



Sfide per l'astronomia nel prossimo decennio: dalla formazione del Sistema Solare all'Origine (e Destino) dell'Universo

A. Ederoclite



Un secolo fa...

- Il Sistema Solare aveva otto pianeti
- Non sapevamo di cosa sono fatte le stelle
- Non conoscevamo l'origine delle galassie
- Ignoravamo l'espansione dell'Universo
- L'unica forma di fare astronomia era nell'ottico (400-800nm)

Un secolo di scoperte

Le Stelle



Le stelle sono fatte di idrogeno.

“indubbiamente la più brillante tesi di laurea mai scritta in astronomia” (O. Struve)

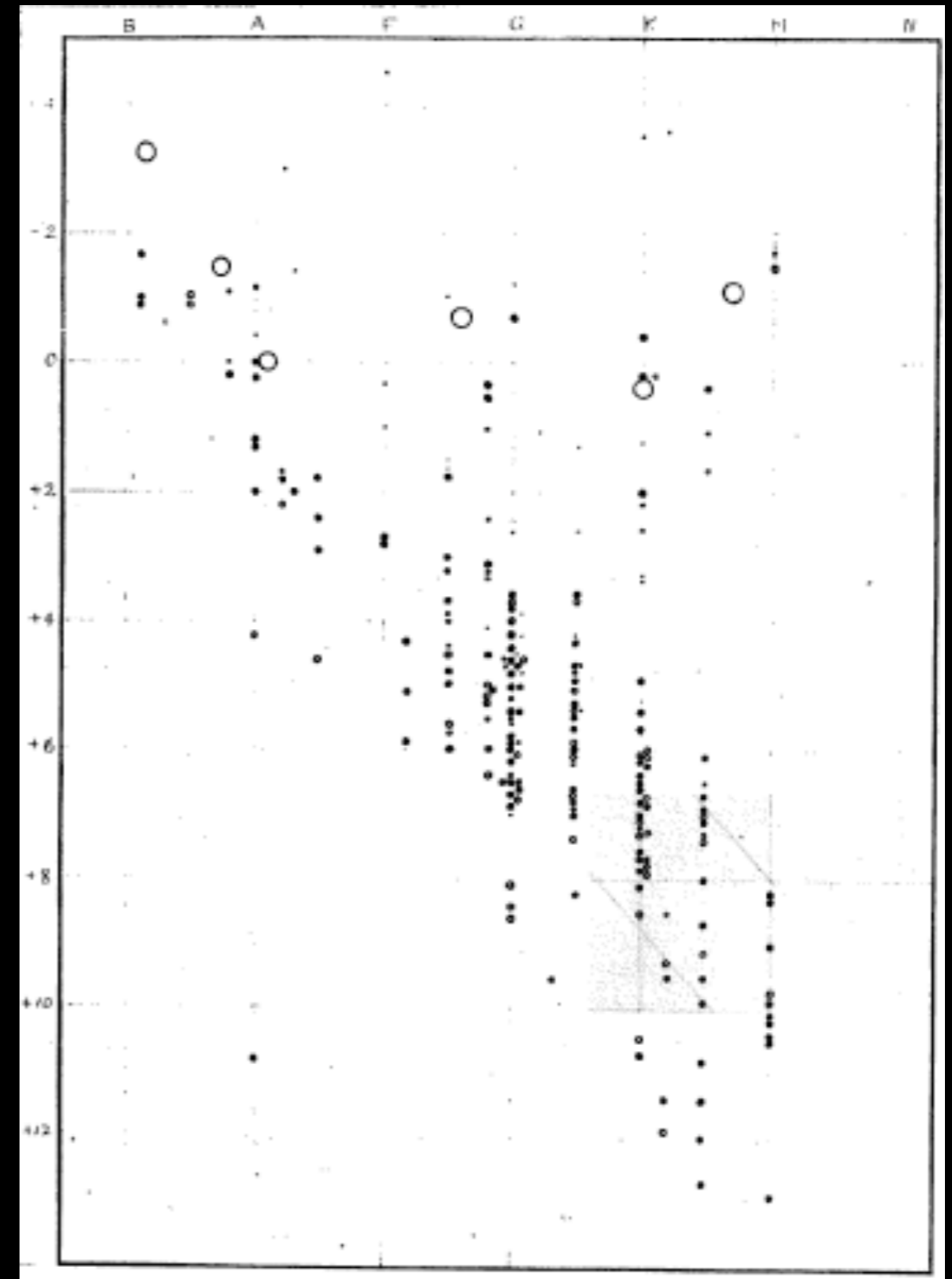
Cecilia Payne-Gaposchkin (1900 - 1979)



Le reazioni termonucleari alla base
dell'evoluzione stellare
Hans Bethe (1906 - 2005)

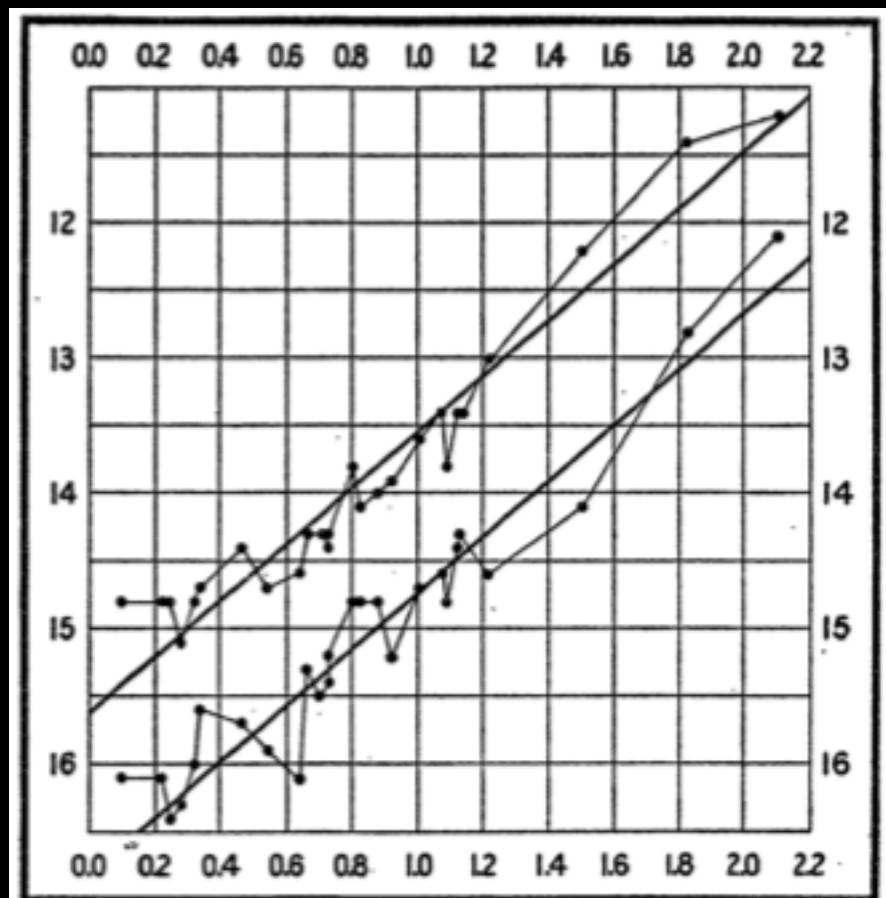
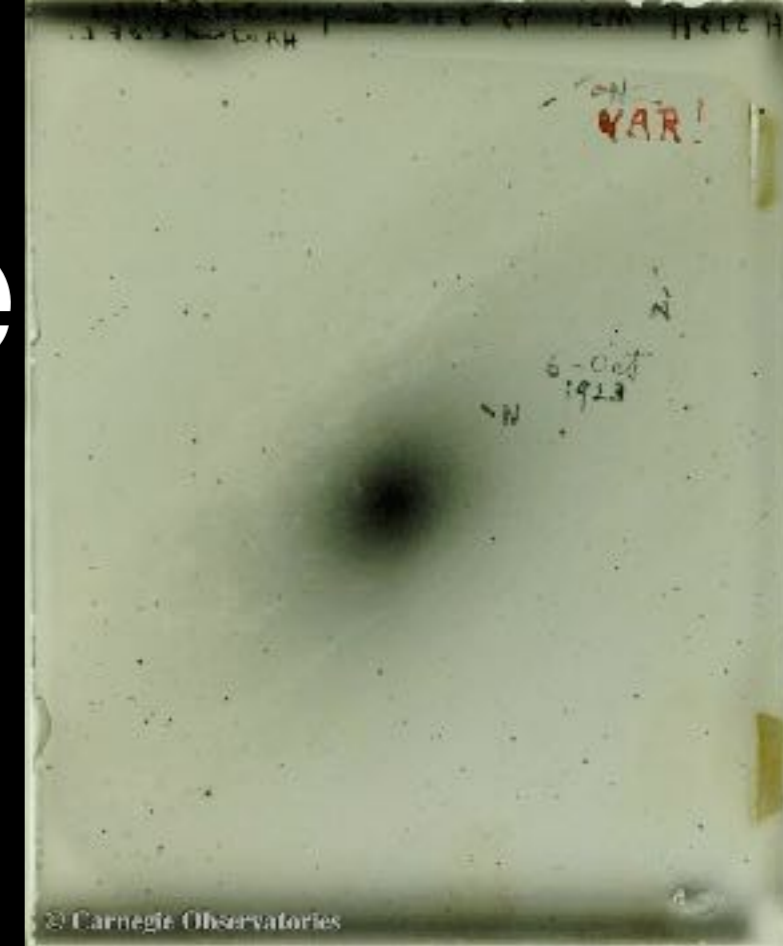
Il diagramma HR

Henry Norris Russell (1877-1957)

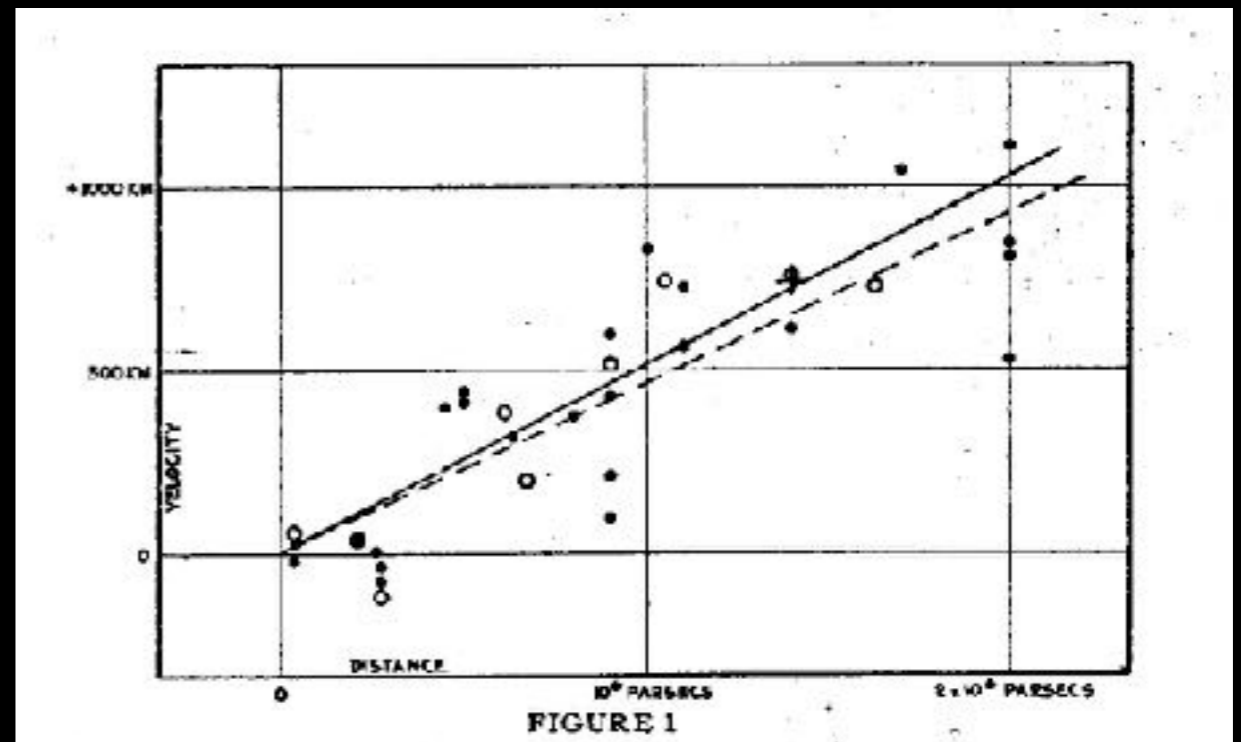


Ejnar Hertzsprung (1873-1967)

Le Galassie

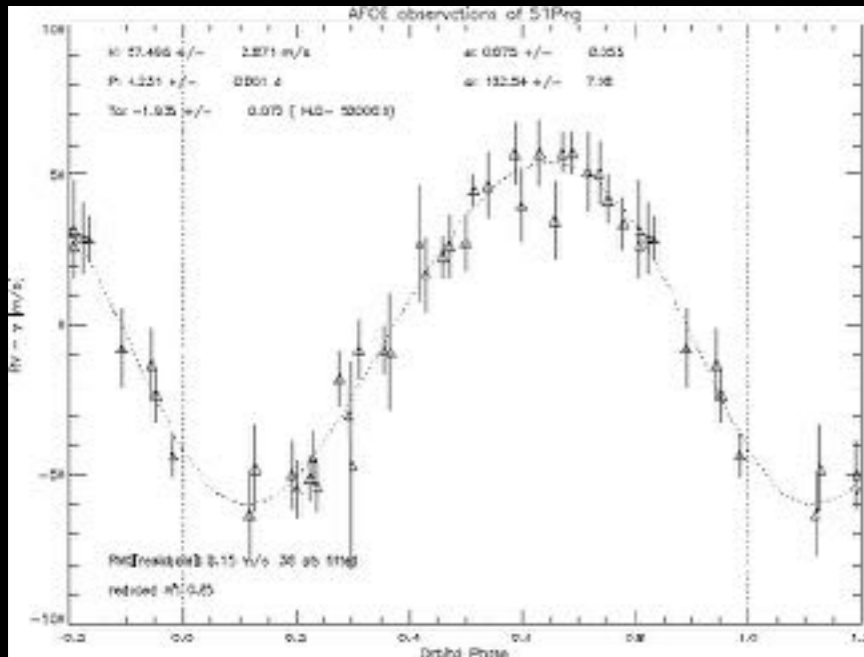


Leavitt & Pickering 1912

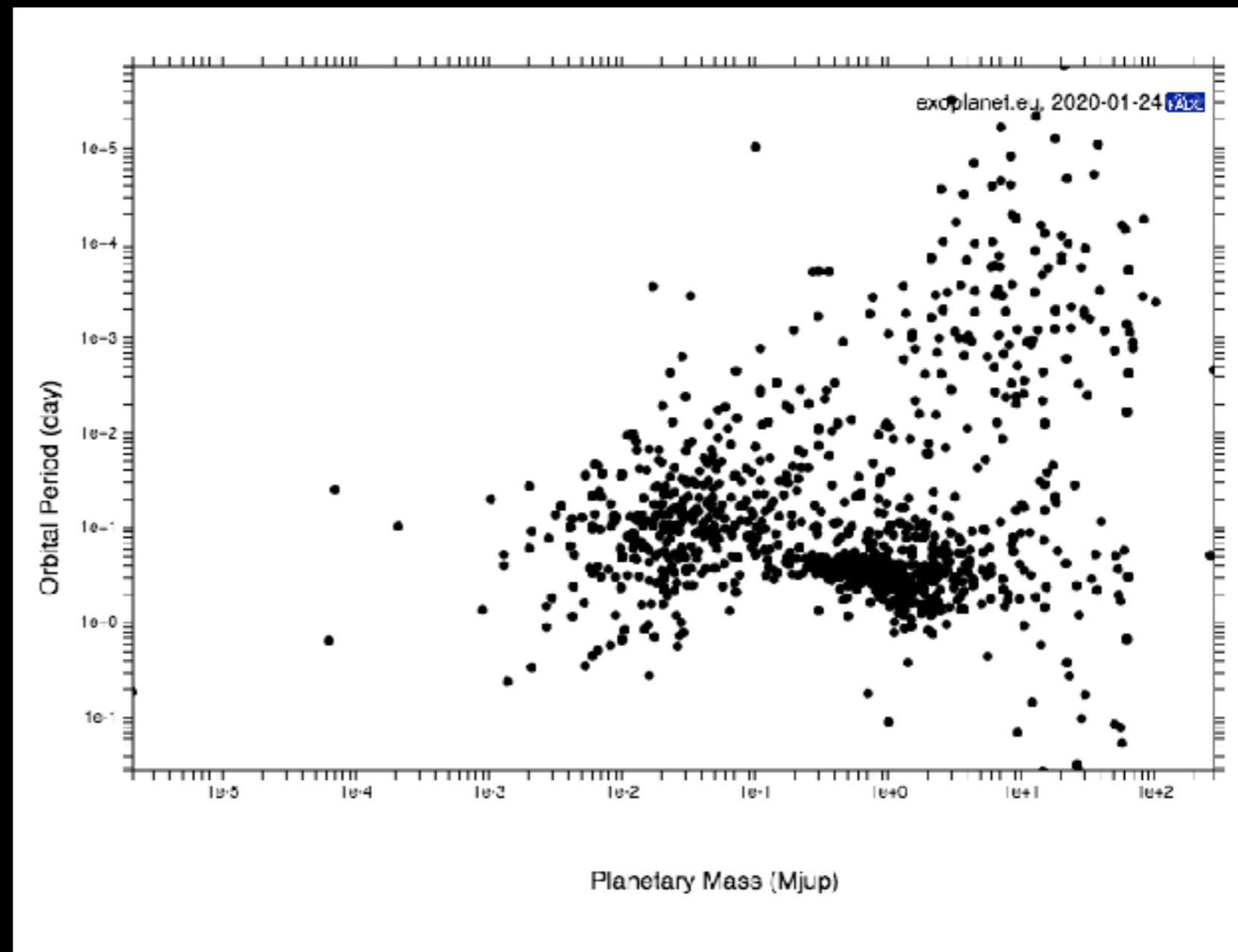
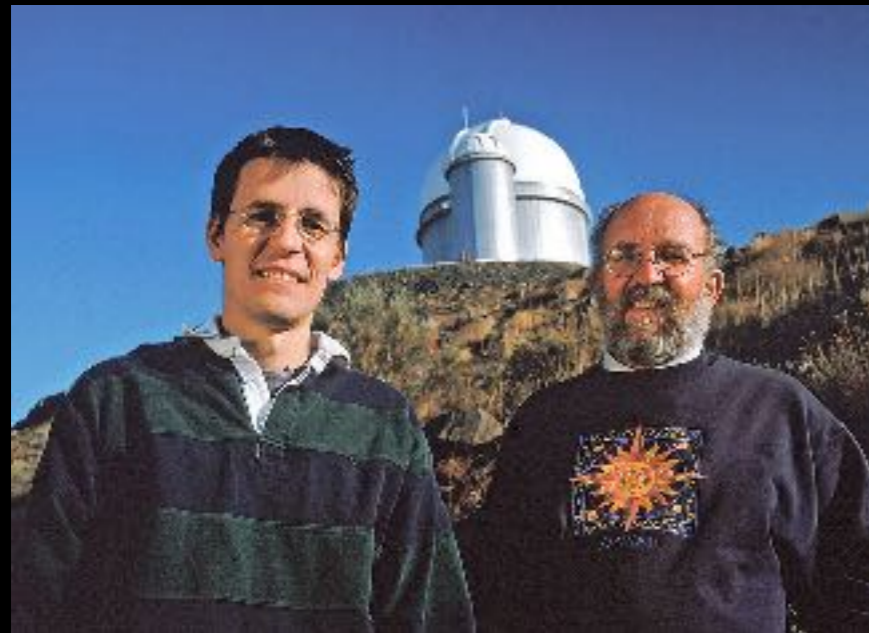


