J-PAS

THE JAVALAMBRE-PAU ASTROPHYSICAL SURVEY

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Garching, 17/X/12

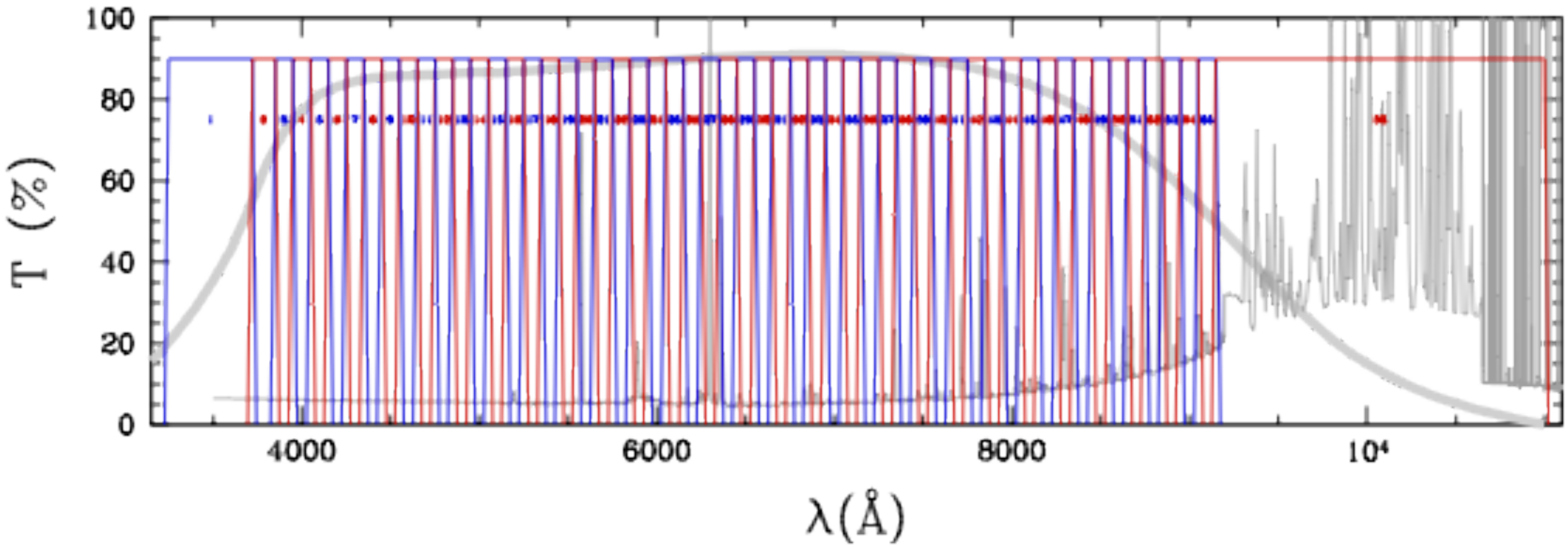
WHAT IS J-PAS?

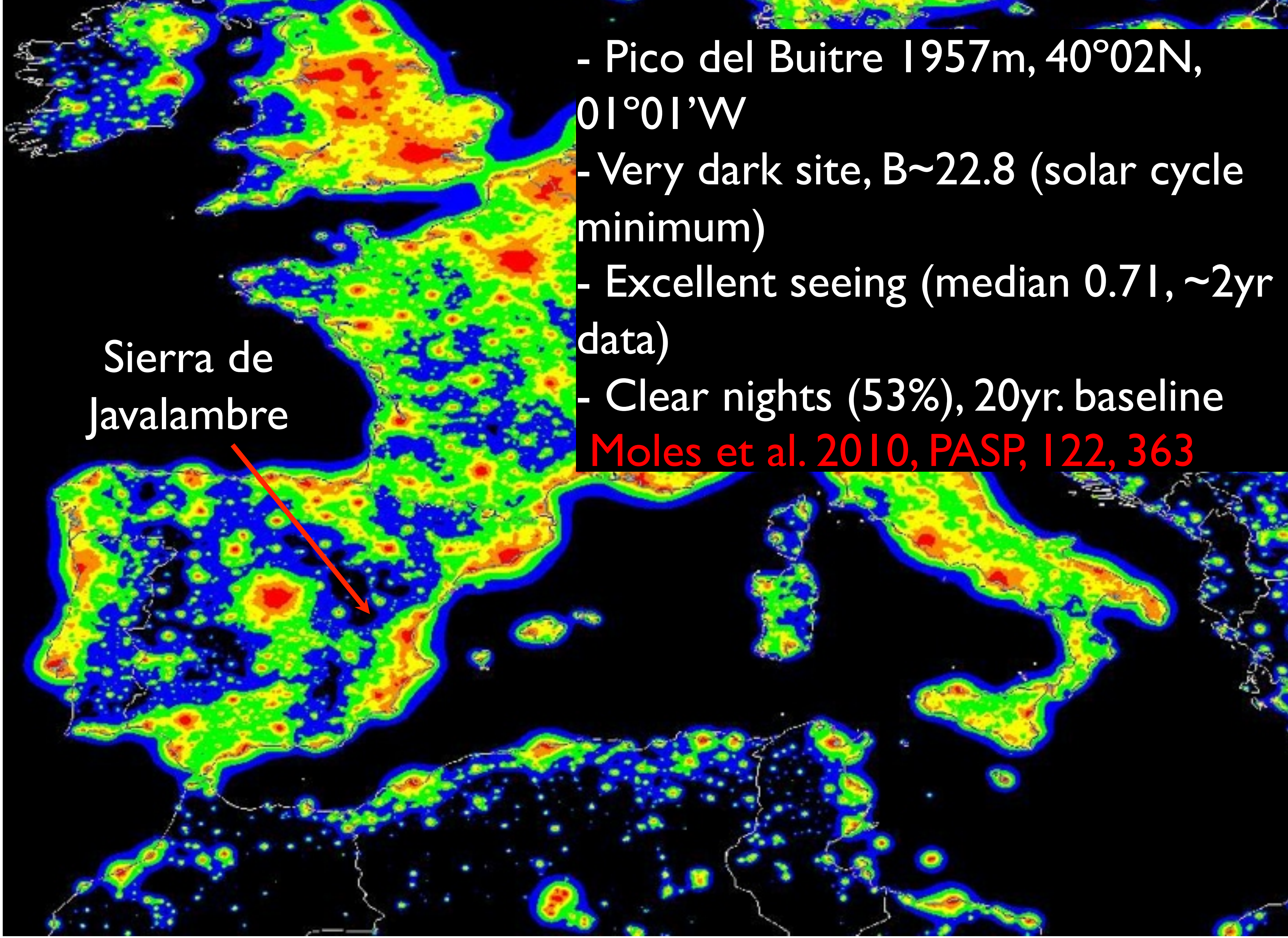
JPAS = JAVALAMBRE+PAU

- Started in 2007 as PAU (Physics of the Accelerated Universe), Spanish Consolider grant (*Benítez et al. 2009*).

