

DESI - Dark Energy Spectroscopic Instrument



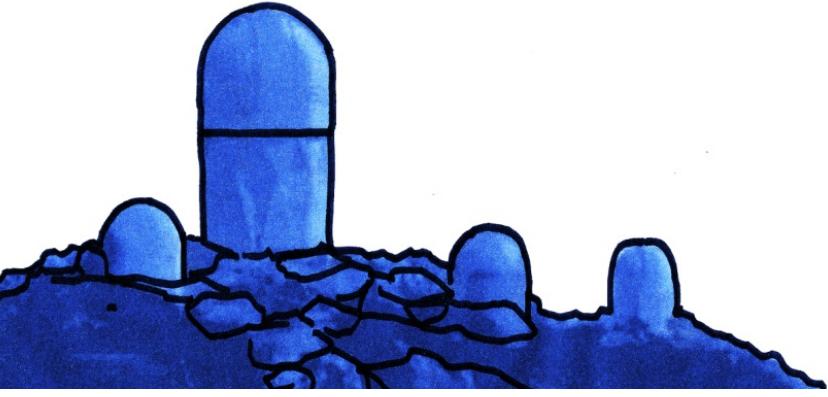
Ch. Yèche (CEA-Saclay)

Outline:

- Overview of DESI
- Target Selection and imaging needs for DESI

NSLS Workshop, IAP, June 2-3, 2013

Overview of DESI

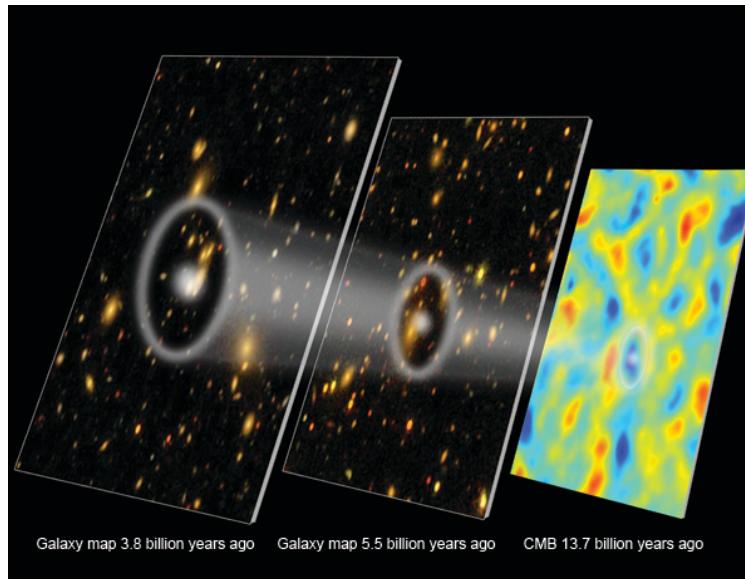




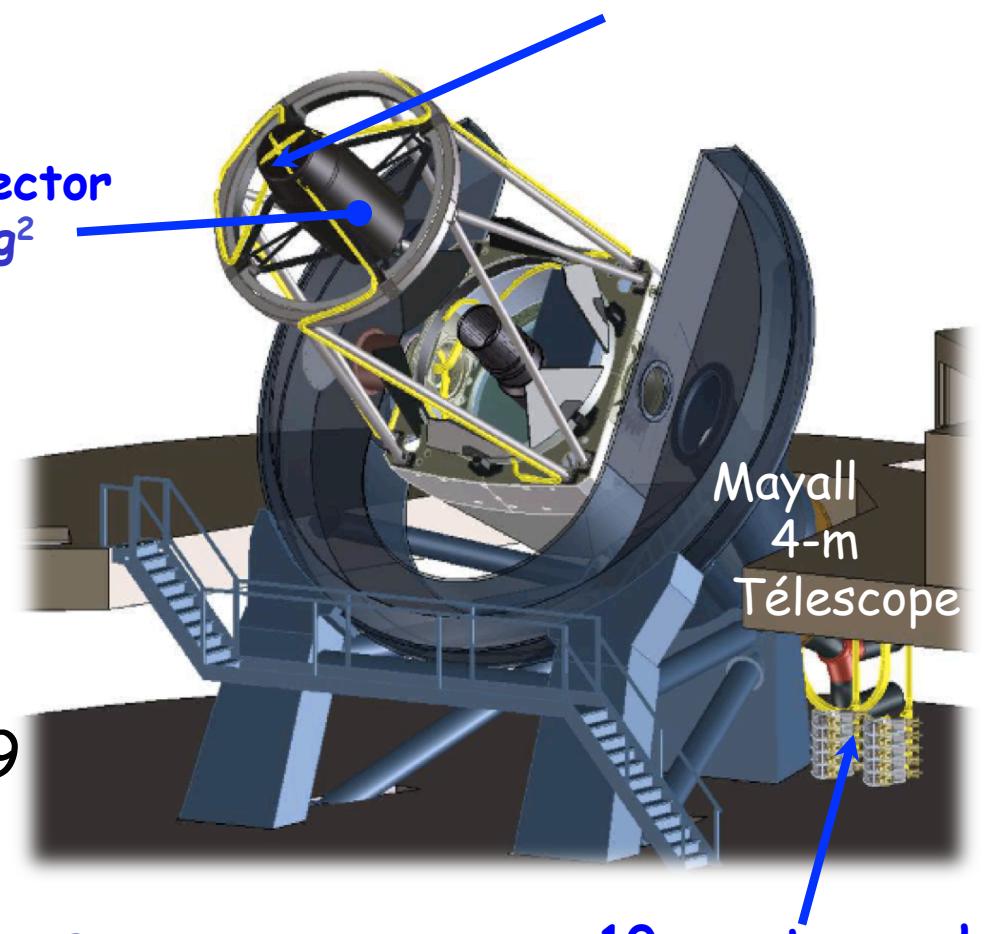
DESI

Instrument

- 4m. telescope at Kitt Peak
- Wide FoV ($\sim 7 \text{ deg}^2$)
- Positioner with 5000 fibers
- 10 spectrographs \times 3 bands (blue, visible, red-NIR)
→ 360-1020 nm
- Survey starts (science) ~Spring 2019

