



ULTIMATE
Subaru

ULTIMATE-Subaru Medium-Band Filters: Improving Photometric Redshifts and Emission-Line Measurements with 10,000+ Mock Galaxies

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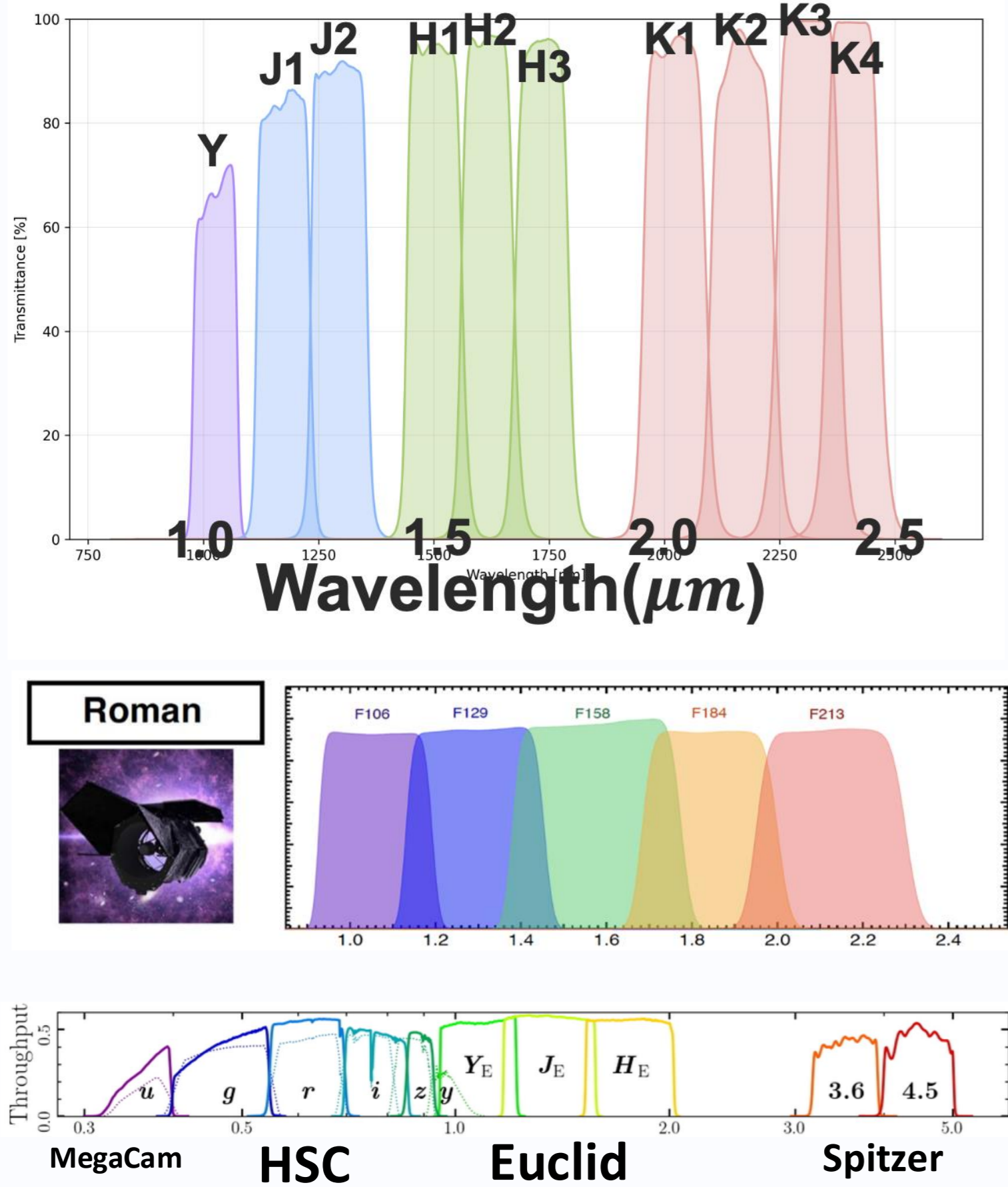


