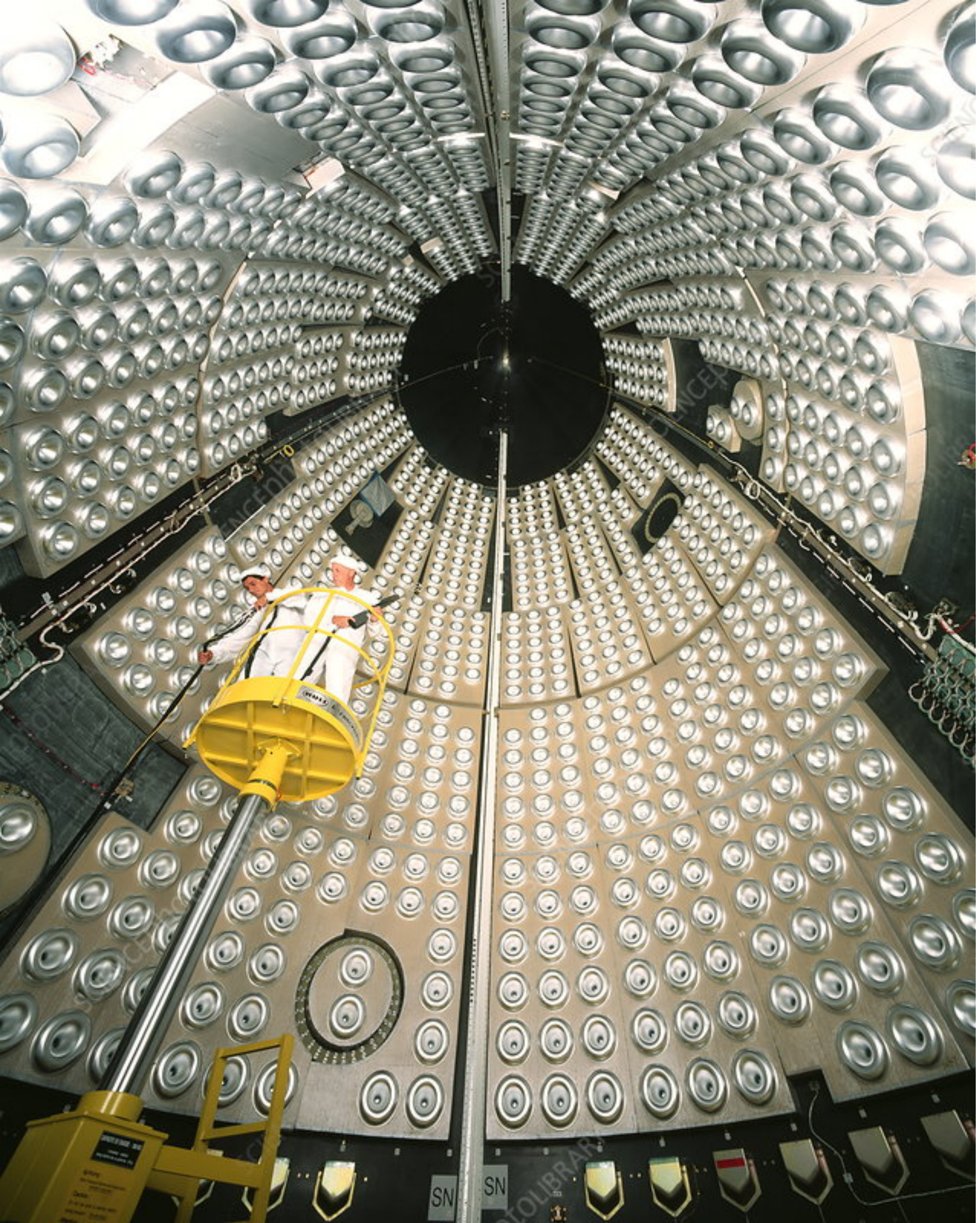
ULTRAVIOLET ASTRONOMY IN THE XXI CENTURY

e-Workshop 2020 – October 27-29

JcUVa



euvo

The EUROPEAN ULTRAVIOLET VISIBLE OBSERVATORY

Ana I Gómez de Castro
on behalf of the EUVO team

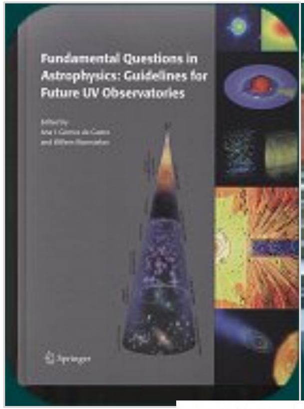
EUVO's ORIGIN AND PURPOSE

2004

CREATION OF THE NETWORK FOR ULTRAVIOLET ASTRONOMY.
A **EUROPEAN UNION** COORDINATION ACTIVITY.

2007

1ST NUVA CONFERENCE. **NUVA GOES GLOBAL.**



2013

ESA ANNOUNCES AN OPEN CALL FOR SCIENCE THEMES WITHIN THE "COSMIC VISION" ENVELOPE – LARGE MISSIONS. THE CONCEPT FOR A EUROPEAN ULTRAVIOLET VISIBLE **OBSERVATORY IS BORN**

357 scientist supported the proposal

euvo


84 CIENCIA/FUTURO LUNES 4_6_2007 ABC

Los astrónomos **sueñan con E.T.**

2019

ESA ANNOUNCES AN OPEN CALL FOR IDEAS FOR THE "VOYAGE TO 2050".
THE euvo CONCEPT IS SUBMITTED AGAIN.

