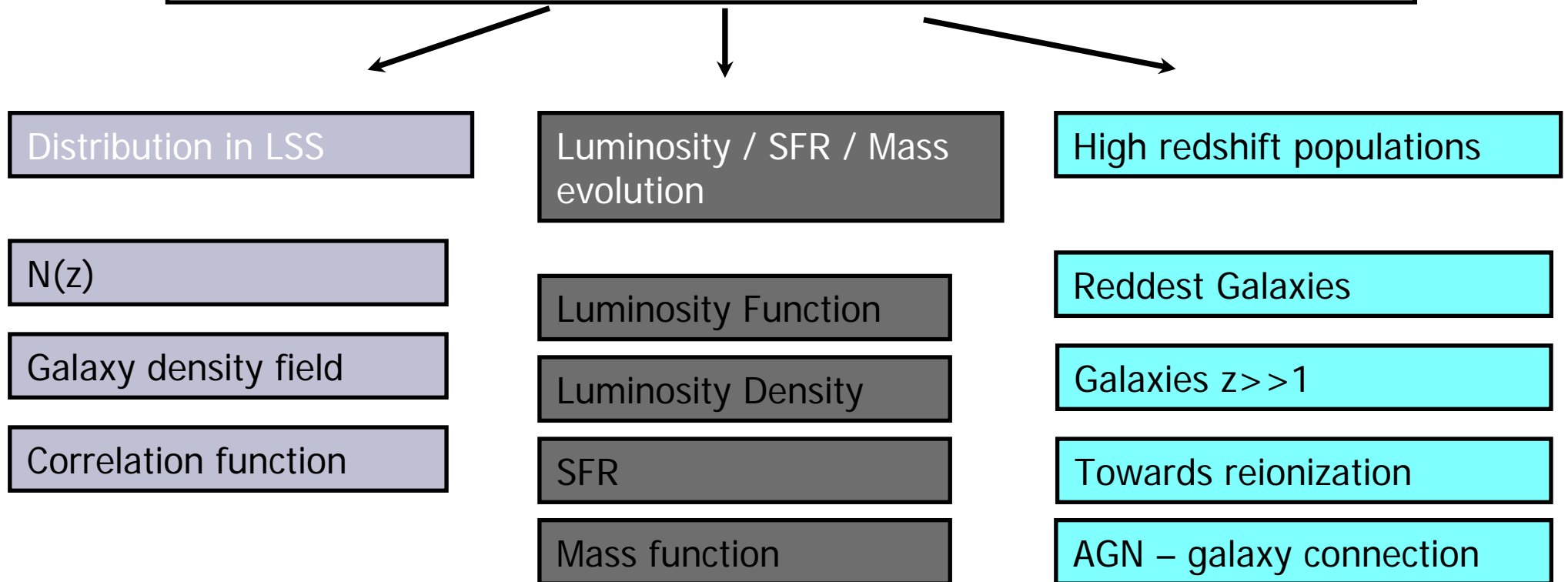


Next generation deep redshift surveys in the XXL

Olivier Le Fèvre, Laboratoire d'Astrophysique de Marseille

- Today state of the art
- Next generation redshift surveys
 - Ultra Deep
 - Ultra Wide
- Strategy for a follow-up of XMM-XXL survey

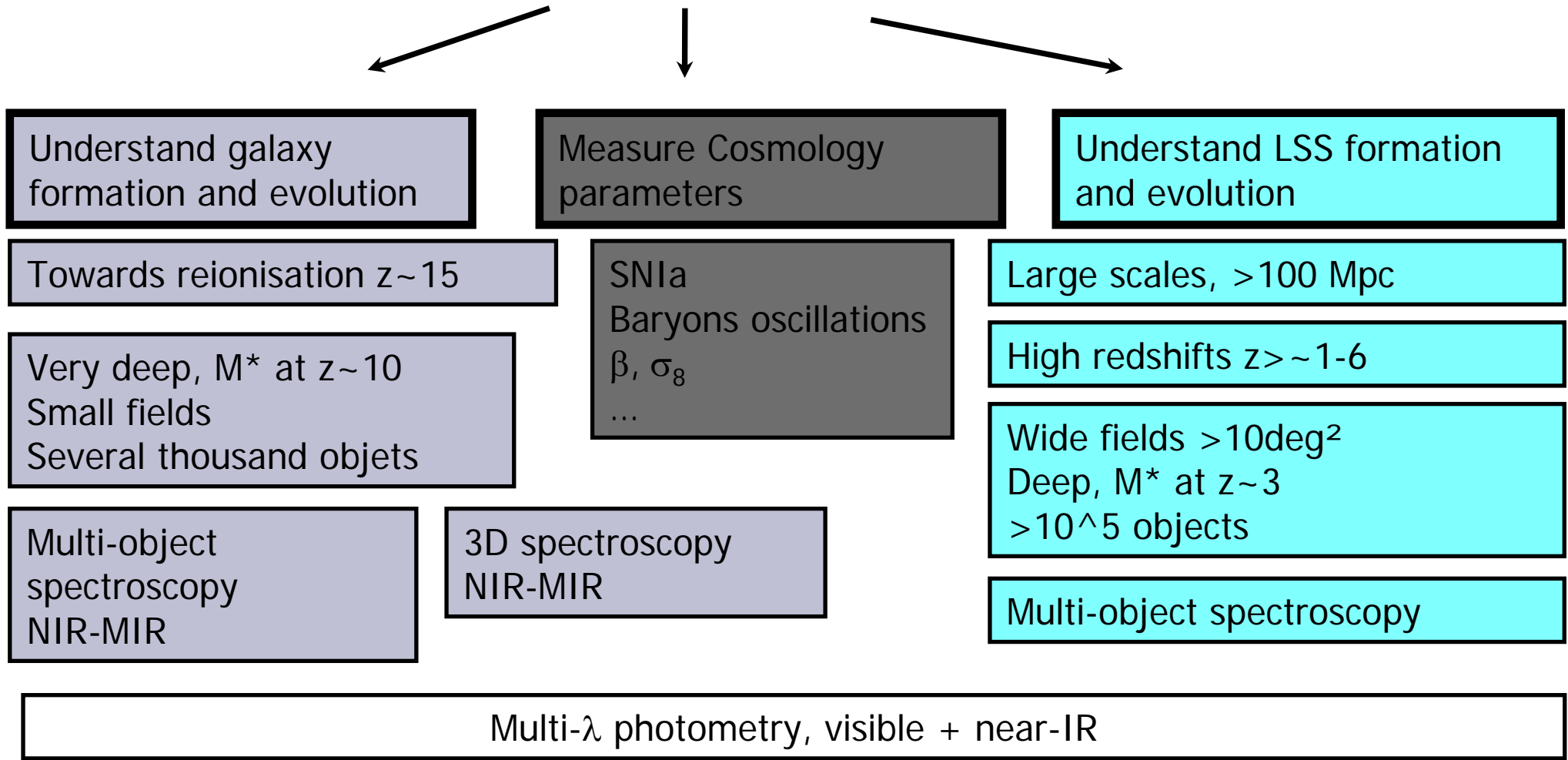
Measuring galaxy, AGN, and LSS evolution from Redshift Surveys



