Synergies between SHARDS, ALHAMBRA and J-PAS

Javier Cenarro
CENTRO DE ESTUDIOS DE FÍSICA DEL COSMOS DE ARAGÓN
Investigador – OAJ Project Manager

SYNERGIES AMONG SHARDS, ALHAMBRA AND J-PAS

Madrid, 20 June 2013

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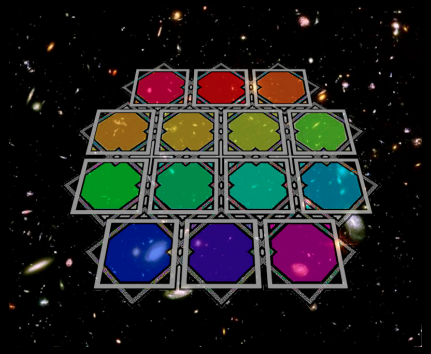
Centro de Estudios de Física del Cosmos de Aragón

MOTIVATION

- Brief review (of some) of the new existing and future multi-filter data of easy access to the SHARDS community.
- Identify synergies, strengths, complementary work, common techniques, etc.
- Present some science cases in progress and motivate new ideas



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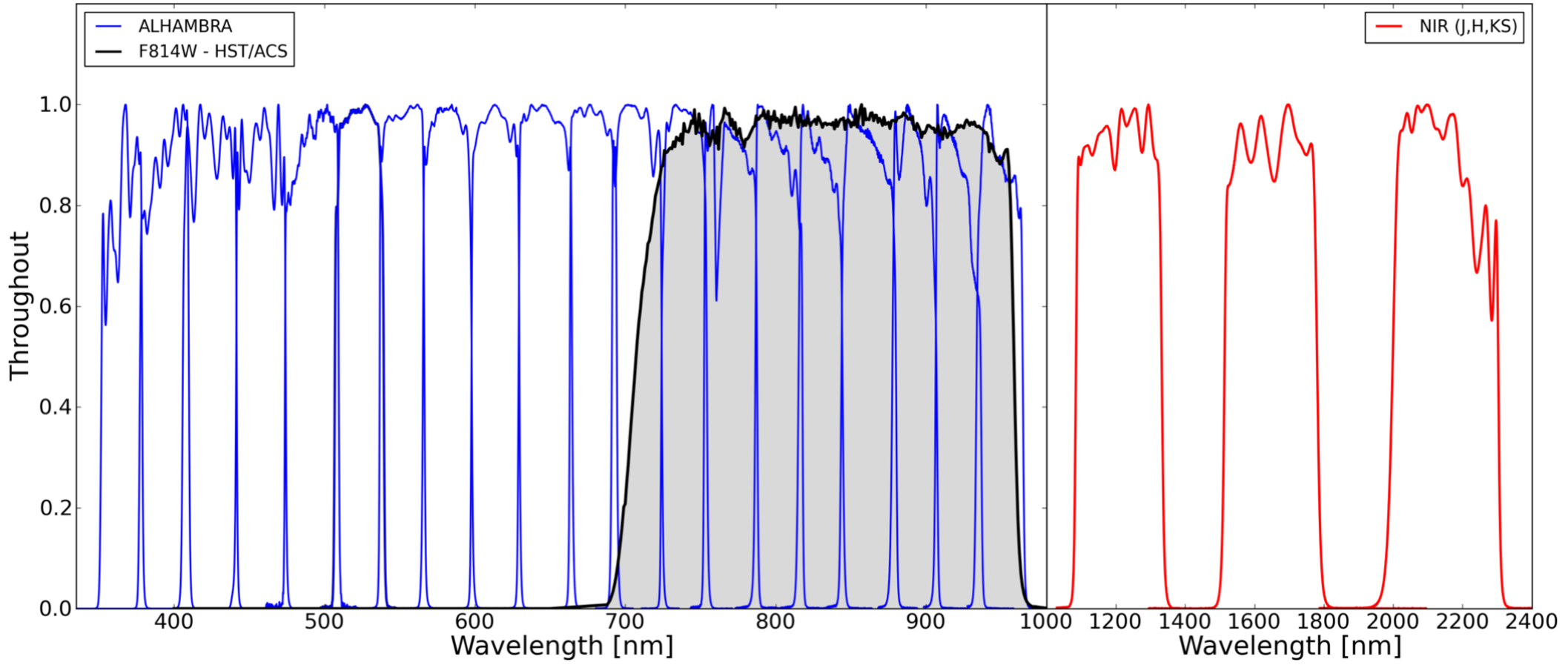
ALHAMBRA

Moles et al. (2008)

4deg^2 (8 fields) in 20 narrow-band filters ($\Delta\lambda$~30nm) + J, H, Ks



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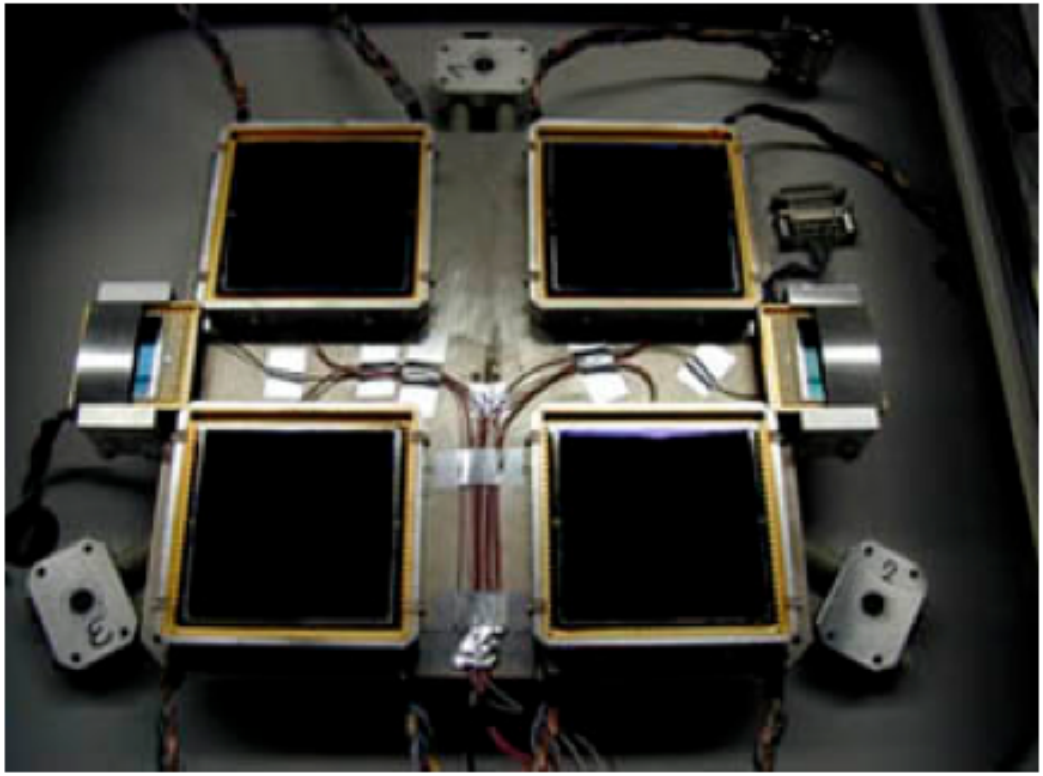
ALHAMBRA

3.5m CAHA + LAICA (Optical filters) + OMEGA2000 (NIR filters)



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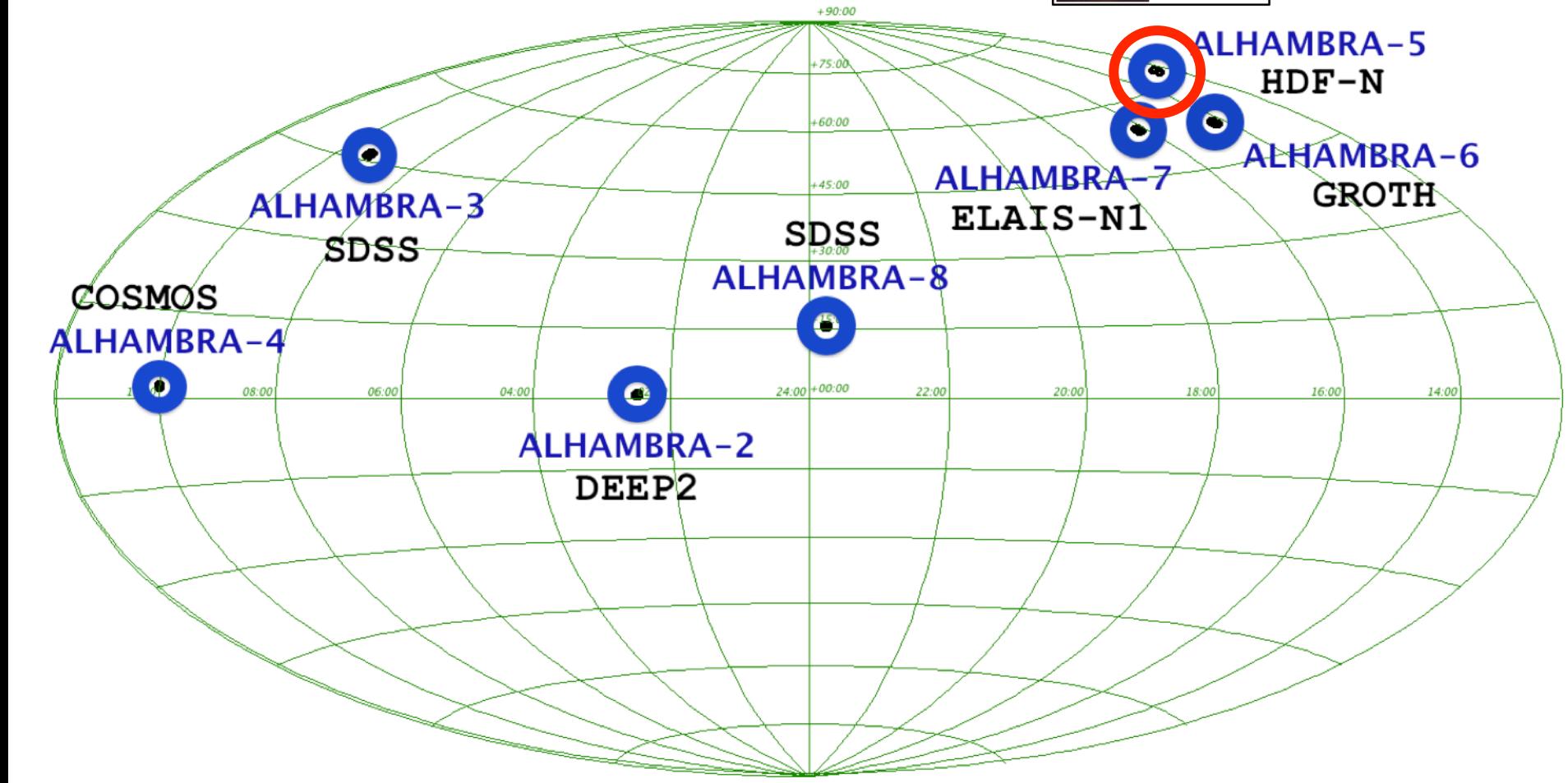
ALHAMBRA
Fields



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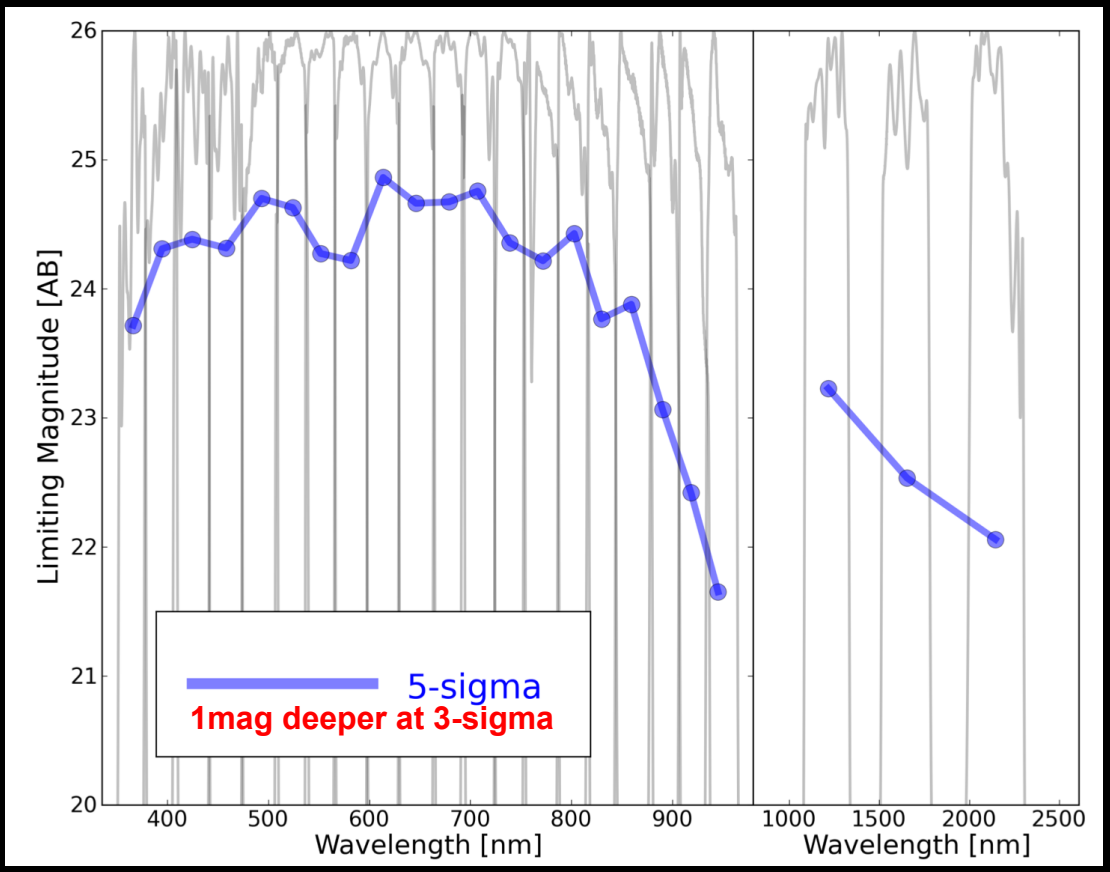
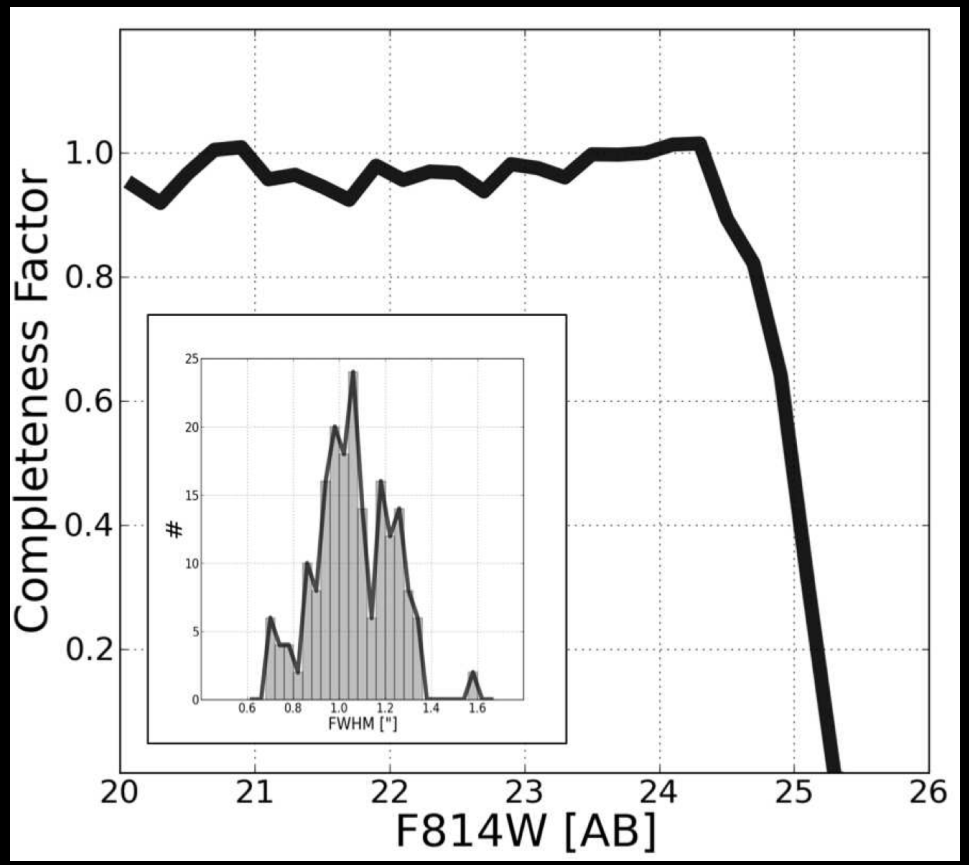
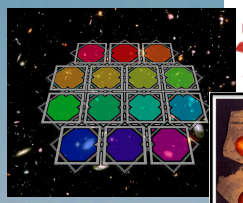
ALHAMBRA
Limiting Magnitudes and Completeness

