

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)



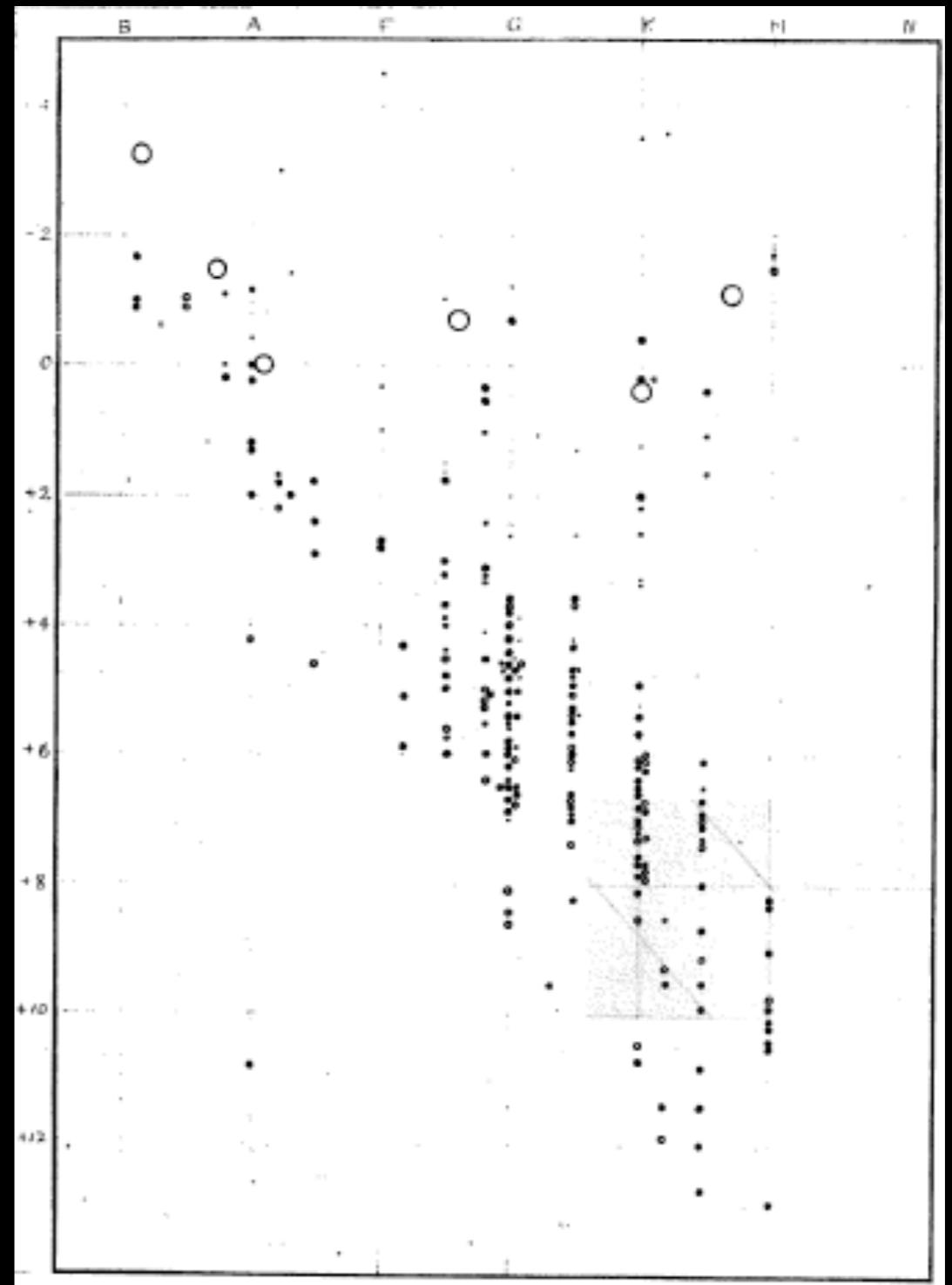
Le reazioni termonucleari alla base
dell'evoluzione stellare
Hans Bethe (1906 - 2005)

Il diagramma HR

Henry Norris Russell (1877-1957)

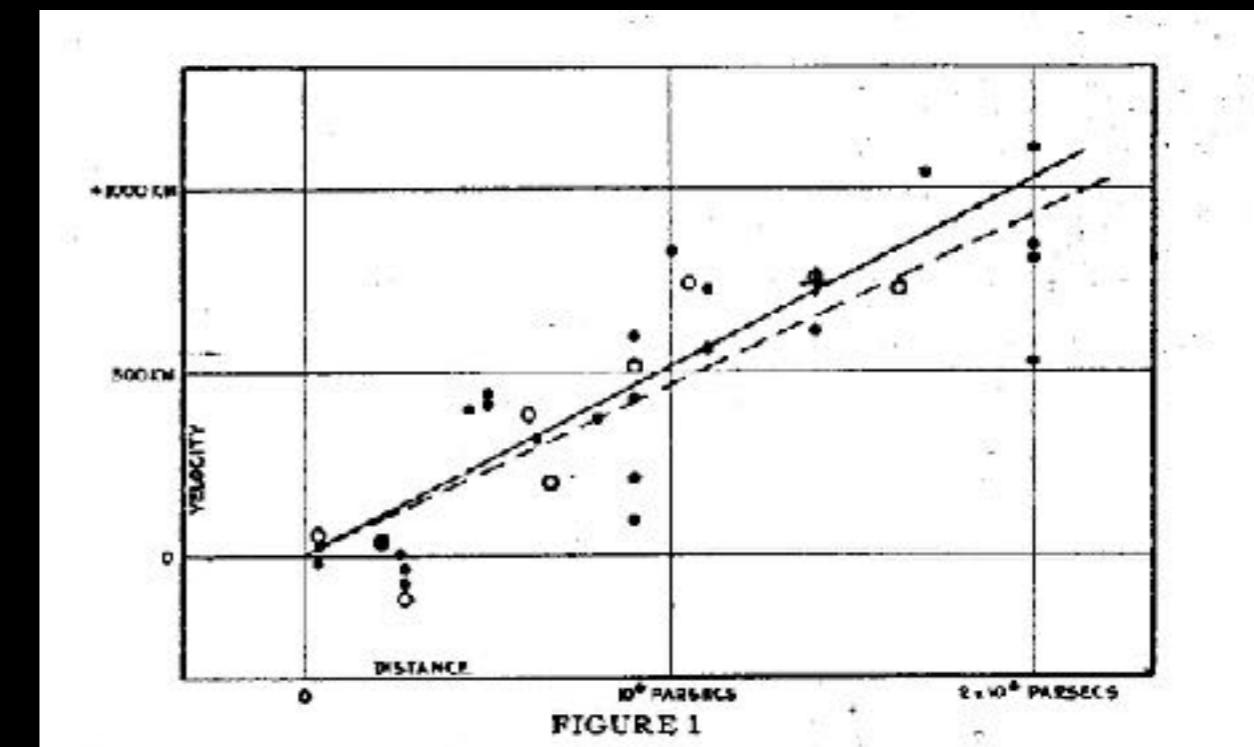
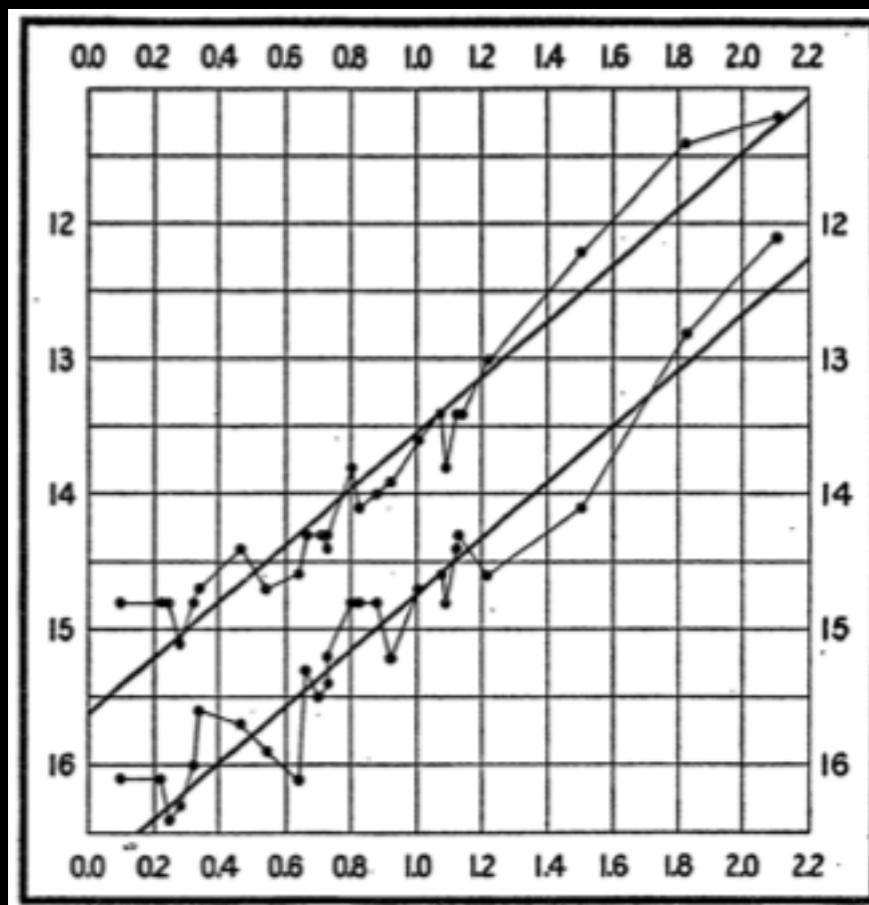
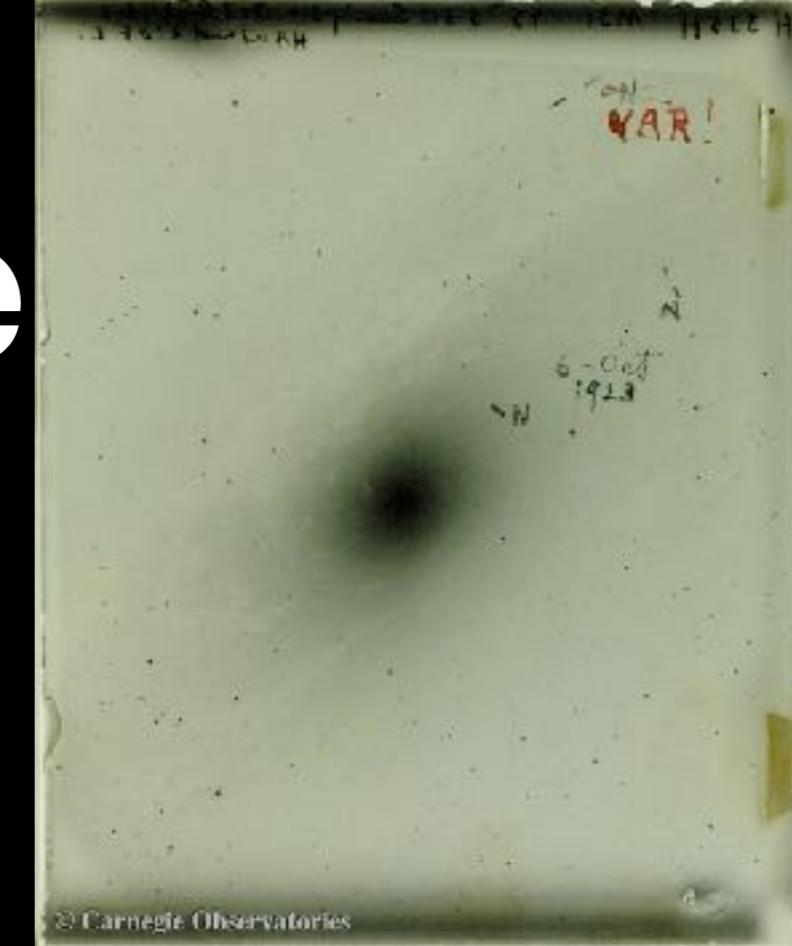


Ejnar Hertzsprung (1873-1967)





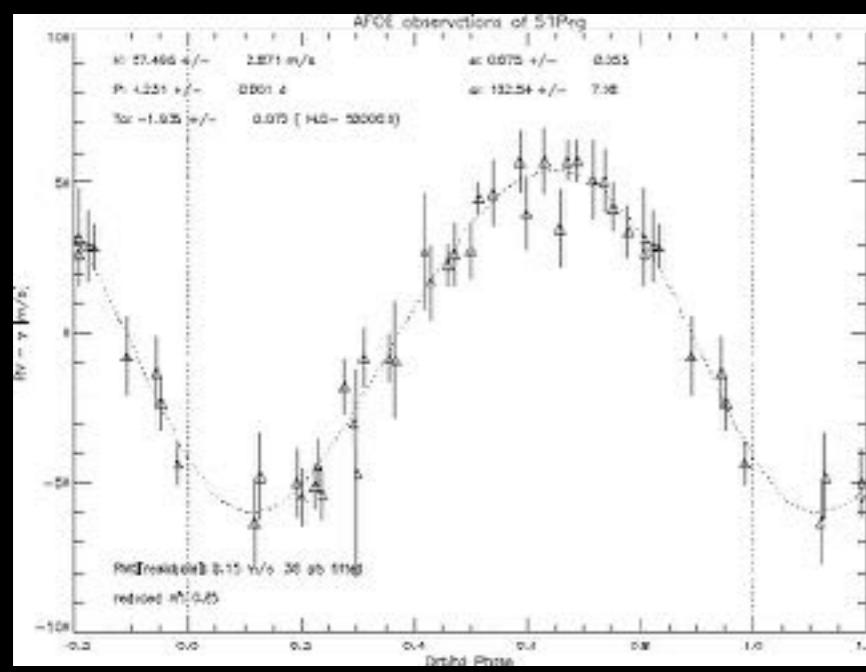
Le Galassie



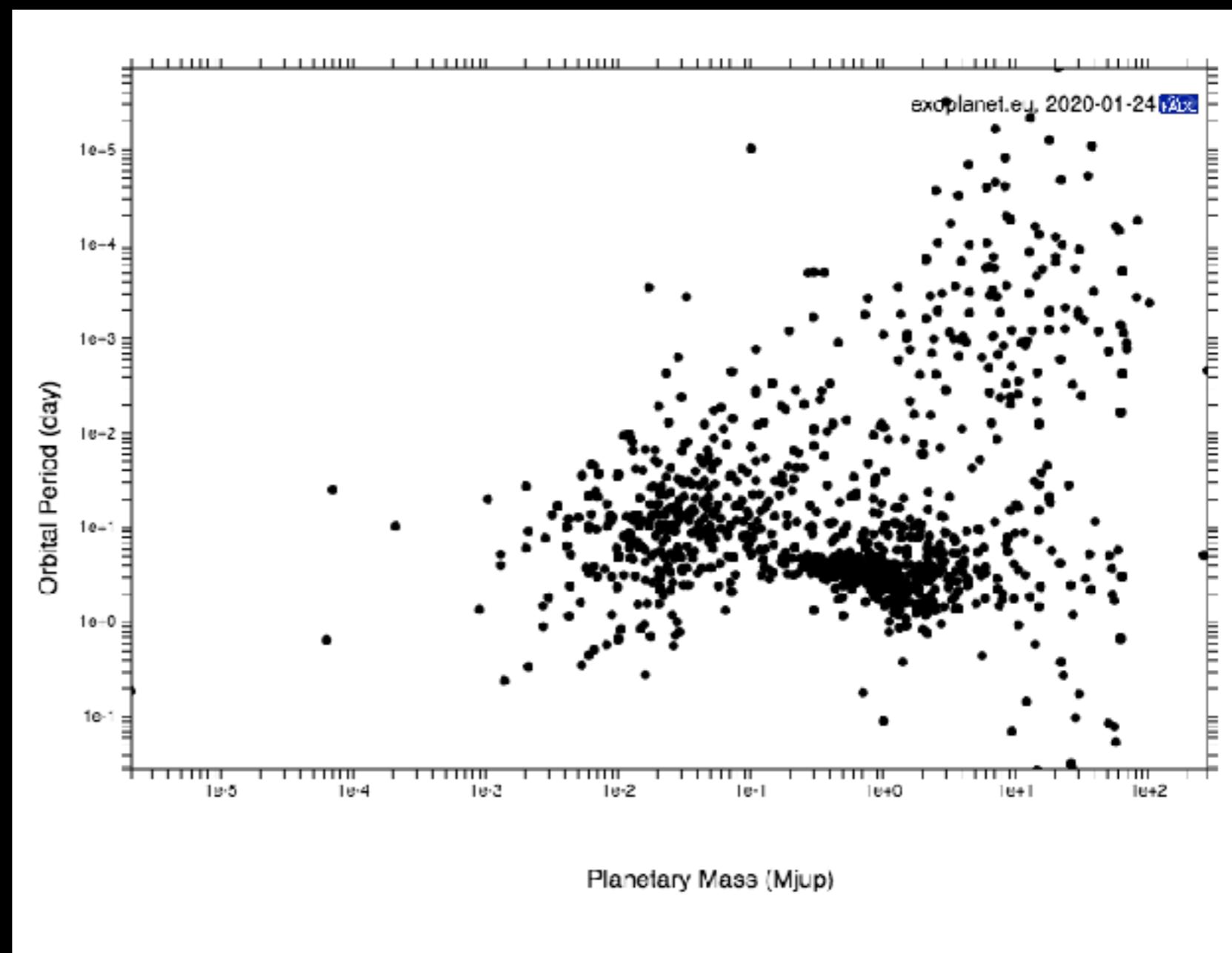
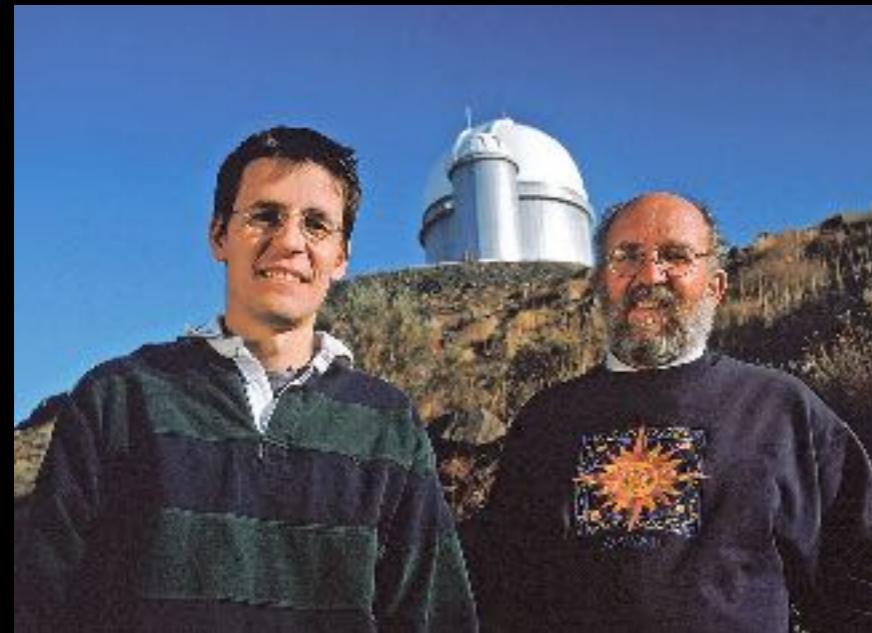
Leavitt & Pickering 1912