Track evolution versus Environment, Luminosity, galaxy Type,...

Explore evolution selecting at different wavelengths: UV, IR, radio, X,...

Next generation deep spectroscopic surveys



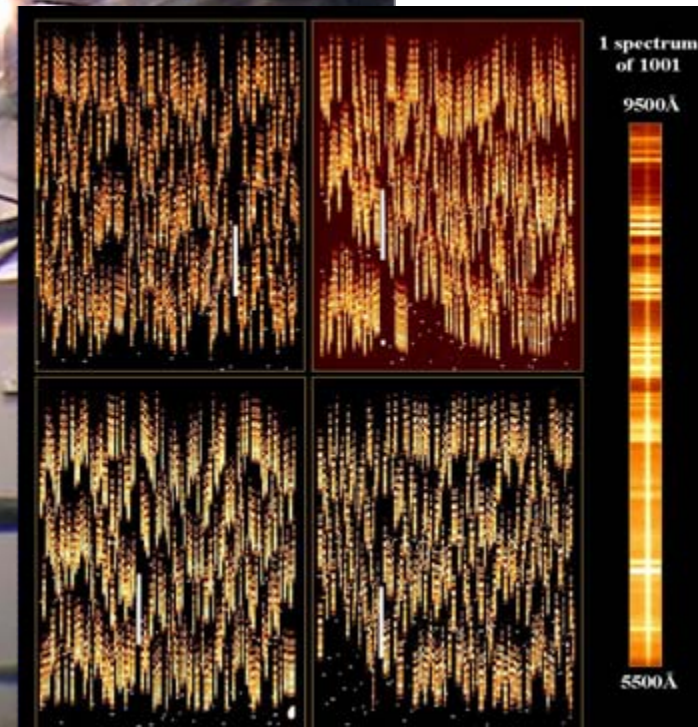
Lensing, CMB, SNIa...

Deep redshift surveys today

- **VVDS (VLT-VIMOS)**: ~100000 redshifts $0 < z < 5$, IAB=22.5-24.75
- **DEEP2 (DEIMOS)**: ~50000 redshifts $0.7 < z < 1.5$, IAB=23.5-24.5 (Davis, Faber et al.)
- **K20-GMASS (VLT-FORS)**: ~a few hundred z , $K \leq 20$, 21.5 (Cimatti et al.)
- **GDDS (Gemini-GMOS)**: ~500 z , IAB = 25 (Abraham et al.)
- **GOODS (VLT-VIMOS)**: 6000 redshifts, B=26
- **zCOSMOS (VLT-VIMOS)**: 20000 z in 2 deg^2 to $z=1.2$, 10000 z $1.4 < z < 3$
- **COSMOS-AGN (Magellan-IMACS+VIMOS)**: 1000 redshifts in 2 deg^2
- **zUDS (VLT-VIMOS)**: 6000 redshifts in 1 deg^2 to $z \sim 2$