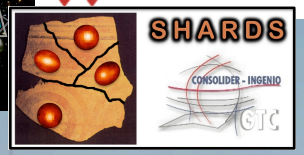




Molino et al. 2013 in prep.



ALHAMBRA SURVEY



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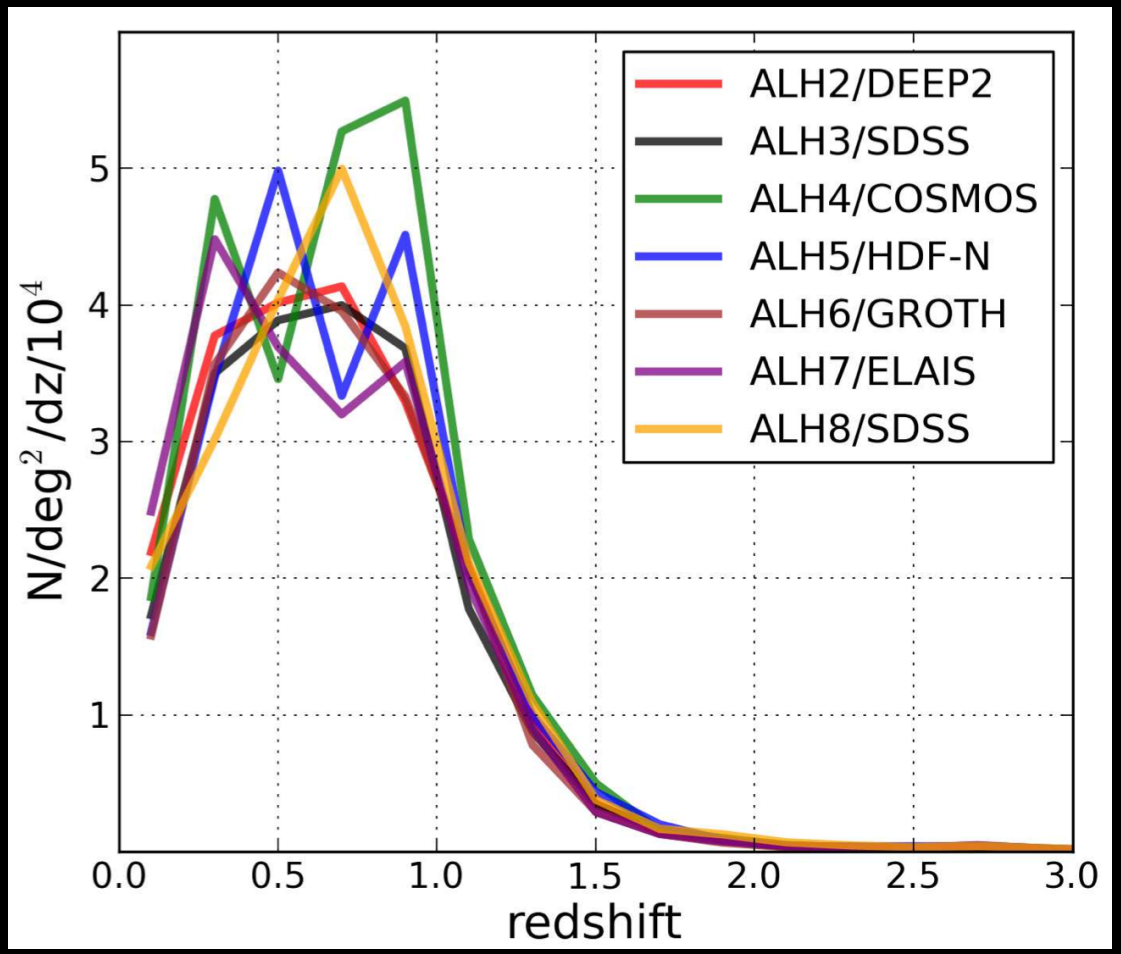
ALHAMBRA

Observed Redshift Distribution



Molino et al. 2013 in prep.

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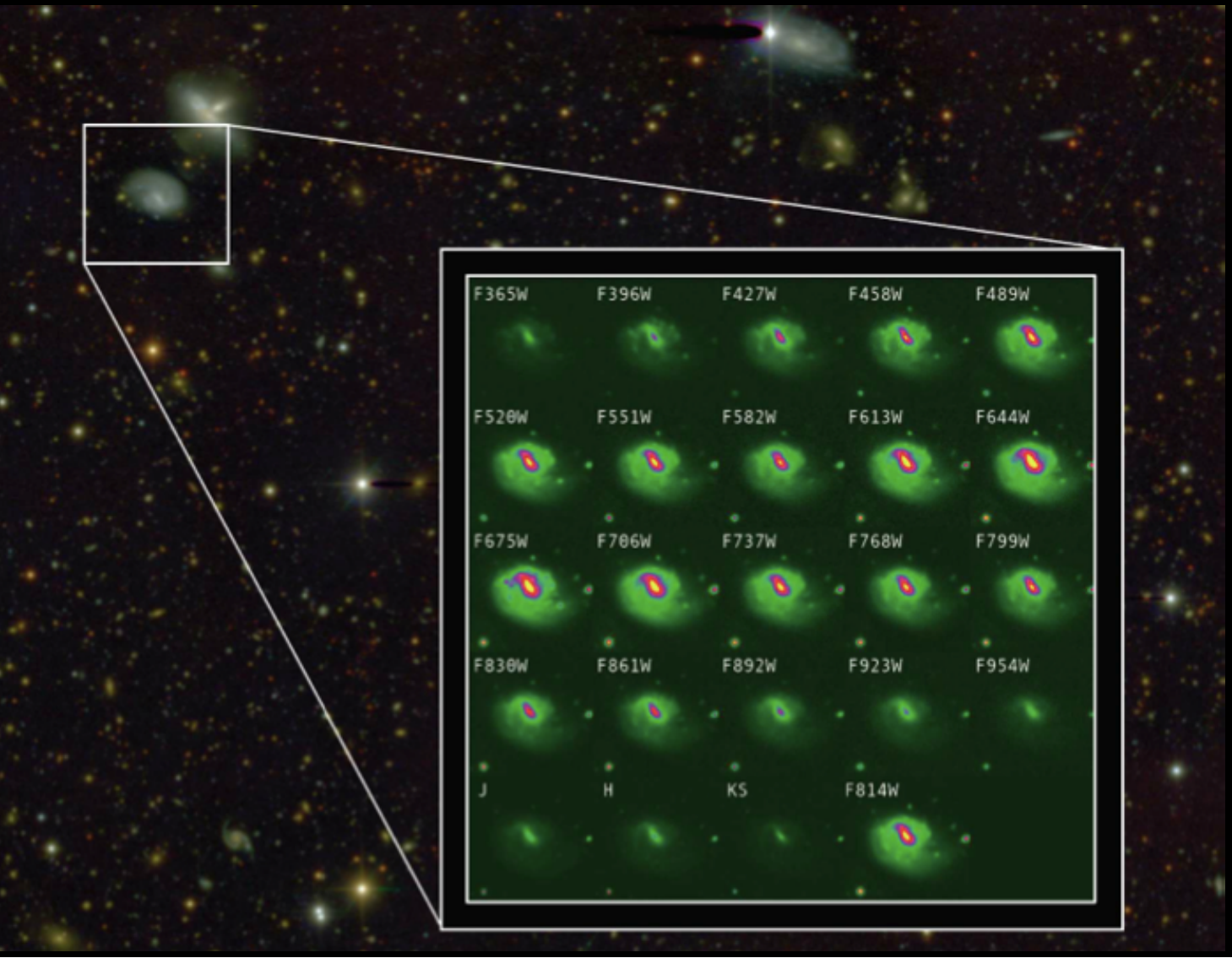
ALHAMBRA



STATUS

- 3deg^2 fully finished (calibrated and ready for science!).
- ALH01 to be calibrated.
- ALH04 and ALH05 half observed.

- 1st papers already published and/or in progress

- 1st catalogue available by Autumn 2013!

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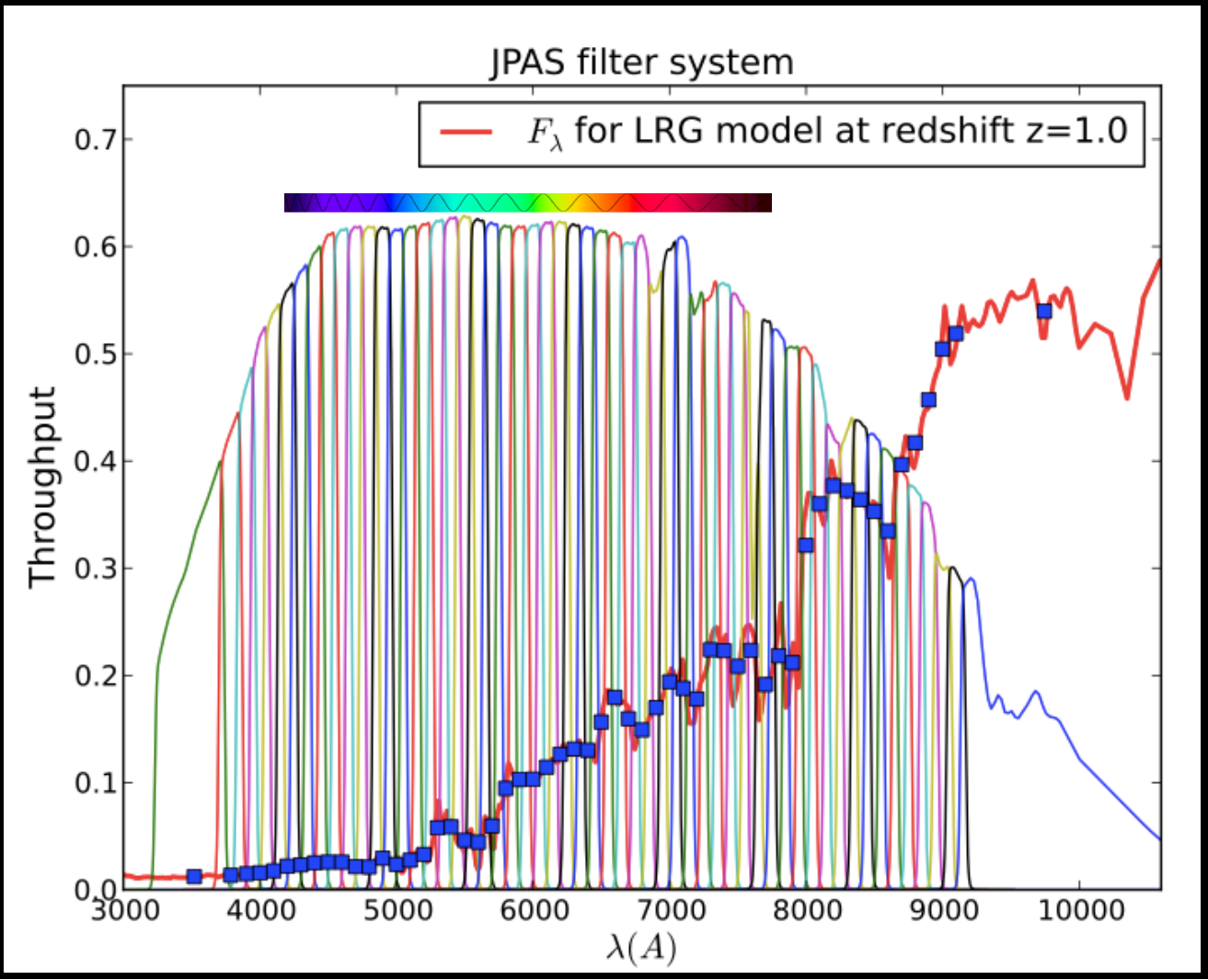
JAVALAMBRE-PAU ASTROPHYSYCAL SURVEY (J-PAS)

Filters



Sky area = 8500 deg^2
54+2 NB filters
($\Delta\lambda$~145Å; ~100Å apart)
+ u, g, r
Time: 5-6 years

- Redshifts determination (Δz ~0.3%) for hundred million galaxies → BAOs → Dark Energy constraints