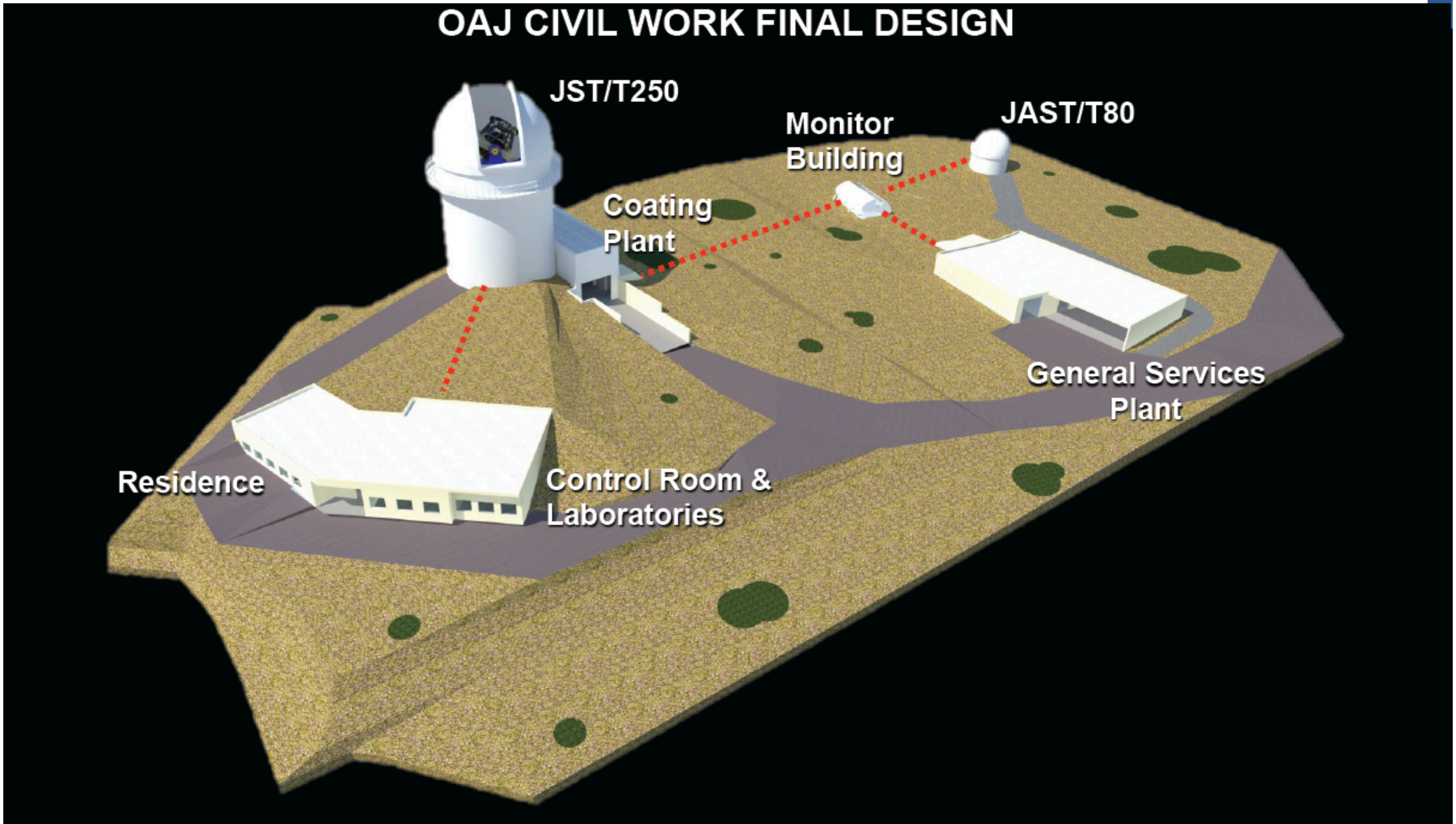
- In 2010, some of the PAU Spanish groups joined forces with a Brazilian consortium to carry out the original PAU project from the Javalambre Observatory (OAJ)

- Starting in 2014, JPAS will image 8600 sq.deg. of the sky using 54 NB filters with 120AA width and 5 broad band filters.

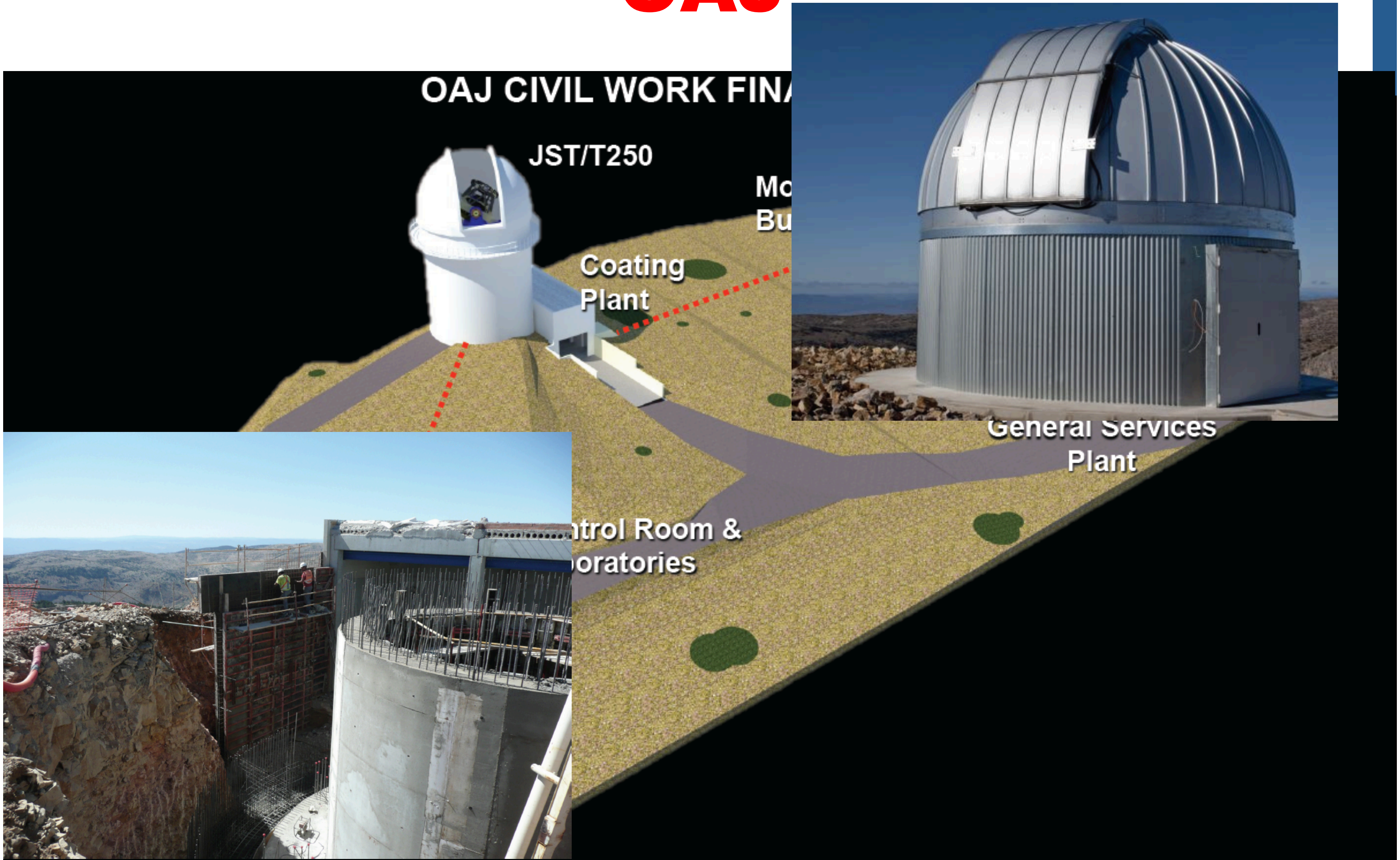



- Pico del Buitre 1957m, 40°02N, 01°01’W
- Very dark site, B~22.8 (solar cycle minimum)
- Excellent seeing (median 0.71, ~2yr data)
- Clear nights (53%), 20yr. baseline
Moles et al. 2010, PASP, 122, 363
Sierra de Javalambre

