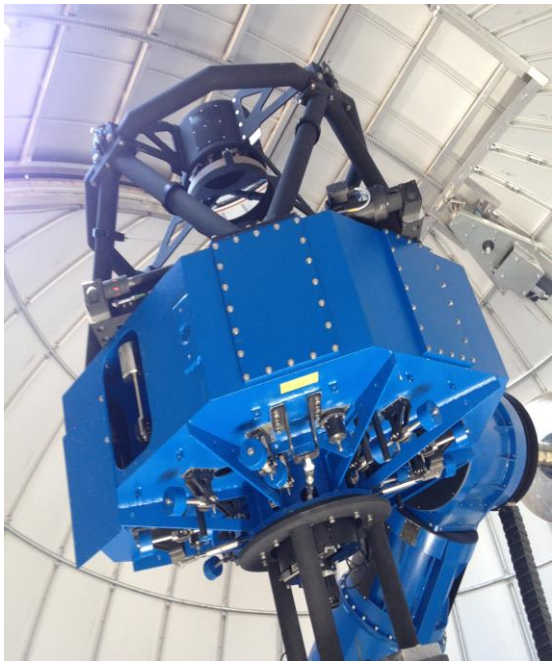
Survey update

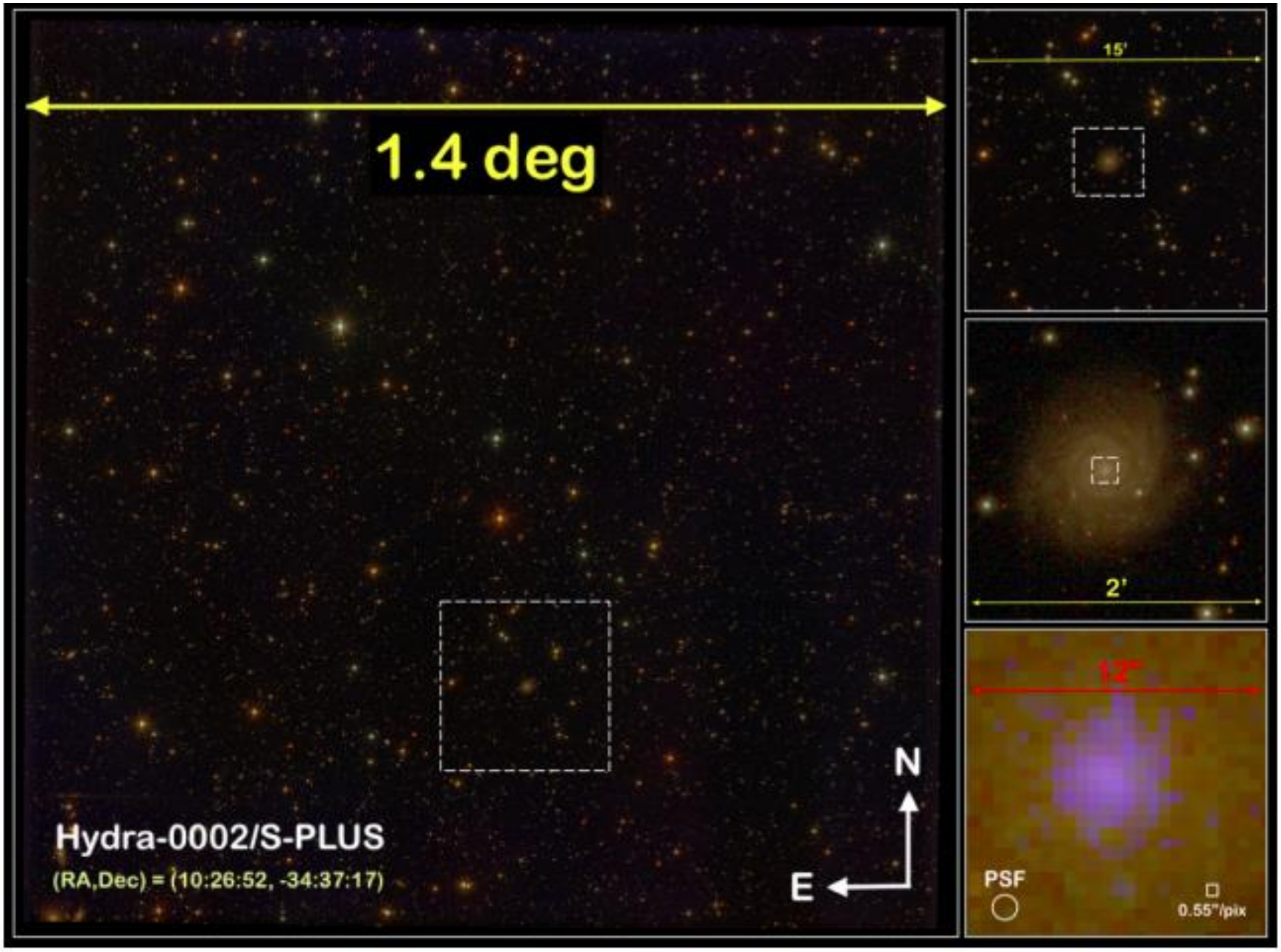
Claudia Mendes de Oliveira

Southern Photometric Local Universe Survey

Coverage: ~9300 deg^2
Telescope: 86cm (T80S)
Plate scale: 0.55 arcsec/pixel
FoV: 1.4 x 1.4 deg^2



Field of view of T80-South images



JAVALAMBRE filter system

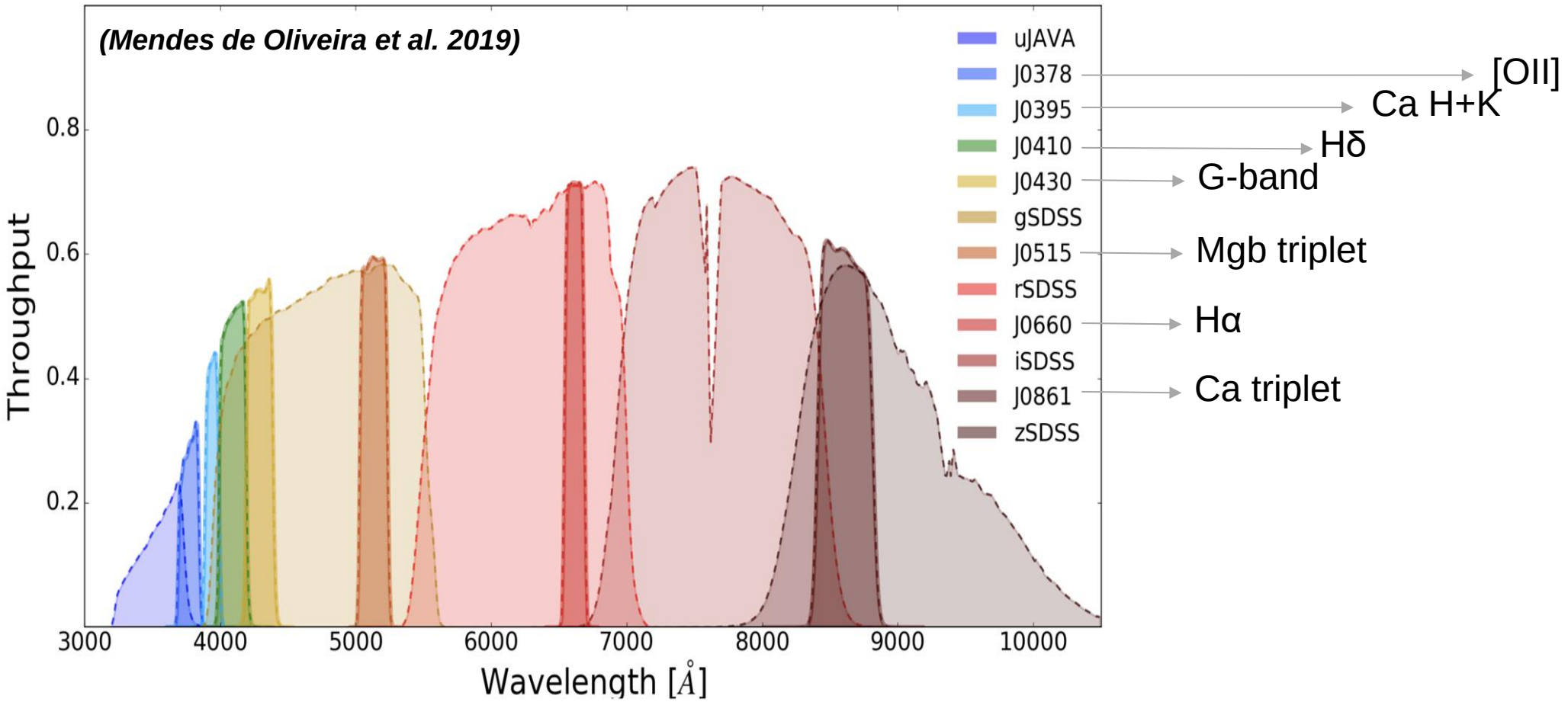
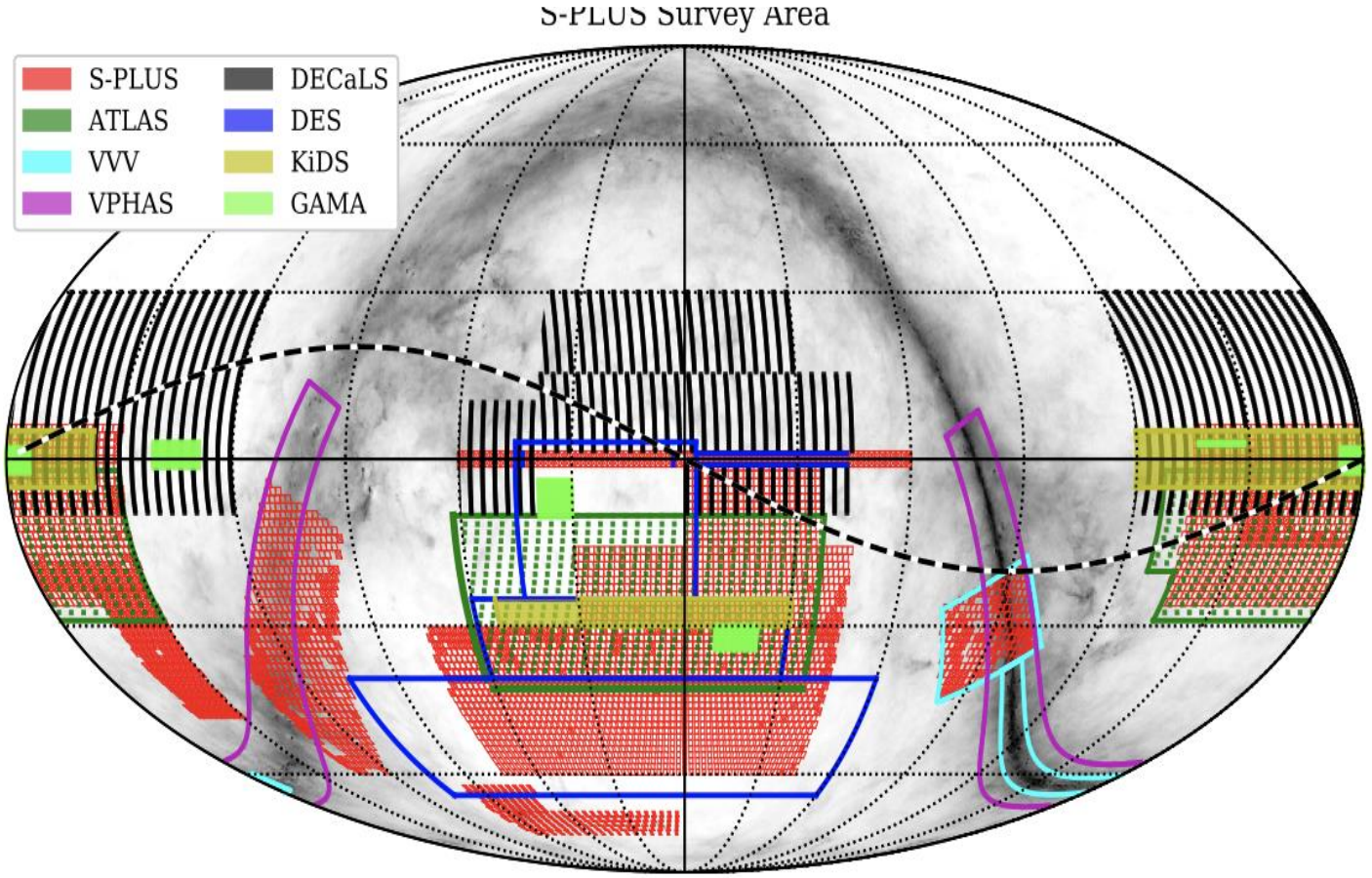
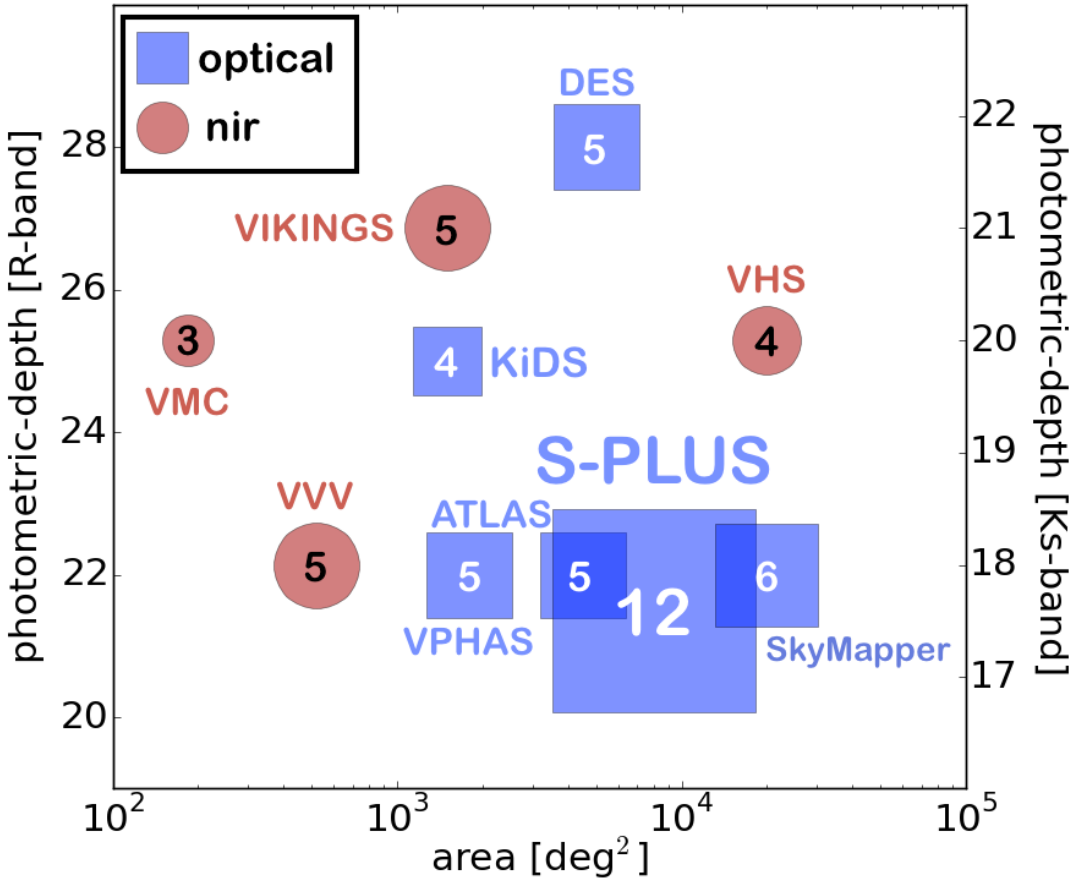