Hubble 1921

I Pianeti Extrasolari

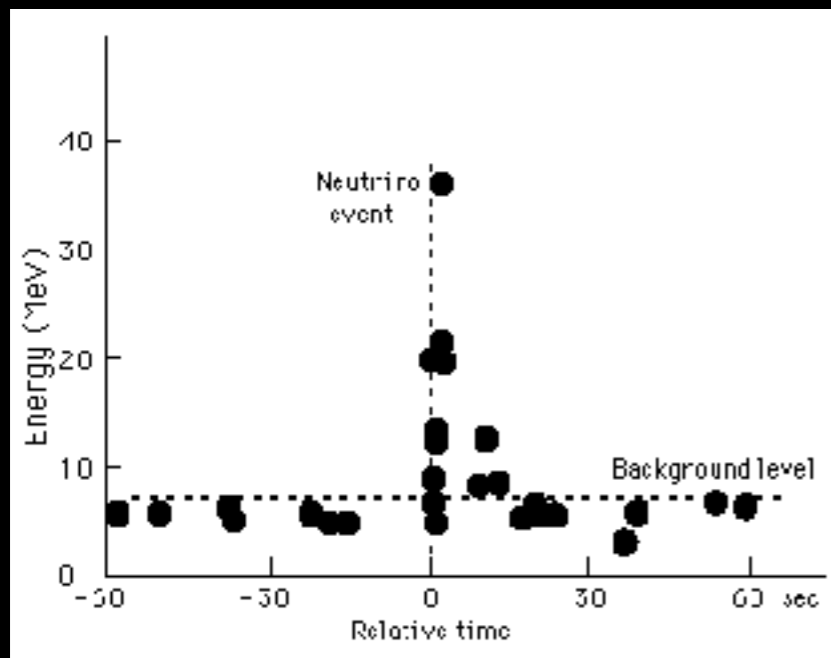
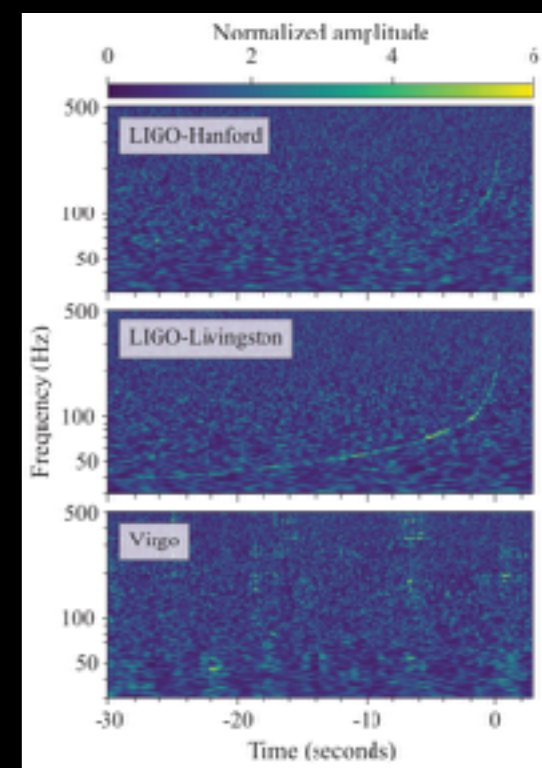
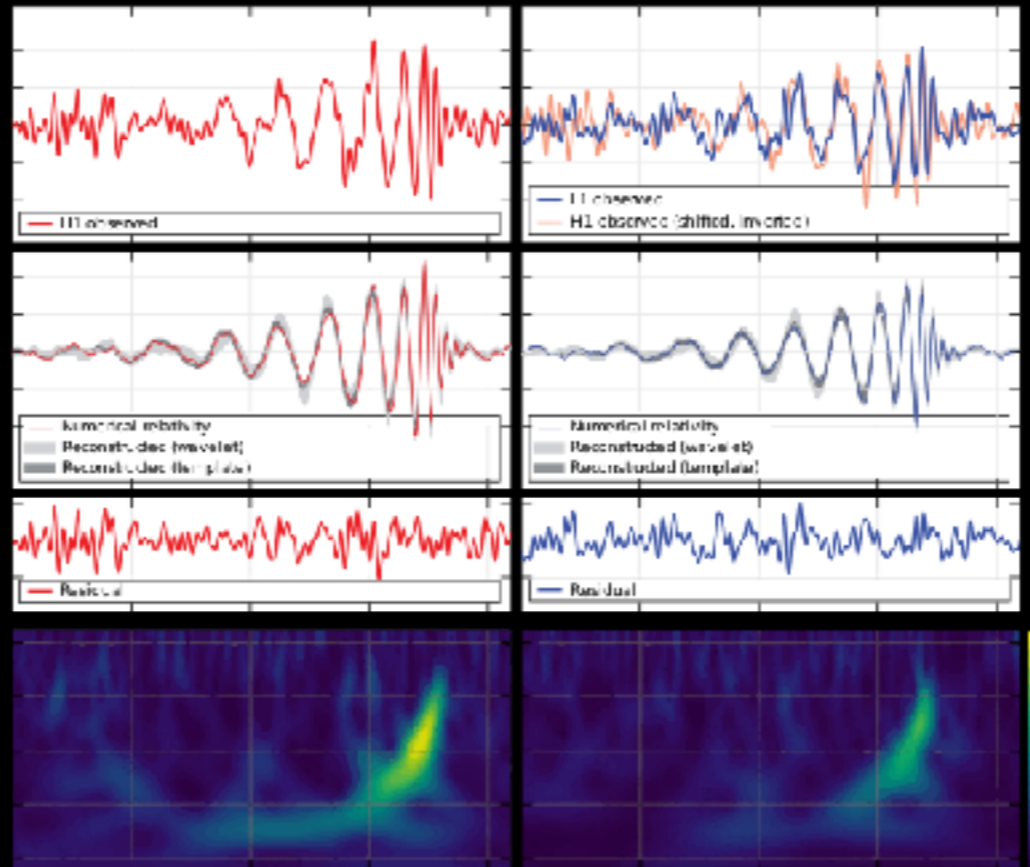


Mayor & Queloz (1994)



<http://exoplanet.eu/>
update : Jan. 24, 2020 (4169 planets)

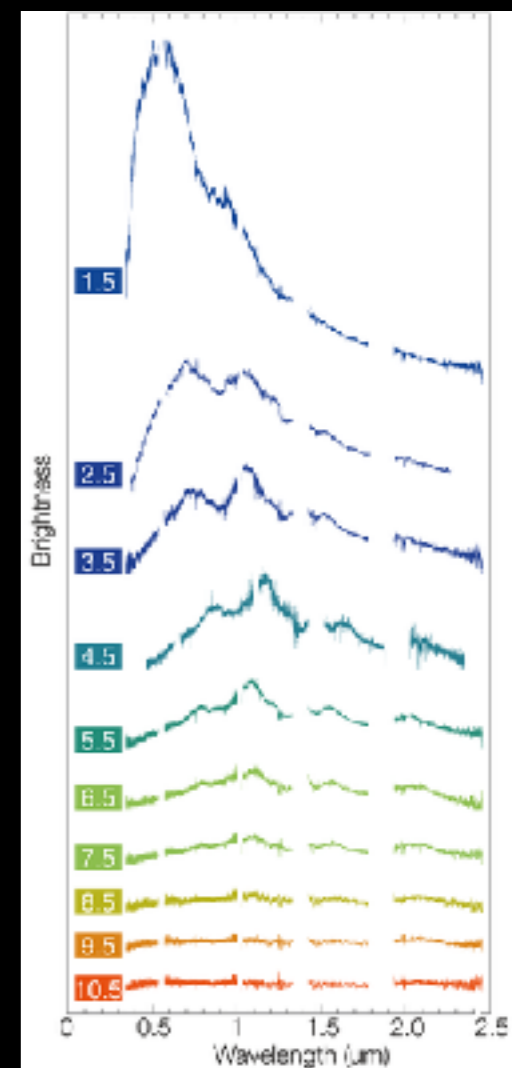
Astronomia “Multi-Messenger”



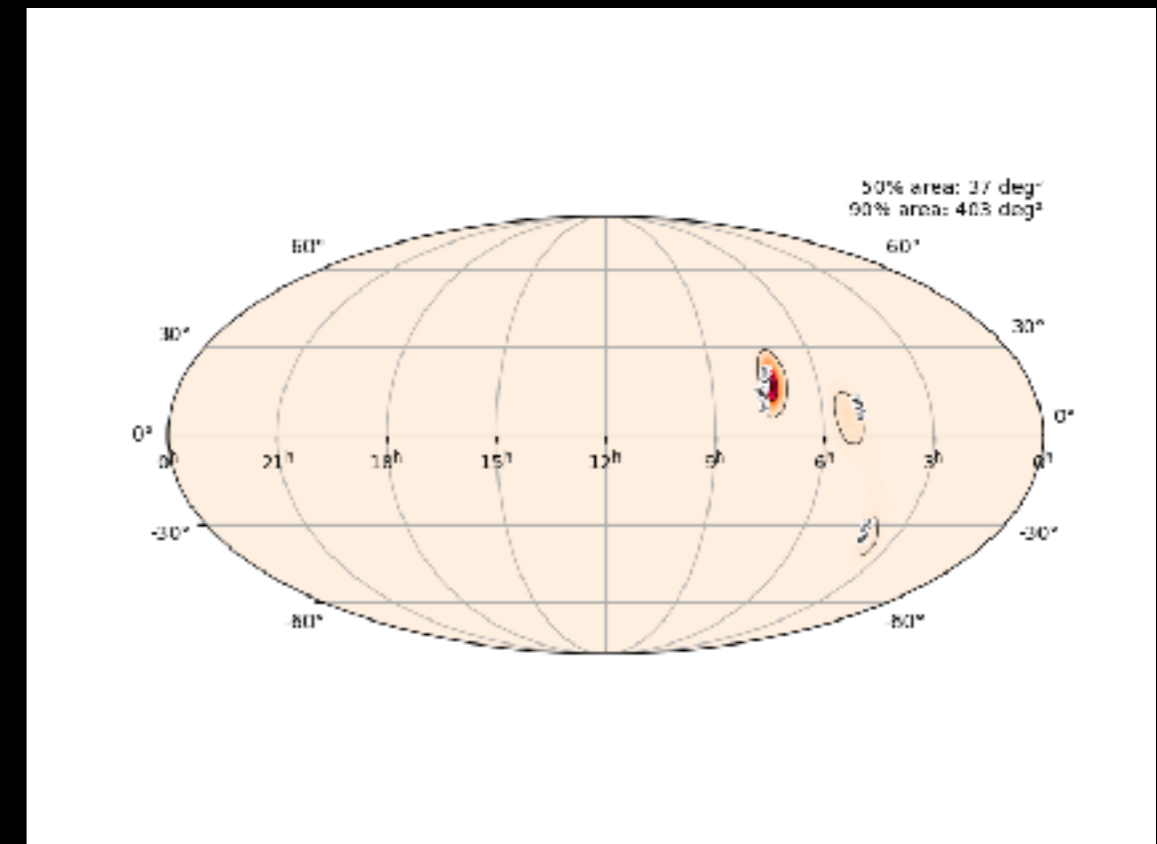
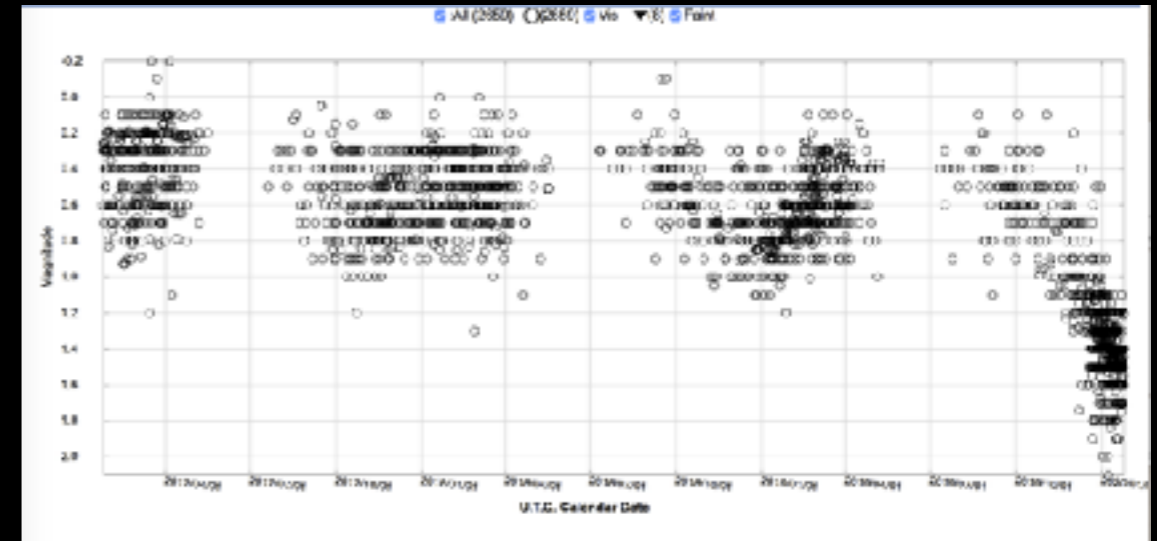
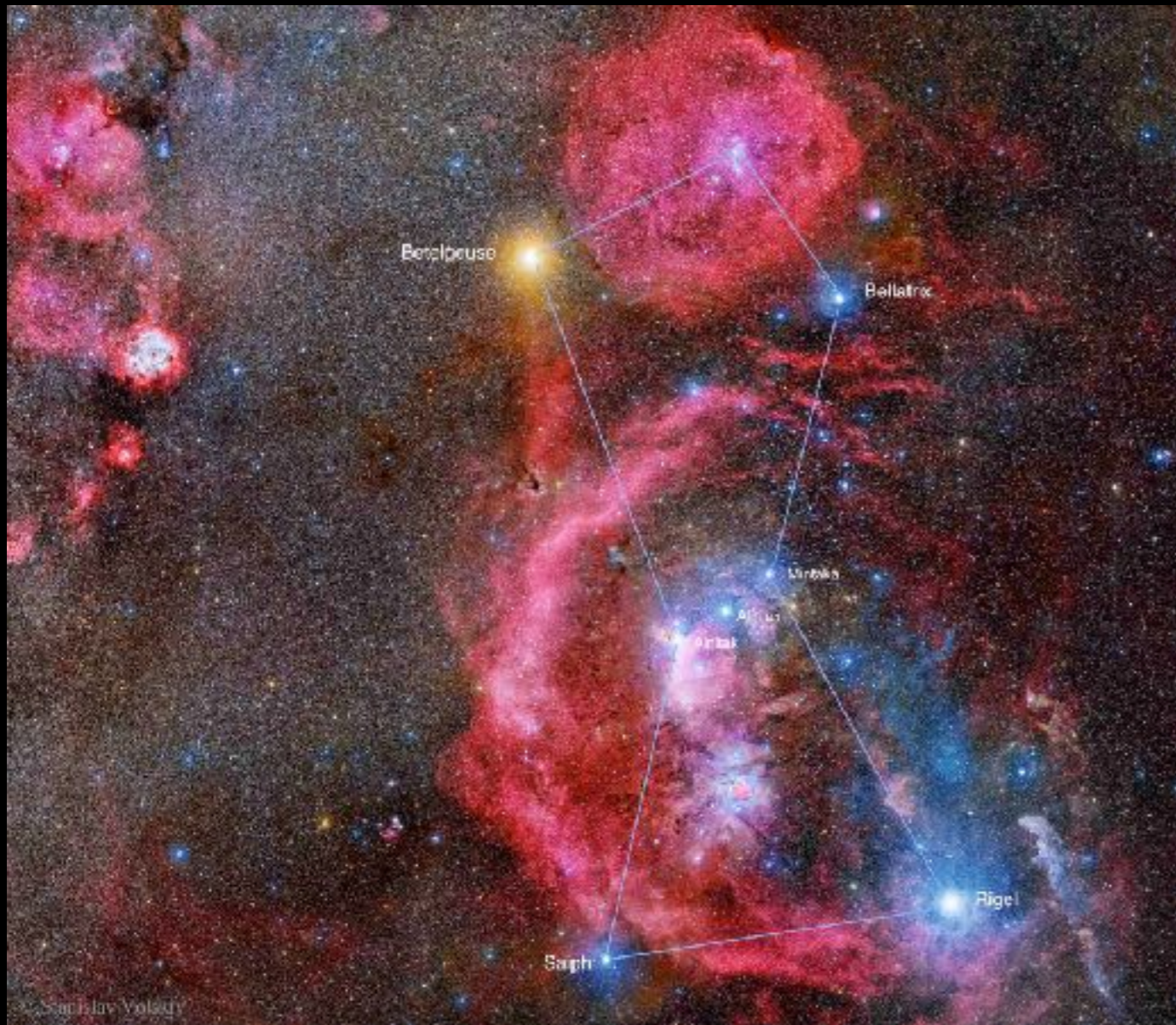
SN 1987a

GW150914

GW170817



Betelgeuse



esposizione di 212 ore

<https://twitter.com/AstroUSP/status/1219630465268752390?s=20>

I Grandi Temi dell'Astronomia Moderna

L'astronomia oggi

- Osservatori
- Teorici
- “minatori di dati”

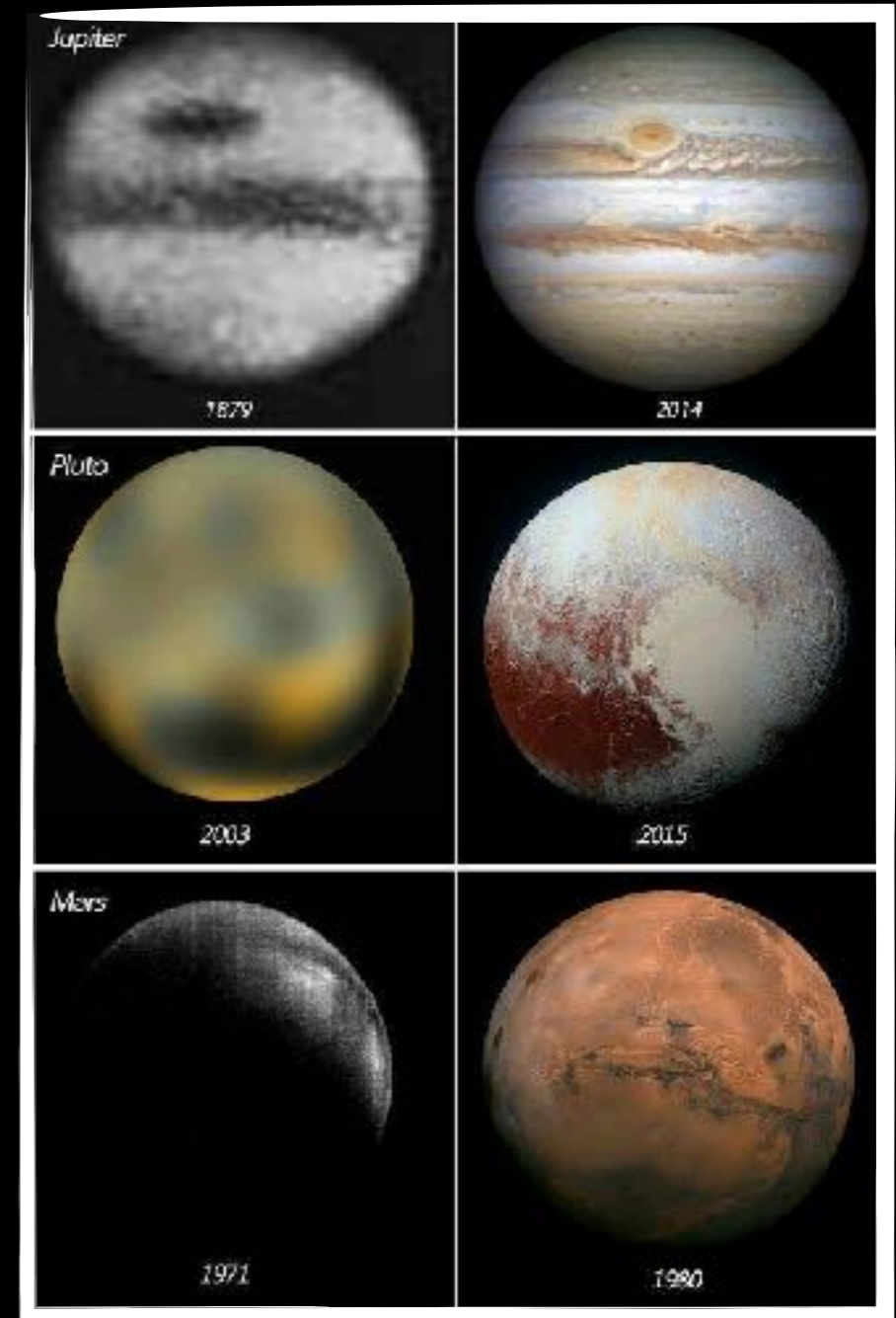


Attenzione:

Spesso siamo così presi dalle minuzie del nostro campo di ricerca da non “vedere” il resto.

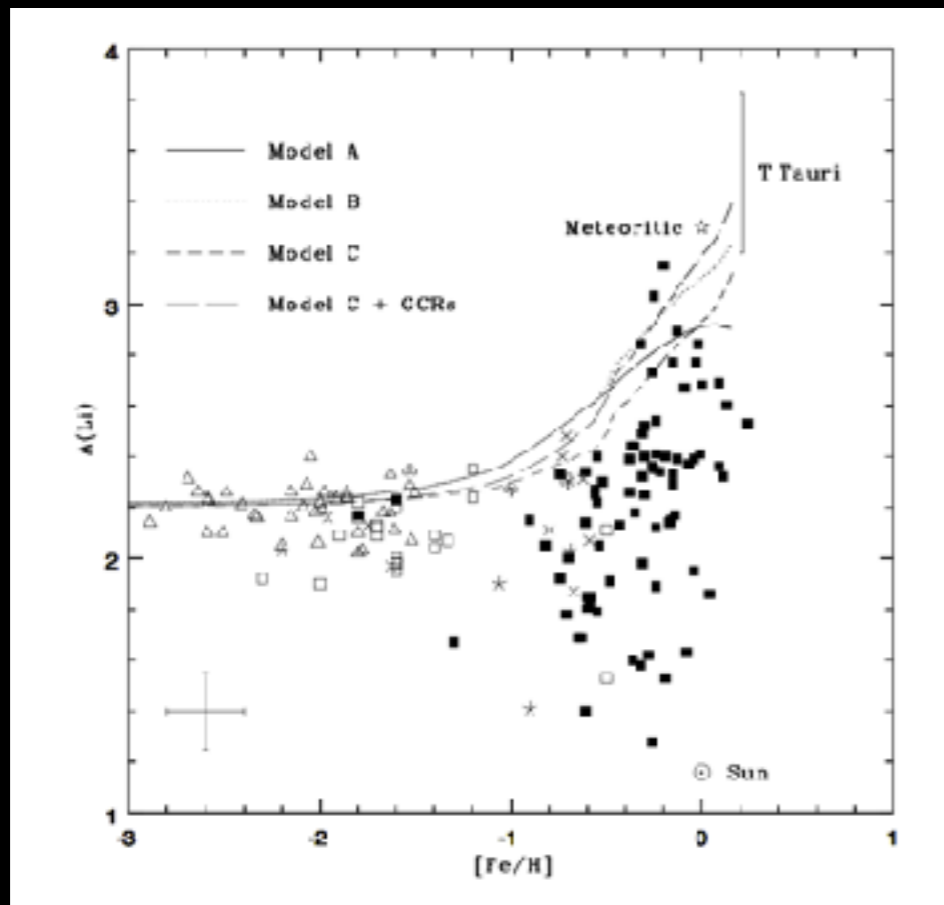
Sistema Solare

- Formazione ed Evoluzione del Sistema Solare
- Polemica sulla "definizione di pianeta"