A highly efficient high redshift
machine in operations since 2002
on the VLT

~5000 redshifts / night @ AB ~22.5



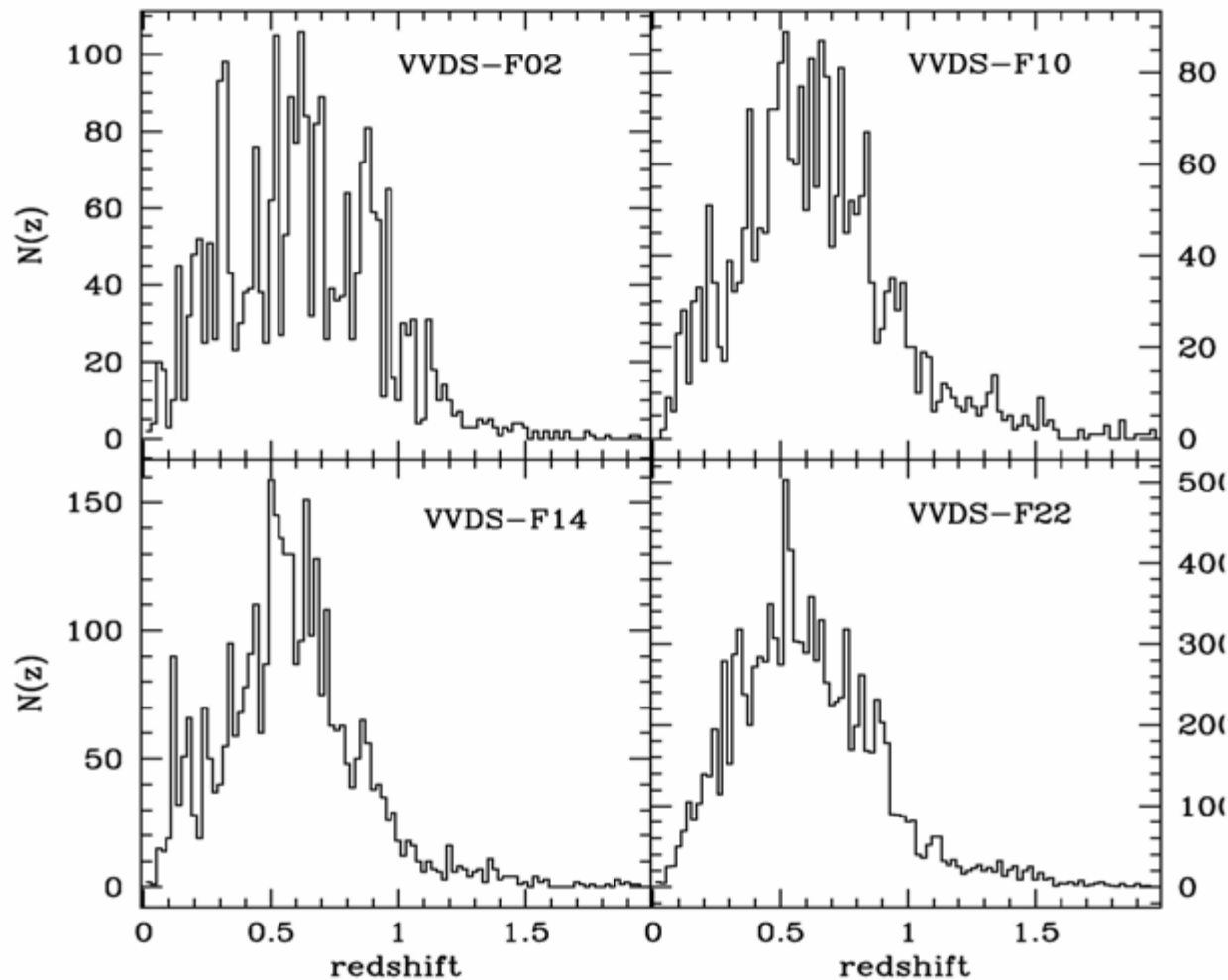
Deep redshift surveys today: The VIMOS VLT Deep Survey

Field	$I_{AB} < 22.5$ WIDE 16+ deg ²	$I_{AB} < 24$ DEEP 1deg ²	$I_{AB} < 24.75$ Ultra-Deep 600 arcmin ²
0226-04		~14000 <i>9000 Public</i>	1000 <i>(on-going)</i>
1000+03	~5000		
1400+05	~11000		
2217+00	~15000 <i>Public</i>		
CDFS		~1600 <i>Public</i>	
Total	~35000	~15500	~1000
GOAL	100000	20000	1000

- R~230, 5500-9300Å
- ~**50000 spectra today**
- Goal >20000 Deep and 100000 Wide

Magnitude selection only: complete census of the population,
minimize a priori selection bias

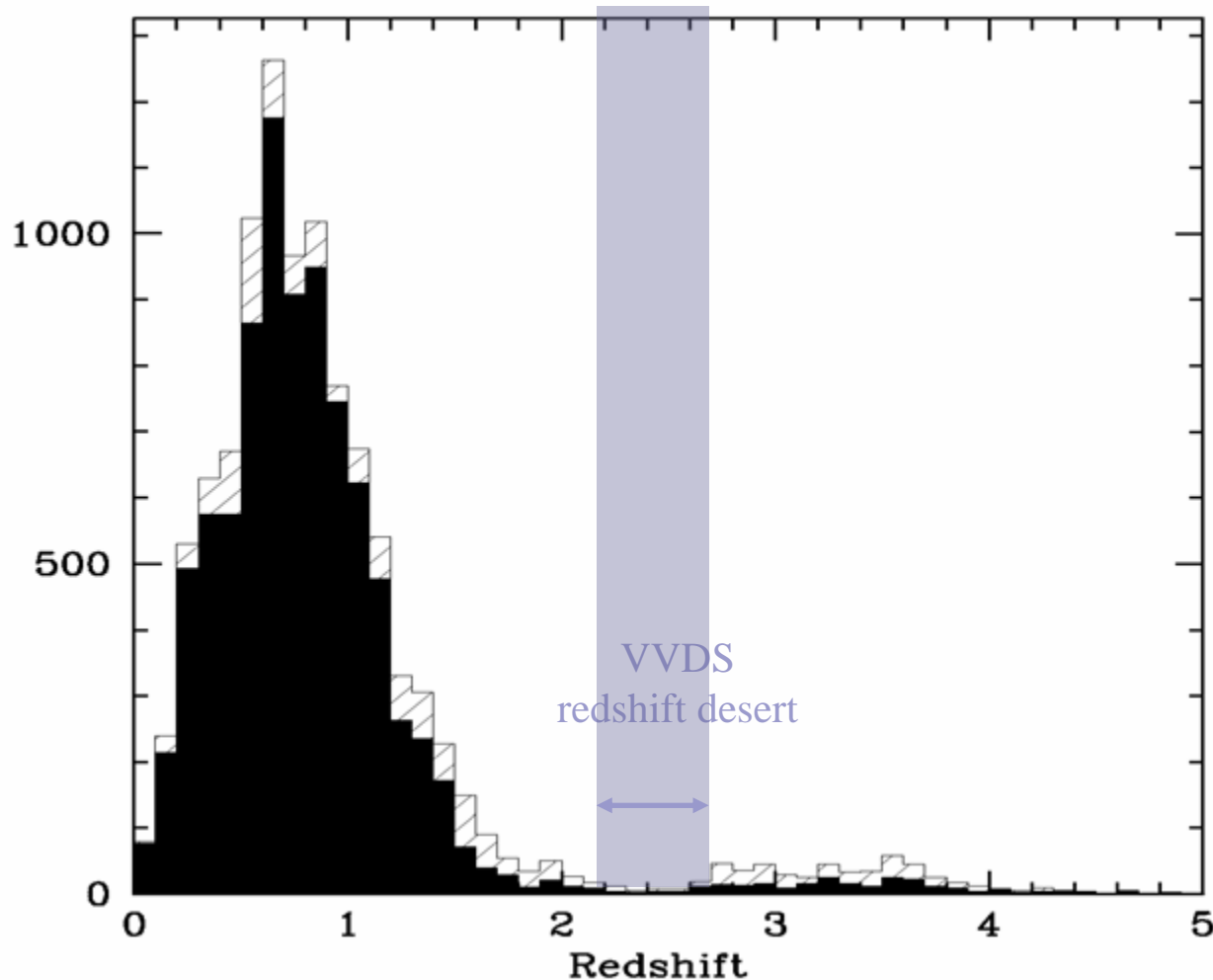
$I_{AB} \leq 22.5,$
 $\langle z \rangle = 0.55$