Figure 6. The Javalambre 12-filter system. The y-axis shows the total efficiency of the S-PLUS filters, obtained through the multiplication of the average filter transmission curves, the atmospheric transmission, the CCD efficiency, and the primary mirror reflectivity curves. Different filters are coloured according to the labels shown in the legend at the right.

S-PLUS Survey Area



JAVALAMBRE filter system

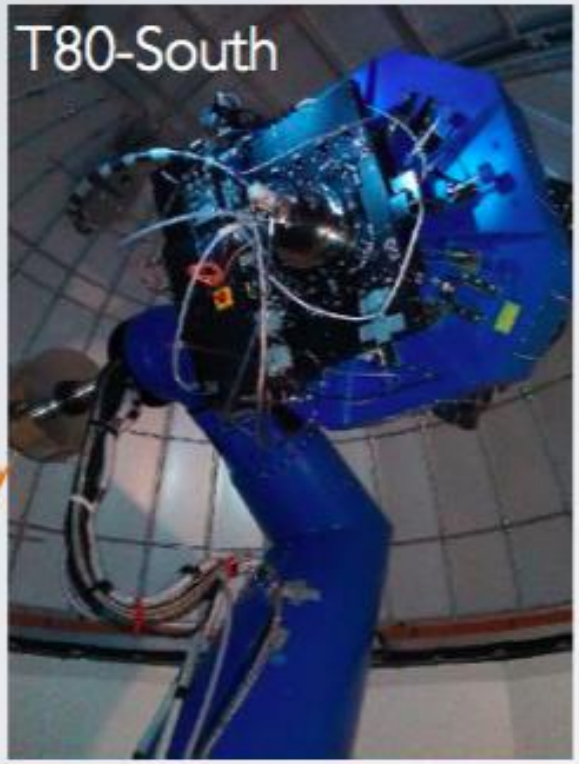


Filter Name	Effective Wavelength (Å)	Width (Å)	Depth (mag)	Comments
u	3536	352	21.07	Javalambre u
J0378	3770	151	20.64	[OII]
J0395	3940	103	20.11	Ca H+K
J0410	4094	201	20.30	Hγ
J0430	4292	201	20.38	G-band
g	4751	1545	21.79	SDSS-like g
J0515	5133	207	20.61	Mgb Triplet
r	6258	1465	21.63	SDSS-like r
J0660	6614	147	21.36	Hα
i	7690	1506	21.22	SDSS-like i
J0861	8611	408	20.32	Ca Triplet
z	8831	1182	20.64	SDSS-like z

Two surveys, North and South

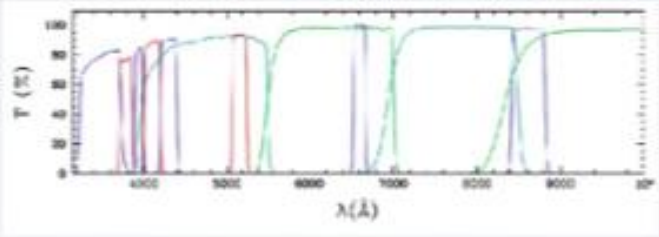
S-PLUS **P.I. CMdO**

J-PLUS **P.I. Javier Cenarro**



T80 and T80-South

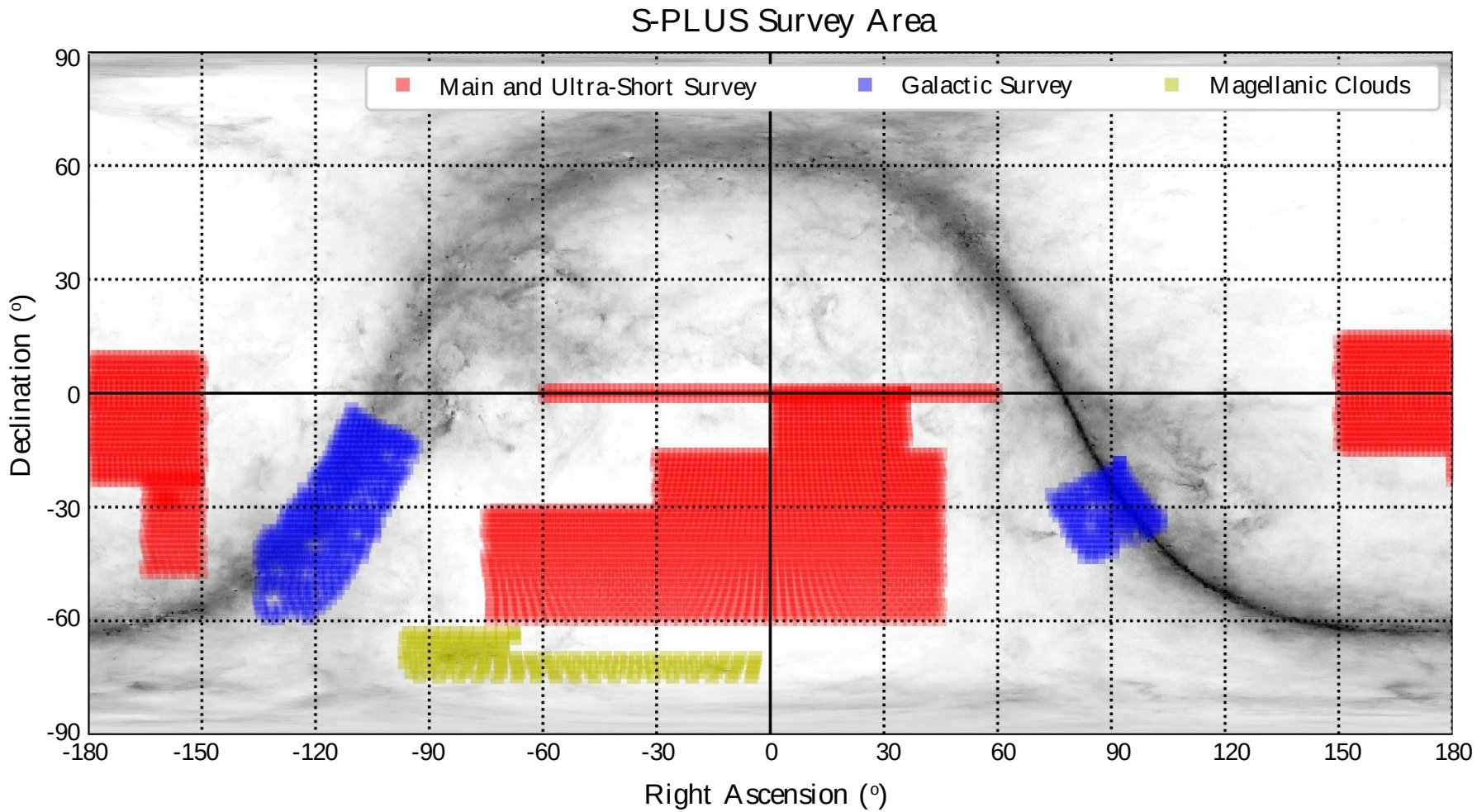
- Mirror: 0.8m
- Field of view: 1.4 x 1.4 deg
- 7 narrow and 5 broad bands



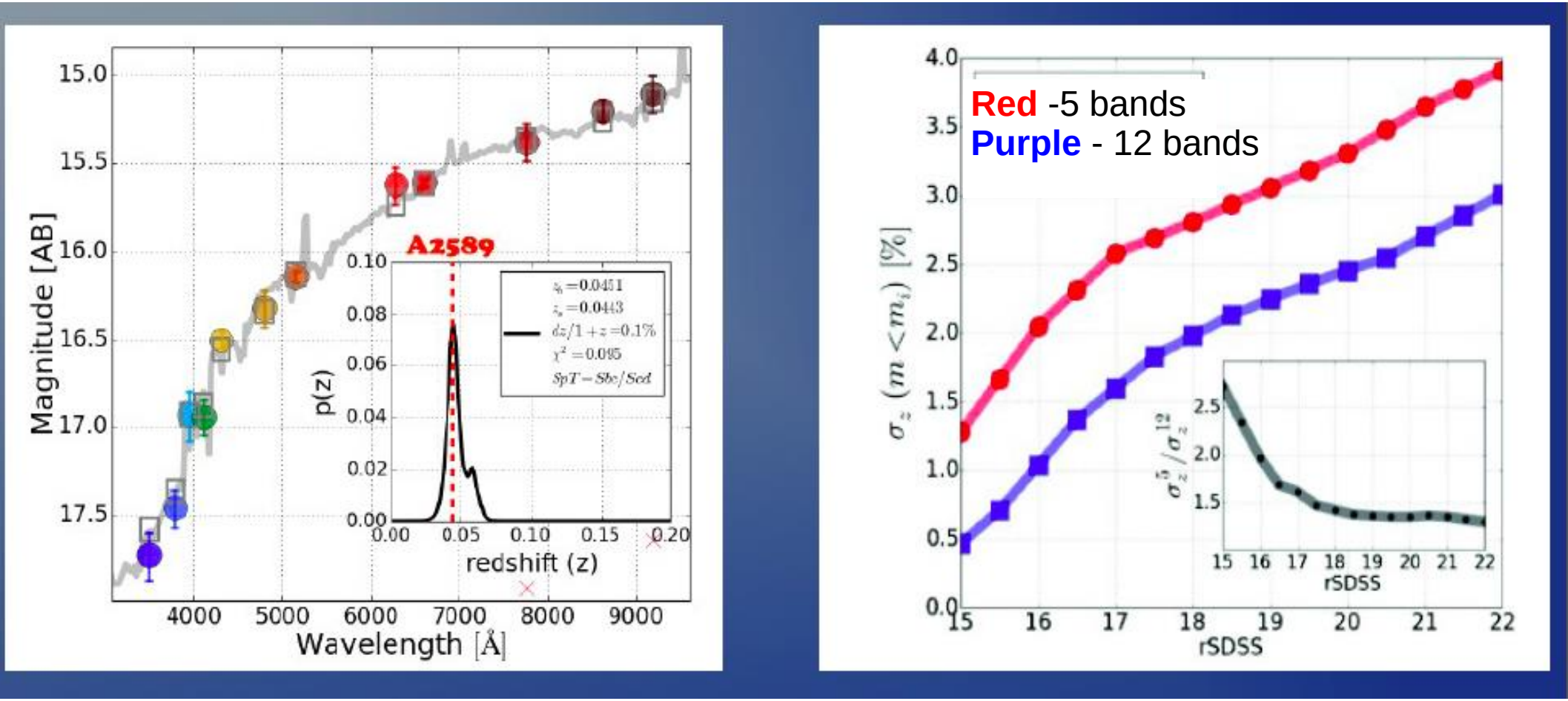
Fabricated by
AMOS/ASTELCO

9300 deg^2 in 5 sub-surveys

- **MainSurvey**
- **Ultra-short survey**
- **Variability fields**
- **Galactic Survey**
- **Marble Fields**