- A wide range of scientific cases: J-PAS will provide a low resolution spectrum for every pixel of ythe sky (low-res IFU)

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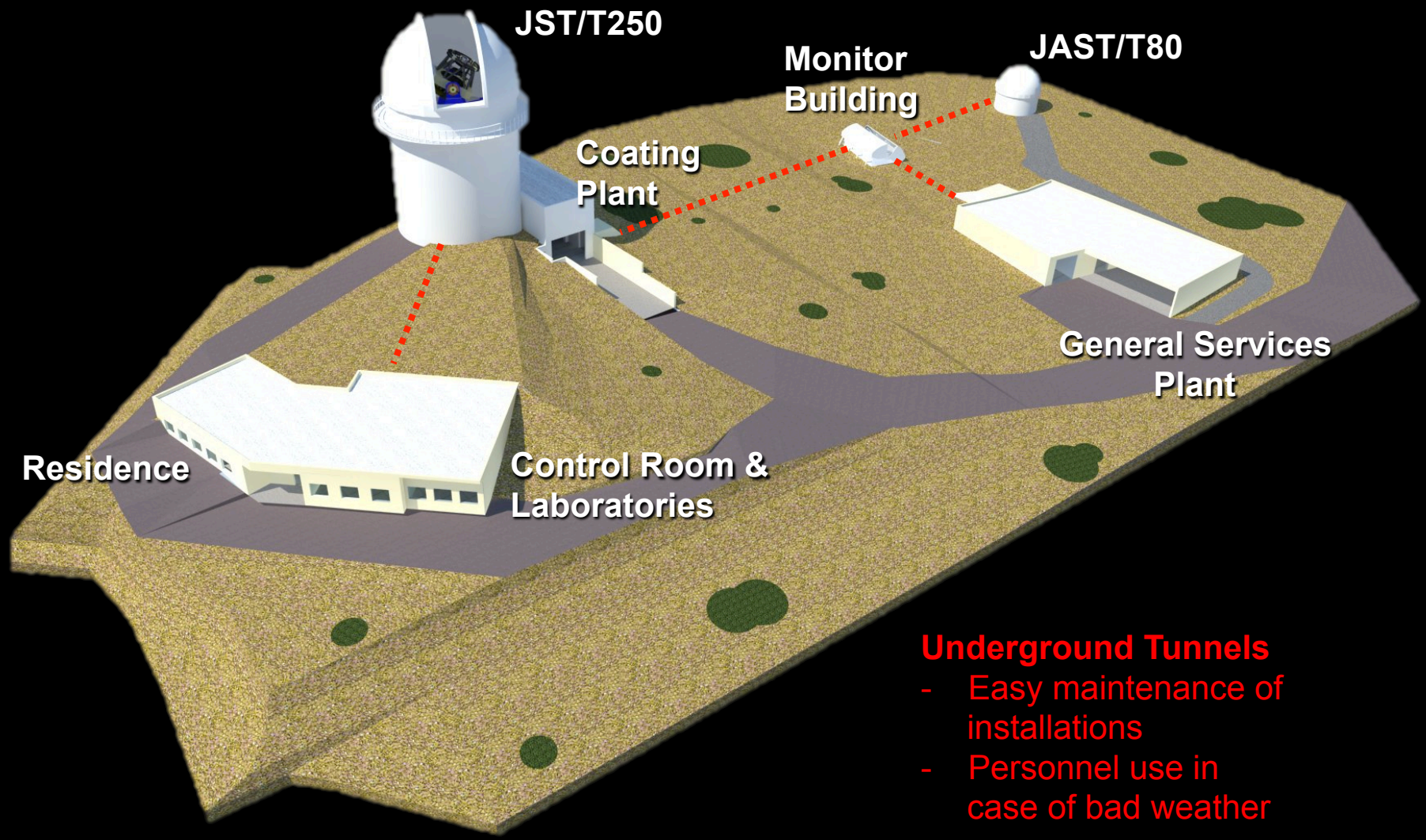
OAJ CIVIL WORK FINAL DESIGN



Underground Tunnels

- Easy maintenance of installations
- Personnel use in case of bad weather


AMONG SHARDS, ALHAMBRA AND J-PAS
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OAJ CIVIL WORK
JUN 2012
JAST/T80
JST/T250
Coating Plant
Monitor Building
General Services Plant
Residence & Control Building
Underground Tunnels

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The Javalambre Survey Telescope (JST/T250) to conduct J-PAS

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

Conceptual design: CEFCA
Manufacturer: AMOS (Belgium)
Current Status: Accepted in factory
On site: when dome is finished

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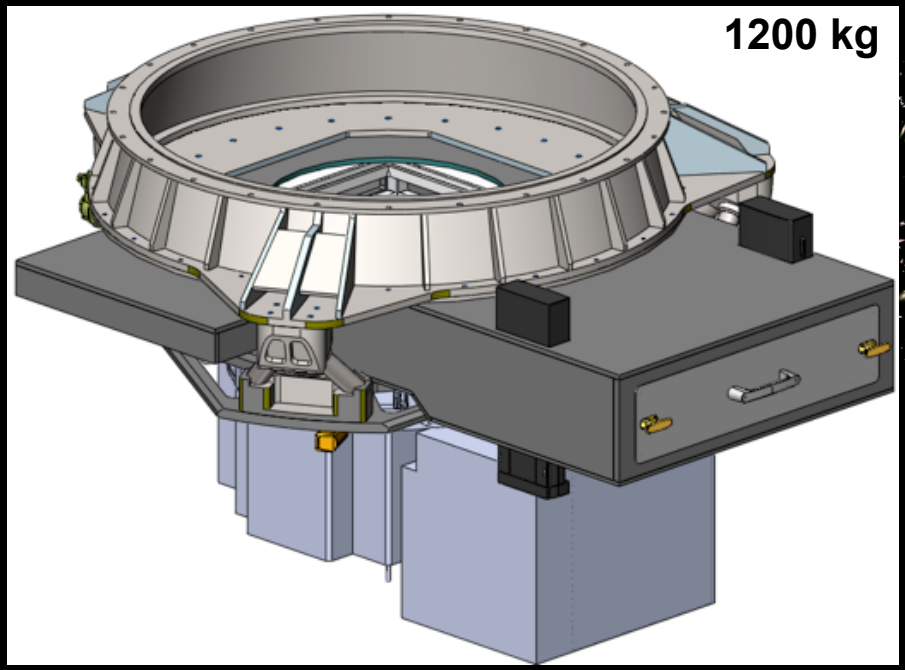
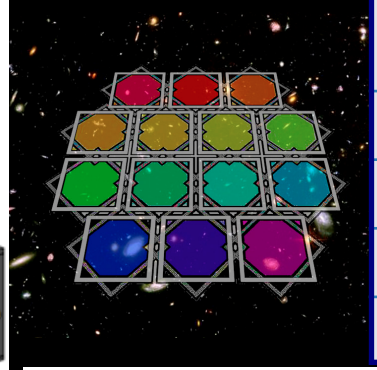
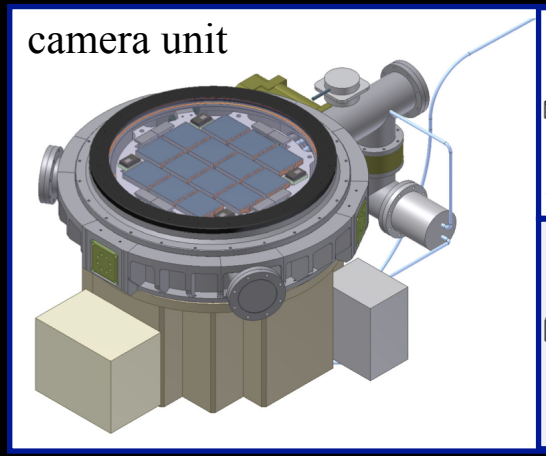
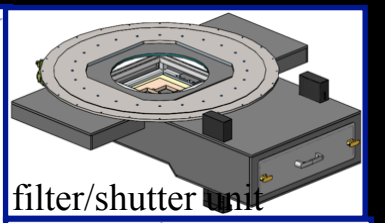
Panoramic Camera JPCam @ JST for J-PAS

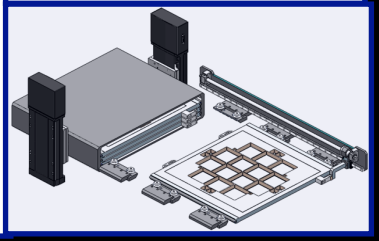


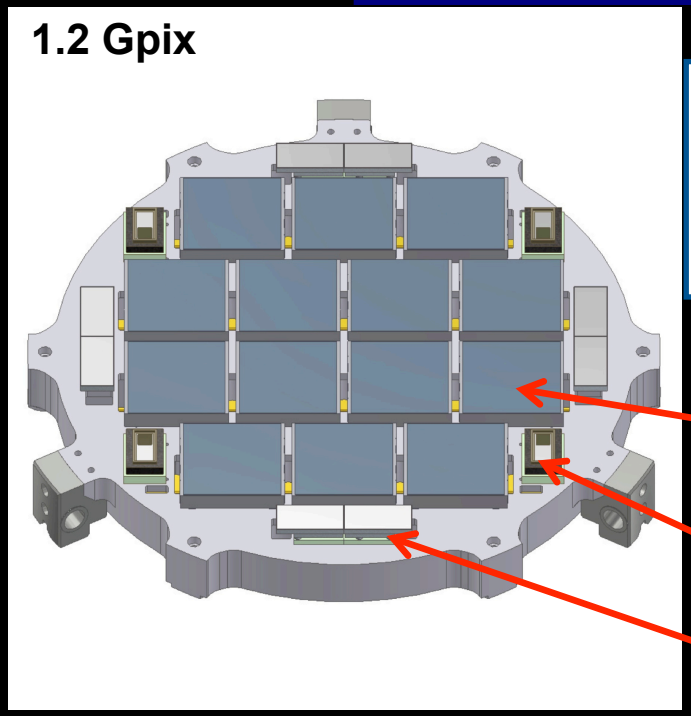


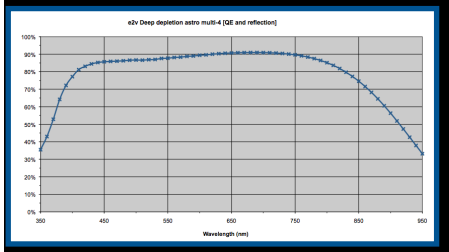
FoV	Ø=3.0º (full performance) Ø = 3.1º (reduced performance)
CCD format	9216 x 9240 pix, 10 µm/pix
Pixel scale	0.22“/pix
Read out time	12s
Read out noise	6 e^-/pixel

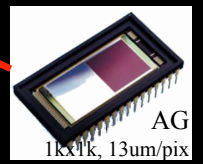












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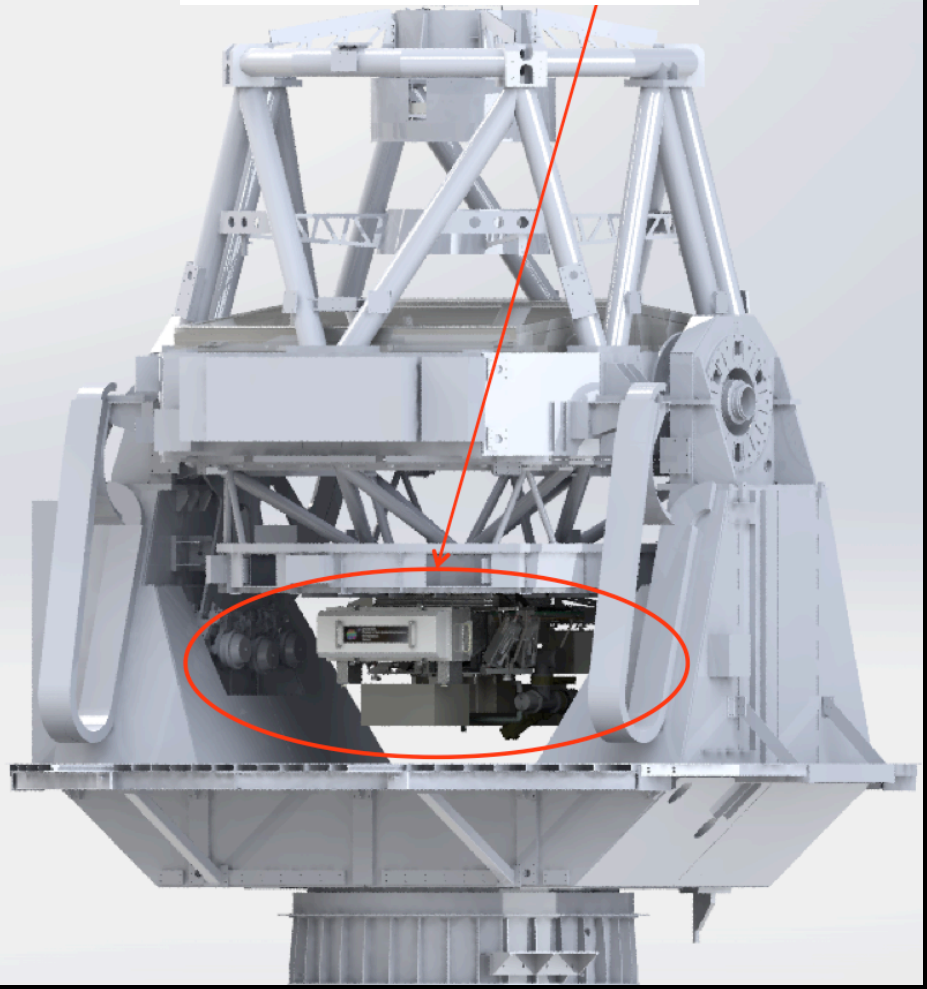
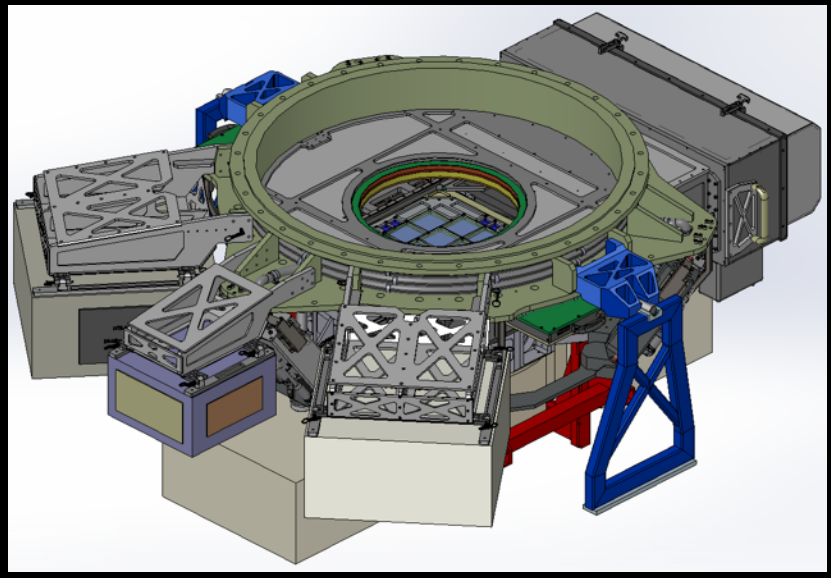
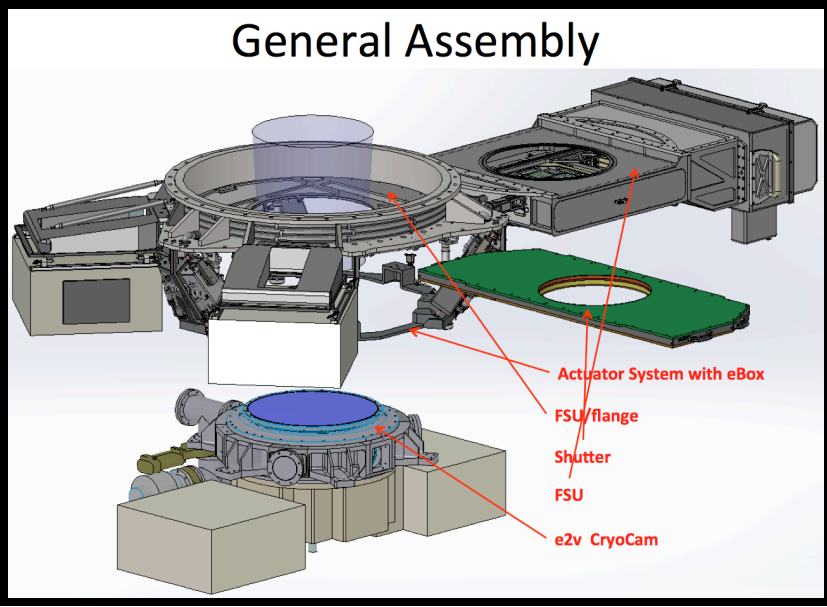
JST/T250 + JPCam