VVDS

$$N(z): I_{AB} \leq 22.5, I_{AB} \leq 24, I_{AB} \leq 24.75$$

Magnitude selection only: complete census of the population,
minimize a priori selection bias



$$I_{AB} \leq 24$$

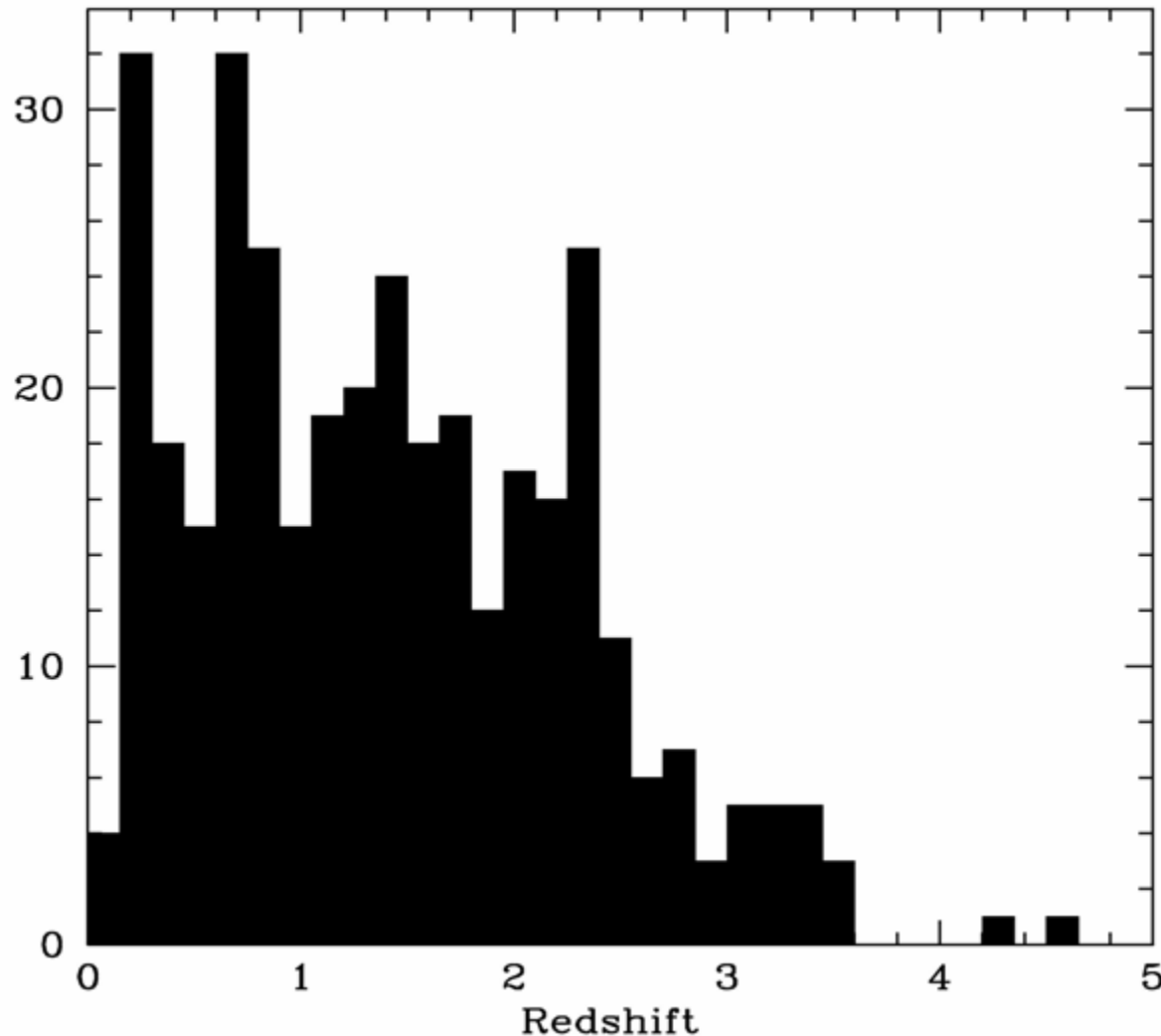
$$\langle z \rangle = 0.75$$

High redshift tail

Type I AGN: 1%

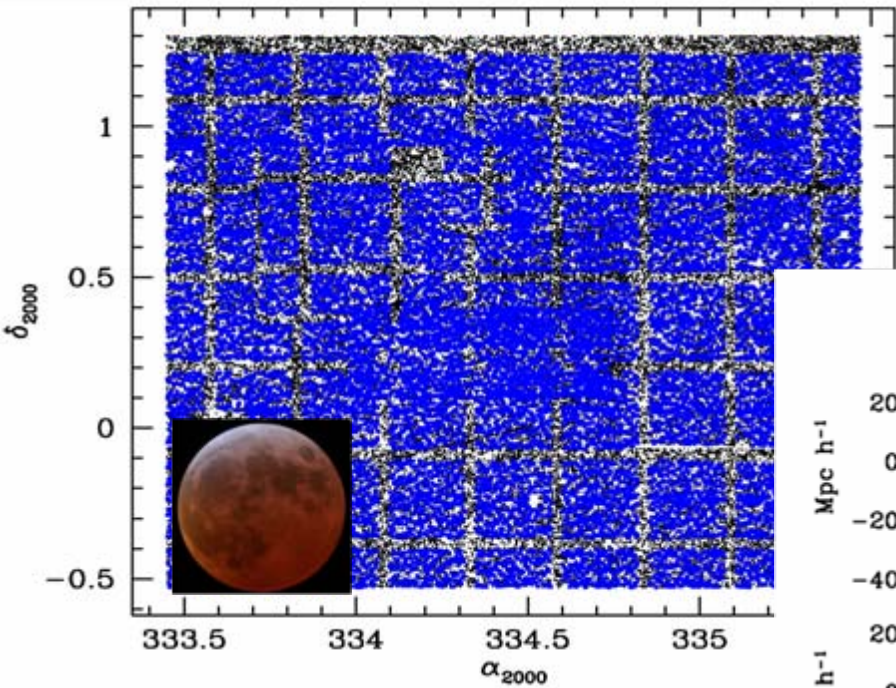

