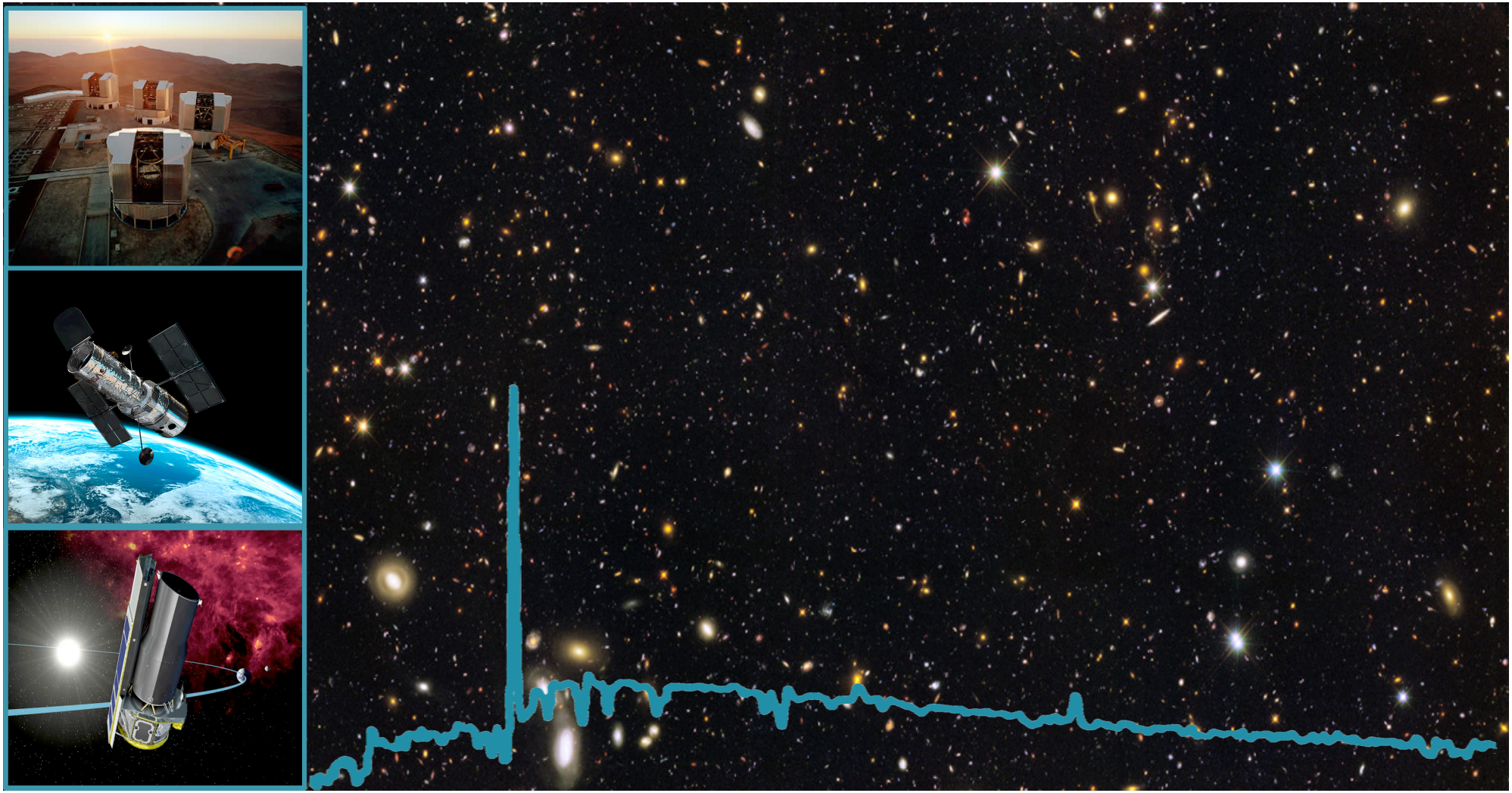

VANDELS

A deep VIMOS survey of the CANDELS UDS and CDFS fields

Unveiling the astrophysics of high-redshift galaxy evolution

VANDELS

Unveiling the astrophysics of high-redshift galaxy evolution

Co-PIs: Ross McLure (Edinburgh), Laura Pentericci (Rome)

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O. Le Fèvre, *LAM, France*
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†V. Sommariva, *University of Bologna, Italy*
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†M. Talia, *University of Bologna, Italy*
L. Tasca, *LAM, France*
T. Treu, *UCSB, USA*
E. Vanzella, *INAF-Bologna, Italy*
V. Wild, *University of St Andrews, UK*
C. Williams, *UMASS, USA*
G. Zamorani, *INAF-Bologna, Italy*

79 Co-Is
10 countries

VANDELS: motivation

Submitted in response to ESO call for public spectroscopy surveys with VIMOS (letter of intent in October 2013), selected to submit full proposal in March 2014.

Proposal was therefore focused on two key aspects:

⊙ Legacy value to astronomy community

⊙ Different science from previous VIMOS surveys (e.g. VUDS, VVDS, zCOSMOS, VIPERS)

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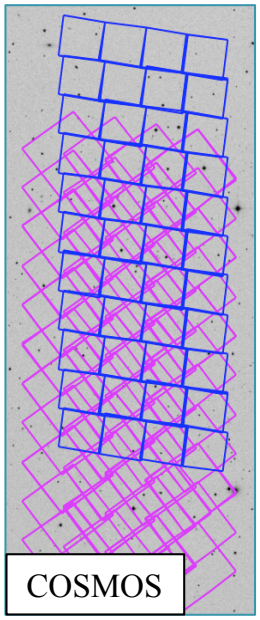
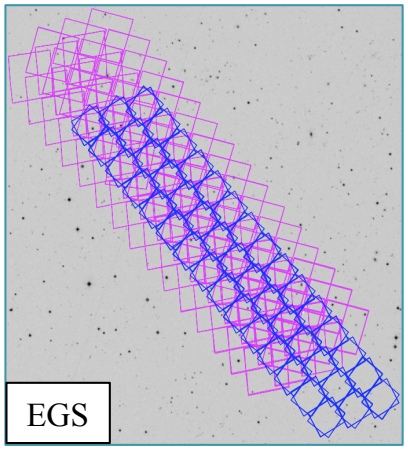
Four key elements of VANDELS:

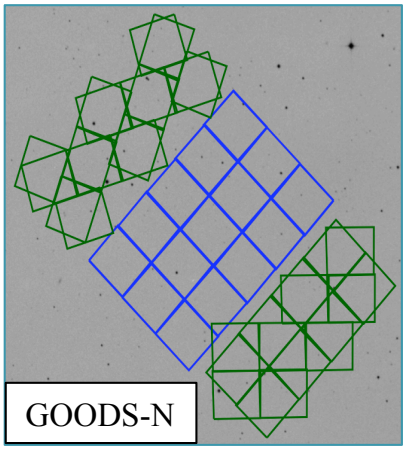
⊙ Small area (0.2 sq. degrees), best available multi-wavelength data
⊙ Ultra-long integrations, minimum 20 hours per source (80 hour max)
⊙ Medium resolution spectra (MR grism)
⊙ Pre-selection biased to very high redshift (85% of targets at $z>3$)

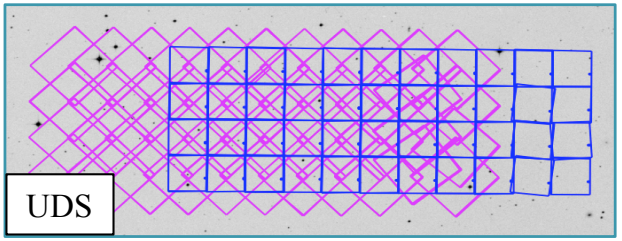
VANDELS: survey fields

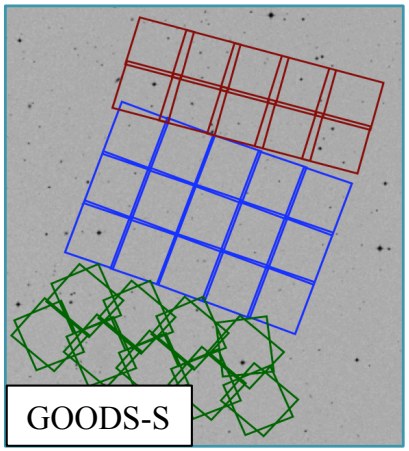
HST optical/near-IR imaging survey covering 0.2 square degrees split over 5 survey fields











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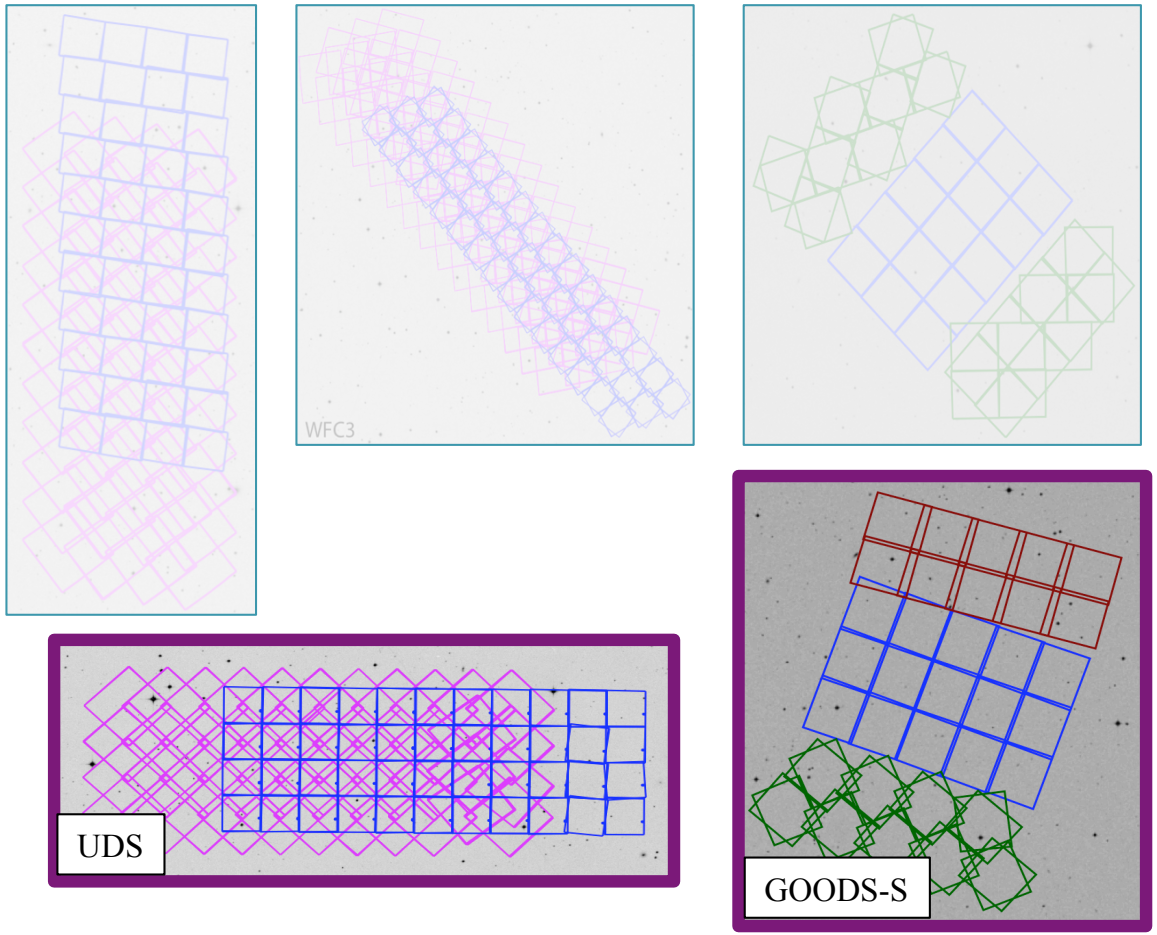