General Assembly



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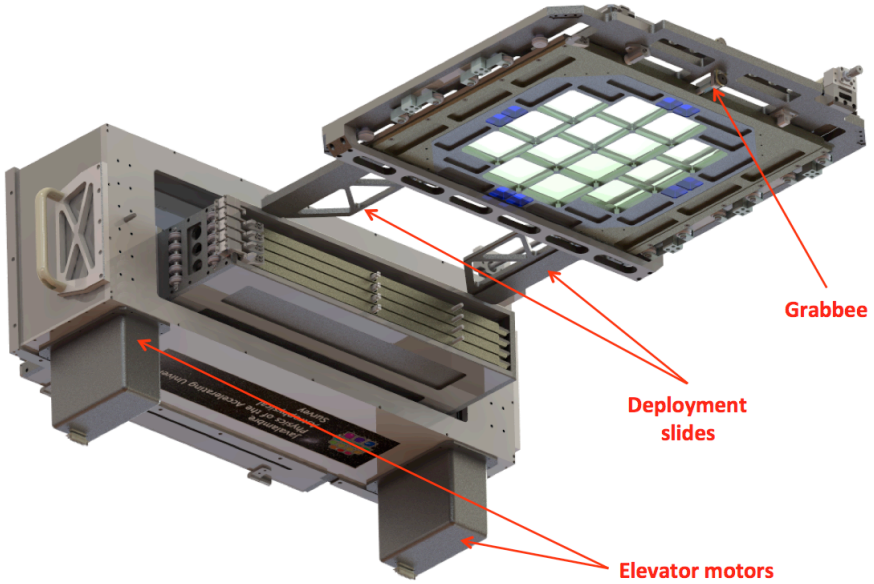
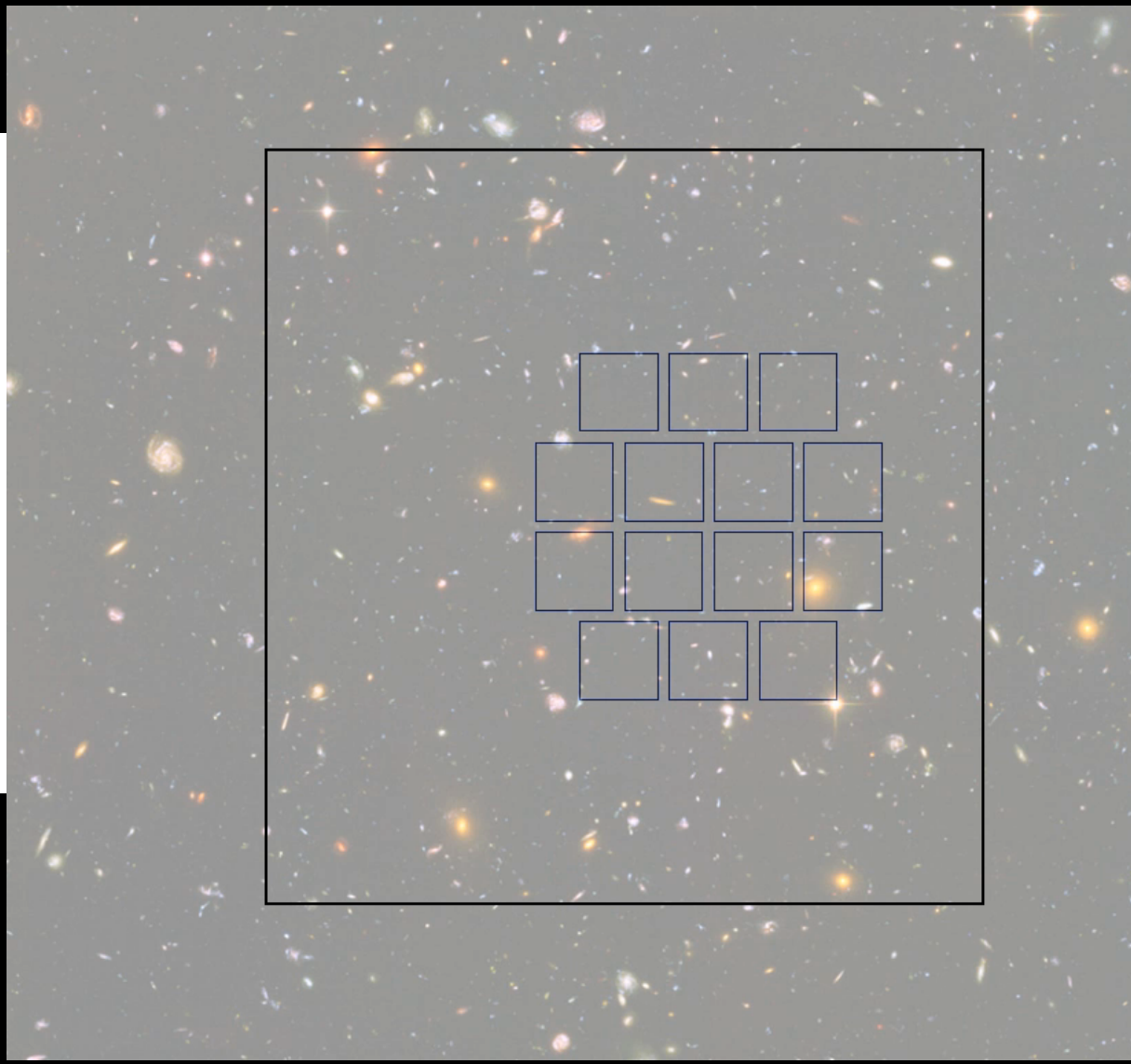
Filter Tray Injection Mechanism





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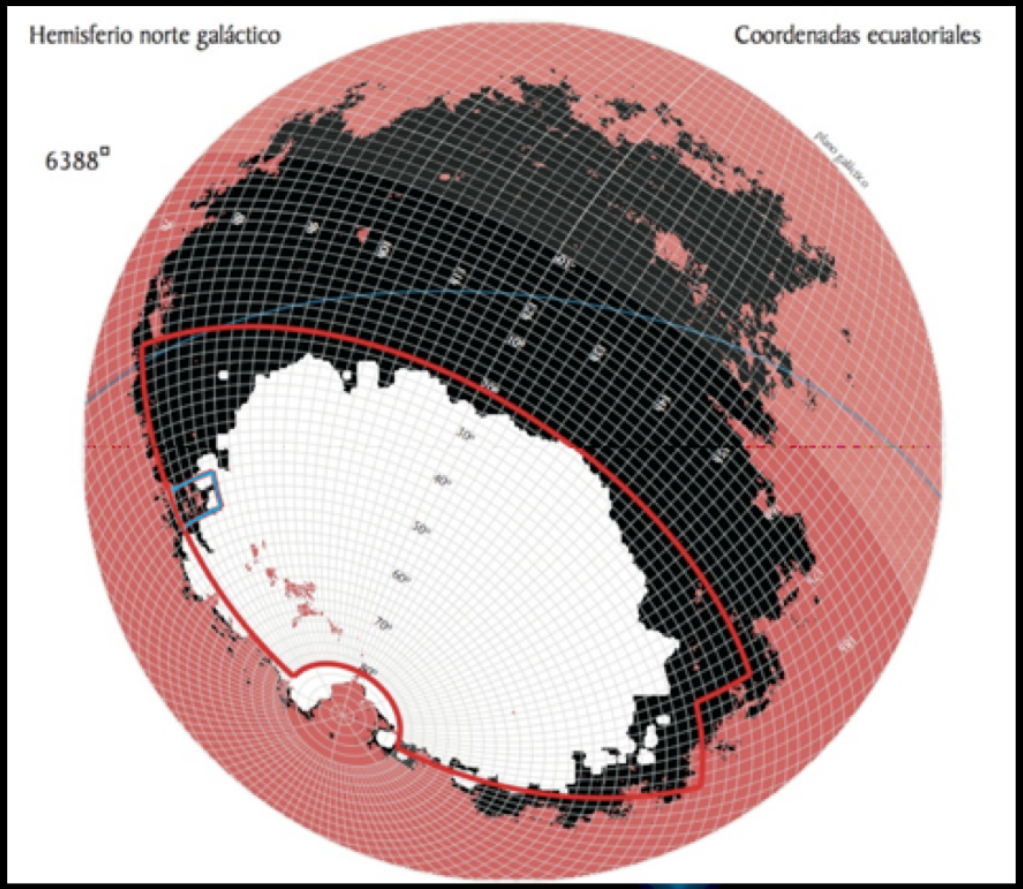
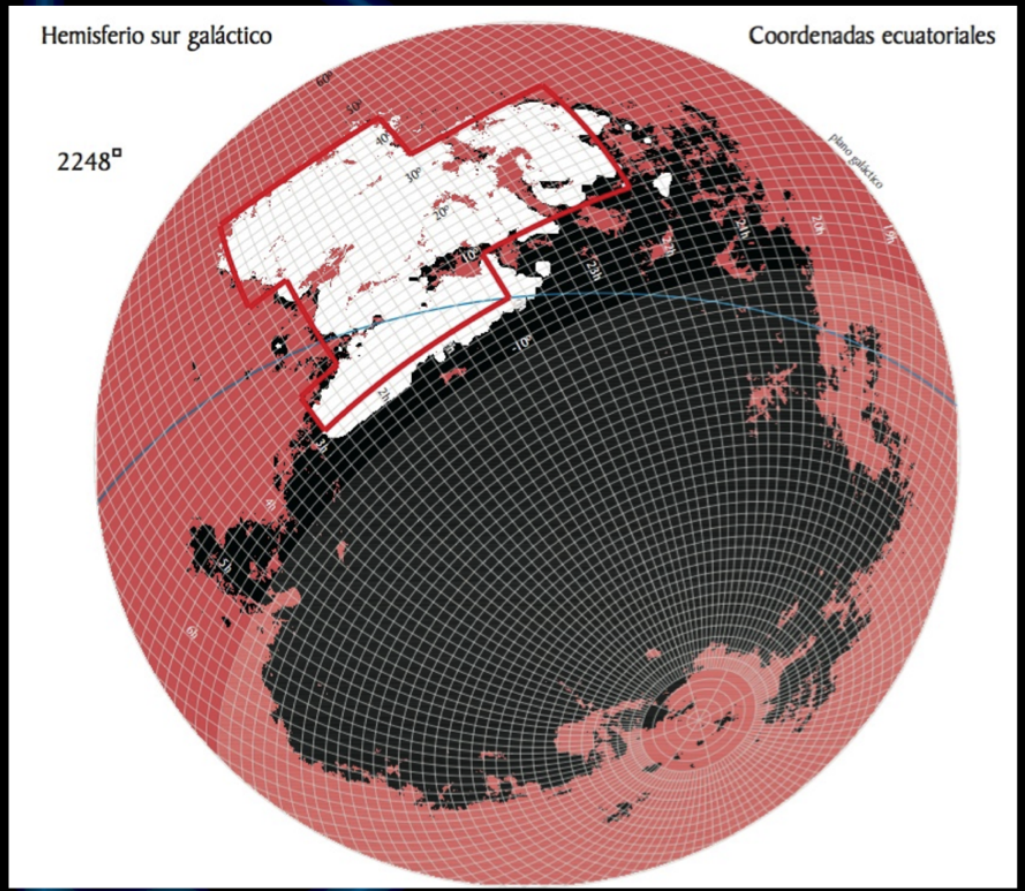
JAVALAMBRE-PAU ASTROPHYSYCAL SURVEY (J-PAS)