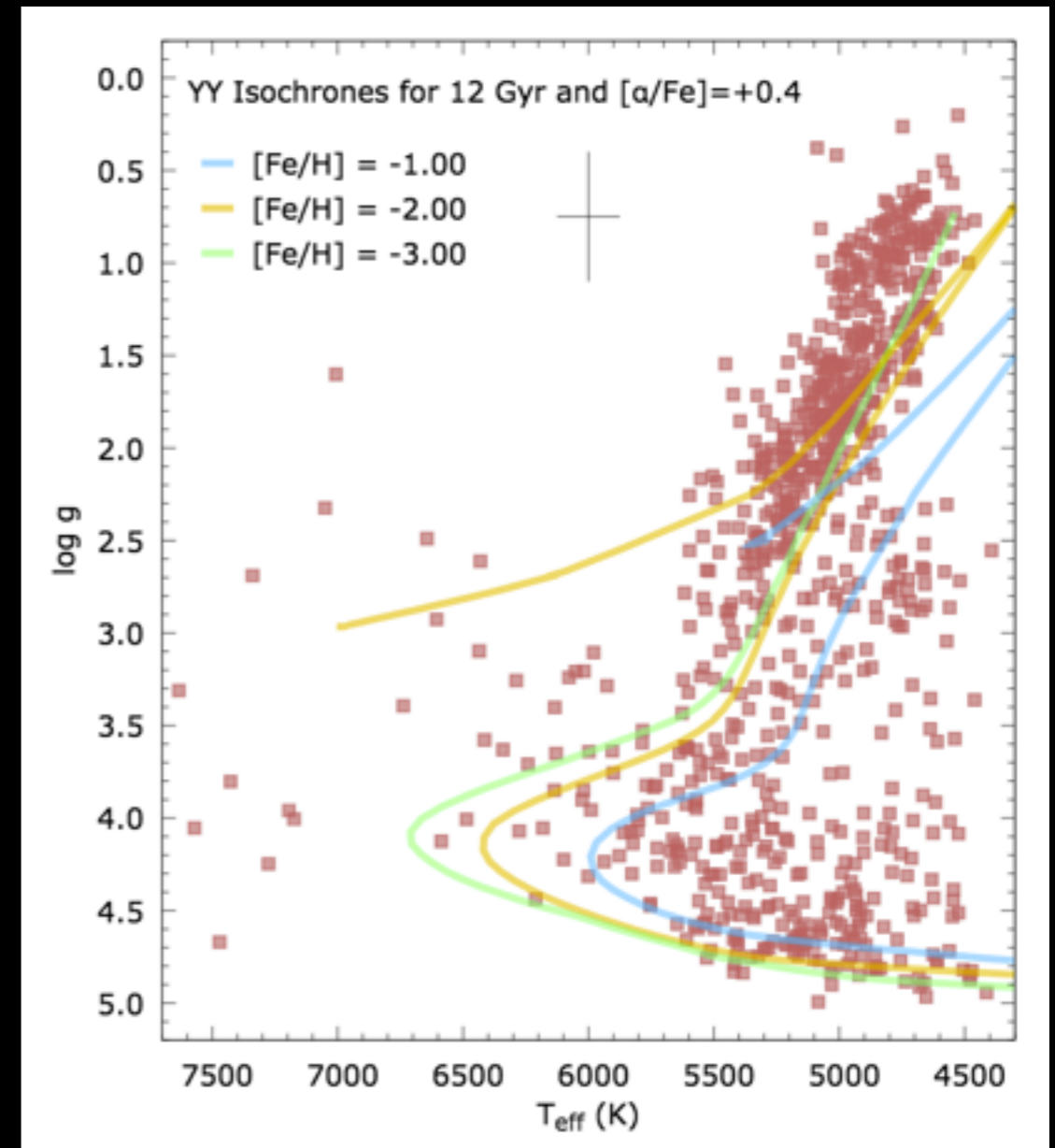


Stelle

- Abbondanze chimiche ed evoluzione chimica



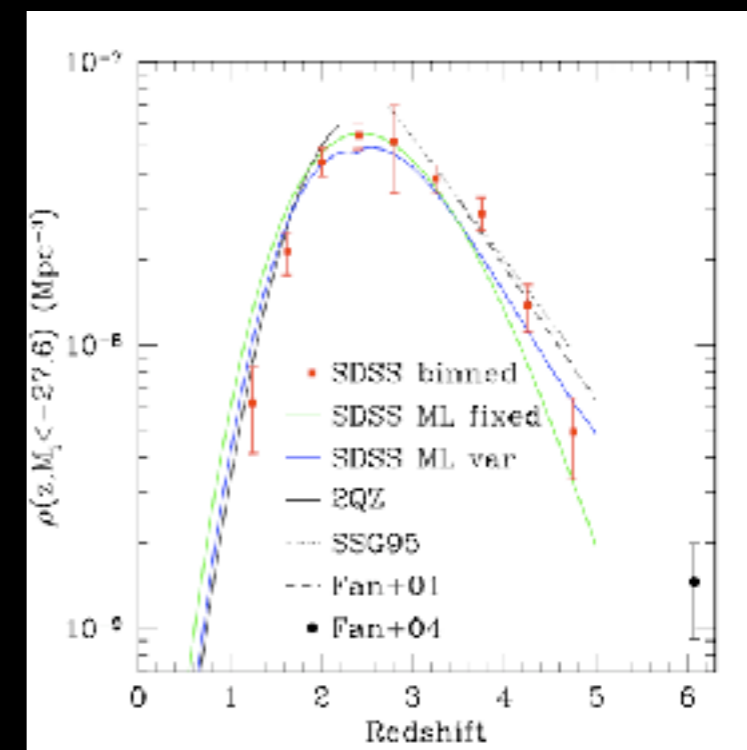
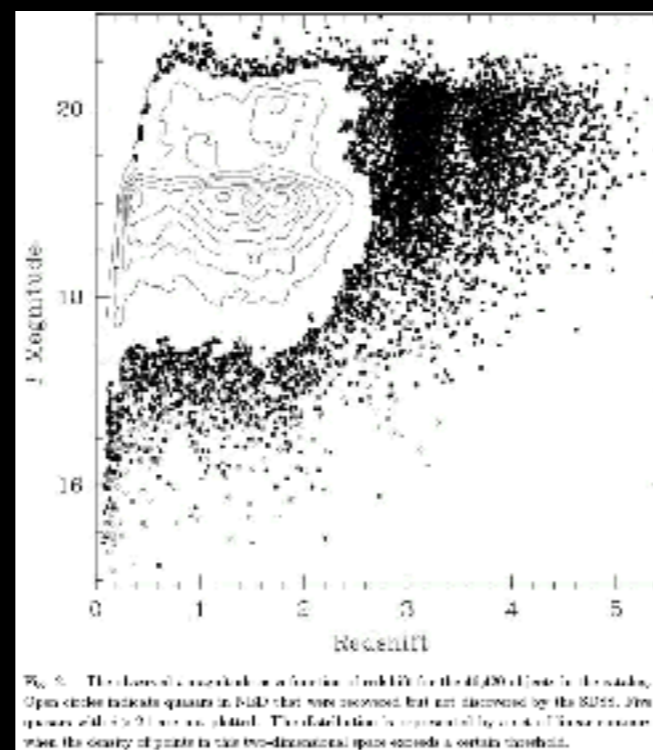
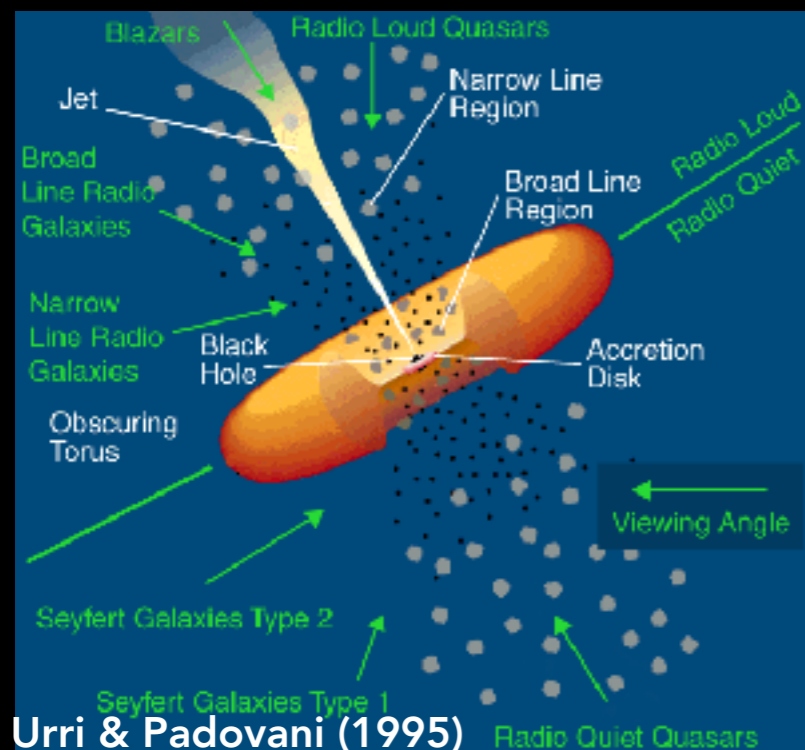
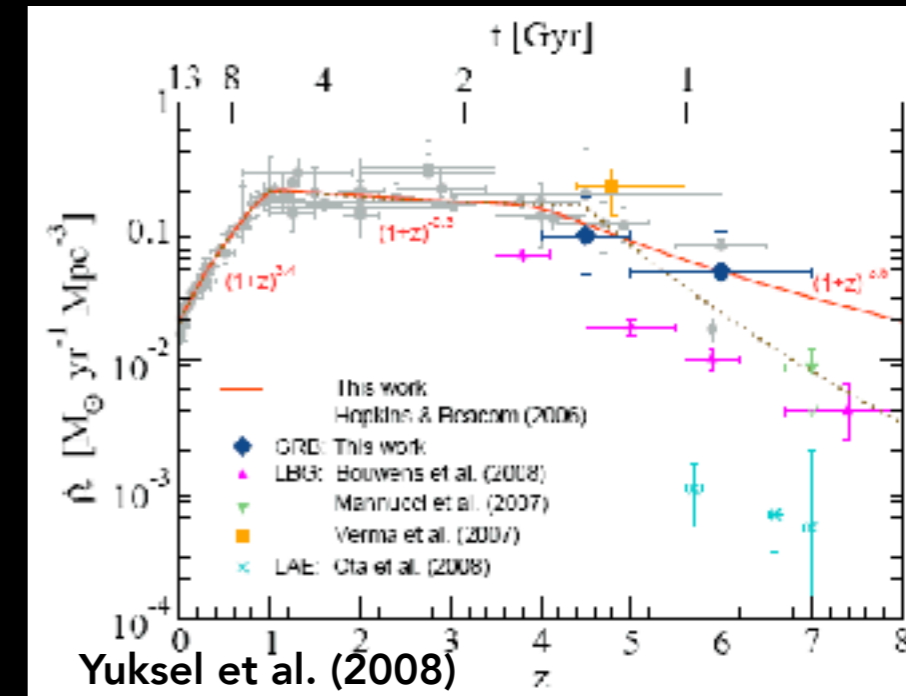
Romano et al. (2001)



Placco et al. (2019)

Galassie

- Evoluzione delle Galassie
- Formazione Stellare
- Ruolo degli AGN

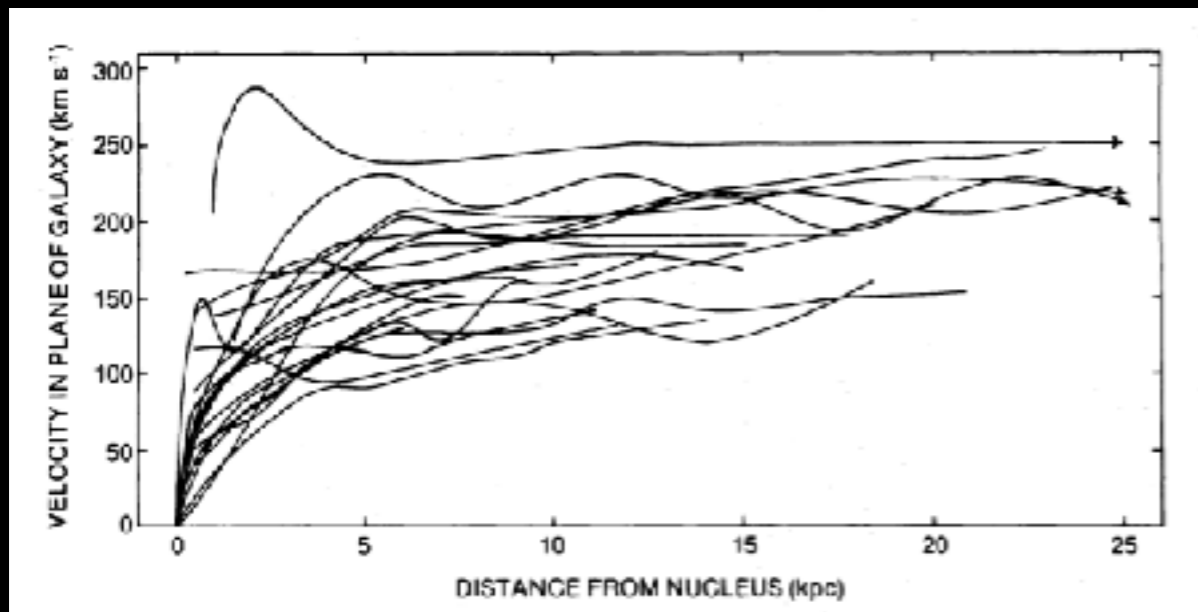


Richards et al. (2006)

Cosmologia

Il nostro modello cosmologico funziona (?) sulla base di :

- Materia Oscura
- Energia Oscura



Rubin et al. 1980, ApJ, 238..471R

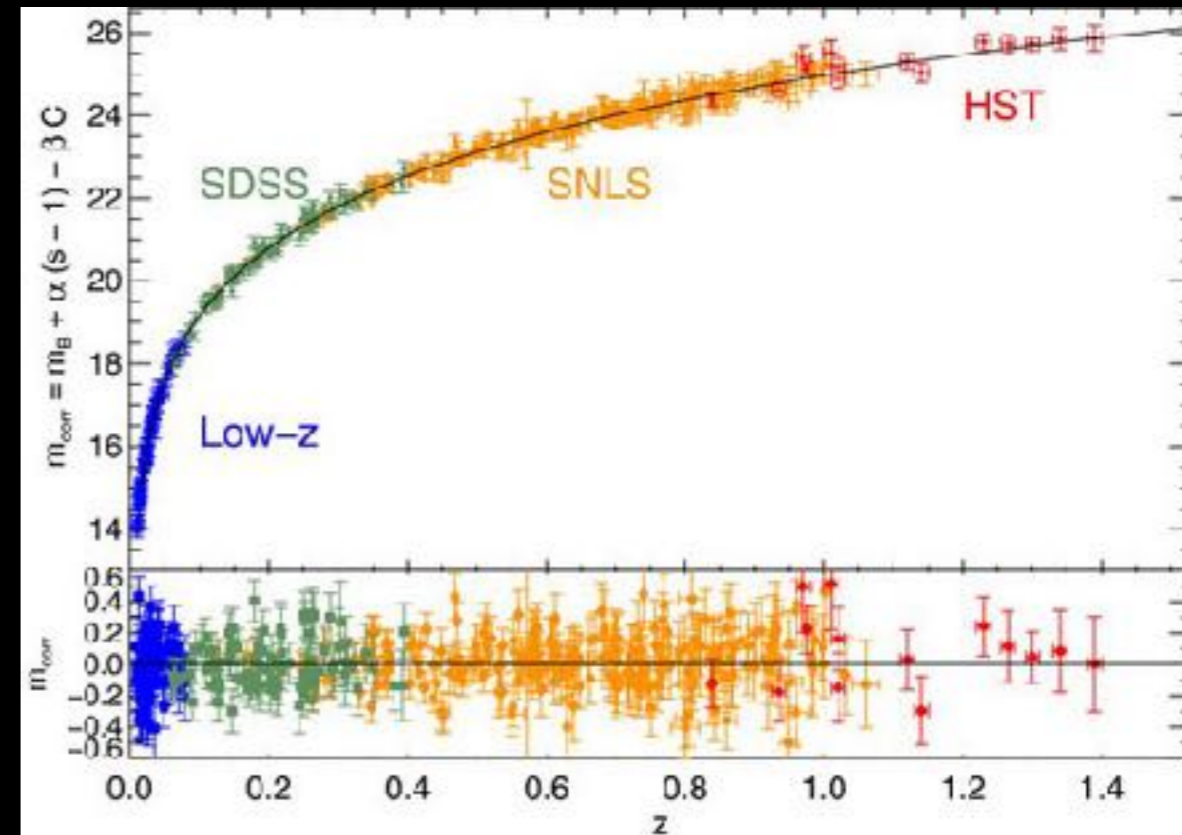


Photo: Roy Kaltschmidt. Courtesy: Lawrence Berkeley National Laboratory

Saul Perlmutter



Photo: Belinda Pretten. Australian National University

Brian P. Schmidt



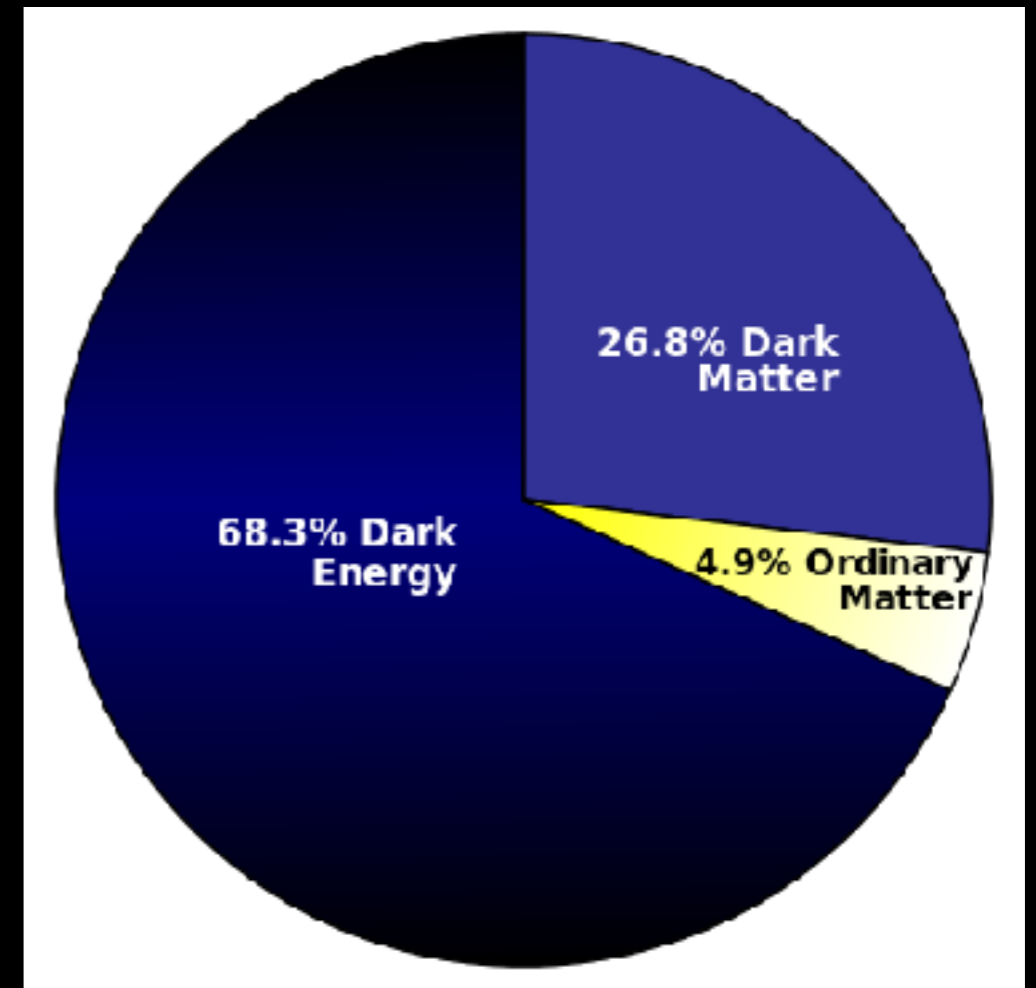
Photo: HomeWood Photography

Adam G. Riess

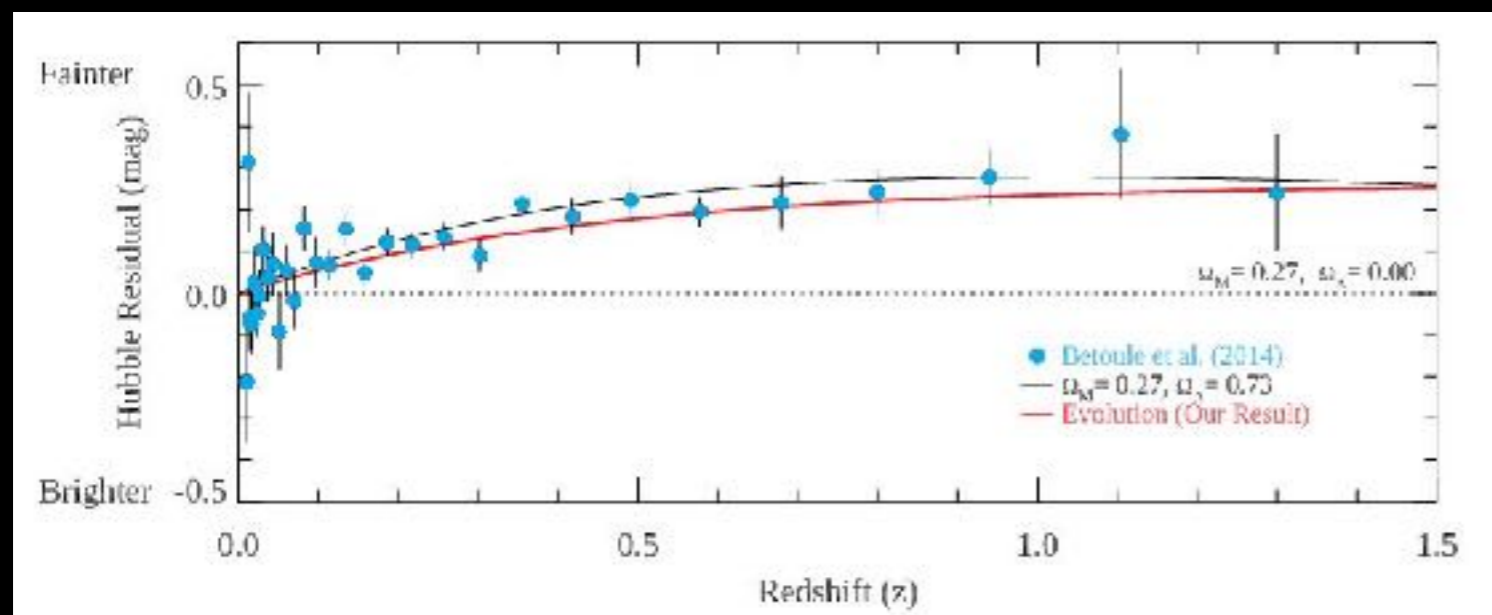
Premio Nobel per la Fisica 2011

“Oscuro”

- La parola “dark” (“oscuro”) definisce la nostra ignoranza
- La materia oscura non interagisce elettromagneticamente ma solo gravitazionalmente (ovvero, no neutrini)



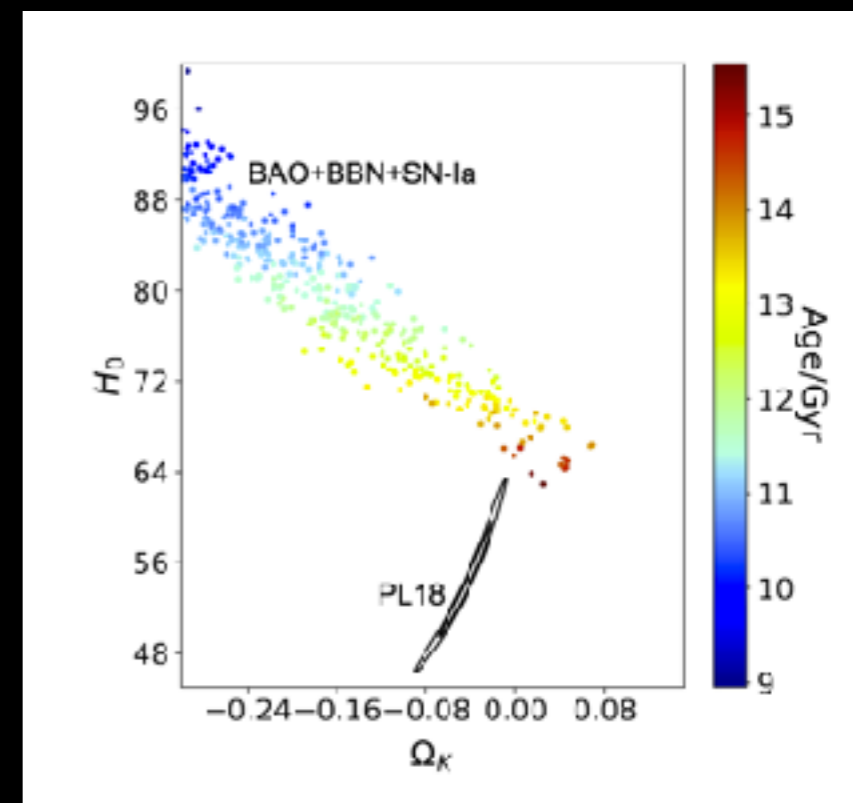
Esiste l'Energia Oscura?