VANDELS targets the two southern CANDELS fields, exploiting unrivalled 15+ band (0.3μm-4.5μm) photometry and near-IR grism spectra (3D-HST)

VANDELS: motivation

Primary Targets

- Star-forming galaxies at $2.5<z<5.0$ ($H_{AB}<24$)
- Passive galaxies at $1.5<z<2.5$ ($H_{AB}<22.5$)
- Lyman-break galaxies at $3.0<z<7.0$ ($H_{AB}<26.5$)

VANDELS: motivation

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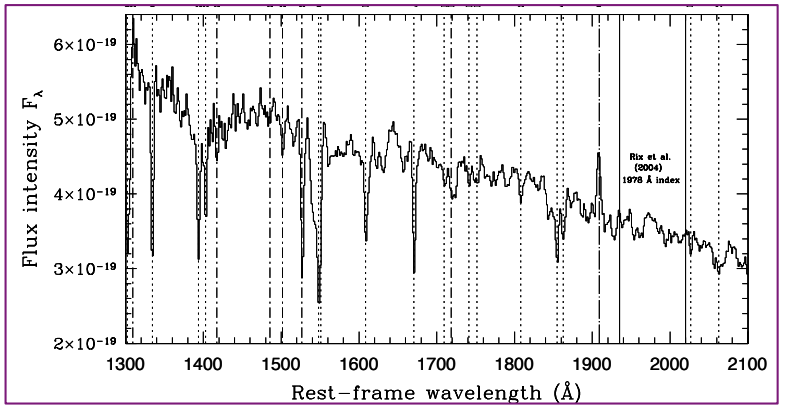
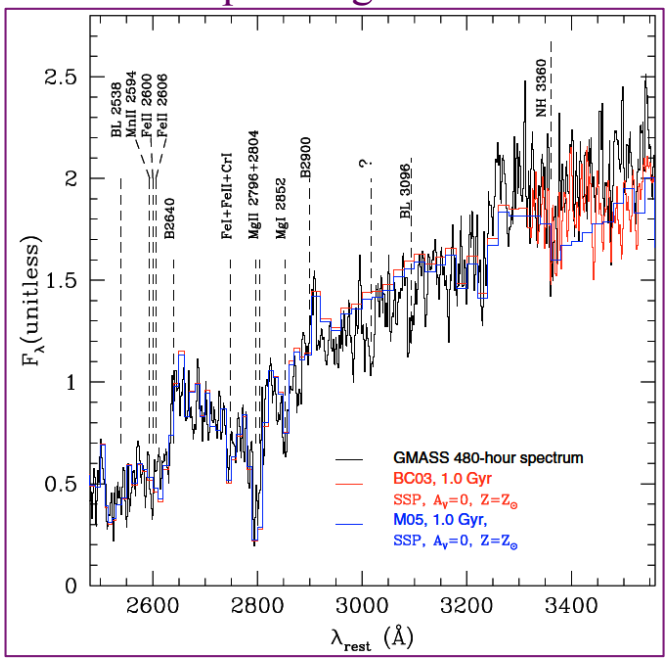
Absorption line metallicities



Combine ultra-deep optical spectroscopy with near-IR grism spectroscopy and 0.3μm-4.5μm photometry to measure *physical* tracers of galaxy evolution: age, mass, dust, SFR, outflows, stellar+gas metallicity….

UV+optical age constraints



Provide sufficient signal-to-noise and resolution to measure physical properties from *individual* spectra as well as stacks

VANDELS: motivation

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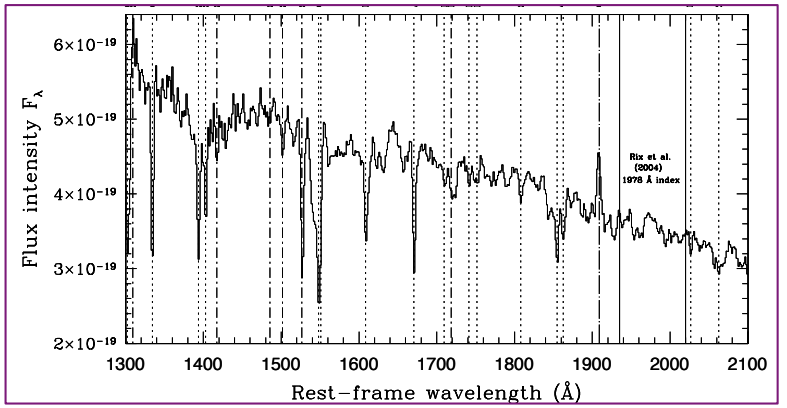
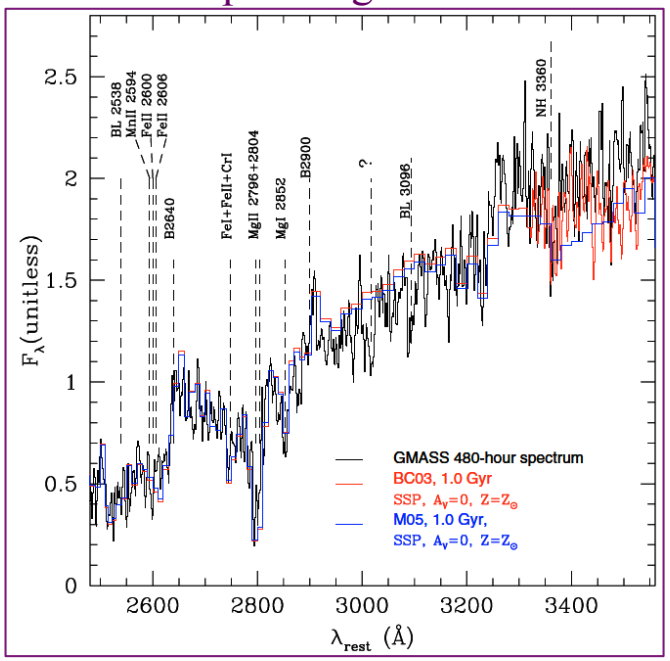


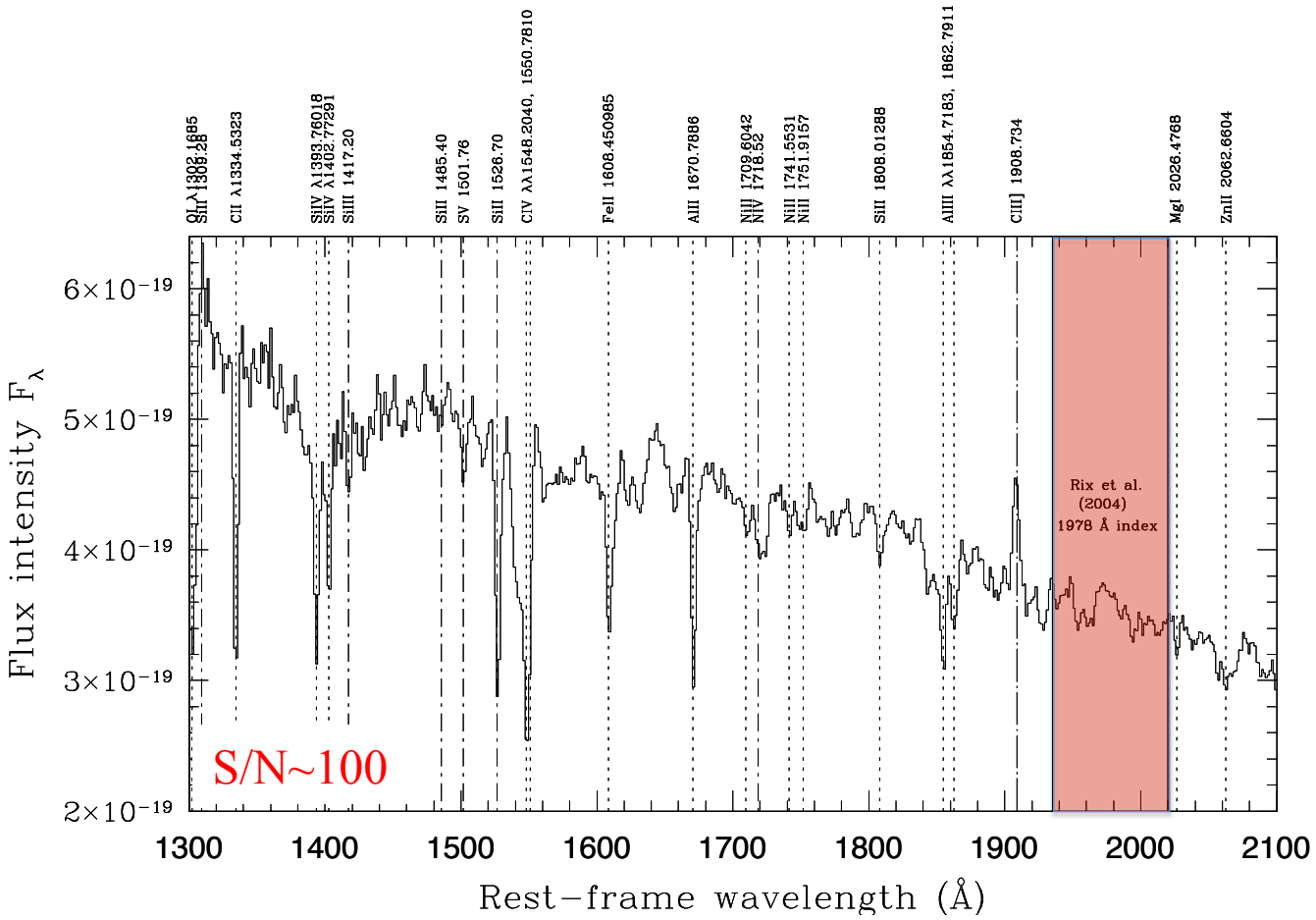
UV+optical age constraints

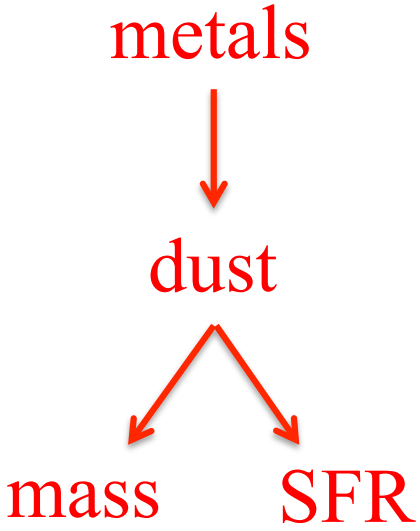


Fundamental aim is to move beyond redshift measurement and extract *physical* information from the spectra