Fields





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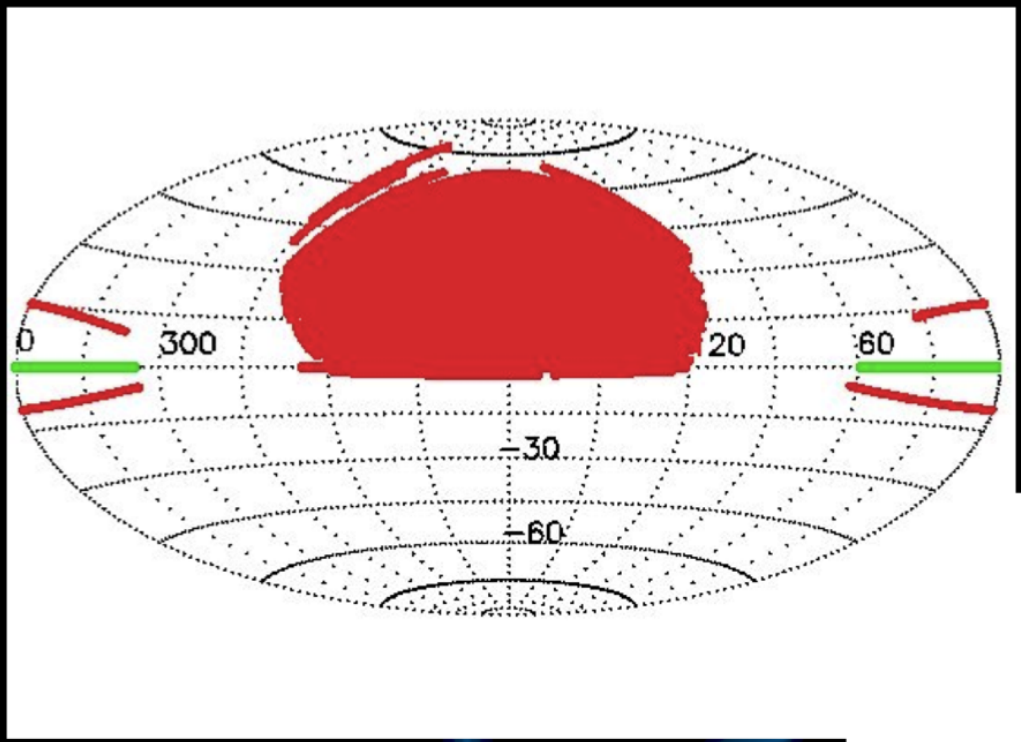
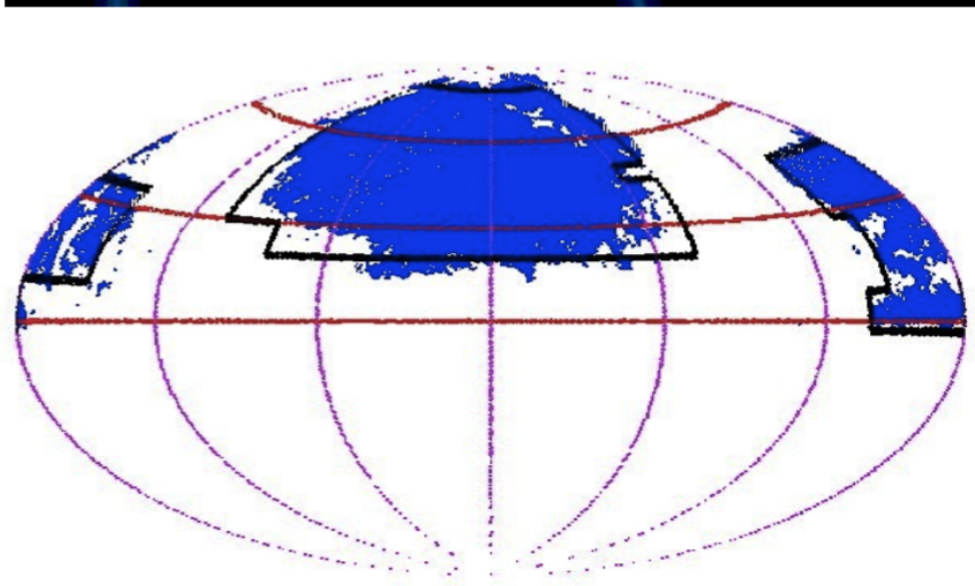


Overlap with Sloan Digital Sky Survey



ALHAMBRA SURVEY

SHARDS

CONSOLIDER - INGENIO

GTC

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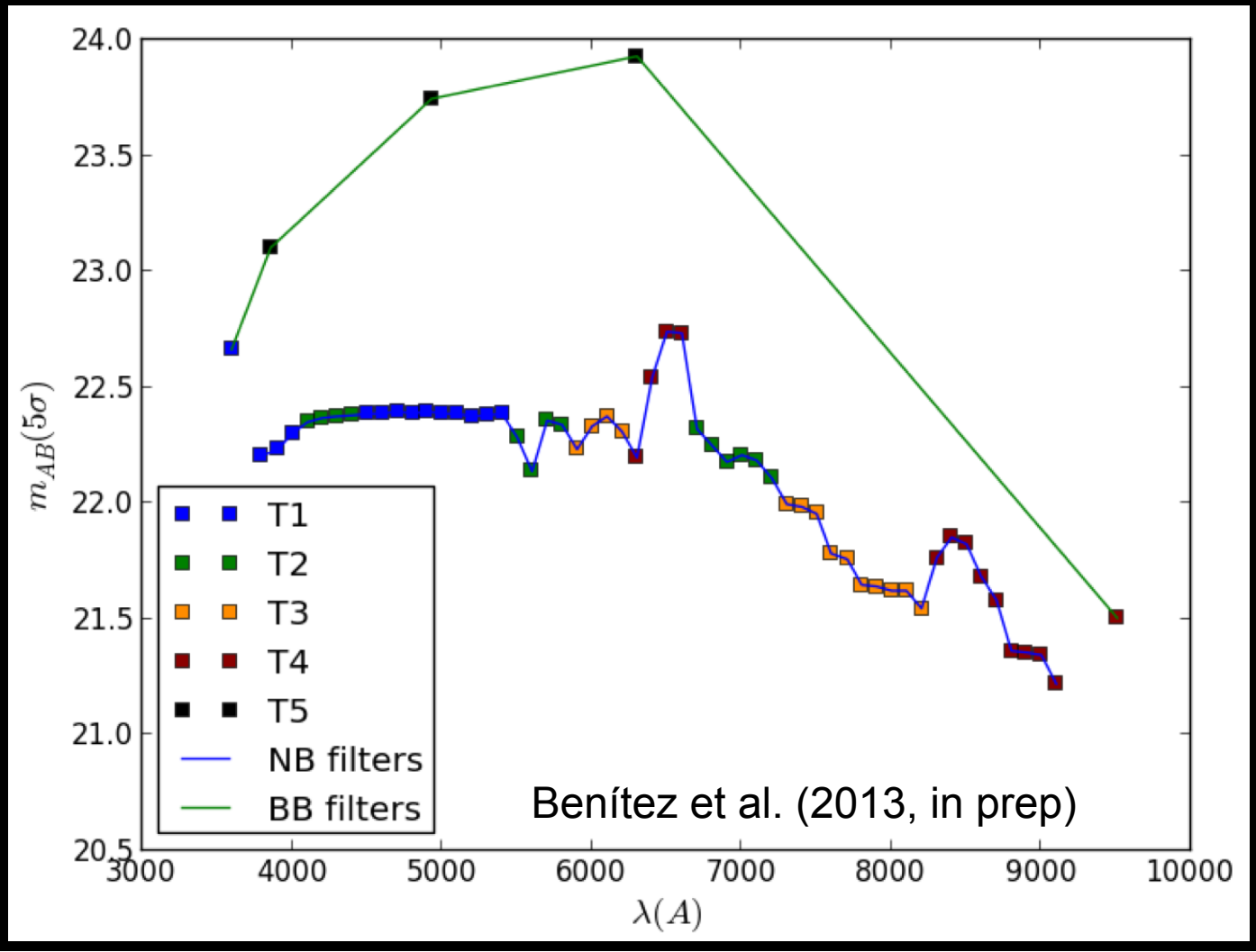
Limiting Magnitudes



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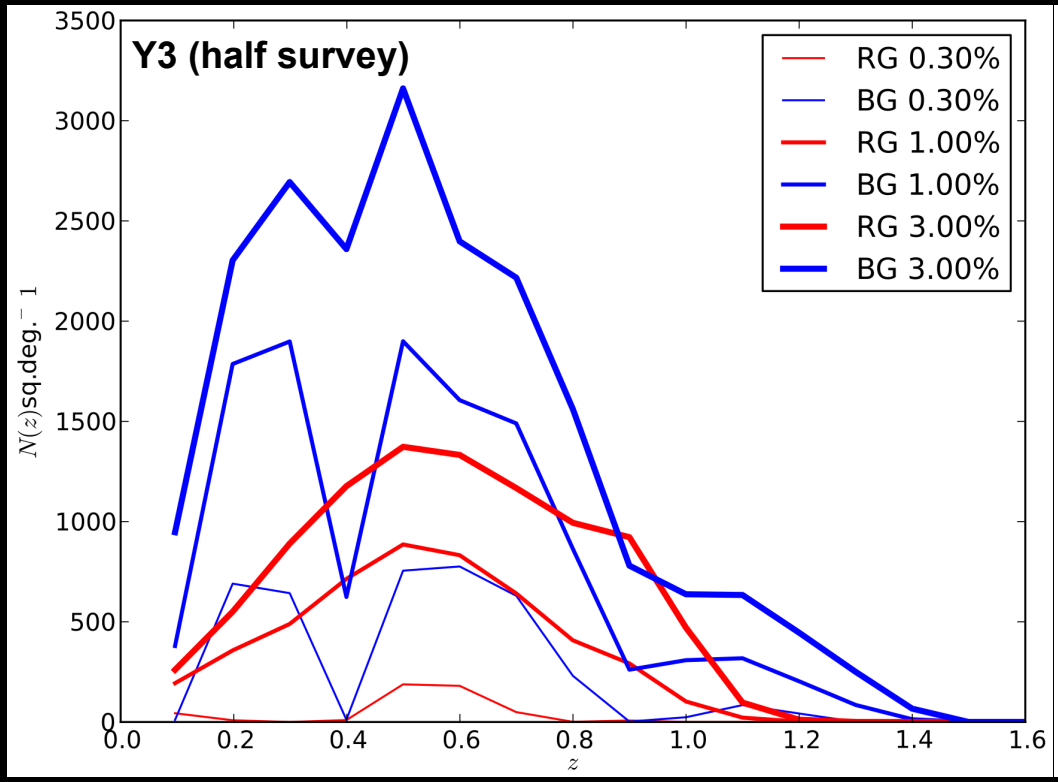
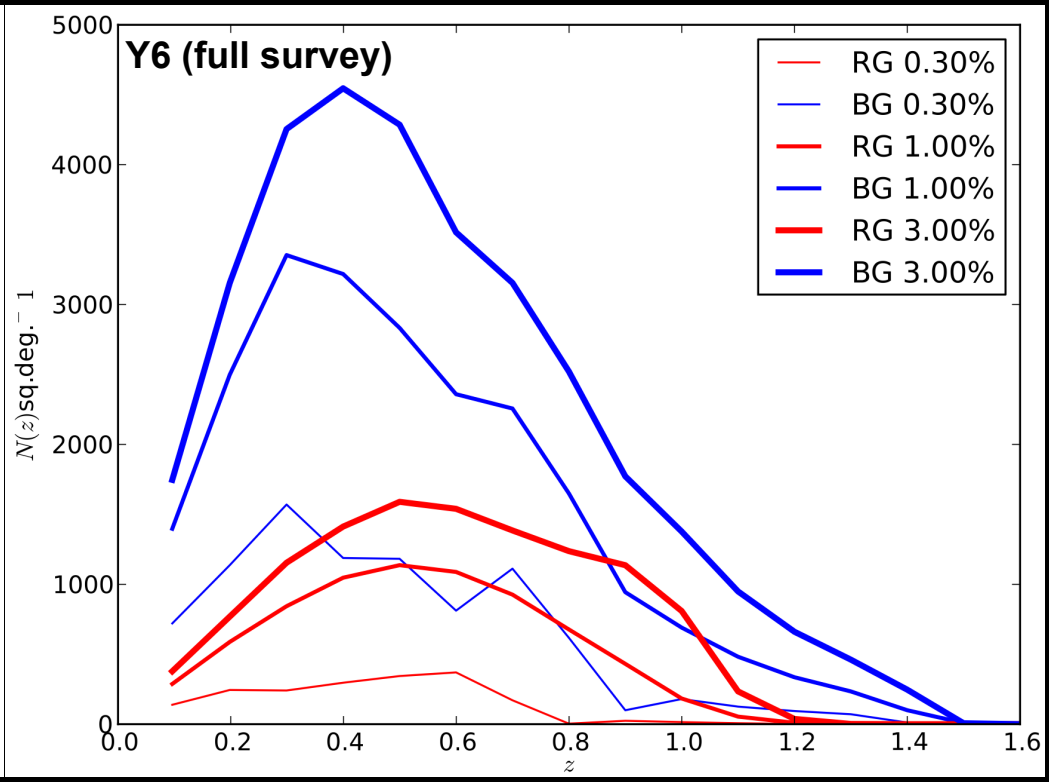
JAVALAMBRE-PAU ASTROPHYSYCAL SURVEY (J-PAS)

Expected Redshift Distribution

(as a function of galaxy type and redshift error)





Benítez et al. (2013, in prep)

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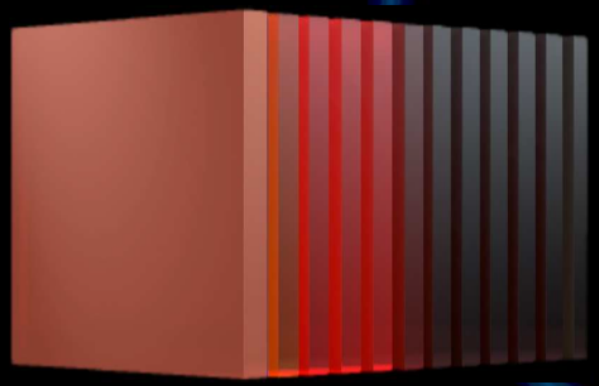
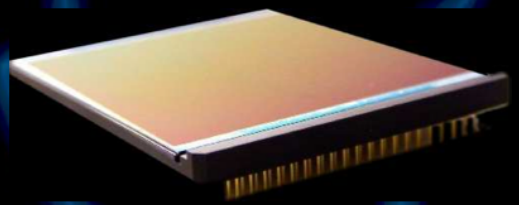
JAVALAMBRE-PAU ASTROPHYSYCAL SURVEY (J-PAS)

PATH-FINDER SURVEY

Need for a Pathfinder survey

- The T250 telescope will come on-line, with all its systems ready, by the end of 2013 (earlier than the JPCam camera).
- A sizeable subset of the JPAS 56-filter set could also be available at the beginning of 2014. We will consider here 12 contiguous filters.