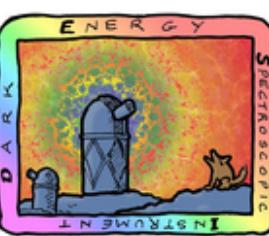


New corrector
 $\sim 7 \text{ deg}^2$

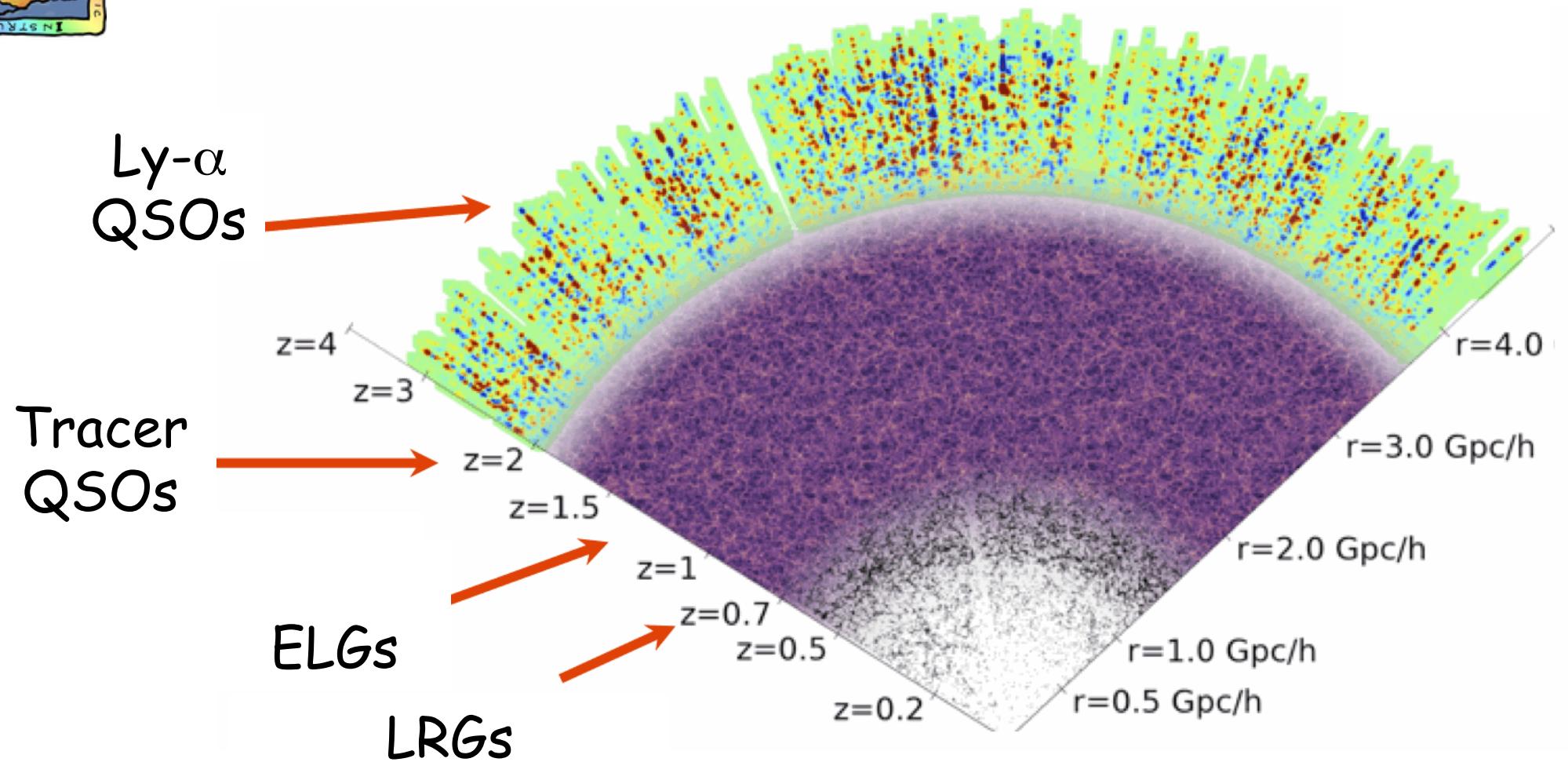


Scientific Project

- International Collaboration steered by Berkeley (DOE)
- 14000 deg^2 survey for $0.3 < z < 4.5$
- $\sim 30M$ galaxies and quasars
- Baryonic Acoustic Oscillations (BAO)



Tracers of matter



$0.3 < z < 1.0$

- Luminous Red Galaxies
- 4M

$0.7 < z < 1.6$

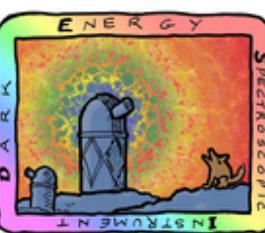
- Emission Line (star-forming) Galaxies
- ~24 M

