Synergies between OAJ's surveys, J-PAS & J-PLUS, and *Gaia*

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CEFCA

Expanding the Gaia legacy:
the role of Spanish ground-based facilities

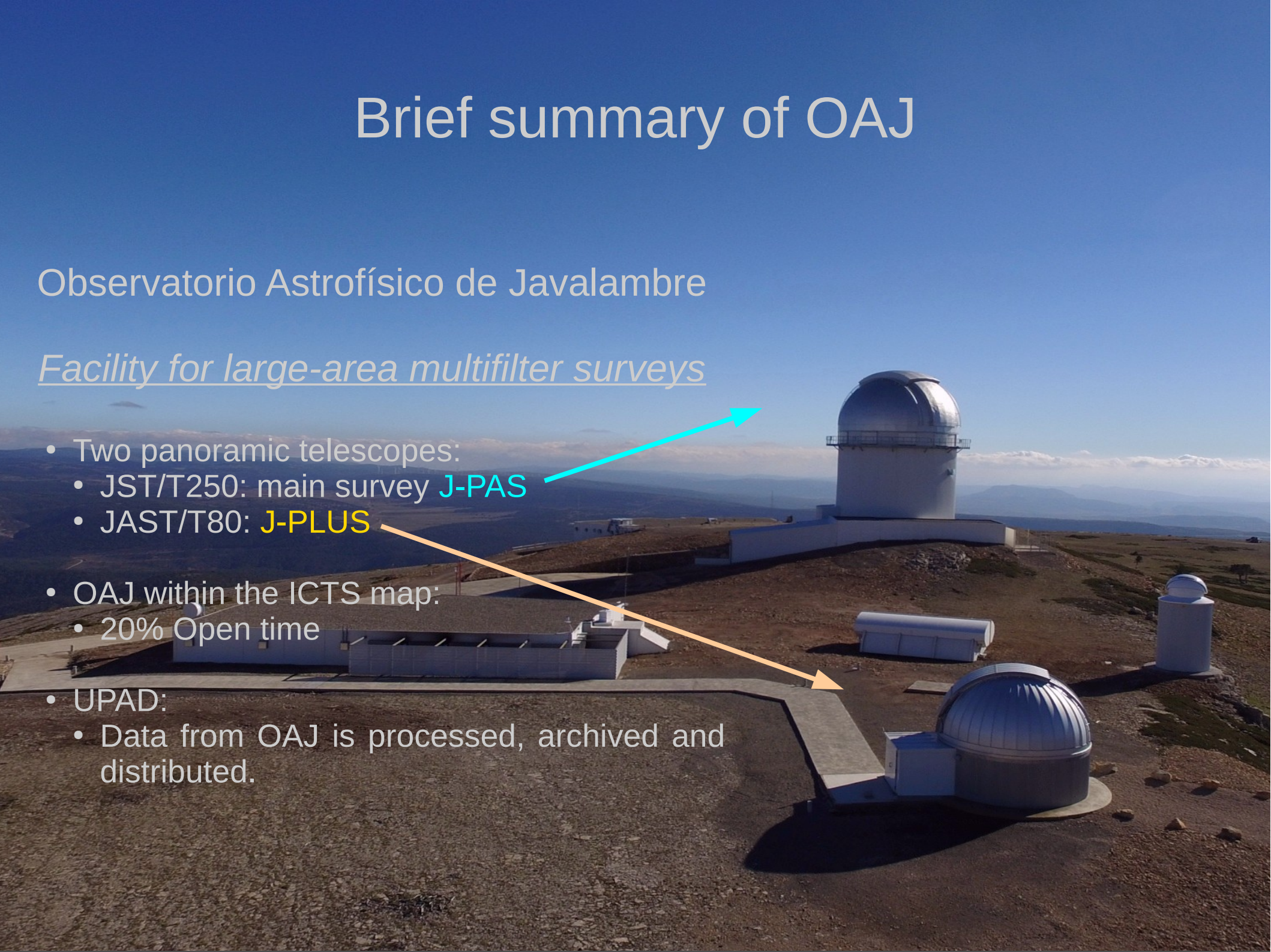
RIA Meeting – Barcelona, 17-19 February 2020

Brief summary of OAJ

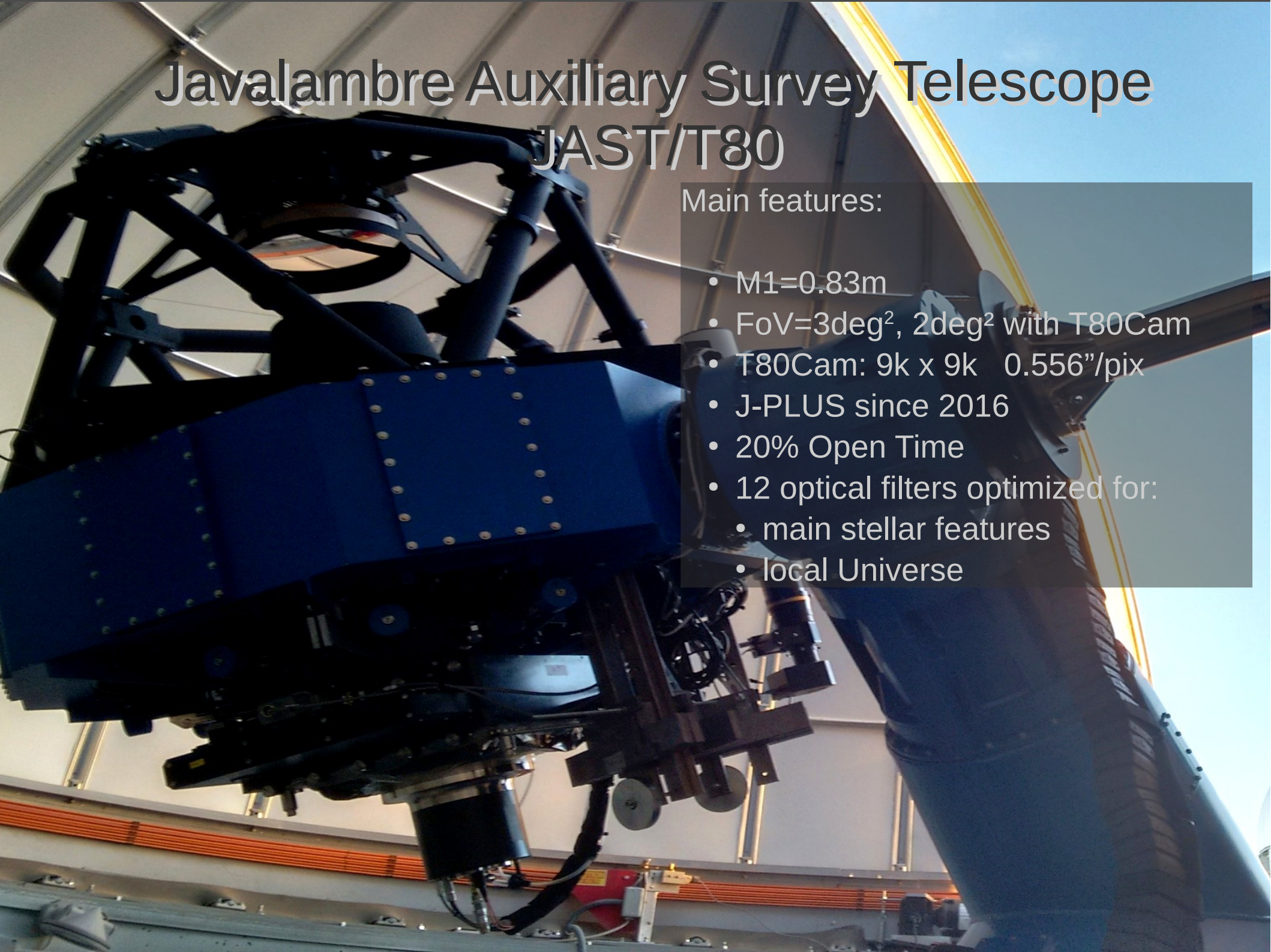
Observatorio Astrofísico de Javalambre

Facility for large-area multifilter surveys

- Two panoramic telescopes:
  - JST/T250: main survey J-PAS
  - JAST/T80: J-PLUS
- OAJ within the ICTS map:
  - 20% Open time
- UPAD:
  - Data from OAJ is processed, archived and distributed.



Javalambre Auxiliary Survey Telescope JAST/T80



Main features:

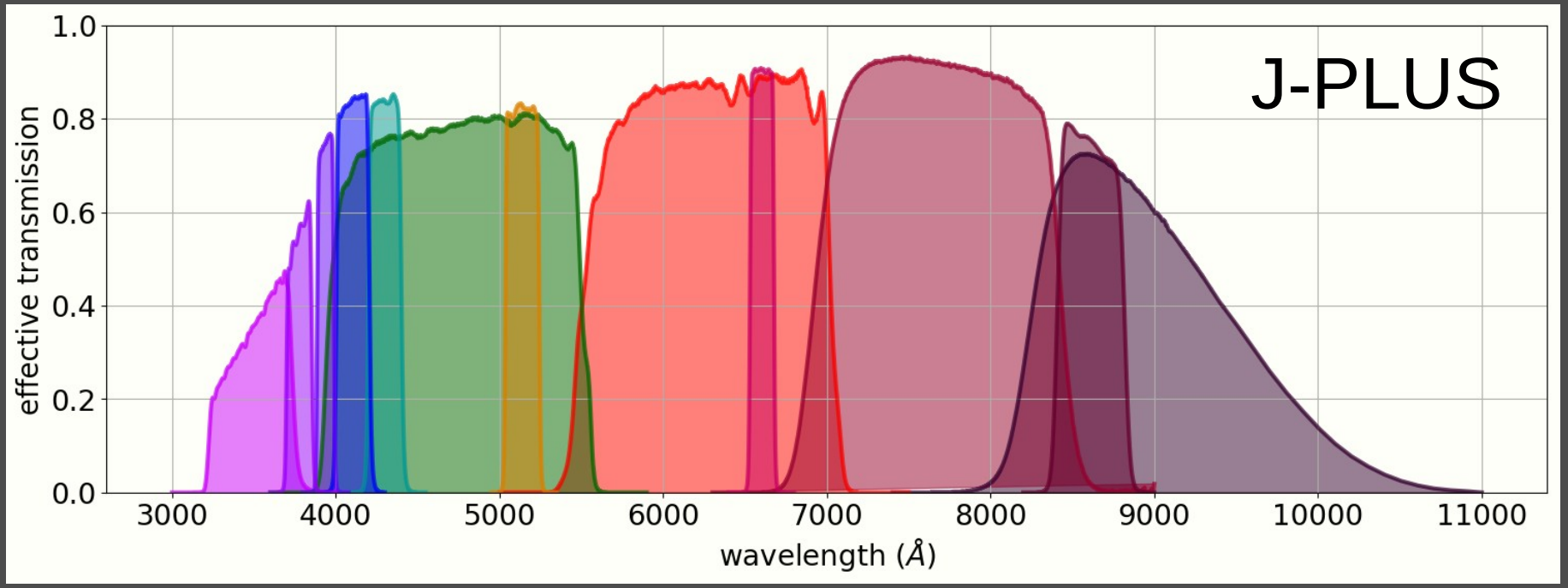
- M1=0.83m
- FoV=3deg^2, 2deg^2 with T80Cam
- T80Cam: 9k x 9k 0.556”/pix
- J-PLUS since 2016
- 20% Open Time
- 12 optical filters optimized for:
  - main stellar features
  - local Universe

