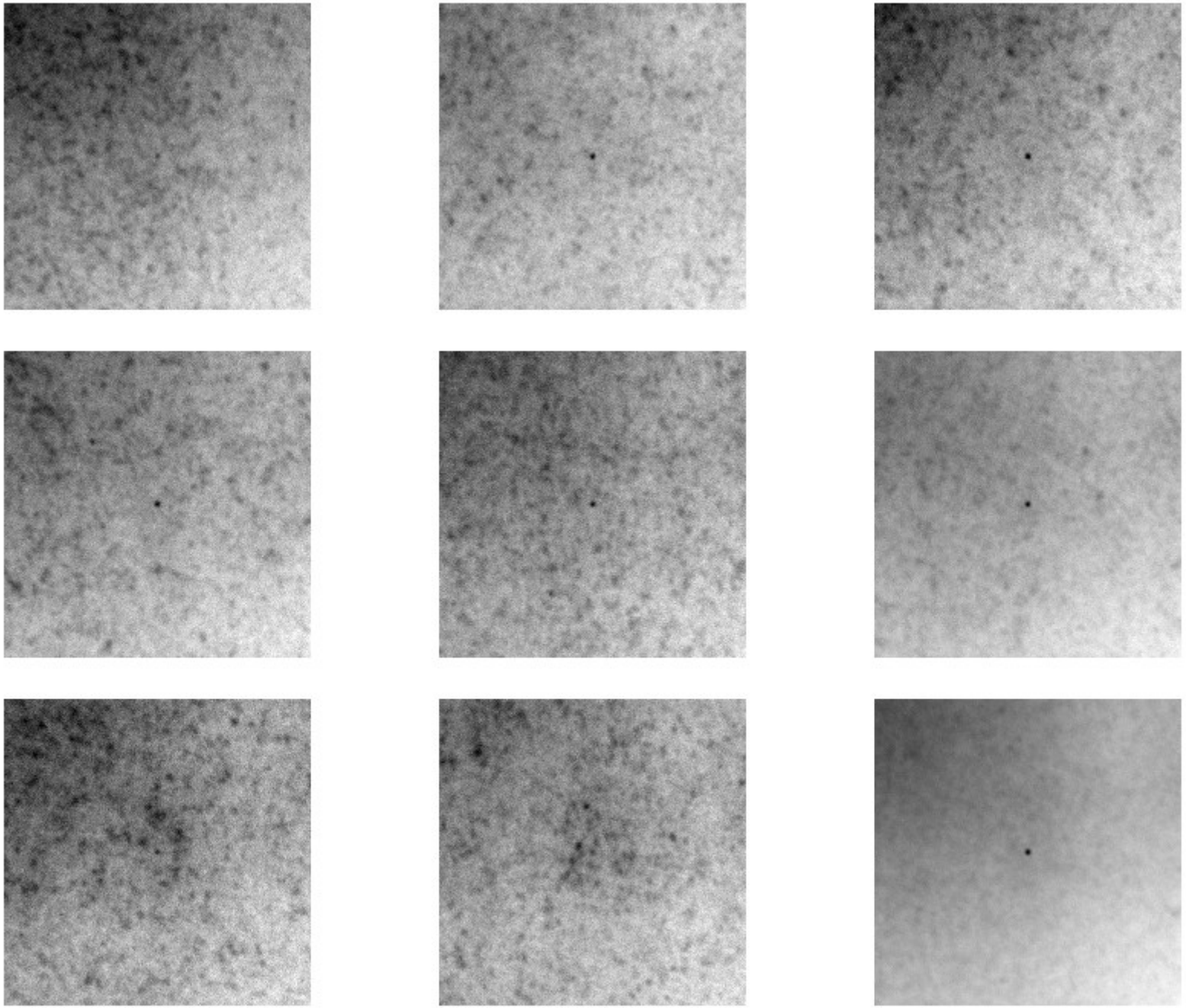
## : search using SPIRE color-color diagram




NEP SPIRE color-color diagram
(S/N > 2 sources in each band)