$0.9 < z < 2.2$

- Tracer QSOs
- 1.4M

$2.2 < z < 4.5$

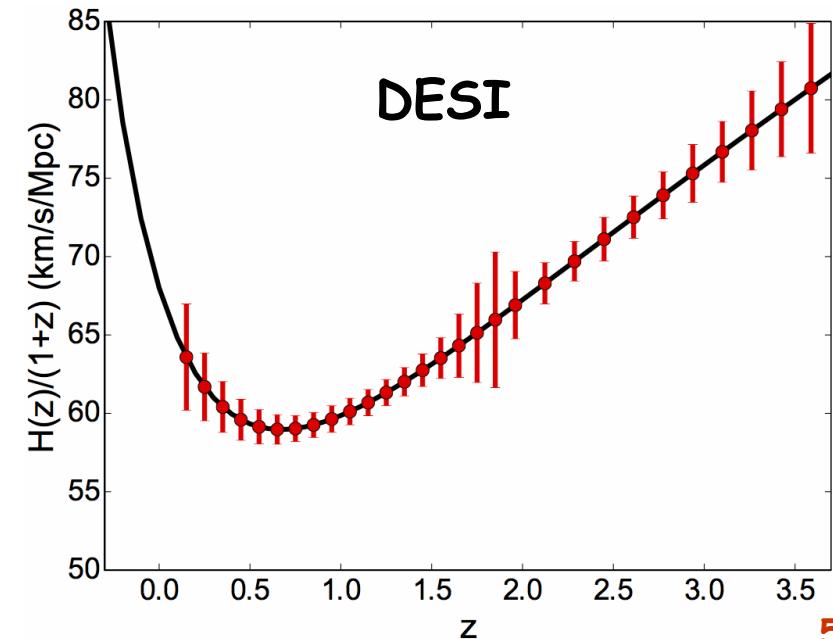
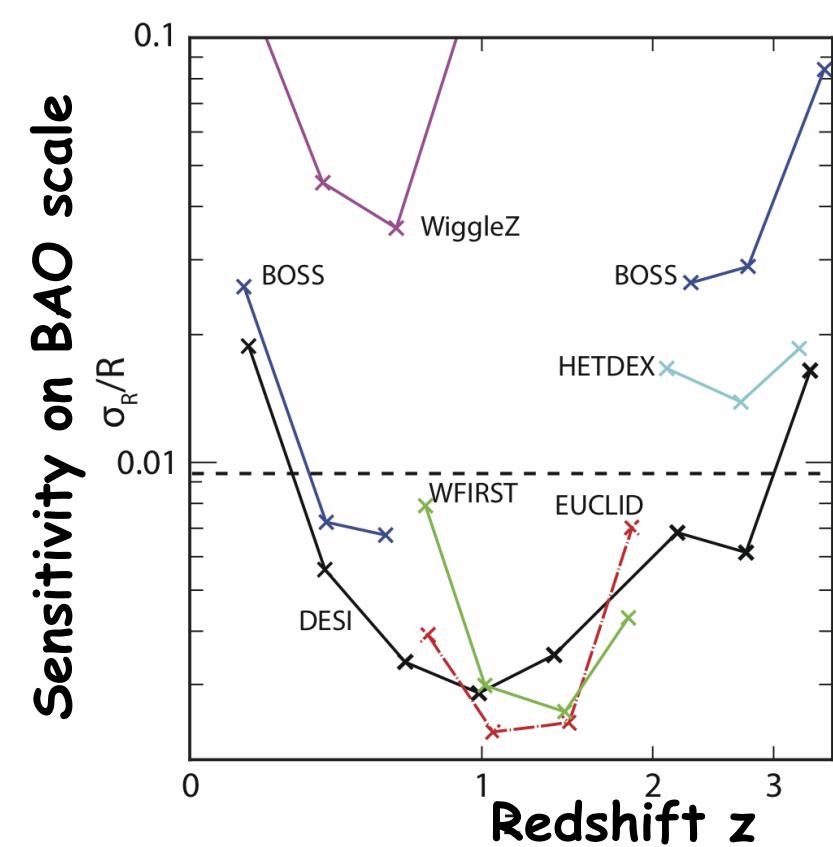
- Ly- α QO: HI absorption in IGM
- 0.6 M

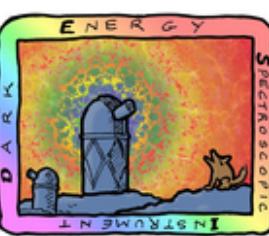


Science with DESI

Study of BAO

- Main goal of DESI
- Continuous measurement of BAO for $0.3 < z < 4.0$ at a few 10^{-3}
- As good as satellite projects
- Impressive measurement of Universe expansion
- Exploration of unknown area:
Dark matter → Dark energy