OAJ


OAJ CIVIL WORK FINAL DESIGN
JST/T250
Monitor Building
JAST/T80
Coating Plant
General Services Plant
Residence
Control Room & Laboratories

OAJ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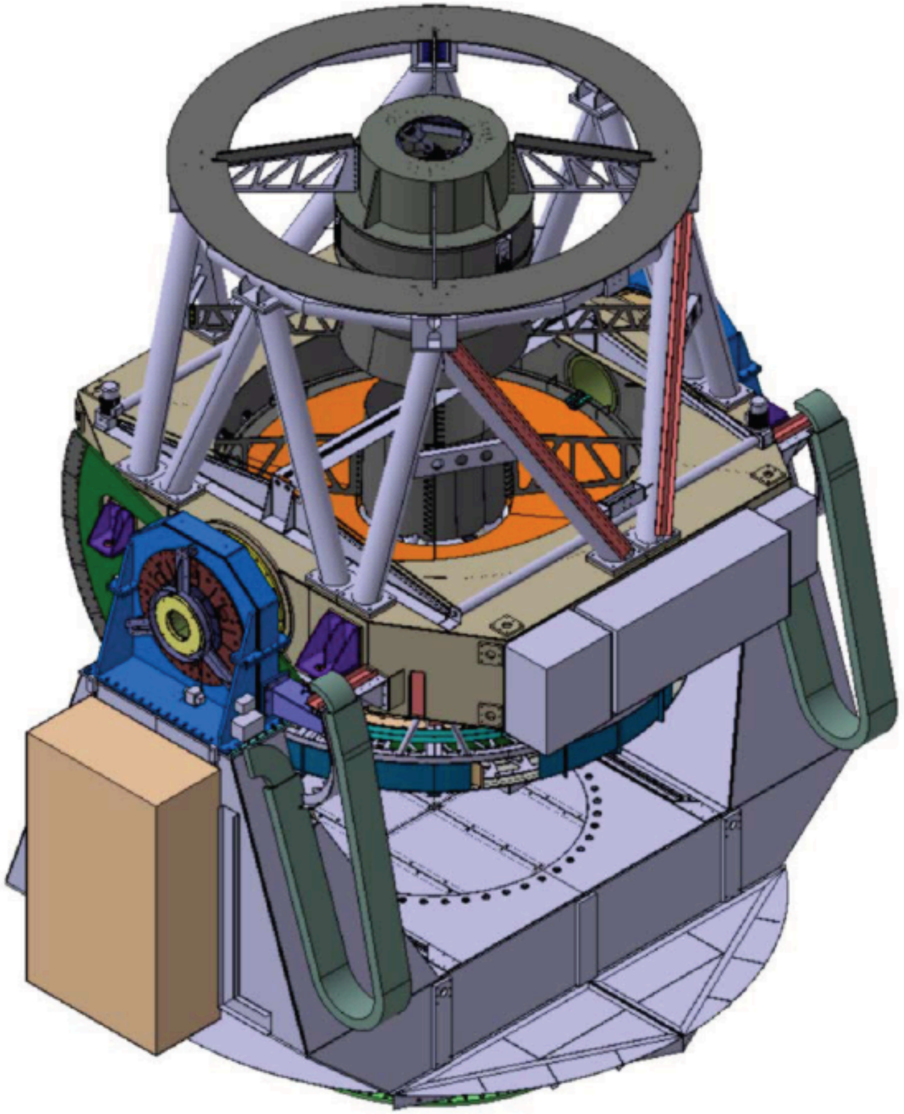


JST/T250

- M1 (∅) = 2.55 m
- FoV (∅) = 3 deg = 476 mm at FP
- Effective collecting area = 3.89 m^2
- Etendue = 27.5 m^2deg^2
- Plate scale = 22.67 arcsec/mm
  = 0.22 arcsec/pix
- Focal length = 9098mm → F#3.5
- IQ EE50 (∅) < 12μm = 0.27 arcsec
- IQ EE80 (∅) < 20μm = 0.45 arcsec

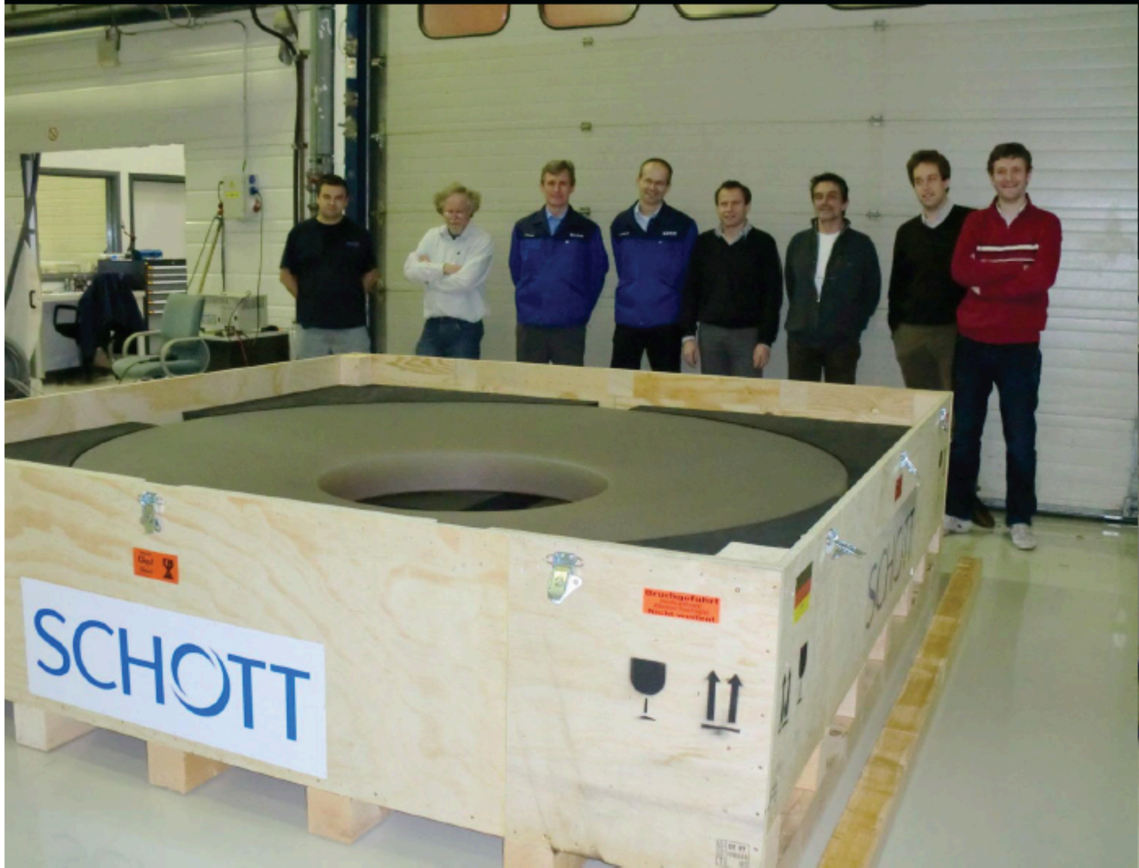
- Mount = Alt-azimuthal
- Config. = Ritchey Chrétien-like
- Focus = Cassegrain
- Field corrector of 3 lenses
- Mass ~45.000 kg
- 1st Eigenfrequencies > 10 Hz

- Manufacturer: AMOS (Belgium)
- Current Status: AIV – Integration
- On site: when dome & building finished