Hubble 1921

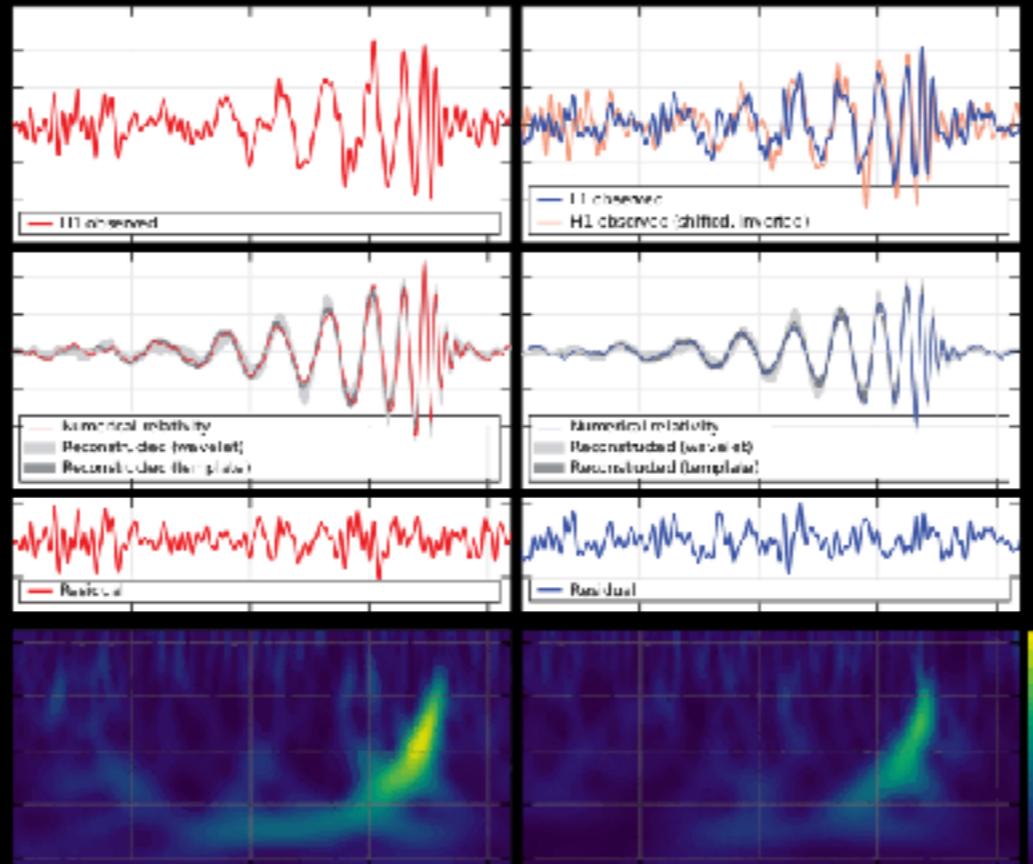
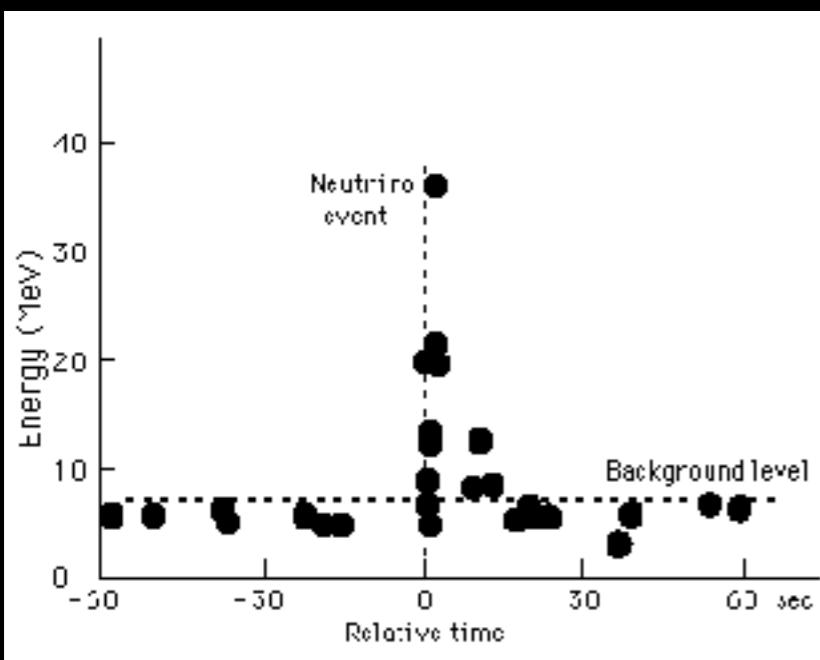
I Pianeti Extrasolari



Mayor & Queloz (1994)



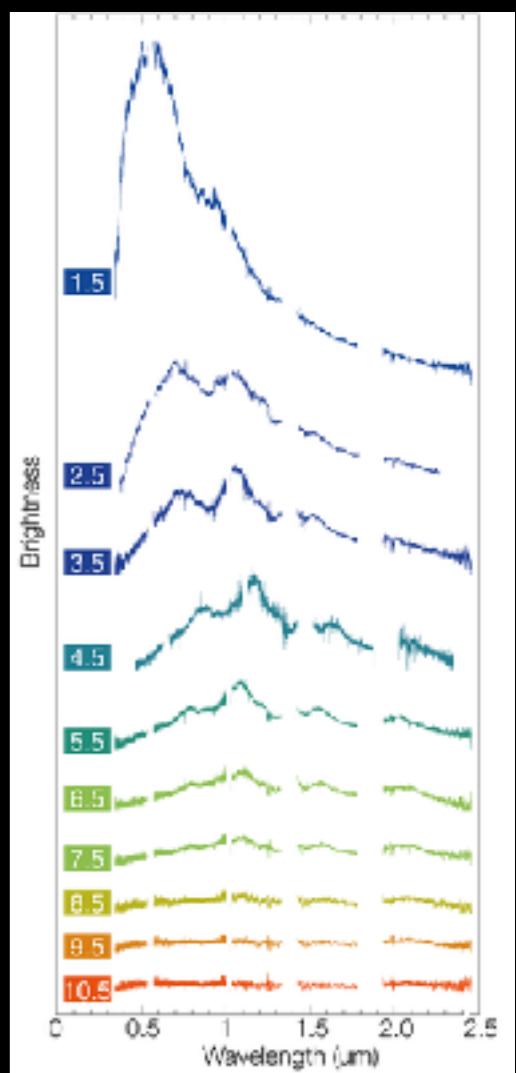
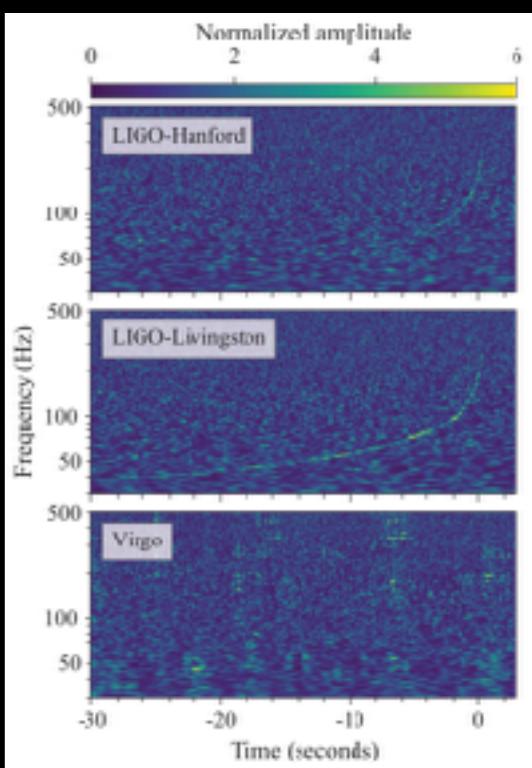
Astronomia “Multi-Messenger”



SN 1987a

GW150914

GW170817

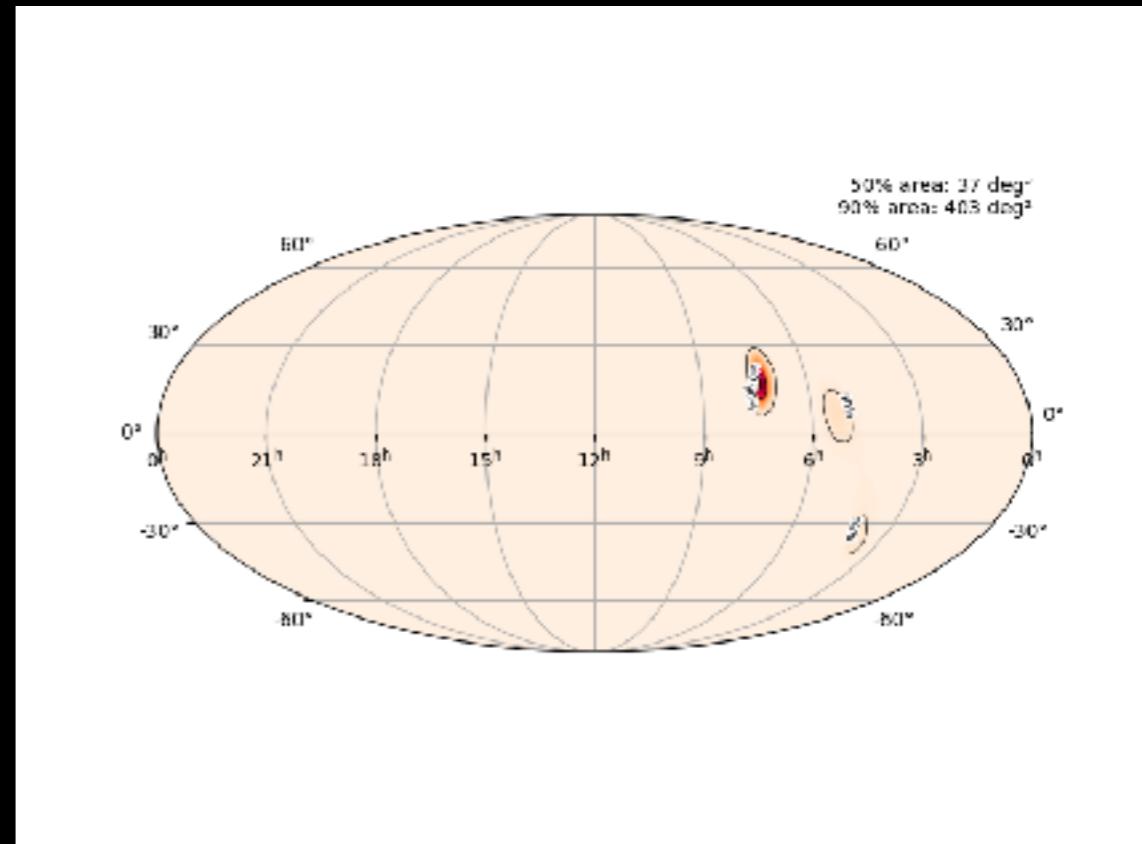
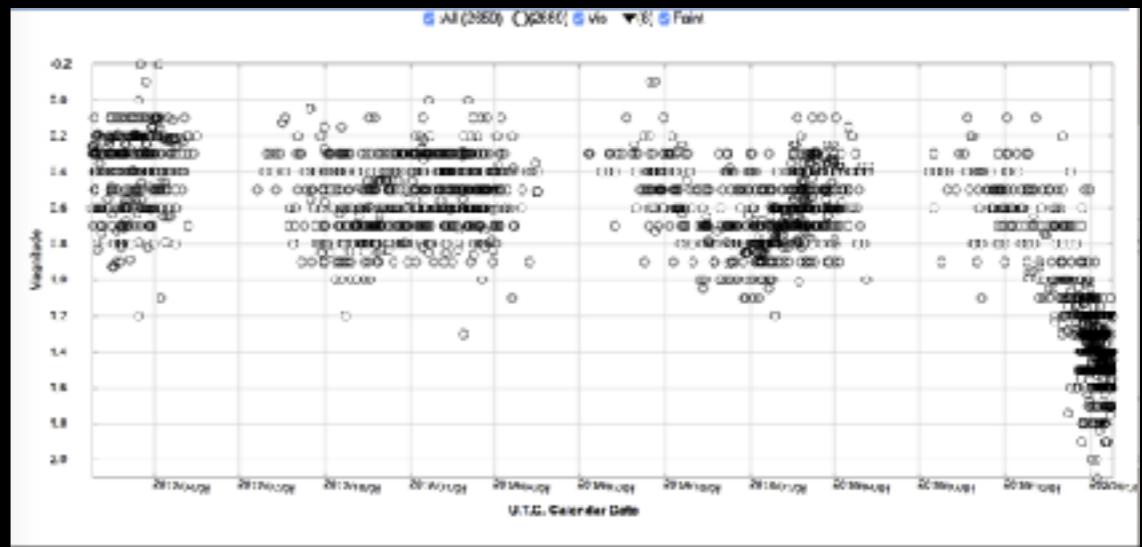


Betelgeuse



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"

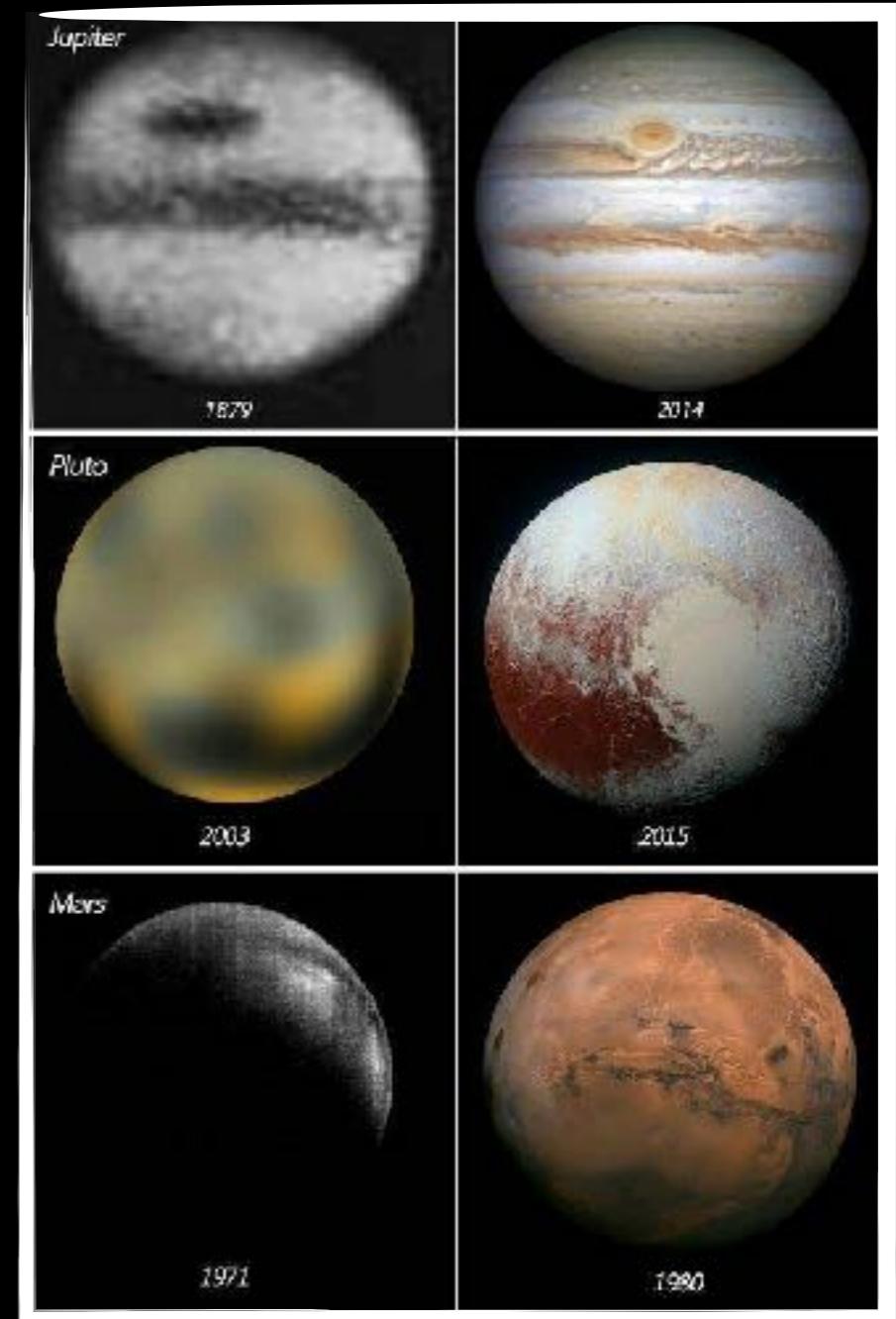


Attenzione:

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

Sistema Solare

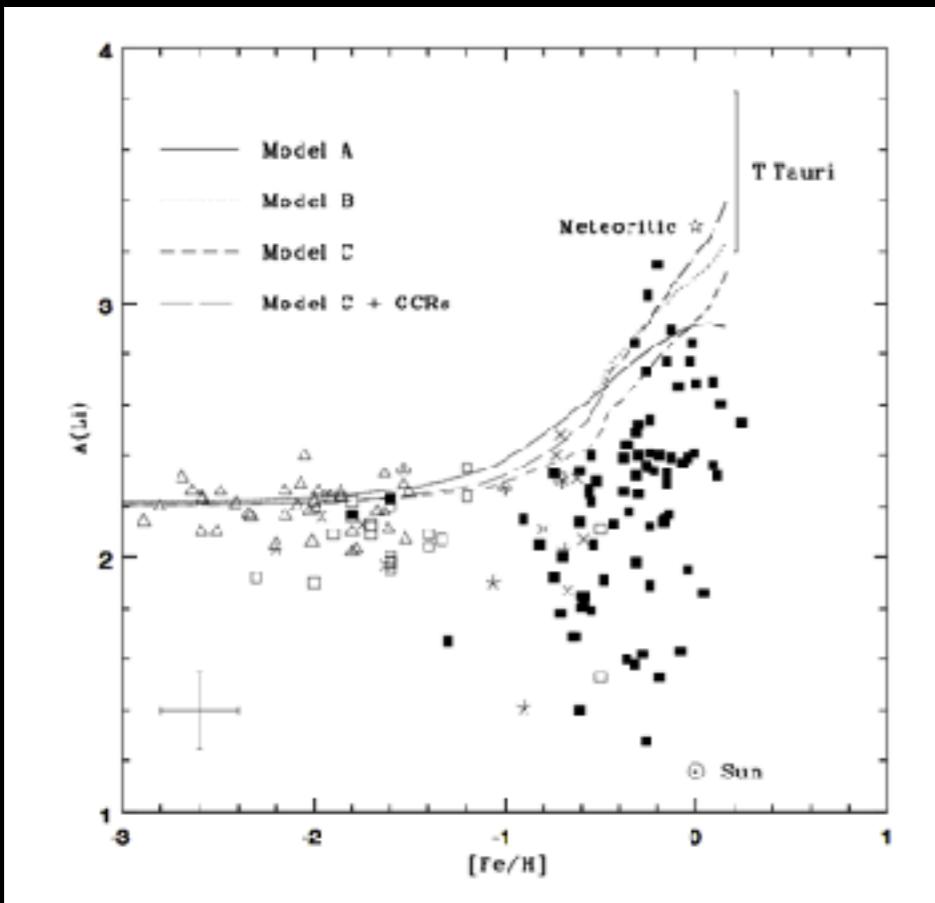
- Formazione ed Evoluzione del Sistema Solare
- Polemica sulla "definizione di pianeta"



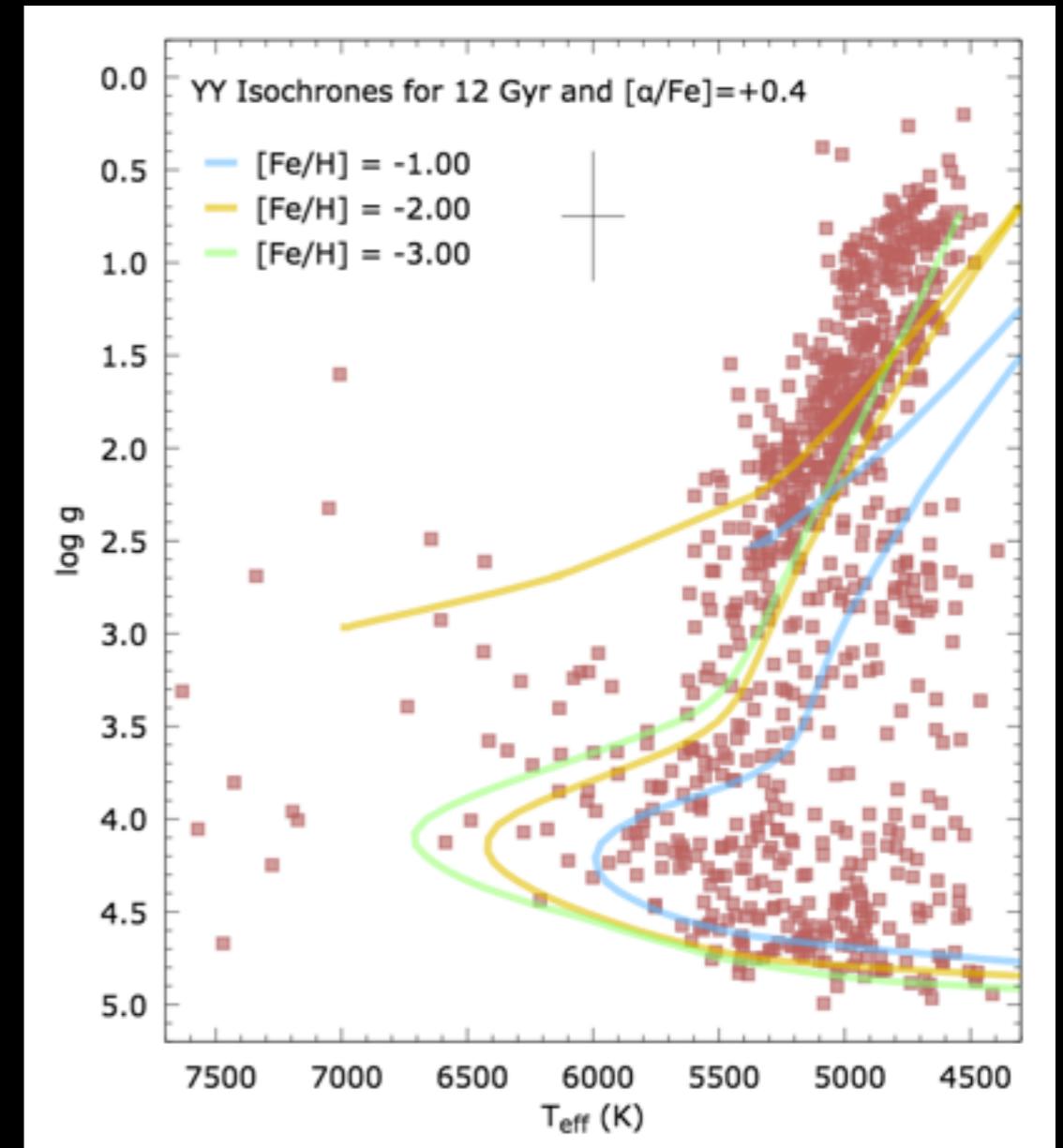
<https://twitter.com/ned35/status/1220511314298253313?s=20>

Stelle

- Abbondanze chimiche ed evoluzione chimica



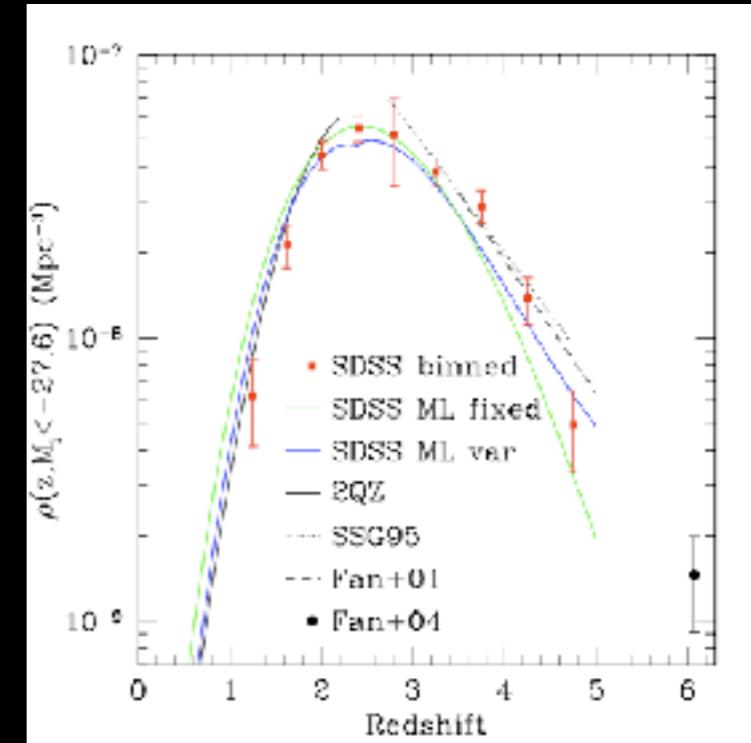
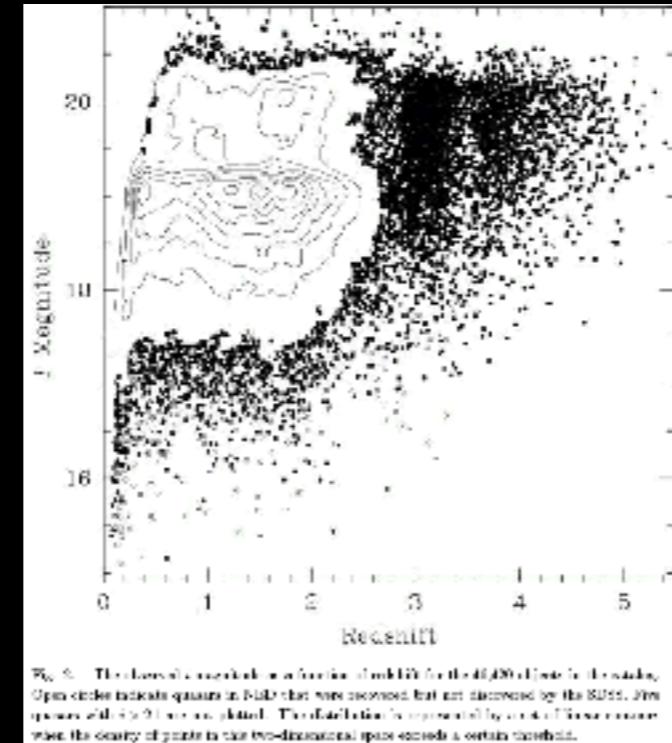
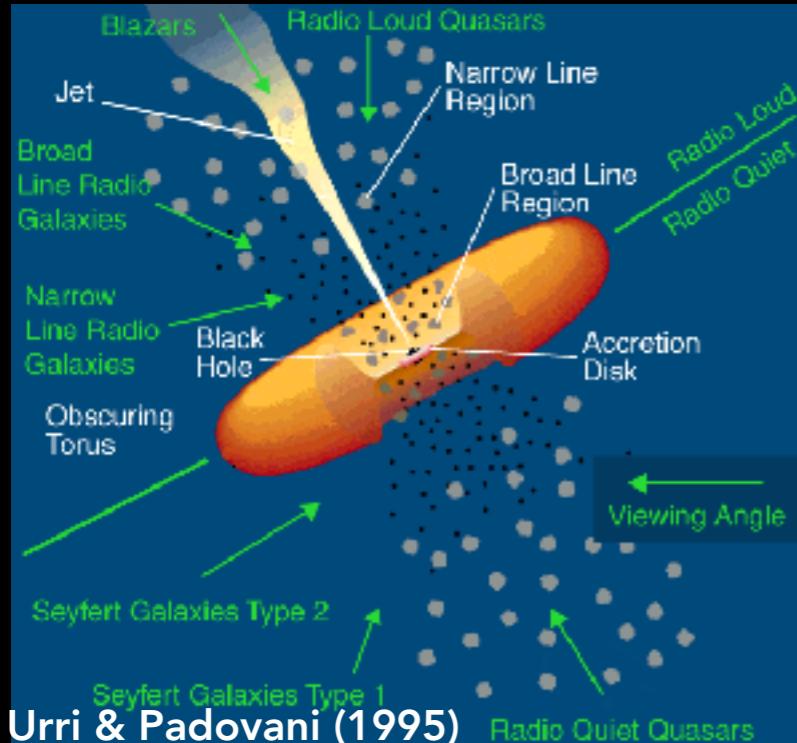
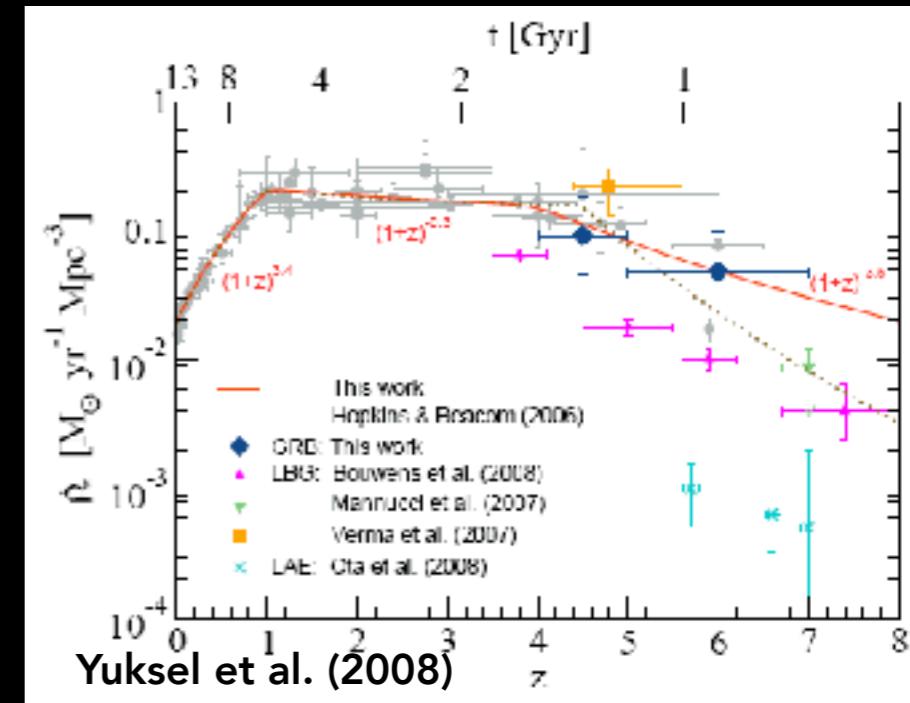
Romano et al. (2001)



Placco et al. (2019)

Galassie

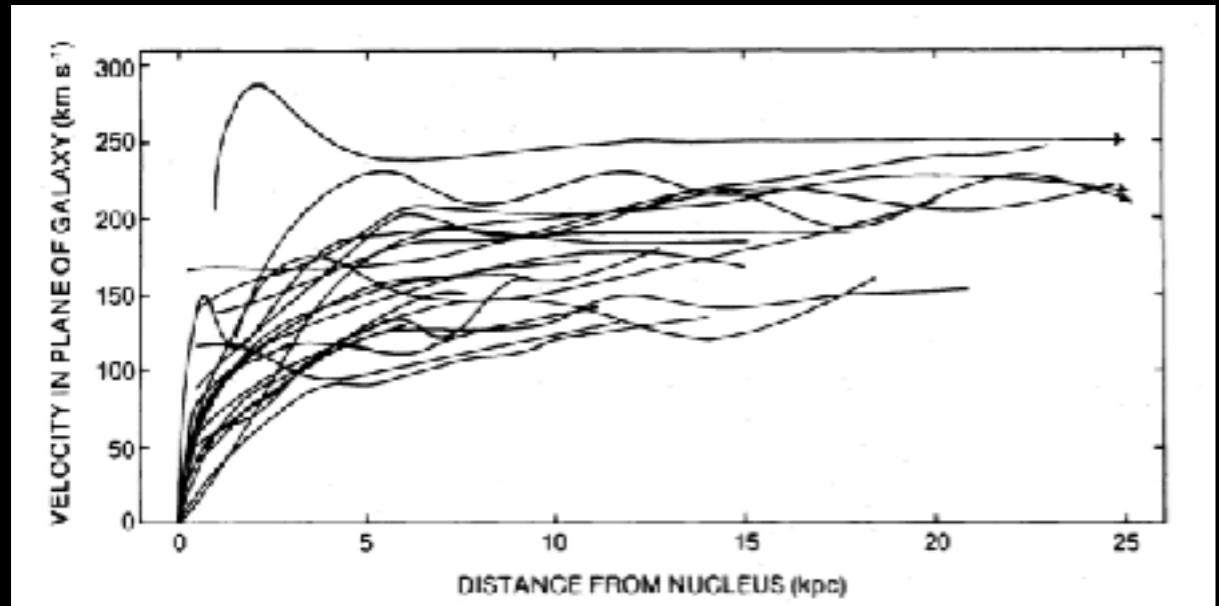
- Evoluzione delle Galassie
- Formazione Stellare
- Ruolo degli AGN