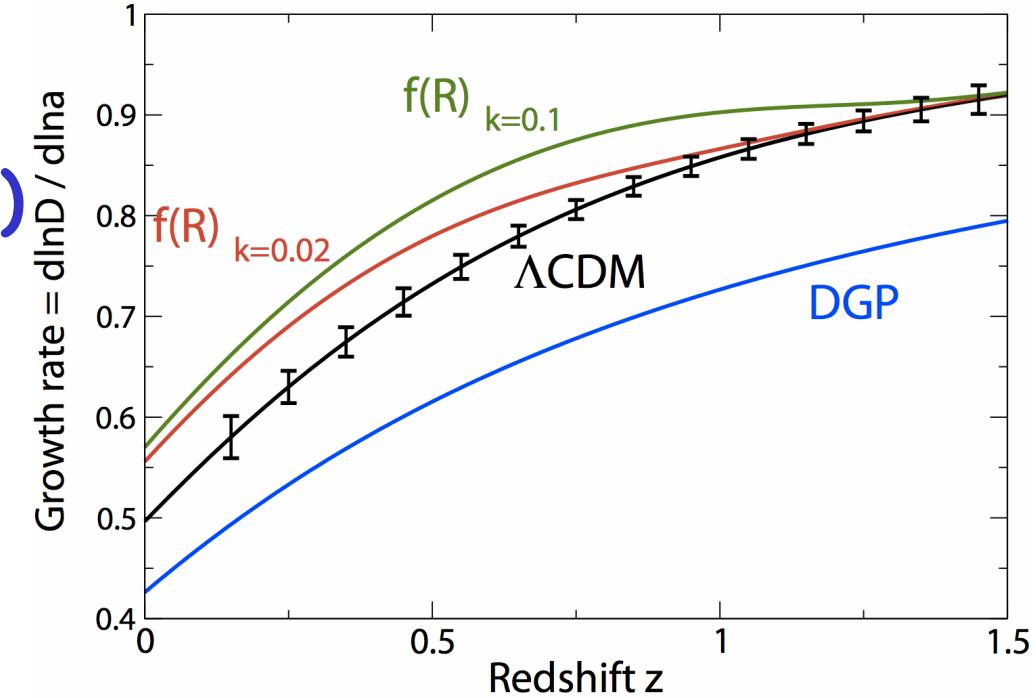




Science with DESI

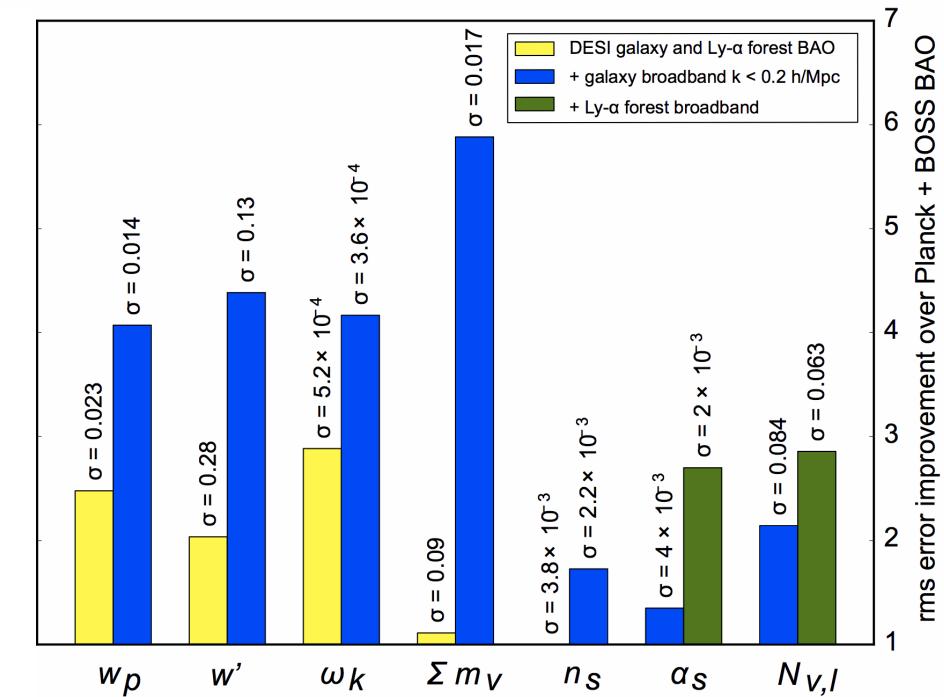
Redshift Space distortion (RSD)

- After BAO, future probe for cosmology
- Measure the effect of gravitation at cosmological distances



Cosmological parameters

- In combination with Planck, improvements of all the parameters
- **Neutrino masses:** accuracy ~20-25 meV on Σm_ν





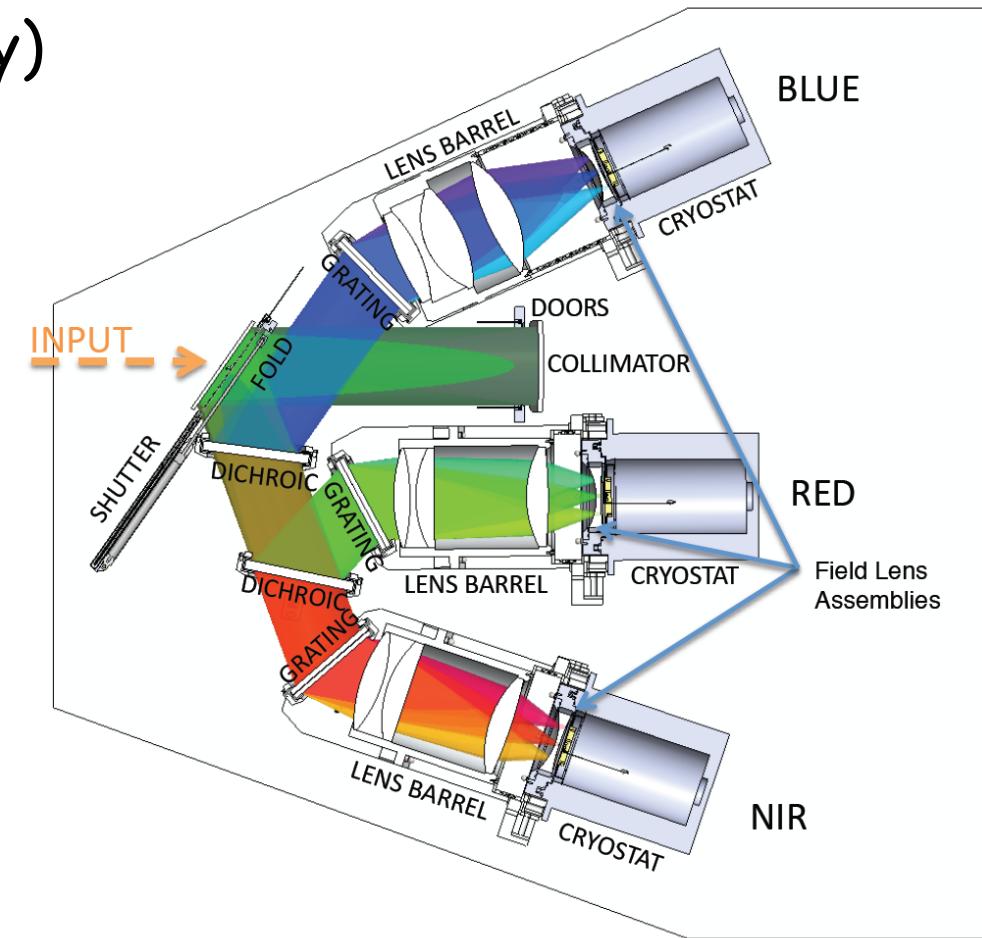
French Participation to DESI

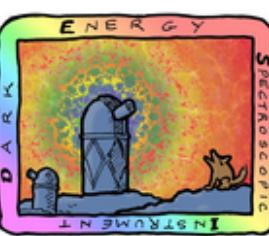
Construction of the instrument

- Spectrograph (Winlight company) with LAM, OHP and CPPM
- Cryostat: CEA-Saclay
- First spectrograph by the end of 2015
- Other nine spectrographs will build from 2016 to 2017
- Commissioning in 2018