ABSTRACT

In recent years, medium-band (MB) imaging has become an increasingly important complement to broad-band photometry, delivering more reliable galaxy physical properties. ULTIMATE-Subaru is deploying unique K-band MB filters spanning 2–2.5 μm to provide high spatial-resolution imaging for intermediate-redshift galaxies. We present the forecasted science gains for ULTIMATE-Subaru MB observations to highlight their role in future extragalactic surveys. We build a library of over 10,000 model galaxies at $1.5 < z < 5.5$ using BAGPIPES, with diverse physical properties including stellar ages, dust attenuation. These setups cover young starburst galaxies, typical star-forming galaxies, dusty galaxies, and quiescent galaxies. We test multiple filter configurations that combine ULTIMATE-Subaru MBs with existing and future facilities including HSC, JWST, Roman. Adding the ULTIMATE-Subaru MB filters improves photometric-redshift accuracy by a factor of ~ 2 , compared to setups without the MBs. The largest benefits appear for galaxies whose strong rest-frame optical emission lines (e.g., H α at $z = 2 - 2.7$, [OIII] at $z = 2.9 - 3.9$) enhance one of the new MBs, significantly improving redshift localization. Quiescent galaxies at $z = 4.4 - 5.2$ also benefit substantially, as the MB coverage captures the Balmer break and sharply reduces redshift degeneracies. These results demonstrate the scientific values of incorporating ULTIMATE-Subaru into future wide and deep extragalactic surveys.

Filter Combinations

ULTIMATE-Subaru MB filters



Wide

~ 1 mag deeper

Deep

~ 0.5 mag deeper

U-Deep

HSC
Euclid
Roman
ULTIMATE

HSC (grizy): 27.5, 27.1, 26.8, 26.3, 25.3
MegaCam (u): 27.1
Euclid (V,Y,J,H): 28.2, 26.5, 26.5, 26.5
Spitzer IRAC1/2: 24.6, 24.6
Roman (ZYJHK): 27.8, 27.7, 27.7, 27.7, 27.0, 25.9
ULTIMATE: (1 hr, K1-K4): 24.9, 25.1, 24.9, 24.3

HSC
MegaCam
Euclid
Spitzer
Roman
HST
JWST
ULTIMATE

MODEL GALAXIES from BAGPIPES

Model Parameters (Main)

redshift = 1.5 - 5.5

#SFH (delayed-tau)