Kang et al. (2019)

$\Lambda = 0?$

Magari le SN non sono così "facili" da standardizzare come pensavamo?

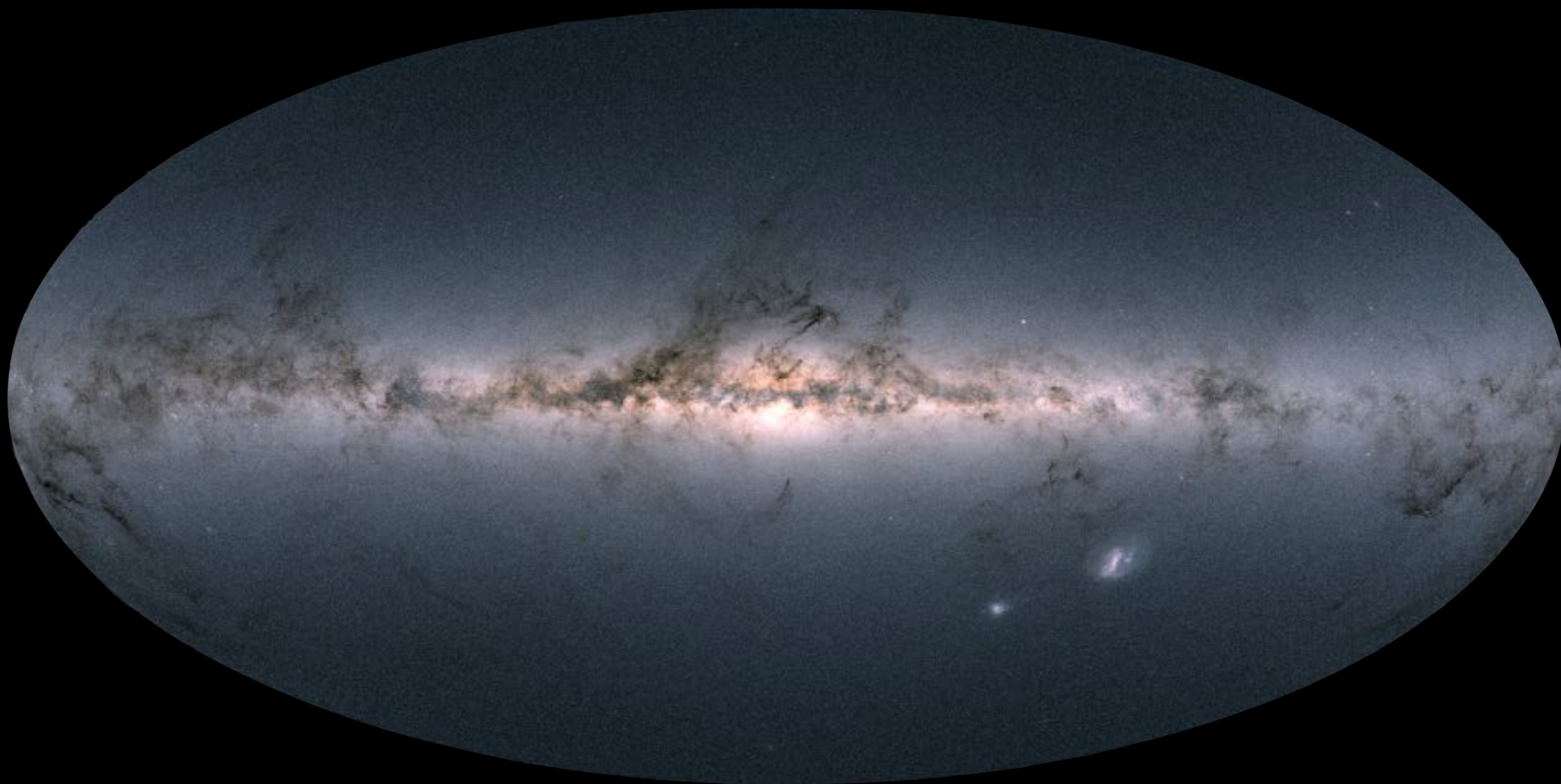


Di Valentino, Melchiorri & Silk (2019)

Nuova analisi dei dati di Plank non è allineata con altri risultati cosmologici (nemmeno con le altre analisi dei dati di Plank)

**Come Cerchiamo le
Risposte?**

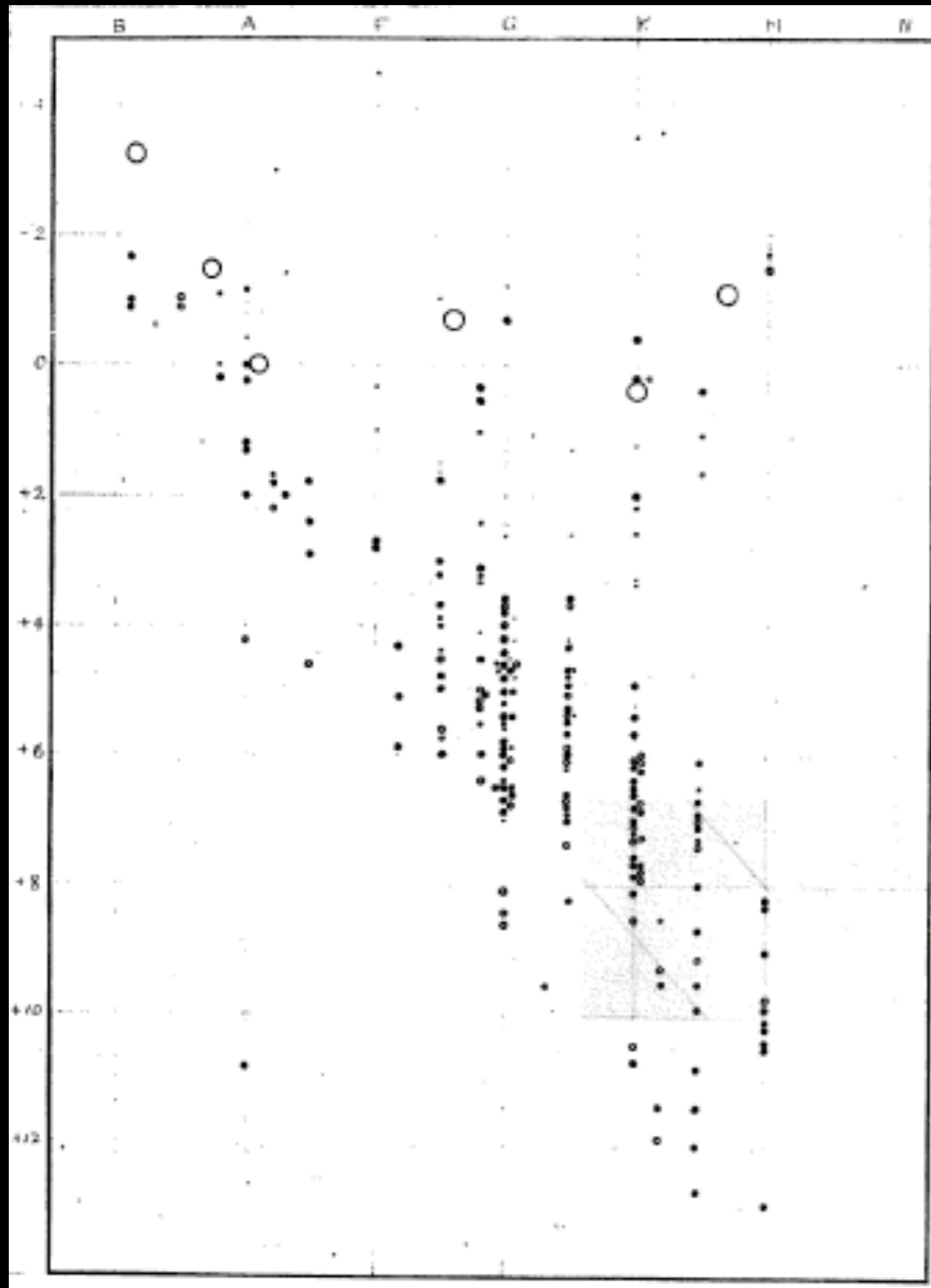
Gaia



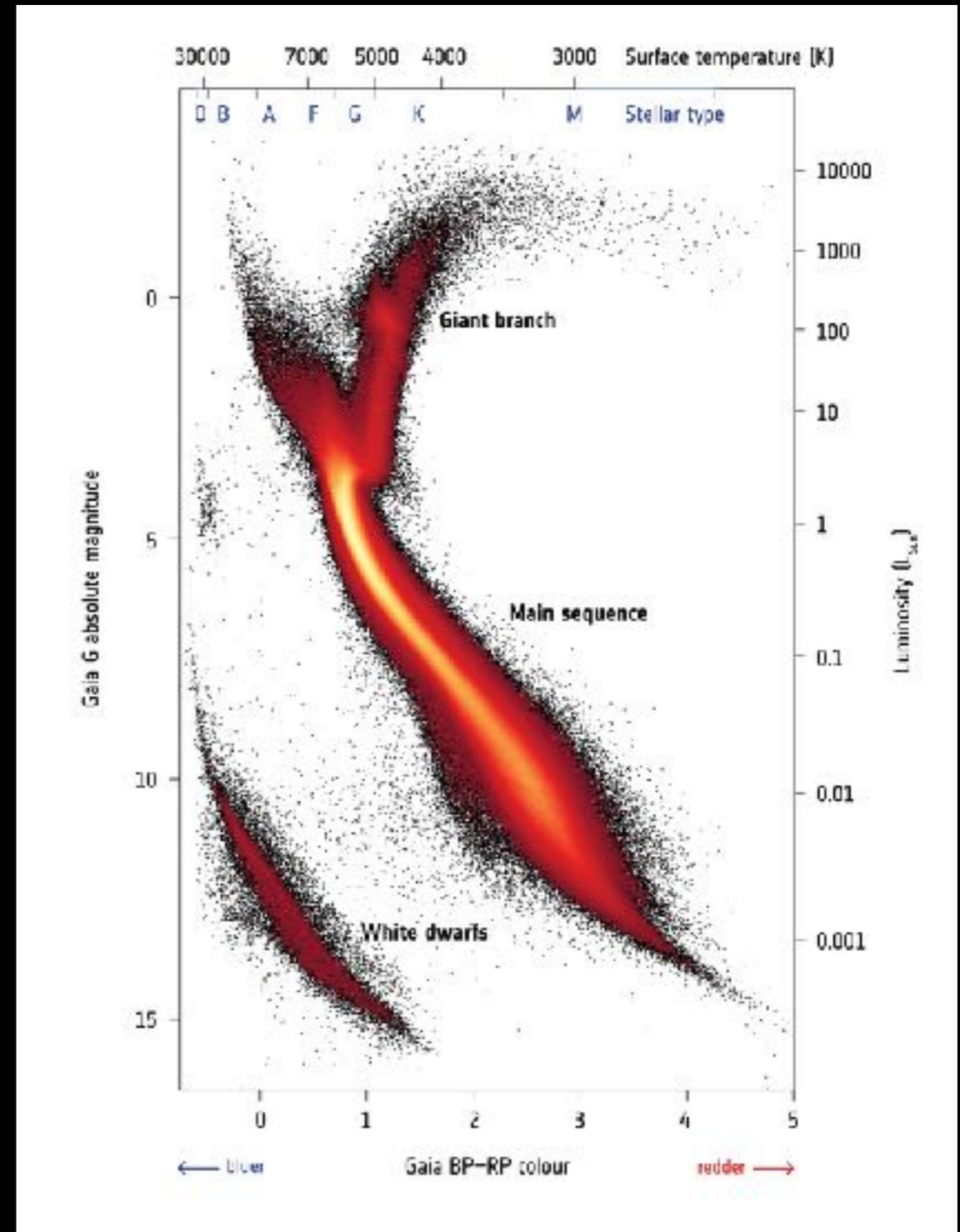
Gaia

Gaia

Il Diagramma HR di Gaia



1.8 miliardi di stelle

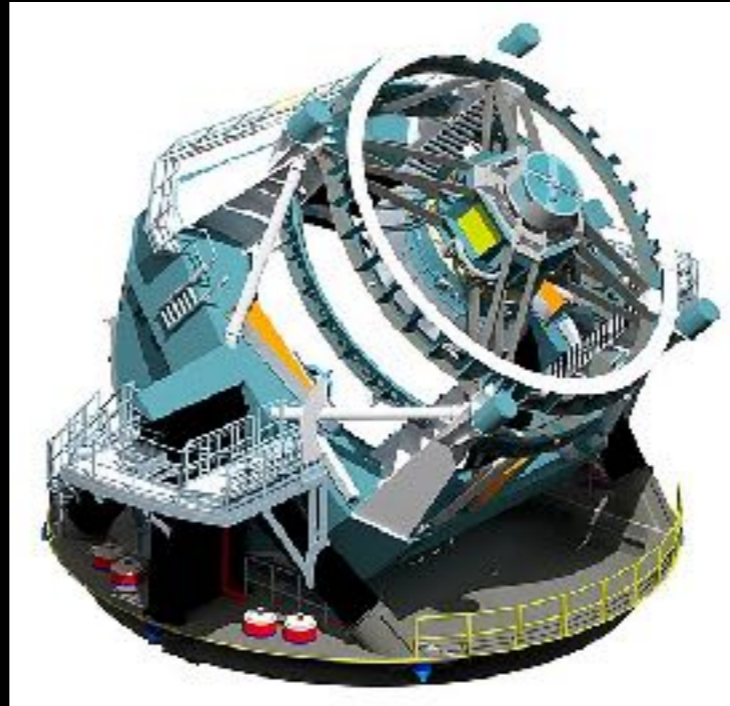
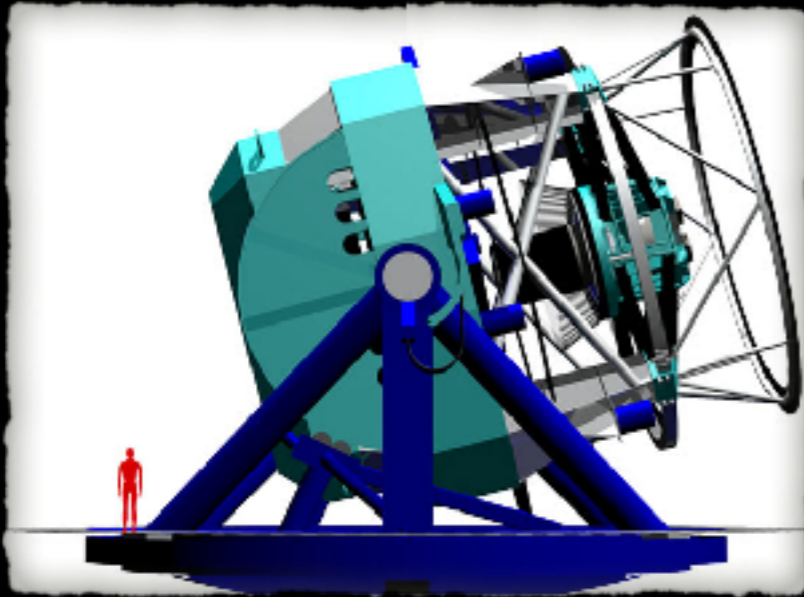


James Webb Space Telescope



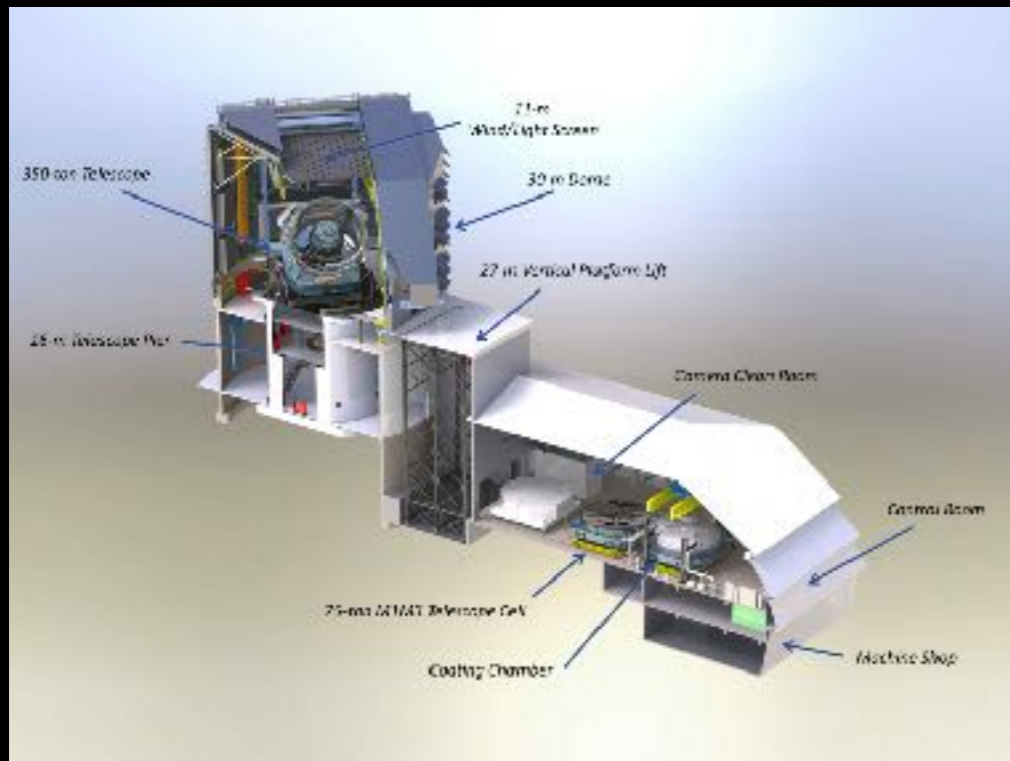
6 metres (segmented)
infrared telescope

Vera Rubin Telescope



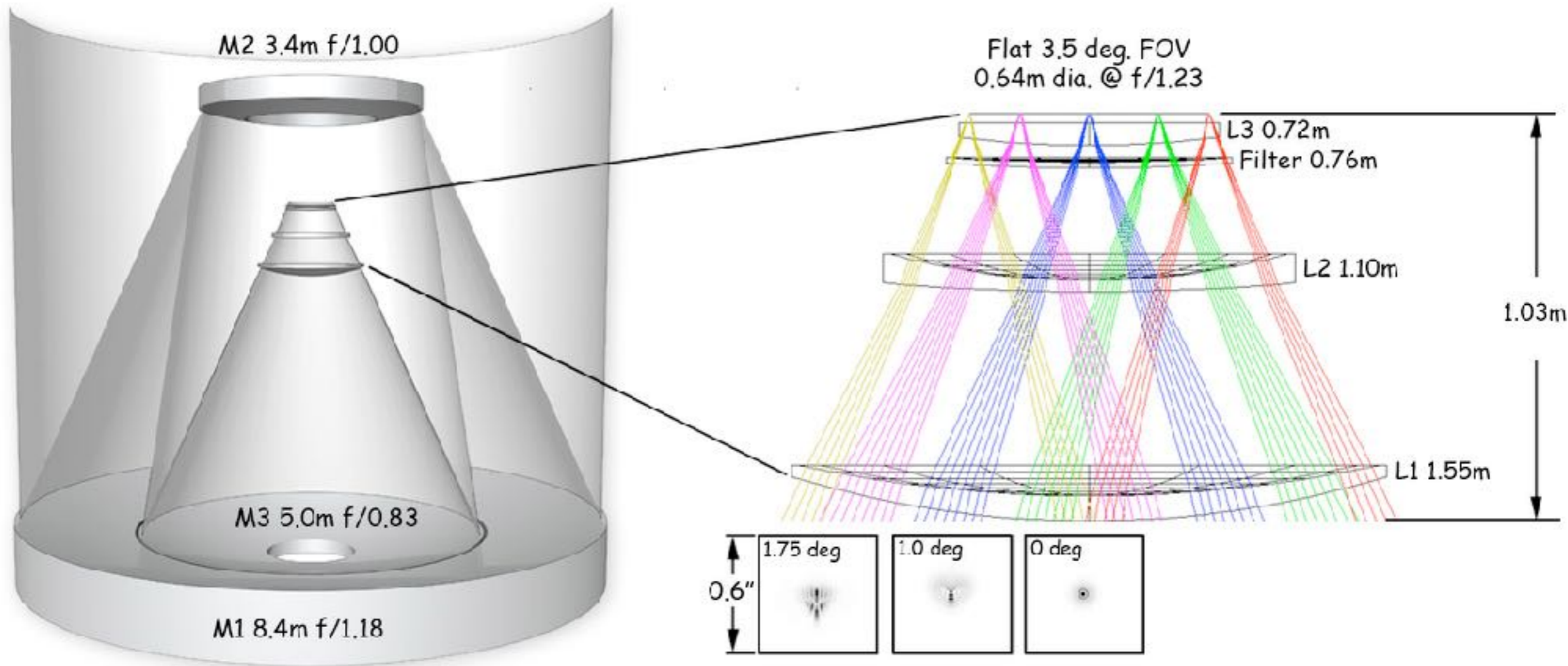
diametro 8m

FoV: 5sq.deg.