VANDELS: main science case

Primary science case is really focused on determining metallicity of star-forming galaxies at 2.5<z<5.5:

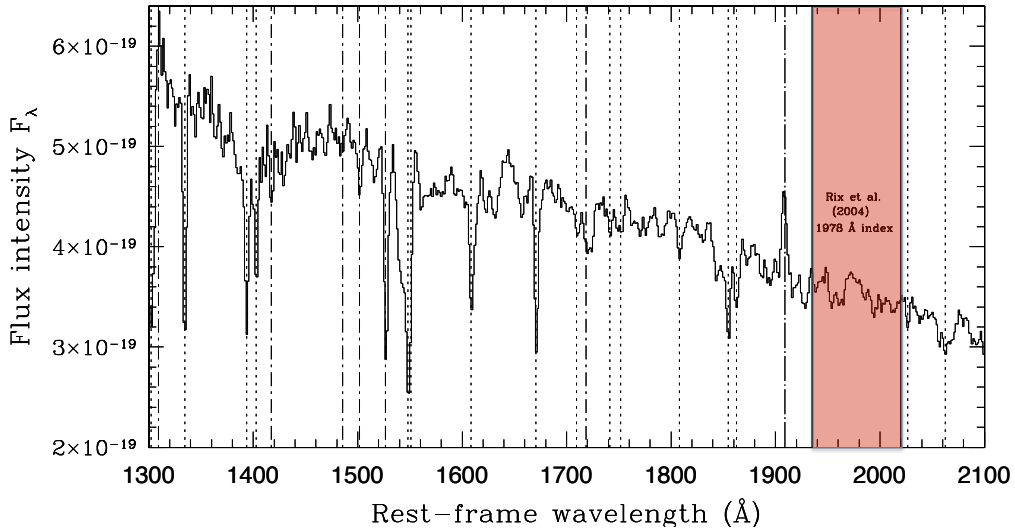




Halliday et al. (2008), stack of 75 GMASS galaxies at z~2

VANDELS: main science case

Primary science case is really focused on determining metallicity of star-forming galaxies at 2.5<z<5.5:



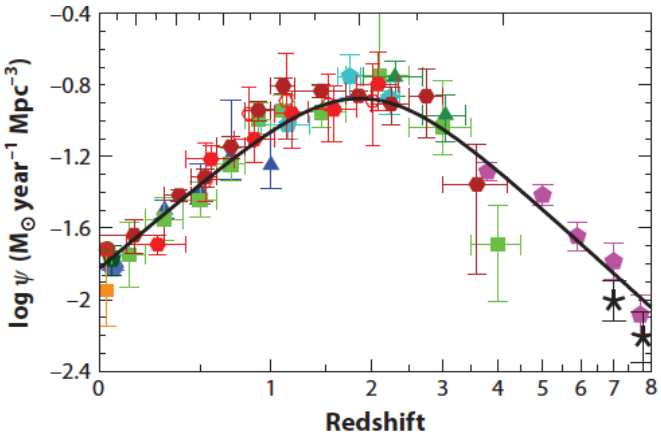
metals

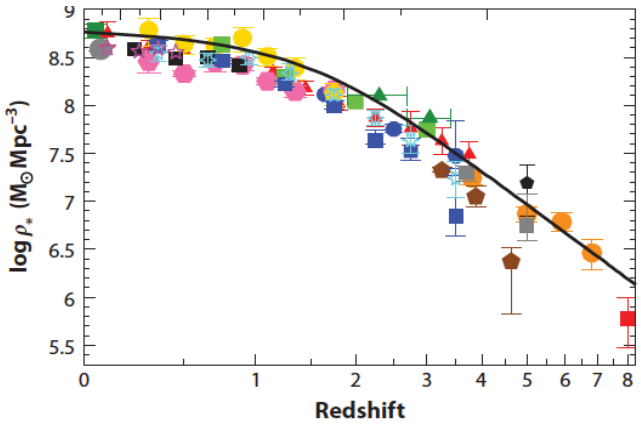
↓

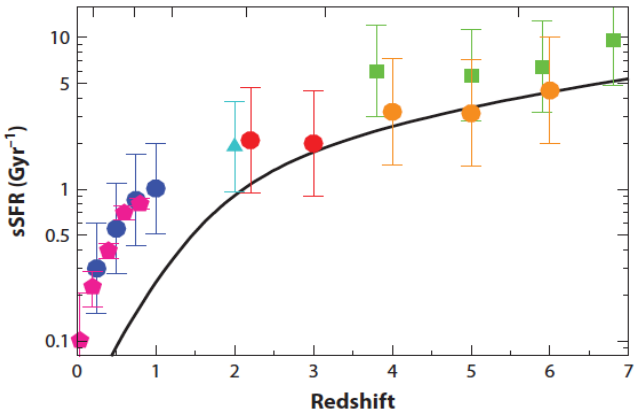
dust

↙ ↘

mass SFR



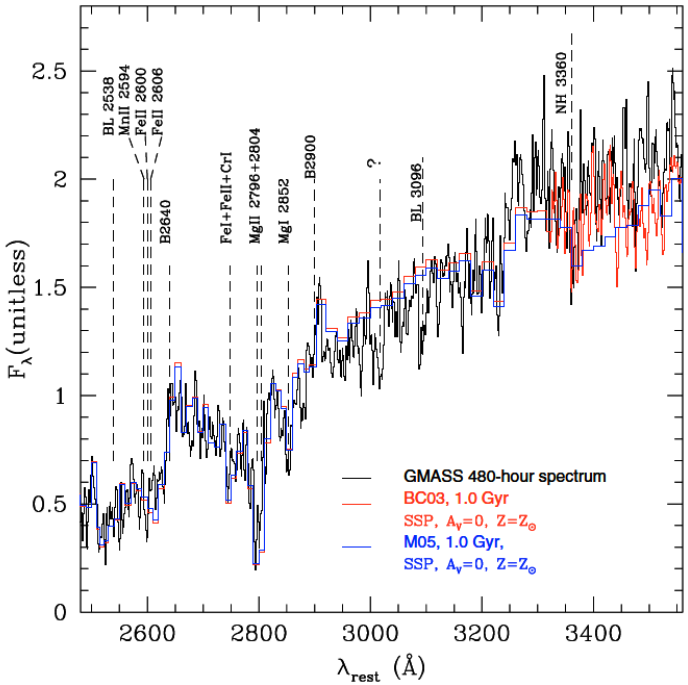




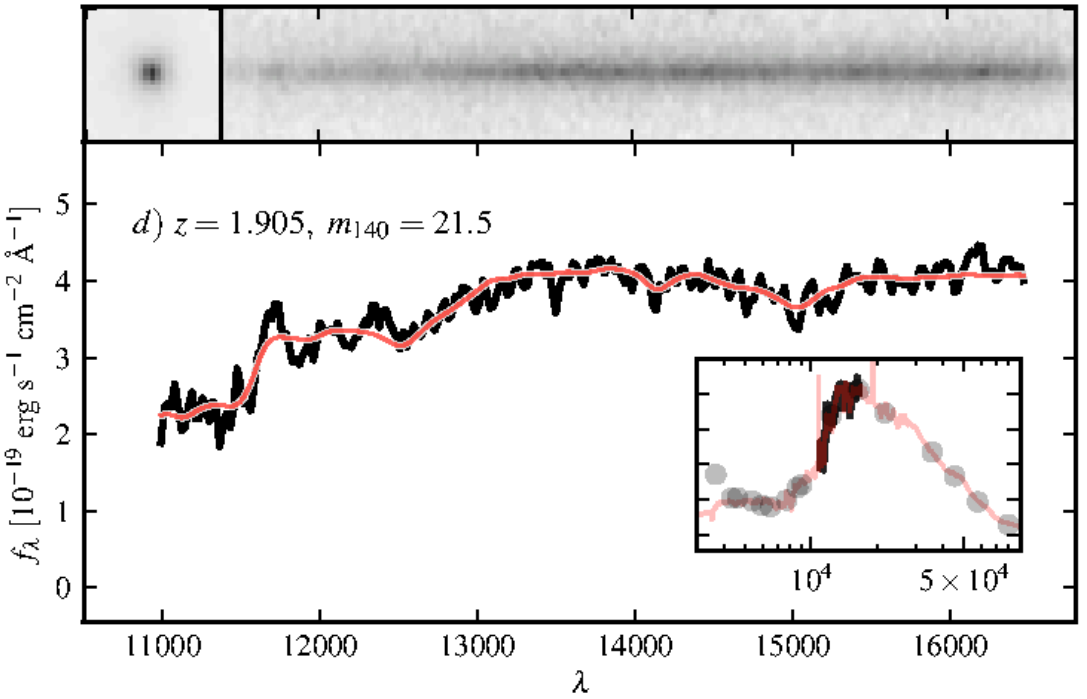
Madau & Dickinson (2014)

VANDELS: main science case

The other primary science case is detailed investigation of the descendents of high-z star-formers: passive galaxies at 1.5<z<2.5



Cimatti et al. (2008)