age = 0.01 - 1.0 Gyr

tau = [0.1, 0.3, 1.0] Gyr

$\log(M^*/M_{\odot}) = 6.5 - 11.5$

metallicity = $0.3 Z_{\odot}$

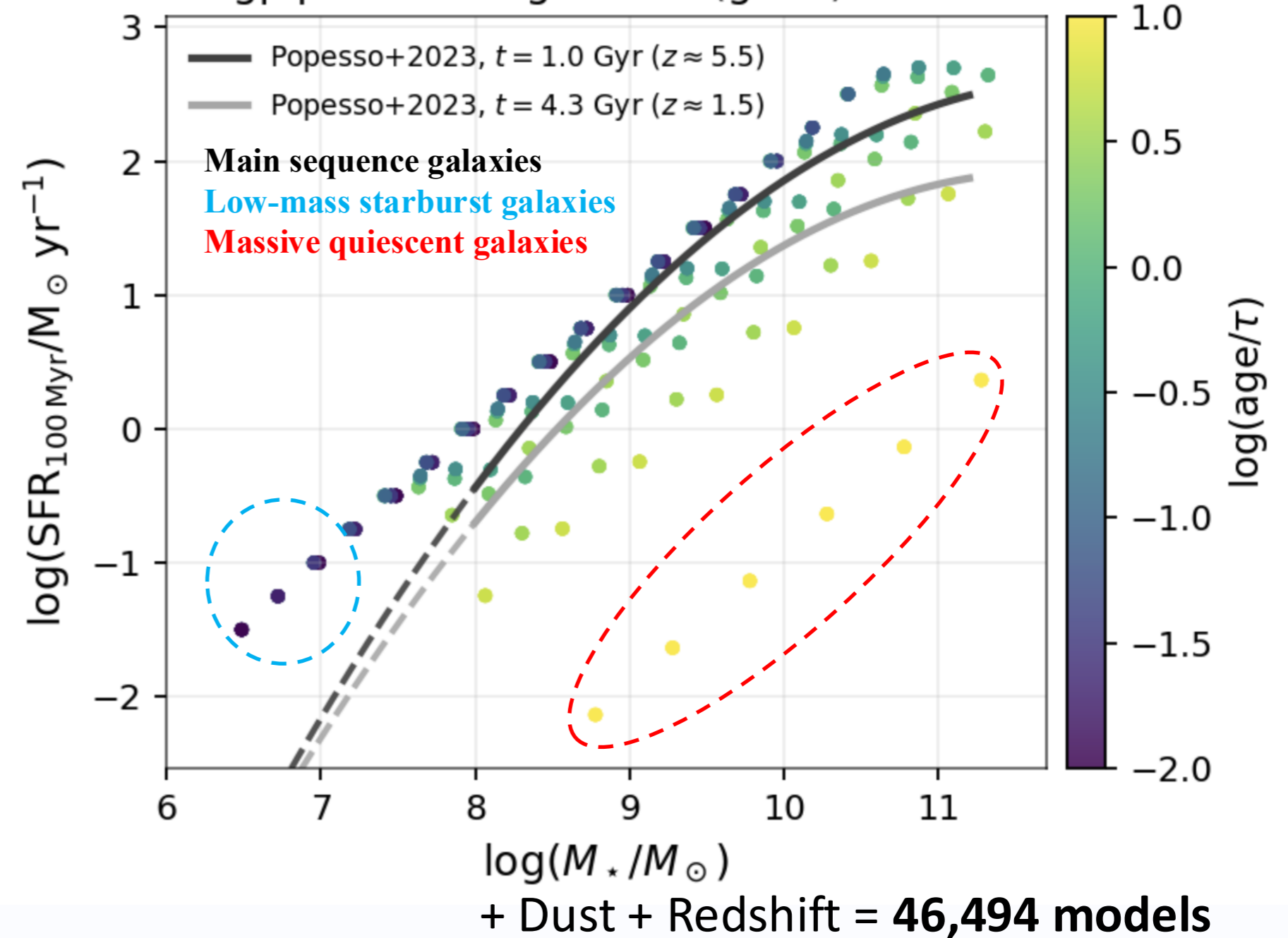
Dust_curve = "Calzetti"