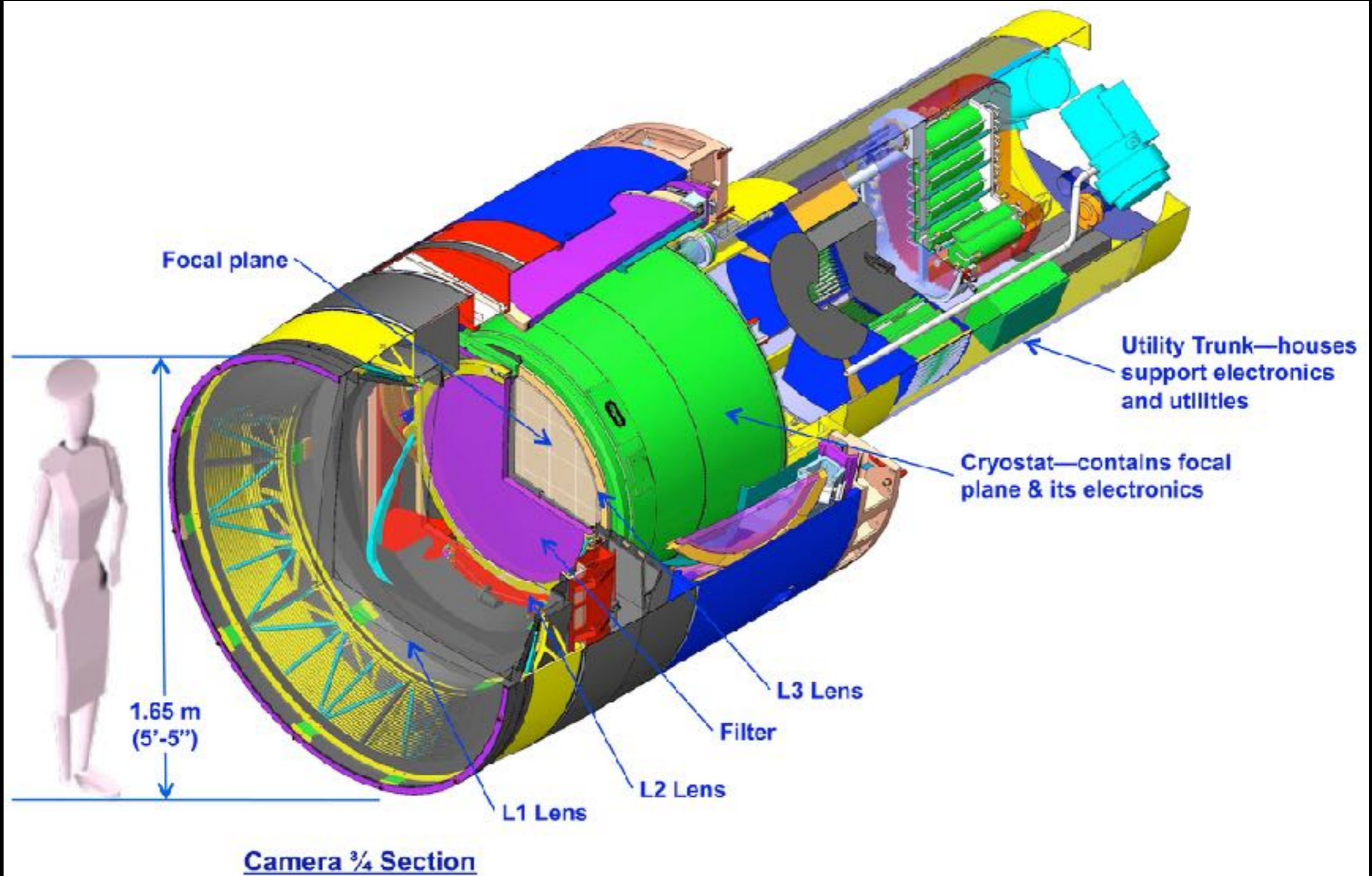


Vera Rubin Telescope

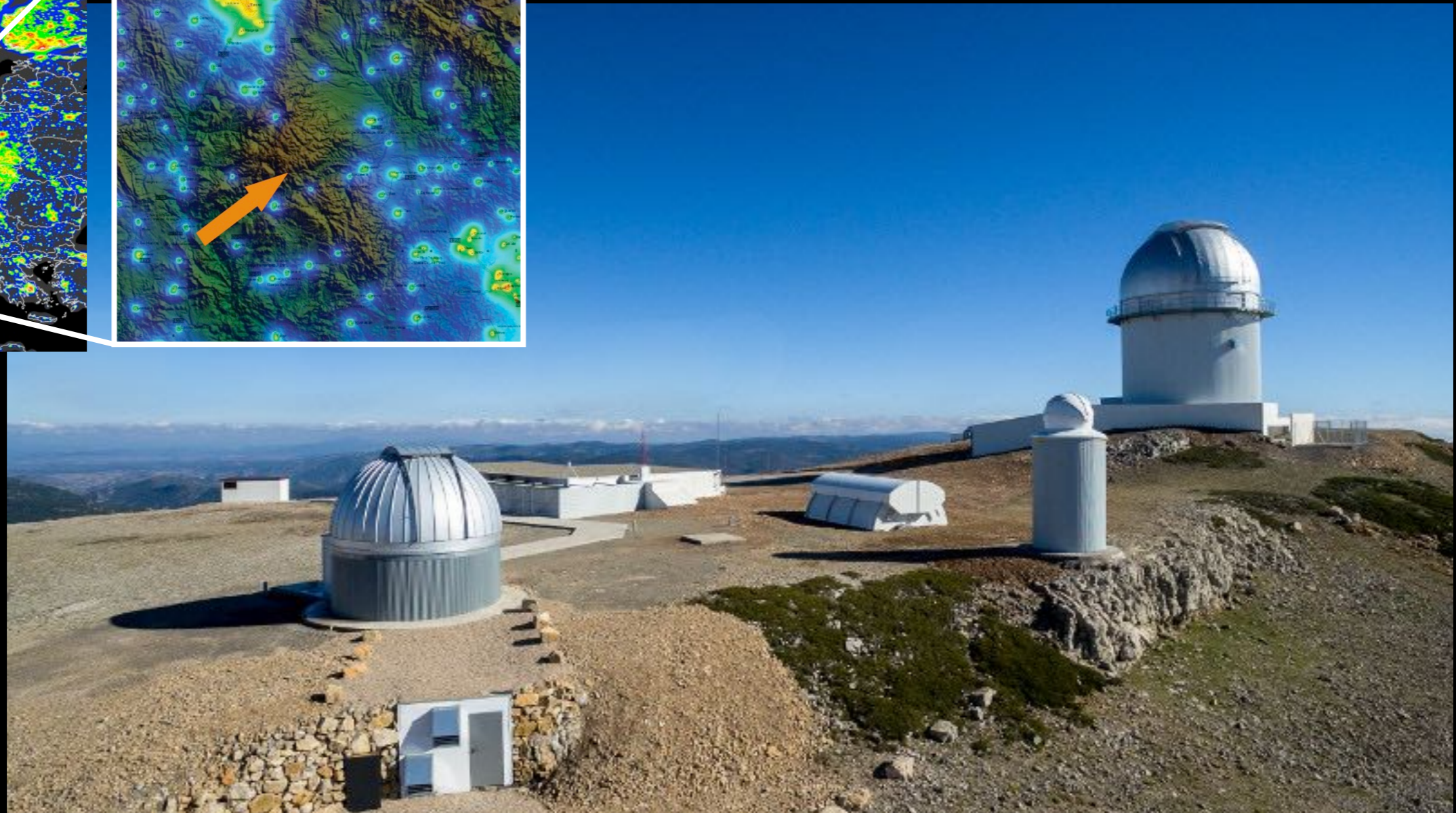
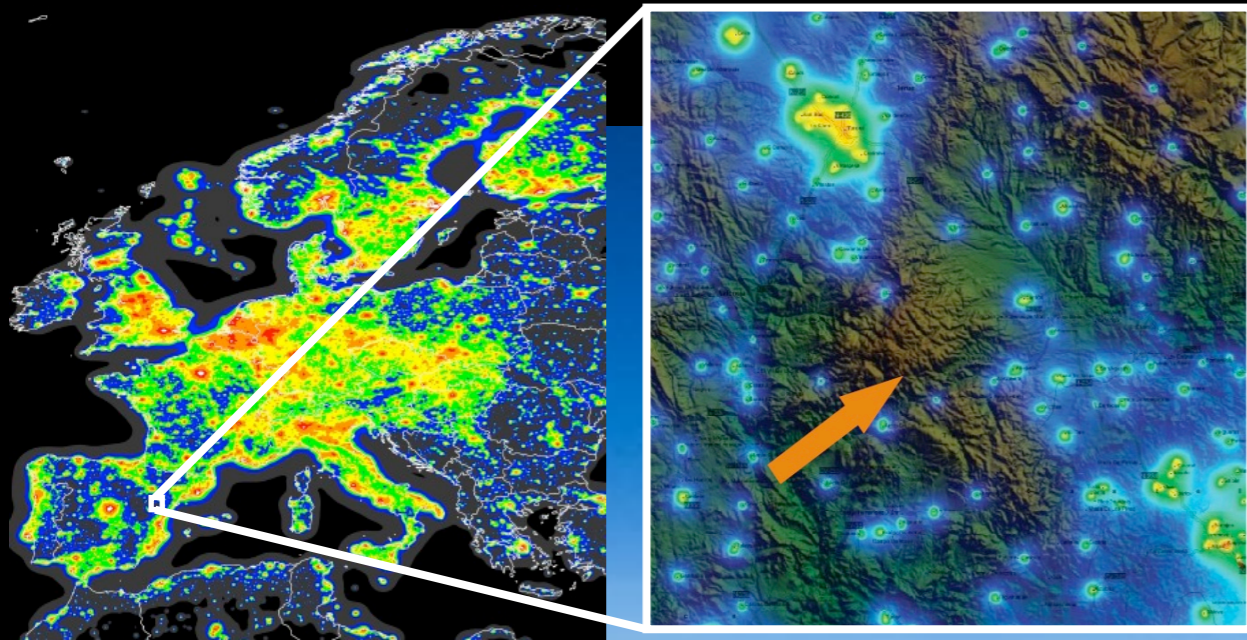
Disegno Ottico del VRT



La Camera del VRT



Observatorio Astrofísico de Javalambre



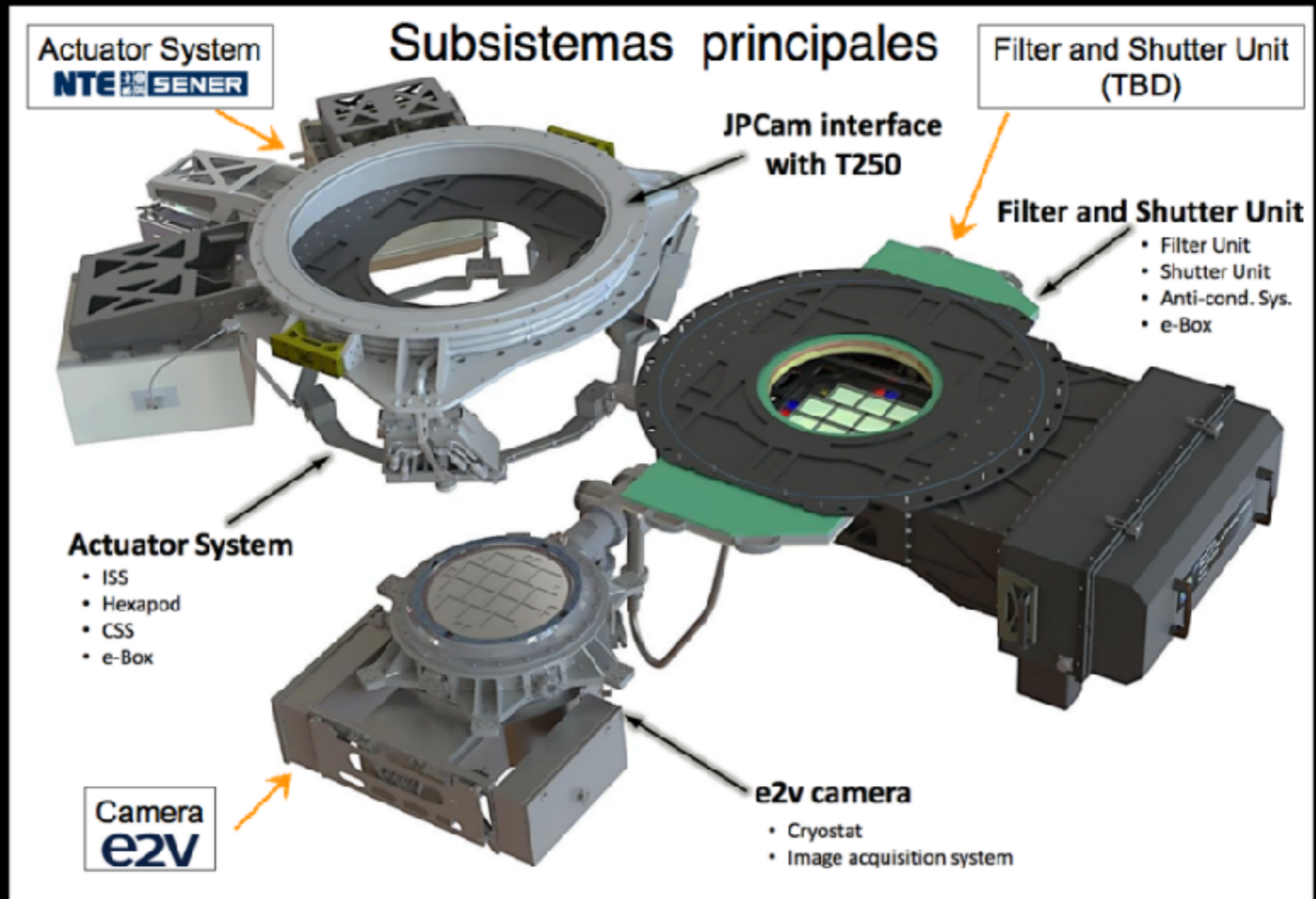
T250/JST



2.50m
f/3.5

FoV = 5sq.deg.