$$N(z): I_{AB} \leq 22.5, I_{AB} \leq 24, I_{AB} \leq 24.75$$

Magnitude selection only: complete census of the population,
minimize a priori selection bias

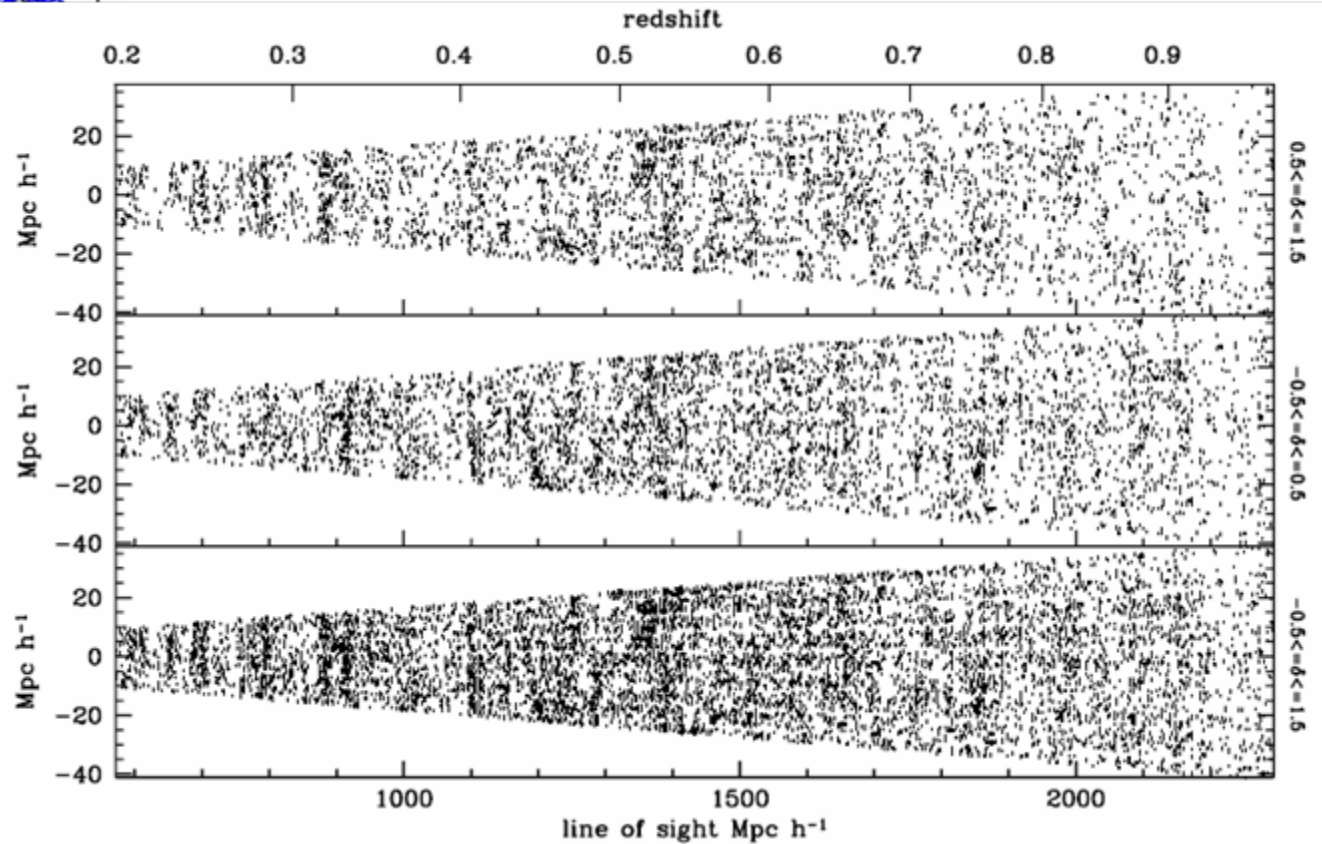


$22.5 \leq I_{AB} \leq 24.75$
 $\langle z \rangle = 1.4$
High redshift tail to
 $z \sim 5$
40% of galaxies
with $z > 1.5$