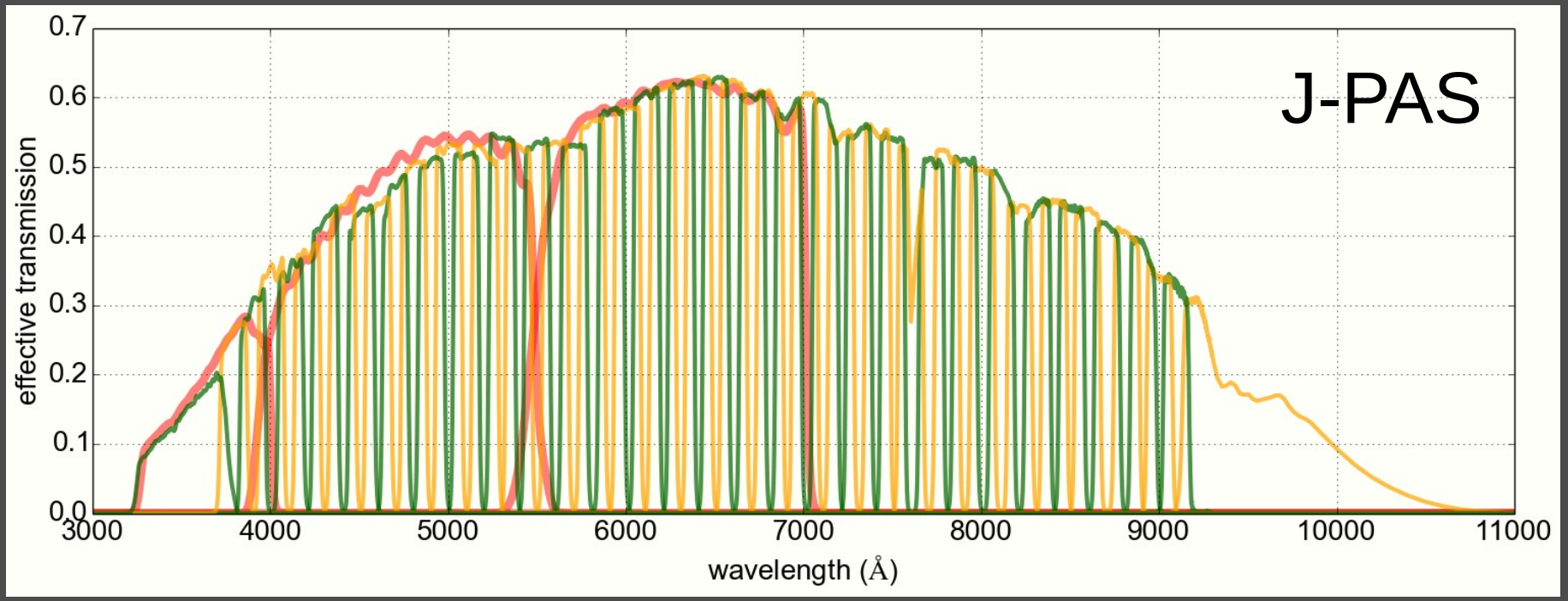
Javalambre Survey Telescope JST/T250

Main features:

- M1=2.55m F#3.5
- FoV=7deg^2, ø3deg with JPCam
- JPCam: 14 CCDs 9k x 9k 0.227”/pix
- J-PAS starting in 2020
- 56 optical filters
  - 54 NB filters
    - FWHM~14.5nm & Δλ~10nm
  - 1 blue MB filter: FWHM~26nm
  - 1 red BB filter: FWHM~62nm
  - uJ−PAS & Sloan g, r
- Driver:
  - Cosmology:
    - Dark Energy, BAOs, photo-z, etc.
  - Applications: many topics in Astrophysics from minor bodies to galaxy evolution

J-PLUS vs J-PAS





J-PLUS vs J-PAS

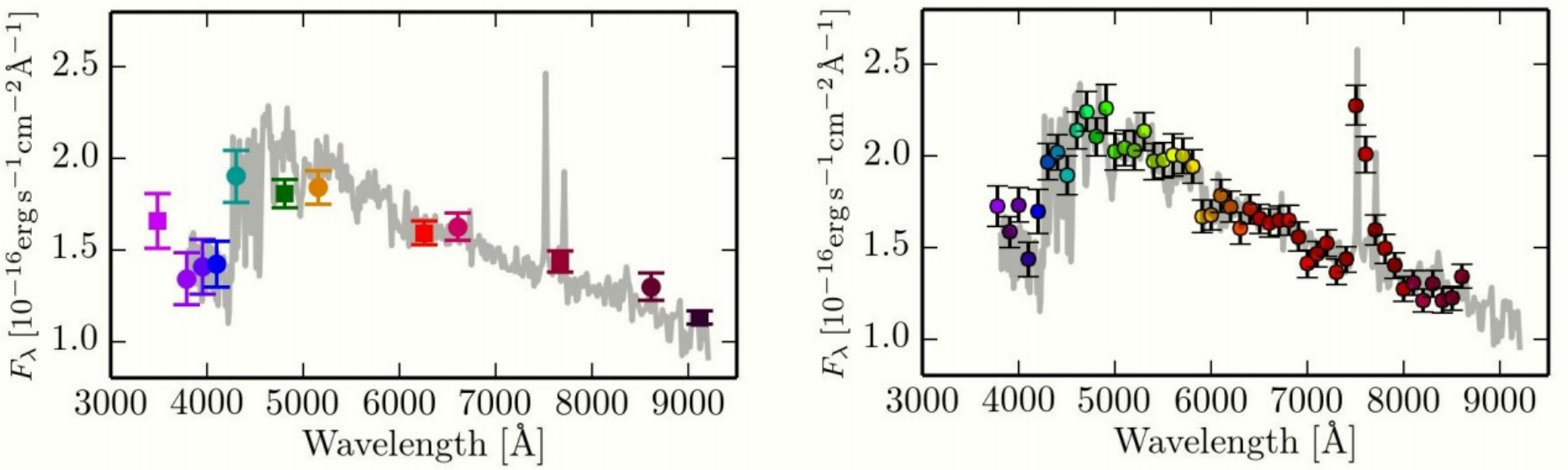


Figure 9 – Example of a $z = 0.145$ emission-line galaxy observed by J-PLUS (*left panel*), mini-JPAS (*right panel*), and SDSS (gray spectra in both panels). We will extract the emission-line fluxes with the updated version of JEFE, that successfully works at $z < 0.017$.

J-PLUS vs J-PAS

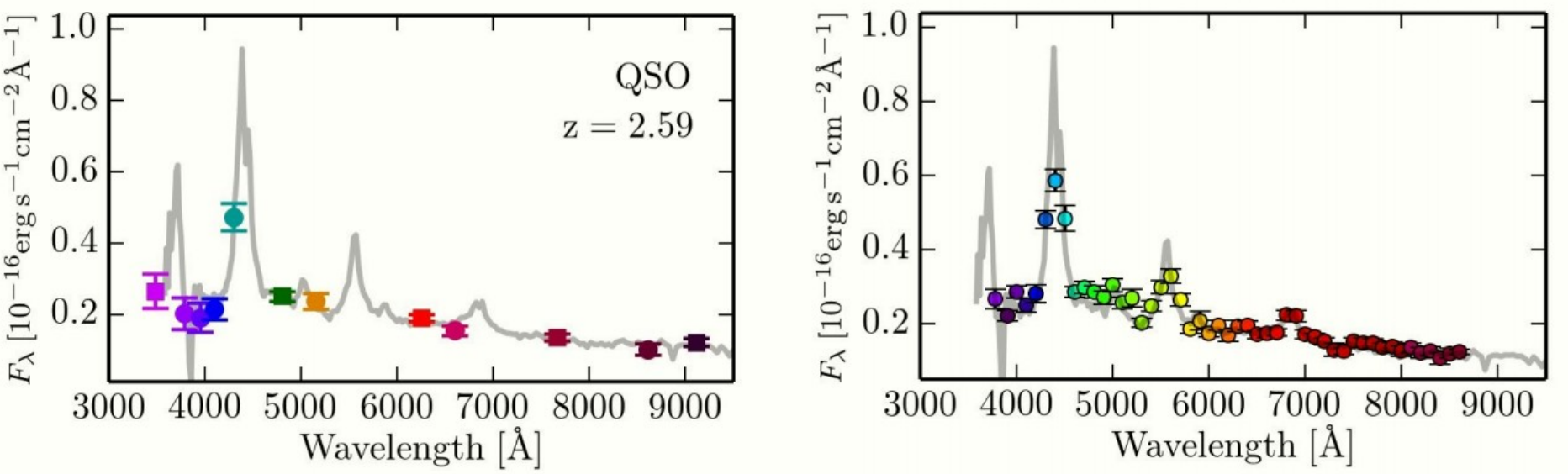


Figure 11 – Example of a $z = 2.59$ QSO observed by J-PLUS (*left panel*), mini-JPAS (*right panel*), and SDSS (gray spectra). J-PLUS permits to study QSOs at $1.2 < z < 1.9$ ([CIV] emission) and $2.0 < z < 2.6$ (Lyα), while J-PAS has a continuous coverage from the local Universe to $z \sim 5$.