Cosmologia

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

- Materia Oscura
- Energia Oscura



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

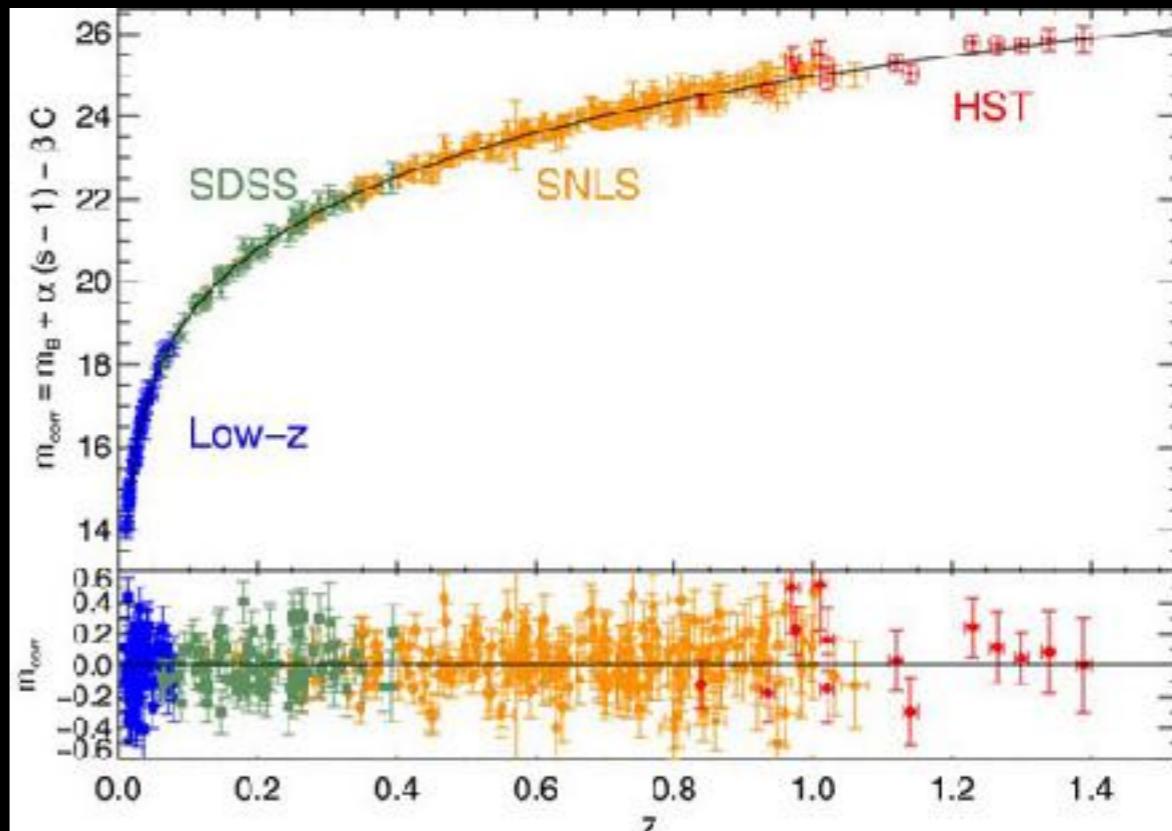


Photo: Ray Kaltschmidt, Courtesy: Lawrence Berkeley National Laboratory

Saul Perlmutter



Photo: Belinda Pratten, Australian National University

Brian P. Schmidt



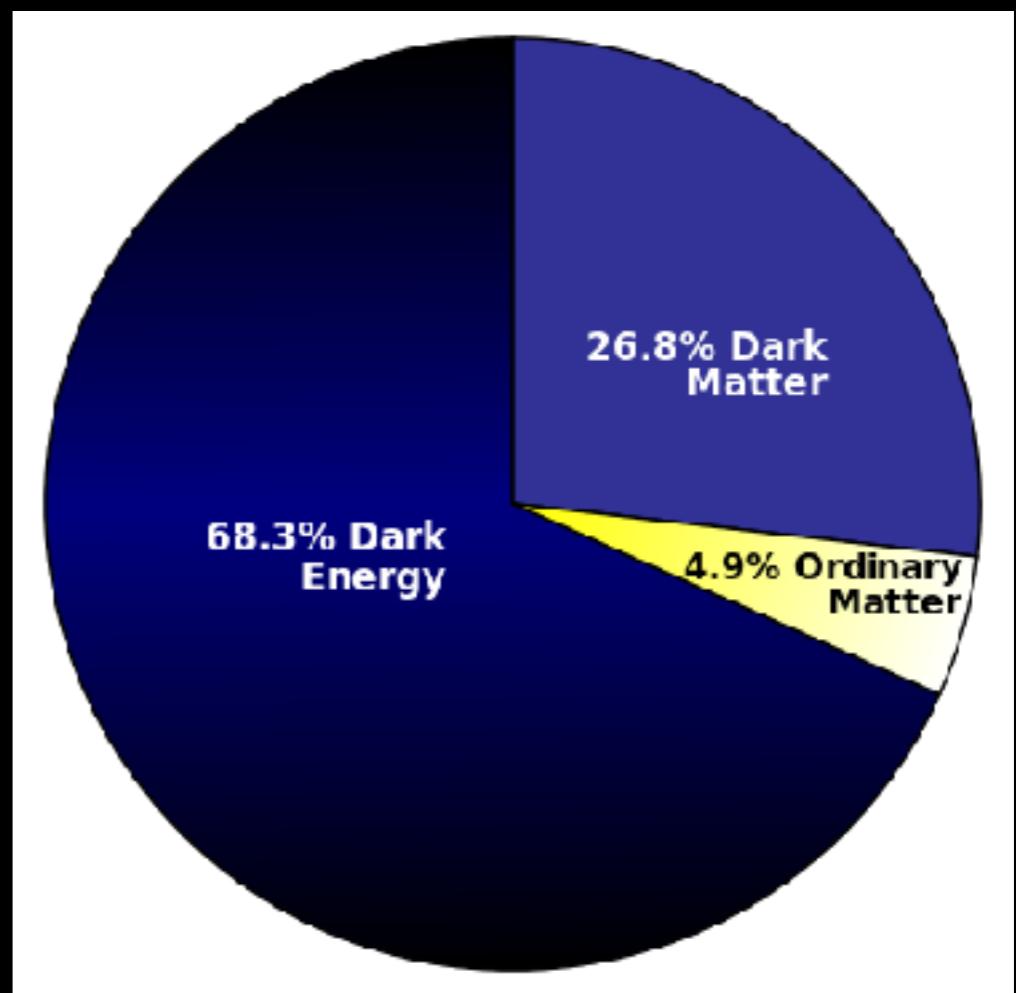
Photo: Homewood Photography

Adam G. Riess

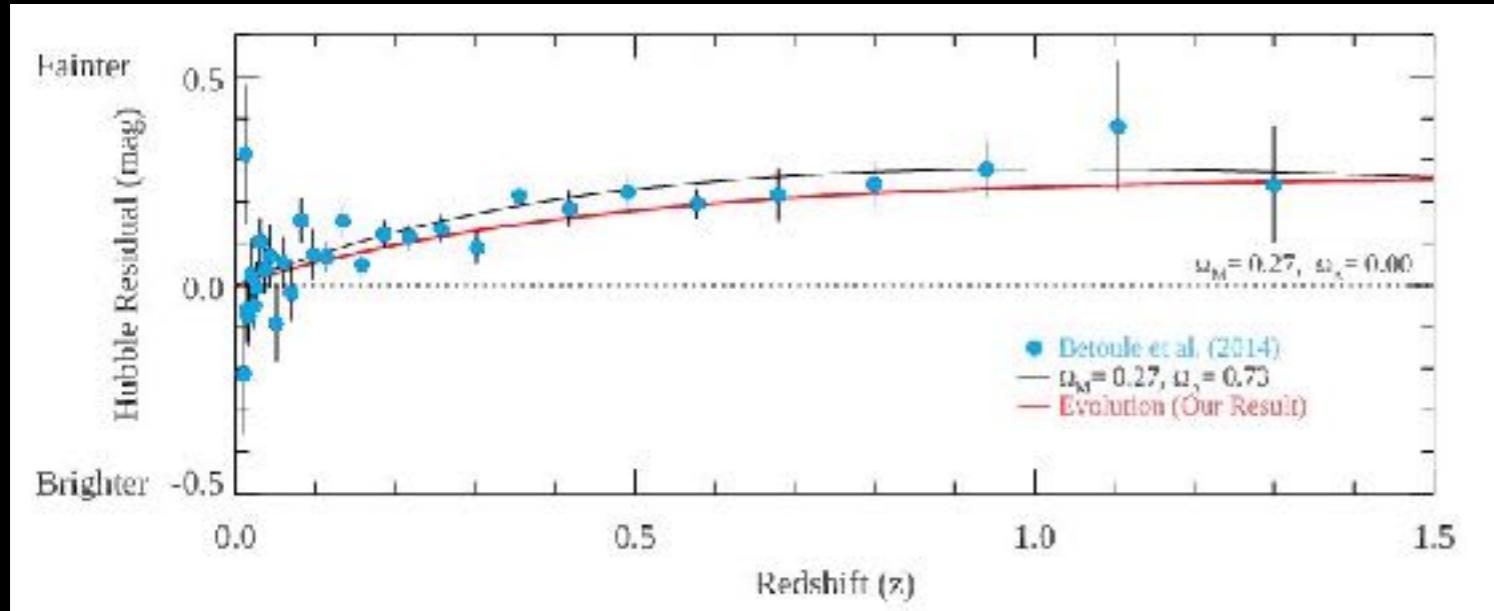
Premio Nobel per la Fisica 2011

“Oscuro”

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



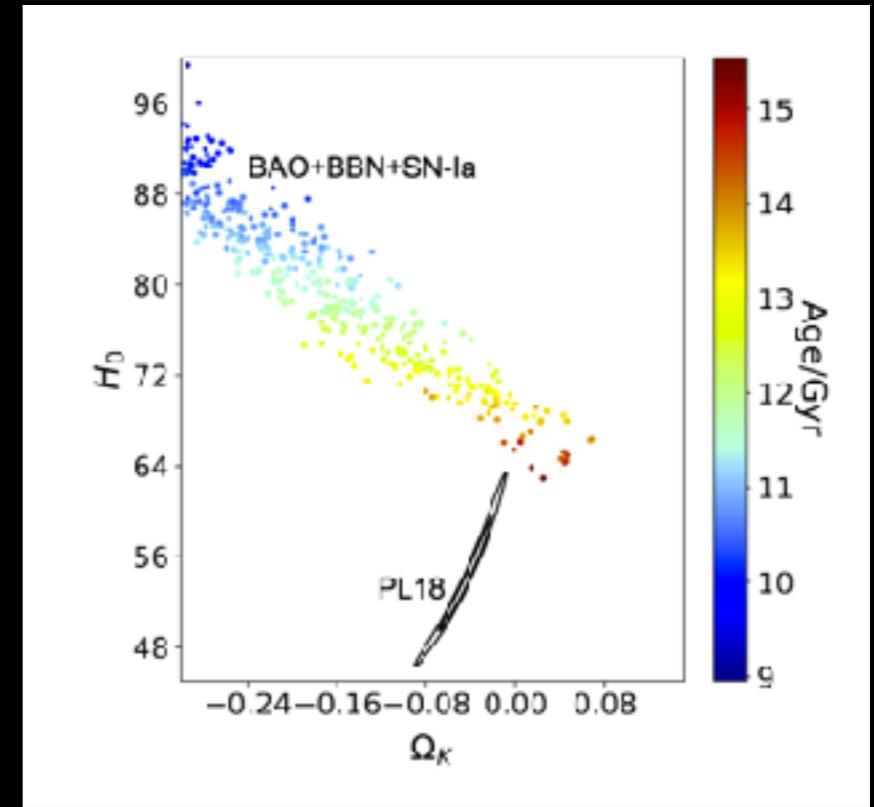
Esiste l'Energia Oscura?



Kang et al. (2019)

$$\Lambda = 0?$$

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

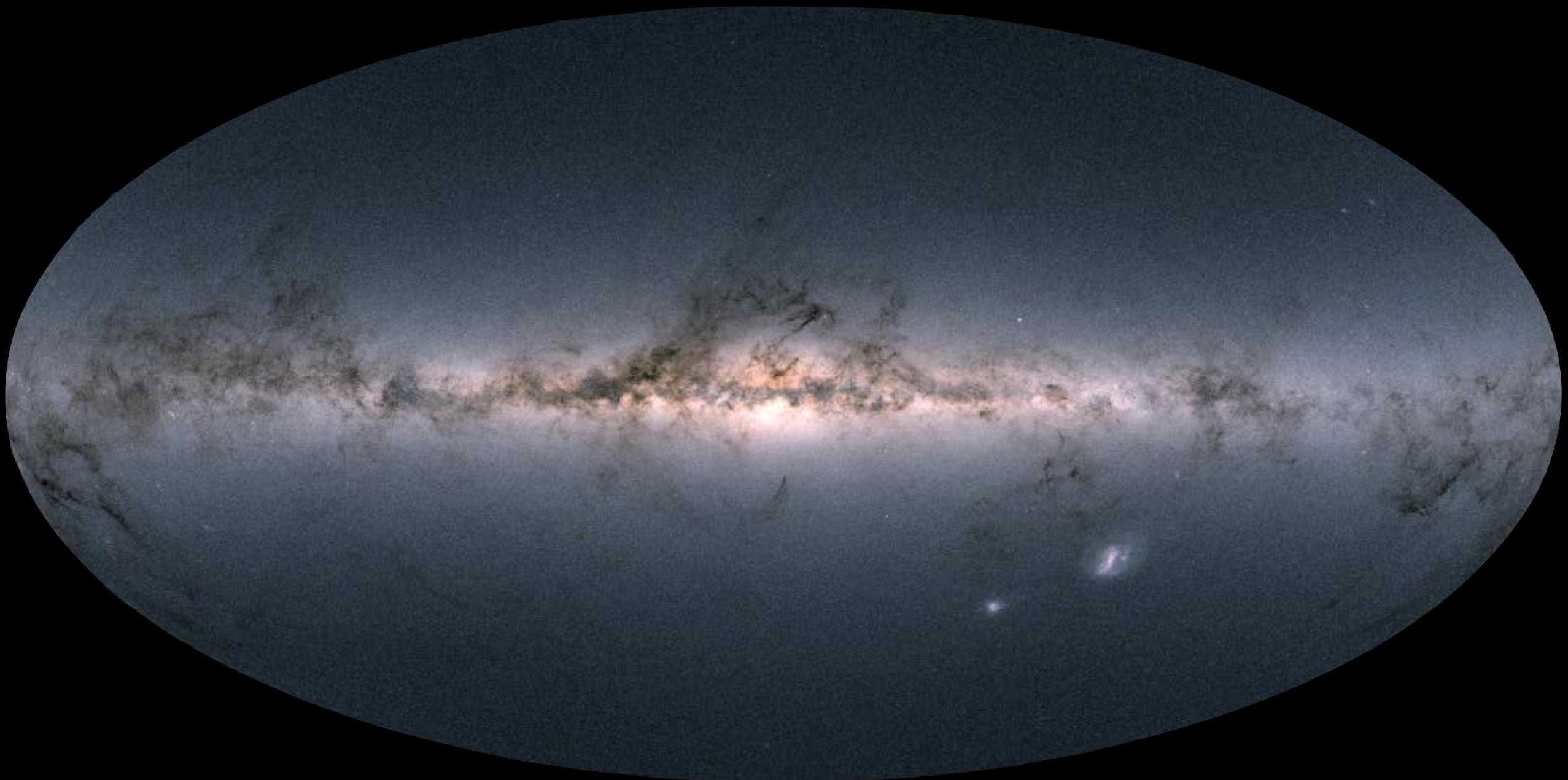


Di Valentino, Melchiorri & Silk (2019)

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?