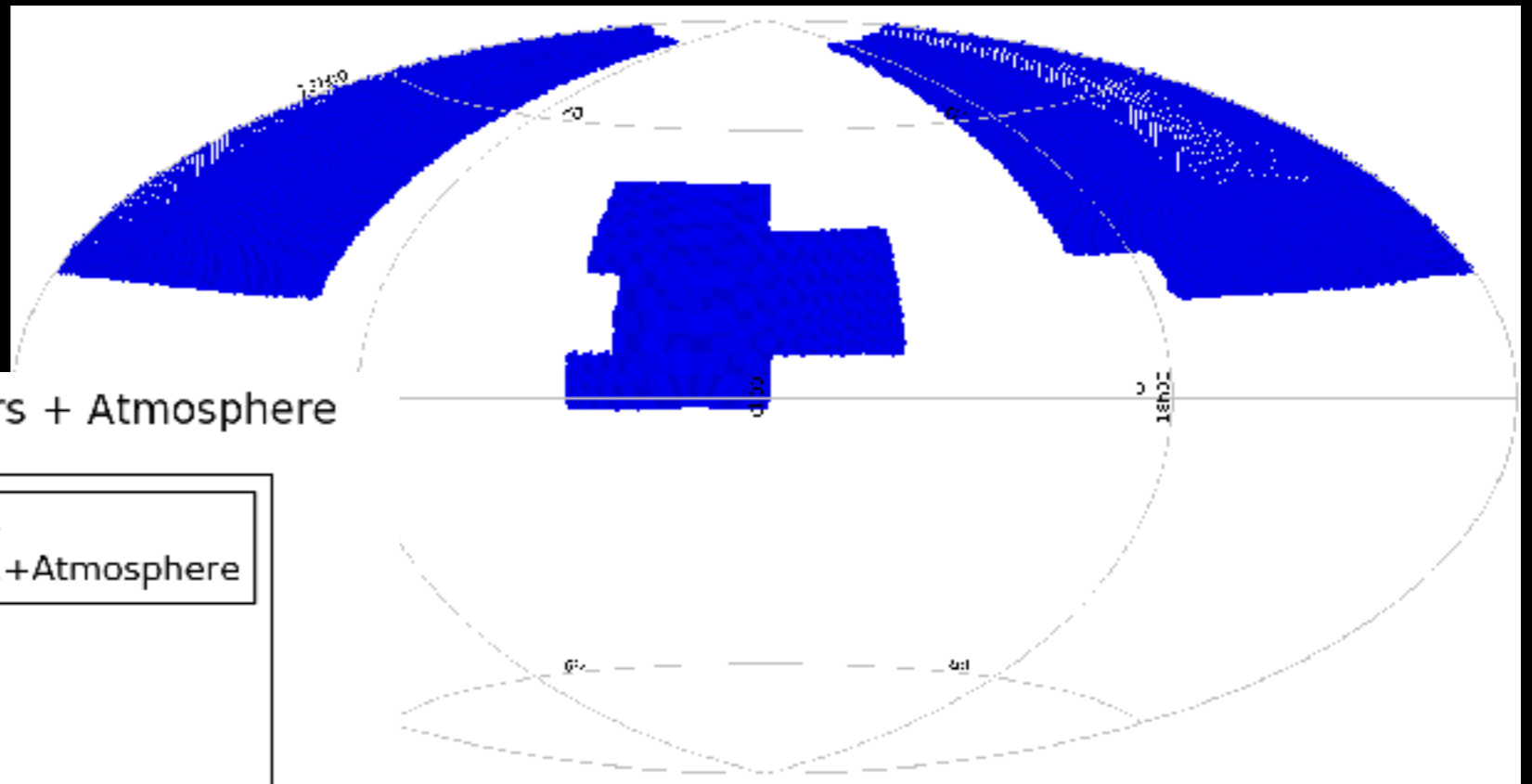
JPCam



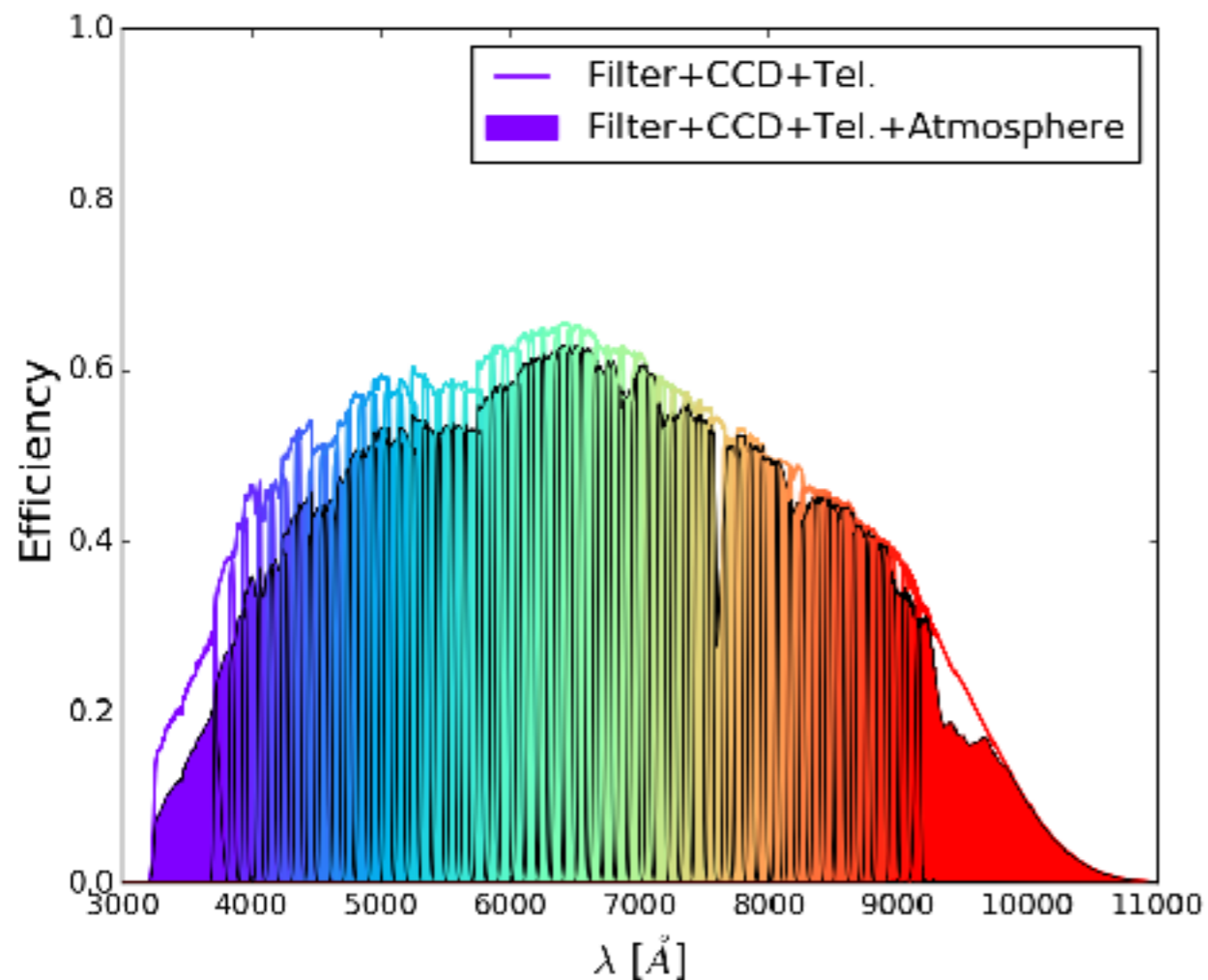
14 x 9kx9k
e2v CCDs

J-PAS

8,500 sq.deg.
54 narrow band filters
2 intermediate band filters
3 broad band



Overall efficiency system JPCam + Filters + Atmosphere



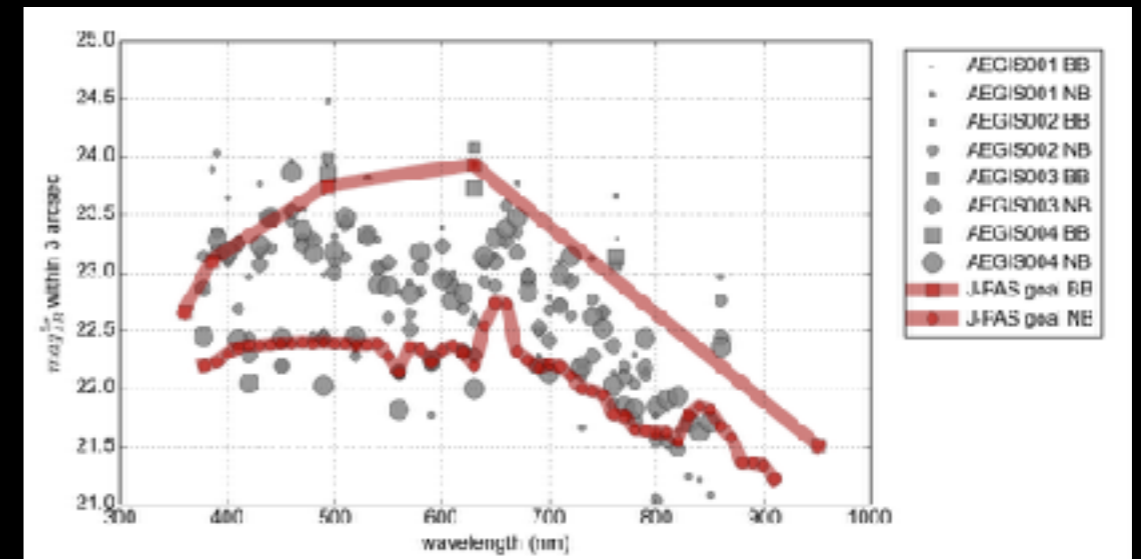
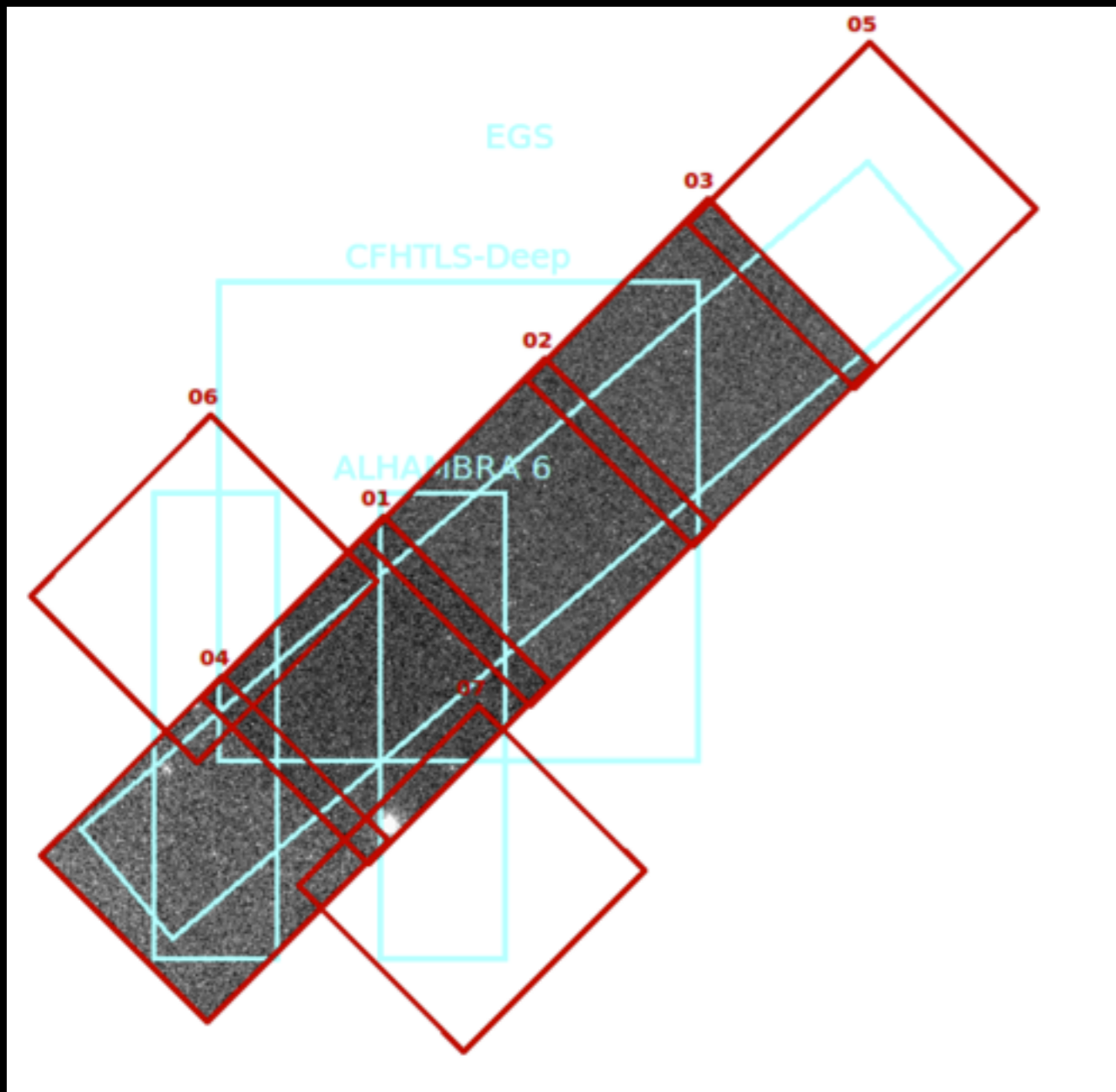
400 M galaxies

400 M stars

2 M quasars

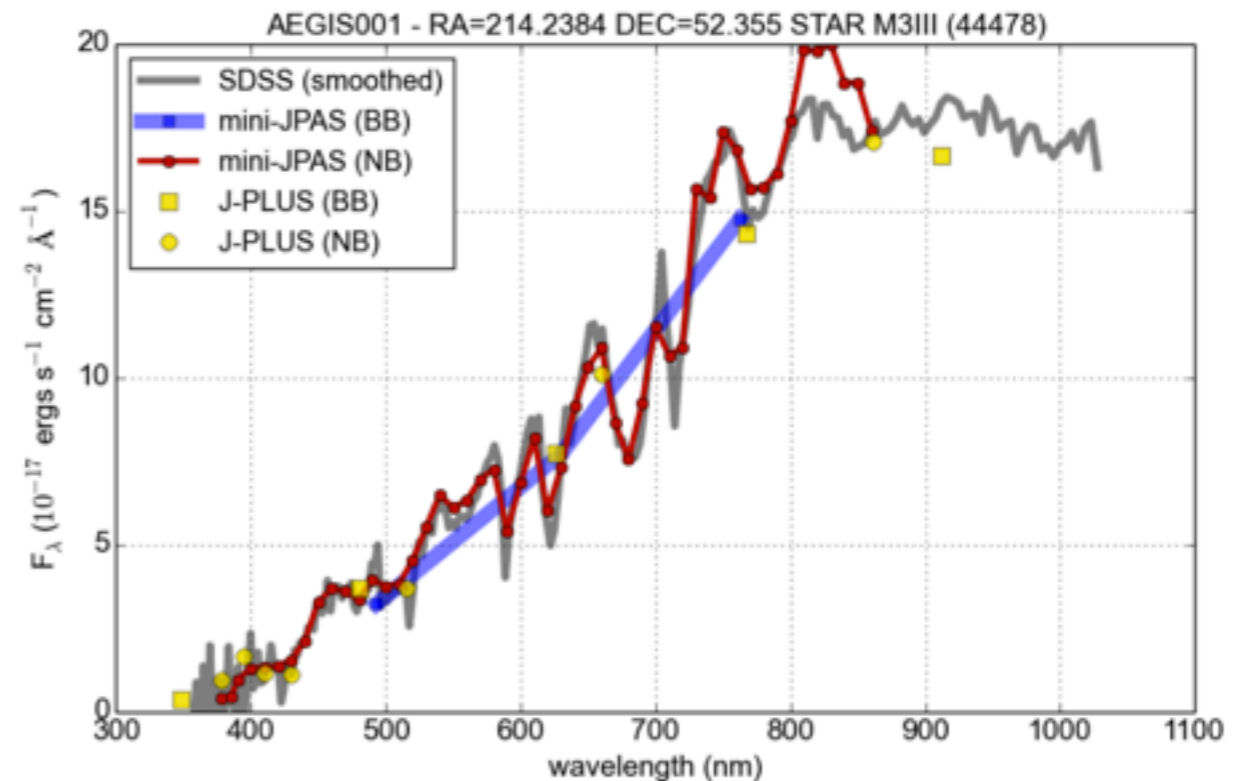
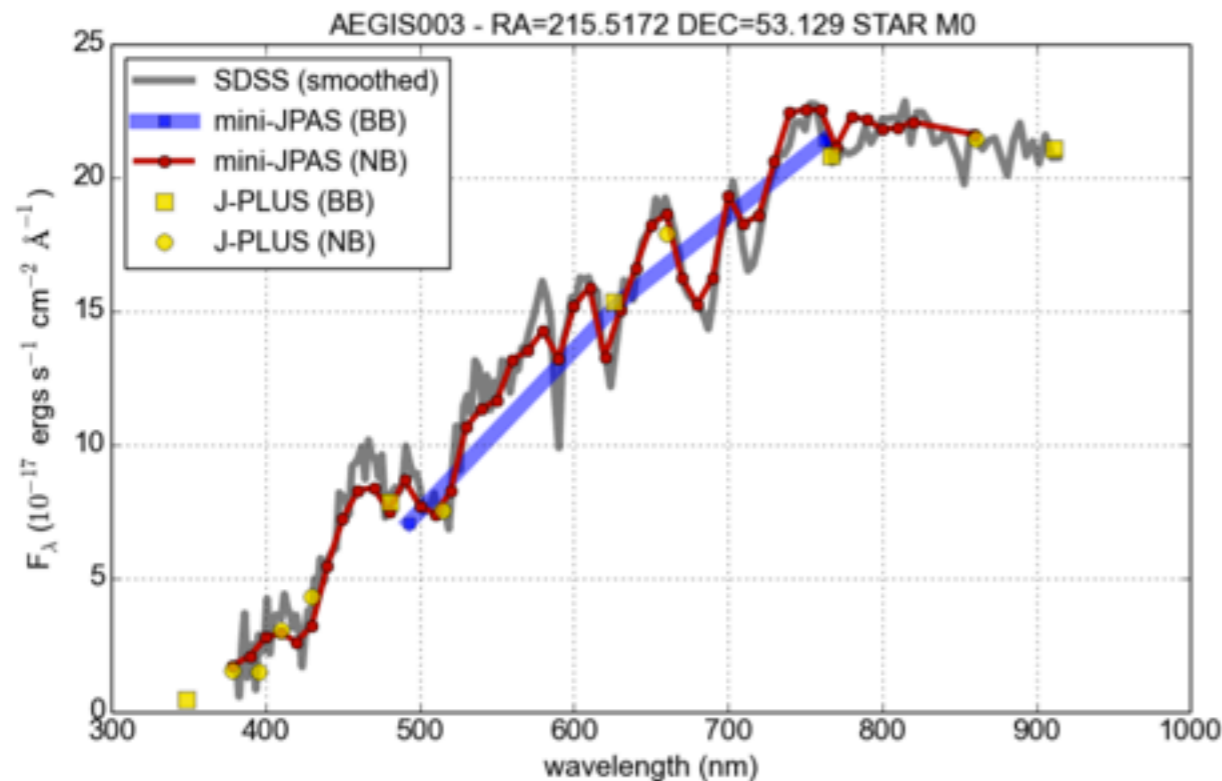
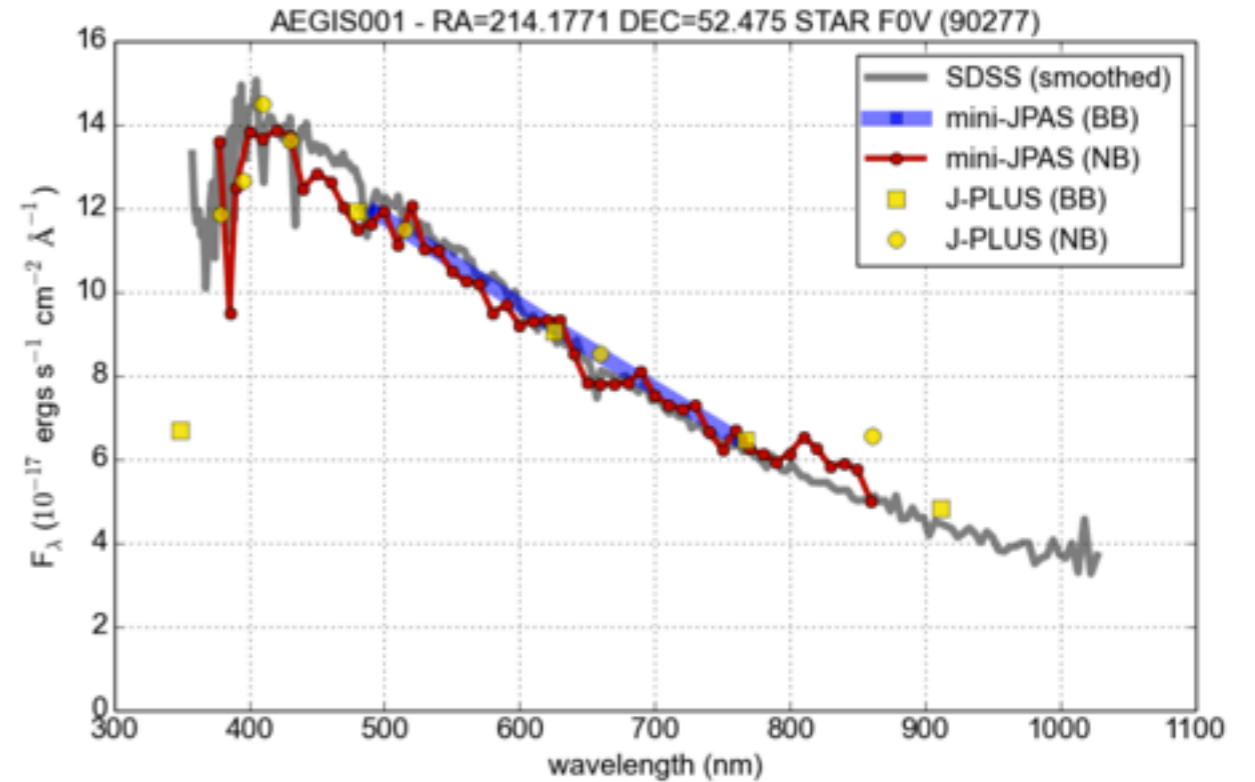
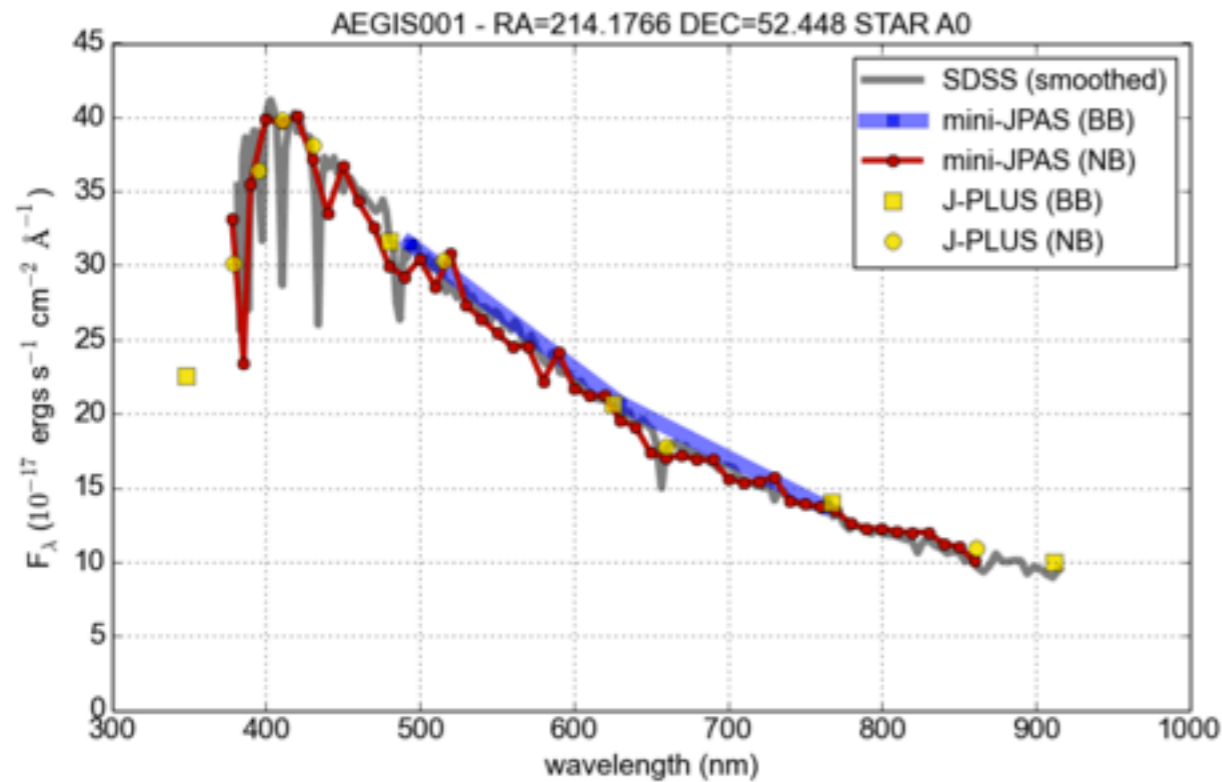
4000 SNe Ia