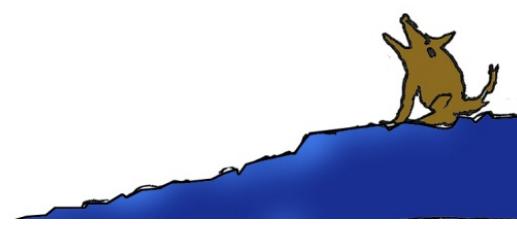
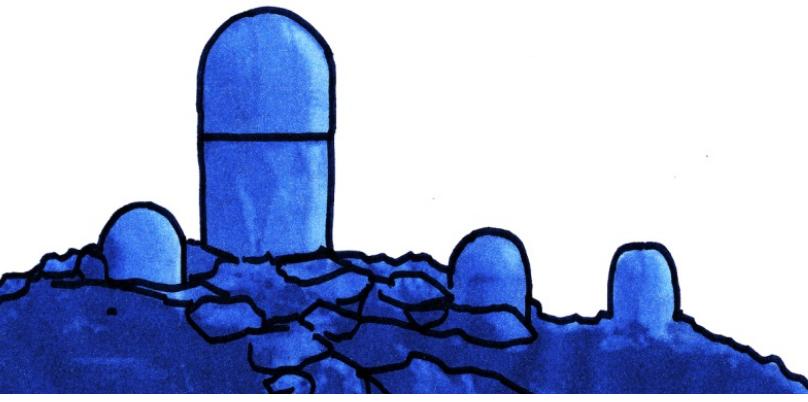
Science

- Strong implications in BAO and RSD (TS of ELGs and QSOs).
- Galaxy evolution science.
- Many opportunities with bright time (GAIA follow-up...).





Target Selection and imaging needs for DESI



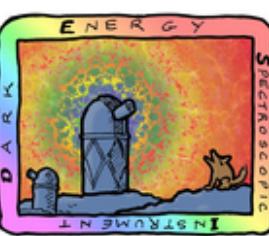


Target selection

Galaxy type	Redshift range	Bands used	Targets per deg ²	Exposures per deg ²	Good z's per deg ²	Extended sample
LRG	0.4–1.0	<i>r,z,W1</i>	350	700	300	4.2 M
ELG	0.6–1.6	<i>g,r,z</i>	2300	2300	1700	23.8 M
QSO (tracers)	0.9–2.2	<i>g,r,z,W1,W2</i>	175	175	100	1.4 M
QSO (Ly- α)	> 2.2	<i>g,r,z,W1,W2</i>	75	235	40	0.6 M
Total				3410	2140	30.0 M