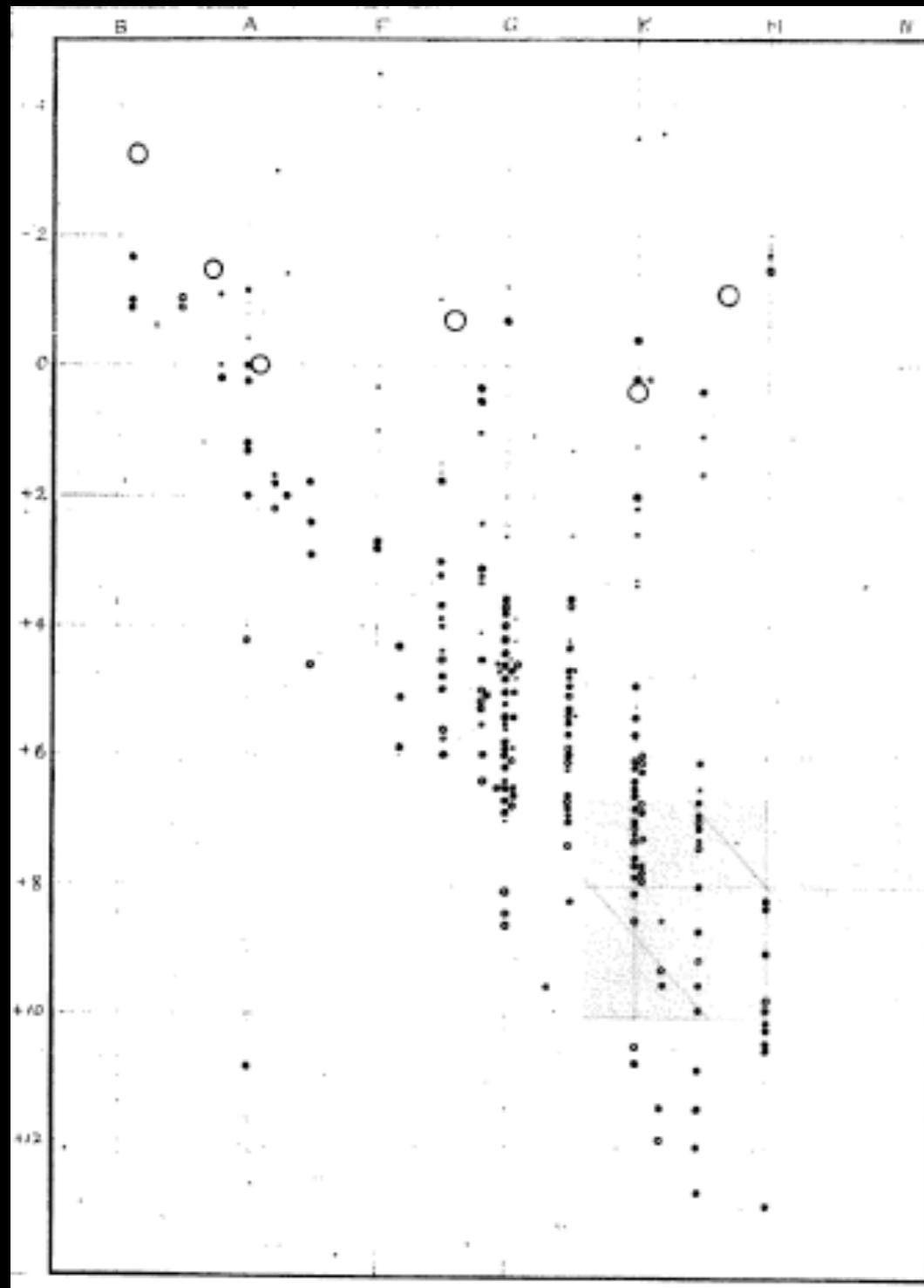
Gaia



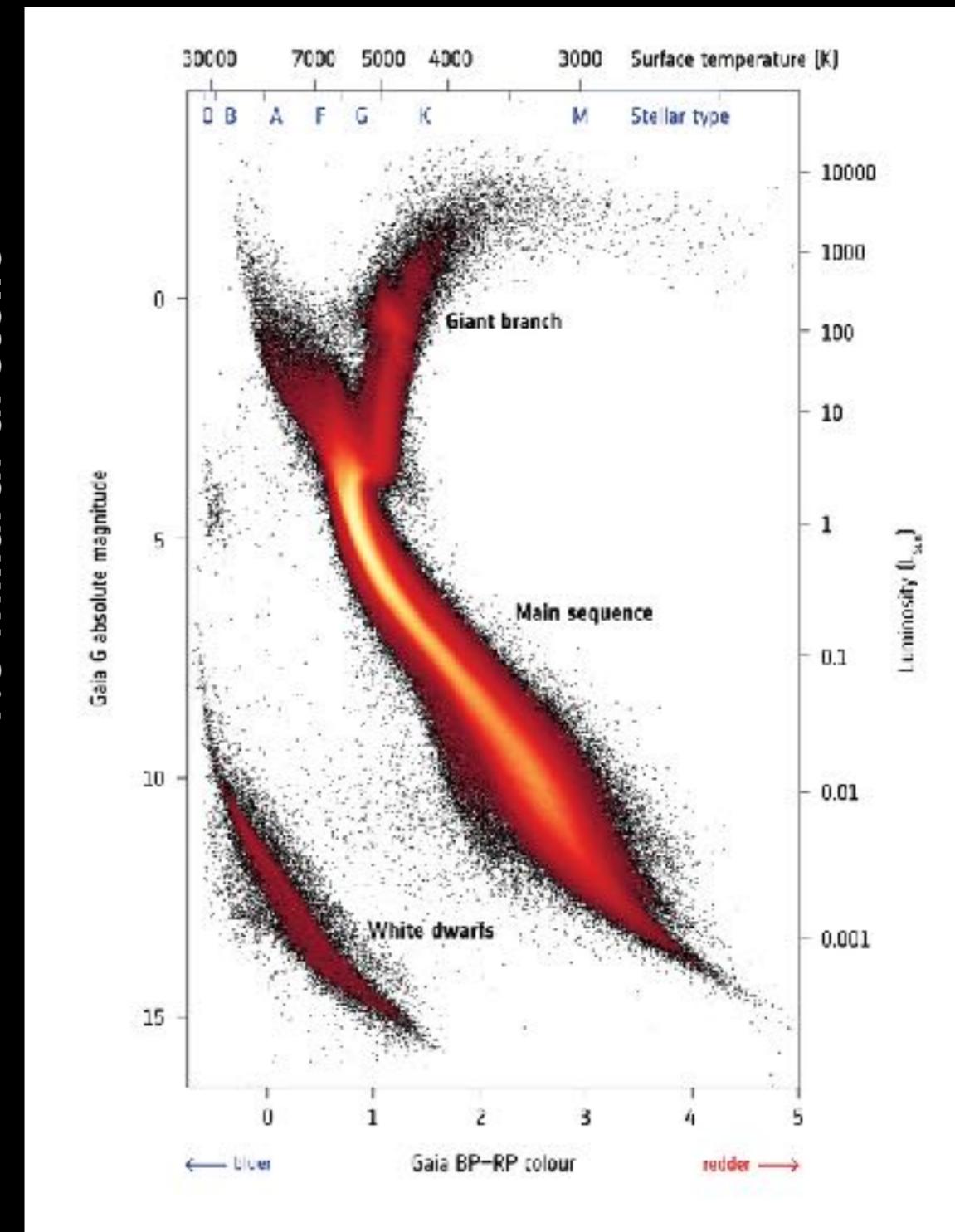
Gaia

Gaia

Il Diagramma HR di Gaia



1.8 miliardi di stelle

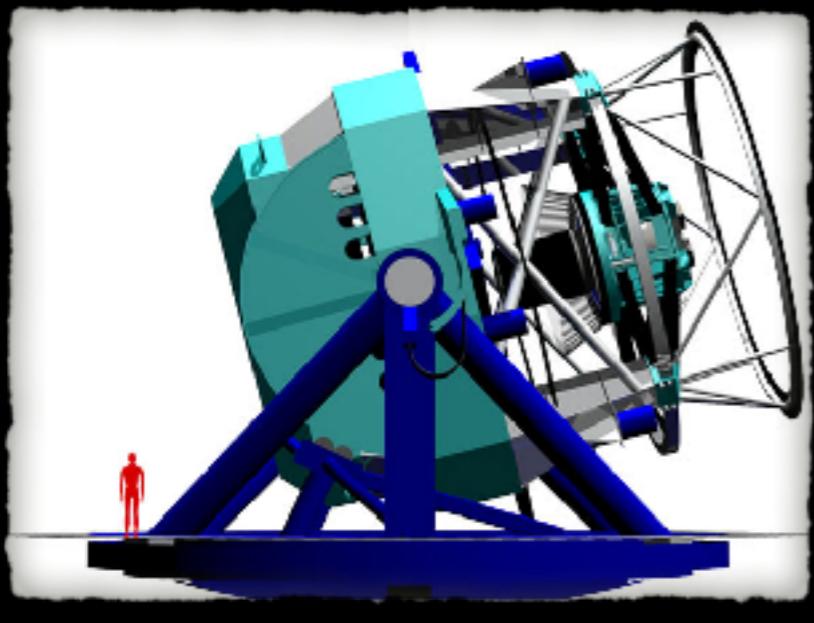


James Webb Space Telescope



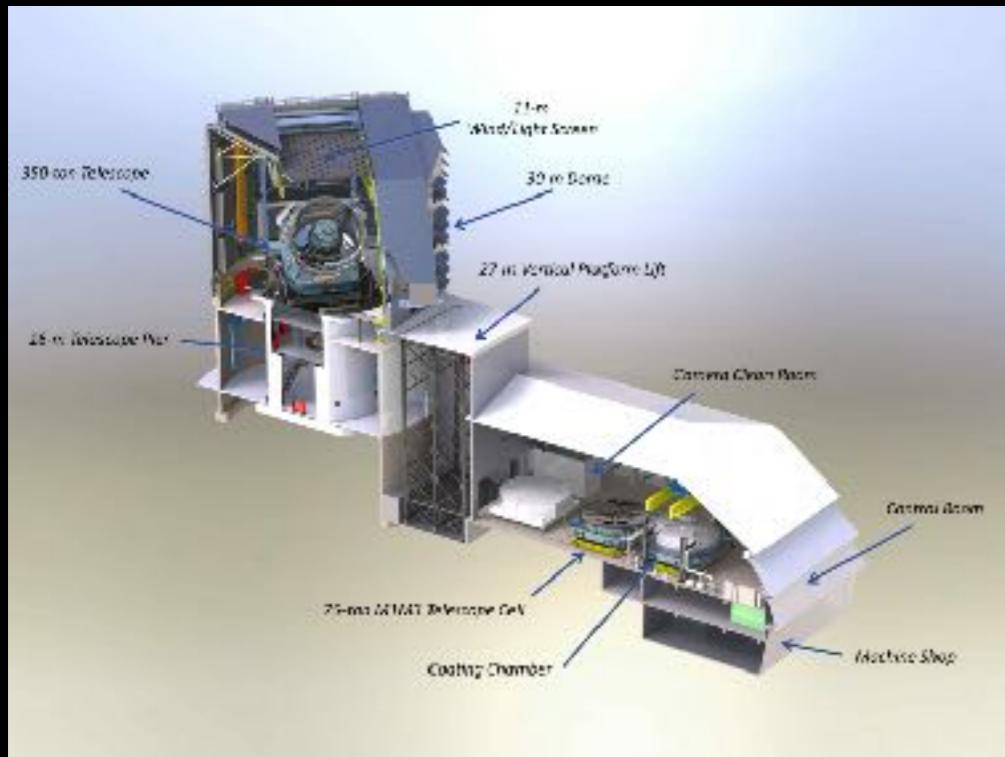
6 metres (segmented)
infrared telescope

Vera Rubin Telescope



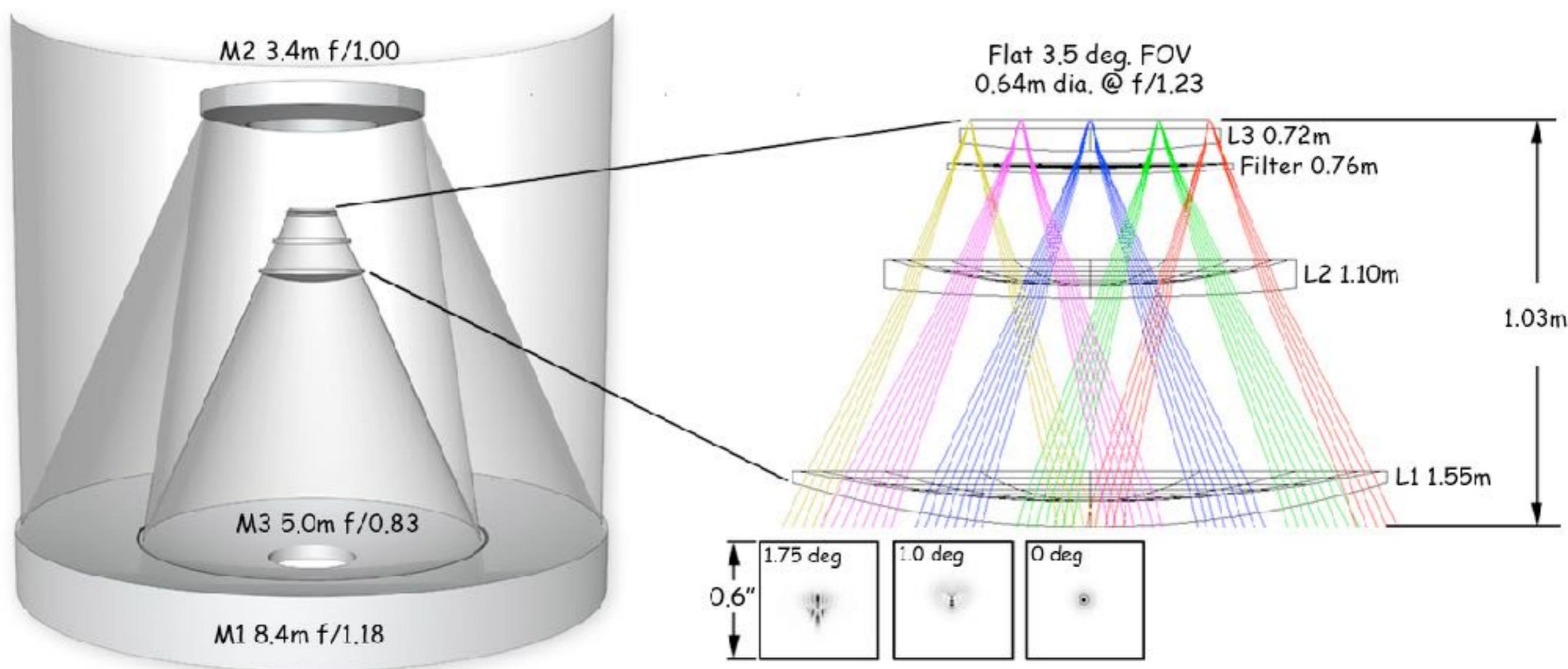
diametro 8m

FoV: 5sq.deg.