mini-J-PAS

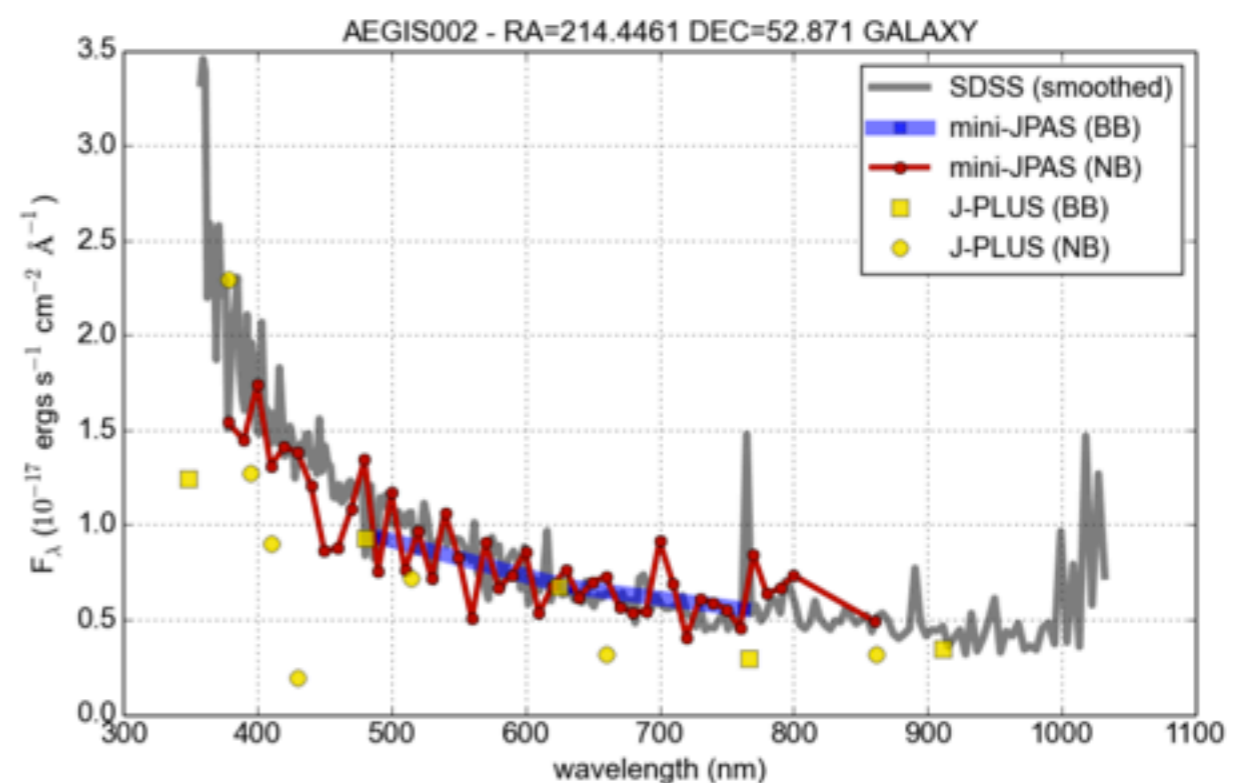
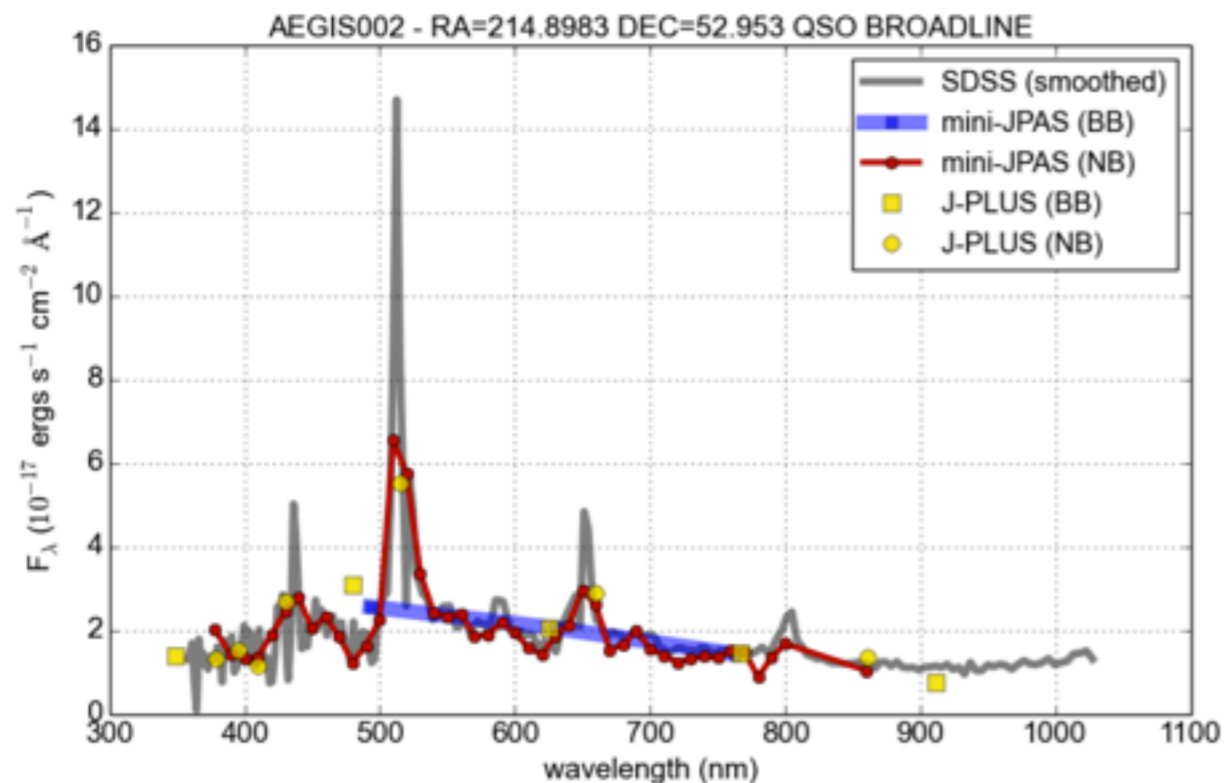
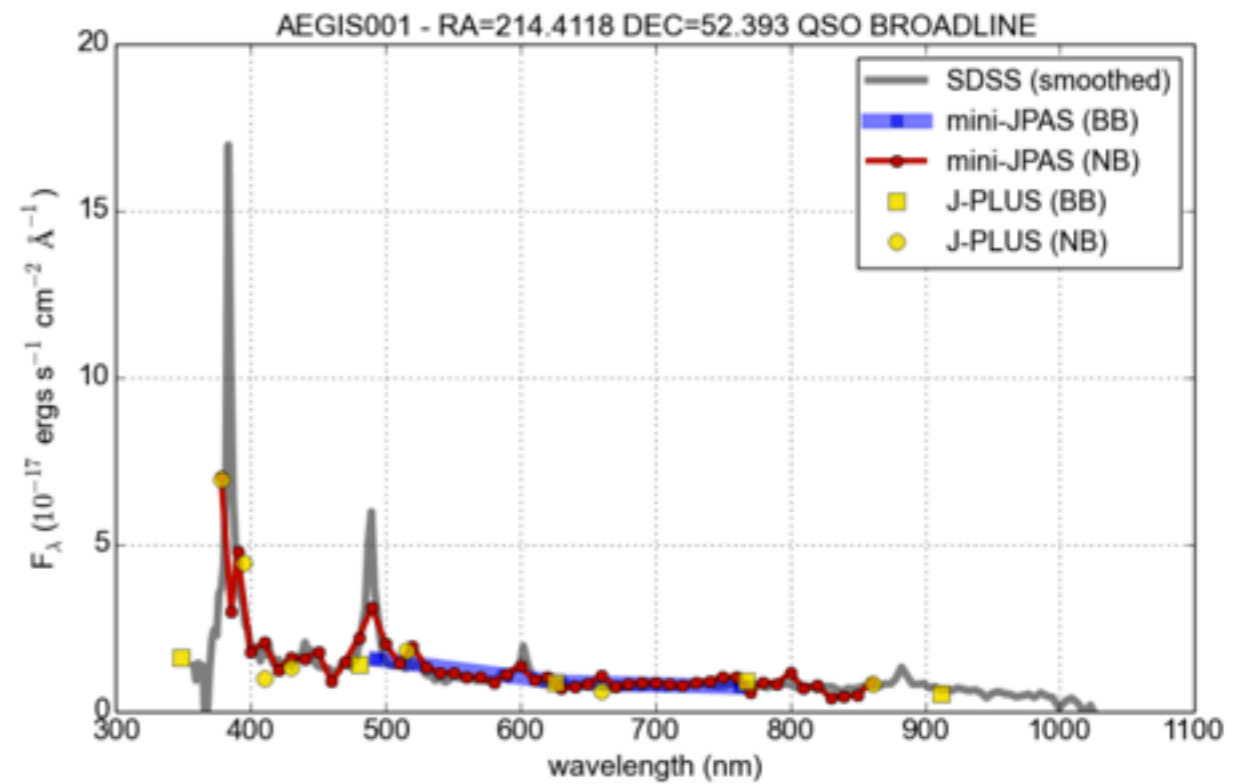
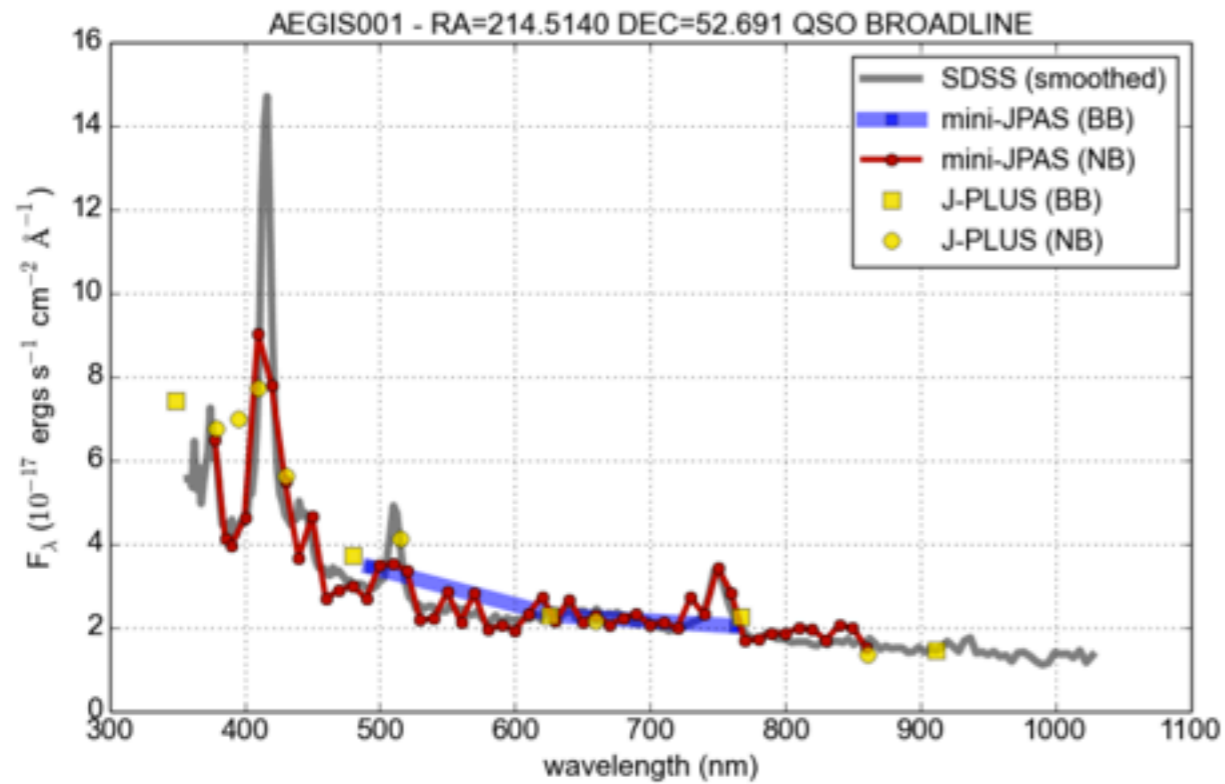


archive.cefca.es

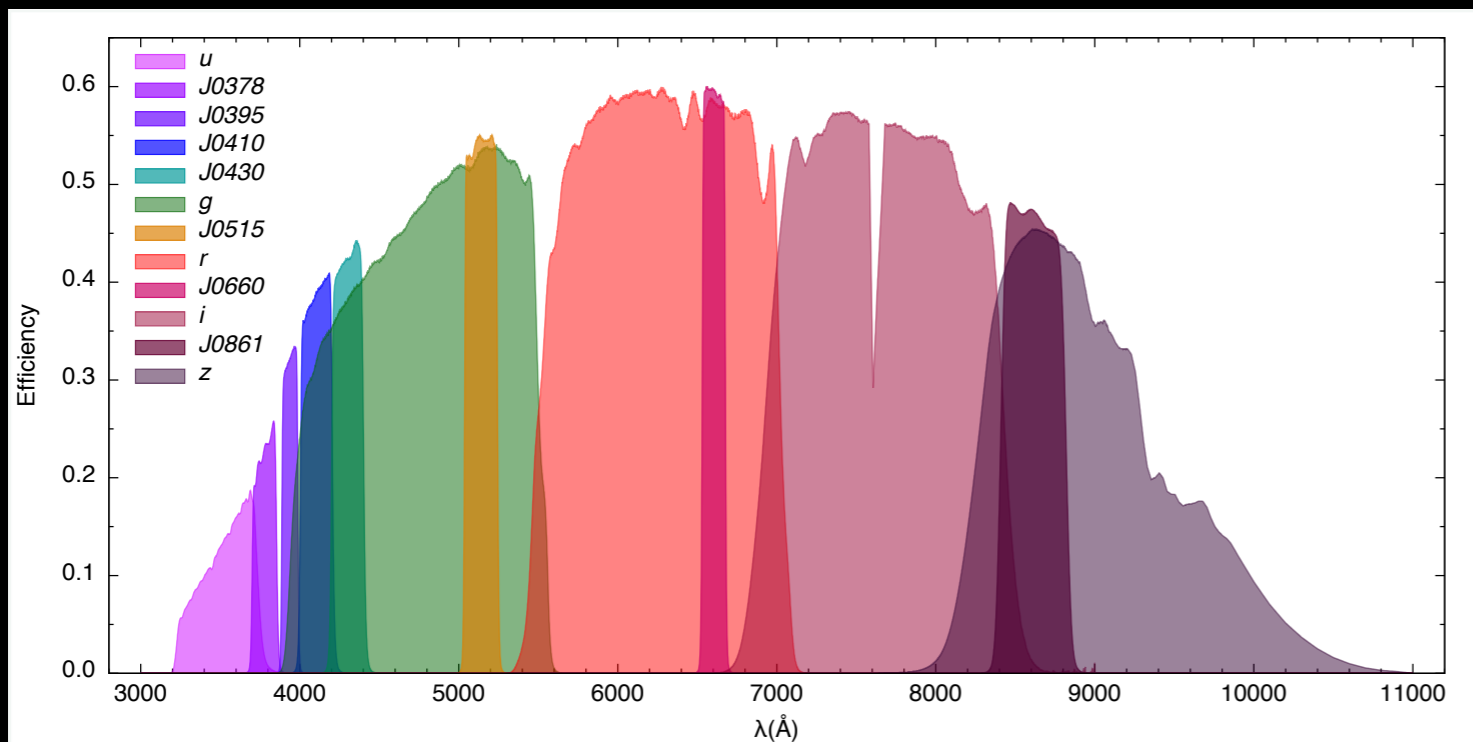
mini-J-PAS stelle



mini-J-PAS extragalactic



J-PLUS



EDR

Oct 2017

36 sq.deg

DR1

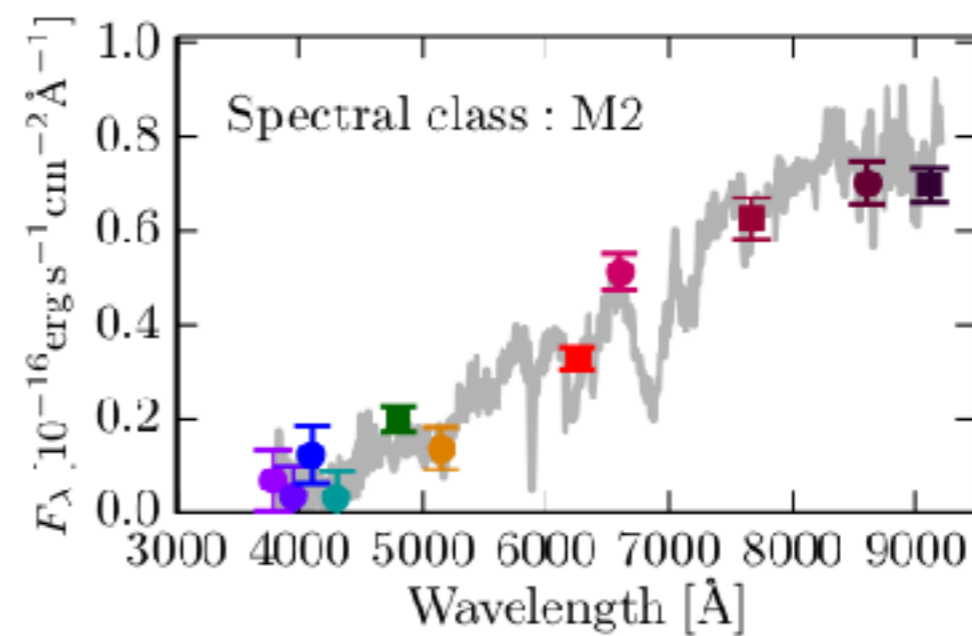
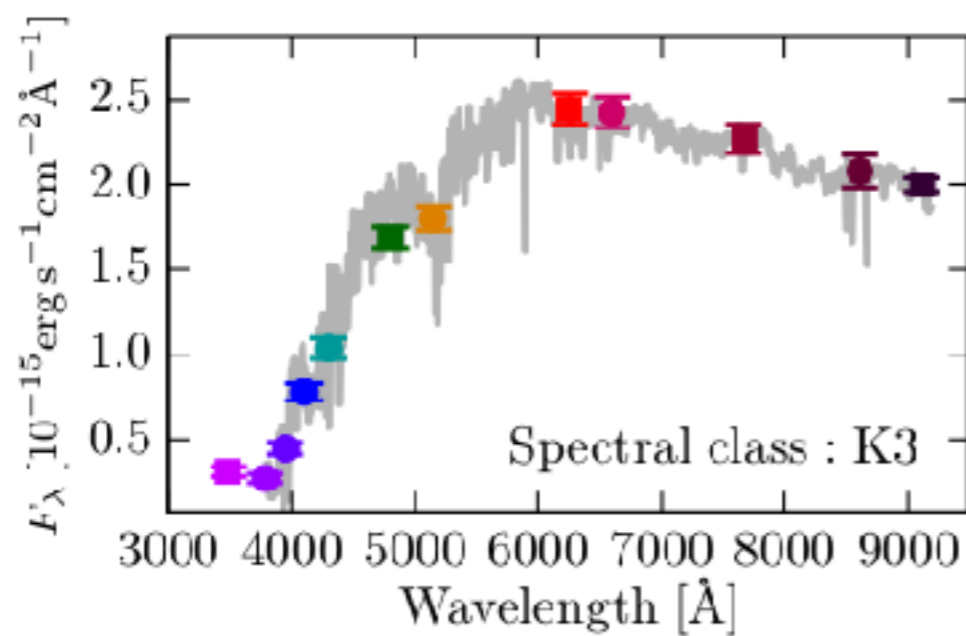
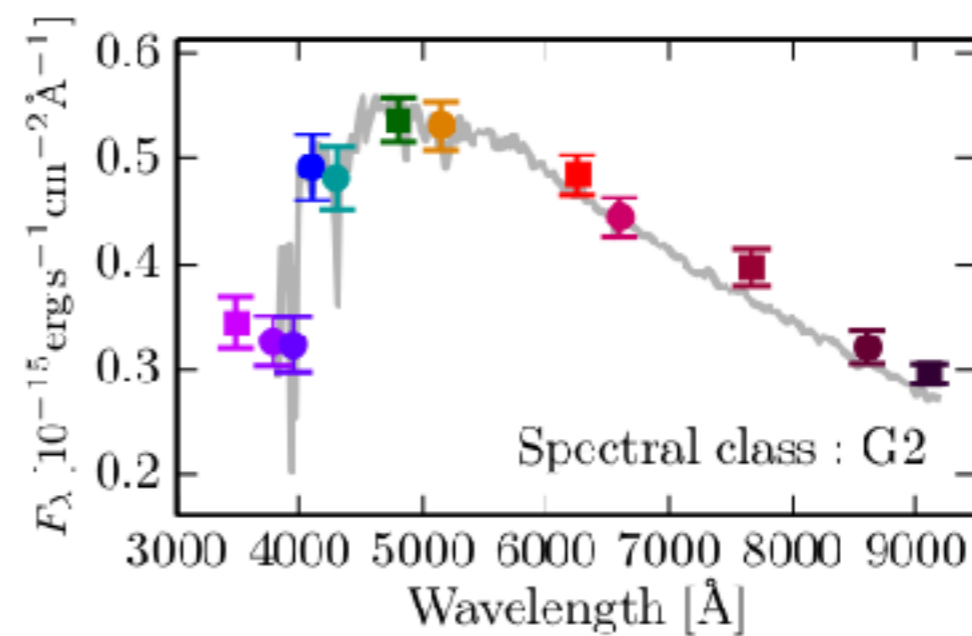
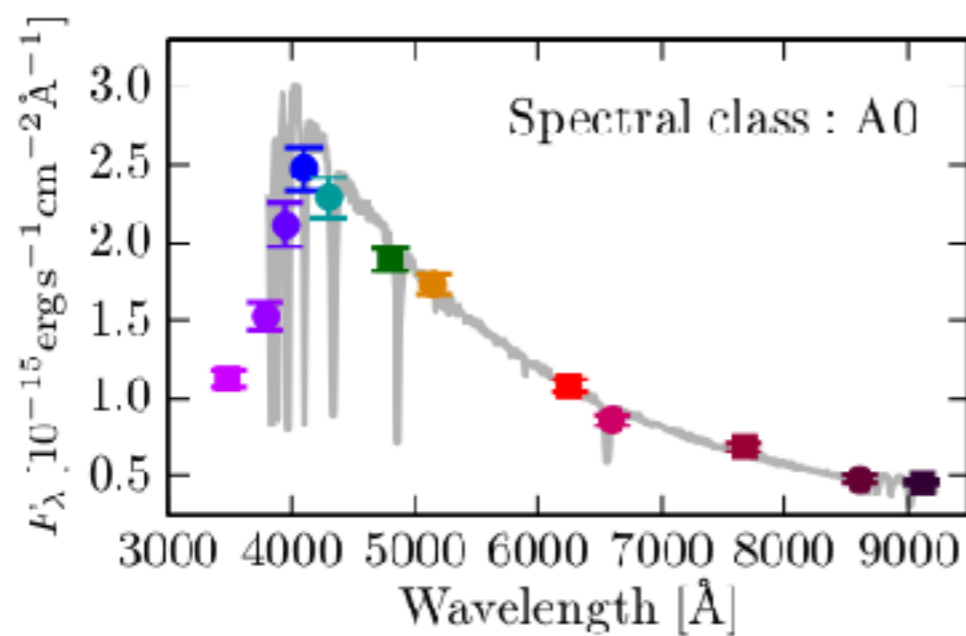
Jul 2018

1000
sq.deg.

T80/JAST



J-PLUS



Gli “Extremely Large Telescopes”



Giant Magellan
Telescope (7 x 8m)


Thirty Metre Telescope
(indovina?)