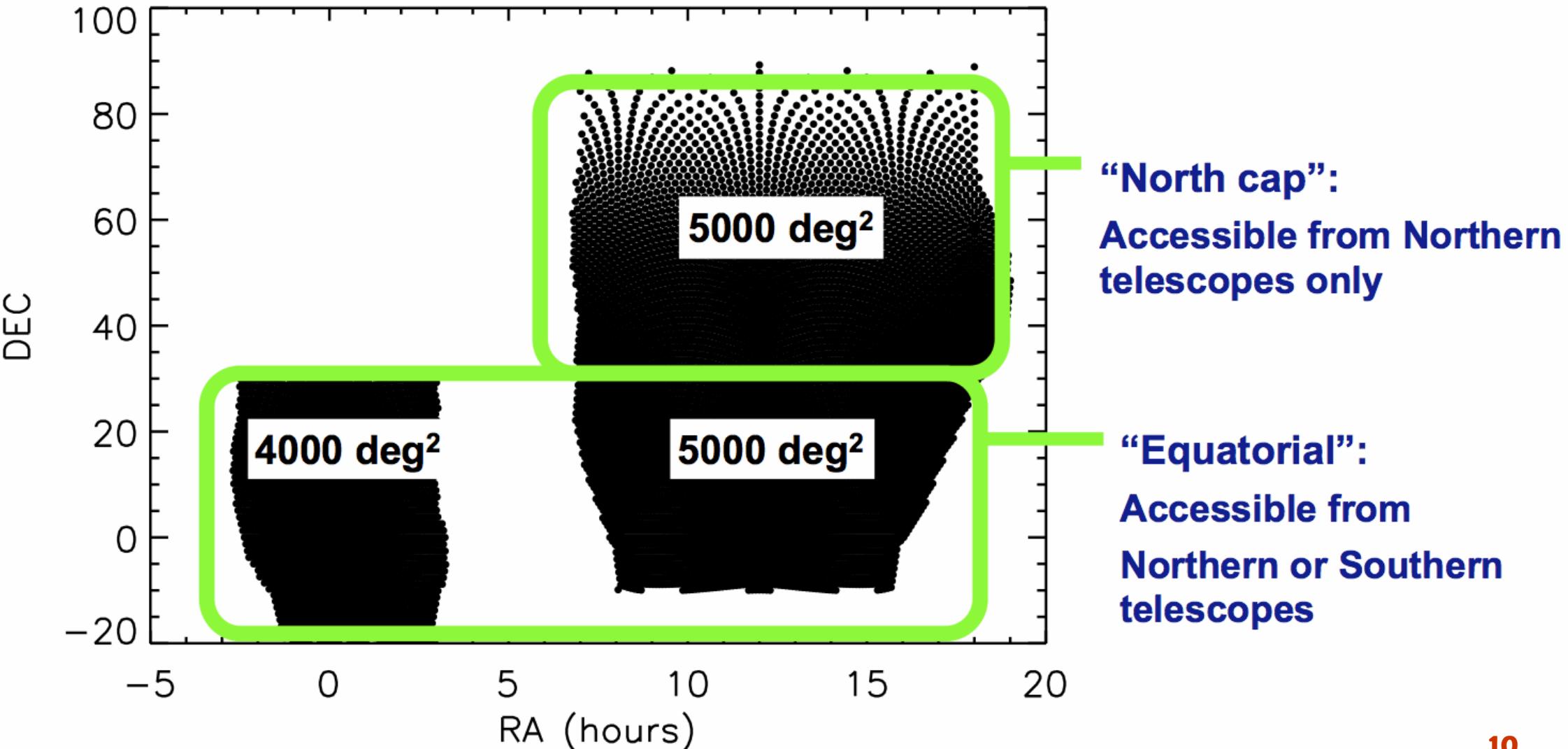
Color Selection – Current strategy

- Ground photometry with grz bands
- WISE (NIR) satellite (bands W1 and W2)
- Very conservative selection (good completeness but medium efficiency, i band instead of z band possible).
- For Ly- α QSO, u band and also variability.
- Mag. limits, $g=24.0$ and $r=23.6$ (5σ), ~5 X deeper than SDSS
→ ~1 first visit of NSLS in gr



DESI footprint

➤ 14 000 deg² footprint defined by low galactic and atmospheric extinction





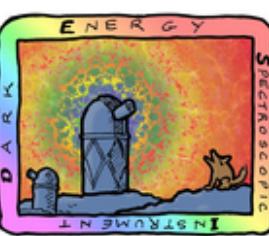
Possible telescopes

	Blanco DECam	Mayall MOSAIC1.1	WIYN ODI	Bok 90Prime	CFHT MegaCam
Exposure time (s) <i>u</i>	...	...	...	1378	162
Exposure time (s) <i>g</i>	87	102	161	270	74
Exposure time (s) <i>r</i>	85	84	136	425	109
Exposure time (s) <i>z</i>	226	269	742	3010	480
Number of nights <i>u</i>	...	...	...	59.0	14.9
Number of nights <i>g</i>	2.4	23.8	31.5	14.9	10.8
Number of nights <i>r</i>	2.3	21.5	29.7	21.1	12.4
Number of nights <i>z</i>	4.3	44.5	73.9	123.8	30.2

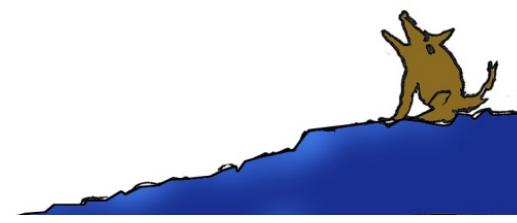
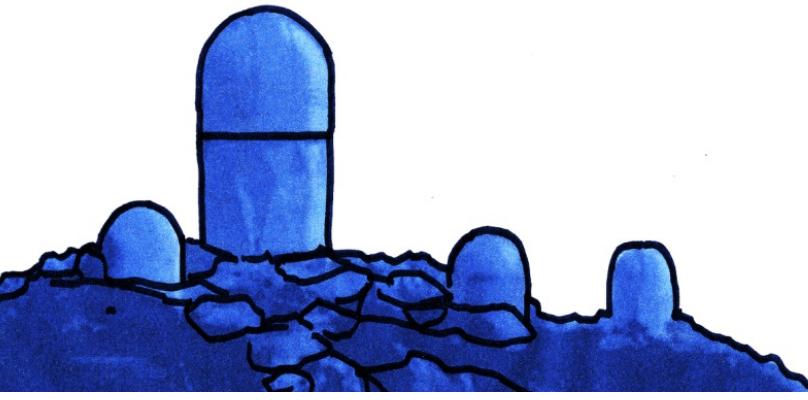
Number of nights per 1000 deg²

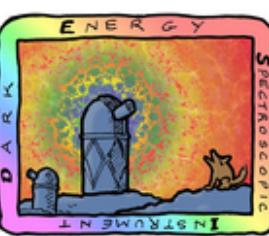
CFHT - NSLS

- For the 5000 deg² in North, NSLS is the best survey
- So far Bok/90Prime is the baseline and NSLS is considered as an option in the DESI proposal (CDR).
- Tremendous need for *u* band, in target selection of QSO and ELGs (not only for the North Cap)



Conclusions and Discussions





Conclusions

DESI a science opportunity for French community

- Best ground cosmological project with BAO and RSD probes in the coming years
- Bright time (~500 hours a year) : galactic halo and stellar activity surveys
- French participation in instrument construction and science