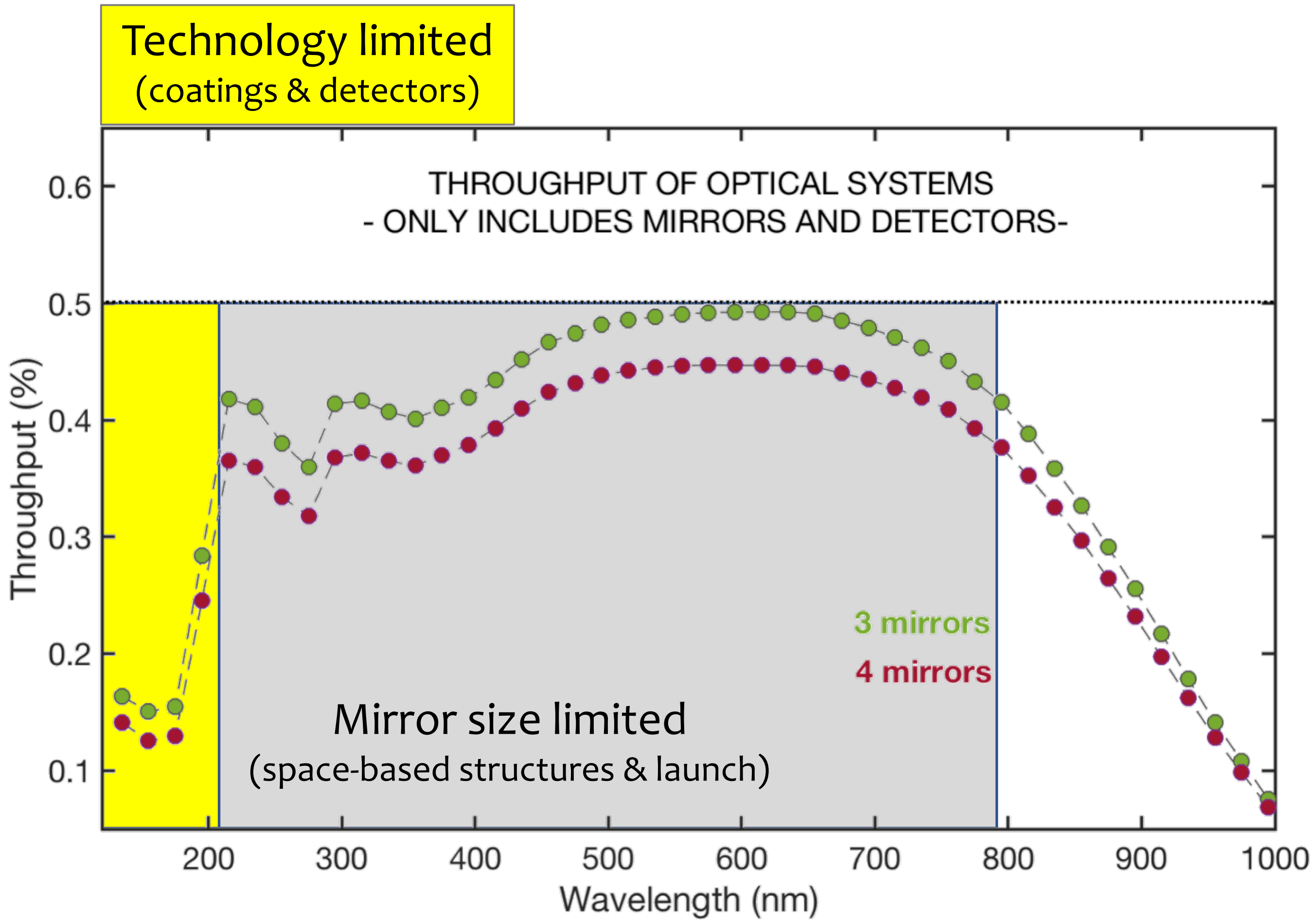
-NOW IS WITHIN THE SYSTEM-

What is EUVO?

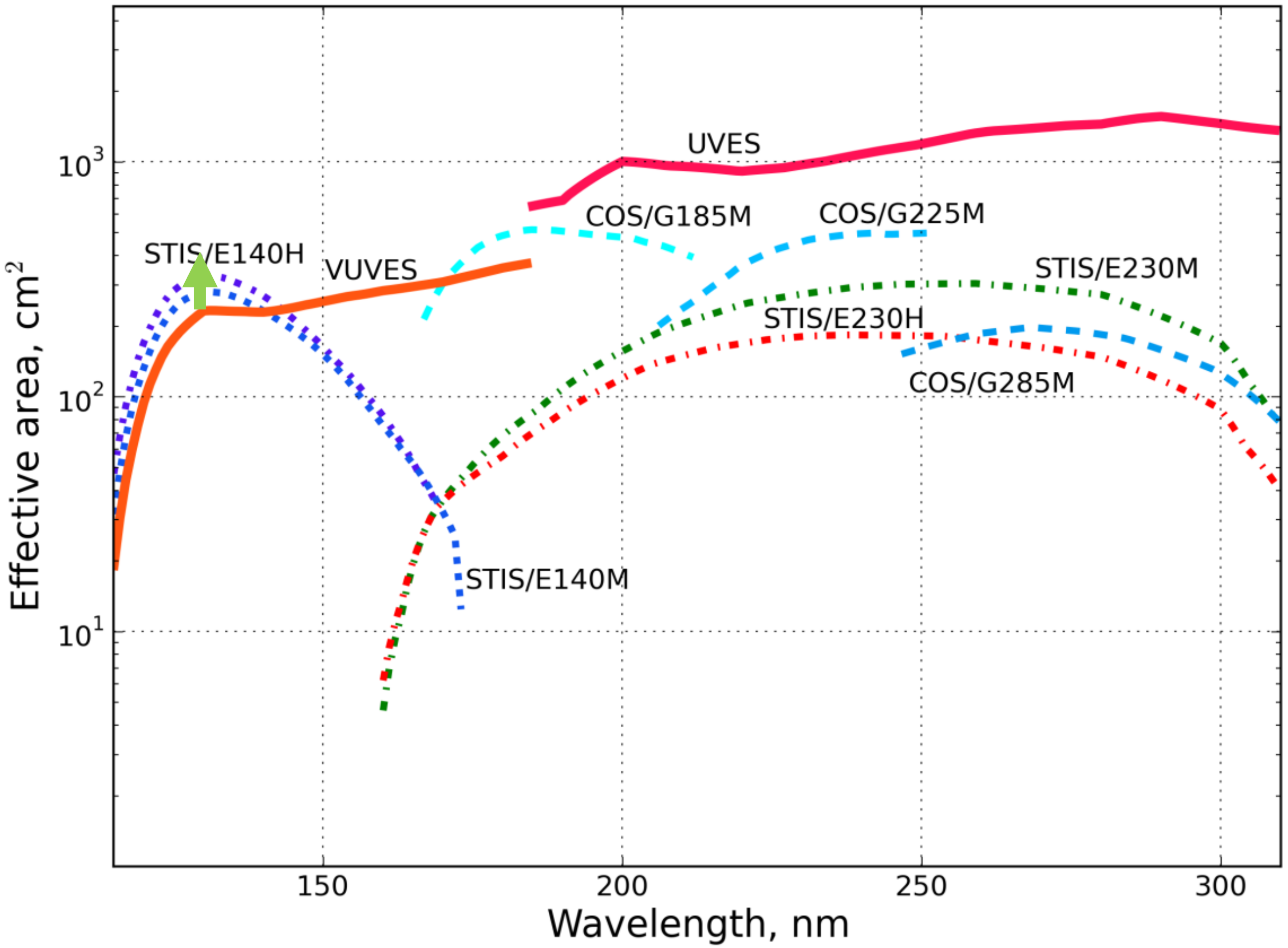
EUVO is a **large observatory** with an effective area at least 10 times that of Hubble to go well beyond where Hubble has gone, in. ***ALL** areas of astrophysical research*.