VVDS-Wide, 35000 redshifts

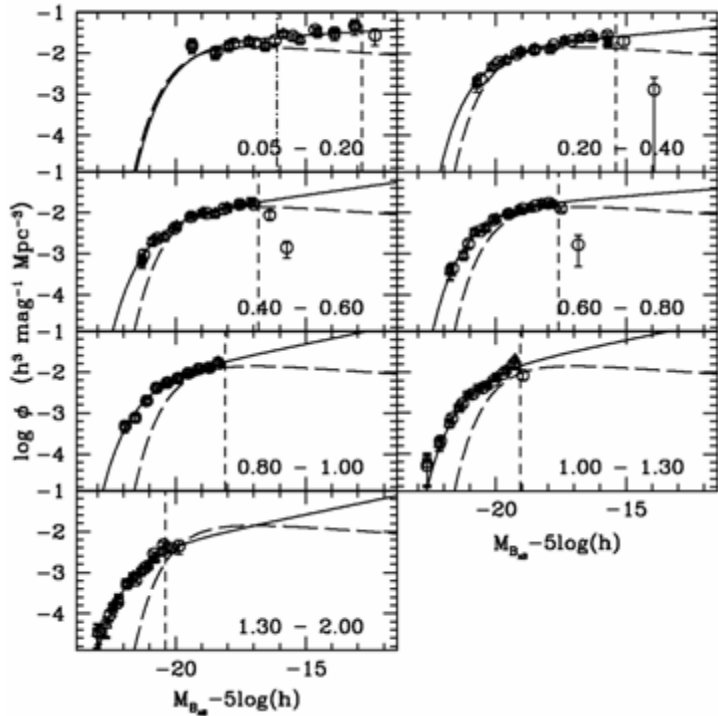


4 deg²



VVDS results

Clustering

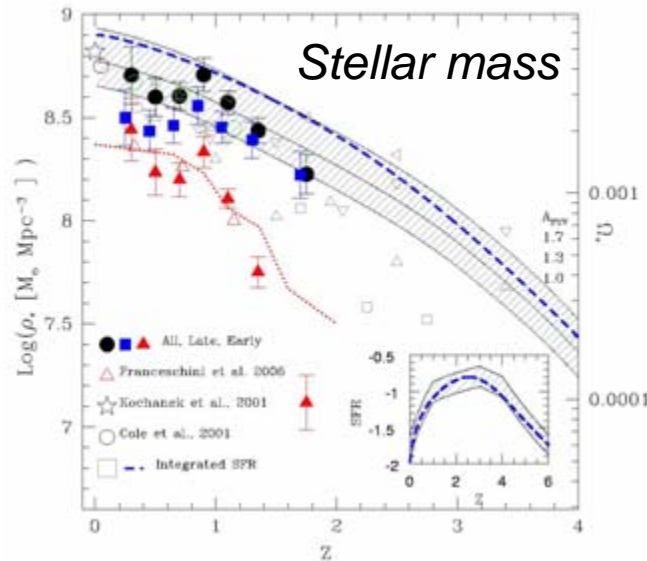


Luminosity function to $z \sim 3$

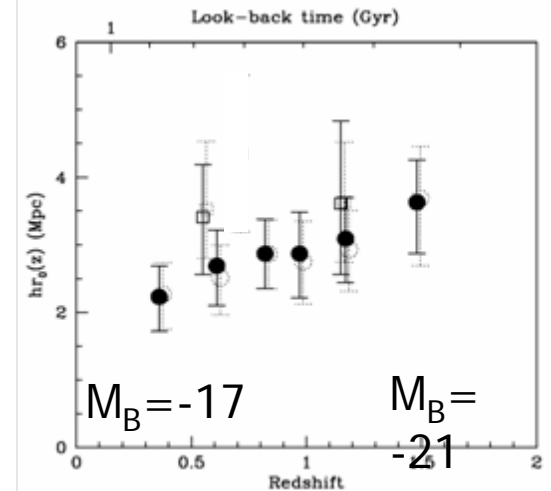
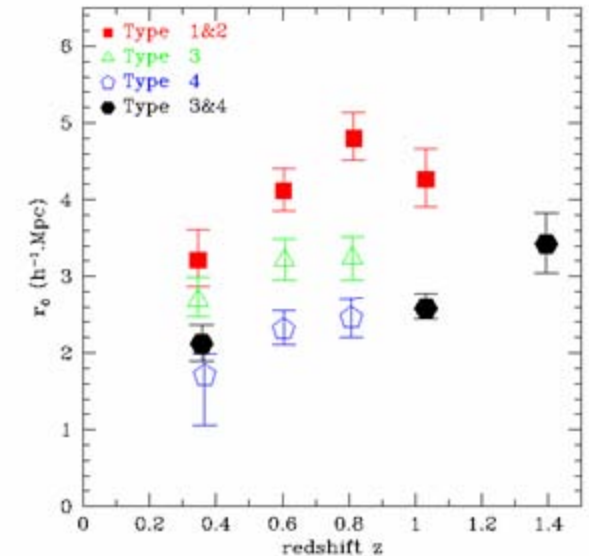
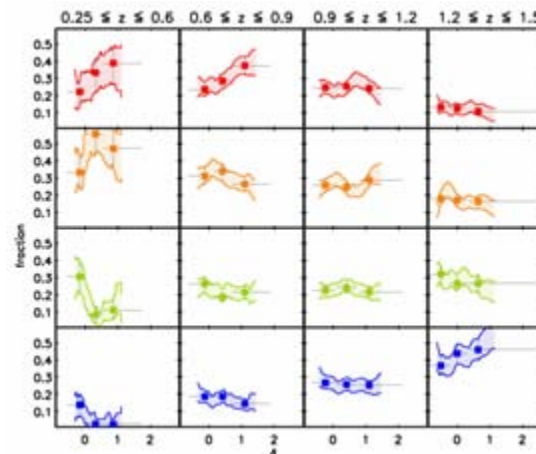
By type