NSLS a good opportunity for DESI target selection

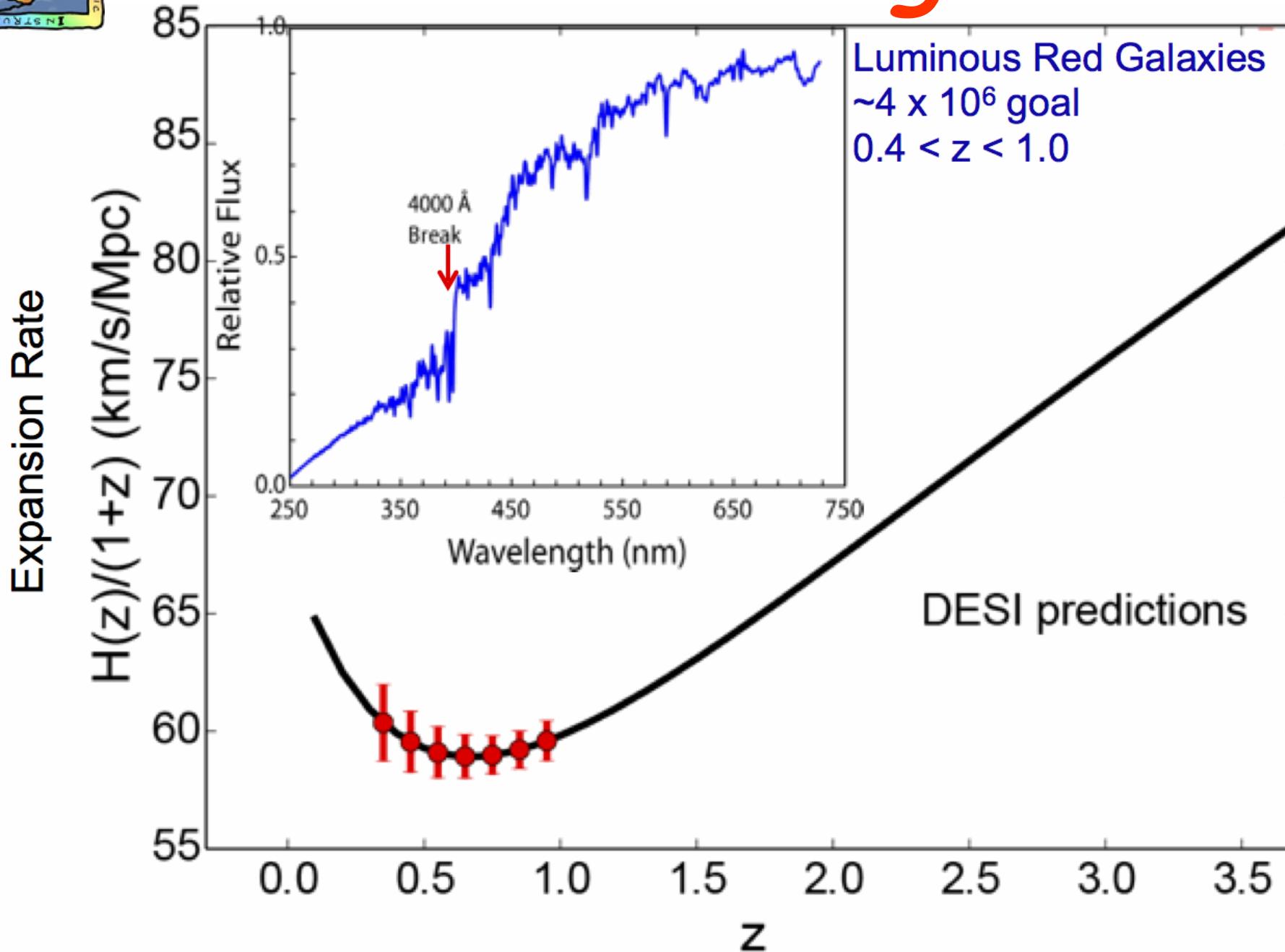
- Best telescope for North cap
- One concern:
 - Need a robust imaging plan for CDR by September and NSLS not included in the baseline so far.
 - NSLS would be a significant upgrade on later plans!
- u band will help QSO and ELG target selection (French activity)
- NSLS: in-kind participation to DESI for French community