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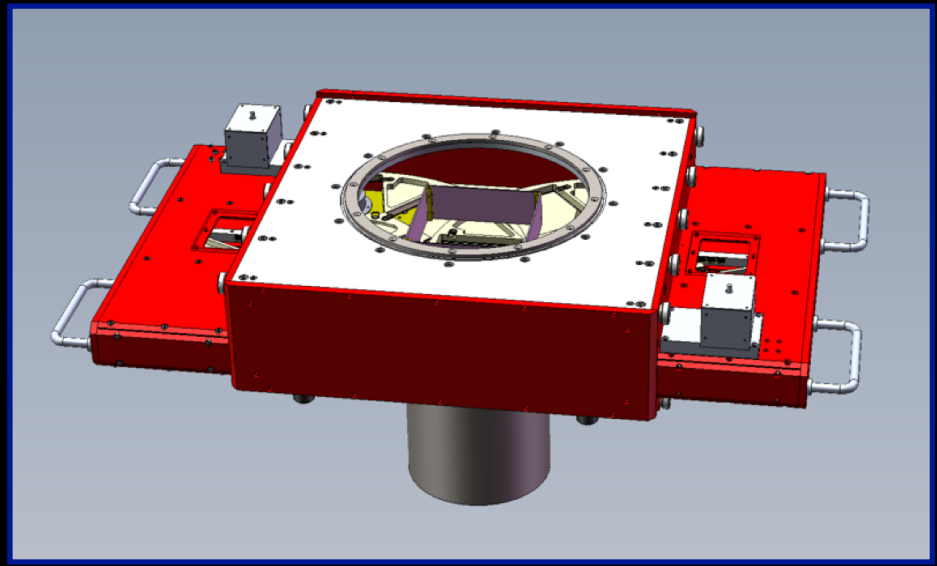
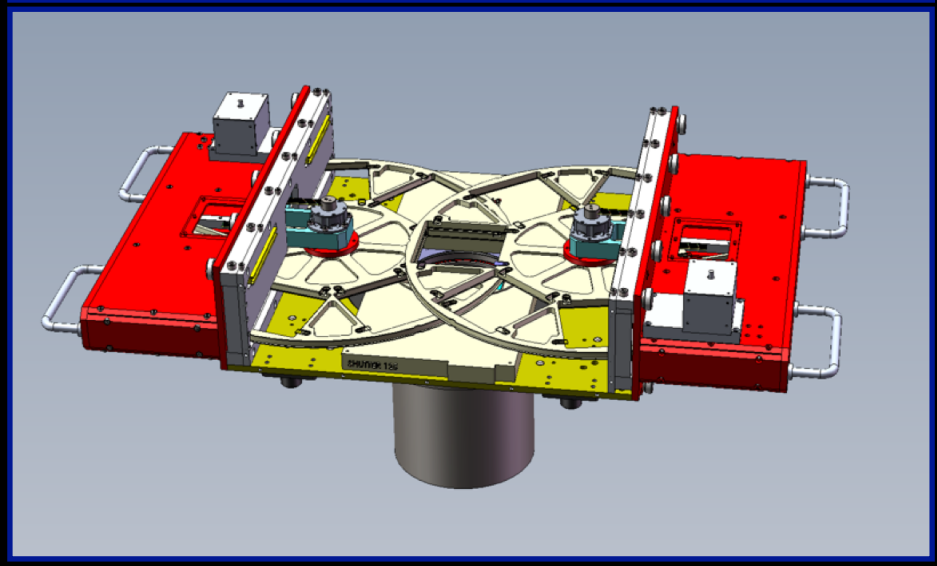
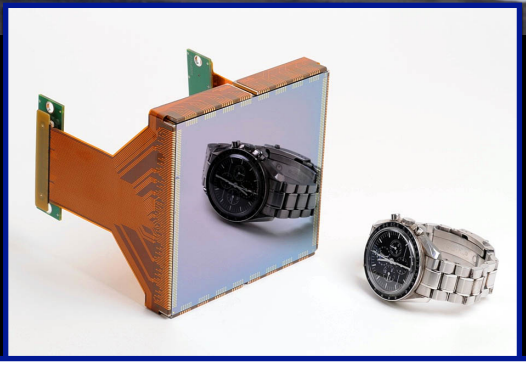
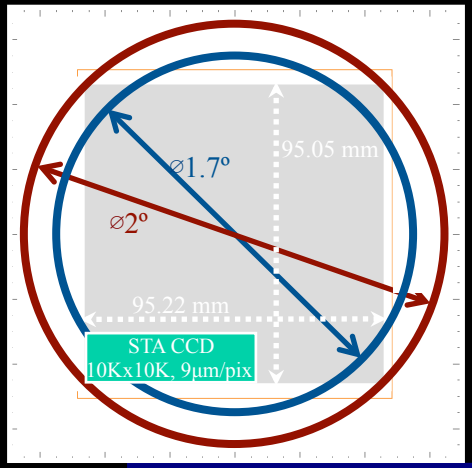
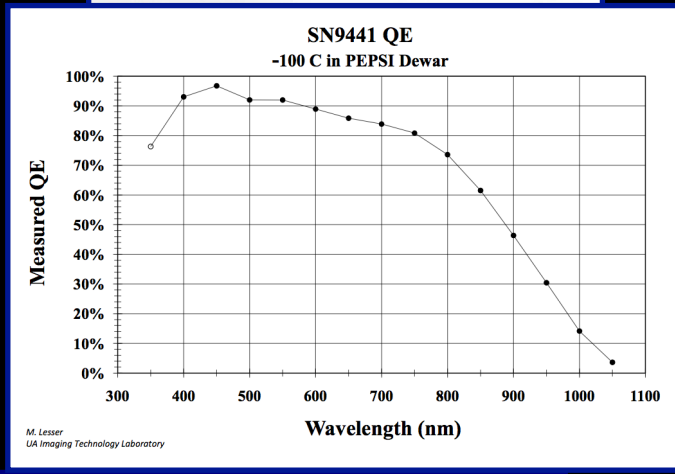
PATHFINDER CAMERA: Replica of T80Cam @ JAST/T80











FoV	Ø=1.7º (full performance) Ø = 2.0º (reduced performance)
CCD format	10580 x 10580 pix, 9 µm/pix
Pixel scale	0.5“/pix
Read out time	<20s
Read out noise	<6 e^-/pixel

JAVALAMBRE-PAU ASTROPHYSYCAL SURVEY (J-PAS)

PATH-FINDER SURVEY

Area/Depth strategy

It was decided to break the survey in three subsurveys á lá VVDS, with different depths:

- A shallow survey with the depth of JPAS (Texp=225 s) covering ~240 sqdeg.
- A medium survey exposing ~4x JPAS (900 s) (~m_{lim}+1) covering ~60 sqdeg.
- A deep survey exposing ~16x JPAS (3600 s) (~m_{lim}+2) covering ~15 sqdeg.

As targets need to be visible along all epochs of the year, we need to split each subsurvey in different sections covering different right ascensions.

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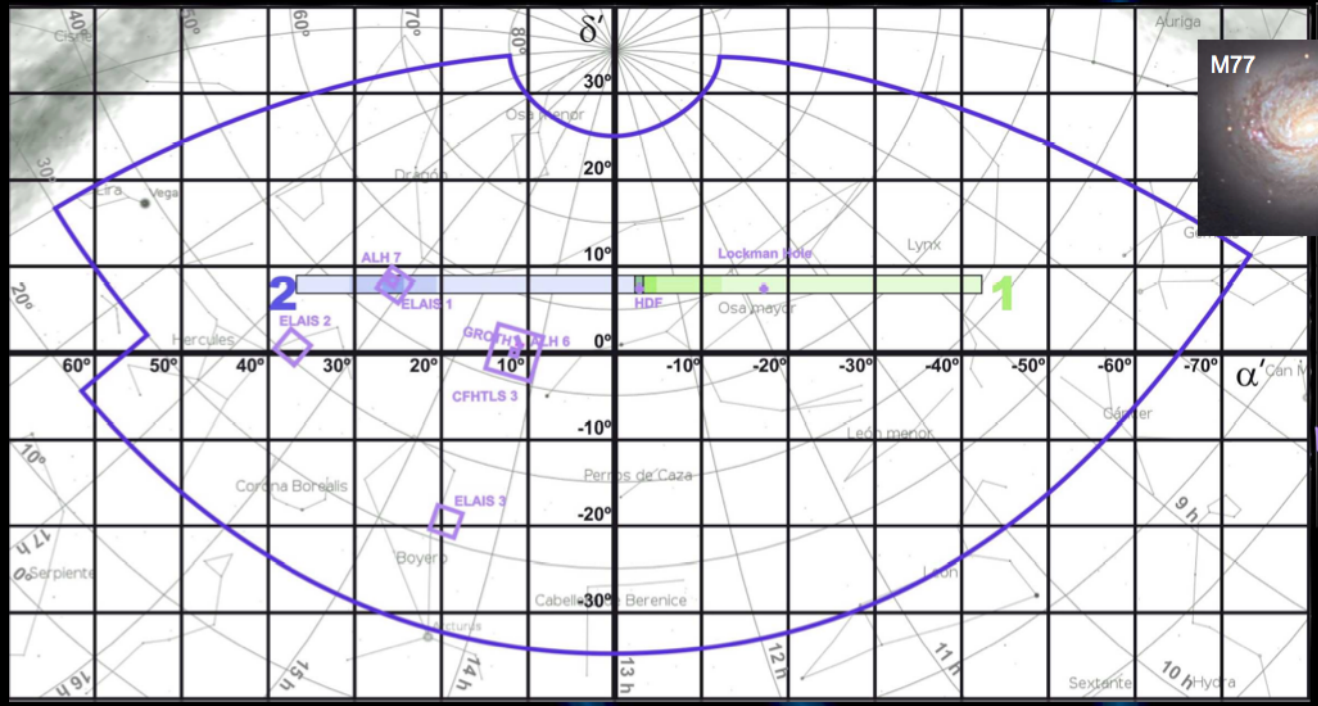
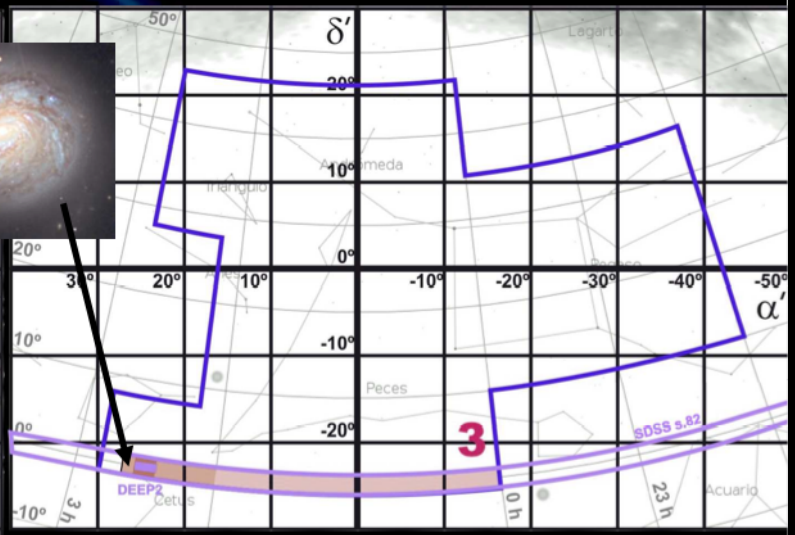
PATH-FINDER SURVEY

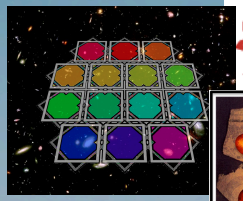
Field proposal





Three stripes (~along RA to assure good observability along the whole year):

- 2 in the North field, defined along JPAS coordinates.
- 1 in the South field, using equatorial coord.
- Stripes 1 and 2 consecutive to create a ~80º long stripe (overlapping at HDF).



ALHAMBRA SURVEY

SHARDS

CONSOLIDER - INGENIO

GTC

SYNERGIES AMONG SHARDS, ALHAMBRA AND J-PAS

Madrid, 20 June 2013

Javier Cenarro

CEFCA

Centro de Estudios de Física del Cosmos de Aragón

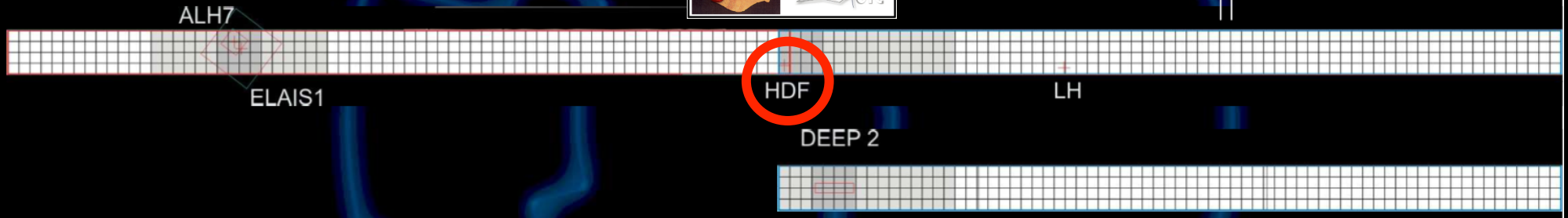
JAVALAMBRE-PAU ASTROPHYSYCAL SURVEY (J-PAS)

PATH-FINDER SURVEY

Field proposal

Shallow, medium and deep subsurveys fit inside each other as russian matryoshkas to gain depth:

distance between pointings (to allow overlap): 0.573º



3x
- Shallow: 4x71 pointings each strip (~93 sqdeg). Texp = 1xJPAS
- Medium: 4x16 pointings each strip (~21 sqdeg). Texp = 5xJPAS
- Deep: 4x4 pointings each strip (~5.25 sqdeg). Texp = 21xJPAS (at HDF: 22xJPAS)