EUVO community will happily go with LUVOIR

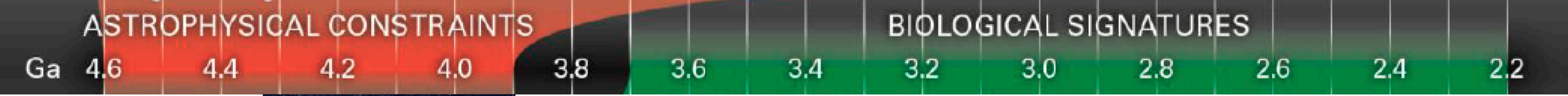
But it is *open to smaller, scalable, classical architectures*.



Comparison between WSO-UV spectrographs (170 cm primary) and Hubble spectrographs (240 cm primary)
(30 years of technology in between)

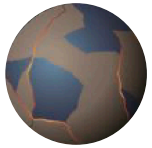


SCIENTIFIC REASONS BEHIND THE INVESTMENT

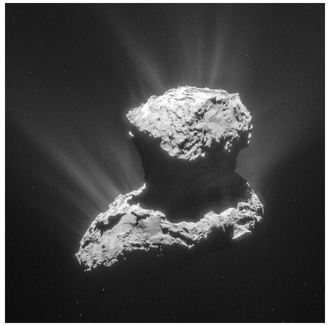


Earth Formation
(4.54 Gy)

Oldest signs of life
-stromatolites-
(3.7 Gy)



Crust & Oceans
(4.5-4.3 Gy)



67P/Churyumov–Gerasimenko

Glycine detected
(Altwegg et al. 2016)