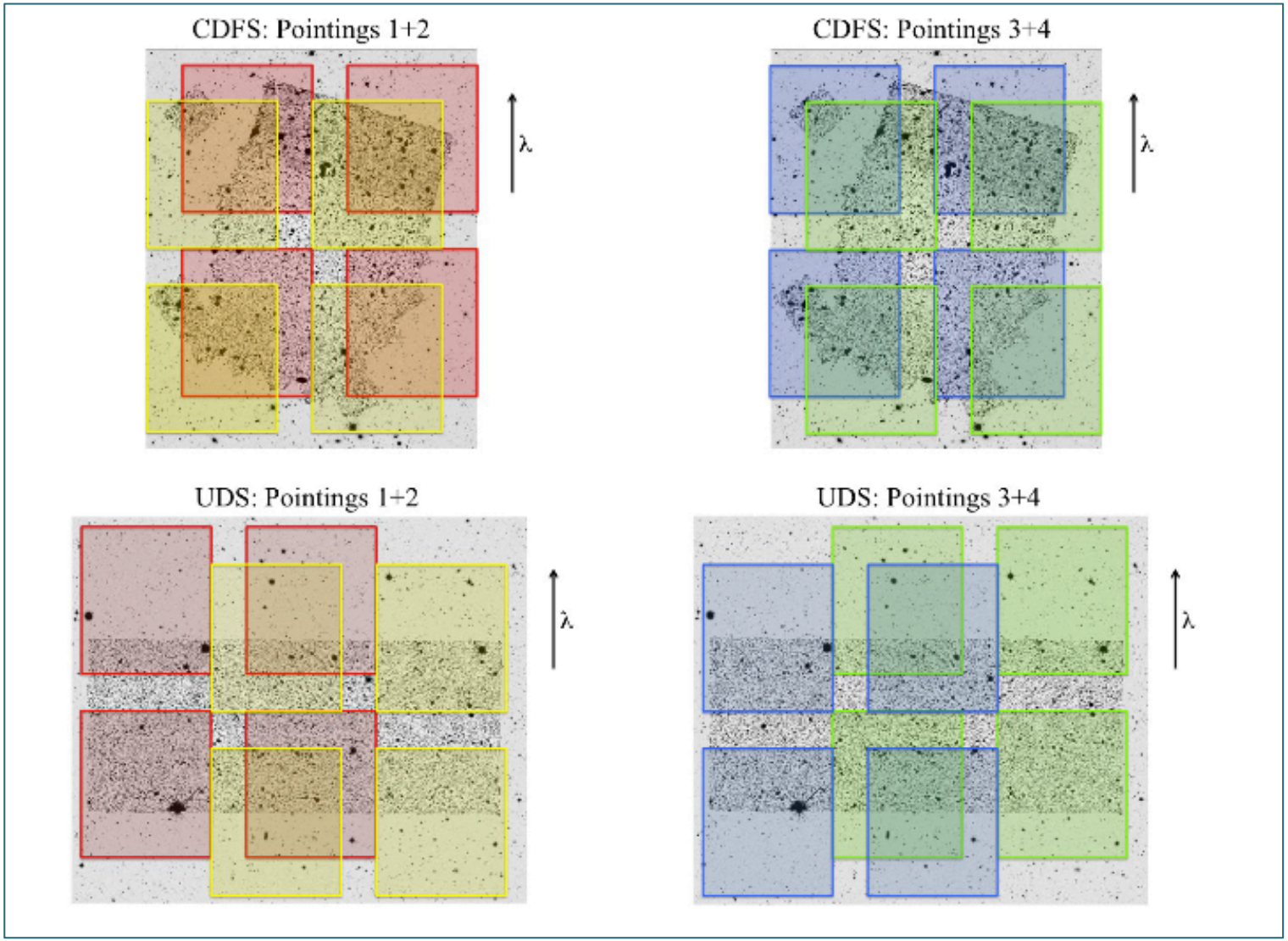


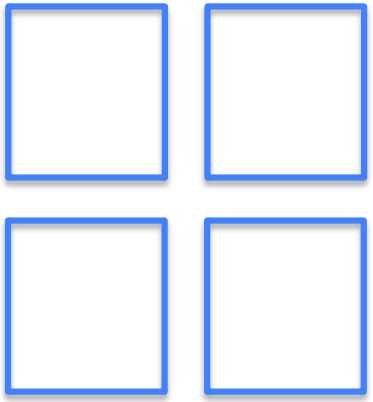
3D-HST (van Dokkum et al.)

- Possible to constrain ages from UV breaks (2600/2800 Angs) from VANDELS and Balmer break from 3D-HST spectra

- Full spectrophotometric fitting (photometry+spectra) offers prospect of delivering accurate stellar ages, masses and metallicities of massive quiescent galaxies at z~2

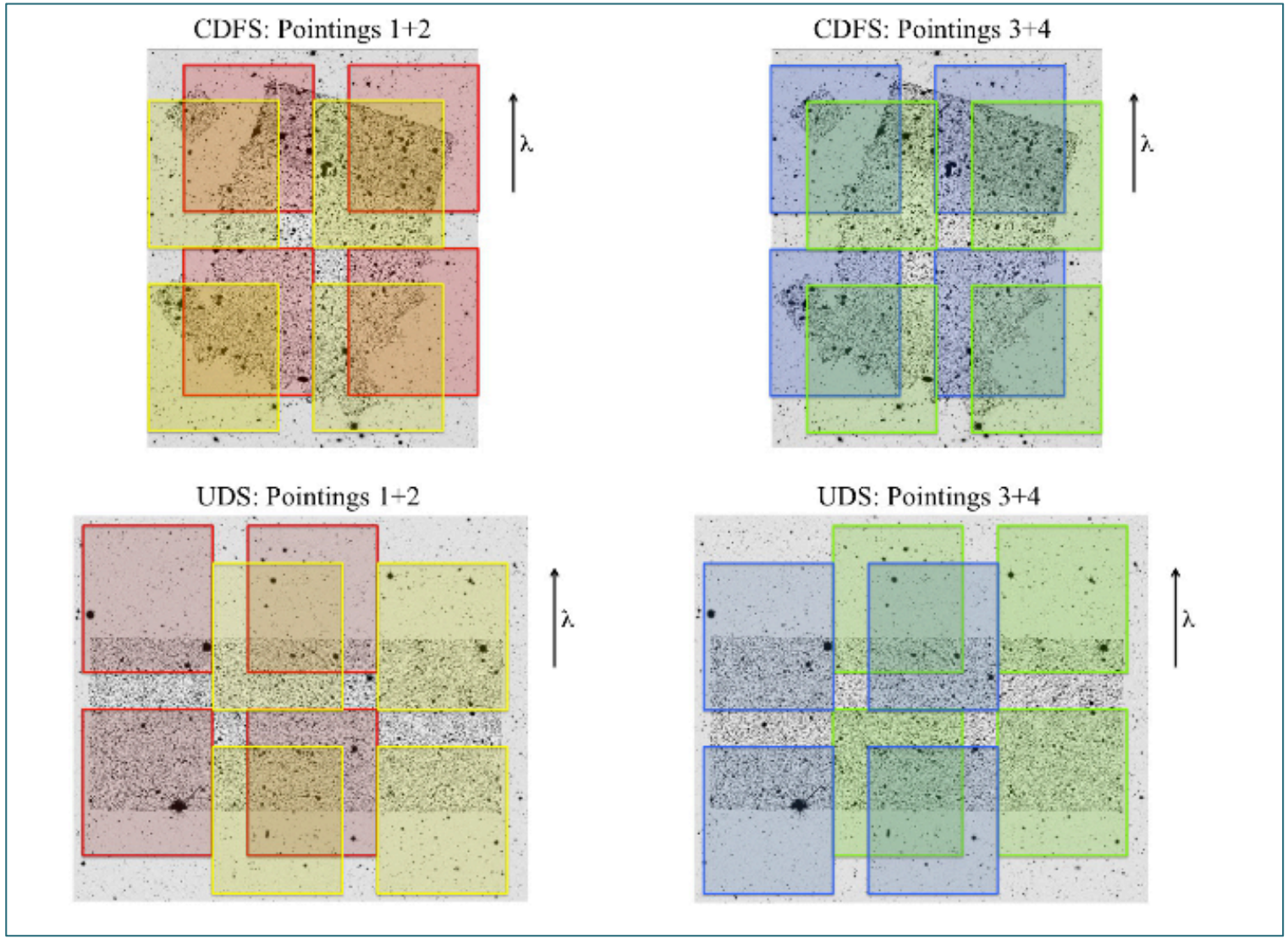
VANDELS: observations

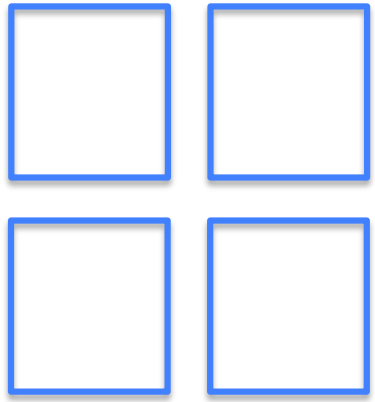




VIMOS FOOTPRINT

VANDELS: observations

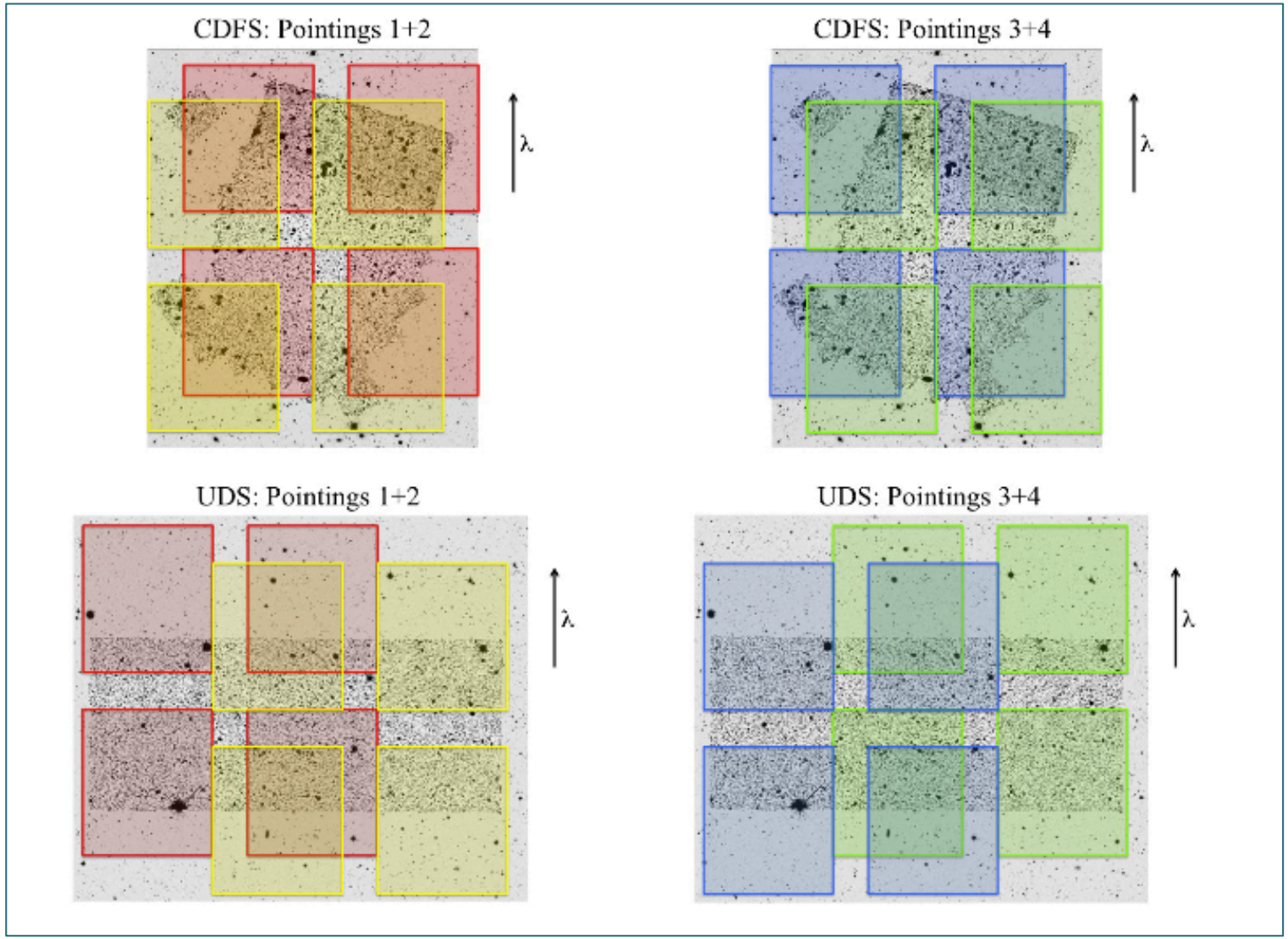


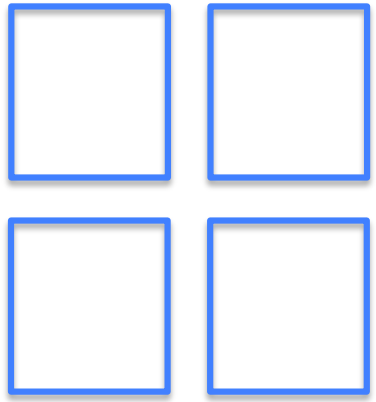


VIMOS FOOTPRINT

8 pointings in total, designed to cover HST imaging area
(75% of slits allocated to HST area)

VANDELS: observations





VIMOS FOOTPRINT

Each pointing targeted four times, for 20 hours each:
bright targets get 20 hours, faint targets get 80 hours

VANDELS: photo-z pre-selection

VANDELS will exploit the multi-wavelength photometry in UDS and CDFS to do uniquely robust photometric redshift pre-selection….