The use of the 12-band system of J-PLUS to obtain membership of cluster galaxies

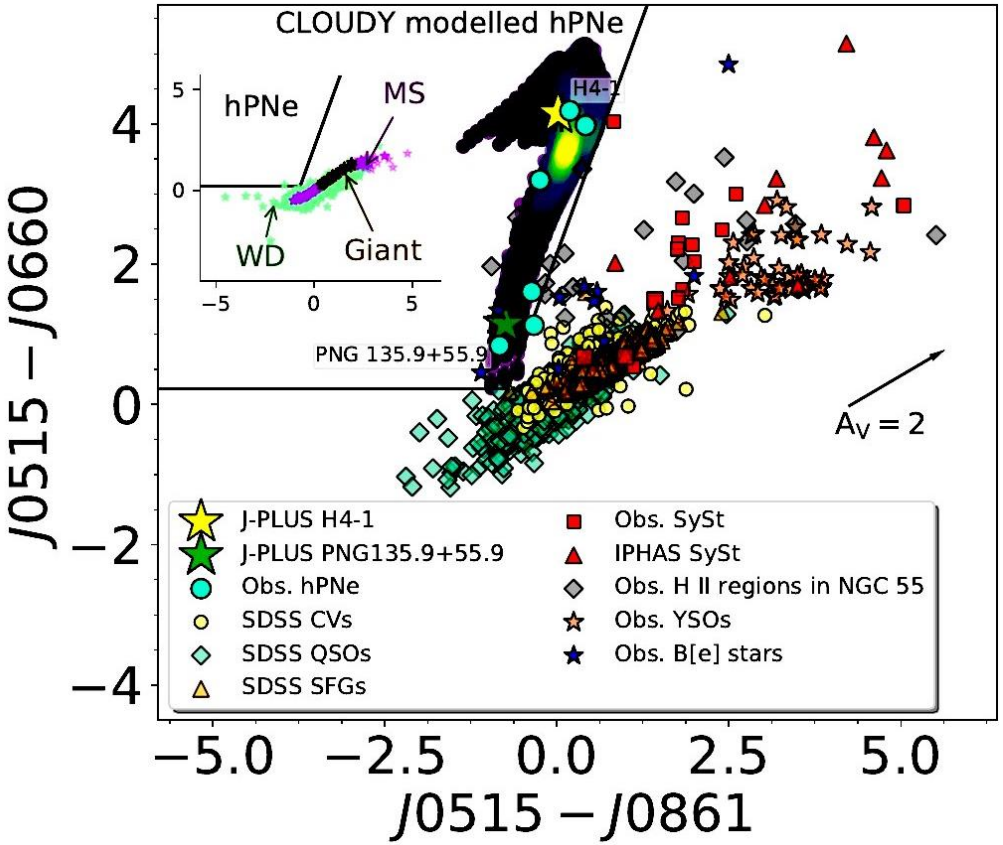


Molino et al. 2018, using J-PLUS data

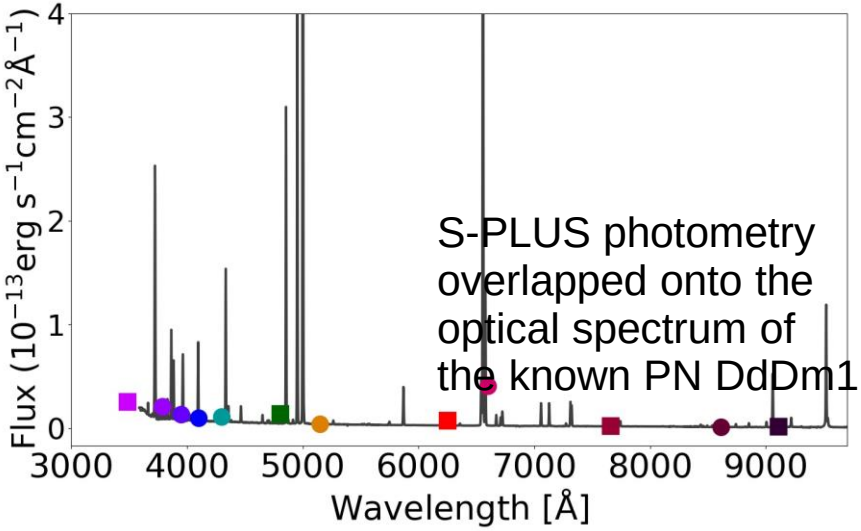
S-PLUS: SEARCHING FOR PNe

One example of S-PLUS colour-colo

[Gutiérrez-Soto et al. 2020]



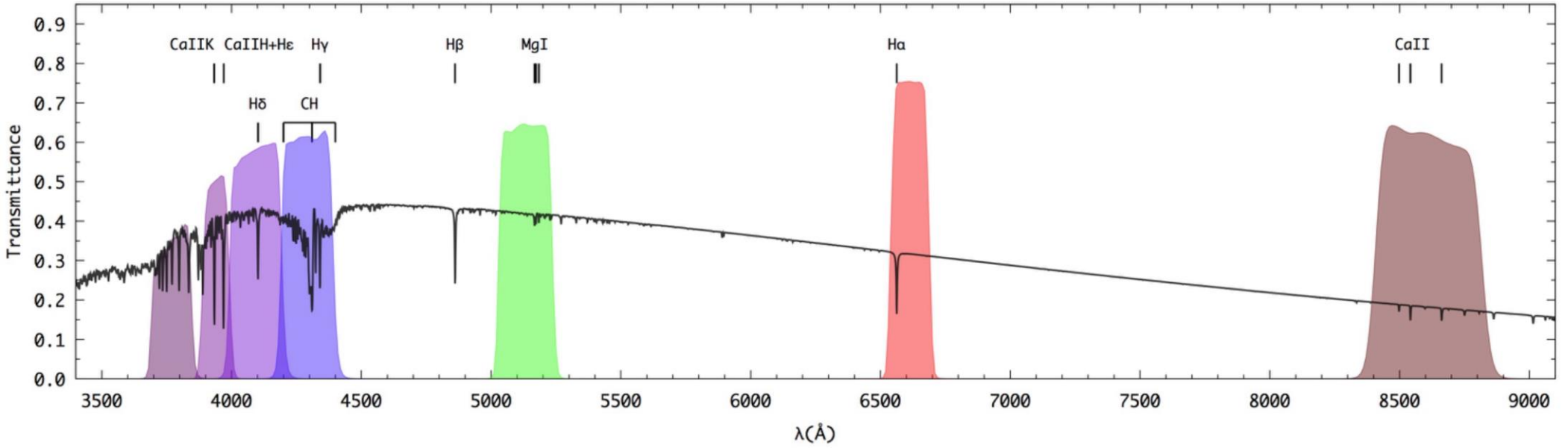
(J0515 – Hα+[N II]) vs (r - i)

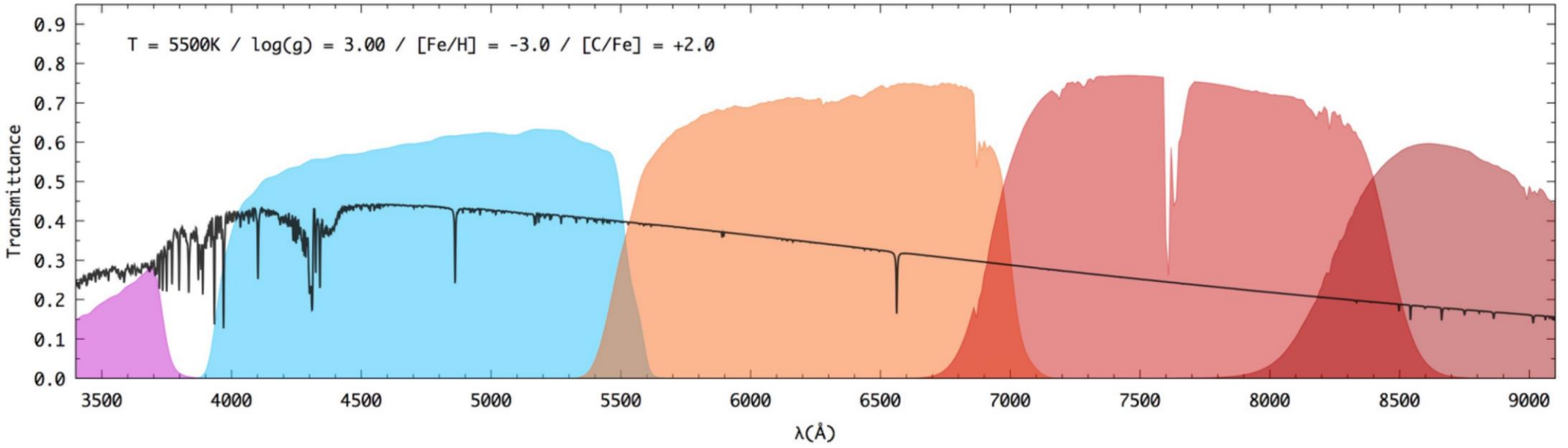


S-PLUS photometry overlapped onto the optical spectrum of the known PN DdDm1

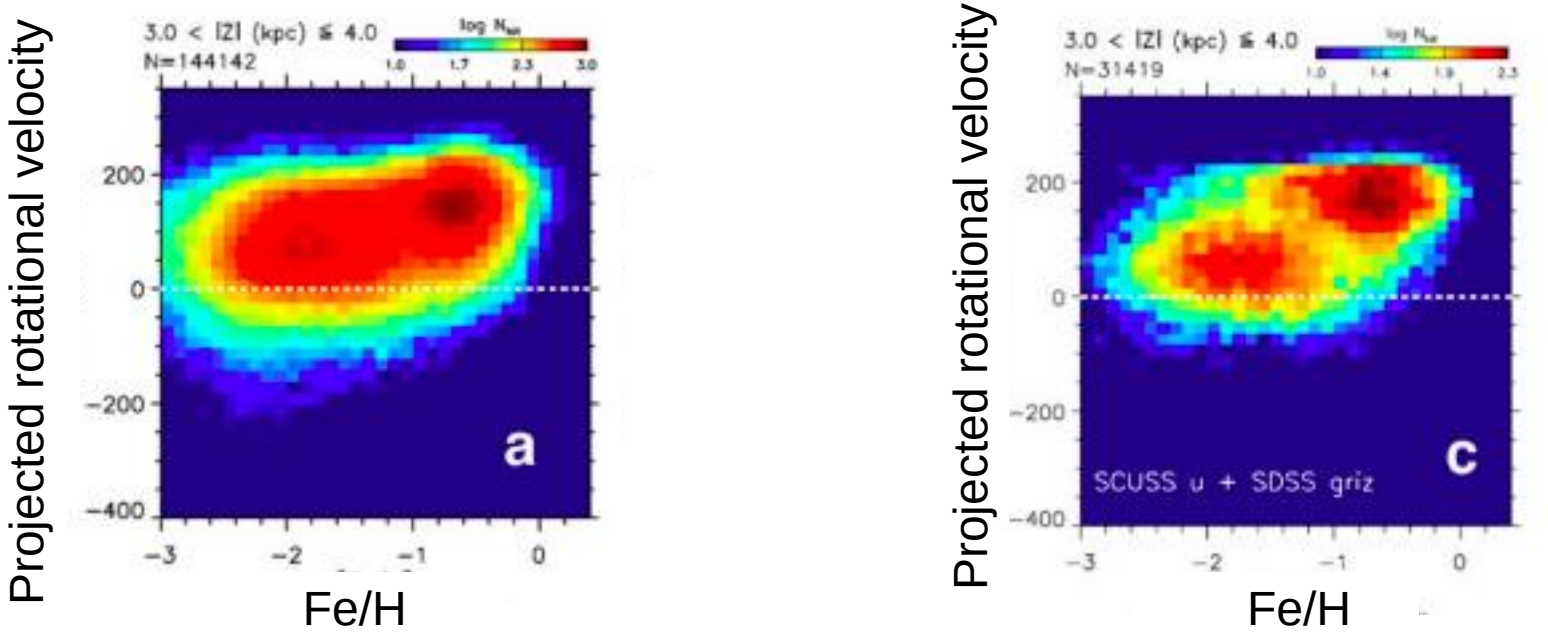
The black lines represent the selection criteria for PNe. These lines are meant to isolate these types of strong line emitters and minimize the contamination from other emission line objects.