PROTEINOGENIC AMINOACIDS formed in the experiments	LABORATORY EXPERIMENTS SIMULATING			
	EARLY EARTH CONDITIONS		SPACE ICE & COMETS	
	Miller 1952	Parker et al. 2011	Muñoz-Caro et al 2002	Chen et al. 2008
Glycine	■	■	■	■
Alanine	■	■	■	■
Aspartic acid	■	■	■	■
Serine		■	■	■
Valine		■	■	
Glutamic acid		■		■
Phenylalanine				■
Methionine		■		
Isoleucine		■		■
Leucine		■		■
Cysteine				
Histidine				■
Lysine				
Asparagine				
Pyrrolysine			■	
Proline				
Glutamine				
Arginine				■
Threonine				
Selenocysteine				
Tryptophan				
Tyrosine				■

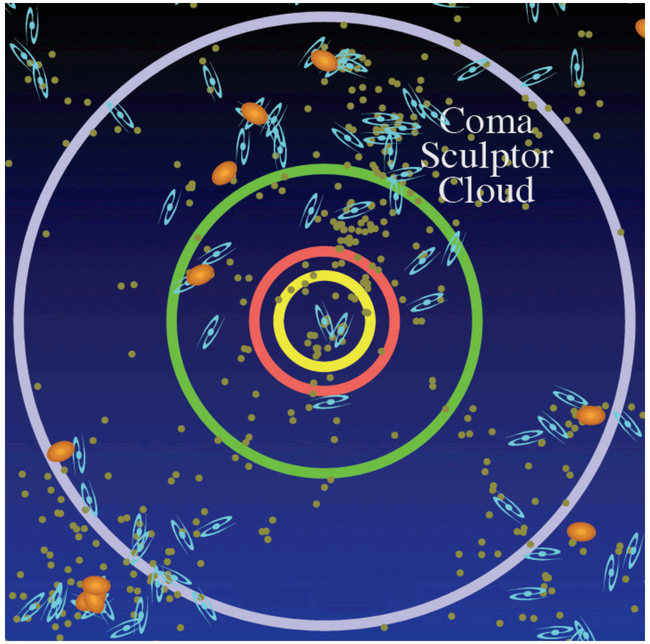
ORIGIN OF LIFE

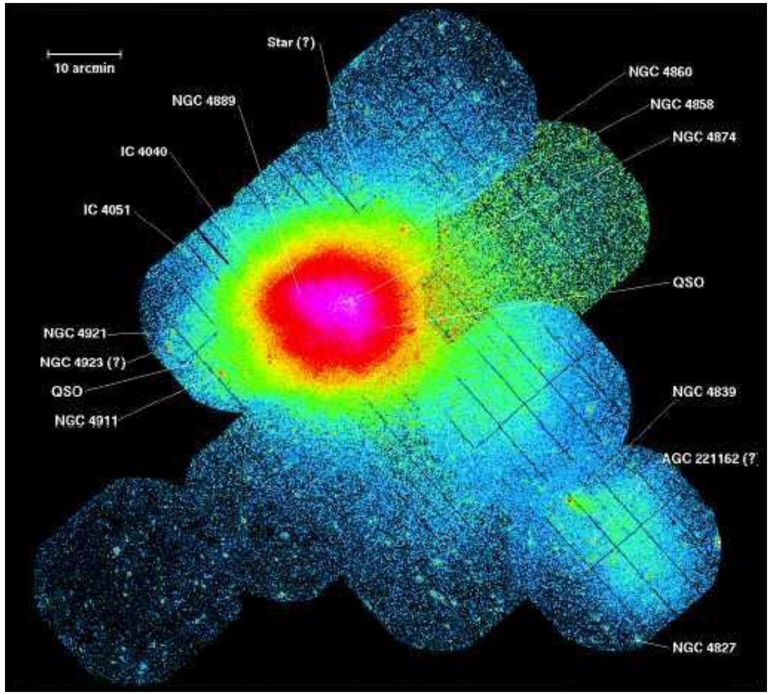
- **Origin & distribution of metals**
- **Origin of Planetary Systems**
- **Search for signatures of life**