J-PLUS vs J-PAS

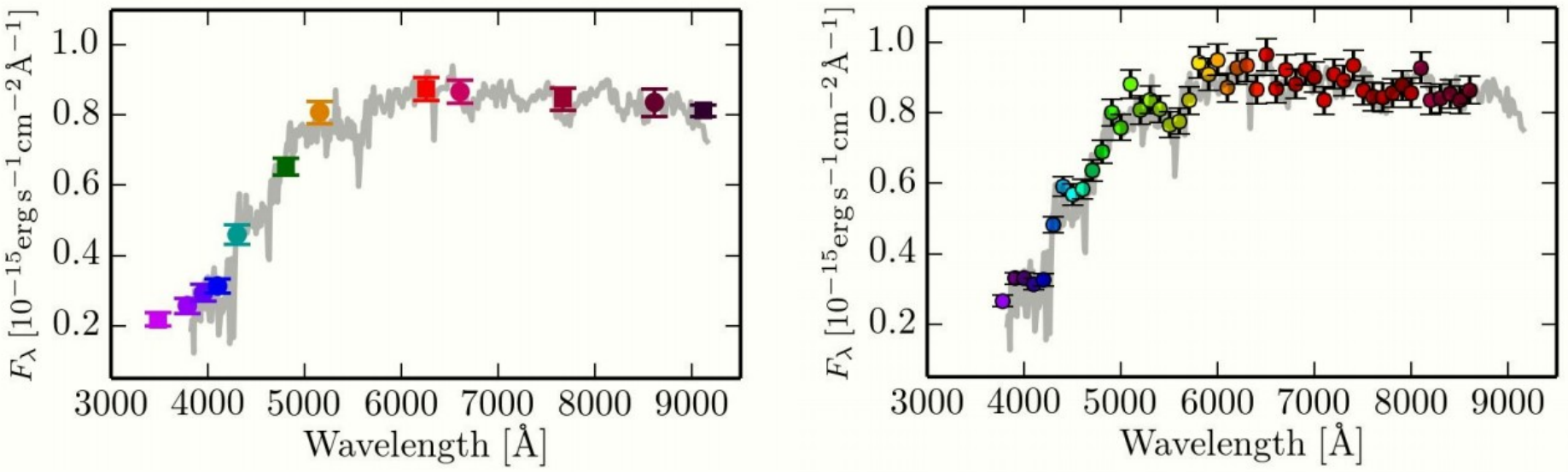


Figure 10 – Example of a $z = 0.075$ early-type galaxy observed by J-PLUS (*left panel*), mini-JPAS (*right panel*), and SDSS (gray spectra in both panels). We will extract the stellar population properties of the Javalambre sources with MUFFIT.

J-PLUS vs J-PAS

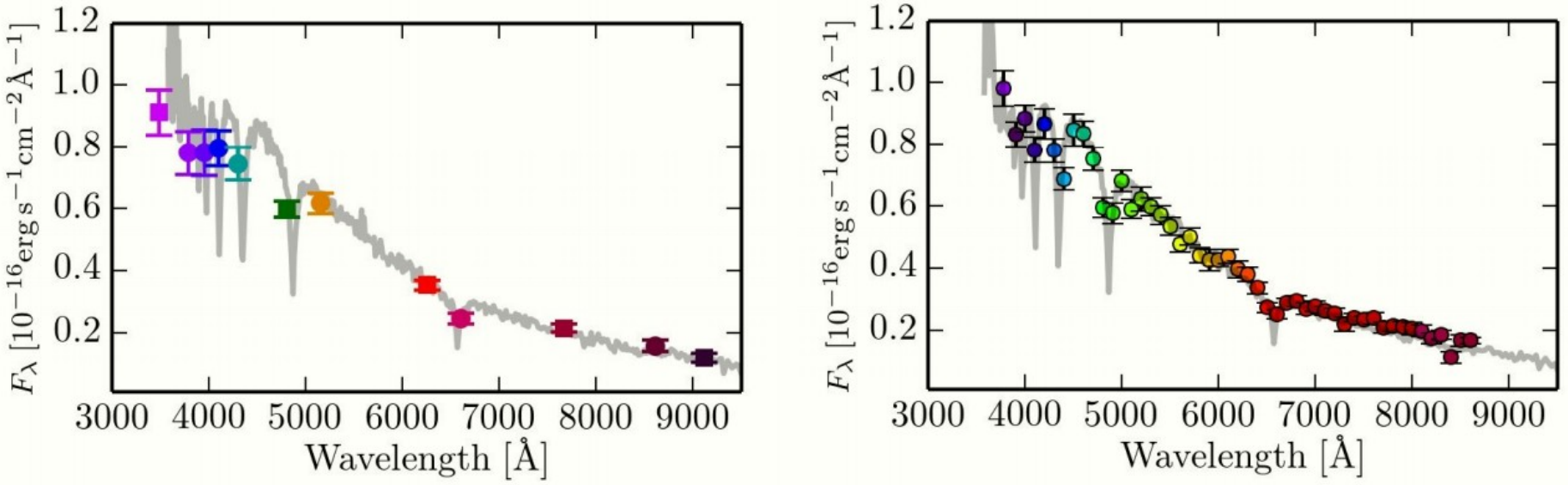


Figure 12 – A WD at 198 pc observed by J-PLUS (*left panel*), mini-JPAS (*right panel*), and SDSS (gray spectra in both panels). The hydrogen absorption lines are visible in our photometry.

J-PLUS vs J-PAS & *Gaia*

	J-PLUS	J-PAS	*Gaia*
# FILTERS	12	59	Low-res. spectra
BB	griz	gr[i]	
NB/MB	8	56	
area goal	8.5kdeg²	8.5kdeg²	All sky
depth (BB)	r~21.5mag$_{AB}$	r~24.0mag$_{AB}$	G~20
depth (NB)	~20.5mag$_{AB}$	~22.2mag$_{AB}$	G<20
start	2016	2020	2014
Driver science	Local Universe	Cosmology: BAOs	Parallaxes/Proper motions/Milky Way
Spectral R	-	~50	30-100

Public data: J-PLUS

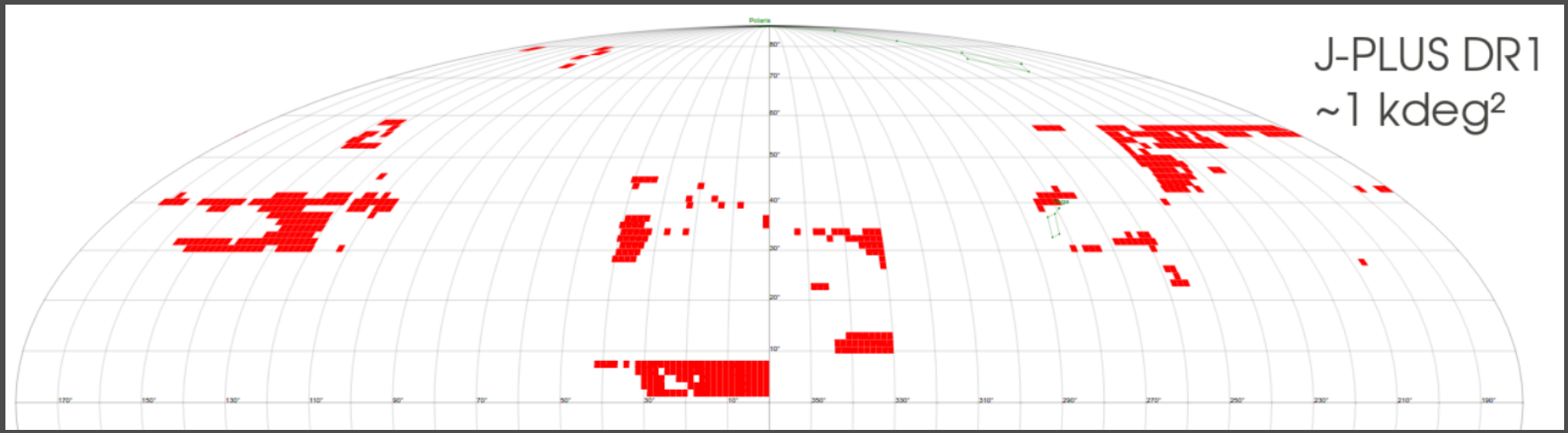
J-PLUS DR1

1k deg² (July 2018)

www.archive.cefca.es/catalogues/jplus-dr1

Cenarro et al. 2019 A&A 622, A176

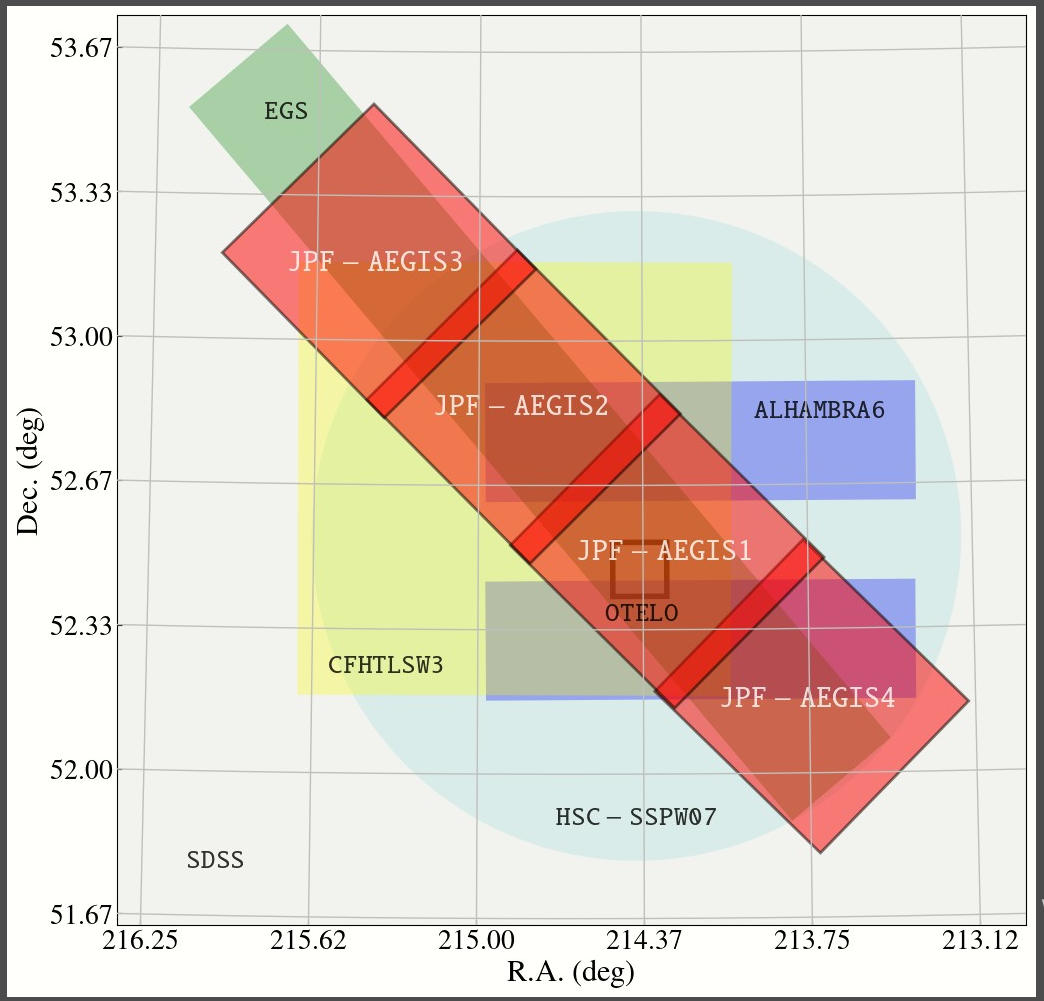
Related papers: www.oajweb.cefca.es/publications/publications