Vs. environment

40+ papers published so far



Type density relation evol



On-going *deep* redshift surveys: summary

- At $z \sim 1$: $\sim 10 \text{ deg}^2$, $\sim 100 \text{ Mpc}$ scales, several 10^4 redshifts, coming up: $\sim 10^5$ redshifts
- At $z \sim 2-3$: $\sim 1-2 \text{ deg}^2$, $\sim 50 \text{ Mpc}$ scales, a few hundred redshifts now, several 10^3 redshifts coming up
- At $z=4-6$: A few tens of redshifts

20-100 \times smaller at $z \sim 1$ in $dz=0.2$ than 2dFGRS-SDSS

Next generation surveys

1. Wide: "SDSS at $z \sim 1-1.5$ "

- 10^6 galaxies, 50-100 deg^2
- $>200\text{Mpc}$ scales
- AB ~ 23



2. Ultra-Wide: All-sky survey to $z \sim 1-2$

- A few 10^8 galaxies, 10000 deg^2
- ESA EUCLID/SPACE instrument
- Wait for $>10\text{y}$

Relevant for XMM surveys in next 5y

3. "VVDS at $z \sim 3-6$ "

- 10^5 galaxies, 25 deg^2

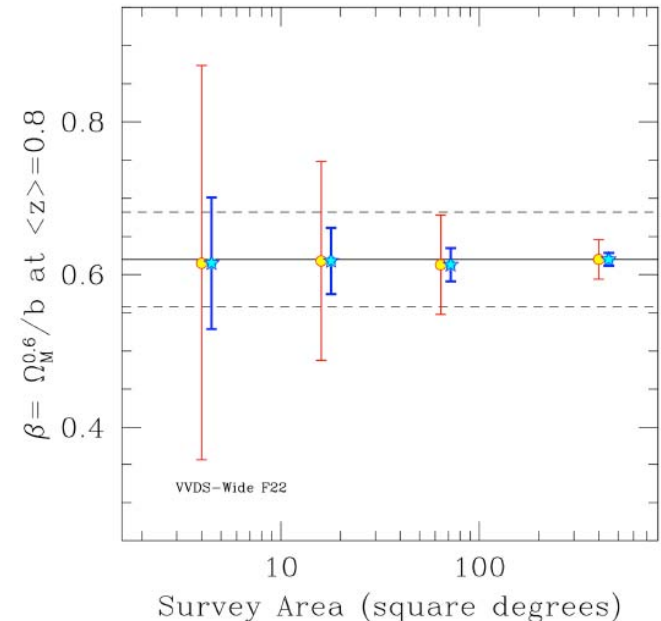
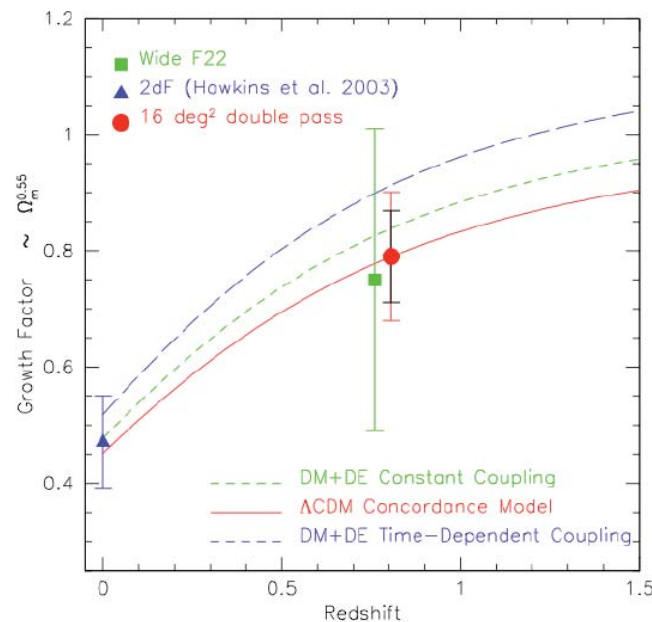