Searching for metal-poor stars
(narrow-band vs. broad-band)





Mapping stellar components of the Milky Way

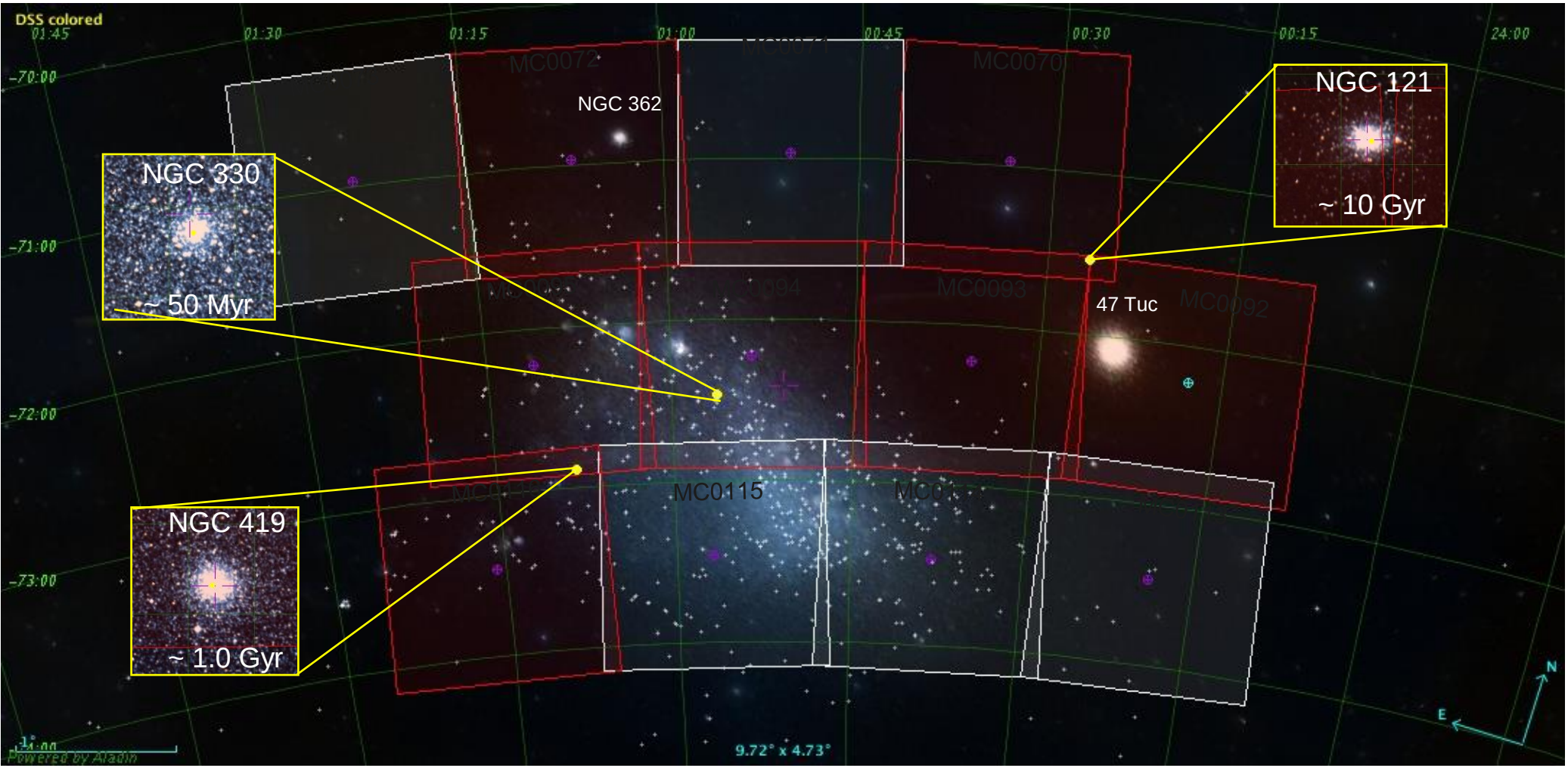


Combining Gaia data with metallicity determinations obtained from broad-band photometry

Distribution of stars at a certain height (3.5 kpc) above the Galactic plane, using 5 sdss bands
In (a) and in (c) the metallicity determinations were improved by using 3-mag deeper u-band,
Reaching photometric metallicities as precise as 0.3 dex for bright stars
(S-PLUS will do better)

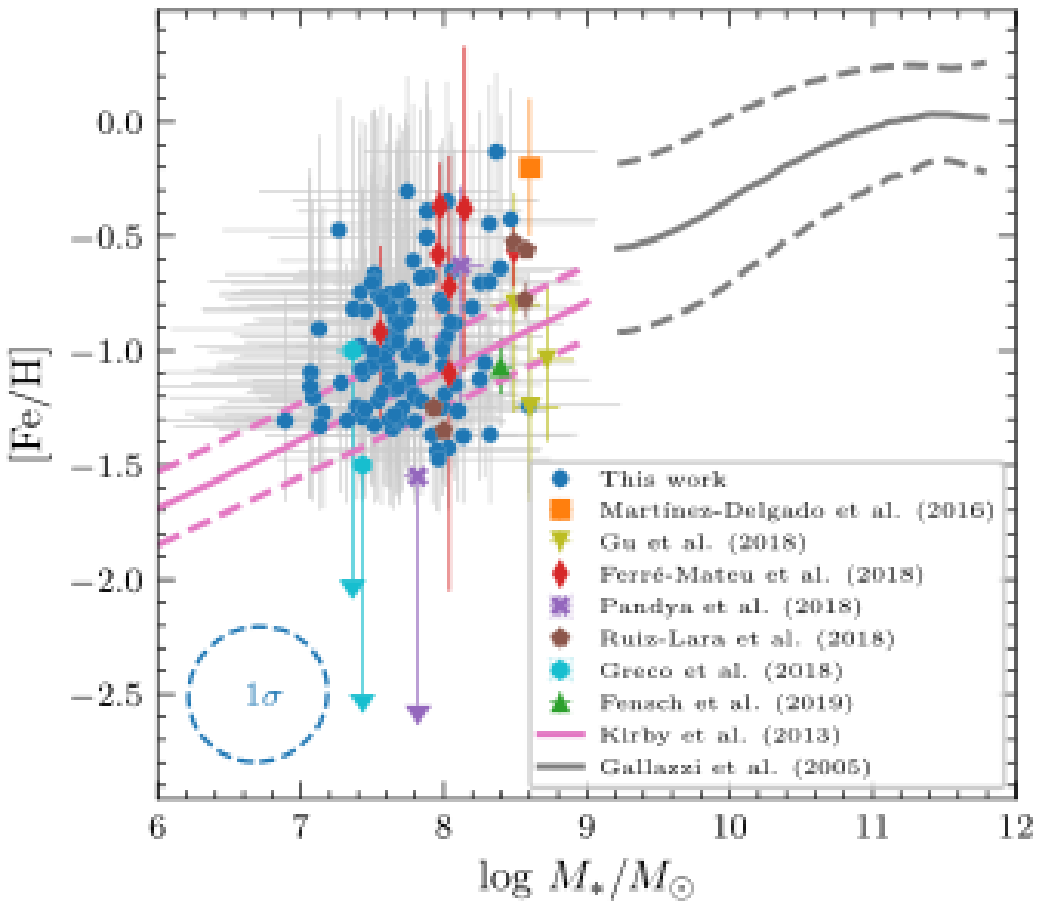
An and Beers 2020

Ages, metallicities and extinctions clusters in MC



Stellar Clusters (Bica et al. 2008)

Studying ultra diffuse galaxies in the Stripe 82 area



- UDGs populate the same locus of the stellar mass-metallicity diagram of dwarf galaxies.
- Field UDGs have slightly smaller ages than those found in clusters, indicating that they may have more extended star formation histories in the field.
- UDGs should arise naturally considering a broad range of galaxies within the current picture of galaxy formation rather than exotic processes.

Barbosa et al. 2020

List of publications

1. **Observations of the First Electromagnetic Counterpart to a Gravitational-wave Source by the TOROS Collaboration**. Díaz, M. C., Macri, L. M., Garcia Lambdas, D., Mendes de Oliveira, C. et al. 2017: AJ, v848, L29
2. **Multi-messenger Observations of a Binary Neutron Star Merger**. Abbot, B. P. et al 2017: AJ, 848, L12
3. **The Southern Photometric Local Universe Survey (S-PLUS): improved SEDs, morphologies, and redshifts with 12 optical filters** Mendes de Oliveira et al. 2019: MNRAS, 489, 241 [ADS]
4. **Assessing the photometric redshift precision of the S-PLUS survey: the Stripe-82 as a test-case**
5. Molino et al. 2019: MNRAS, accepted [arXiv:1907.06315]
6. **The S-PLUS: a star/galaxy classification based on a Machine Learning approach**
7. Costa-Duarte et al. 2019: MNRAS, submitted [arXiv:1909.08626]
8. **J-PLUS: Tools to identify compact planetary nebulae in the Javalambre and southern photometric local Universe surveys** [ADS] Gutiérrez-Soto et al. 2020: A&A, 633, 123
9. **One Hundred SMUDGes in S-PLUS: Ultra-diffuse Galaxies Flourish in the Field** [ADS] Barbosa et al. 2020: ApJS, 247, 46
10. **On the discovery of stars, quasars, and galaxies in the Southern Hemisphere with S-PLUS DR1** Nakazono et al. 2020: MNRAS, submitted
11. **Searching for active low-mass stars in CMa star-forming region: multi-band photometry with T80S** Jane Gregorio-Hetem et al. 2020: AJ, submitted

Seven defended theses withS-PLUS data

Star formation history of Canis Major OB1

III. Stellar groups contents revealed by GAIA

Searching for active low-mass stars in CMa star-forming region: multi-band photometry with T80S

The Photometric Metallicity and Carbon Distributions of the Milky Way's Halo and Solar Neighborhood from S-PLUS Observations of SDSS Stripe 82

Deep Learning Assessment of galaxy morphology in S-PLUS Data Release 1

On the discovery of stars, quasars, and galaxies in the Southern Hemisphere with S-PLUS DR1

DR1 - Very first dataset taken with the telescope

Accurate calibration

Area covered: 336 square degrees over Stripe82 (170 tiles)

Bands: u, g, r, i, z, J0378, J0395, J0410, J0430, J0515, J0660, J0861

gal (r<21 in S-PLUS): 2M, 16M and 32M with photo-z precisions < 1%, 2% and 2.5%

Astrometric accuracy = 0.1 arcsec

Depth (S/N > 3, r band) = 21.4

First Data Release (DR1)

described in Mendes de Oliveira et al. 2019

- The DR1 catalogue is publicly available on https://datalab.noao.edu/splus

- DR1 contains photometric data for **~3M objects** in the region of Stripe82 (~330 deg^2)

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After DR1 (the survey grew by a factor of 7 since then)