J-PLUS DR2

2k deg² (July 2020 SEA Tenerife)

Public data: J-PAS

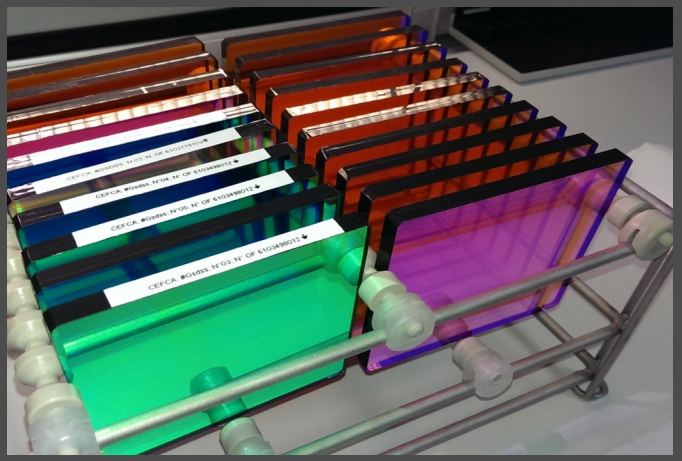


Extended Groth Strip

Region on the sky with abundant spectroscopic observations

mini J-PAS PDR201912

1 deg² (December 2019) with JPAS-Pathfinder and all J-PAS filters



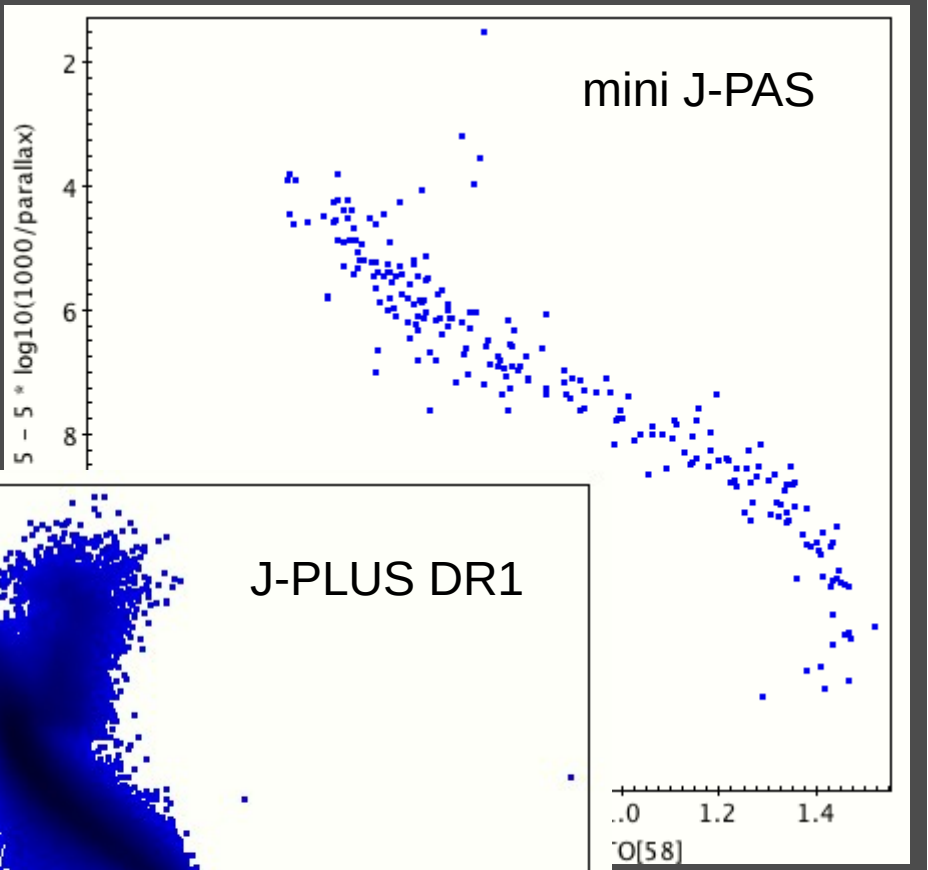
www.archive.cefca.es/catalogues/minijpas-pdr201912

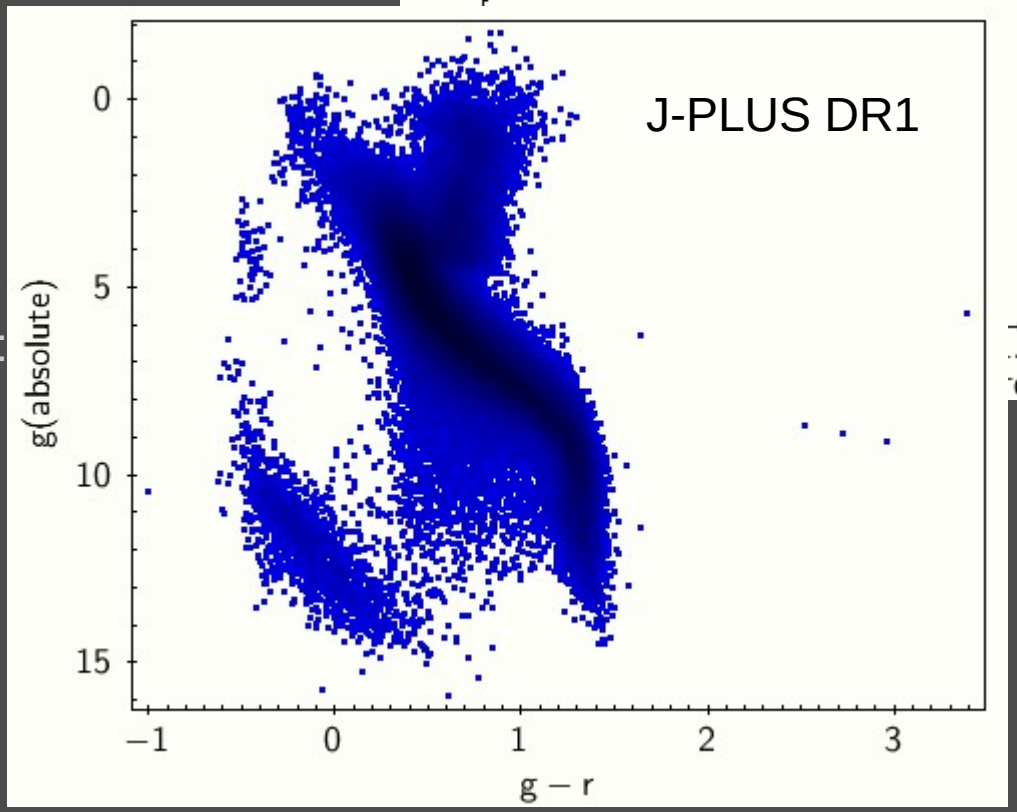
Bonoli et al. (in prep)

J-PAS starting in 2020

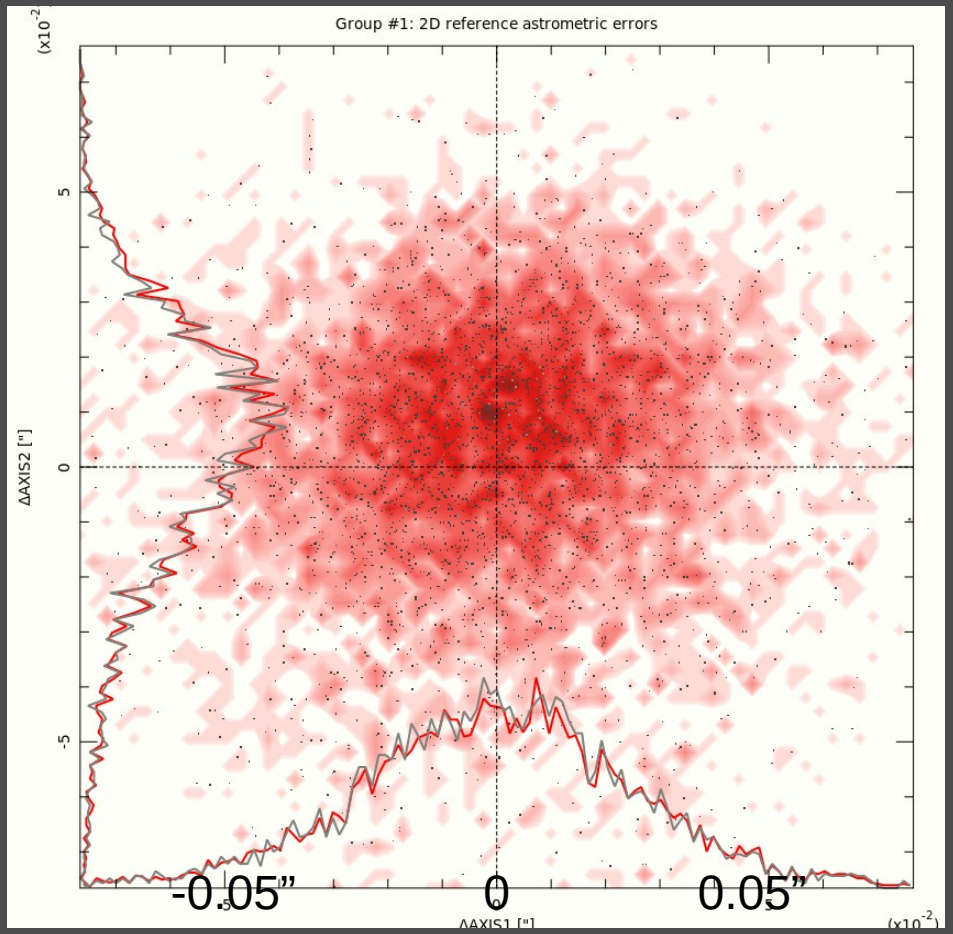
The *Gaia* era

- Breaking a few degeneracies trough distance
- Solar neighborhood
- Low-res spectra of millions and millions of objects
- RV for objects up to G~17
- Light curves of variable stars
- Galactic extinction
- Proper motions:
  - e.g. Galactic archaeology
- Identification of different species:
  - WDs, RRLyr, QSO, etc.
- And many more