850μm sources

250μm



0 < z < 0.02,

0.02 < z < 0.04,

0.04 < z < 0.06,

0.06 < z < 0.08,

0.08 < z < 1,

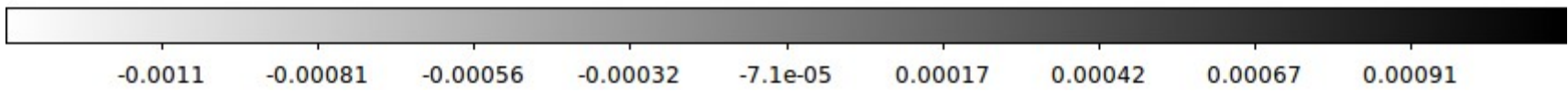
1 < z < 2,

2 < z < 3,

z > 3,

all

Using Oi et al.(201
phot-z catalog ove
NEP-Deep



350μm

0 < z < 0.02,

0.02 < z < 0.04,

0.04 < z < 0.06,

0.06 < z < 0.08,

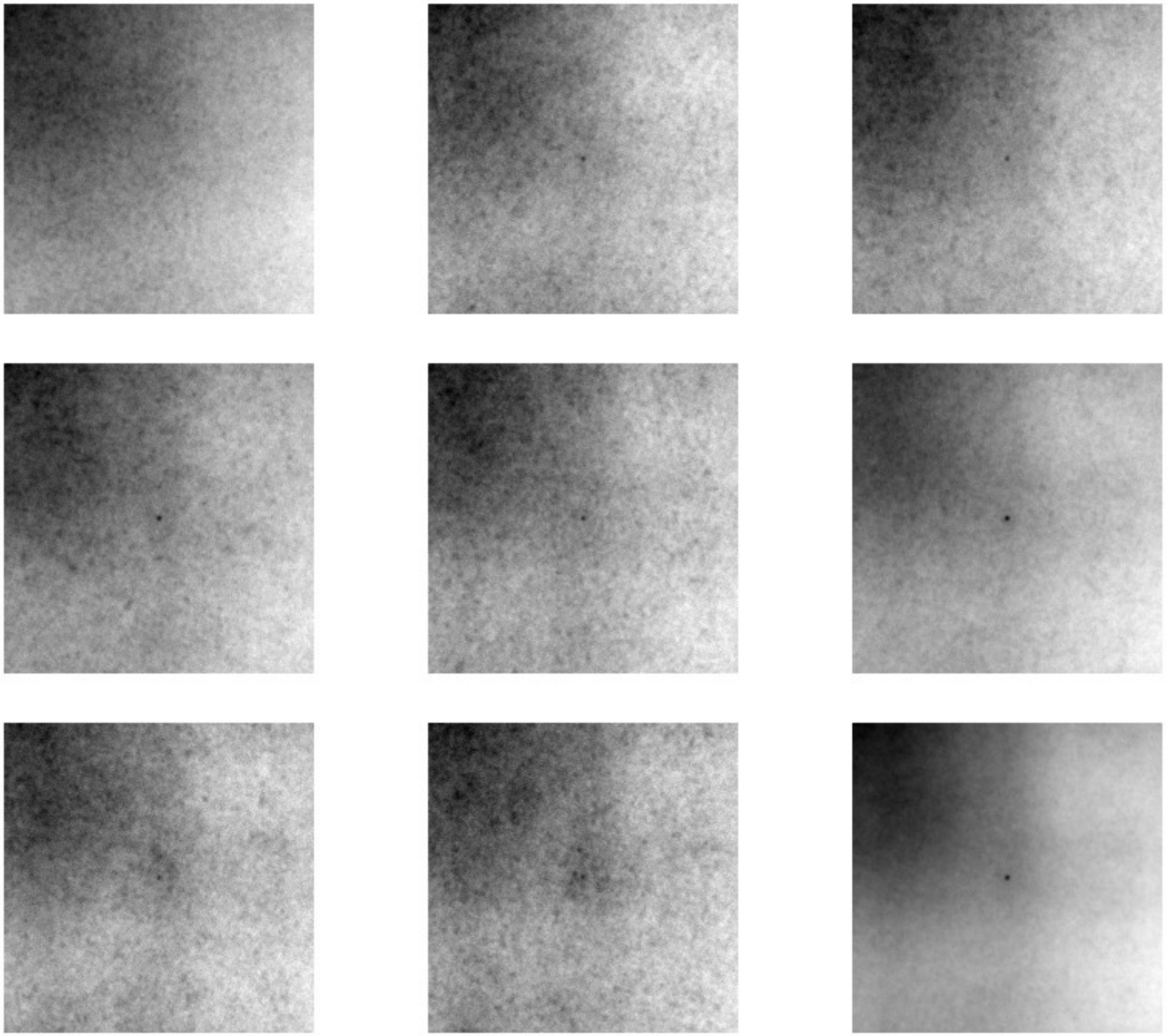
0.08 < z < 1,

1 < z < 2,

2 < z < 3,

z > 3,

all



500μm

0 < z < 0.02,

0.02 < z < 0.04,

0.04 < z < 0.06,

0.06 < z < 0.08,