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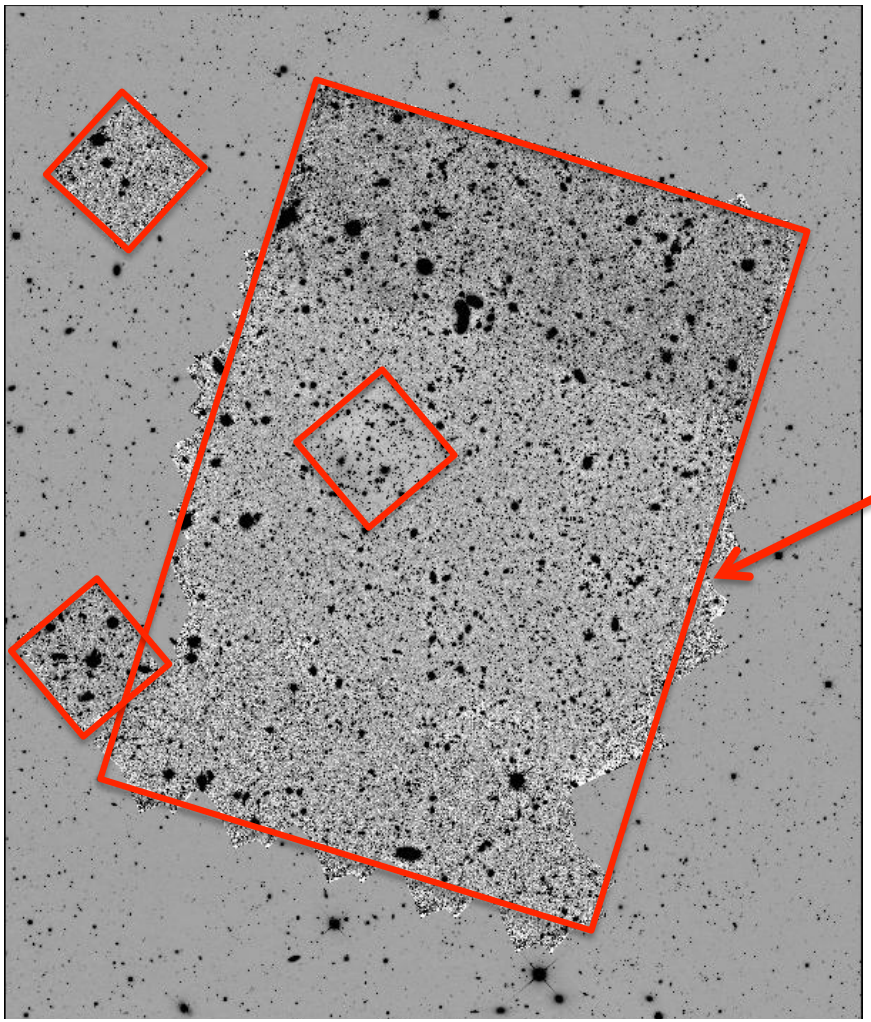

VANDELS CDFS FIELD

In area covered by CANDELS HST imaging use the Guo et al. (2013) TFIT catalogues featuring aperture matched, 14-band photometry 0.3-4.5μm

VANDELS: photo-z pre-selection

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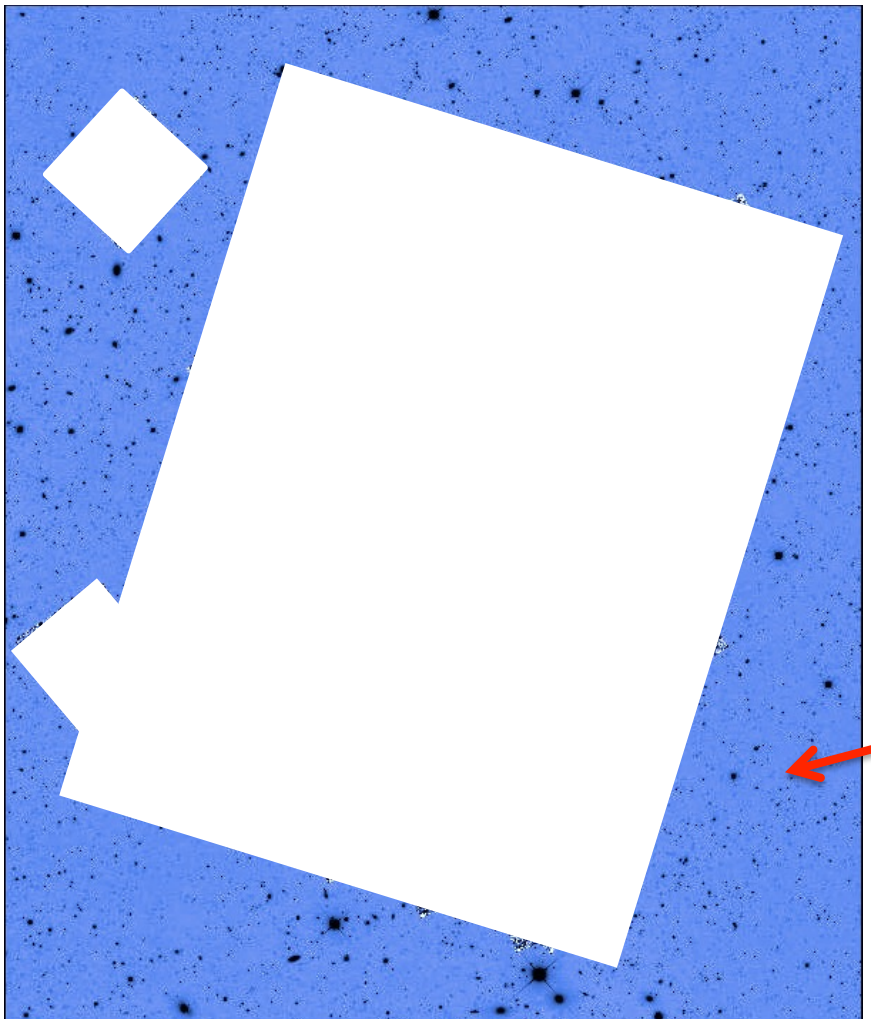


VANDELS CDFS FIELD

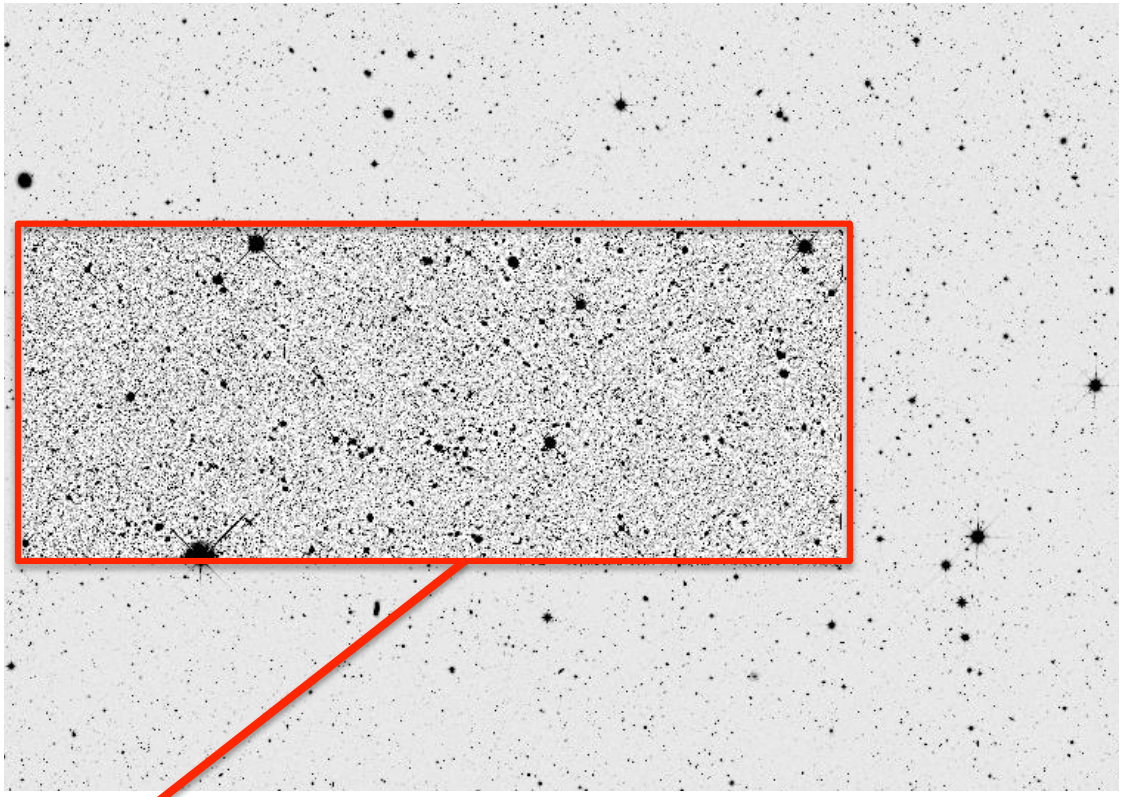
For extended CDFS region, new VANDELS catalogue, utilizing a combination of 16-band photometry:

VIMOS U+R imaging
GEMS HST imaging in V_{606} and z_{850}
Subaru medium band imaging (7 bands)
J+K imaging from TENIS survey on CFHT
H-band imaging from VISTA VIDEO survey
IRAC "supermap" of all CDFS Spitzer programmes

For the test runs we employed the Hsu et al. 2015 catalogue based on MUSYC +TENIS

VANDELS: photo-z pre-selection

VANDELS will exploit the multi-wavelength photometry in UDS and CDFS to do uniquely robust photometric redshift pre-selection….