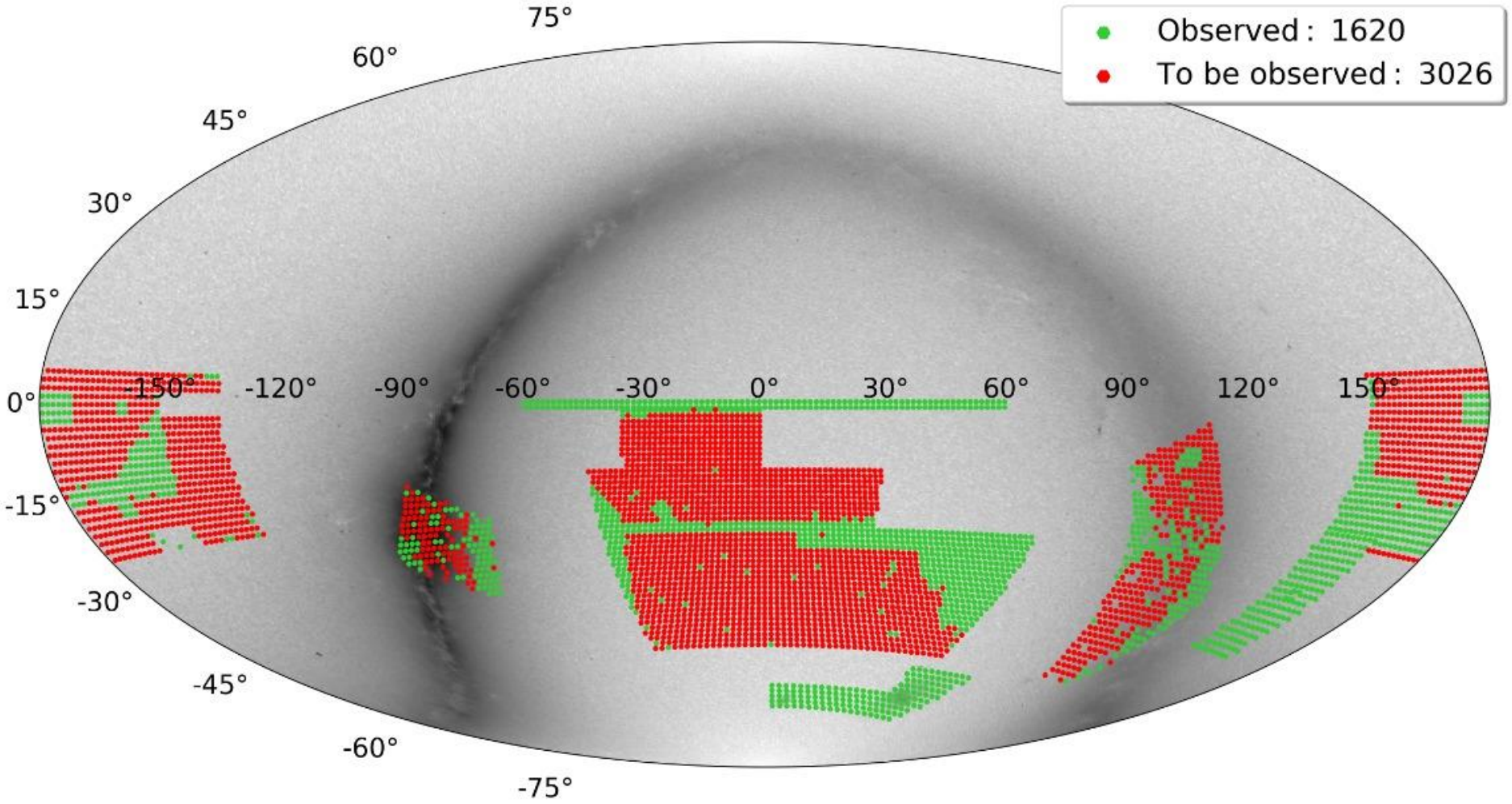
New calibration

Refined photometry – standard catalogues

VACs (value added catalogues: photozs, classification, masks)

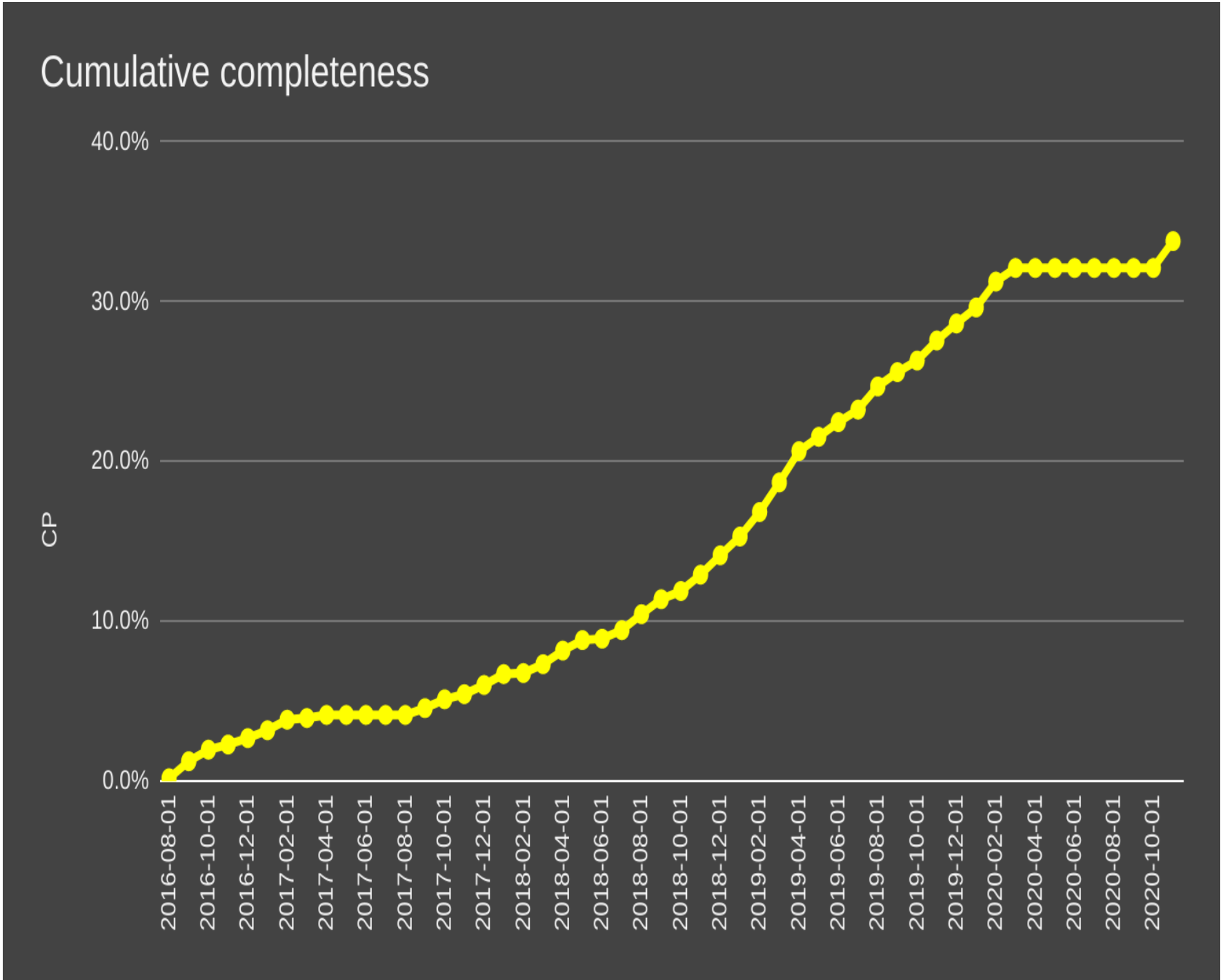
New database server – can query the data, get catalogues, get colour images, fits images, S-spectra

In red + green the survey footprint
In green what has been observed so far

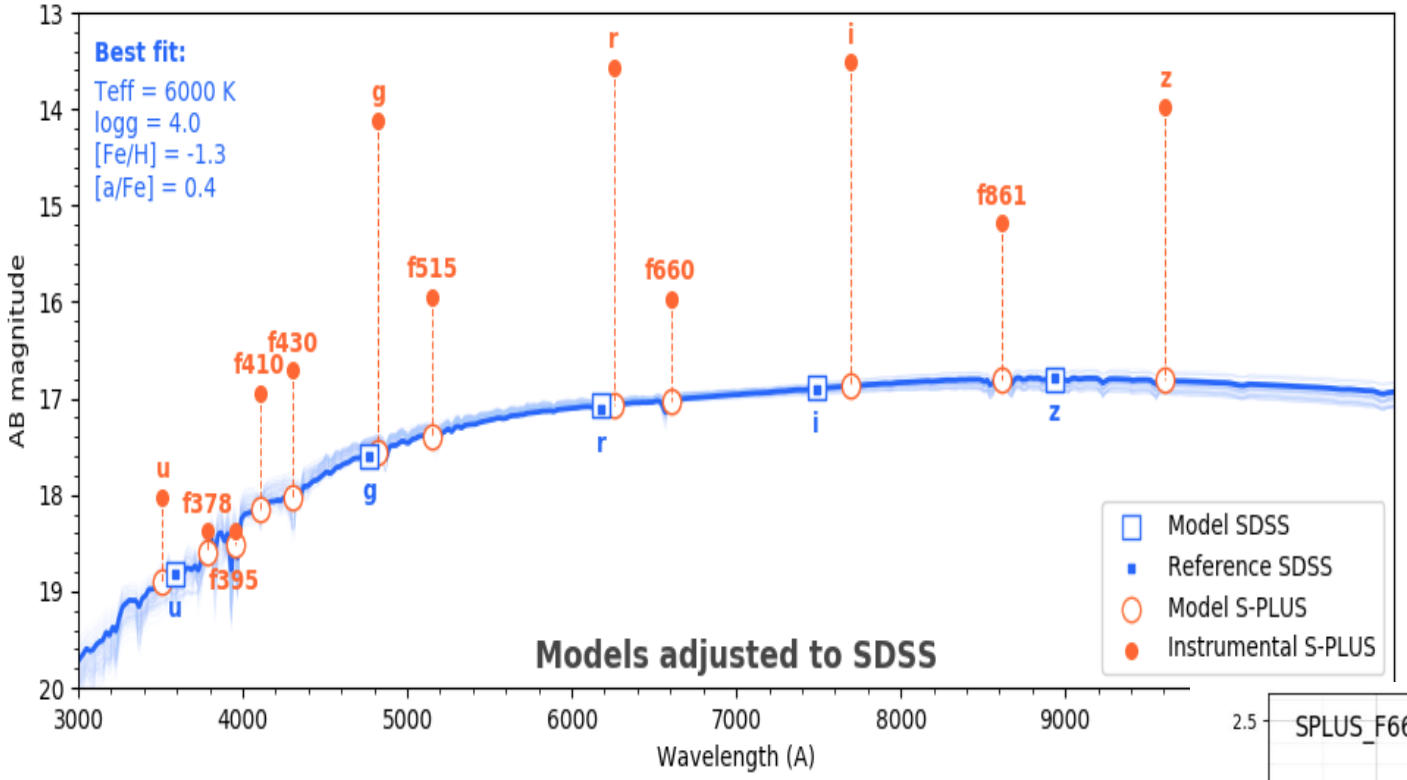


It should be possible to ask for prioritizing target observations that may lead to fast turn-around science

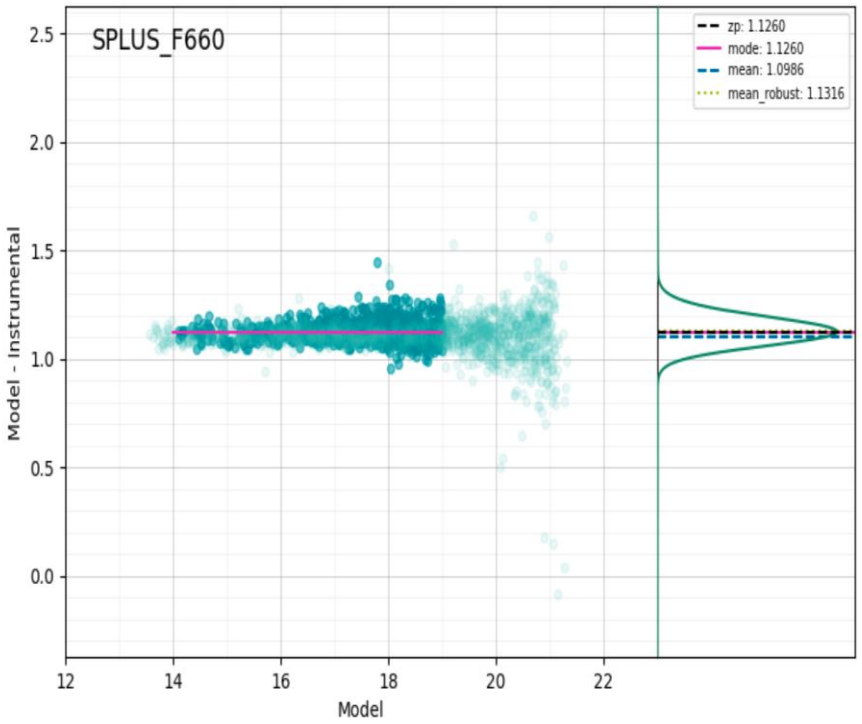
S-PLUS progress - Completeness



Calibration Technique



Photometric Zero Points are derived from the difference between instrumental and model predicted S-PLUS