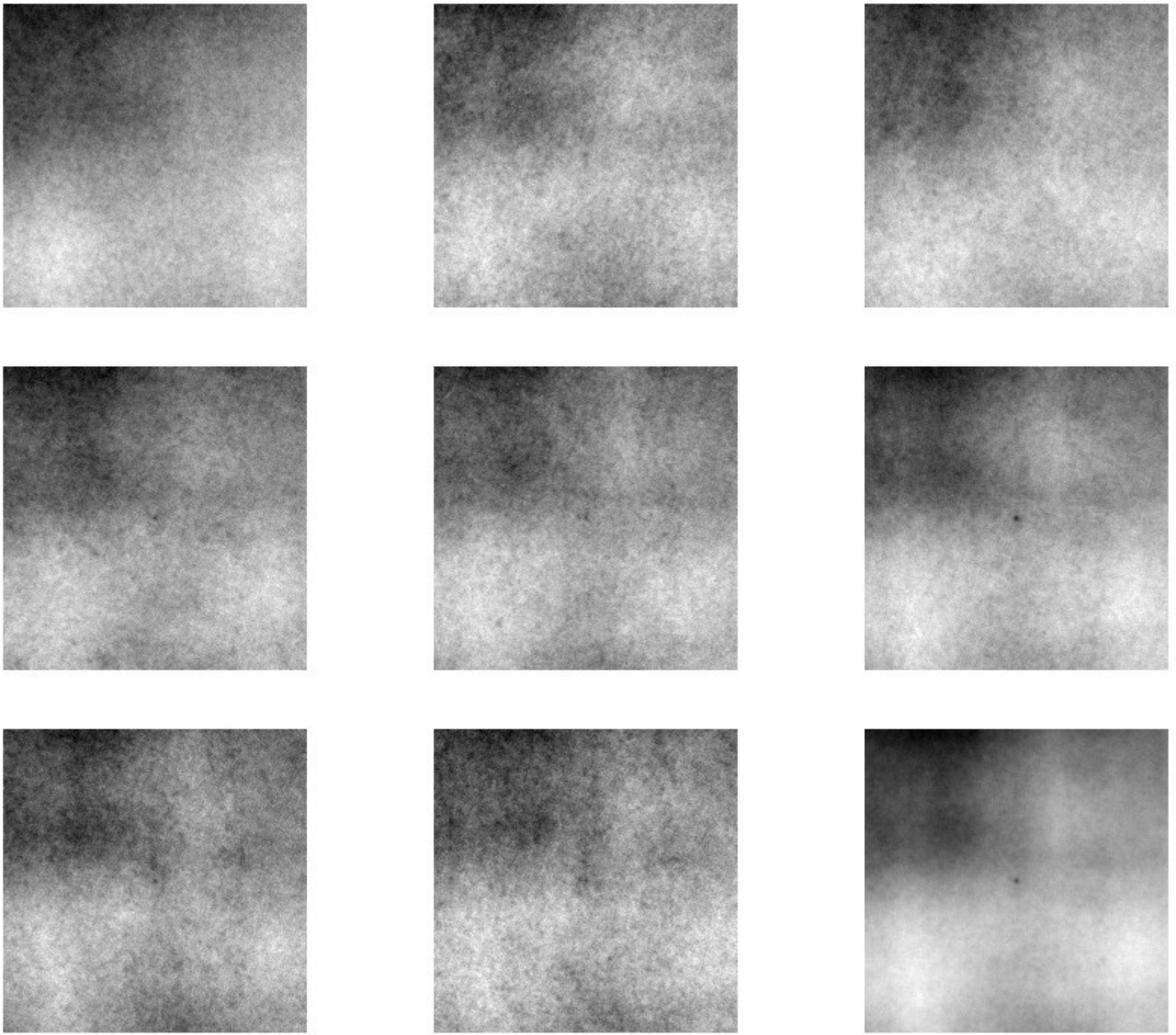
0.08 < z < 1,

1 < z < 2,

2 < z < 3,

z > 3,

all



850μm

0 < z < 0.02,

0.02 < z < 0.04,

0.04 < z < 0.06,

0.06 < z < 0.08,

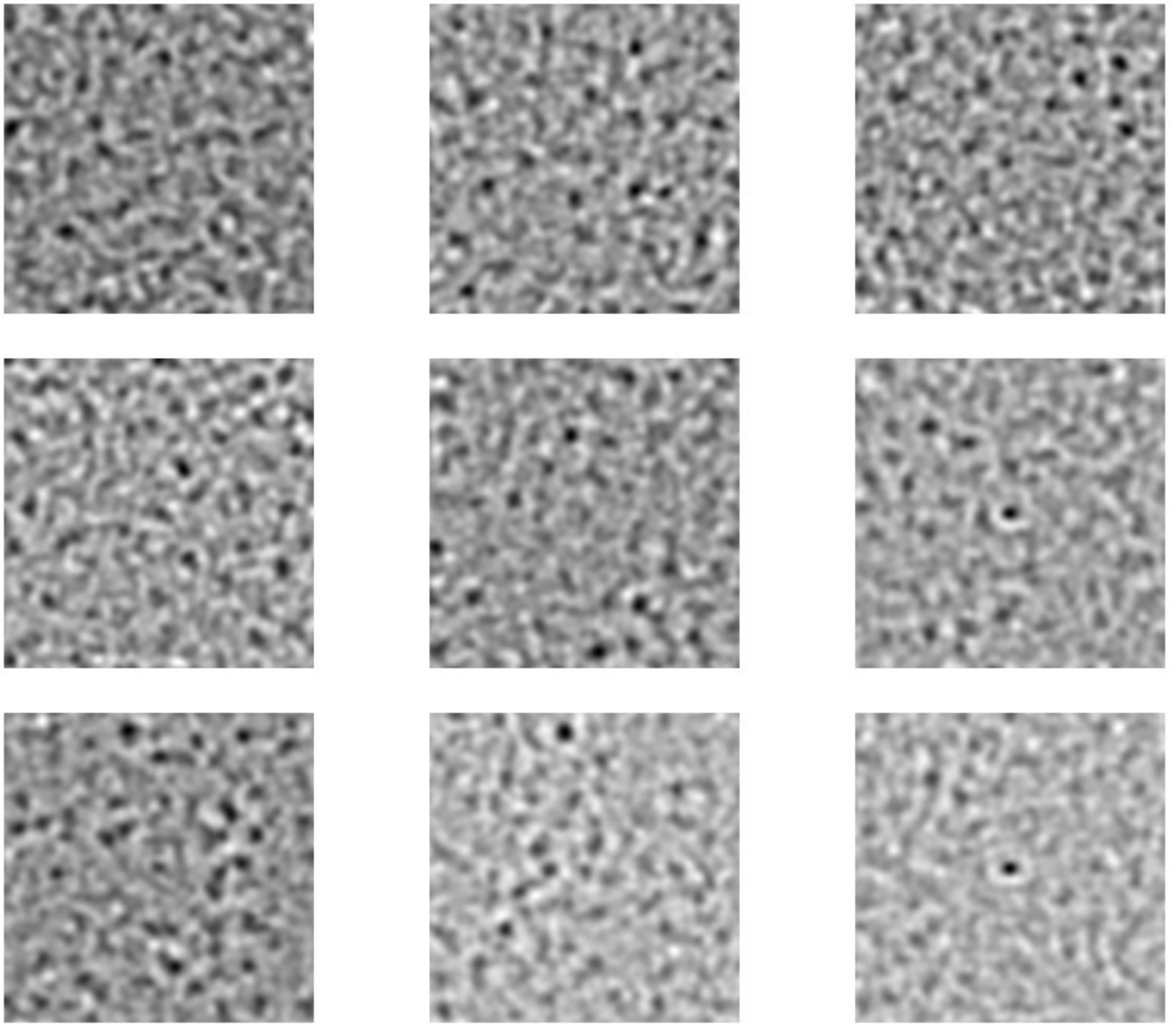
0.08 < z < 1,

1 < z < 2,

2 < z < 3,