$A_v = 0.0 - 2.5$

#ionization parameter

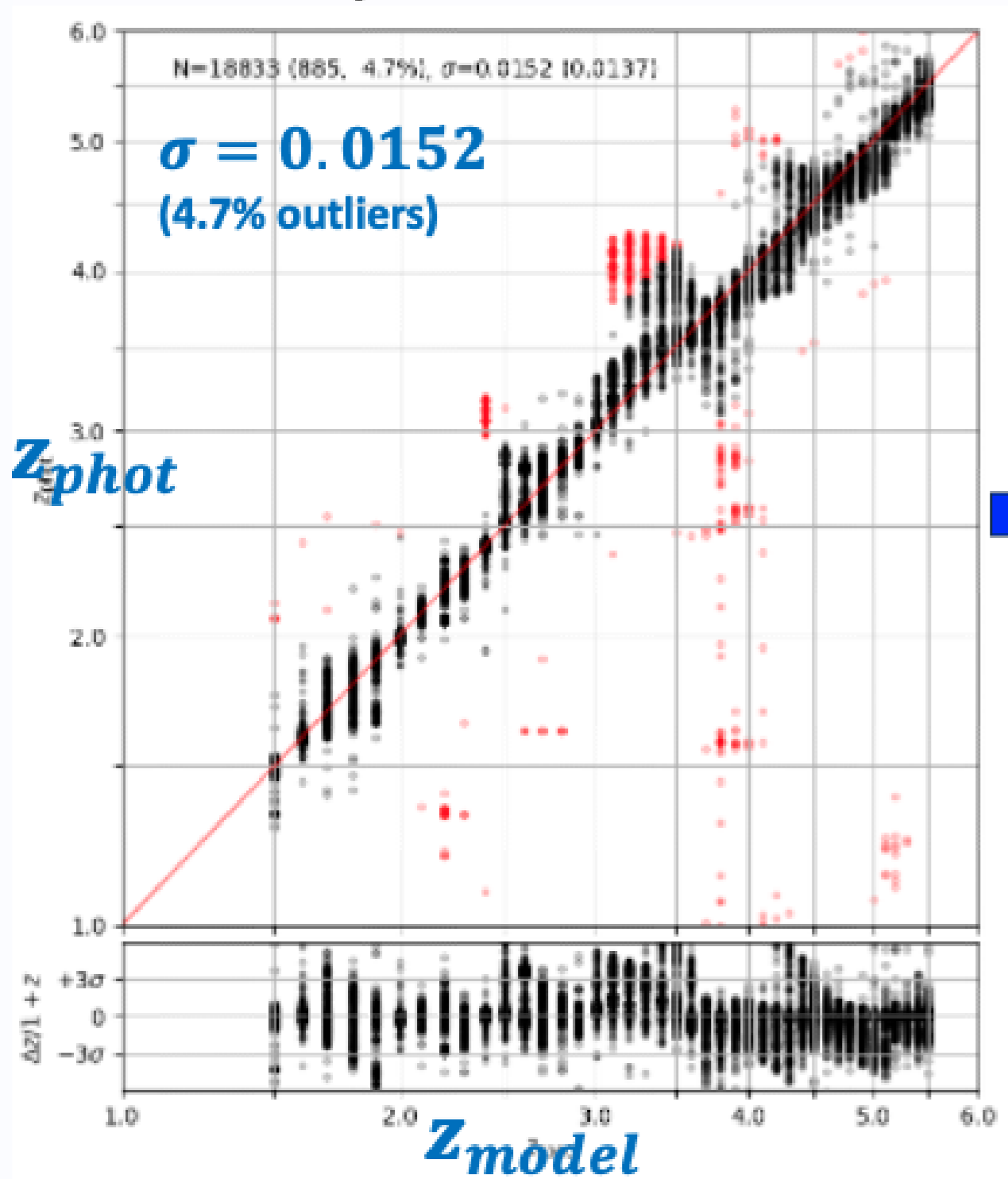
$\log U = -2.5$

Bagpipes model galaxies (grids) on SFMS

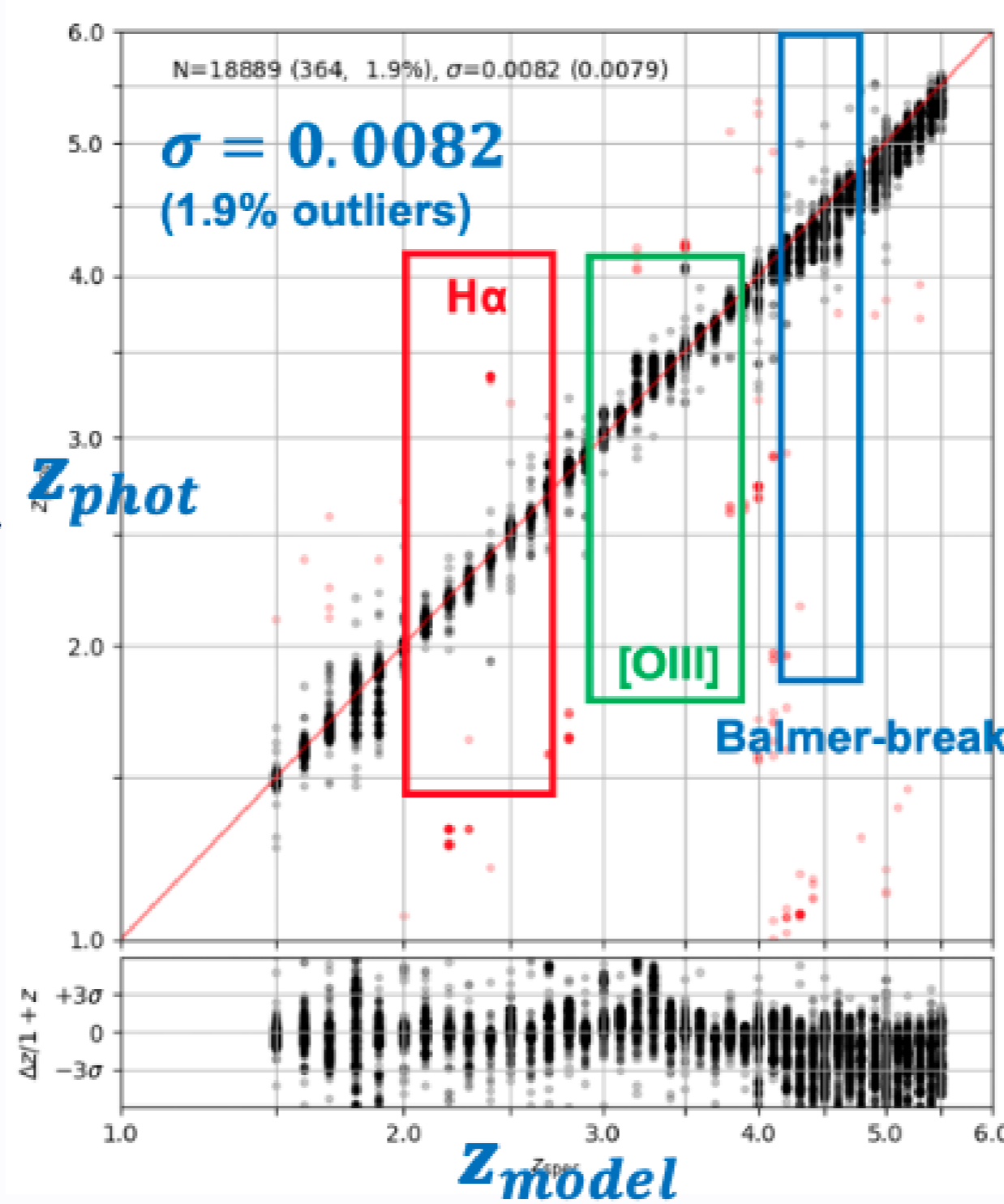


+ Dust + Redshift = 46,494 models

w/o MB filters



w/ ULTIMATE K-band MB filters



$z=3.0$

[OIII] emitter

ID: 35134

$\log(M_*/M_{\odot}) = 8.91$

$SFR(M_{\odot}/\text{yr}) = 10.02$

$A_v = 0.5$

$z=3.00$

w/ K-band MB

[OIII]

Roman F213

K2, K3, K4

$z=4.4$

Massive QG

ID: 66384

$\log(M_*/M_{\odot}) = 10.06$

$SFR(M_{\odot}/\text{yr}) = 5.69$

$A_v = 0.5$

$z=4.35$

w/ K-band MB

K4

K3

K2

K1

Conclusions

ULTIMATE-Subaru will install unique MB filters from J to K bands

Investigating improvements in photometric redshifts in Euclid/Roman fields, which represent the important SSP of ULTIMATE Bagpipe model galaxies in three configuration: wide, deep, udeep

The model shows good agreement with SFMS

EAZY to get z_{phot} on model galaxies with / without ULTIMATE MB filters

More than a factor of two improvements on z_{phot} would be achieved by introducing MB photometry

Especially for extreme emission line galaxies and balmer-break galaxies, we can obtain much more accurate z_{phot}

Our model galaxies catalog also contain upcoming filters in Japan's society:

Subaru HSC-MB filters (16 filters, HSC-NIJI)

GREX-PLUS filters (5 filters from 2 μm to 7 μm)