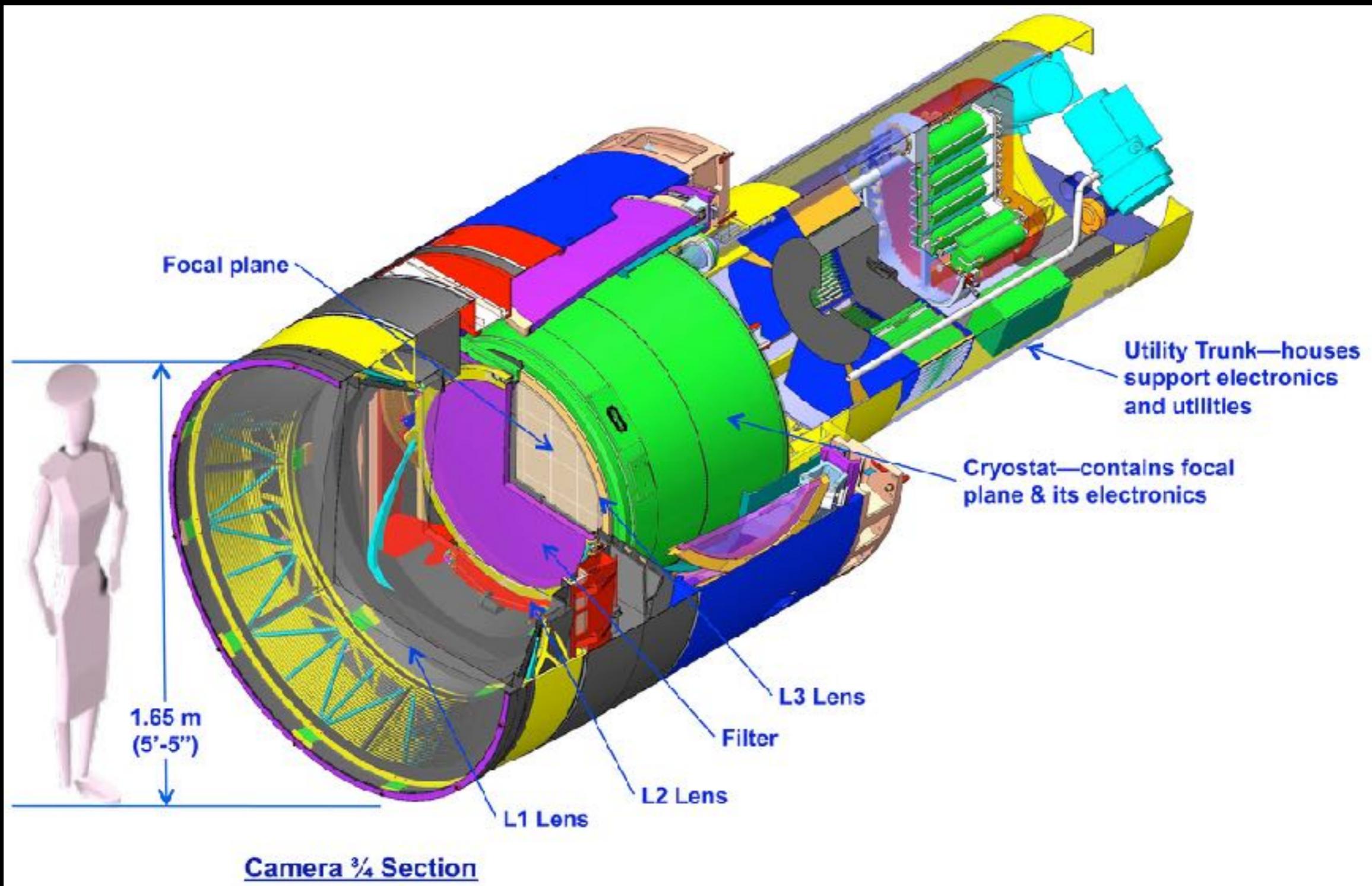


Vera Rubin Telescope

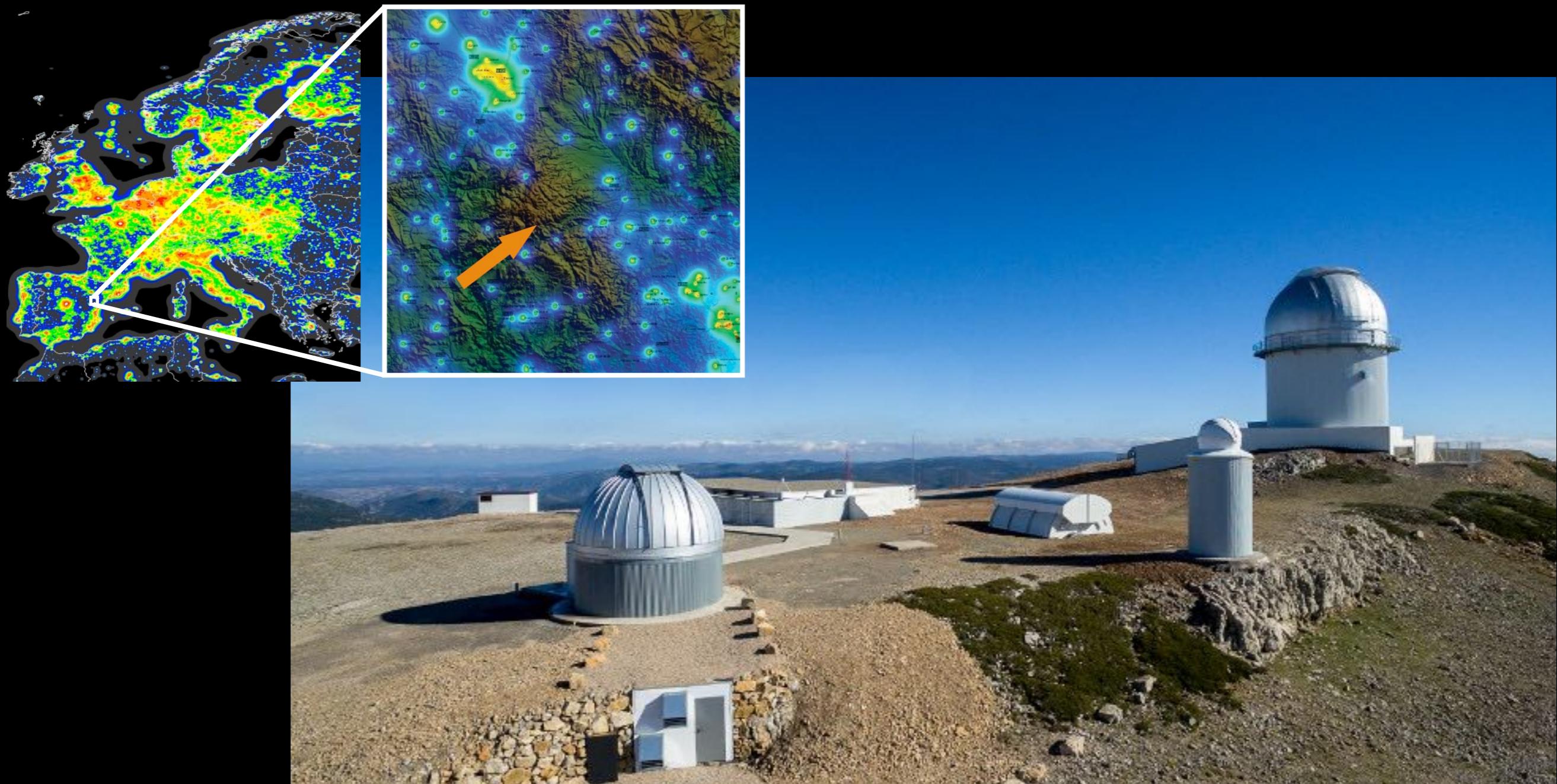
Disegno Ottico del VRT



La Camera del VRT



Observatorio Astrofísico de Javalambre

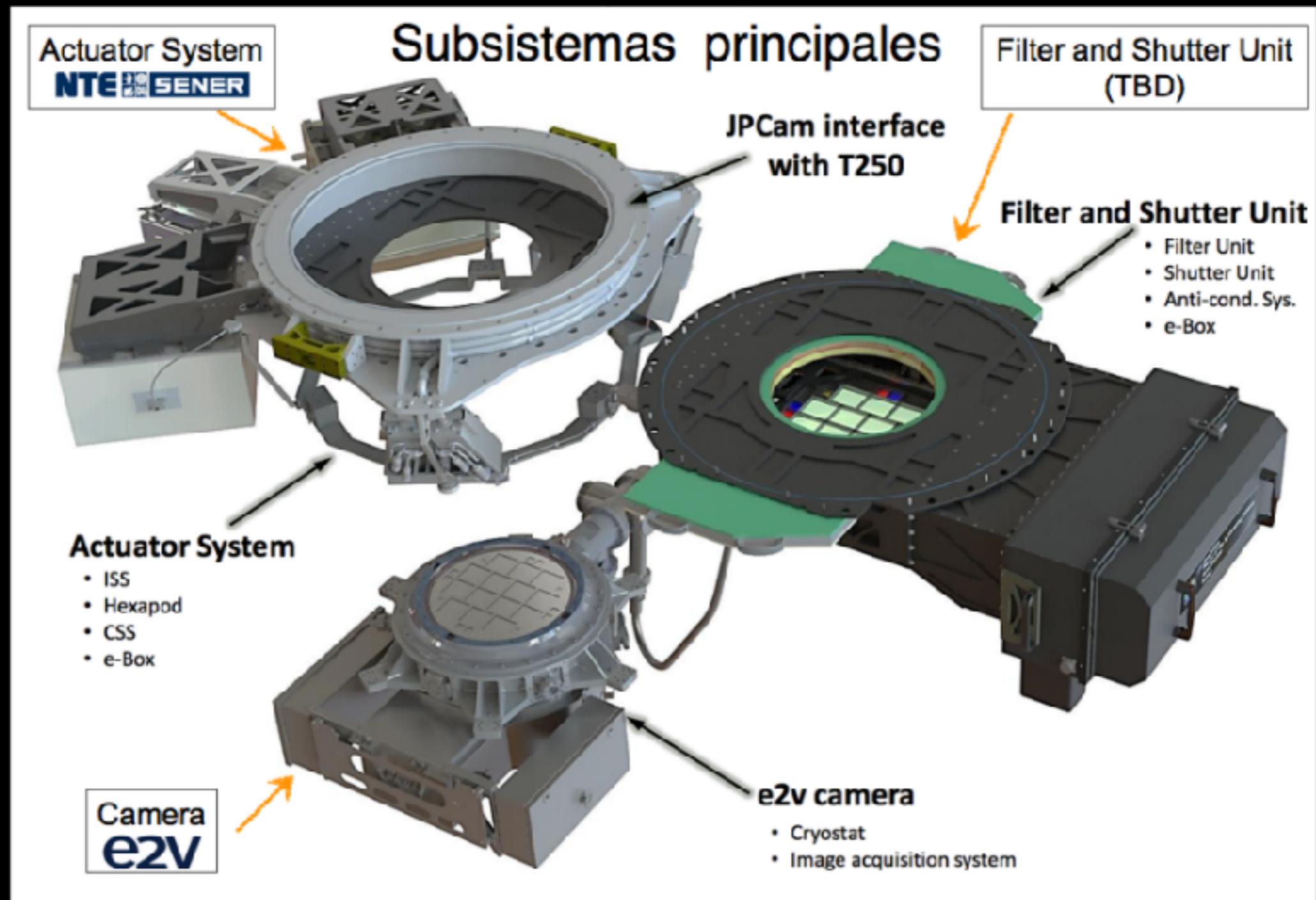


T250/JST



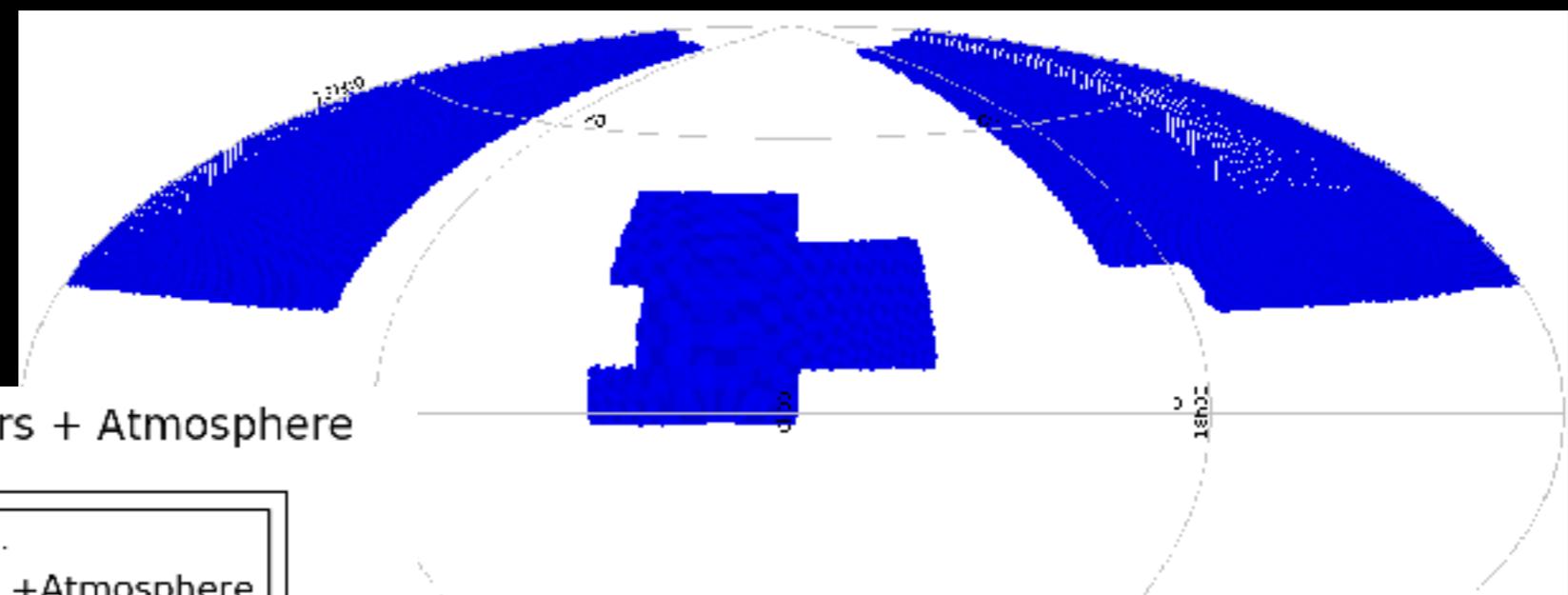
FoV = 5sq.deg.

JPCam

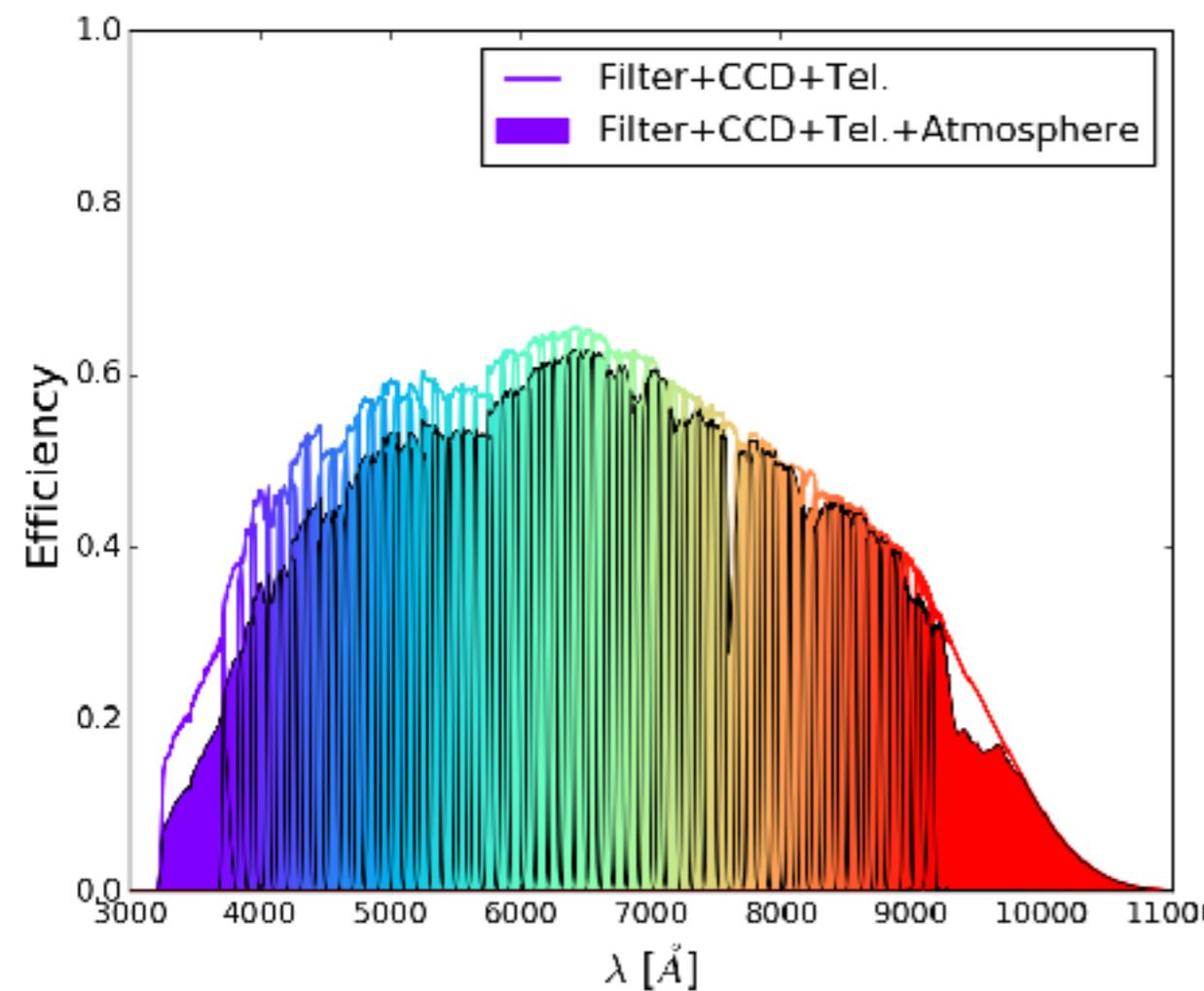


J-PAS

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

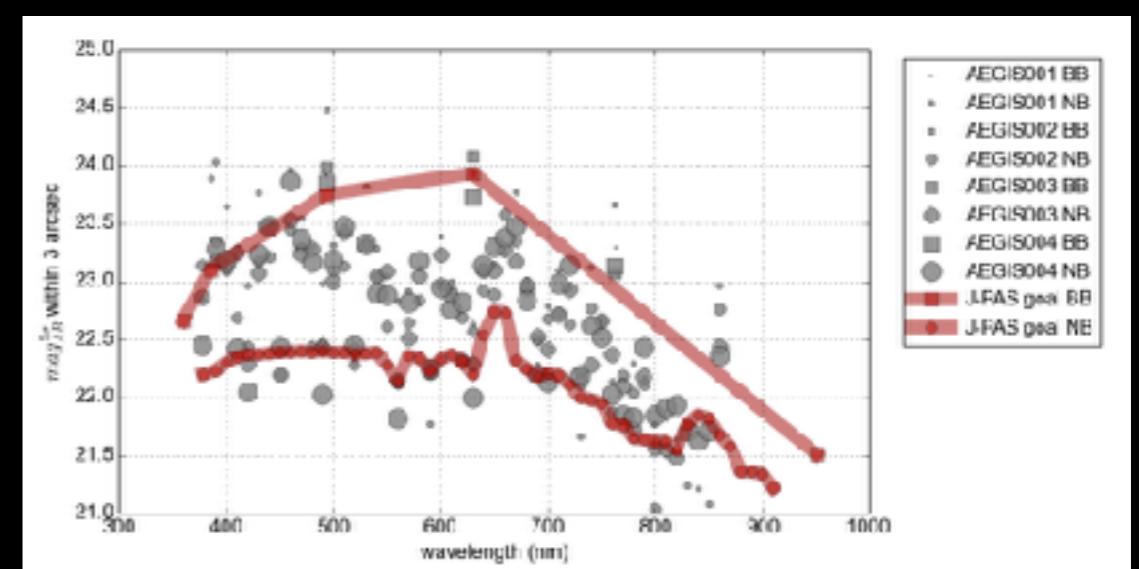
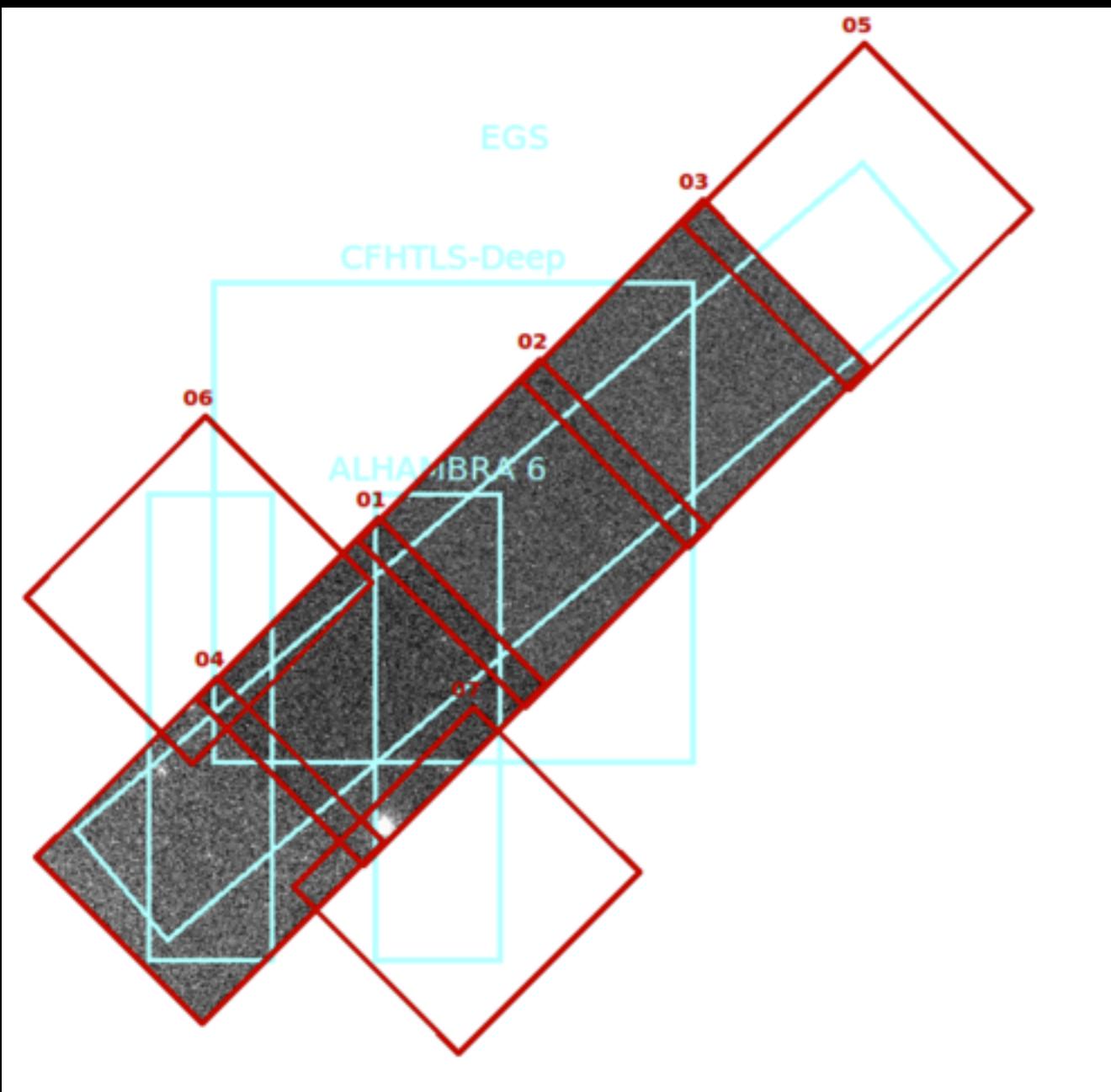