Technical synergies: astrometry

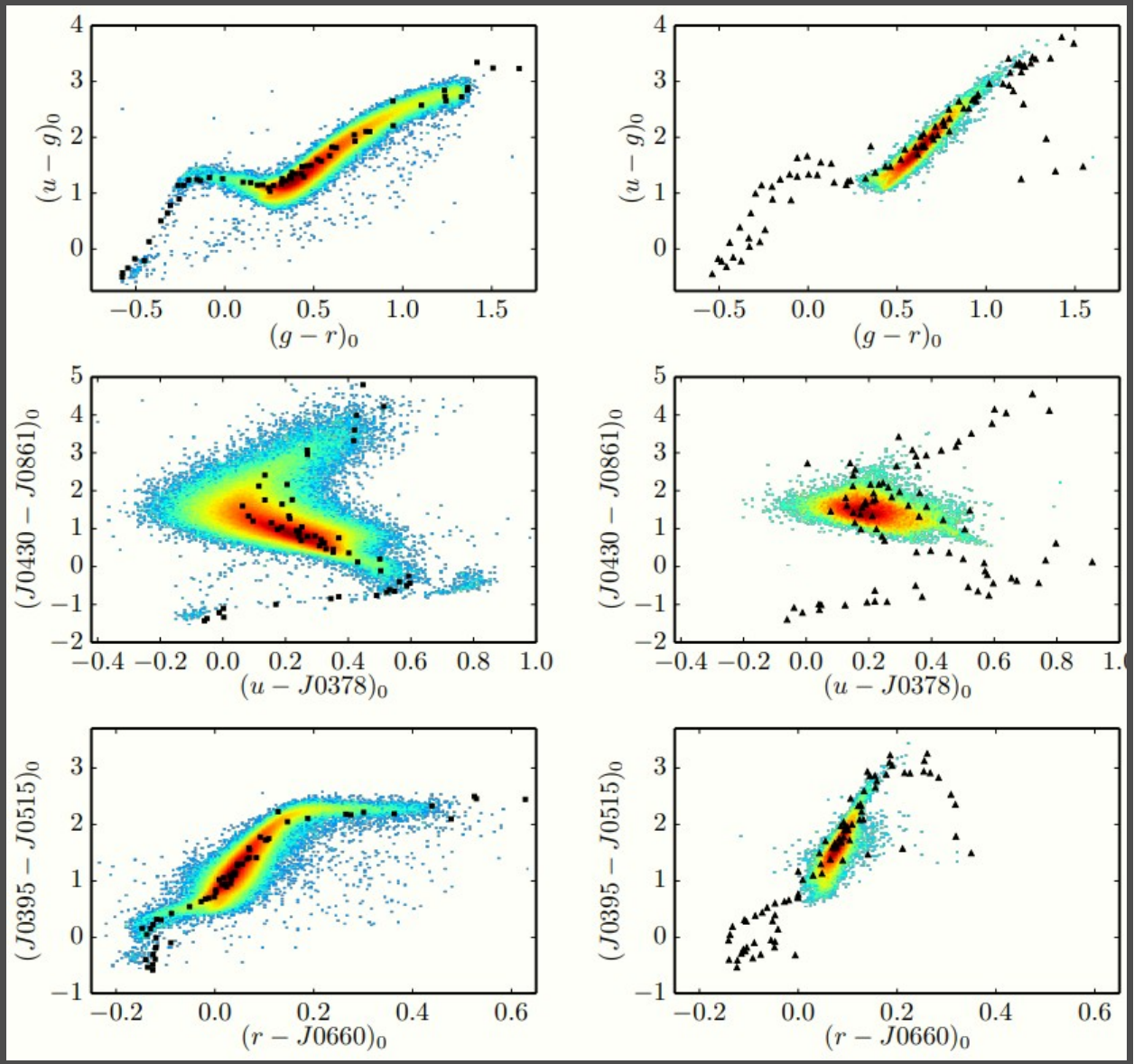


Gaia is a must

- Astrometry using Gaia adopted in the pipeline for OAJ data:
  - Long-term proper motions
- Cross-match with Gaia offered in OAJ’s Drs.
- Gaia measurements are used as a prior for stellarity of the sources:
  López-Sanjuan et al. (2019b)

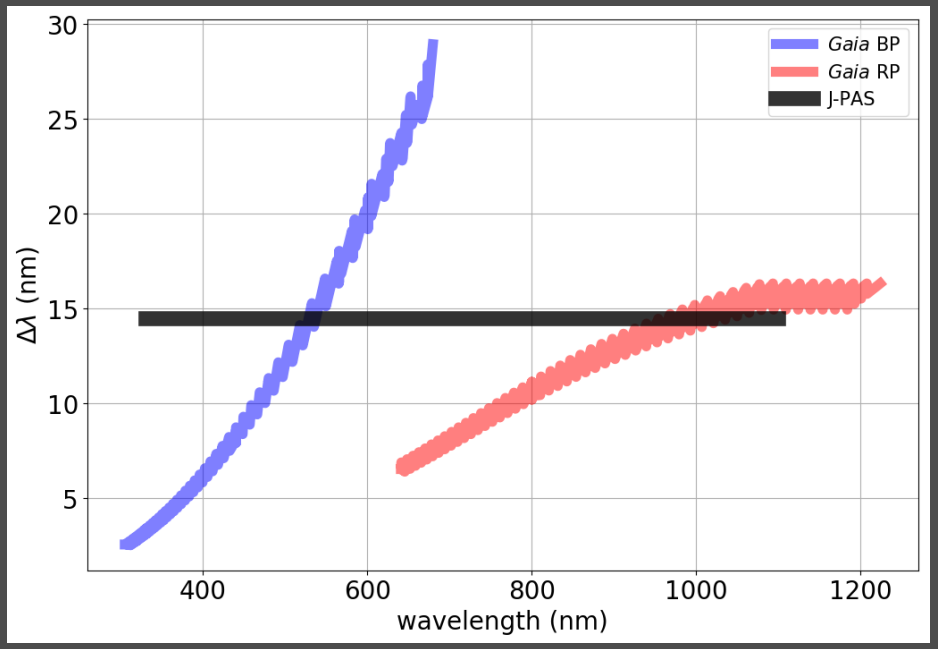
Technical synergies: photometric calibration

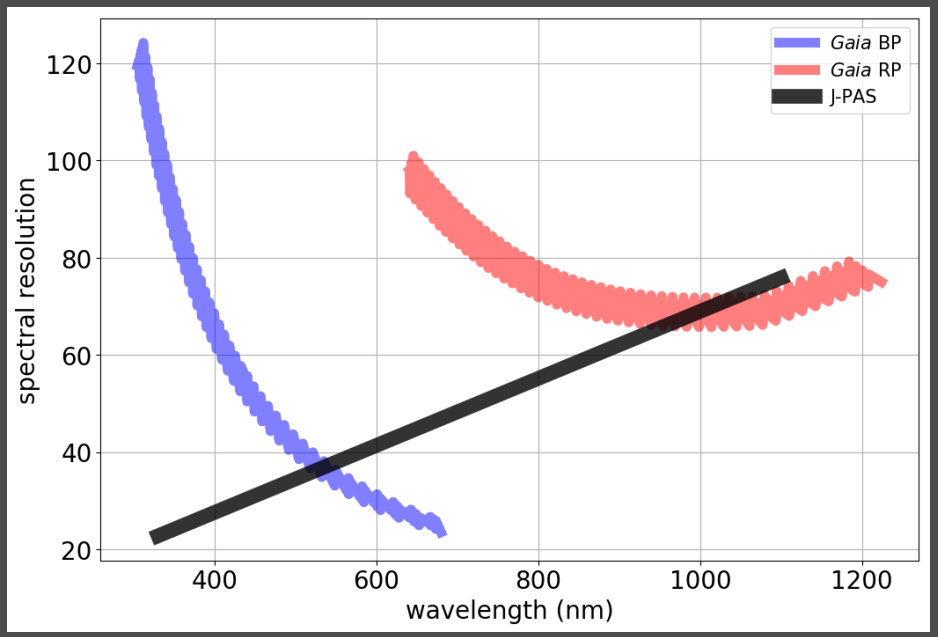
- Photometric calibration J-PLUS:
  - It includes curtial information provided by *Gaia*
  - See Carlos López-Sanjuan talk on J-PLUS calibration this afternoon



Stellar loci in J-PLUS bands. The homogenization of the photometry is part of the photometric calibration procedure. Taken from López-Sanjuan et al. 2019c.