Best template for each star is derived by minimizing the chi2

Templates are used to predict S-PLUS calibrated magnitudes

Calibration Technique - Results

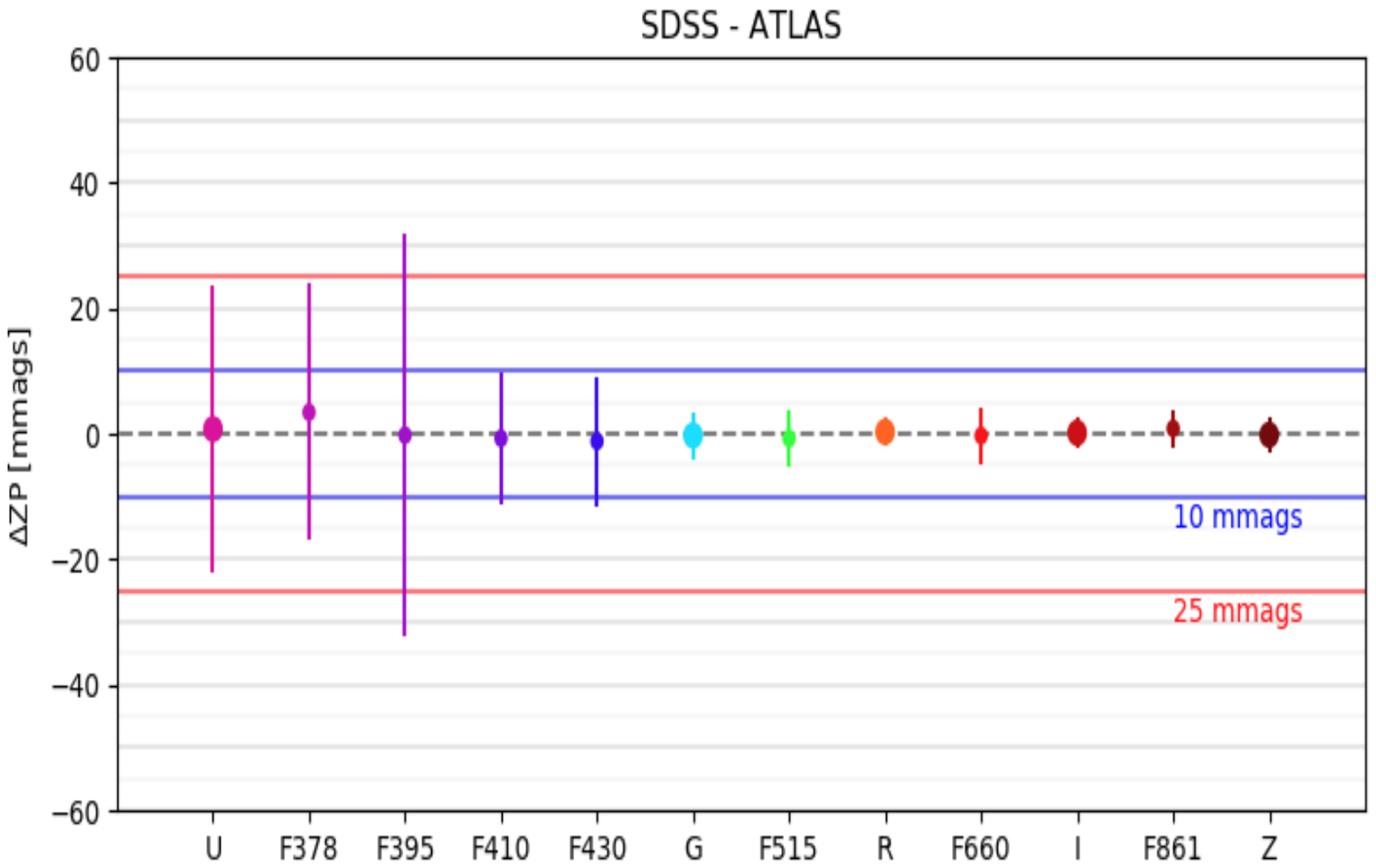
Comparison between STRIPE82 calibrations using different reference catalogs shows that we can expect an internal accuracy:

better than 5 mmags for:
G, F515, R, F660, I, F861, Z

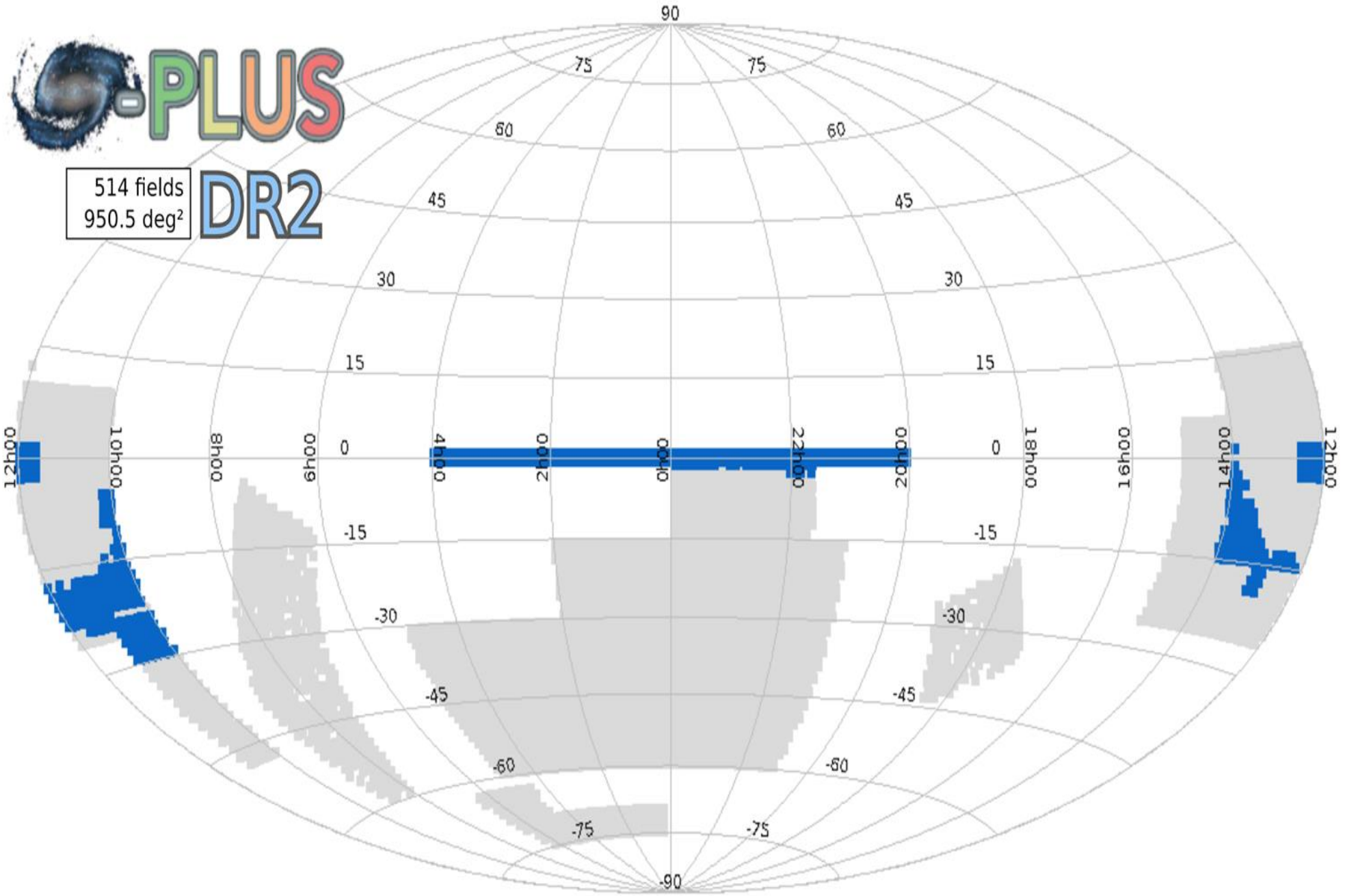
better than 10 mmags for F410 and F430

better than 25 mmags for U and F378

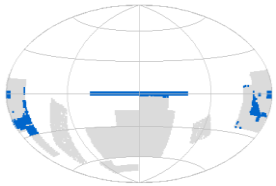
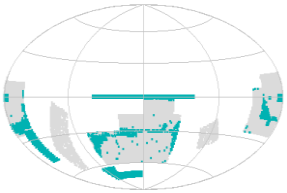
around 30 mmags for F395



DR2 – will be public to the world in 2021A

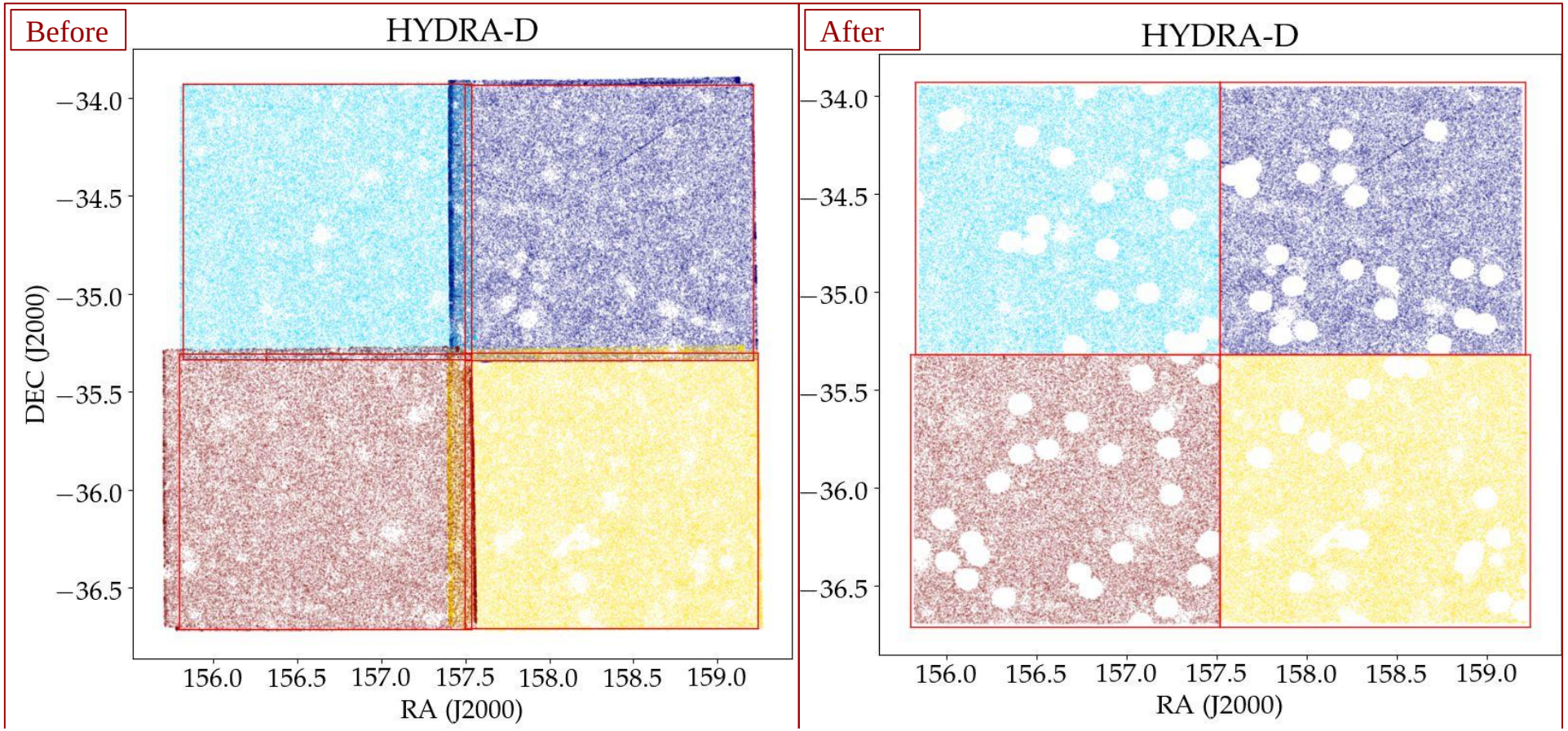


All S-PLUS Data Releases

iD	Release Date	Type	№ Fields	Area [Sq deg]	№ Detections	Footprint RA, DEC
DR1	**Mar/19**	**Public**	**170**	**335.9**	**~3 Million**	
iDR2	Dec/19	Internal	434	858.5	~25 Million	
iDR3	Sep/20	Internal	967	1818.8	>50 Million	
DR2	**Mar/21**	**Public**	**514**	**950.5**	**>30 Million**	
DR3	**Late 21**	**Public**	**1117**	**2108.5**	**>50 Million**	
iDR4	Late 21	Internal	TBD	TBD	TBD	