SCIENCE with EUVO

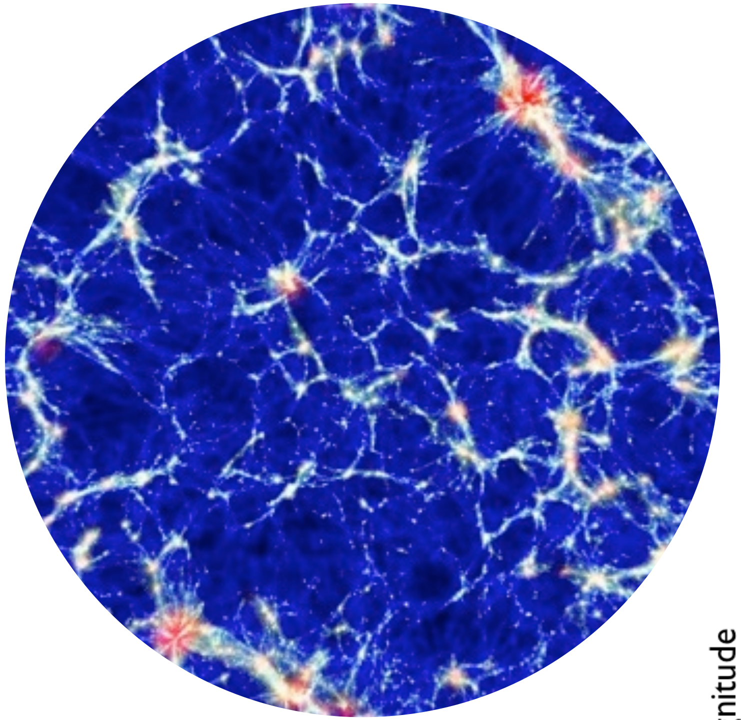
METALS IN THE INTERGALACTIC SPACE

An 8m telescope could observe more than 10 QSOs behind every galaxy out to 10 Mpc

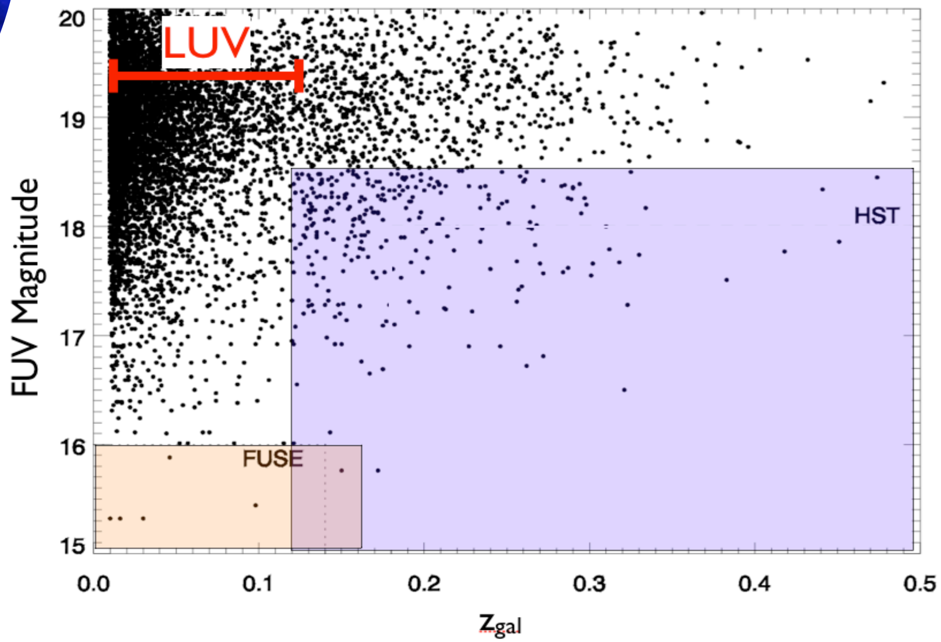




Hot gas in the Coma Cluster (XMM-Newton)