OAJ

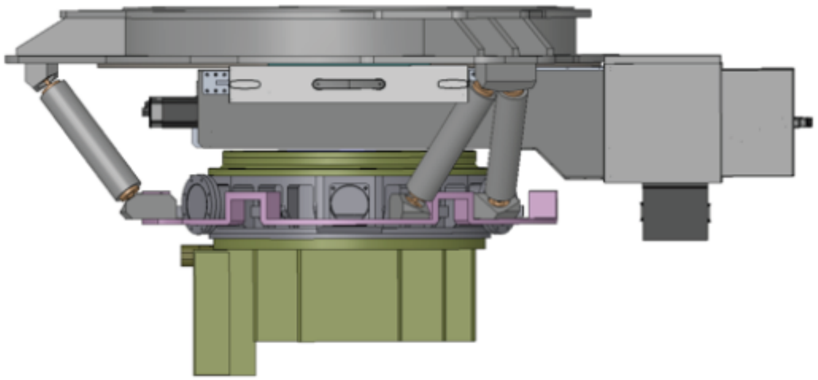
JST/T250

Dec 2010 – Primary Mirror (M1)



JPCam

JPCam	
FoV	Ø=3.0º (full performance) Ø = 3.1º (reduced performance)
Ø EE50	0.23" / 10 µm / 1 pix
Ø EE80	0.45" / 20 µm / 2 pix
CCD format	(14 x) 9216 x 9240 pix 10 µm/pix **1.2 Gpixel camera**
Pixel scale	0.23"/pix
FoV coverage	4.45 sq. deg. (fill factor ~60%)
Read out time	12s
Read out noise	4 e⁻/pixel (goal)



JPAS IN A NUTSHELL

Spanish-Brazilian Stage IV “experiment”: FoM > 100 by ~2018

Equivalent to 720 nights at a 4m telescope with a 5000 fiber spectrograph:

~ 100M galaxies with 0.3% photo-z

~ 300M galaxies with 1% photo-z

~ few M QSOs with 0.3% photo-z

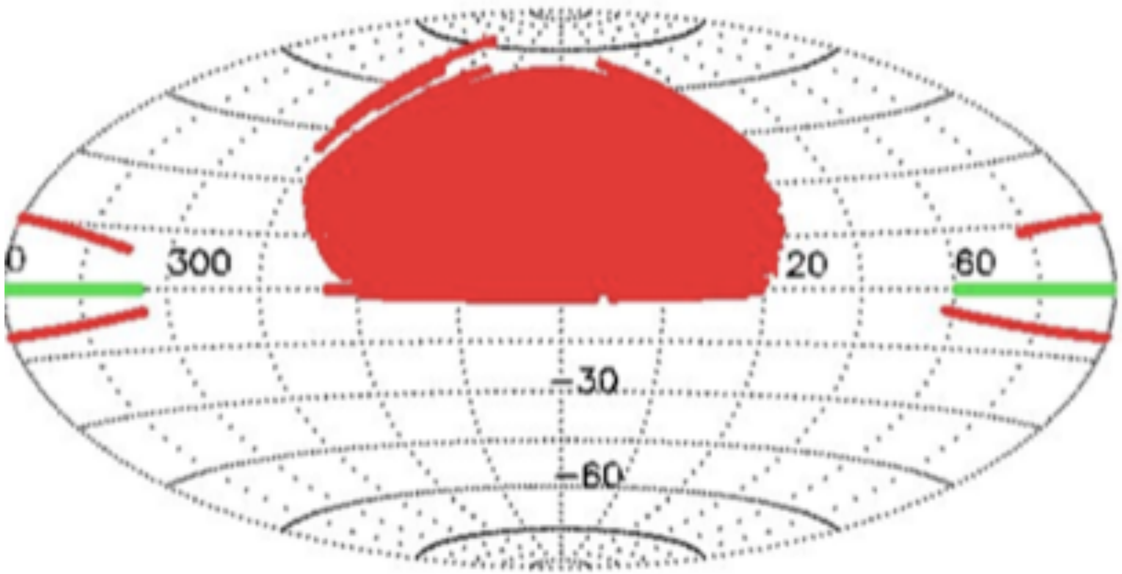
~ 0.7 arcsec image of the Northern Sky

Extremely mass sensitive optical cluster catalog

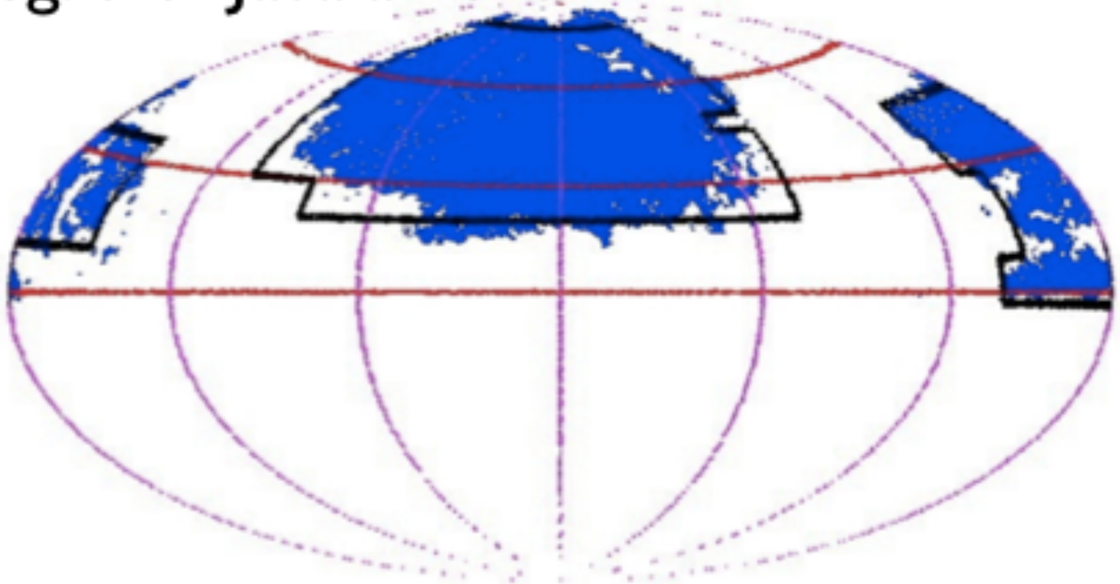
Excellent characterization of low-z SN systematics

Pixel-by-pixel low-res spectrum of the whole northern sky up to m~23/arcsec^2

Overlap with SDSS



Apache point is ~7 deg. S of Javalambre



THE J-PAS COLLABORATION

- IAA-CSIC (MICINN)
- CEFCA
- Observatorio Nacional, Río de Janeiro
- Departamento de Astronomia, Universidade de São Paulo
- Centro Brasileiro de Pesquisas Físicas