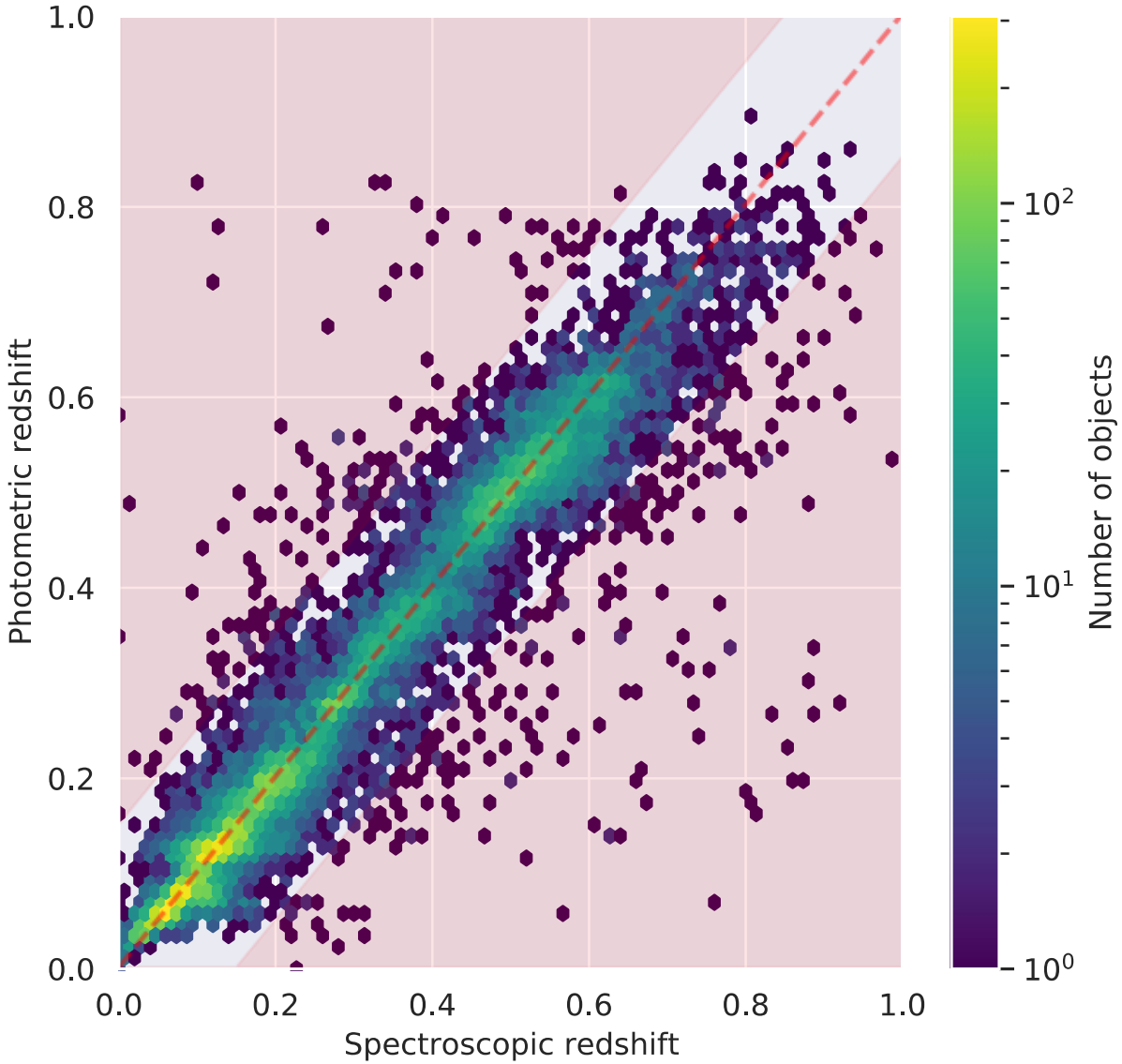
Border and bright star masking

- Removes artifacts generated by dithering (borders) and by the presence of bright objects.
- Data: iDR3_n3, with s2n_det_iso > 5



- VACA masks
- VACA photozs com template fitting.
- VACA point/extended source separation
- Data curation: maps revealing the variation of main parameters across the survey in every wavelength: depth, seeing values, density of objects, etc..

Buzzo, Overzier et al. 2021



Lima et al. 2021

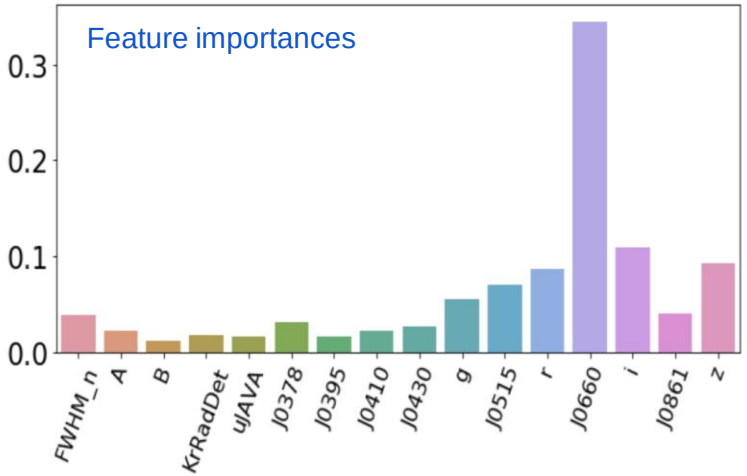
PhotoZs vs SpecZs - colors show densities of points. This is a preview of the results that will later be shown by Erik Vinicius. He is fine-tuning his results – more results in his talk.

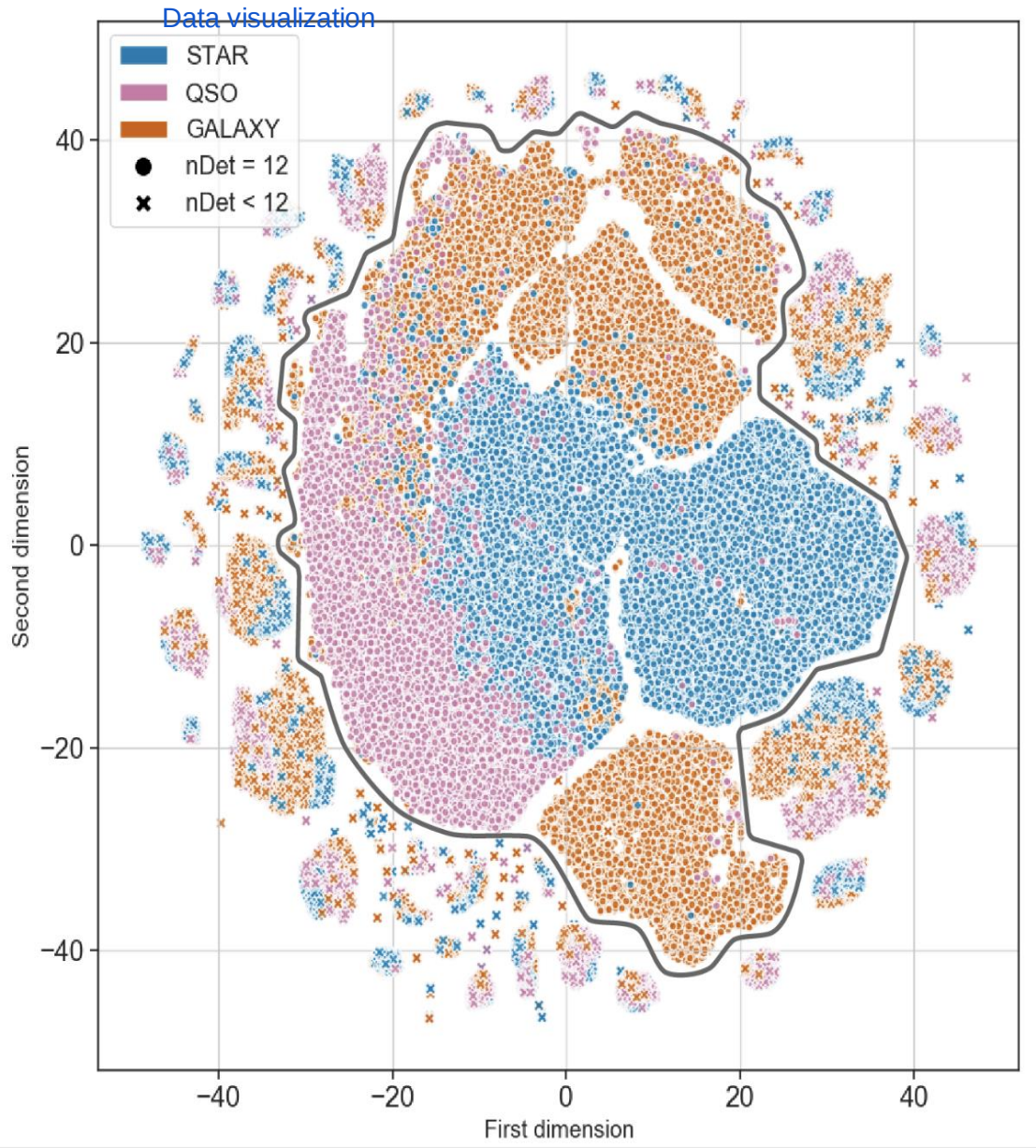
Another VACA – photoz´s from deep learning methods

Classification of stars, quasars and galaxies are provided with the corresponding probabilities using Random Forest algorithm (Nakazono et al. 2020, submitted)

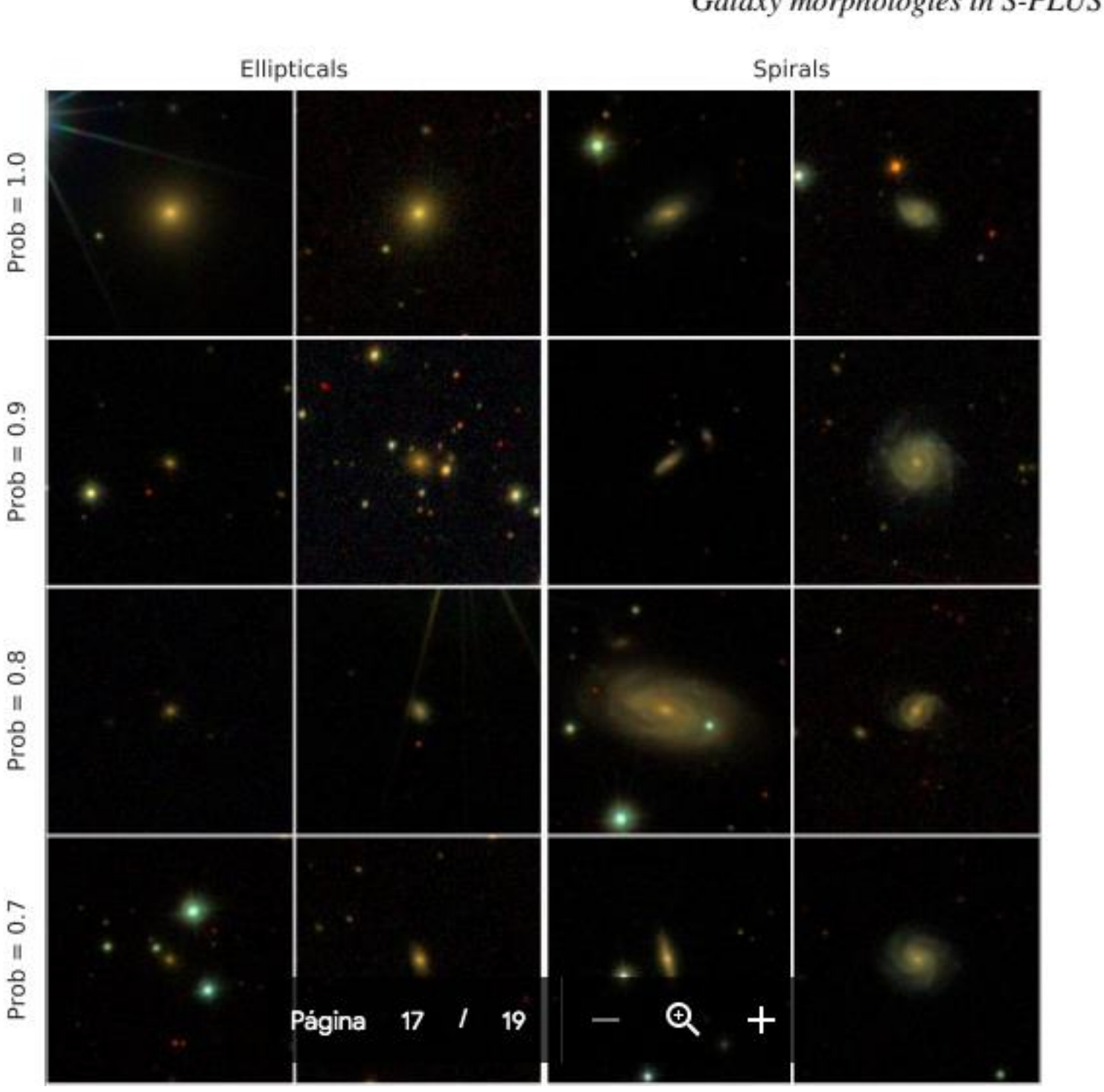
Good performance for the feature space consisting of **12 S-PLUS magnitudes + 4 morphological parameters** (see table below)

Class	Purity (%)	Completeness (%)	F-score (%)
QSO	93.48	97.87	95.36
STAR	99.57	97.78	98.66
GALAXY	99.16	99.54	99.35
Macro-averaged F-measure: 97.88 %			