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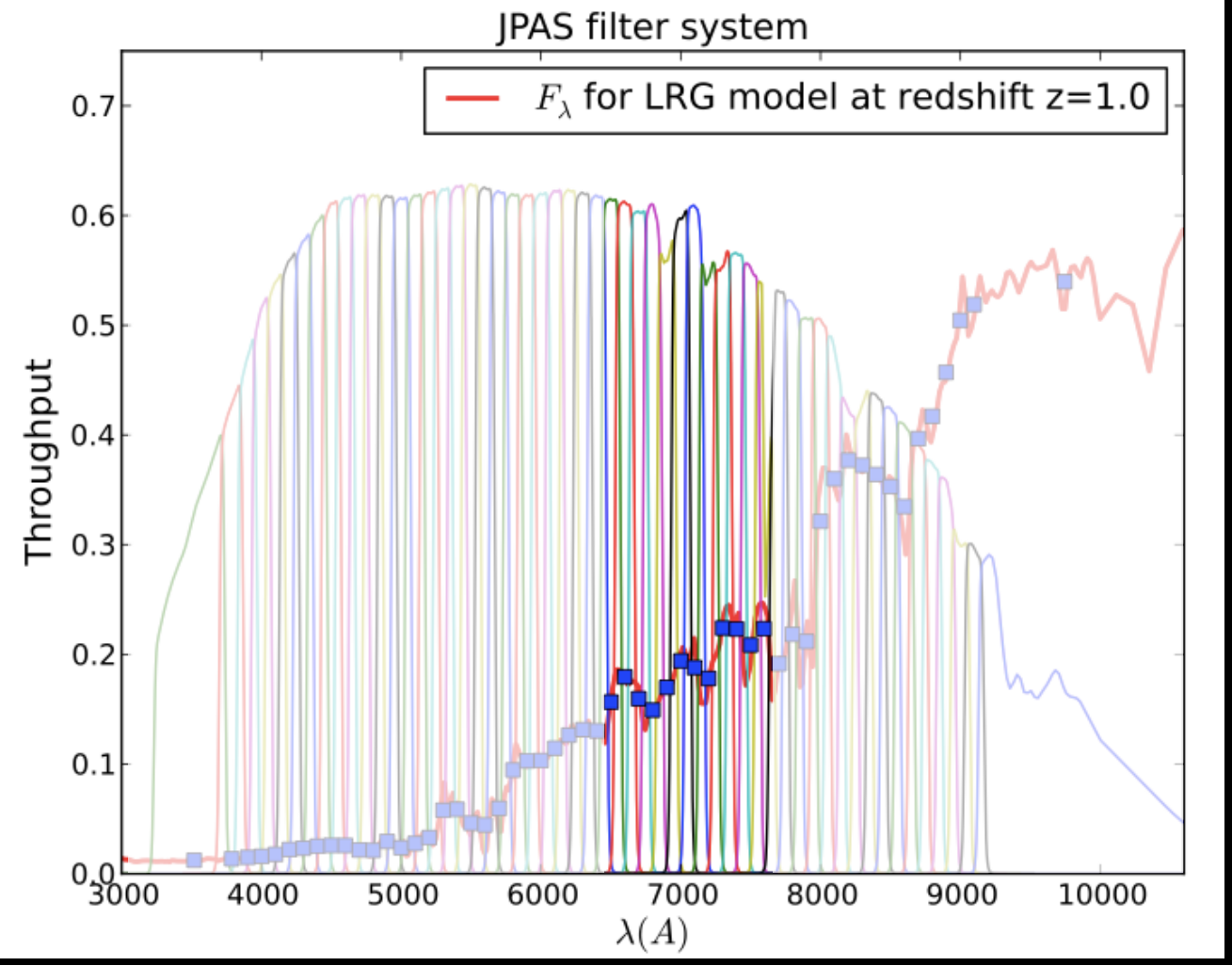
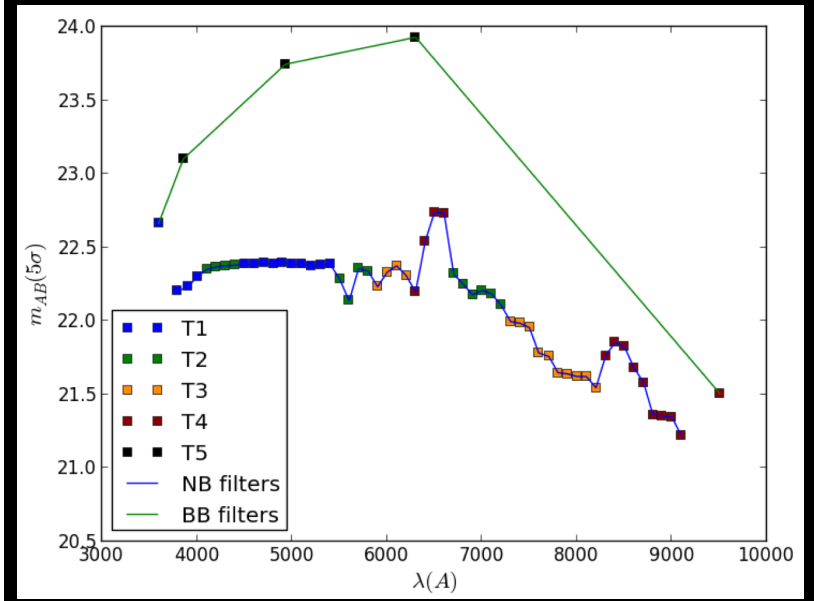
PATH-FINDER SURVEY





For the deepest 5.25 deg^2 fields
HDF-N (SHARDS), DEEP2 ELAIS,
Magnitude limit = J-PAS+2
(J-PAS+3 at 3-sigma)

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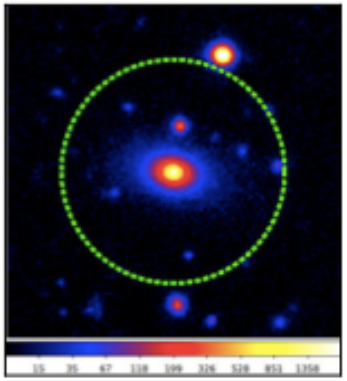
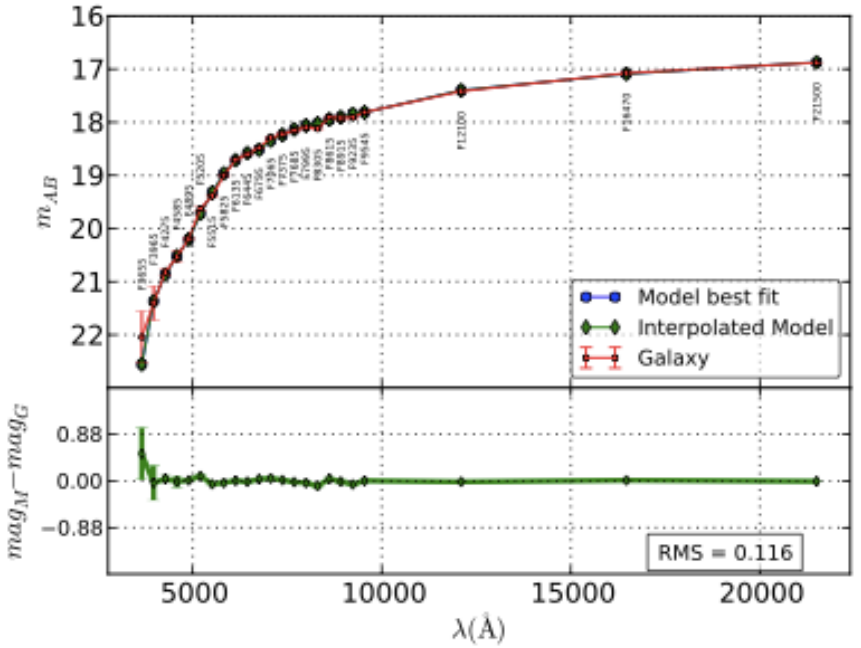
ONGOING SCIENCE CASES

DETAILED STELLAR POPULATION ANALYSIS FOR ALHAMBRA EARLY TYPES





Info
====
$\frac{S}{N}$ = 52.77 [2.23-120.06]
χ^2 = 2.986 → 2.986
N_{Ok} = 23
N_{SSP} = 2
E.L. = 0 - 0

Best SSP Model (N_{sim} = 100)
==========
z = 0.310 → 0.310 (0.306 ±0.006)
A_V = 0.100 → 0.100 (0.166 ±0.097)
Age = 1.434 → 1.434 (1.822 ±0.951)
[Fe/H] = 0.559 → 0.559 (0.474 ±0.180)
$M_\star$[dex $M_\odot$] = 10.813 → 10.813 (10.869 ±0.128)
%$M_\star$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$C_{M_\star}$ = 0.58 → 0.58
χ^2 = 3.82347 → 3.82347
E.L. = 0 - 0

Best Model (N_{sim} = 100)
==========
z = 0.310 → 0.310 (0.306 ±0.005)
$A_{V,L}$ = 0.000 → 0.000 (0.024 ±0.042)
$A_{V,M}$ = 0.000 → 0.000 (0.024 ±0.042)
Age_L = 3.779 → 3.779 (3.742 ±0.872)
Age_M = 4.340 → 4.340 (4.782 ±1.438)
$[Fe/H]_L$ = 0.266 → 0.266 (0.319 ±0.068)
$[Fe/H]_M$ = 0.186 → 0.186 (0.209 ±0.101)
%$M_{\star\,L}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
%$M_{\star\,M}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$M_\star$[dex $M_\odot$] = 11.079 → 11.079 (11.049 ±0.057)

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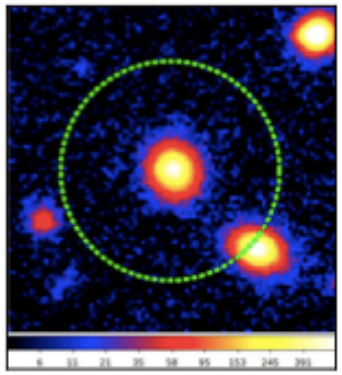
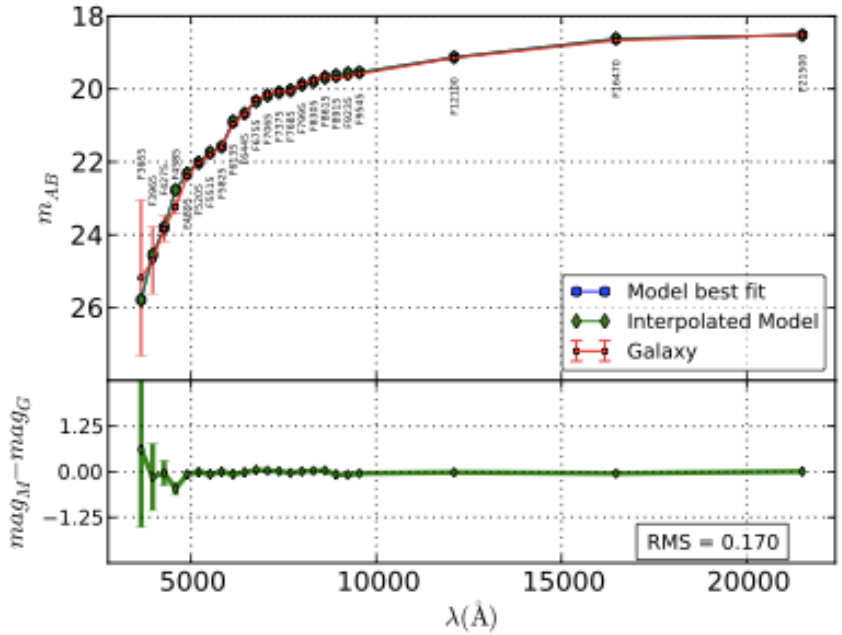
DETAILED STELLAR POPULATION ANALYSIS FOR ALHAMBRA EARLY TYPES





Info
====
$\frac{S}{N}$ = 43.74 [0.51-134.41]
χ^2 = 2.511 → 2.511
N_{Ok} = 23
N_{SSP} = 2
E.L. = 0 - 0

Best SSP Model (N_{sim} = 100)
==========
z = 0.500 → 0.500 (0.502 ±0.004)
A_V = 0.000 → 0.000 (0.029 ±0.057)
Age = 1.680 → 1.680 (1.645 ±0.386)
[Fe/H] = 0.559 → 0.559 (0.557 ±0.047)
$M_\star$[dex $M_\odot$] = 10.672 → 10.672 (10.680 ±0.057)
%$M_\star$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$C_{M_\star}$ = 0.58 → 0.58
χ^2 = 2.72937 → 2.72937
E.L. = 0 - 0

Best Model (N_{sim} = 100)
==========
z = 0.500 → 0.500 (0.501 ±0.004)
$A_{V,L}$ = 0.000 → 0.000 (0.001 ±0.010)
$A_{V,M}$ = 0.000 → 0.000 (0.001 ±0.010)
Age_L = 1.939 → 1.939 (2.252 ±0.916)
Age_M = 2.074 → 2.074 (2.857 ±1.595)
$[Fe/H]_L$ = 0.560 → 0.560 (0.537 ±0.069)
$[Fe/H]_M$ = 0.559 → 0.559 (0.522 ±0.113)
%$M_{\star\,L}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
%$M_{\star\,M}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$M_\star$[dex $M_\odot$] = 10.731 → 10.731 (10.761 ±0.091)

SYNERGIES AMONG SHARDS, ALHAMBRA AND J-PAS

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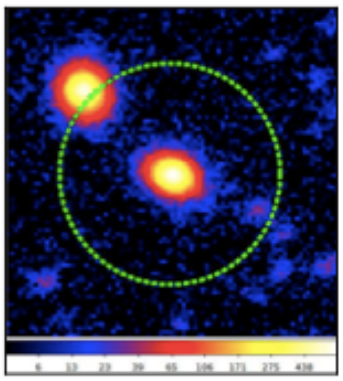
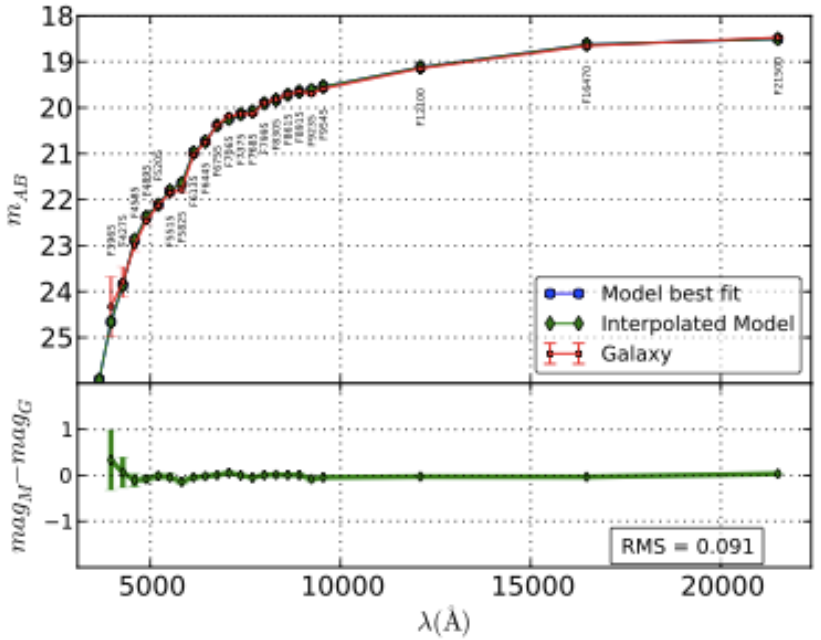
ONGOING SCIENCE CASES