Additional Slides



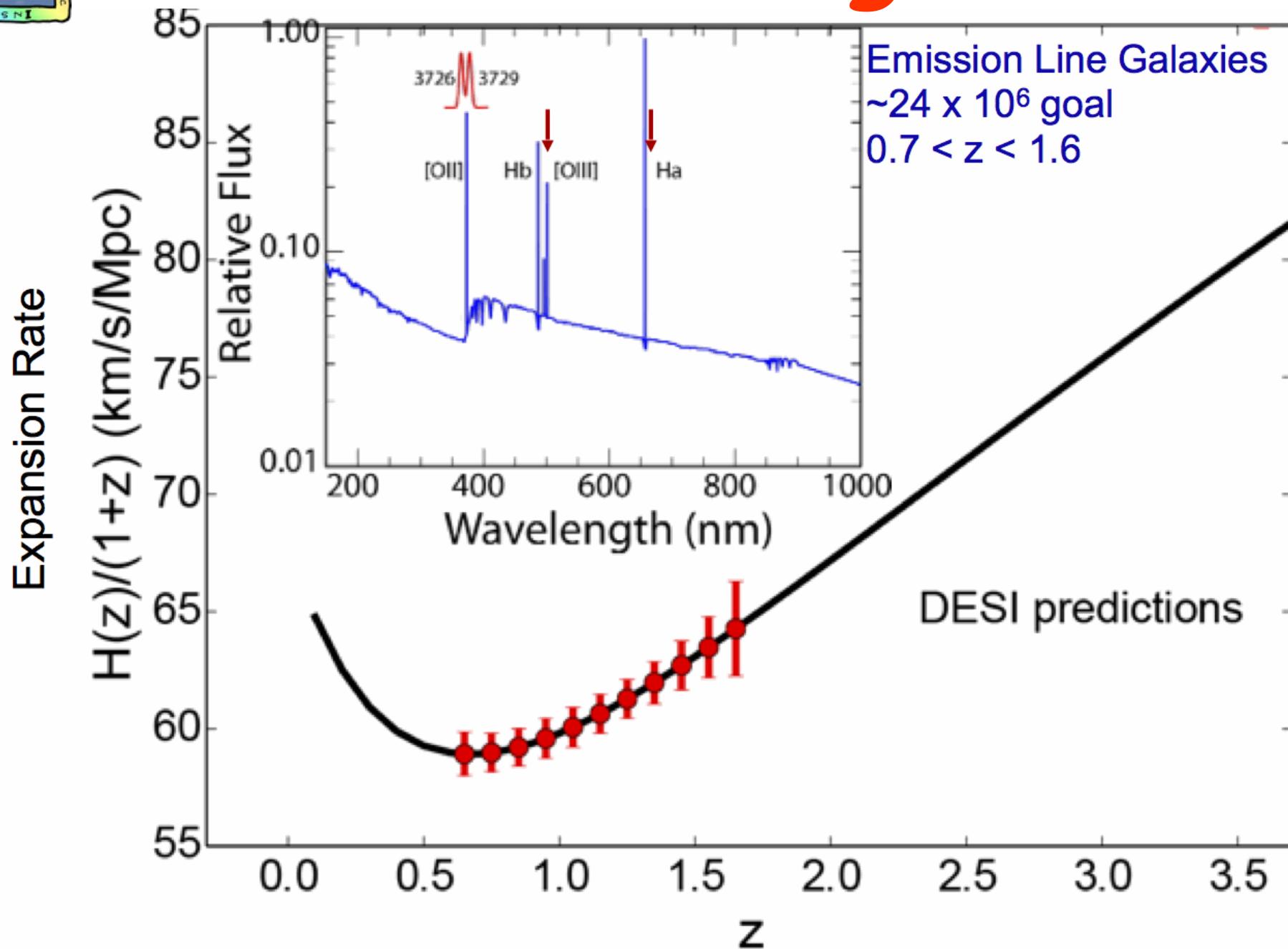


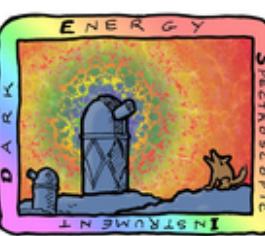
LRG Targets



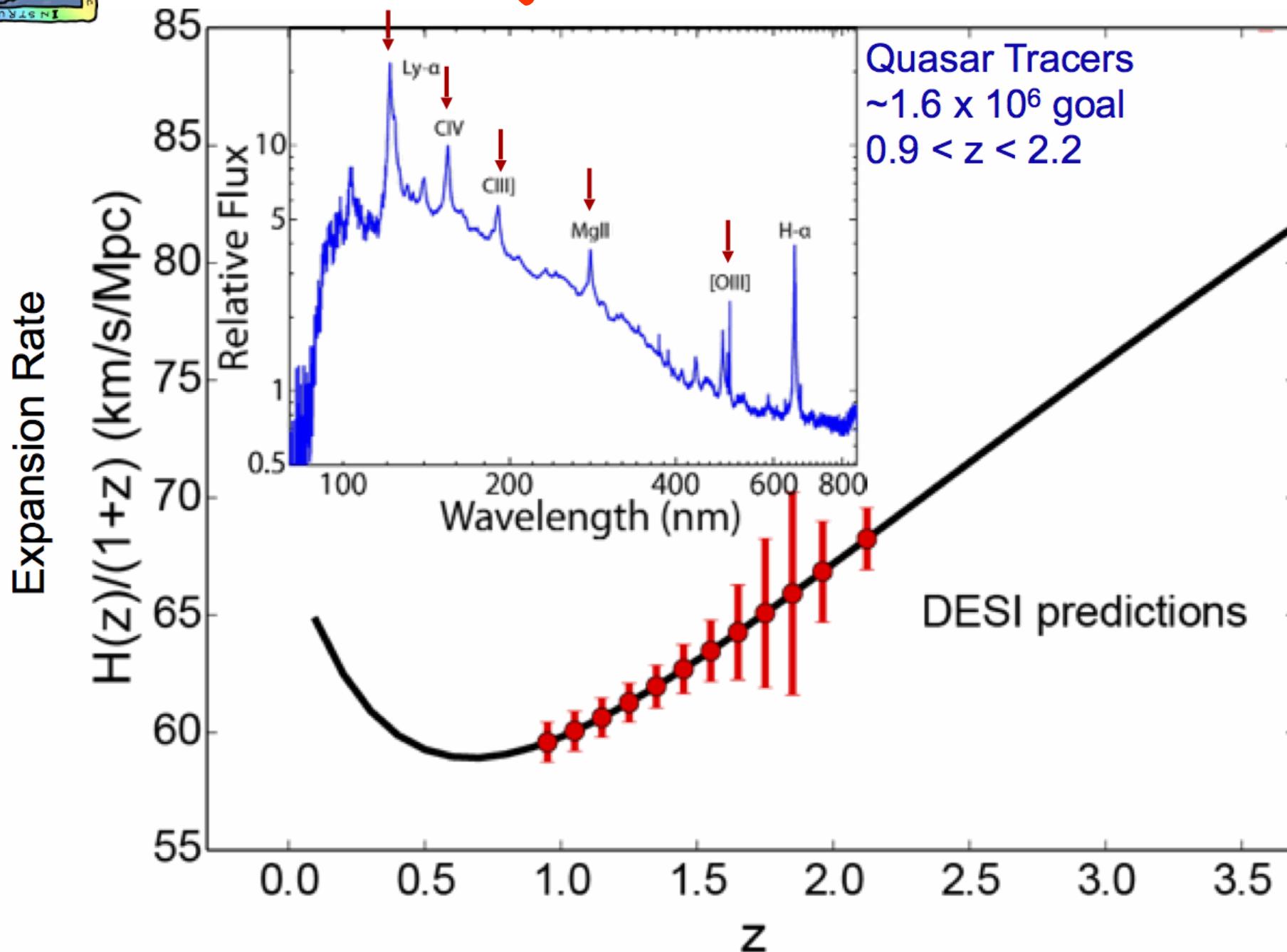


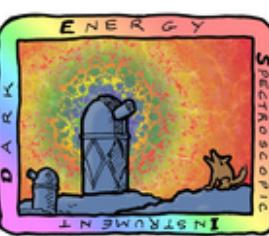
ELG Targets





QSO Tracers





Ly- α QSO Targets