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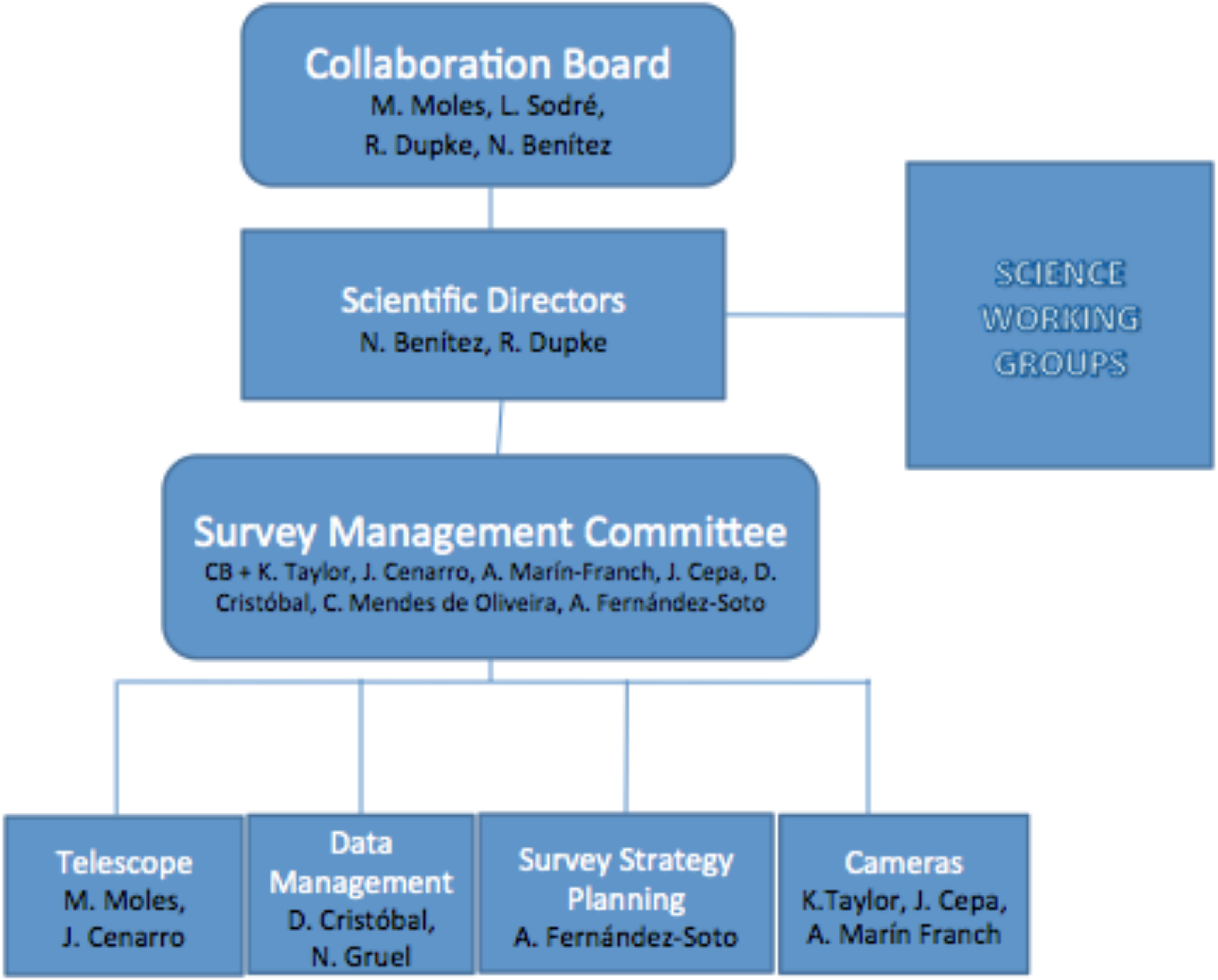
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5th J-PAS workshop @ Sao Paulo

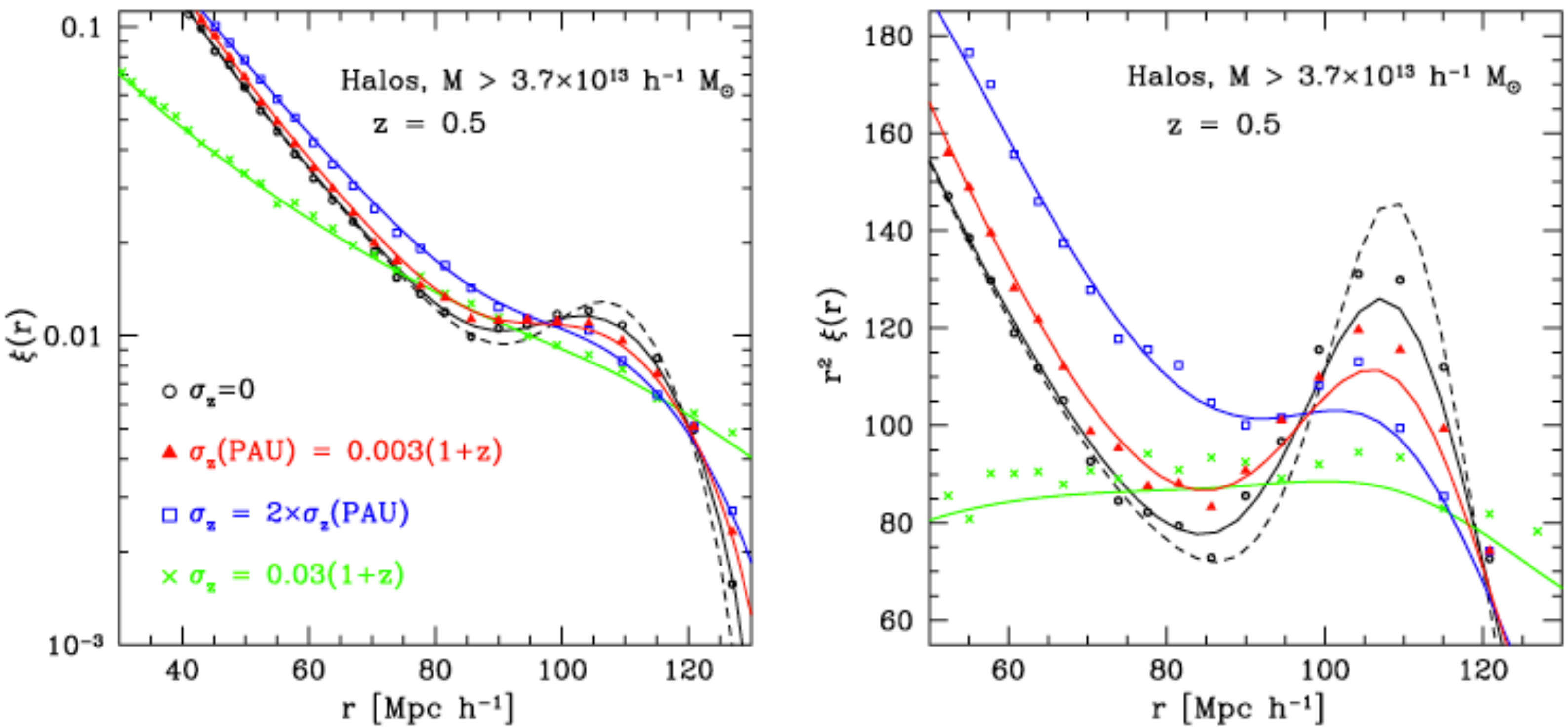
SCIENCE WITH J-PAS

Garching, 17/X/12

INITIAL SCIENTIFIC MOTIVATION

DARK ENERGY:

Measuring the radial scale of Baryonic Acoustic Oscillations at the Stage IV (DETF) level



Benítez et al. 2009

INITIAL SCIENTIFIC MOTIVATION

- Requires a very large volume >10(h/Mpc) Gpc^3 and therefore a very large area, (>5000 sq deg) and redshift range (z<1.2)

- High enough density of LSS tracers (n~0.0005-0.001 $(h/Mpc)^3$)

- This implies measuring ~10M galaxy redshifts (LRGs) or (~40M ELGs)

- **Key idea: to measure the BAO scale it is enough to measure redshifts with 0.3%(1+z) precision.**
- **NB imaging is much more efficient that spectroscopy for this purpose.**

SPECTROSCOPY vs NB imaging

Compare imaging with N_F filters to a spectrograph

v_S for spectroscopy: N_{max} x η

v_S for imaging: n_g x A x η_i / N_F = $(n_g A) x (\eta_I / N_F)$ = N_{max} x η

We can compare N_{max} with $n_g A$ and η with η_I / N_F

The effective number of filters is (9100-5100)/136 ~30

Spectrospic efficiency η ~ 0.25 Imaging efficiency η_I / N_F ~ 0.02

But look at the multiplexing:

Spectroscopy (BOSS): N_{max}=1000 v_S~250

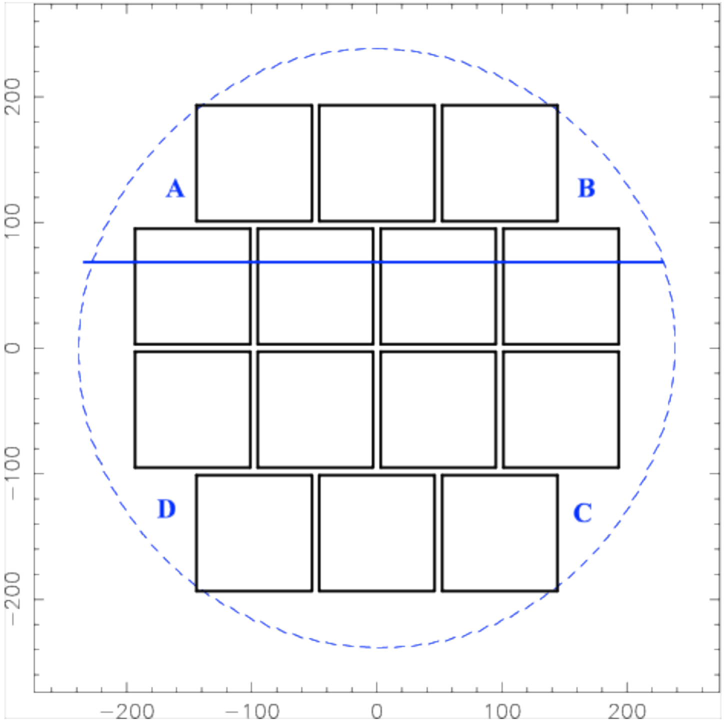
JPAS N_{max}= 12000x5= 60000 (!!) so v_S~1200

Right moment, technologically speaking

CCD "real state" has become very cheap

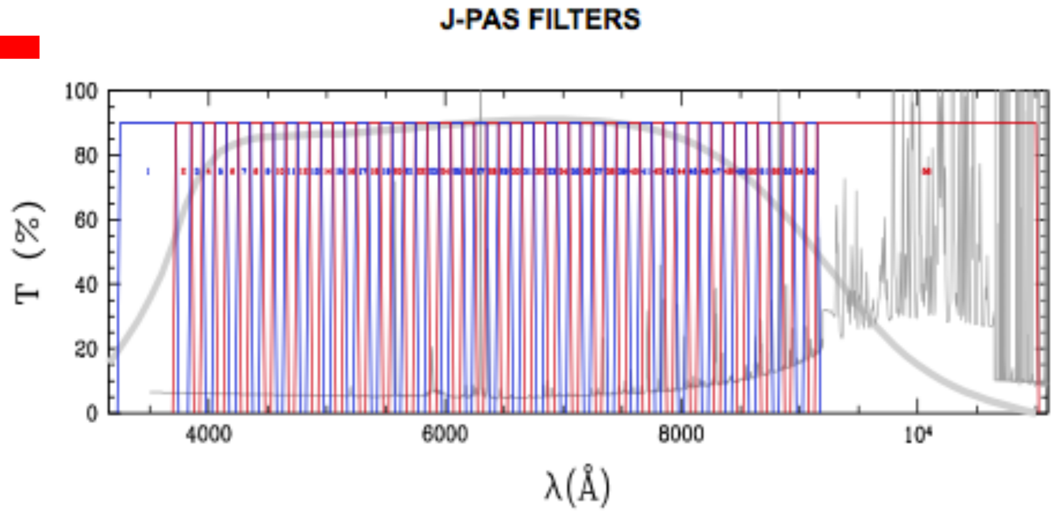
Filter companies are now able to produce extremely homogeneous, large format NB filters of almost arbitrary shape

SPECTROSCOPY vs NB imaging



Cheap, very large format CCDs

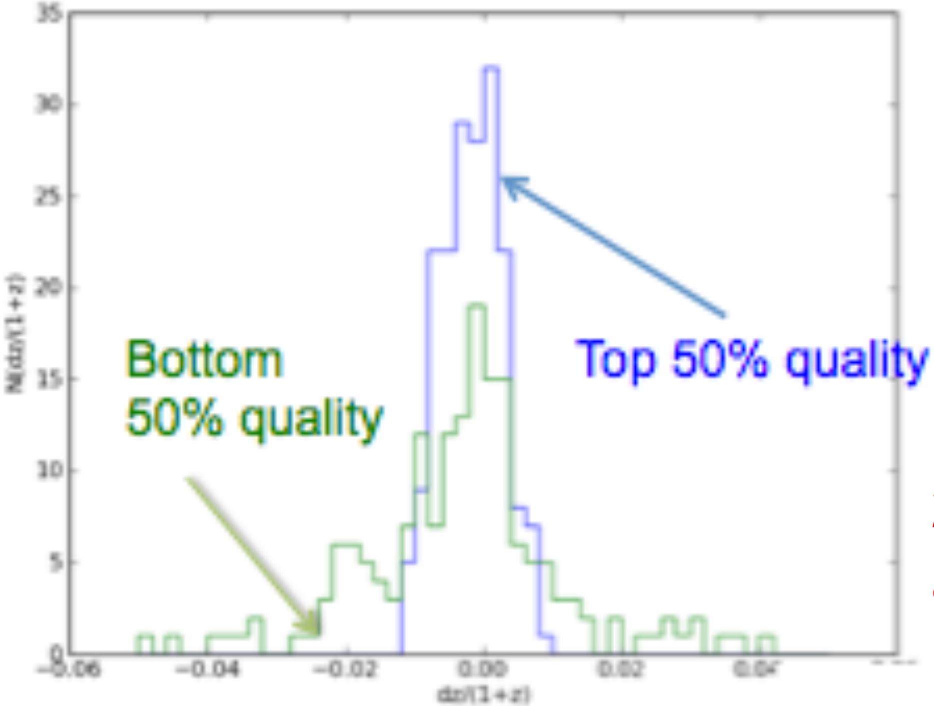
+



100A NB contiguous filter system

≈ 5000 multiplex spectrograph

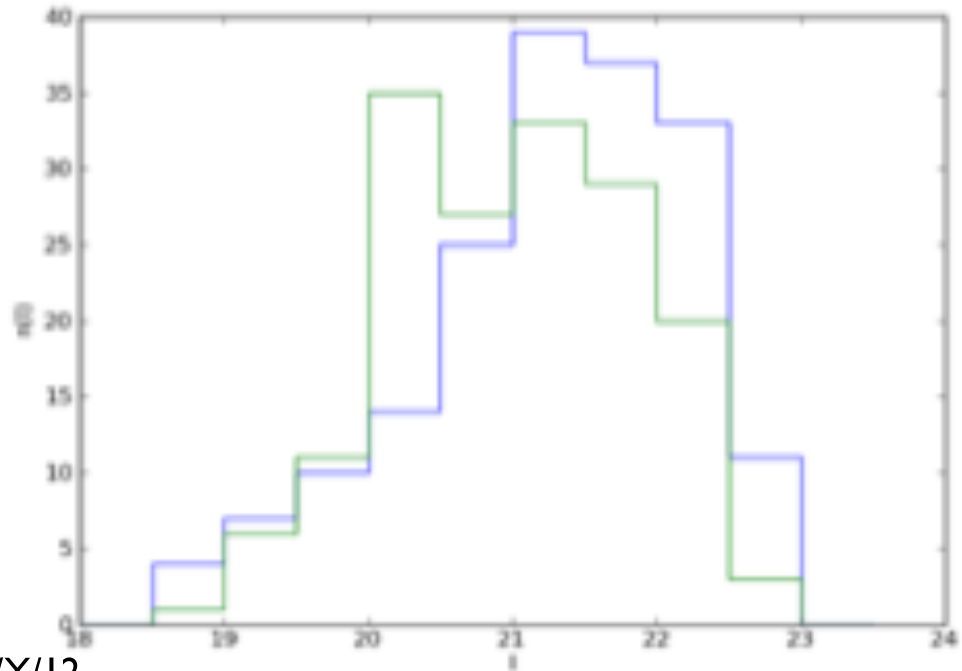
But 10 times cheaper and 2 times faster to build