Overall efficiency system JPCam + Filters + Atmosphere



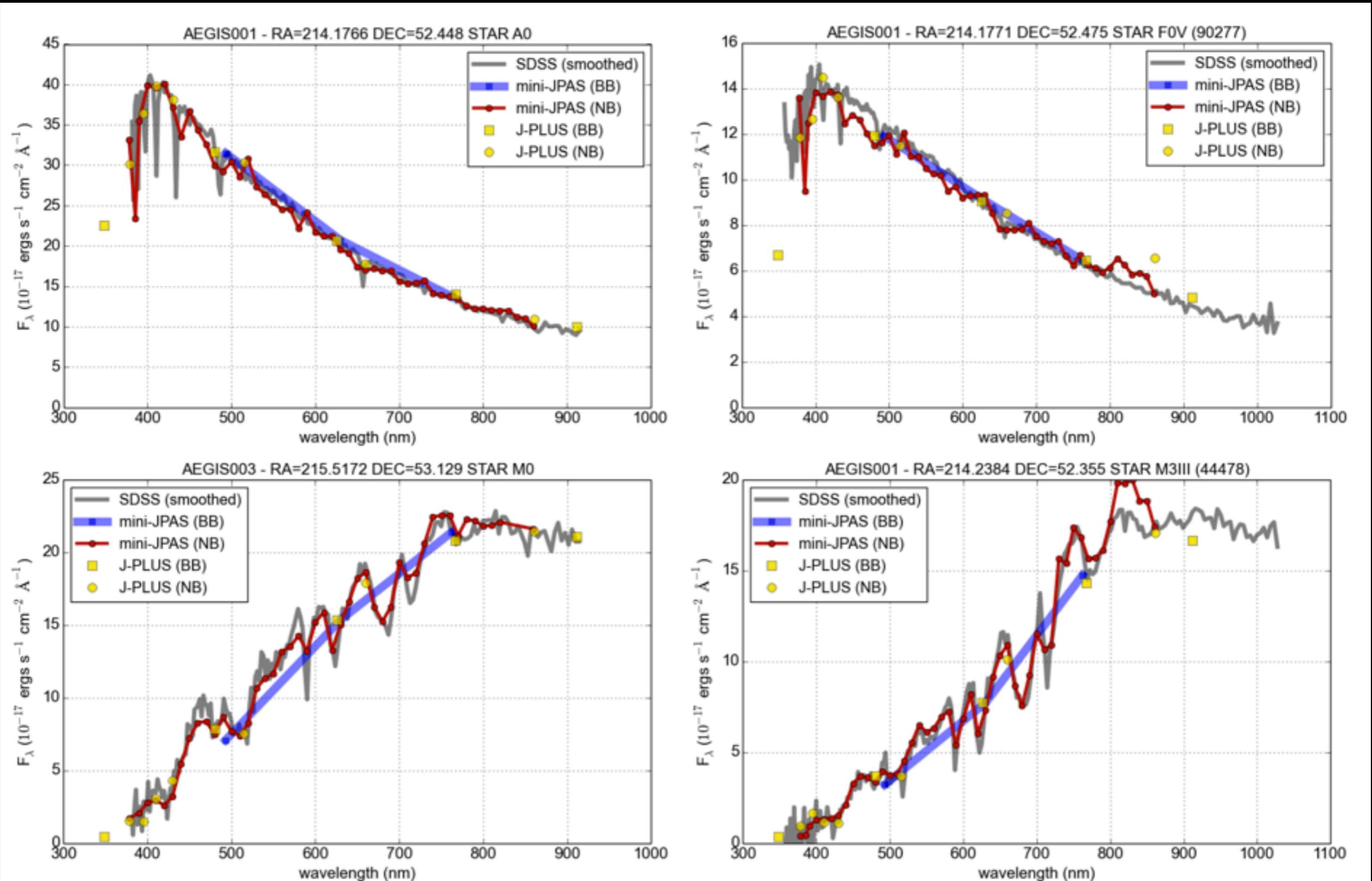
400 M galaxies
400 M stars
2 M quasars
4000 SNe Ia

mini-J-PAS

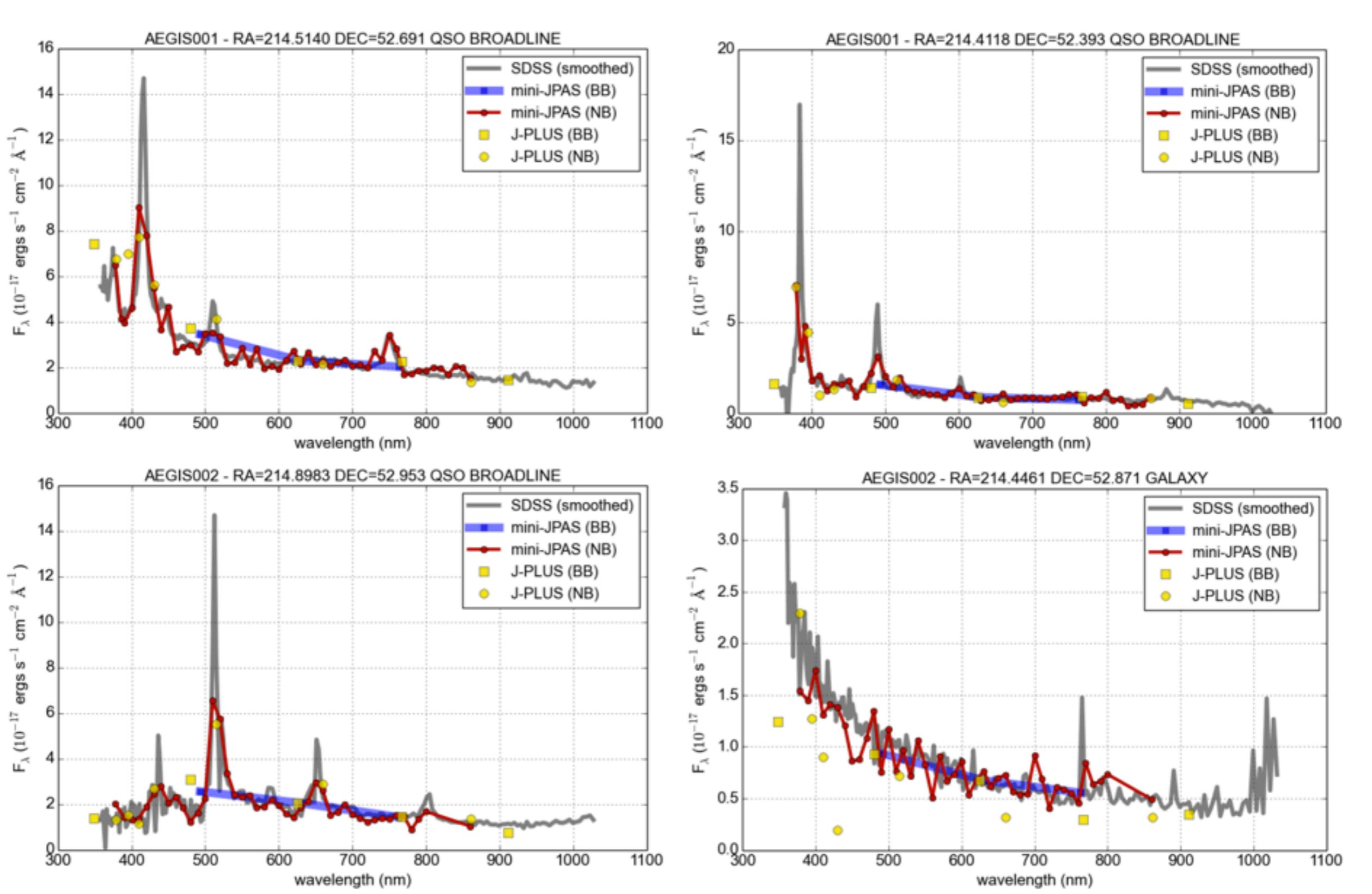


archive.cefca.es

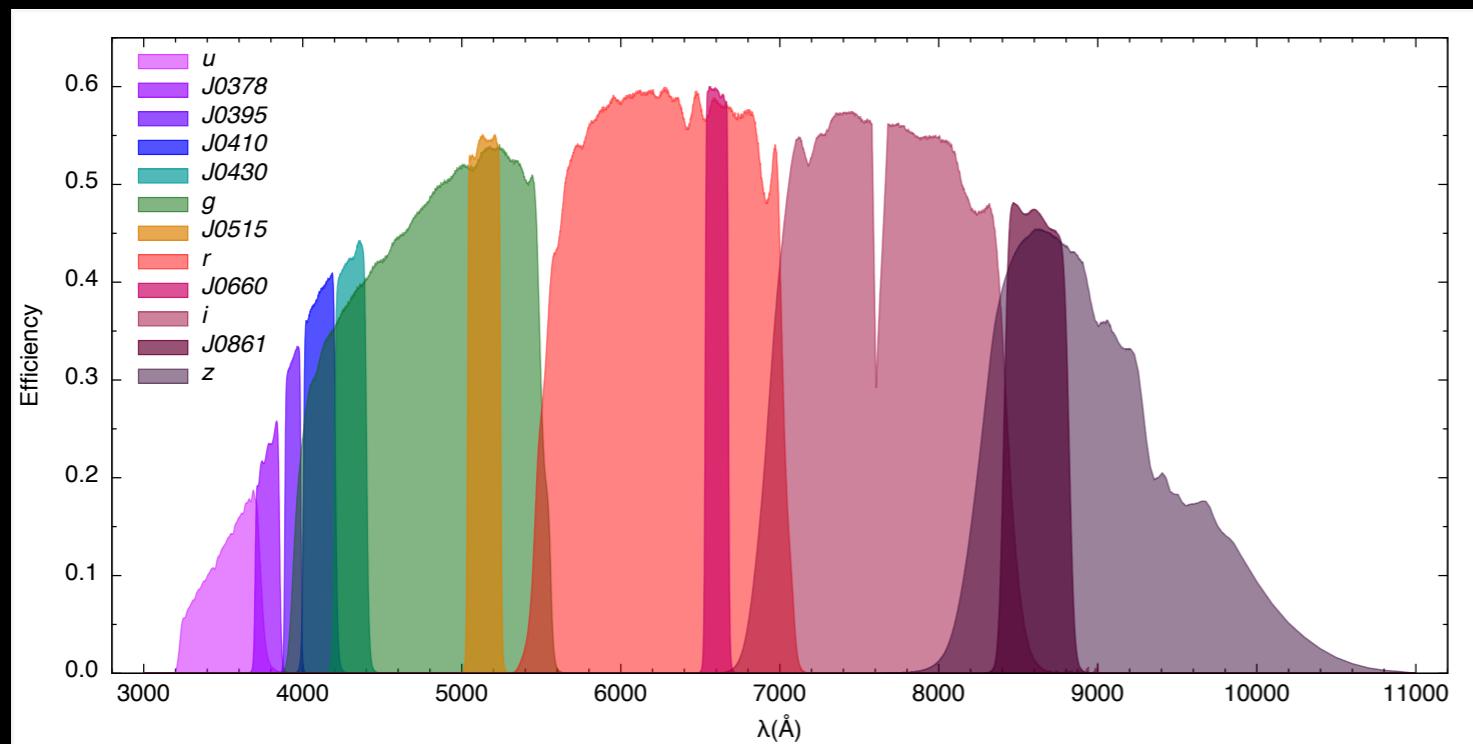
mini-J-PAS stelle



mini-J-PAS extragalactic



J-PLUS

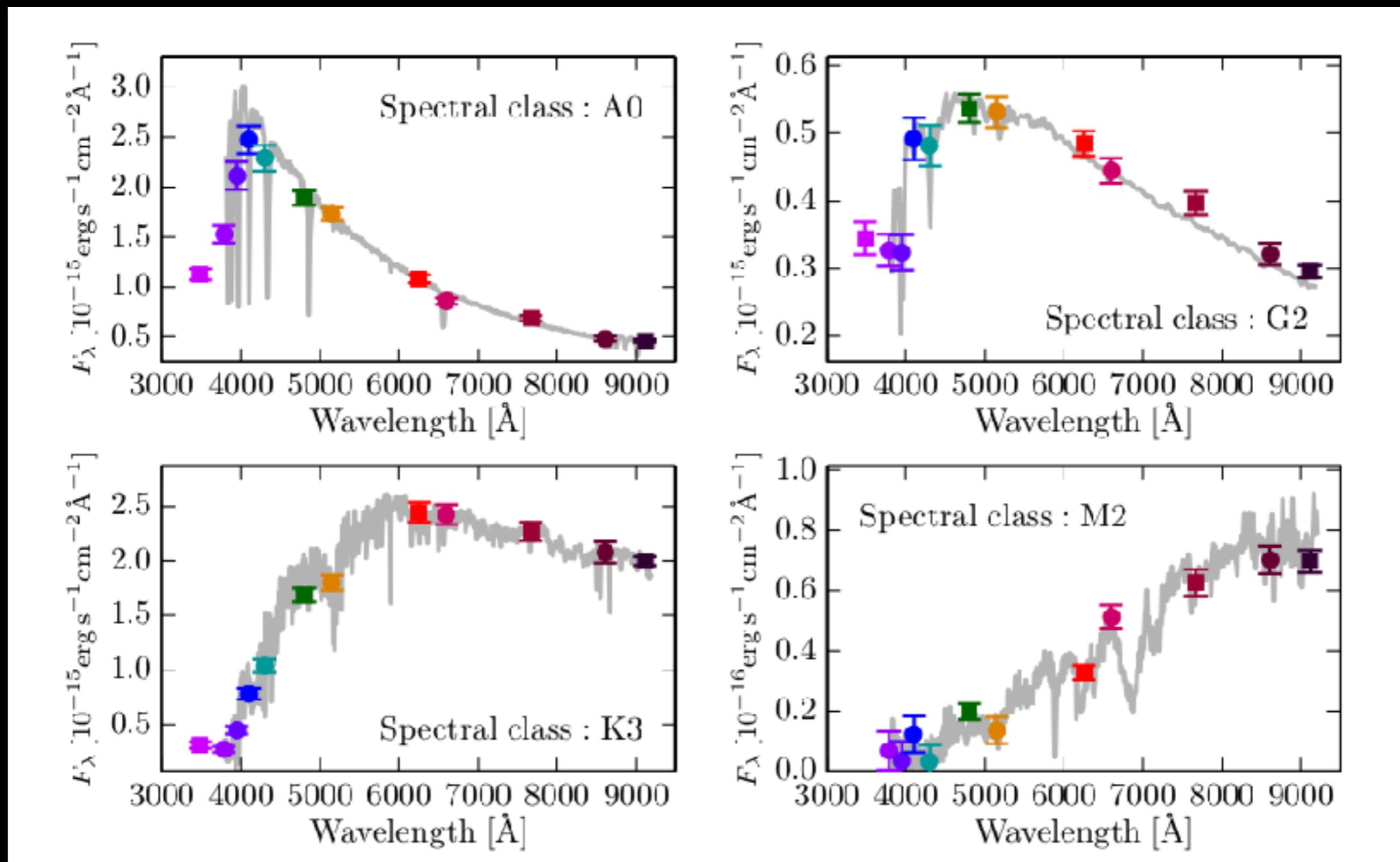


EDR Oct 2017 36 sq.deg
DR1 Jul 2018 1000
sq.deg.

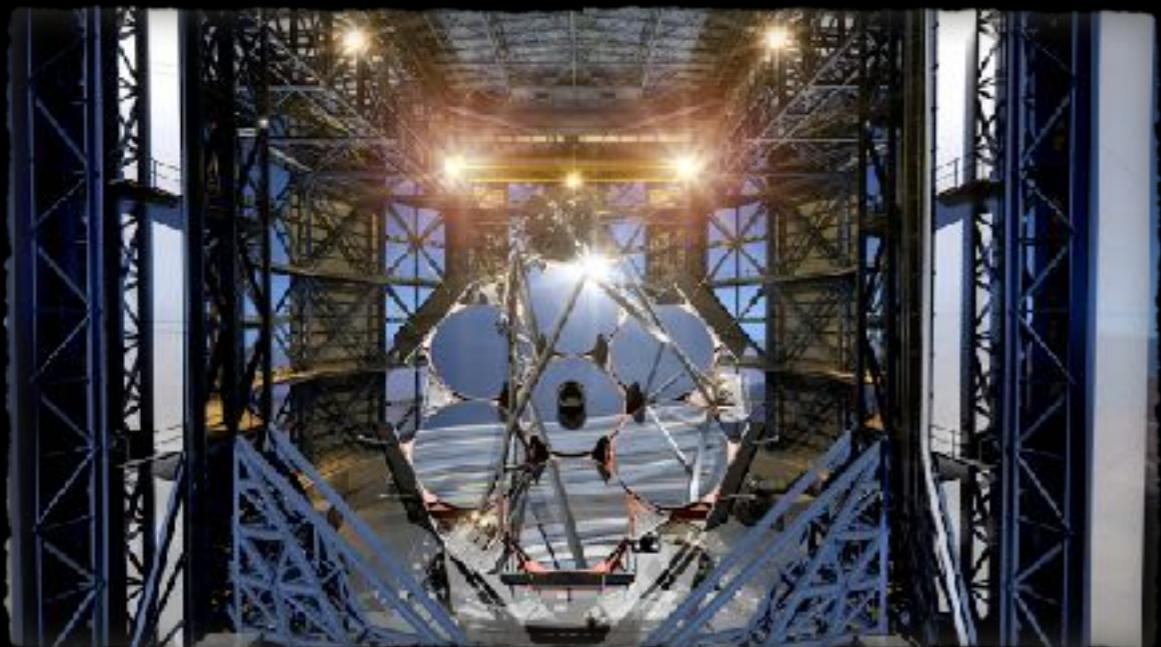
T80/JAST



J-PLUS



Gli “Extremely Large Telescopes”



Giant Magellan
Telescope (7 x 8m)

Thirty Metre Telescope
(indovina?)