FUV accessibility to OVI
a key tracer to
circumgalactic gas



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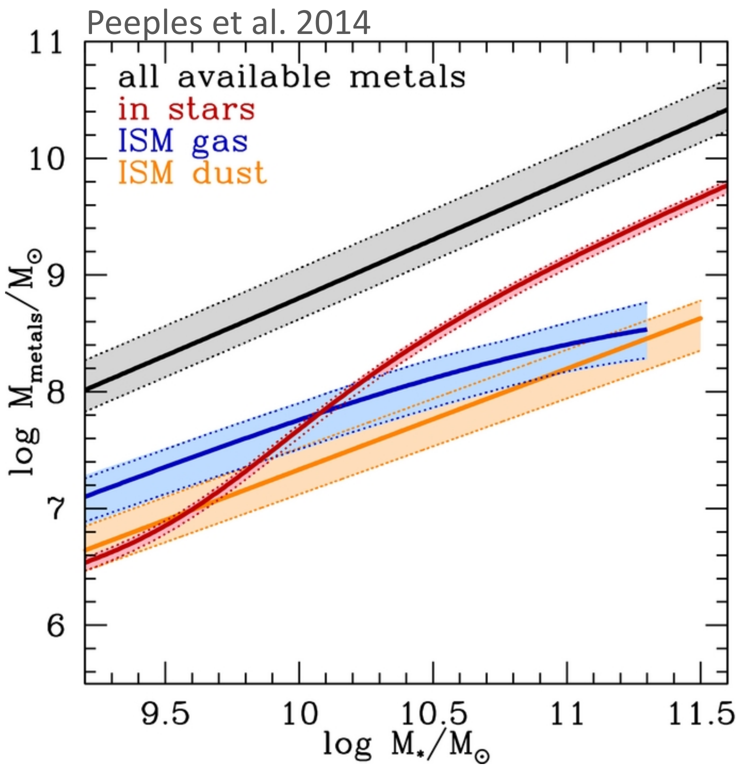
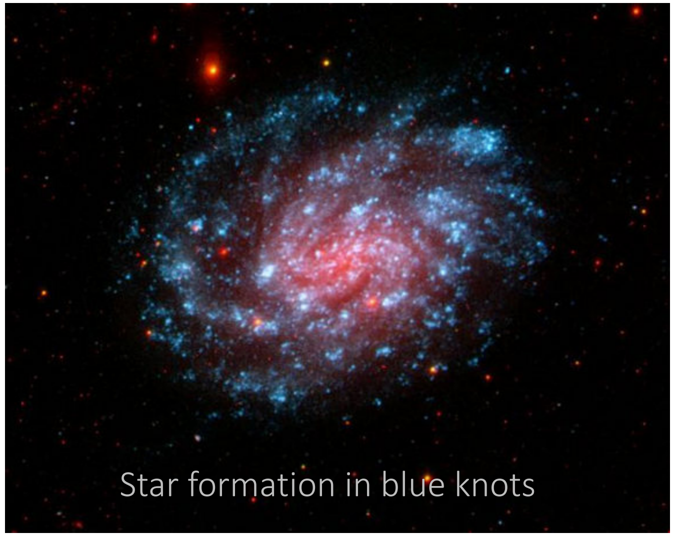
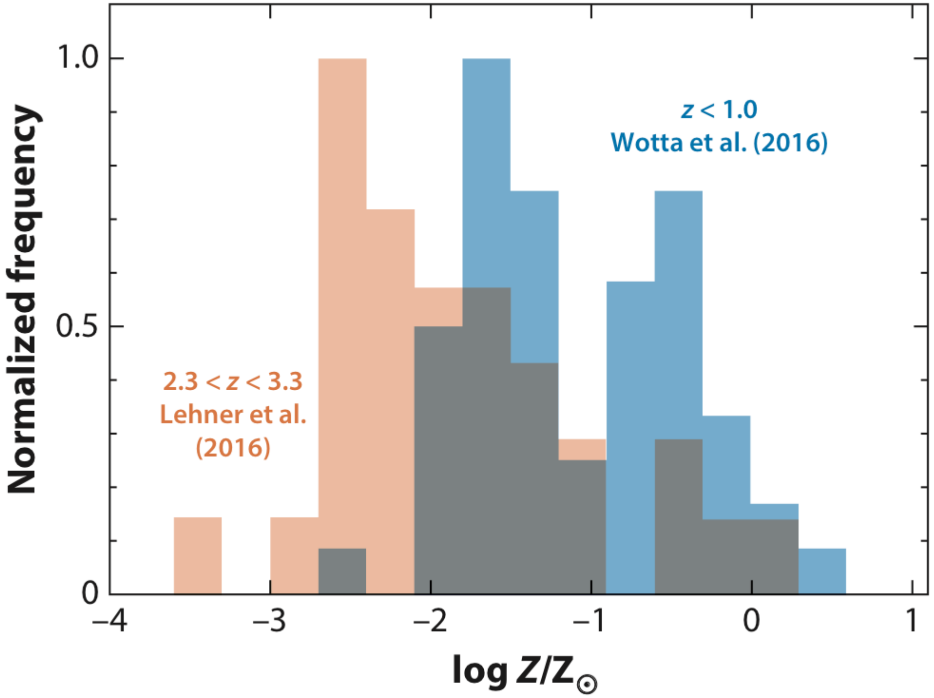
STAR FORMATION & MISSING METALS