Similarities: spectral resolution





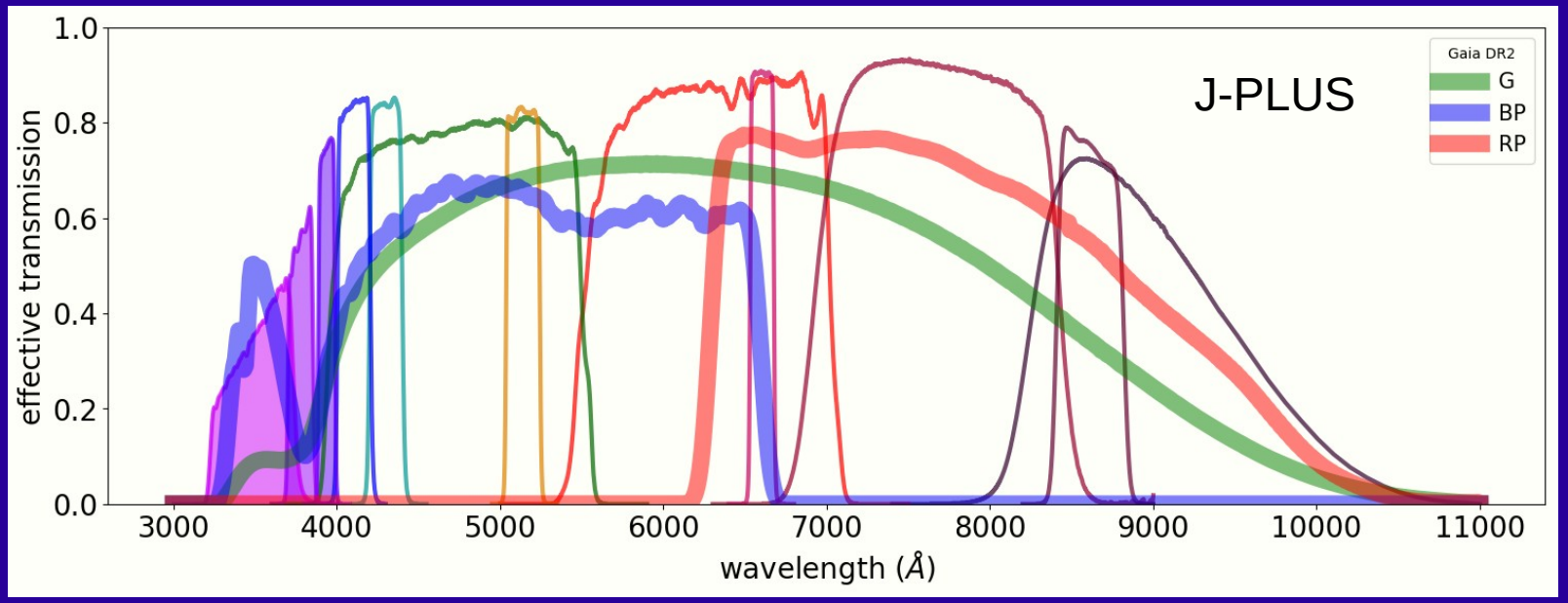
www.cosmos.esa.int/web/gaia/resolution

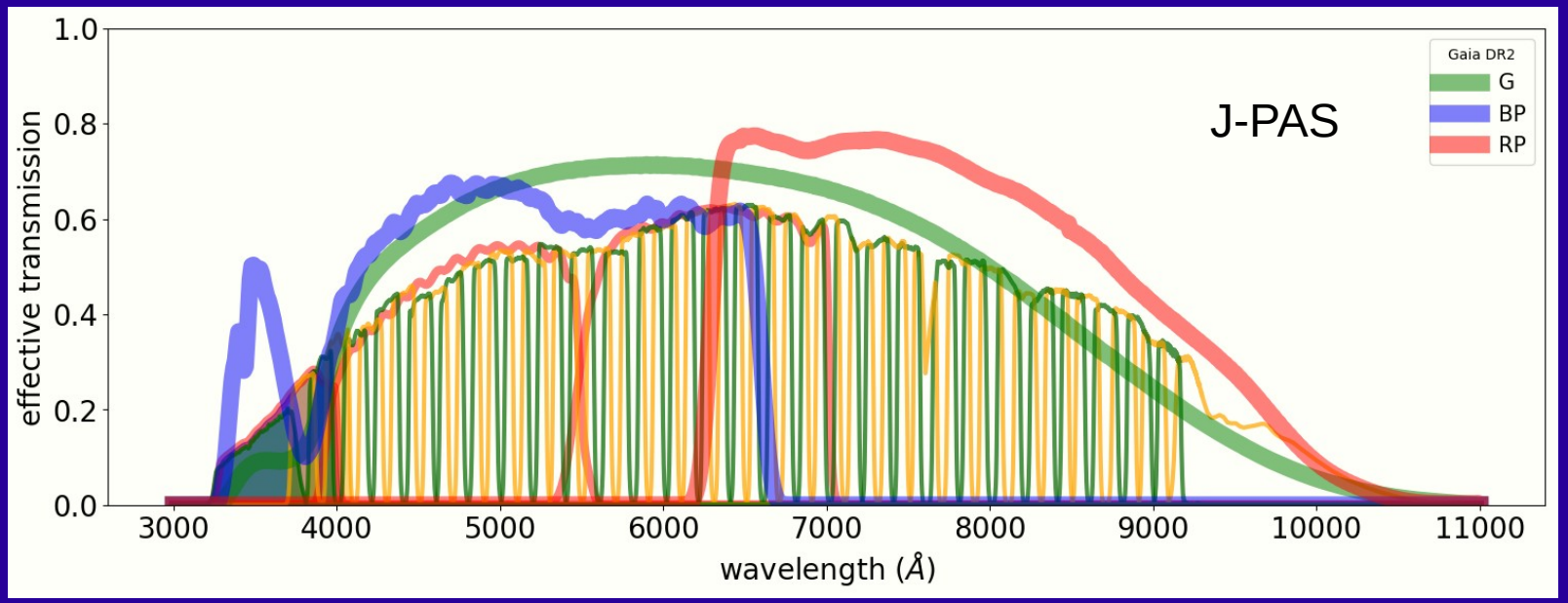
- J-PAS spectral resolution is of the same order of that of *Gaia*
- *J-PLUS and J-PAS lie between photometry and spectroscopy*

Same science with other "eyes"

Important for finding systematics in both datasets

Complementarity: bluest bands





May be relevant for:

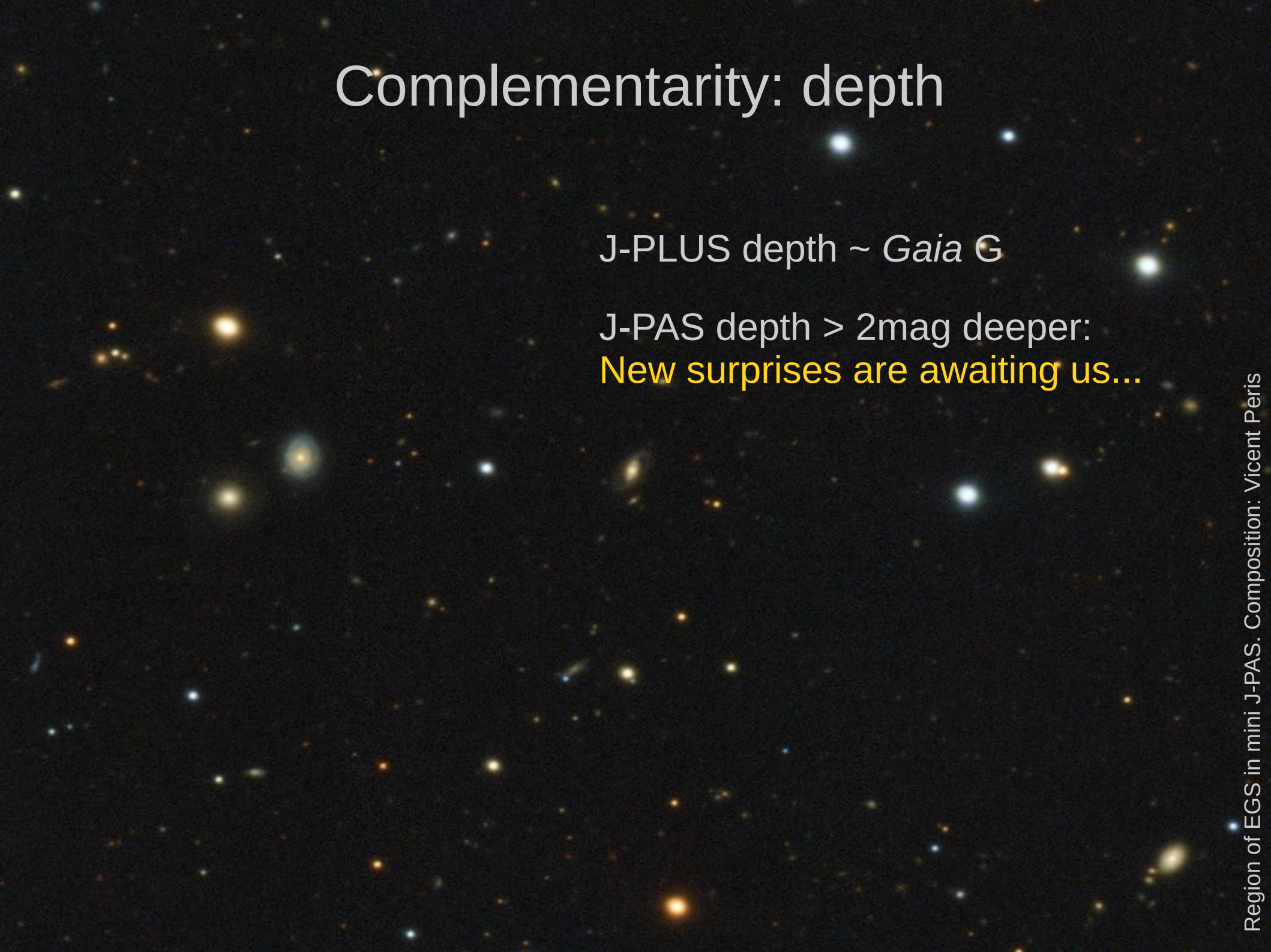
- Temperatures
- Metallicity
- log g
- Classification

www.cosmos.esa.int/web/gaia/iow_20180316

Complementarity: depth

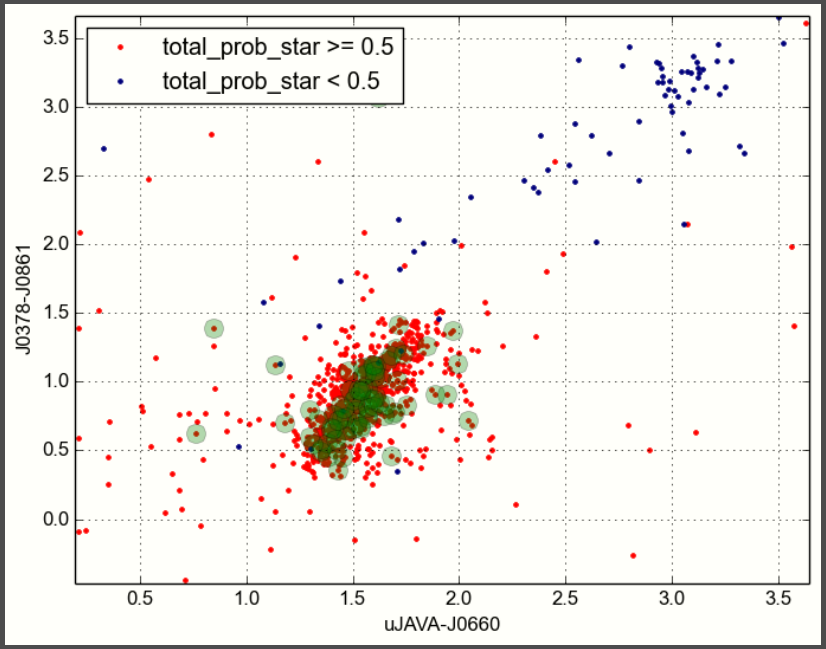
J-PLUS depth ~ *Gaia* G

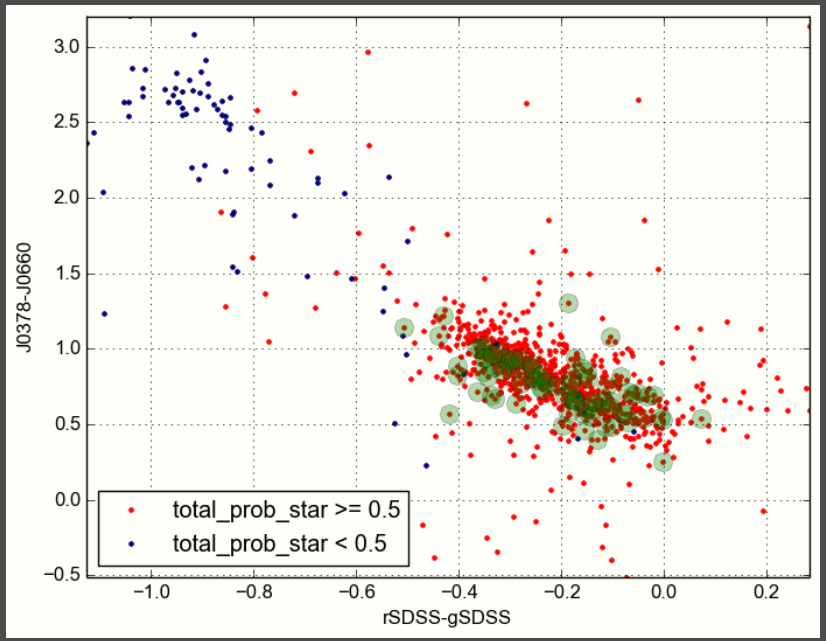
J-PAS depth > 2mag deeper:
New surprises are awaiting us...