Extremely Large
Telescope (39m)

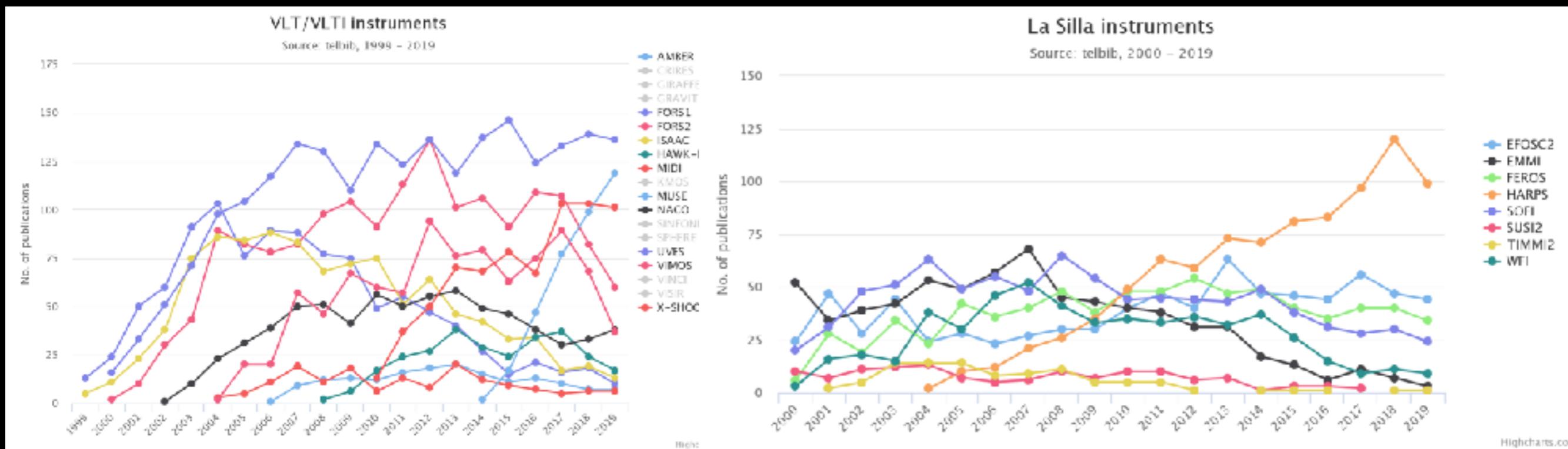


Gli “Extremely Large Telescopes”



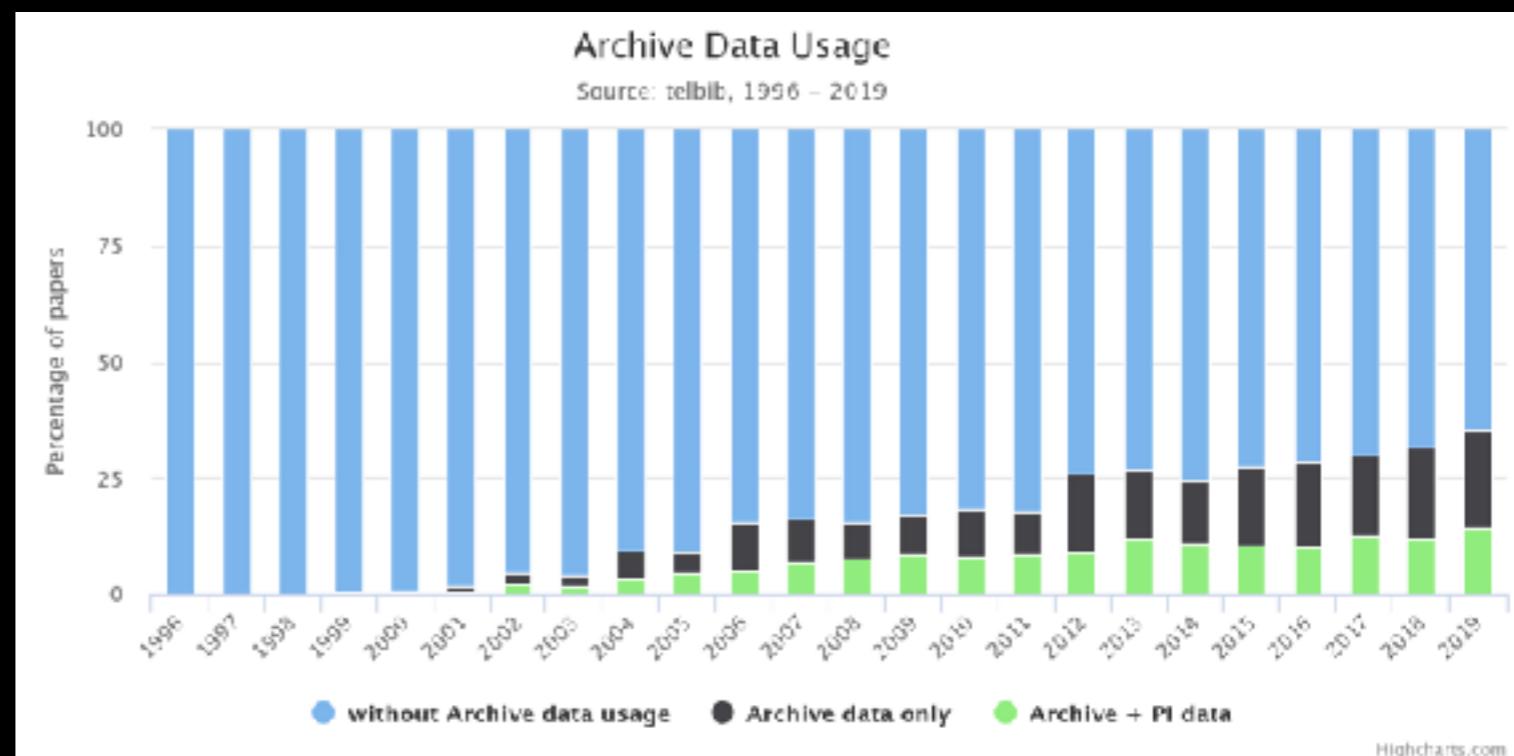
MEDIA  INAF^{TV}

Archivi e “VO”

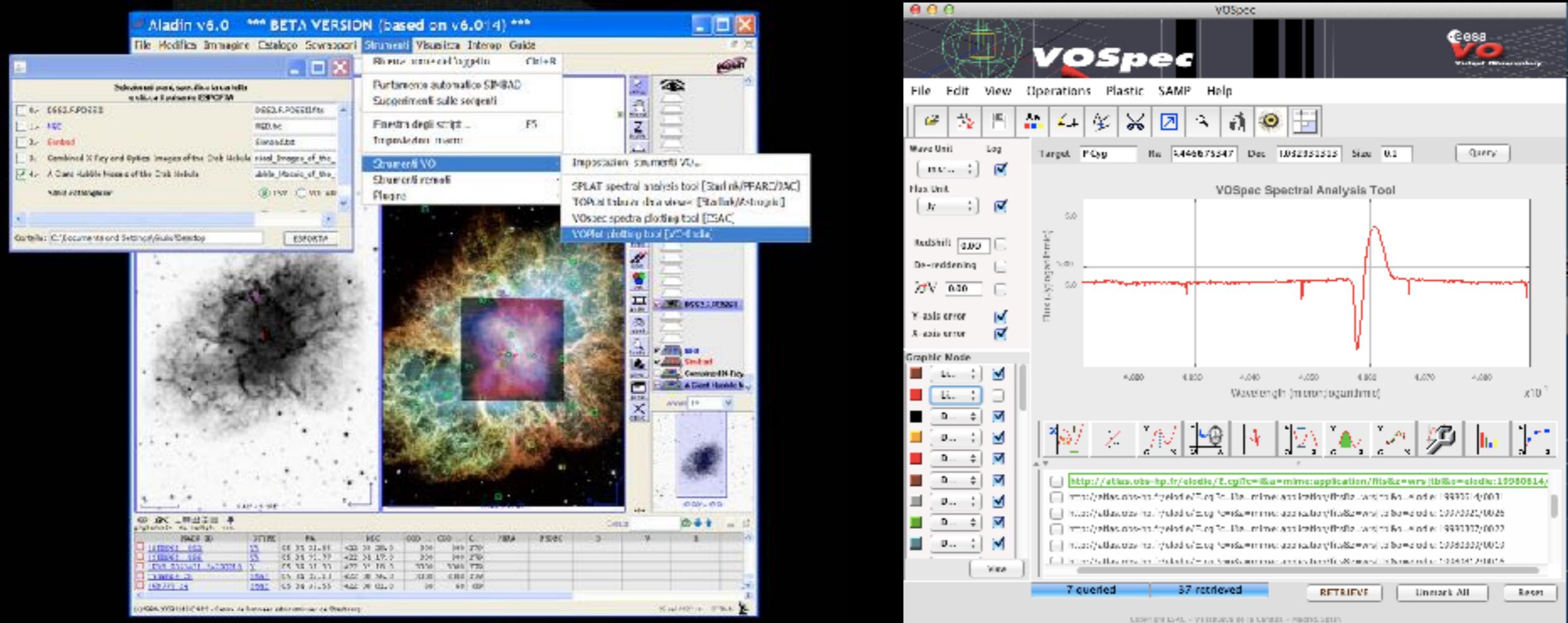


Tutti i grandi osservatori
offrono accesso ai propri
dati attraverso un archivio.

(Non sempre i dati sono
“science ready”)



Archivi e “VO”

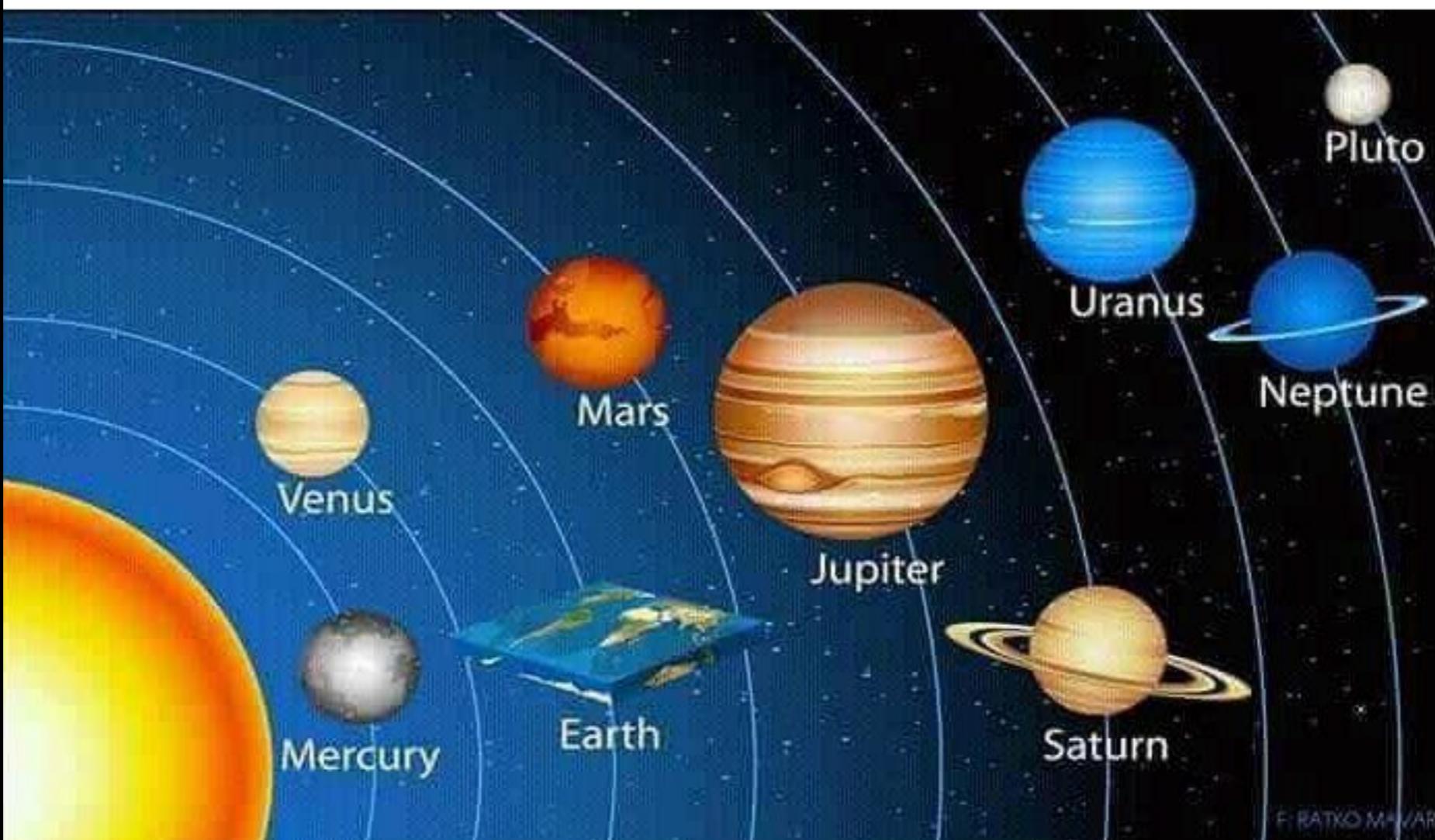


L'Osservatorio Virtuale è uno sforzo internazionale per la standardizzazione per l'uso e la distribuzione di dati astronomici.

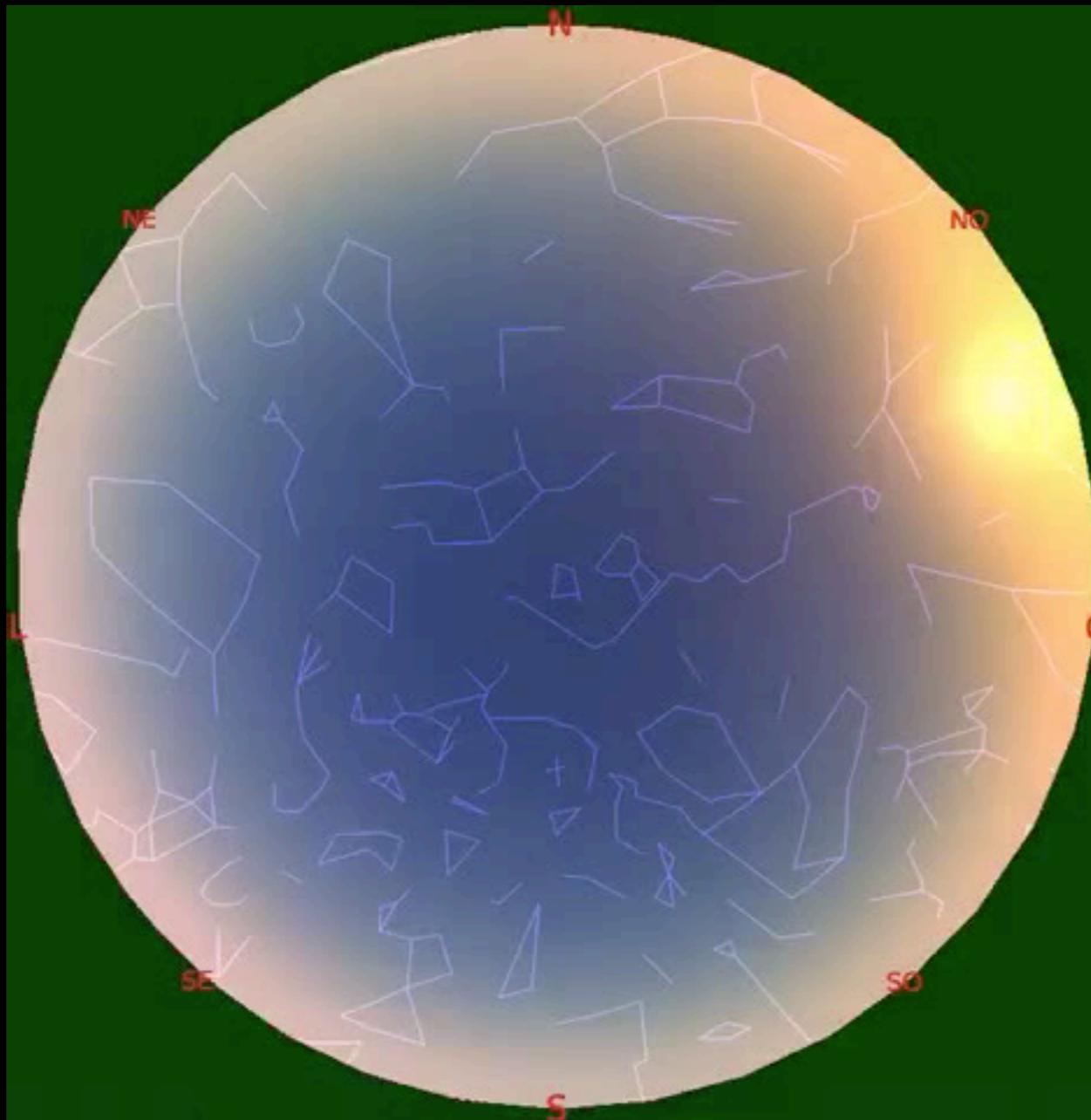
<http://www.ivoa.net/>

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!