-COSMOS (Ilbert et al. 2009) catalog
~300A filters
-Photo-z with high odds 0.0045(1+z)

BAYESIAN PHOTO-Z (Benitez 2000): Bayesian Odds provide a reliable precision and purity predictor

- Magnitude or S/N cuts are not Efficient
- Need to use Bayesian approach with a quality indicator
- "Battle tested"



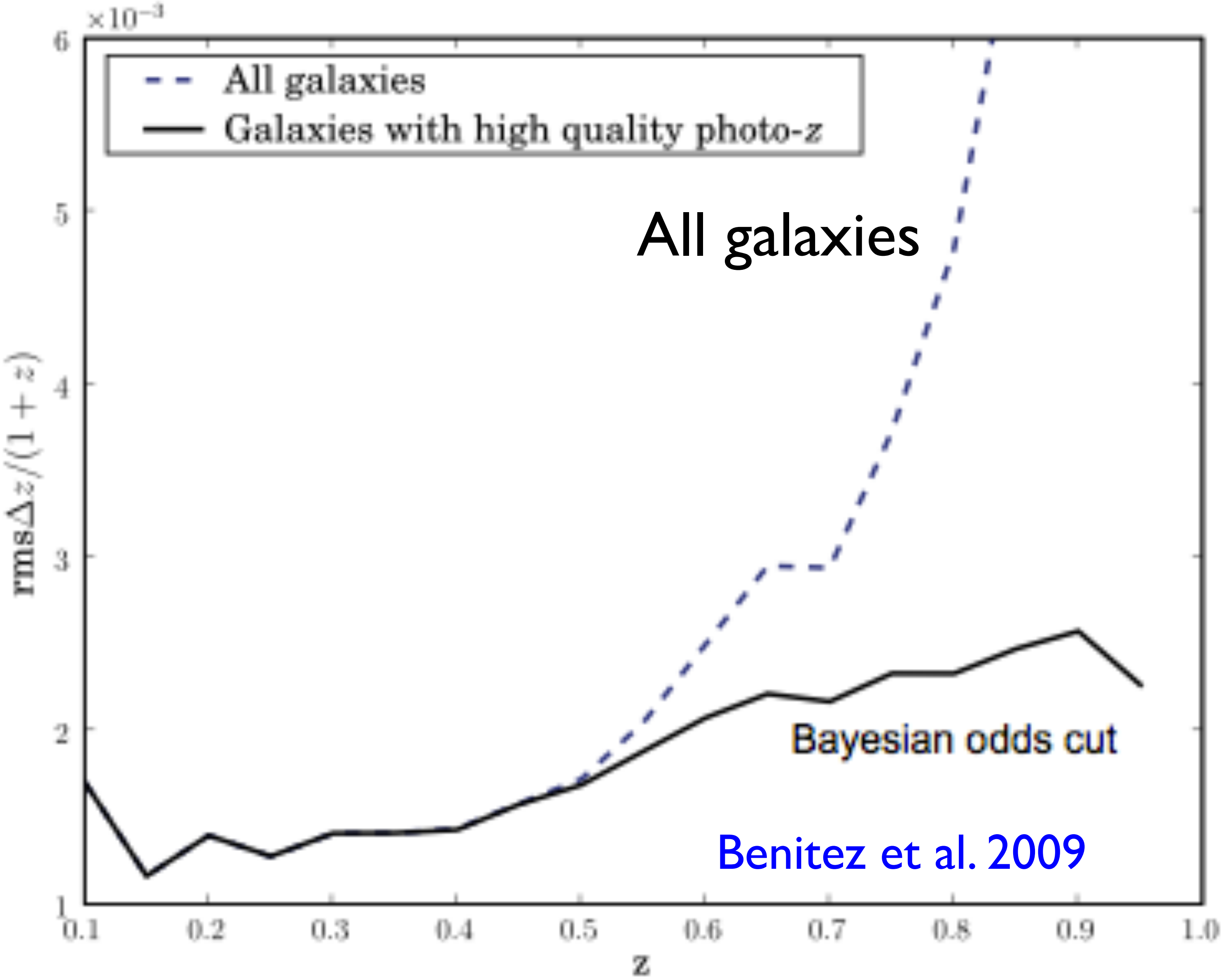
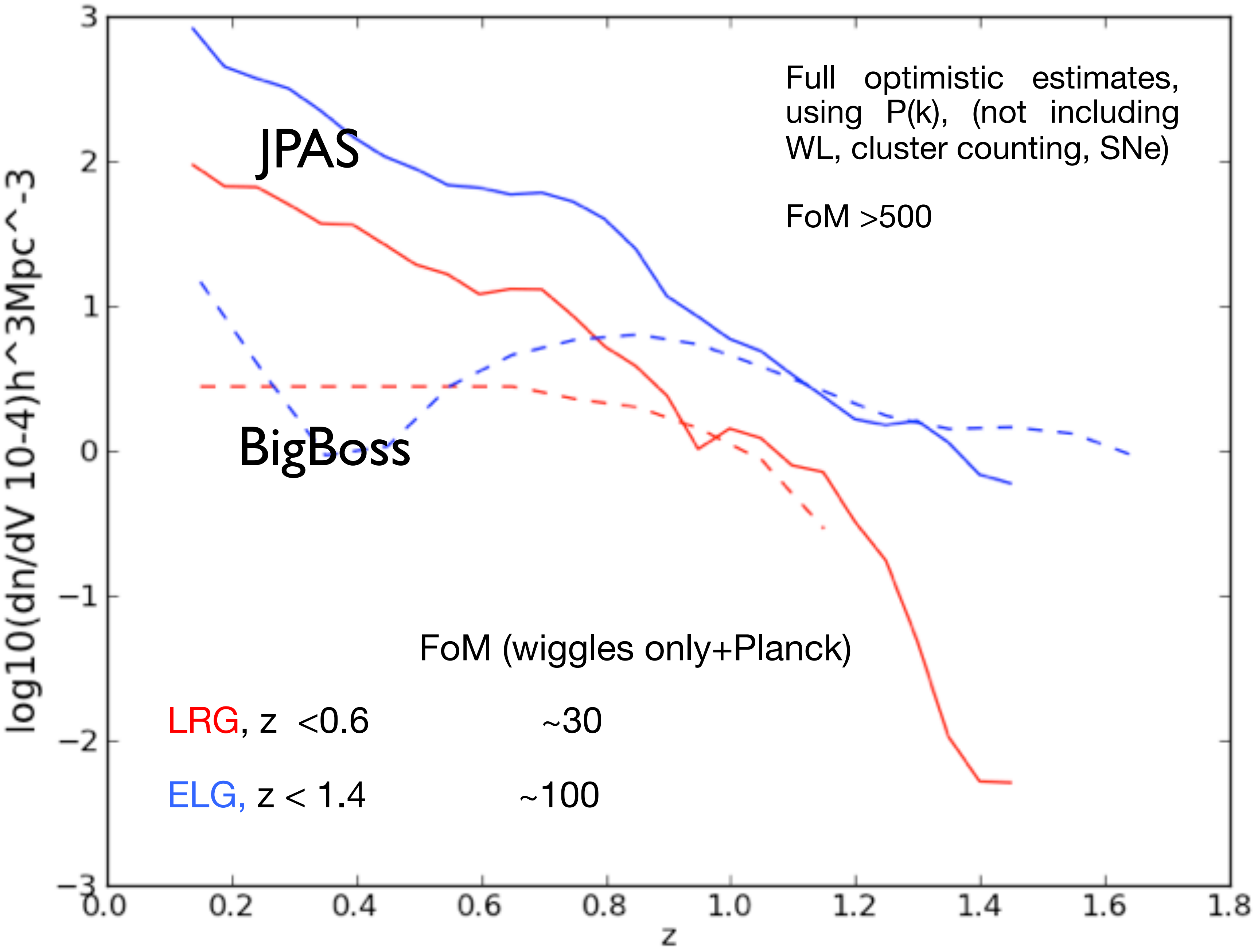