Region of EGS in mini J-PAS. Composition: Vicent Peris

Complementarity: extended objects/images



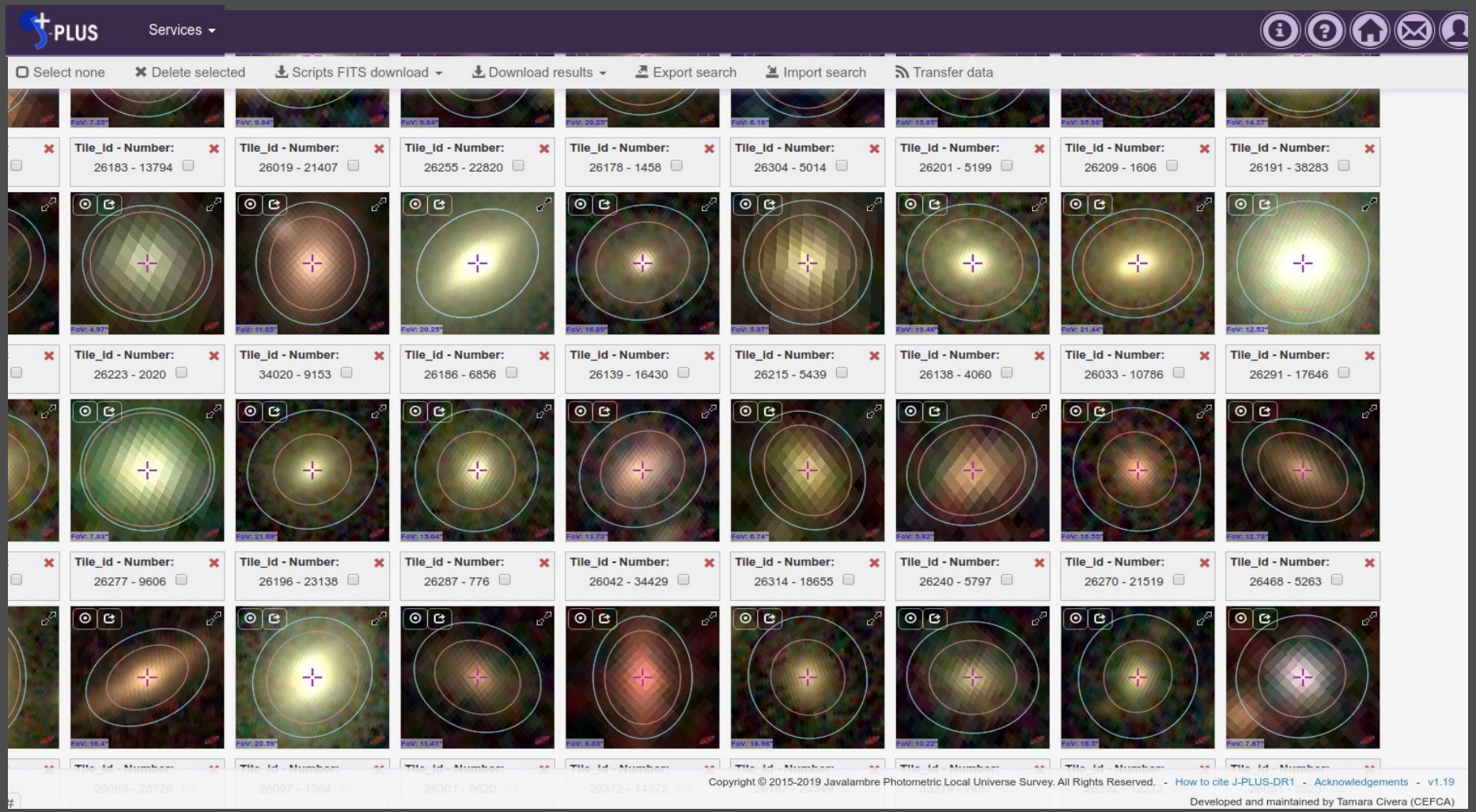


- J-PLUS & J-PAS observe extended objects (nearby extended galaxies, 2D studies, star-forming regions, etc.)
- Morphological parameters.
- Images available. Example:
  - 1016 RR Lyrae stars candidates from *Gaia* (Clementini et al. 2019) in J-PLUS DR1:
    - Unexpected secondary population in color-color diagrams

Color-color locus of RR Lyrae candidates from Gaia in some J-PLUS bands

Complementarity: extended objects/images

- 8% of the sources not point-like (total_prob_star < 0.5)
- ~80% of those are seem to be galaxies
- Other have problems in J-PLUS or a close source



Transients - *Gaia* Alerts

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Index to Gaia Photometric Alerts

If you publish any results based on these Gaia discoveries, we would appreciate an acknowledgement along the lines of: *"We acknowledge ESA Gaia, DPAC and the Photometric Science Alerts Team (http://gsaweb.ast.cam.ac.uk/alerts)"*

These are all the alerts raised to date. You might wish to view or download these as a table in CSV format or using any of the tools described in this page.

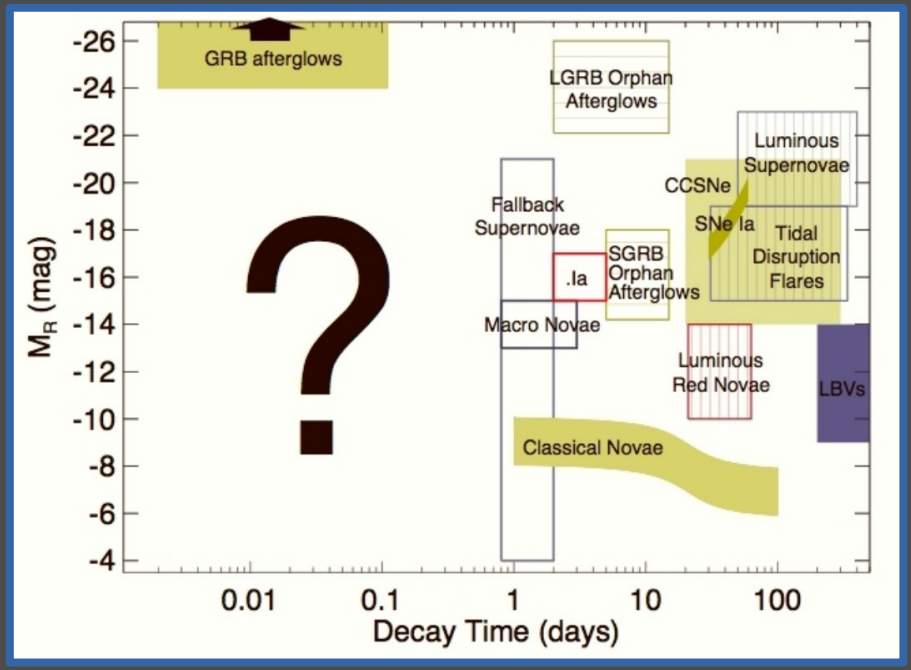
See here for an explanation of the columns.

Show 10 entries Search:

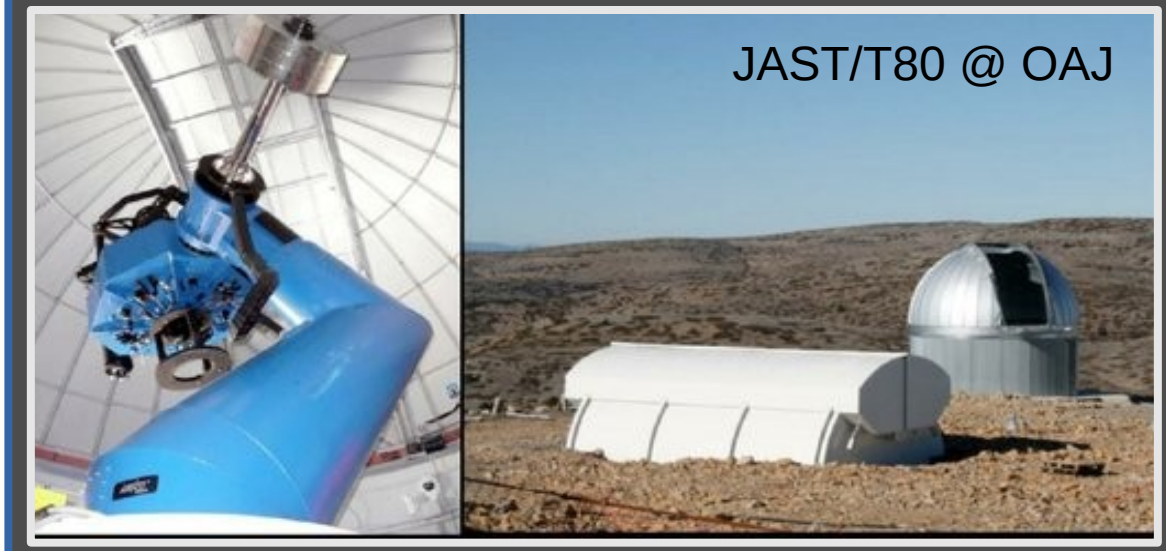
Name	TNS	Observed	RA (deg.)	Dec. (deg.)	Mag.	Historic mag.	Historic scatter	Class	Published	Comment	RVS
Gaia20avl	AT2020cub	2020-02-14 12:39:39	215.30048	3.72620	18.21	18.55	0.08	QSO	2020-02-17 14:30:55	slow rise of ~0.3 mags in known QSO	
Gaia20avk	AT2020cua	2020-02-14 04:59:31	25.65843	-19.77475	17.36	17.92	0.17	unknown	2020-02-17 14:30:25	long-term rise of ~0.4 mags in Gaia source coincident with galaxy 6dFGS gJ014238.0-194630	
Gaia20avj	AT2020cty	2020-02-15 15:20:58	255.93247	-44.21329	18.01	19.35	0.07	unknown	2020-02-17 10:54:20	1.5mag rise on a red source - candidate microlensing event	
Gaia20avi	AT2020ctx	2020-02-15 15:13:55	249.08154	-38.40418	17.32			unknown	2020-02-17 10:54:04	blue hostless transient close to the Galactic plane	
Gaia20avh	AT2020btt	2020-02-14 21:37:29	38.02809	-1.36404	18.81			unknown	2020-02-17 10:53:52	candidate SN in galaxy UGC 02010	
Gaia20avg	AT2020cry	2020-02-15 18:48:22	223.74272	-1.54175	18.77			unknown	2020-02-17 10:53:40	hostless blue transient	
Gaia20avf	AT2020ctw	2020-02-15 15:56:02	314.04024	-60.39031	18.96	20.02	0.29	unknown	2020-02-17 10:53:27	candidate QSO brightens by more than 1 mag in 7 months. WISE and UV detected	
Gaia20ave	AT2019vkv	2020-02-15	108.26770	57.97941	18.26	18.83	0.14	unknown	2020-02-17	candidate QSO brightens by 0.8 mag in 18 months, X-ray detected	