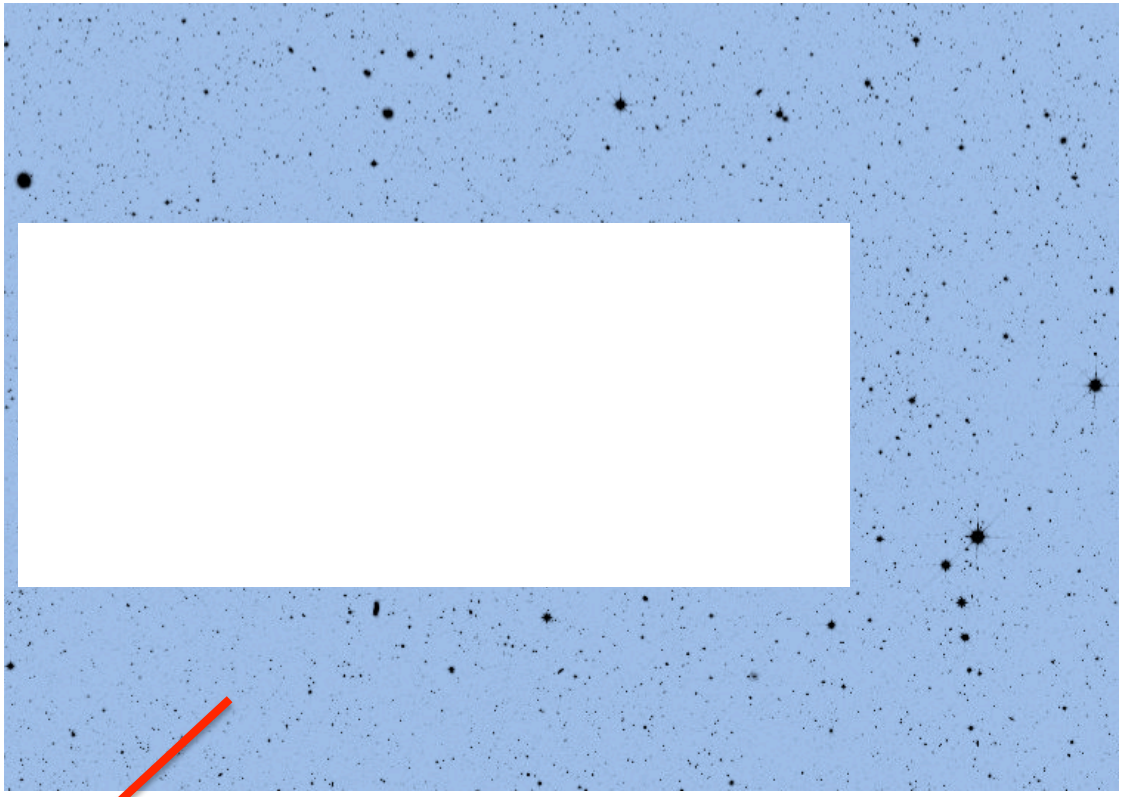


VANDELS UDS FIELD

Within CANDELS HST region, exploit Galametz et al. (2013) TFIT catalogue, which features 15-band aperture matched photometry covering 0.3-4.5μm

VANDELS: photo-z pre-selection

VANDELS will exploit the multi-wavelength photometry in UDS and CDFS to do uniquely robust photometric redshift pre-selection….



VANDELS UDS FIELD

Within extended UDS region, Edinburgh VANDELS catalogue using 13-band photometry:
CFHT U-band, Subaru BVRizz$_{nb}$, VIDEO Y-band, JHK from UKIDSS UDS, IRAC from SEDS

VANDELS: photo-z pre-selection

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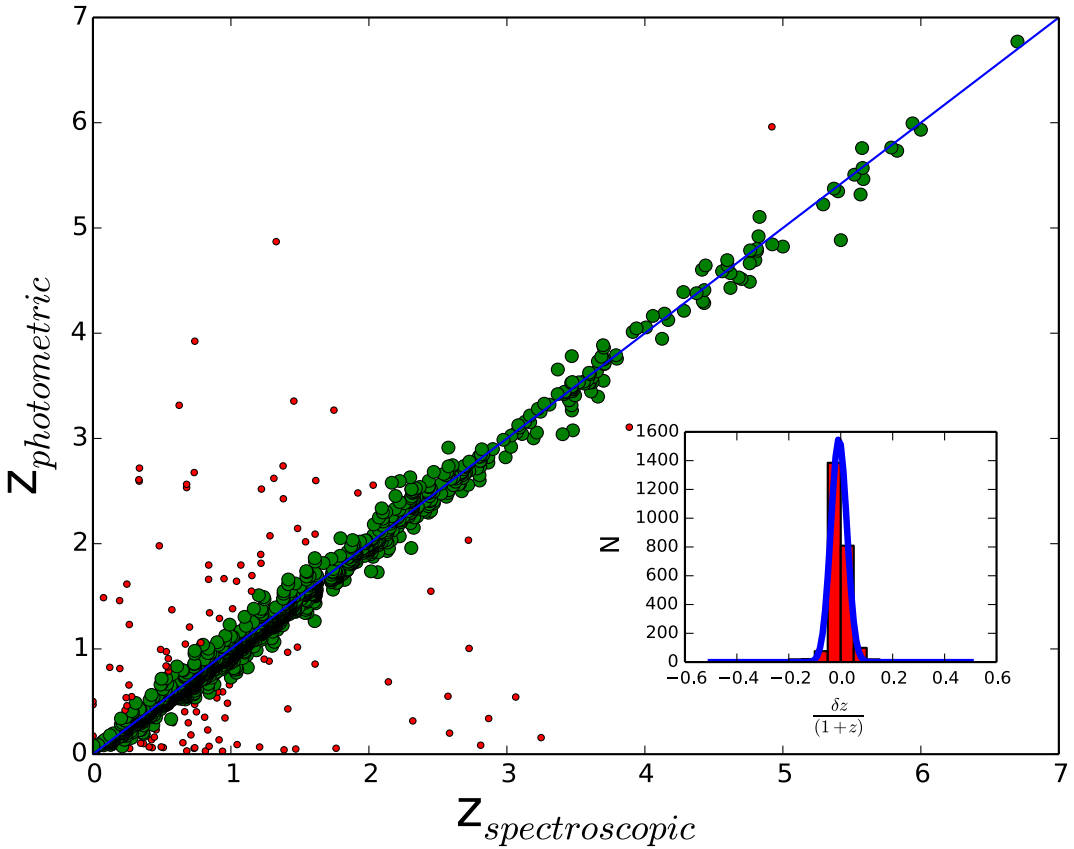