z > 3,

all



850μm
- specz

0 < z < 0.02,

0.02 < z < 0.04,

0.04 < z < 0.06,

0.06 < z < 0.08,

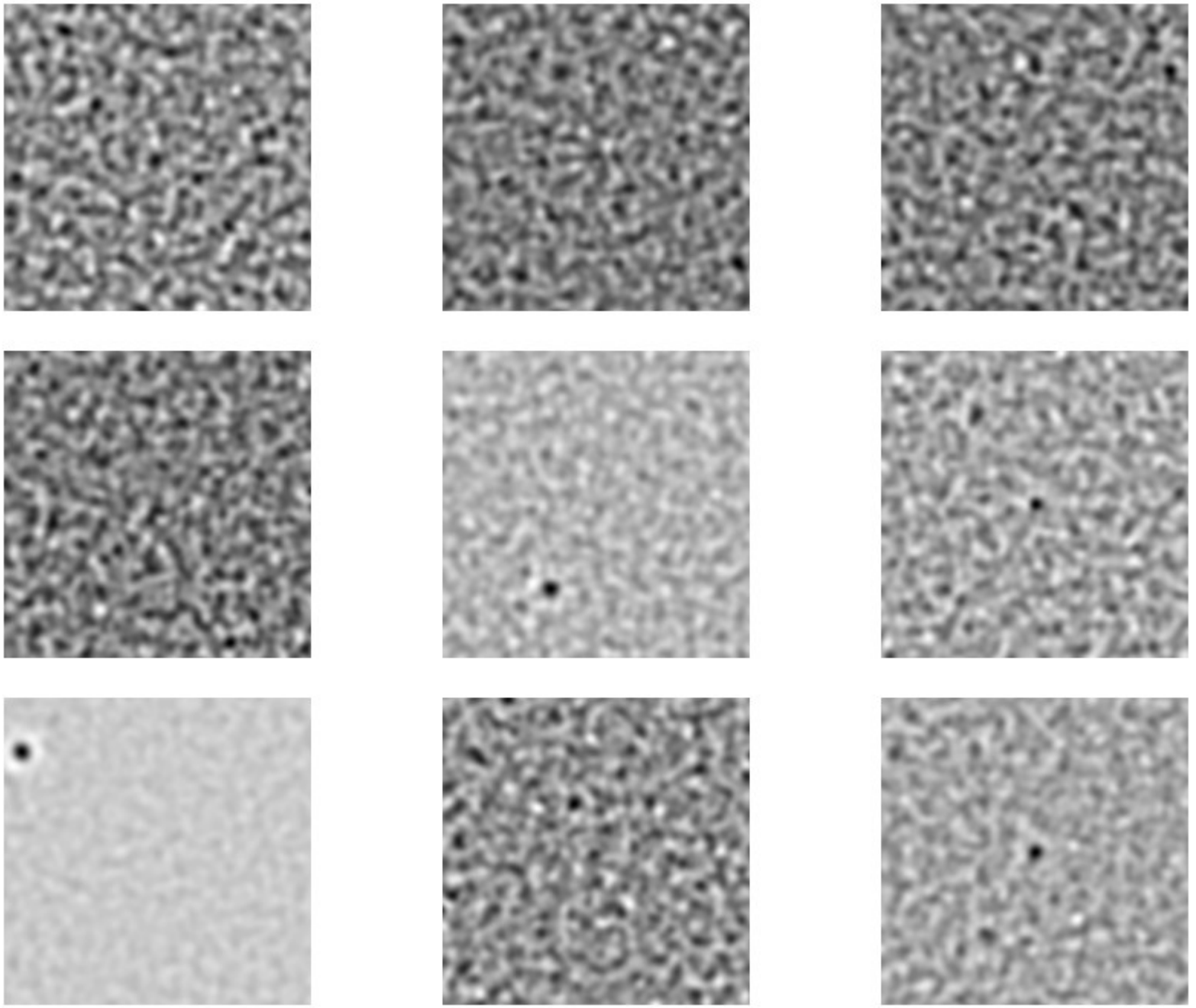
0.08 < z < 1,

1 < z < 2,

2 < z < 3,

z > 3,

all



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