www.gsaweb.ast.cam.ac.uk/alerts/alertsindex

Gaia Alerts and JST/T80



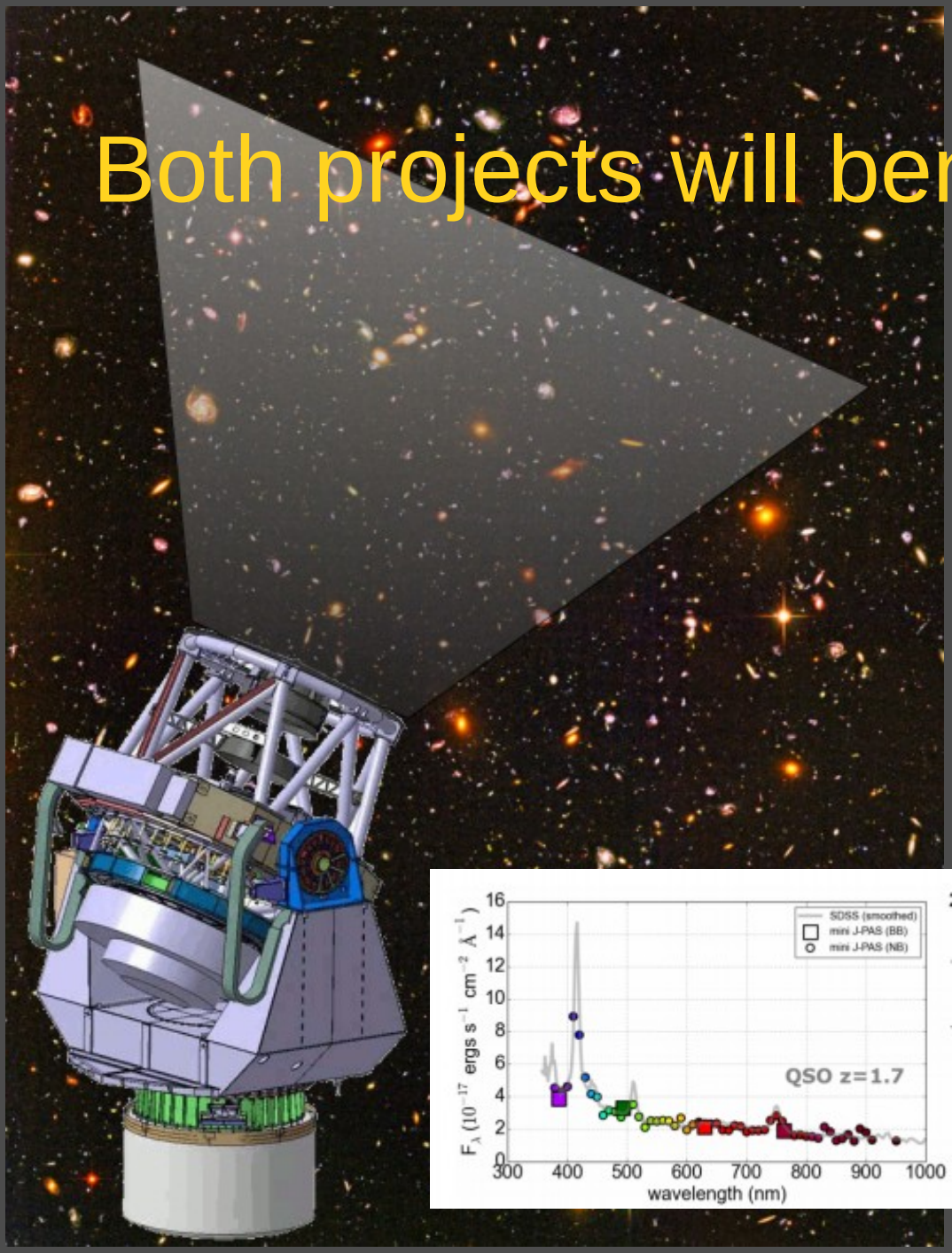
Discovery space for cosmic transients from VRS (former LSST).
www.lsst.org



- Many *Gaia* alerts are of “unknown” type
- Magnitud ranges fit very well with T80
- Use of OAJ’s Open Time

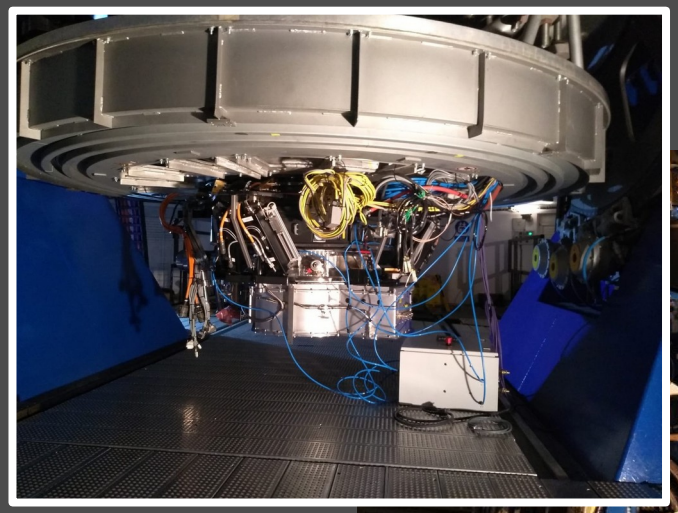
JAST/T80 could provide a quick measurement of the SED for an early classification of the transient

Both projects will benefit from each other

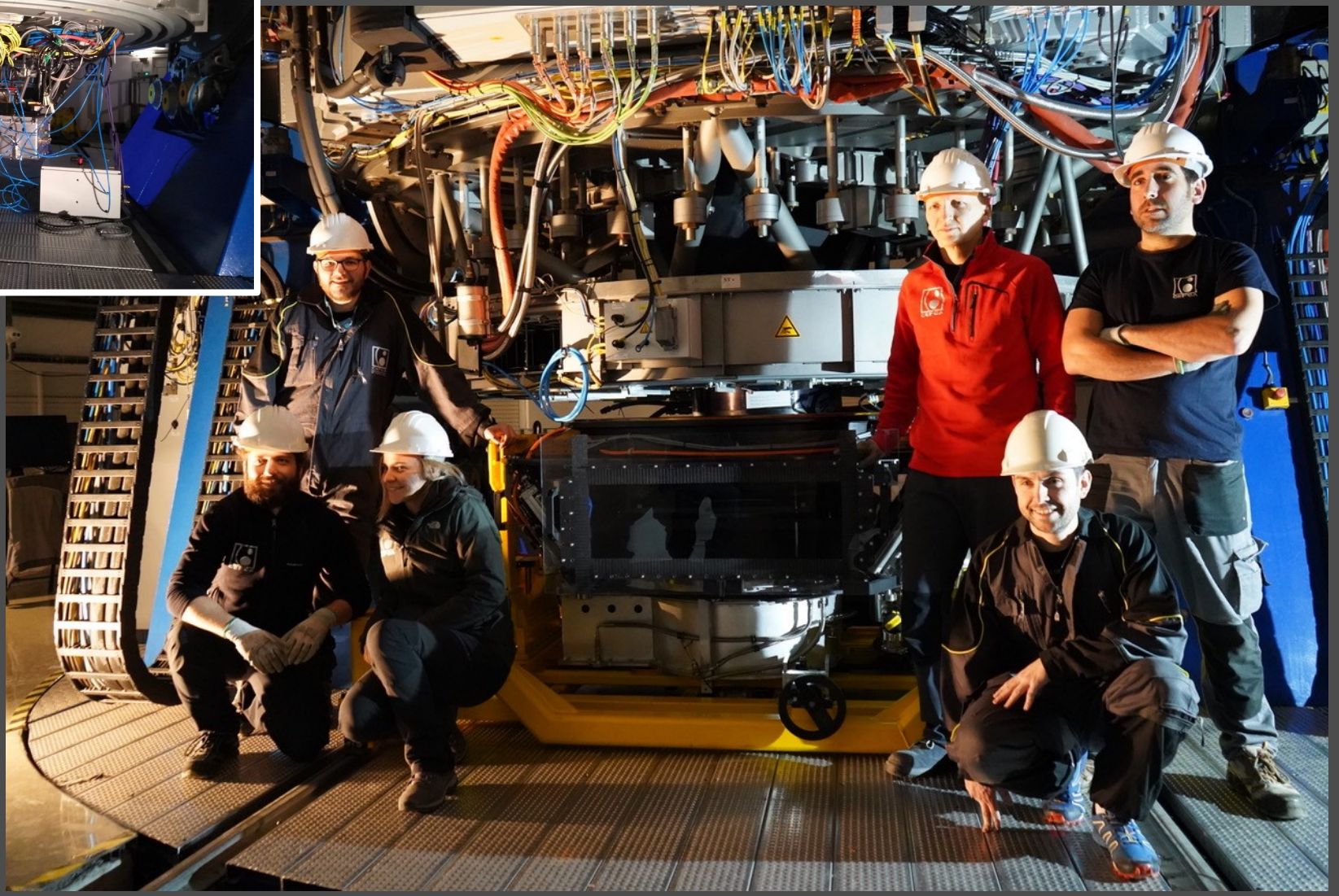


Schetch of JST/T250 (OAJ) – AMOS and a observed pseudo-espectrum. **www.cefca.es**

JPCam attached to JST/T250 (2020-02-13)



Looking forward first light



Moltes gràcies!

Credits: Óscar Blanco Varela