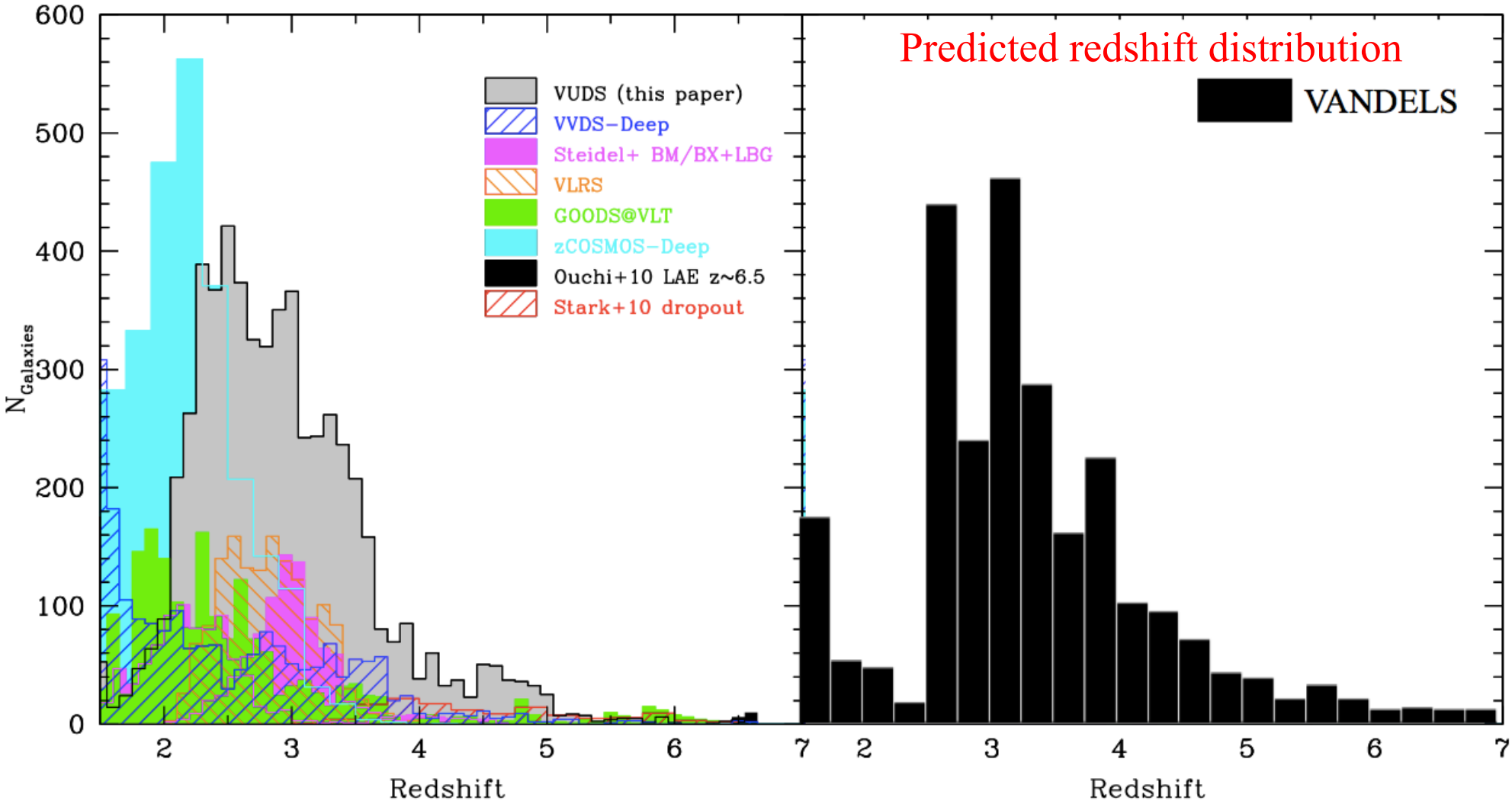
CDFS photometric redshifts

σ_{MAD}=0.013

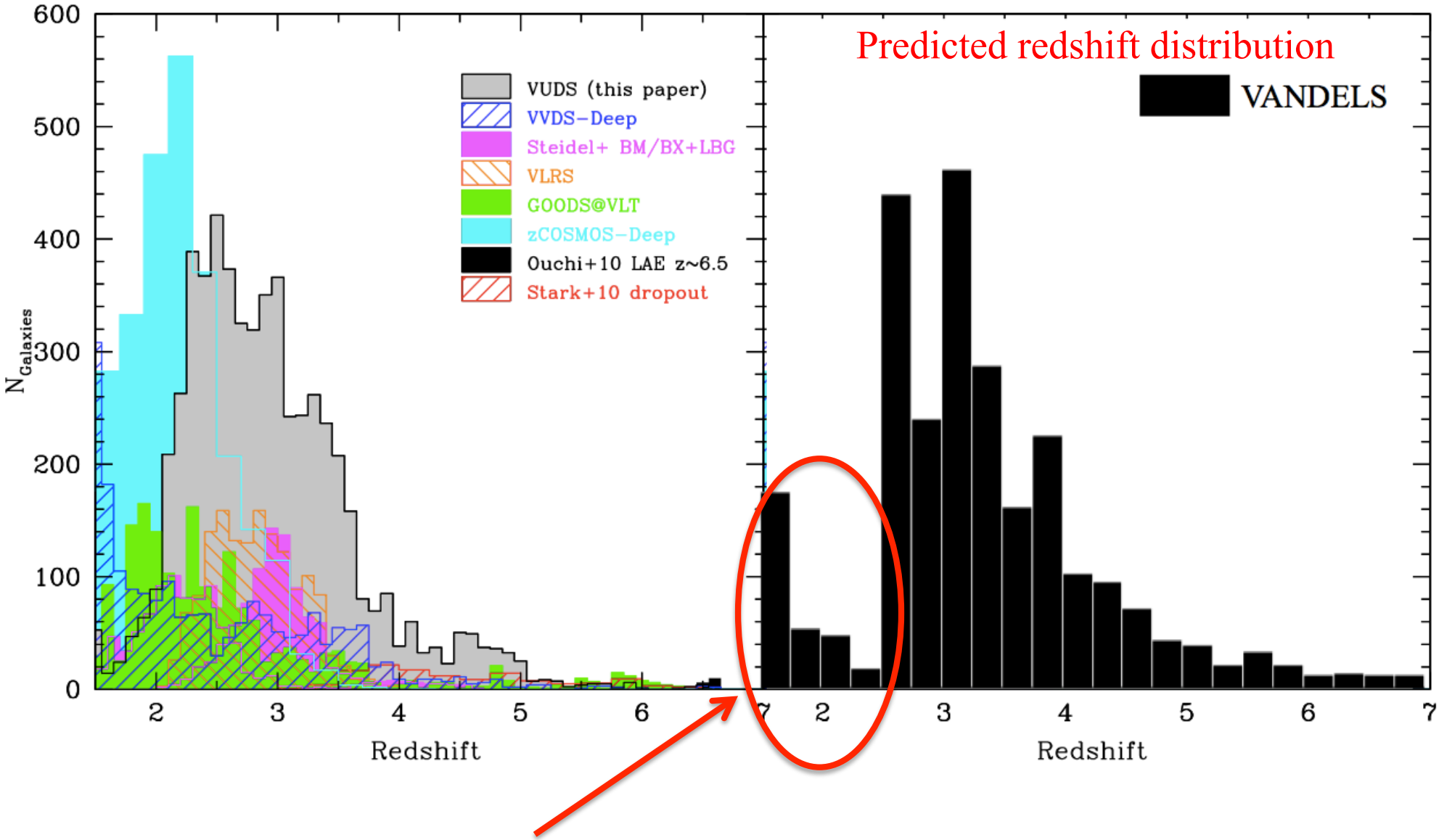
Outlier fraction < 4%
down to H_{AB}=26

Aim is for <100 low-redshift interlopers in final sample of 2600 galaxies

VANDELS: photo-z pre-selection



VANDELS: photo-z pre-selection

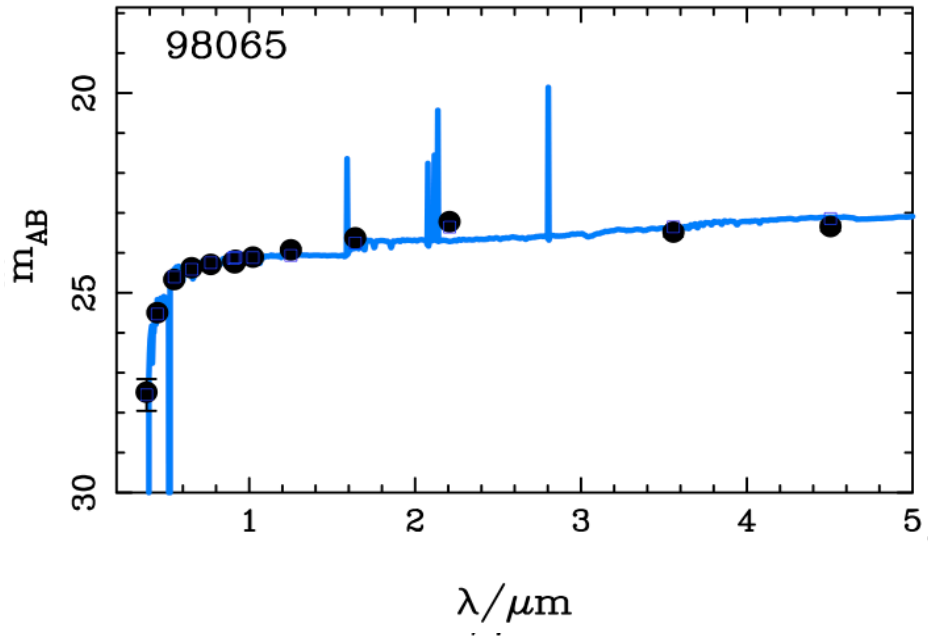


Passive galaxy sub-sample at 1.5<z<2.5

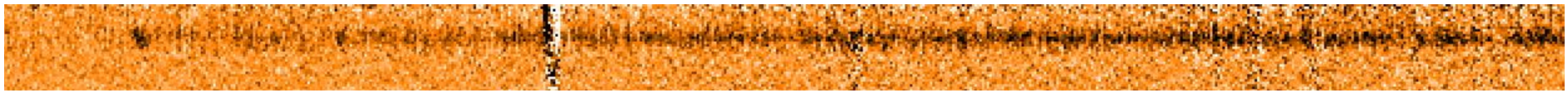
VANDELS: test observations

Allocated two observing runs in Nov/Dec 2014 to test mask preparation and observing strategy. Obtained ~10 hours of integration in both UDS and CDFS on two masks.

Example 2D spectra from UDS mask:



FIELD: UDS (EXTENDED AREA)
ID: 98065
CLASS: 2.5<z<5.5 SF
z_{phot} = 3.27
z_{spec} = 3.24



SF at z=3.24

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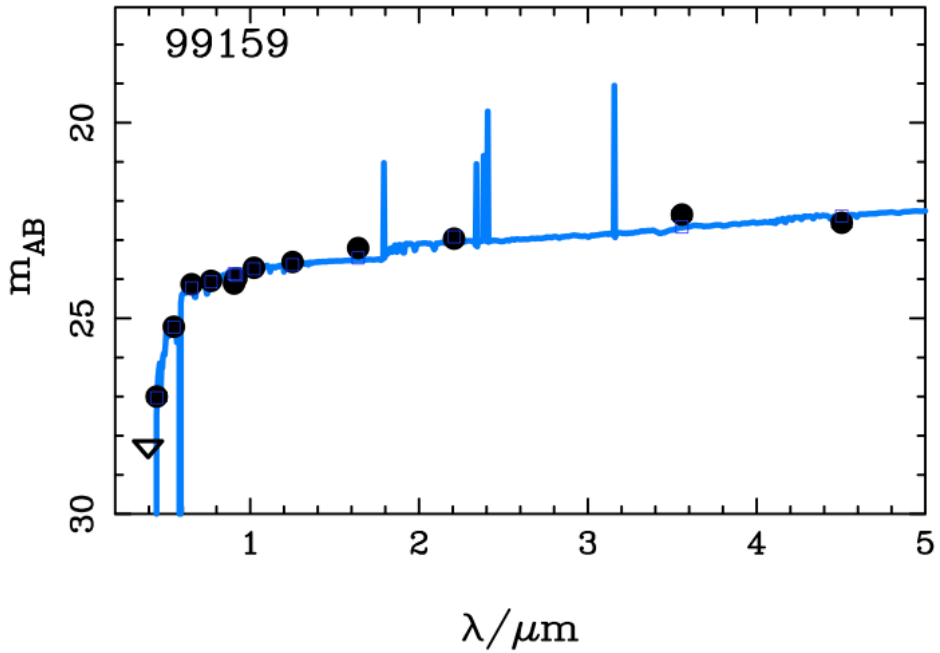
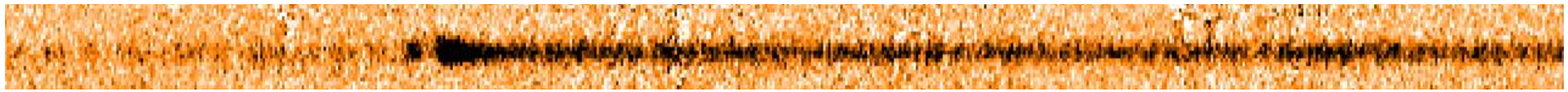


FIELD: UDS (EXTENDED AREA)
ID: 99159
CLASS: High-z AGN
$z_{phot} = 3.81$
$z_{spec} = 3.97$



Type 1 AGN at z=3.97

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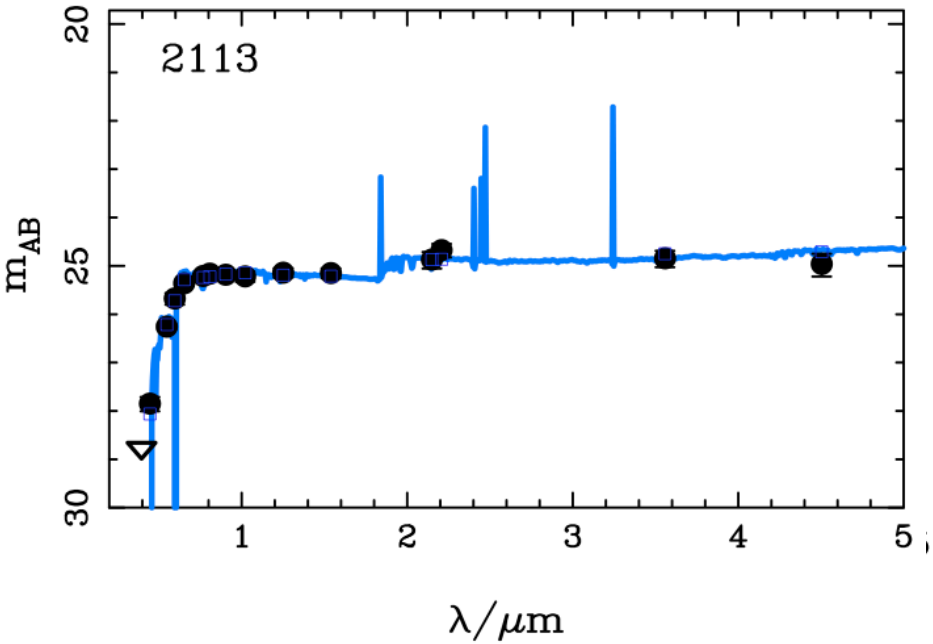