Figure 13. Photometric redshift error as a function of redshift, for all $L > L_{\star}$, $I < 23$ red galaxies, and for the subset with high-quality photo-z.



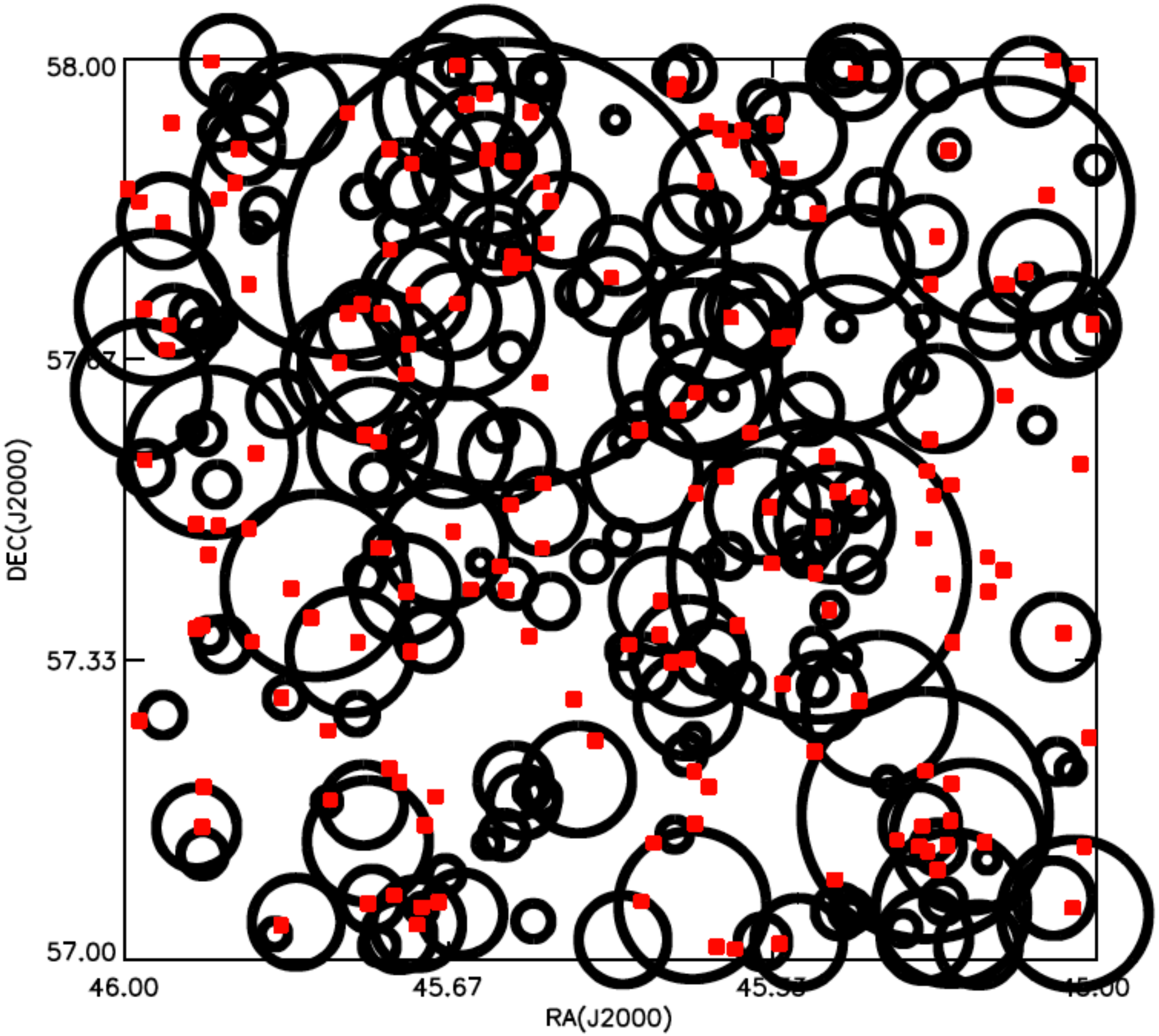
Full optimistic estimates, using P(k), (not including WL, cluster counting, SNe)
FoM >500
JPAS
BigBoss
FoM (wiggles only+Planck)
LRG, z <0.6 ~30
ELG, z < 1.4 ~100
log10(dn/dV 10-4)h^3Mpc^-3
z
3
2
1
0
−1
−2
−3
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8

J-PAS NON-BAO SCIENCE

- SN all types
- Weak lensing
- Galaxy clusters
- Galaxy evolution

- QSOs
- Stars/Planetary Nebula
- Asteroids/Transients
- GRBs

GALAXY CLUSTERS



>1.000.000 clusters/groups down to ~$4 \times 10^{13} M_{\odot}$

Ascaso et al. 2012, to be submitted, Zandivárez et al. 2012, to be submitted

BCF, *Ascaso et al. 2012*

FoF, $N_{mie} \geq 5$

+

Cosmological constraints with cluster counting

FINAL REMARKS

J-PAS IN THE SOUTH

- Extension **of J-PAS to the southern hemisphere**: the plan is to clone the northern telescopes and cameras.

    - T-250-South: Either in Tololo or Pachón (Chile)

    - T-80-South: At Cerro Tololo (fully funded). Already happening

J-PAS North+ South:

The first whole sky mapping (IFU-like)

TIMING

T250

March 2010: T250 contracted with AMOS

December 2011: T250 camera contracted

Early 2013: T250 telescope delivered

Early 2014: T250 operational

Late 2014: T250 camera delivered

2014/2015: JPAS survey starts

2017-2018: 0.6< z<1.3 BAO survey finished

End 2020: Full survey finished

T80

November 2011: T80 Camera contracted

Fall 2012: T80 operational

November 2012: T80 camera delivered

Spring 2013: T80 camera operational: JPLUS starts

JPAS = ALL SKY IFU

JPAS = Javalambre-*Physics of the Accelerated Universe* Astrophysical Survey, Spanish-Brazilian collaboration

8600 sq.deg. survey with 54 filters with 136A width, 100A spacing I~22
2.5m tel. + 5 sq.deg. cam, 1.2Gpix, etendue = 1.5 x PS2
Dark site with ~0.7 arcsec seeing: Javalambre in Teruel, Spain

It will measure 0.003(1+z) photo-z for ~100M galaxies
It will measure 0.01(1+z) photo-z for ~300M galaxies
It will measure radial BAOs up to z~1.3: 11 $(Gpc/h)^3$
Clusters, Weak lensing, SN, QSOs, Galaxy evolution, Stars, Solar system
Total budget ~30M euros
Start= 2014 End= 2020

http://j-pas.org/

DANKE!