DETAILED STELLAR POPULATION ANALYSIS FOR ALHAMBRA EARLY TYPES



Info
====
$\frac{S}{N}$ = 45.46 [1.67-134.40]
χ^2 = 2.404 → 2.404
N_{Ok} = 22
N_{SSP} = 2
E.L. = 0 - 0



Best SSP Model (N_{sim} = 100)
==========
z = 0.490 → 0.490 (0.496 ±0.007)
A_V = 0.000 → 0.000 (0.018 ±0.054)
Age = 2.200 → 2.200 (2.101 ±0.630)
[Fe/H] = 0.559 → 0.559 (0.557 ±0.047)
$M_\star$[dex $M_\odot$] = 10.754 → 10.754 (10.753 ±0.060)
%$M_\star$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$C_{M_\star}$ = 0.56 → 0.56
χ^2 = 2.52419 → 2.52419
E.L. = 0 - 0

Best Model (N_{sim} = 100)
==========
z = 0.490 → 0.490 (0.495 ±0.007)
$A_{V,L}$ = 0.000 → 0.000 (0.003 ±0.020)
$A_{V,M}$ = 0.000 → 0.000 (0.003 ±0.020)
Age_L = 4.351 → 4.351 (3.481 ±1.443)
Age_M = 6.200 → 6.200 (4.487 ±2.165)
$[Fe/H]_L$ = 0.403 → 0.403 (0.472 ±0.107)
$[Fe/H]_M$ = 0.280 → 0.280 (0.424 ±0.161)
%$M_{\star\,L}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
%$M_{\star\,M}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$M_\star$[dex $M_\odot$] = 10.918 → 10.918 (10.869 ±0.102)

SYNERGIES AMONG SHARDS, ALHAMBRA AND J-PAS

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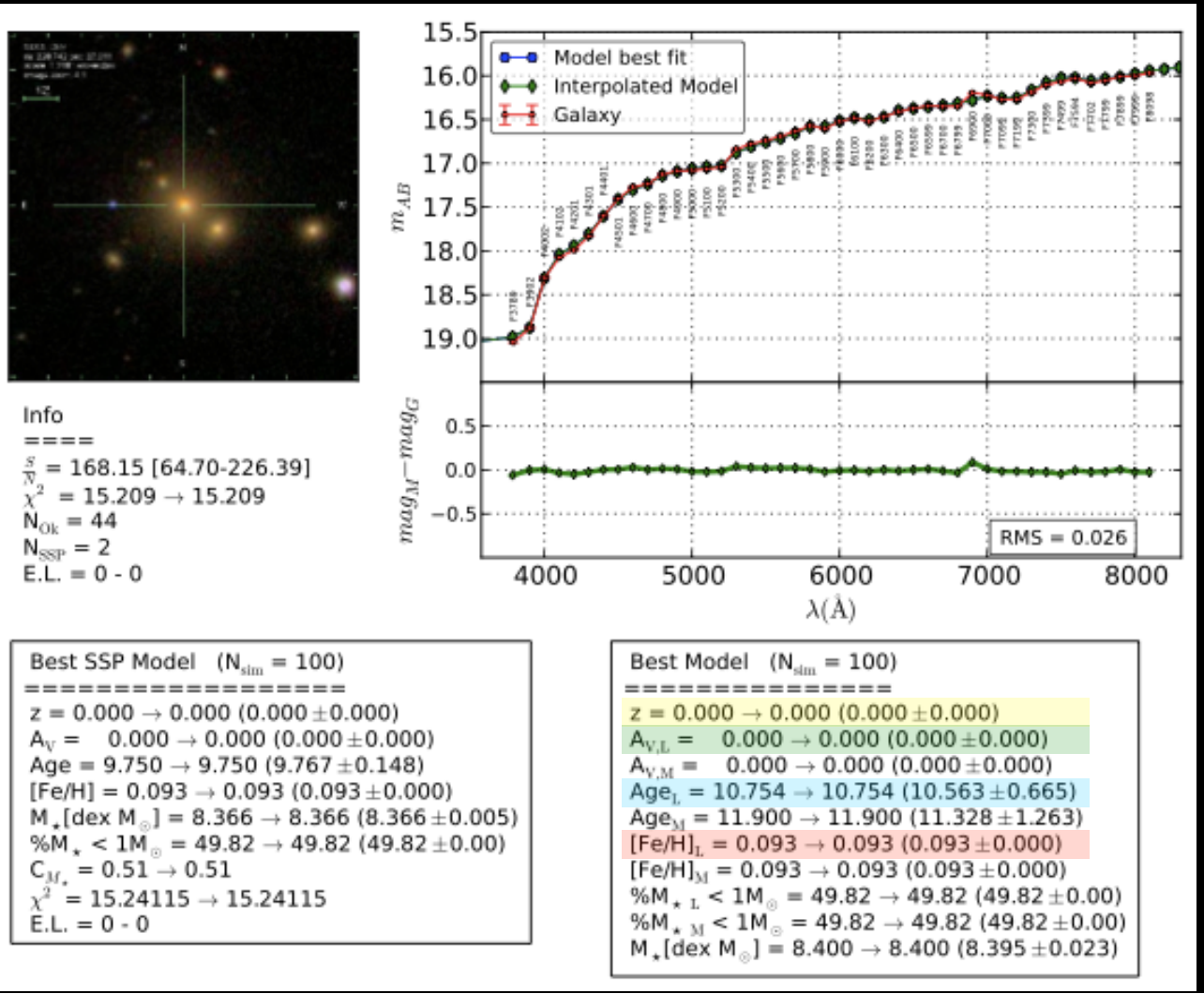
ONGOING SCIENCE CASES

DETAILED STELLAR POPULATION ANALYSIS FOR SDSS/J-PAS EARLY TYPES



SYNERGIES AMONG SHARDS, ALHAMBRA AND J-PAS

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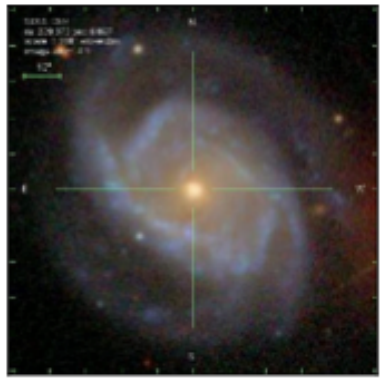

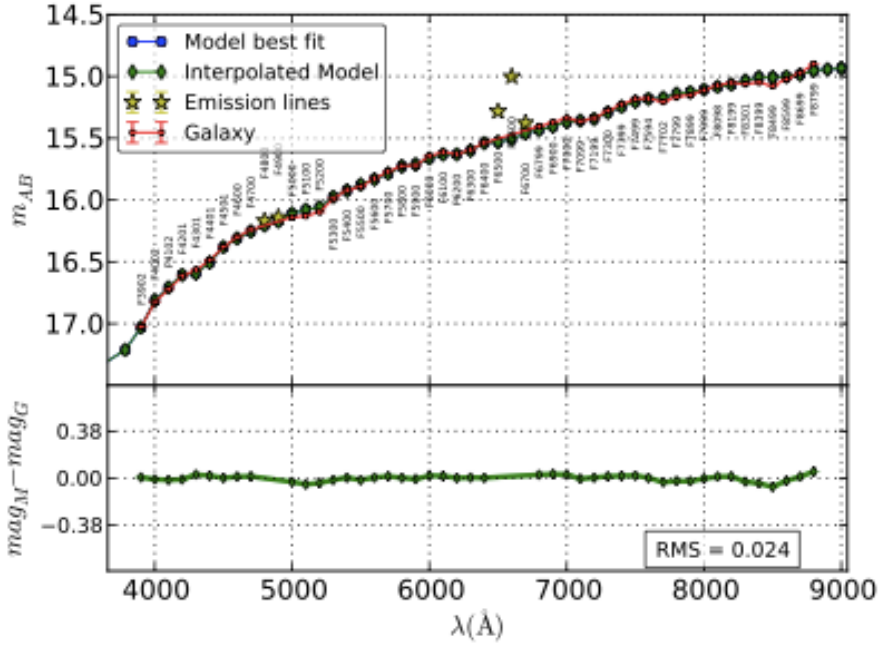

Info
====
$\frac{S}{N}$ = 272.26 [173.25-339.57]
χ^2 = 32.950 → 32.950
N_{Ok} = 45
N_{SSP} = 2
E.L. = 5 - 101111

Best SSP Model (N_{sim} = 100)
==========
z = 0.000 → 0.000 (0.000 ±0.000)
A_V = 1.000 → 1.000 (1.000 ±0.000)
Age = 1.680 → 1.680 (1.680 ±0.000)
[Fe/H] = -1.646 → -1.646 (-1.646 ±0.000)
$M_\star$[dex $M_\odot$] = 8.268 → 8.268 (8.268 ±0.000)
%$M_\star$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$C_{M_\star}$ = 0.56 → 0.56
χ^2 = 85.51925 → 85.51925
E.L. = 101111 - 5

Best Model (N_{sim} = 100)
==========
z = 0.000 → 0.000 (0.000 ±0.000)
$A_{V,L}$ = 1.000 → 1.000 (1.000 ±0.000)
$A_{V,M}$ = 1.000 → 1.000 (1.000 ±0.000)
Age_L = 1.074 → 1.074 (1.053 ±0.020)
Age_M = 1.617 → 1.617 (1.764 ±0.143)
$[Fe/H]_L$ = -0.170 → -0.170 (-0.221 ±0.049)
$[Fe/H]_M$ = -0.309 → -0.309 (-0.120 ±0.183)
%$M_{\star\,L}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
%$M_{\star\,M}$ < 1$M_\odot$ = 49.82 → 49.82 (49.82 ±0.00)
$M_\star$[dex $M_\odot$] = 8.195 → 8.195 (8.235 ±0.037)

SYNERGIES AMONG SHARDS, ALHAMBRA AND J-PAS

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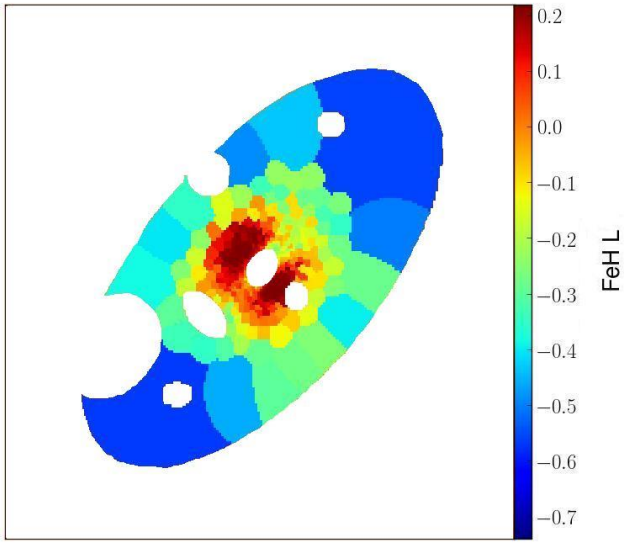
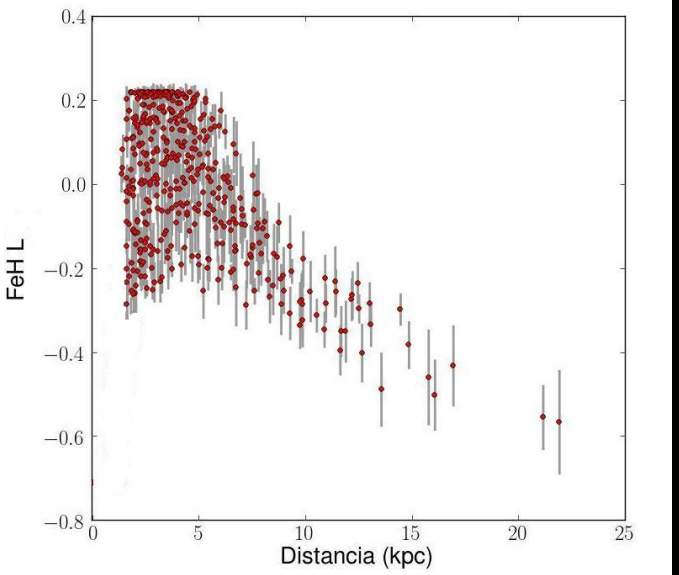
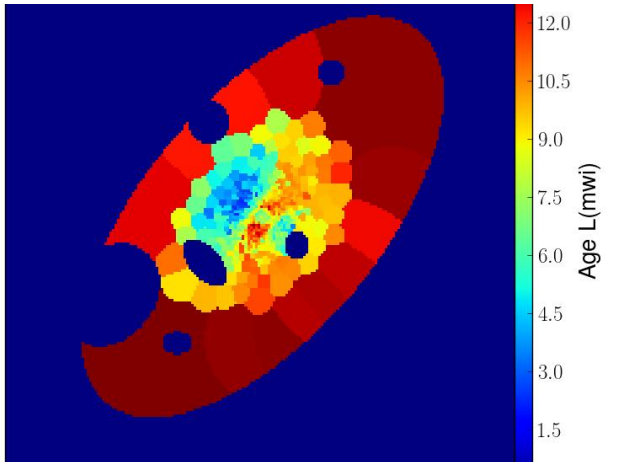
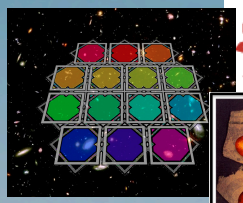
ONGOING SCIENCE CASES

2D STELLAR POPULATION ANALYSIS – IFU SCIENCE WITH ALHAMBRA

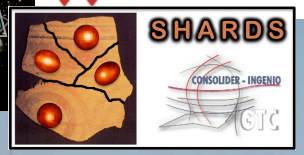








ALHAMBRA SURVEY



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SYNERGIES

	Area (deg^2)	# Filters	Spec. Range (nm)	NB $\Delta\lambda$ (Å)	STATUS	m_{lim}			
SHARDS	0.036	24	500-950	170	READY	26.5			
ALHAMBRA	3-4	20+3	350-970+J,H,Ks	300	READY	23-26			
J-PAS **J-PAS-PF**	8500 300-60-15	54+5 ~12	378-910+u,u_J,g,r,z_J	145 145	>2015 2015	23.5 <25.5			

- Analysis techniques in common
- HDF-North as a common dataset
- ALHAMBRA + J-PAS/PATH-FINDER will provide detailed stellar population analysis down to z~1.2-1.4. SHARDS to complete up to z~2. How well-suited and accurate are the UV model predictions for these purposes?
- ALHAMBRA + SHARDS filters used together for HDF-North (this can be done already!)
  - 20 + 24 optical filters + 3 NIR
  - Increase depth and overall S/N
  - Variable sources? SNe?