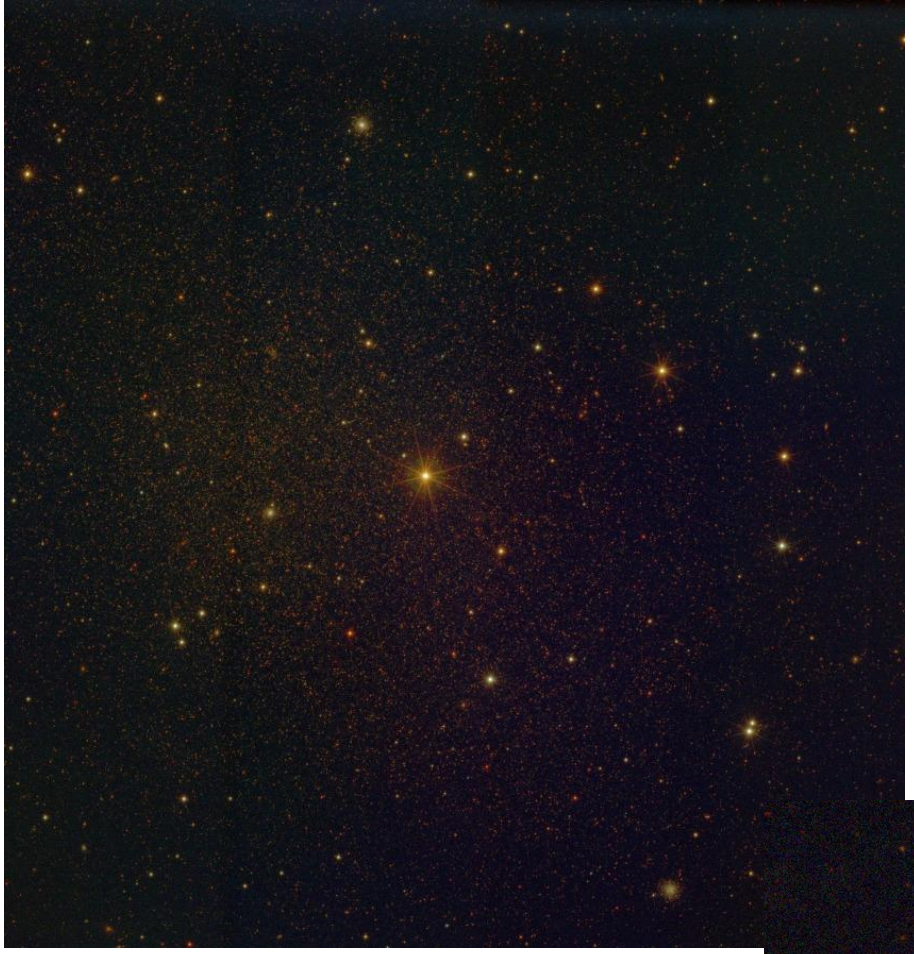




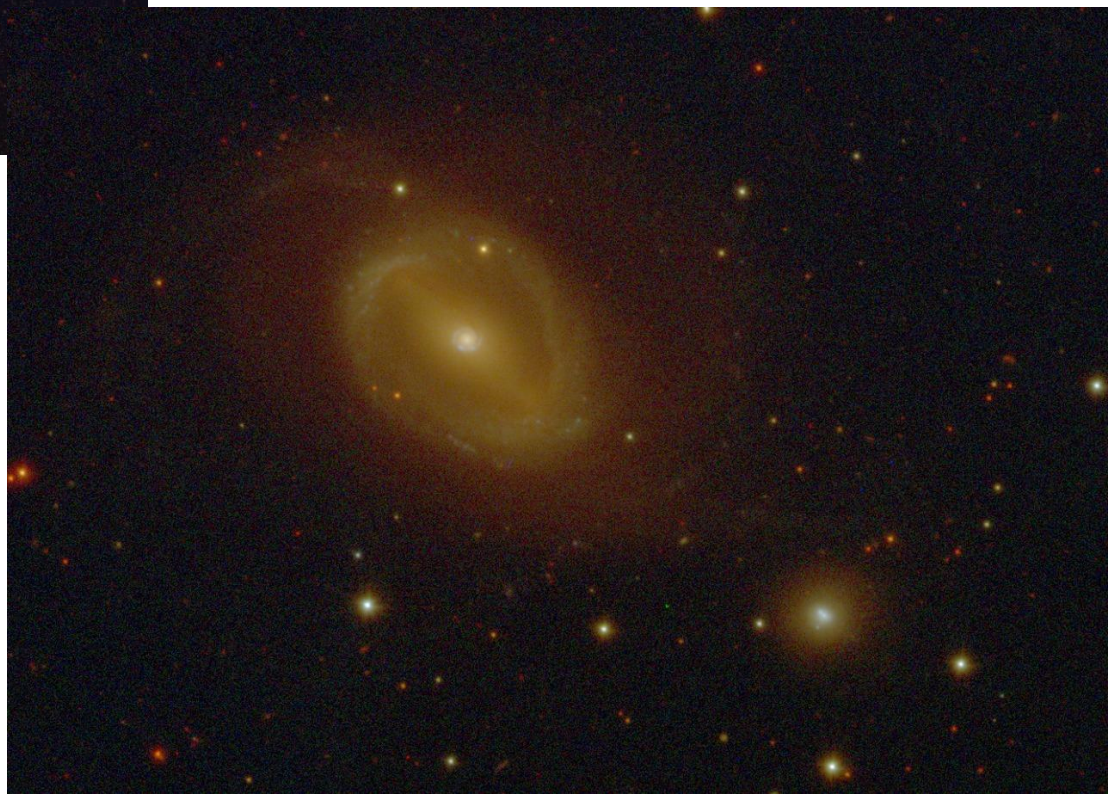
VACA – For galaxies with r < 17, probability of being E or S



De Bom et al. 2021

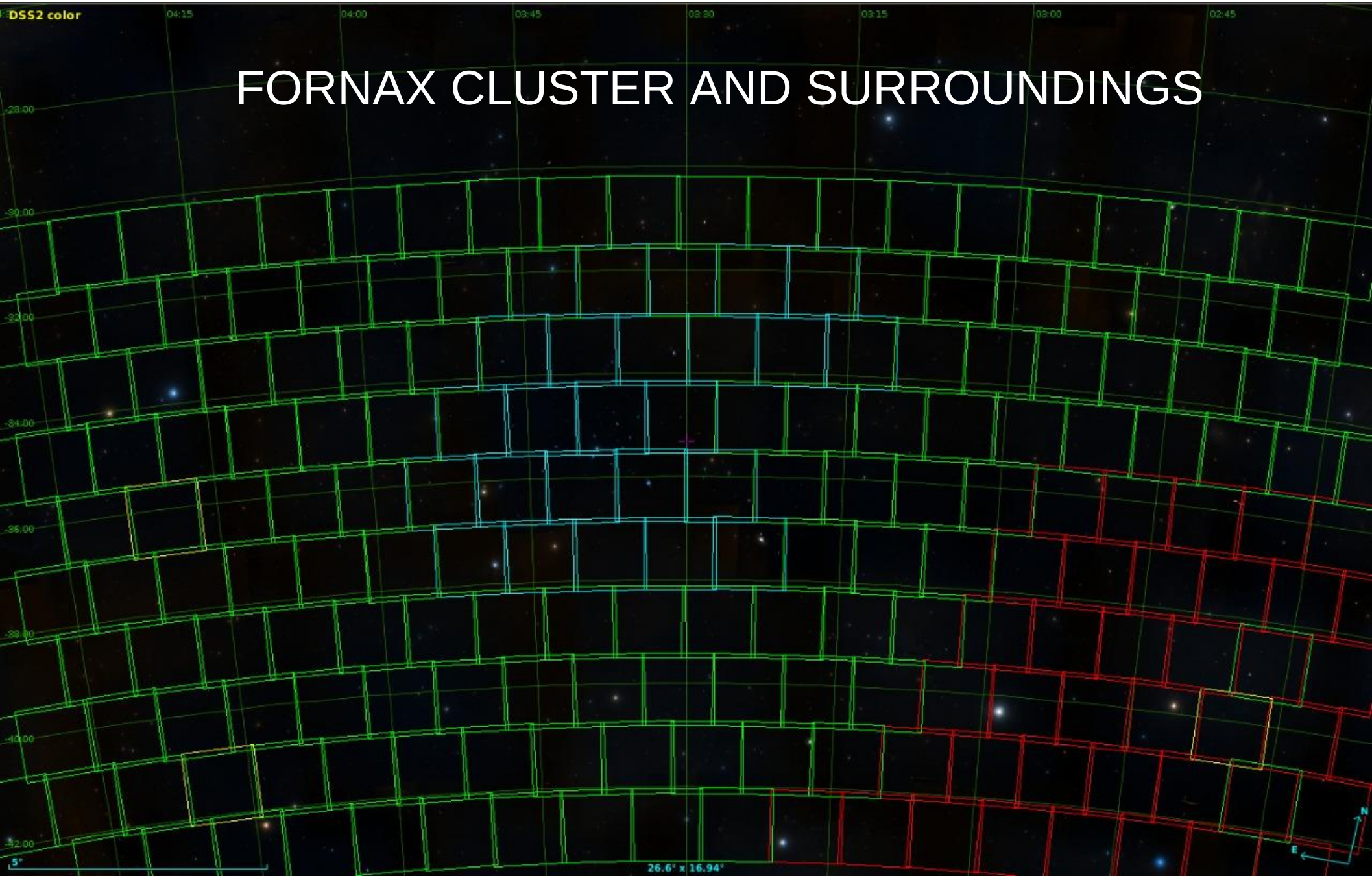


New Fields of Fornax cluster



Telescope was closed on March 1st

Observations re-started on Nov 1st



FORNAX CLUSTER AND SURROUNDINGS

S-PLUS Outreach Group

(is back in business…)

Outreach goals for 2021:

For internal distribution:

- mugs, t-shirts and (more) stickers;
- *S-PRESSO* newsletter;

For all audiences:

- old/new hig-res images (re)processed for public downloads
- for wallpapers, posters, and/or printed material;
- explanatory e-folders presenting the project and subprojects for press;
- press releases;
- renew social media accounts.

and a lot more!

S-PLUS projects in the wiki

#001: S-PLUS Survey Overview Paper (PL: Claudia Mendes de Oliveira)
#002: Large-scale structures in the local Universe: clustering properties of groups and clusters at extremely low redshifts (PL: Raul Abramo)
#003: Identification and characterization of WD+M binaries (PL: Tiago Ribeiro)
#004: Luminous Quasars near the end of Re-ionization (PL: Roderik Overzier)
#005: Technical documentation for the wiki (PL: Roderik Overzier)
#006: Identifying Metal-Poor Stars from the SPLUS Survey (PL: Vinicius Placco)
#007: An accurate photo-z catalogue for nearby galaxy clusters in the South hemisphere (PL: Alberto Molino)
#008: The Largest Astrometric and Photometric Open Cluster (LAPOC) Catalogue. (PL: Laura Sampedro)
#009: Configuration of Artificial Neural Network Pipeline for CEMP Candidate Identification (Devin Whitten)
#010: Blue stars in the Galactic Halo (PL: Marcelo Borges)
#011: Identifying BSS and BHBs (PL: Rafael Santucci)
#012: Southern Galactic Halo Age-maps (PL: Rafael Santucci)
#013: SPLUS mock catalogs using GALFAST code (PL: Rafael Santucci)
#014: PNe and symbiotics in the Galactic halo and nearby galaxies (PL: Denise Gonçalves)
#015: Learning about stars from their S-PLUS colors (PL: Tiago Ribeiro)
#016: Star/galaxy separation in multi-band photometric surveys based on machine learning techniques (PL: Walter Santos)
#017: The environment of Lyman break analogs (PL: Thiago Gonçalves)
#018: A Panchromatic (FUV-OPT-MIR) study of the energy output of the Local Universe (PL: Alberto Molino)
#019: An alternative methodology to calibrate the S-PLUS survey (PL: Laura Sampedro)
#020: Short period variables (PL: Antonio Kanaan)
#021: S-PLUS morphology classification (PL: Arianna Cortesi)
#022: Unveiling the nature of unknown gamma-ray sources (PL: Raniere Menezes)
#023: Luminosity function of compact groups of galaxies in Stripe 82 (PL: Sergio Torres Flores)
#024: Star formation in compact groups observed by SPLUS (PL: Sergio Torres Flores)
#025: Unveiling star-forming early-type galaxies in dense environments using the S-PLUS survey (Riguccini)
#026: The differential evolution of the star formation in low mass galaxy clusters from the perspective of the S-Plus Survey. (PL: Jose Nilo Castellon)
#027: Mapping stellar streams and substrucures in the galactic halo (PL: Hélio J. Rocha Pinto)
#028: Nature of the Galactic substructures located in low latitudes fields (PL: Hélio J. Rocha Pinto)

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Thank you!