Extremely Large
Telescope (39m)

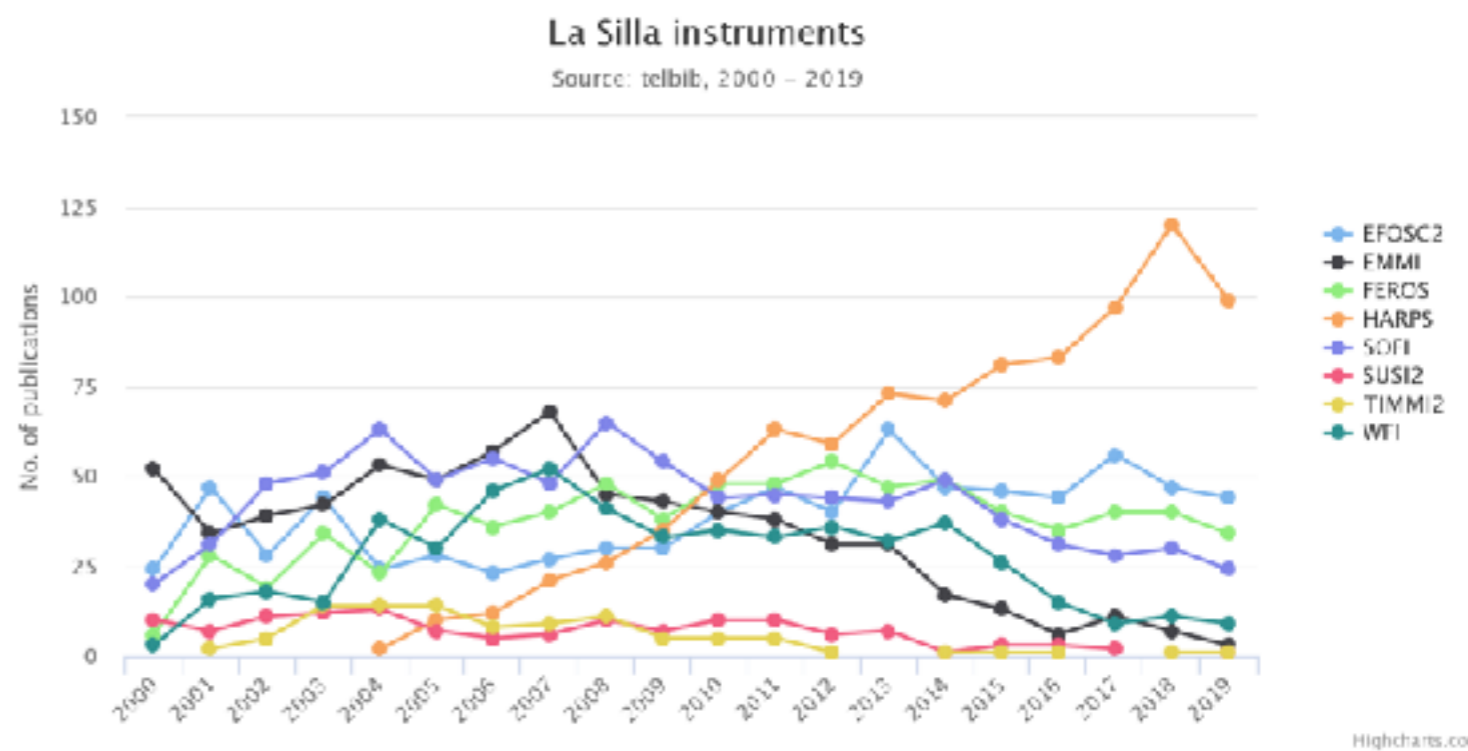
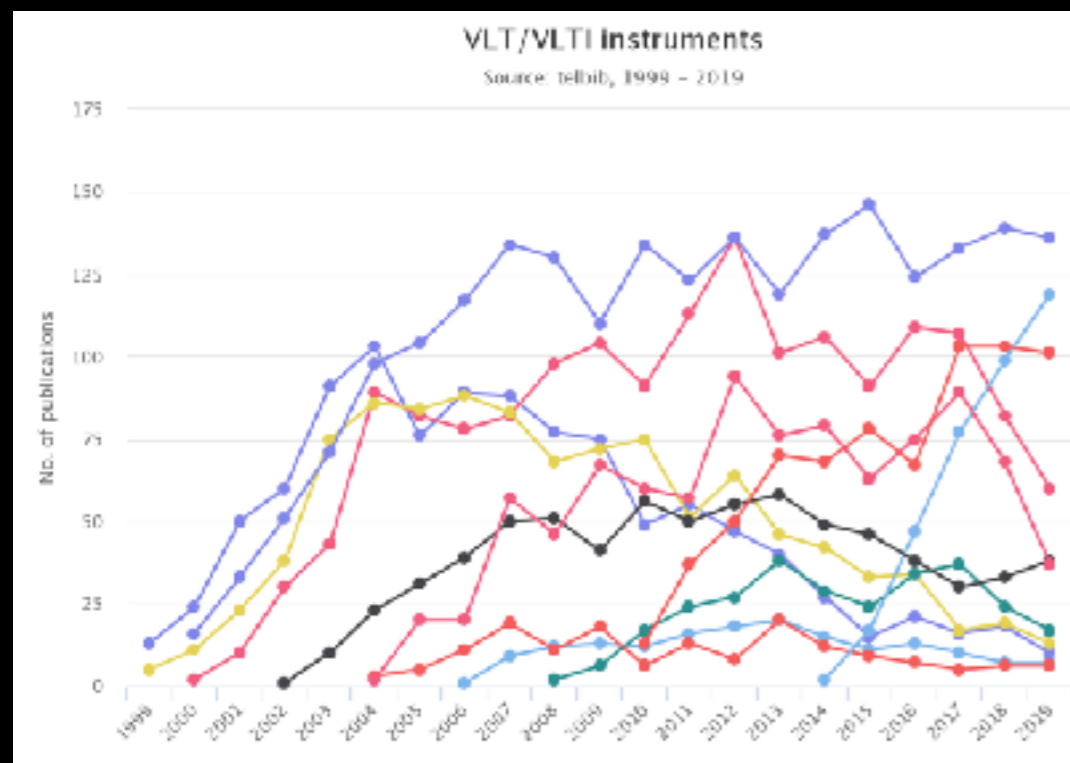


Gli “Extremely Large Telescopes”



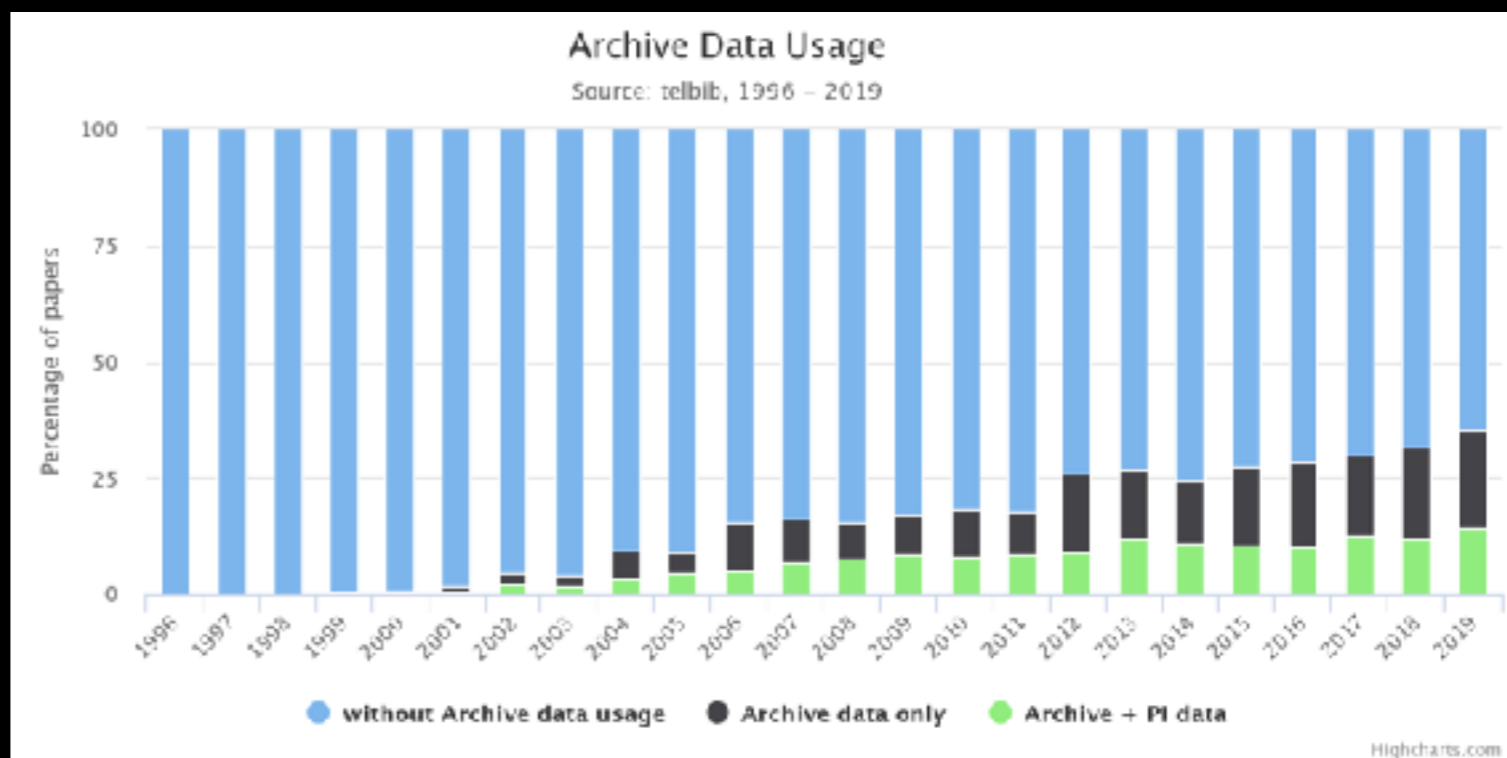
MEDIA  INAF^{tv}

Archivi e “VO”

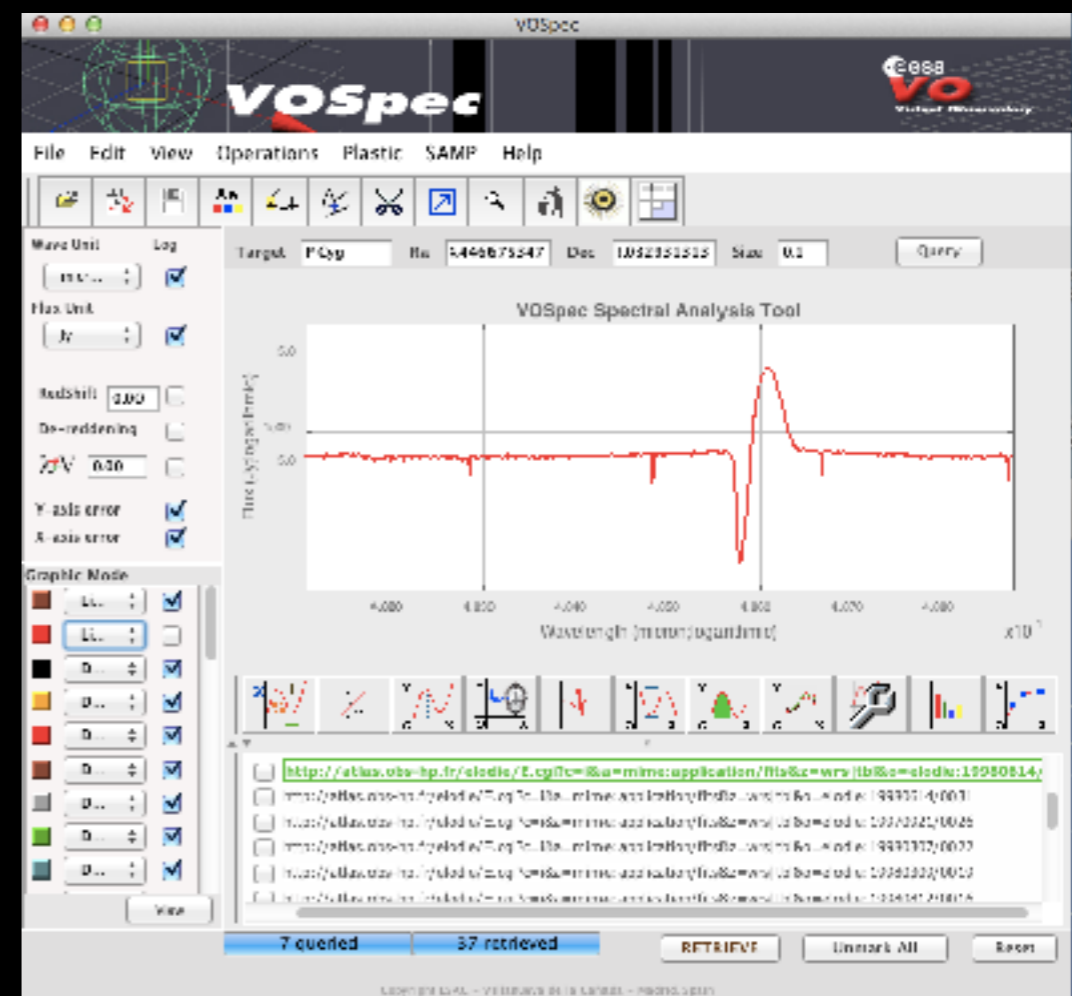
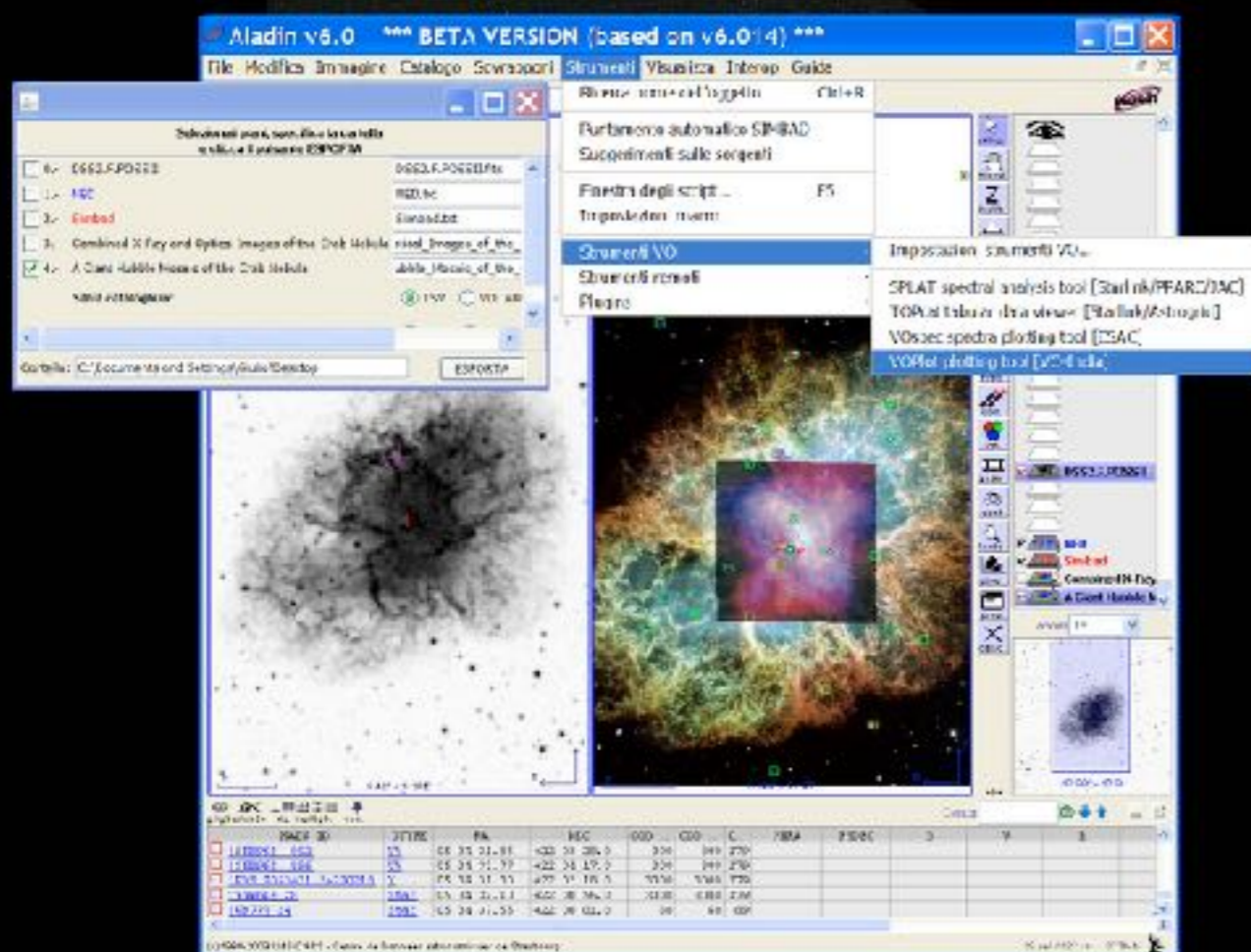


Tutti i grandi osservatori offrono accesso ai propri dati attraverso un archivio.

(Non sempre i dati sono “science ready”)



Archivi e “VO”

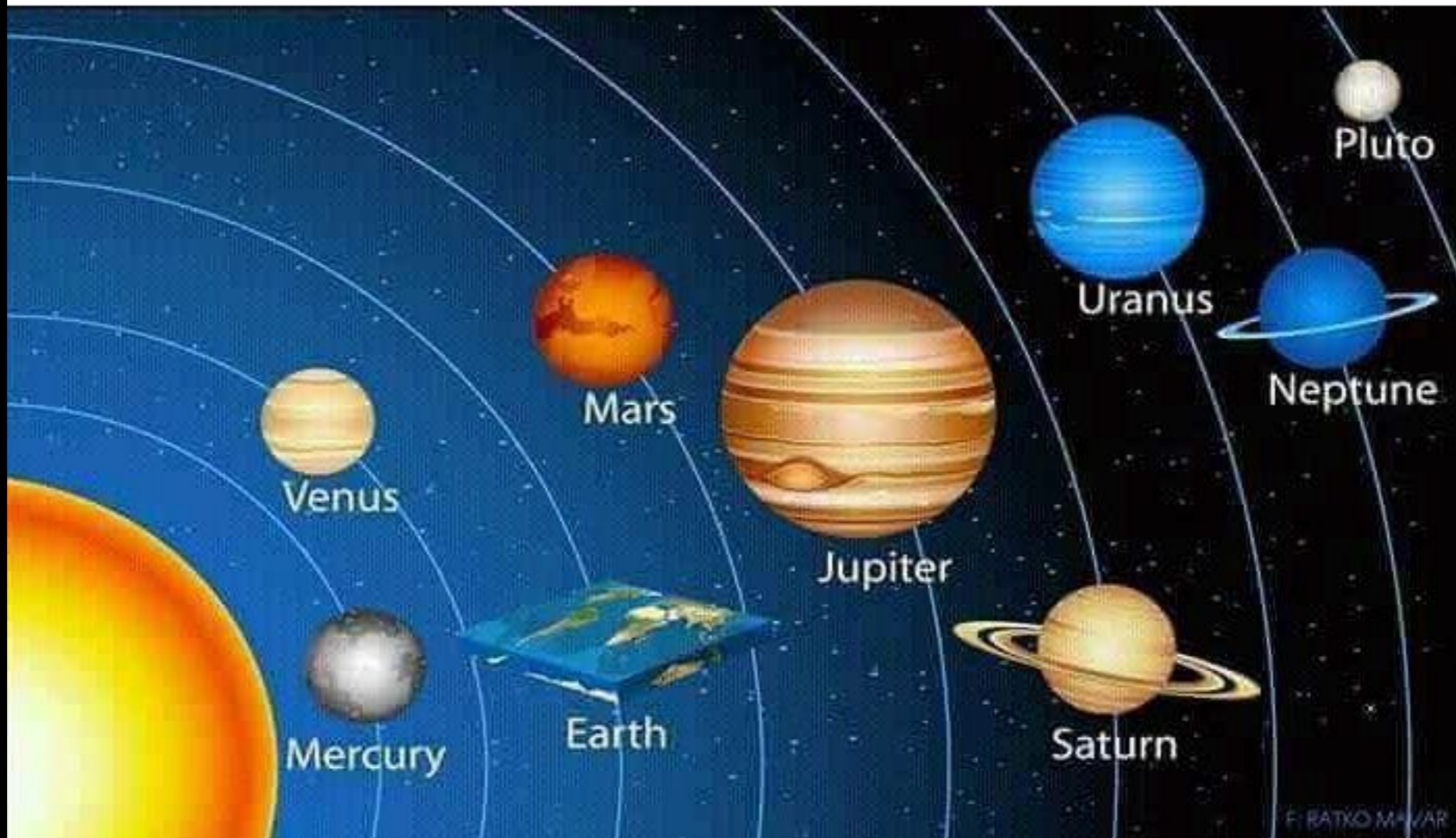


L'Osservatorio Virtuale è uno sforzo internazionale per la standardizzazione per l'uso e la distribuzione di dati astronomici.

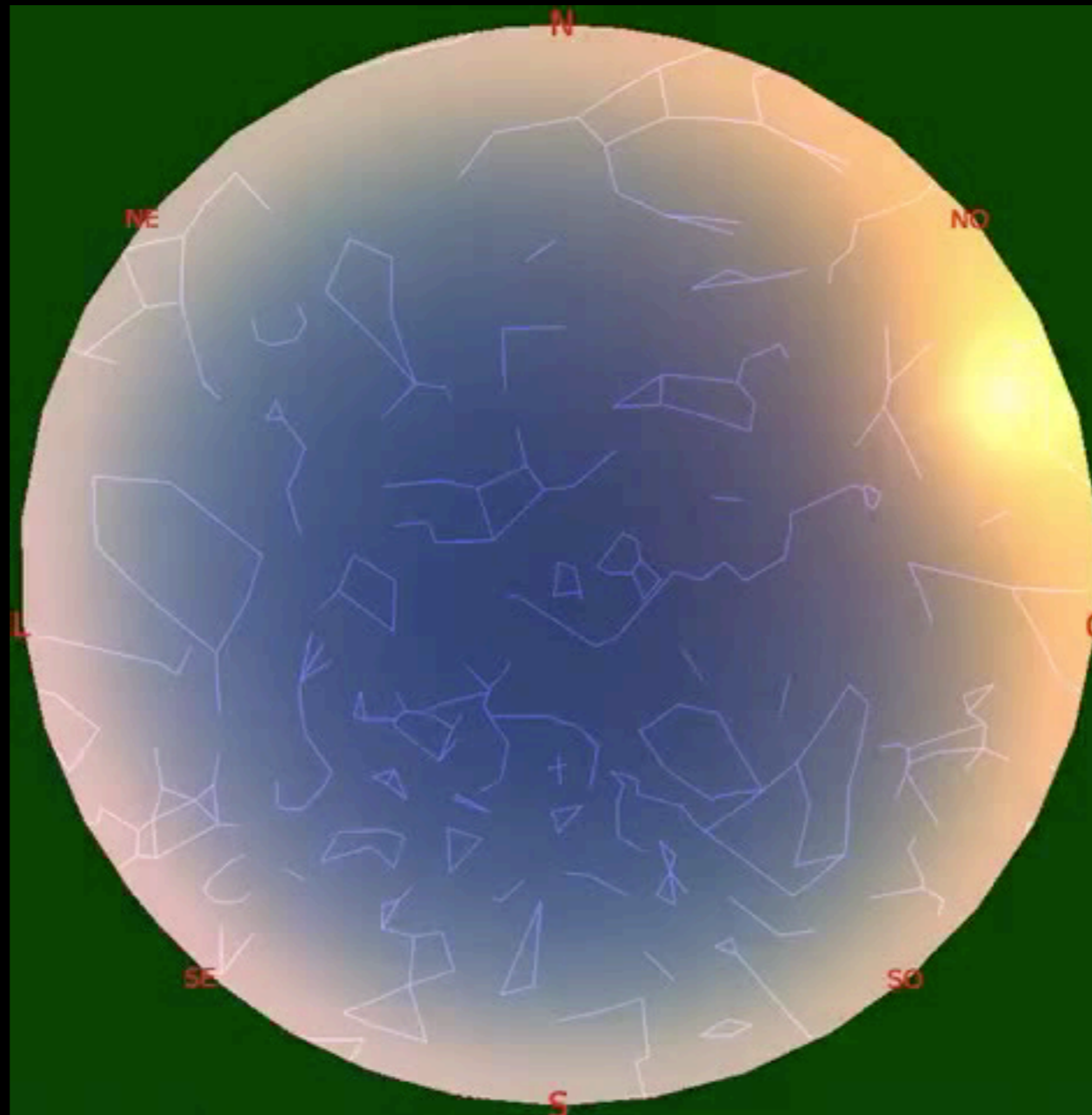
<http://www.ivoa.net/>

I pericoli per l'astronomia moderna - l'ignoranza

Crazy how nature does that



I pericoli per l'astronomia moderna - Starlink



Conclusione

- Veniamo da un secolo (e un ultimo decennio) rivoluzionario
- Il prossimo decennio è pieno di affascinanti scoperte
- Grazie agli archivi e all'Osservatorio Virtuale, tutti possono partecipare
- Abbiamo fatto un buon lavoro con l'inquinamento luminoso ma, improvvisamente, è apparso un nuovo e inquietante nemico

Grazie!