4. Extremely deep probe $z \sim 10$

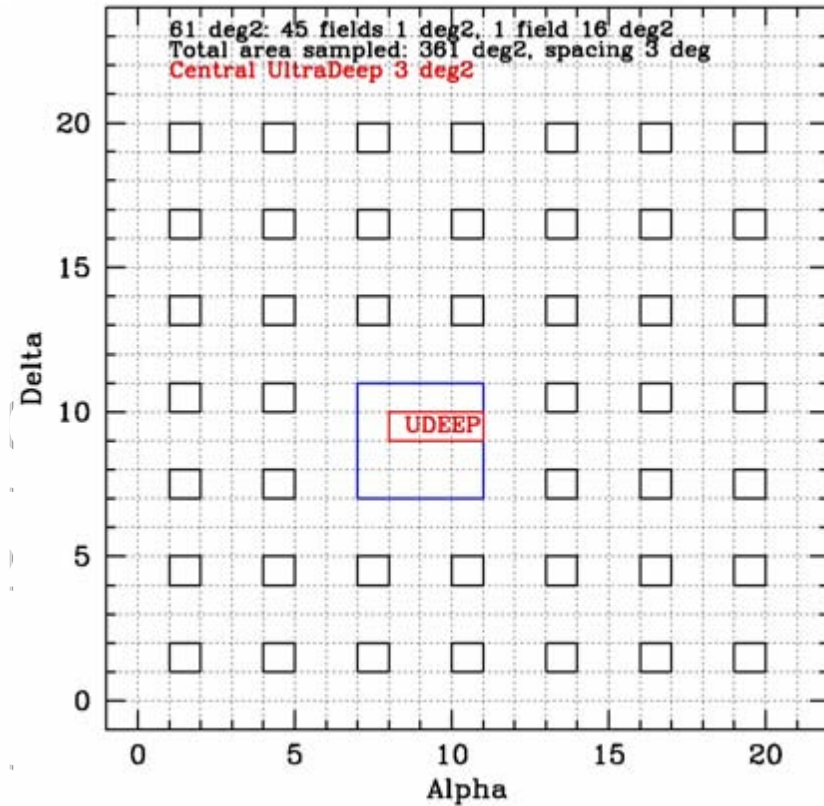
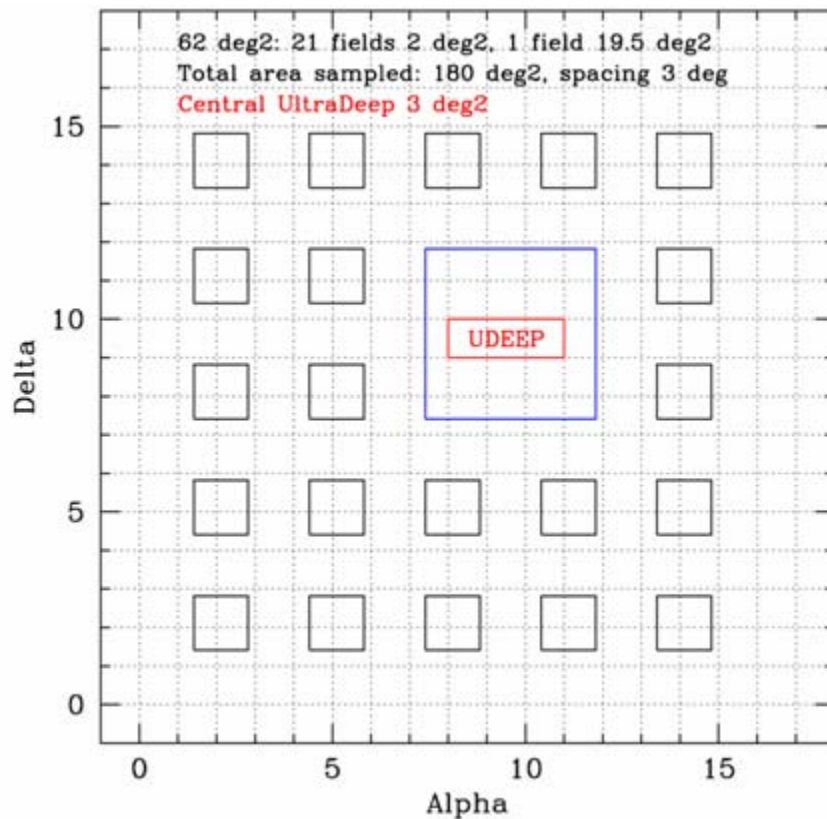
- A few hundred objects, AB ~ 26
- JWST
- ESA EUCLID/SPACE

A WIDE Survey with VLT: SDSS at $z \sim 1-1.5$

- “SDSS at $z \sim 1$ ”:
 - Cosmology: BAO+growth of structure+clusters+...
 - Evolution: galaxies, QSOs
- 100 deg²
- 5 years project



A WIDE Survey with VLT: SDSS at $z \sim 1-1.5$



Spectroscopic survey layout: square 10x10 deg² or some other geometry

A Deep VVDS-like survey with VLT at $z=3-6$

- Requirements:
 - U, B, V and R-band Lyman-break and Ly- α selection at $I_{AB} \leq 25$
 - 10 deg² to probe >100Mpc and beat cosmic variance
 - A few 10^4 spectra for stats ($<10^3$ today)
- Survey design
 - need ~10h integrations
 - 500 nights program
- Can be started today (pilot program proposed at ESO)

Connecting next generation redshift surveys with the VLT with the XXL

- Test the feasibility of using 8m telescopes + current multi-slit instruments: VIMOS on VLT
- Goal: measure redshifts + spectral features for sources in the XXLS:
 - AGN up to $z \sim 4$
 - Clusters up to $z \sim 1-1.5$, 10 galaxies per cluster, 10 clusters per deg^2
- Baseline specifications:
 - Identify clusters to $z \sim 1.5$, need to reach $AB \sim 22.5$
 - Identify AGN to $z \sim 4$
- 2 test cases: 30 deg^2 and 100 deg^2

A deep redshift survey in the XXLs: clusters

- About 1 cluster is expected per VIMOS field (220arcmin^2)
 - Not a good use of instrument
- To get redshifts for 10 galaxies per cluster, especially in the core, requires 2 VIMOS passes
 - AB \sim 22.5, 1h integration
- *Case 1: cover 30 deg²*
 - Needs 720h in spectroscopy
- *Case 2: cover 100 deg²*
 - Needs 2400h

A deep redshift survey in the XXLs: AGN

- *Case 1: cover 30 deg² with a density 1000/deg²*
 - One VIMOS field would include about 60 sources.
 - VIMOS covers 30deg² with 360 pointings, 80% of targets measured (geometry).
 - >4h per pointing, total 1440h
- *Case 2: cover 100 deg² with a density 300/deg²*
 - One VIMOS field would include about 20 sources.
 - 100 deg² needs 1200 VIMOS pointings, with 4h per pointing this means 4800h of spectroscopy

Summary: Next generation *deep* redshift surveys in XXLS

- Faint XXLS targets need an 8m telescope
- X-ray source density not high enough to justify use of high multiplex multi-slit spectrographs like VLT-VIMOS
 - Develop wide field 1deg² spectrograph on 8m ? ~10y
- Need to define a joint strategy with a galaxy/AGN redshift survey
 - Force X-ray sources in slit assignment
 - Or rely on statistical identification (1/3 to 2/3 of all sources)
- Cluster and bright AGN survey: in a WIDE survey (1h exp)
- Faint AGN survey: in a DEEP survey (>4h exp)

Need to coordinate multi- λ surveys