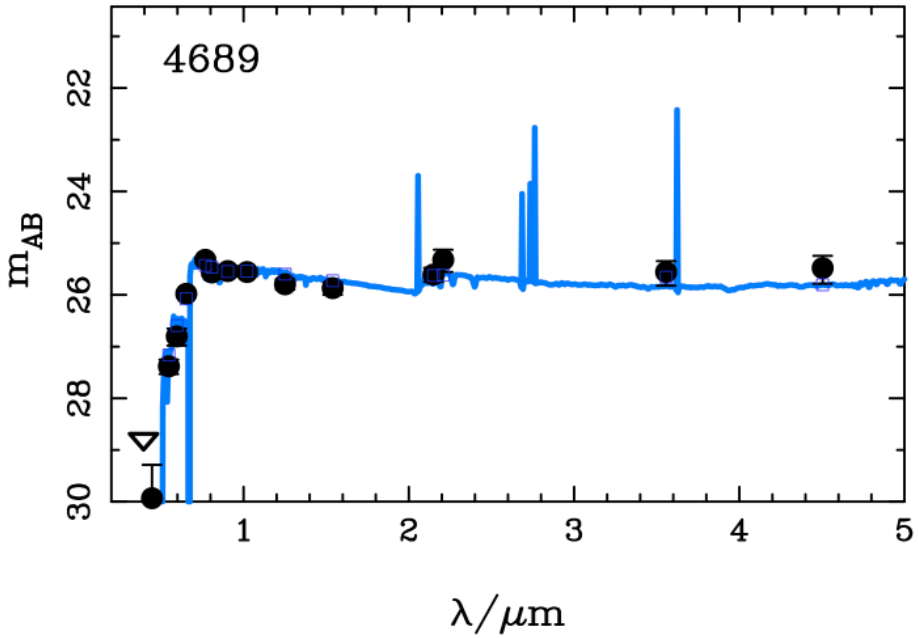
FIELD: UDS (CANDELS AREA)
ID: 2113
CLASS: 3.0<z<7.0 LBG
z_{phot} = 3.94
z_{spec} = 4.03

LAE at z=4.03

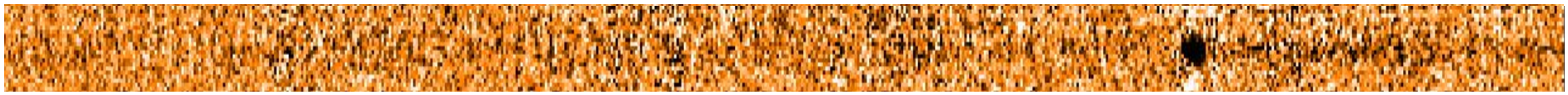
VANDELS: test observations

Allocated two observing runs in Nov/Dec 2014 to test mask preparation and observing strategy. Obtained ~10 hours of integration in both UDS and CDFS on two masks.

Example 2D spectra from UDS mask:



FIELD: UDS (CANDELS AREA)
ID: 4689
CLASS: 3.0<z<7.0 LBG
z_{phot} = 4.52
z_{spec} = 4.62



LAE at z=4.62

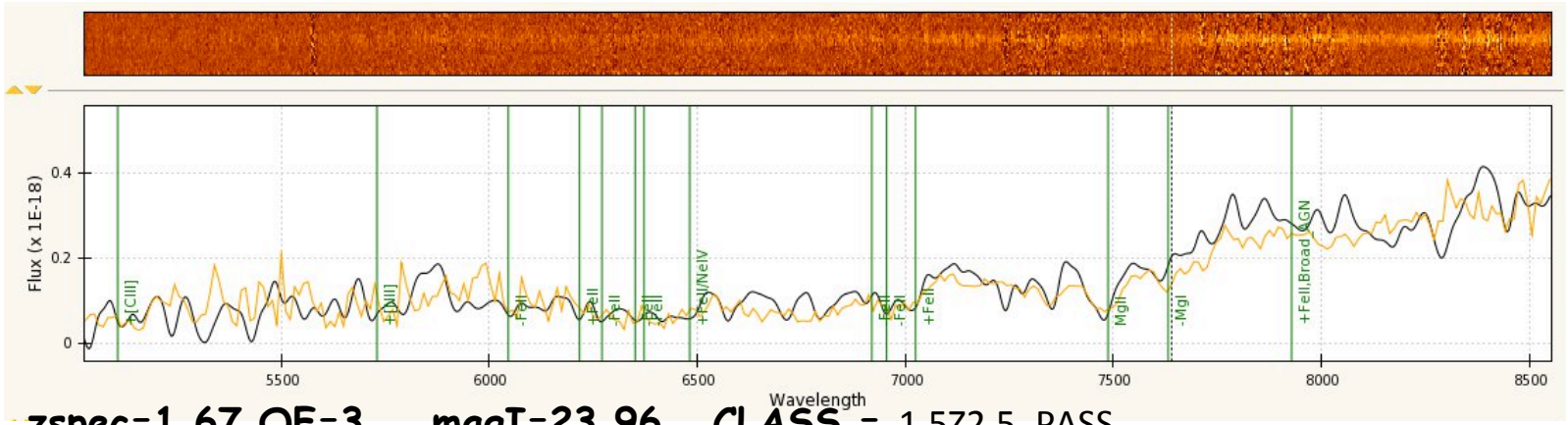
VANDELS: test observations

Allocated two observing runs in Nov/Dec 2014 to test mask preparation and observing strategy. Obtained ~10 hours of integration in both UDS and CDFS on two masks.

Example 1& 2D spectra from CDFS mask:

FIELD: CDFS (CANDELS AREA)
ID:
CLASS: 1.5 < z <1.5 PASSIVE
z_{phot} = 1.522
z_{spec} = 1.67

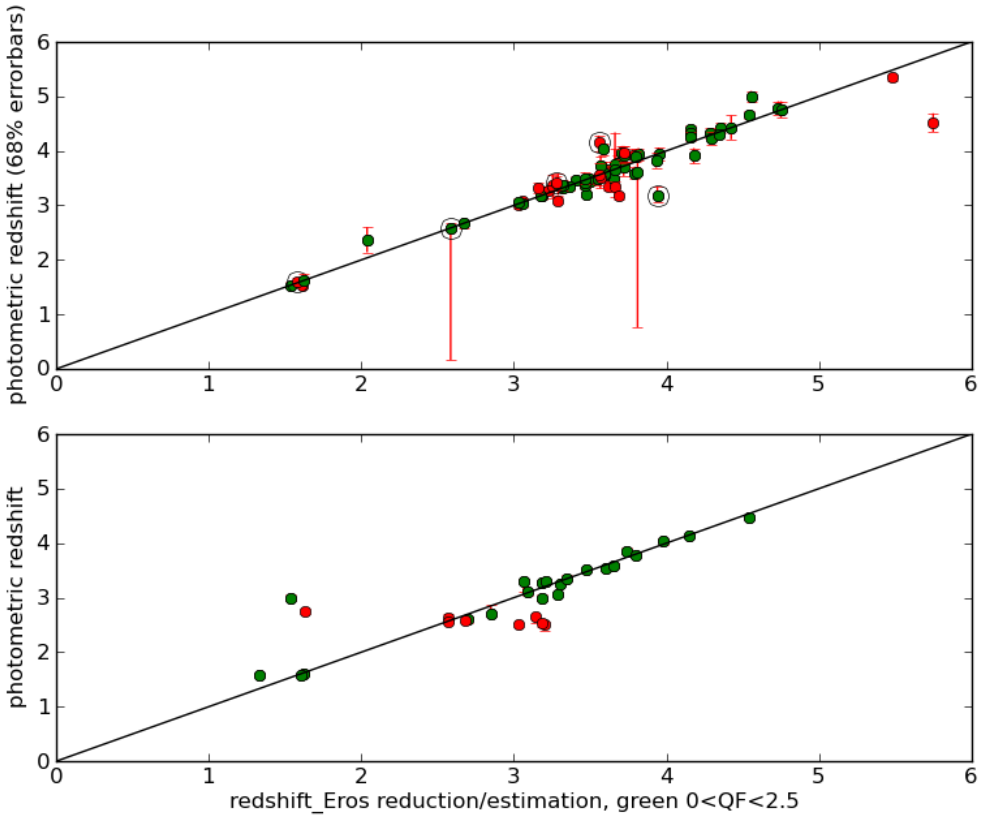
Example of sources with zphot = z_spec



zspec=1.67,QF=3 magI=23.96 CLASS = 1.5Z2.5_PASS
comment = MagII2600, break; g-band break

VANDELS: test observations

Allocated two observing runs in Nov/Dec 2014 to test mask preparation and observing strategy. Obtained ~10 hours of integration in both UDS and CDFS on two masks.



z_{spec}-z_{phot} comparison from test mask in CDFS: upper plot CANDELS area Lower plot EXTENDED area

Green = high quality redshift

Red = low quality redshift

Target selection appears to be working well…

VANDELS: schedule

VANDELS has been allocated 912 hours **of visitor mode observations**, spread over 240 nights to be carried out in four observing seasons (Aug-Dec) during 2015-2018. All raw data are immediately public on ESO archive, and reduced data will be released ~9 months after observations.

Provisional Data Release Schedule:

		No. of completed spectra			No. of partially complete spectra			
Data release	Date	20-hrs	40-hrs	80-hrs	40-hrs(50%)	80-hrs(25%)	80-hrs(50%)	Total
DR1	Sept 2016	160	160	0	320	320	160	1120
DR2	Sept 2017	320	480	160	320	320	160	1760
DR3	Sept 2018	480	960	320	0	0	320	2080
DR4	Sept 2019	640	1280	640	0	0	0	2560

Data Reduction:

Data reduction is being carried out in Milan, by the team responsible for reducing VIMOS data obtained in VVDS, zCOSMOS, VIPERS and VUDS surveys
Fully calibrated 1d and 2d spectra as well as additional data products will be made available

Summary

- 912 hours of VIMOS visitor time: 2015-2018
- 20-80 hour integrations focused on z>3 SF galaxies and z>1.5 passive
- Science goals: ages, masses, metallicities and outflows at high-z
- Raw data immediately public
- Reduced data released ~9 months after observations taken
- Full details can be found at: vandels.inaf.it

VANDELS

A deep VIMOS survey of the CANDELS UDS and CDFS fields

Unveiling the astrophysics of high-redshift galaxy evolution