The missing metals problem





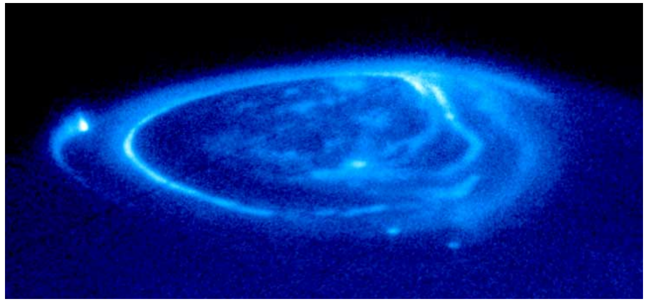
a sequence with time (redshift) to higher metallicities and cleaner separation between the two components as present is approached in the lifetime of the Universe (Lehner et al. 2016, Tumlinson et al. 2017)

Which is the star formation history from z=2 till now?
How this shows into a chemical enrichment of the stellar nurseries?

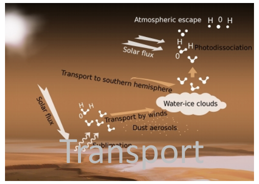
SCIENCE with EUVO

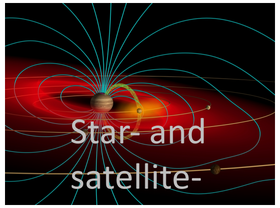
PLANETS: SOLAR SYSTEM

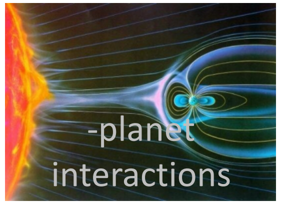
- Global circulation and local atmospheric dynamics.
- Source, loss and transport processes, cold traps and cryovolcanism.
- Atmosphere evolution, including ancient ocean loss.
- Composition, pre-solar nebular temperature distribution.
- Thermal structure, exospheric energy crises, thermosphere-ionosphere-magnetosphere coupling.
- Magnetic field structures, interaction of planets with the solar wind, satellites and rings, and other small bodies.
- Comparison with exoplanet studies.

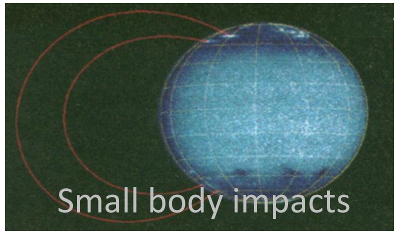


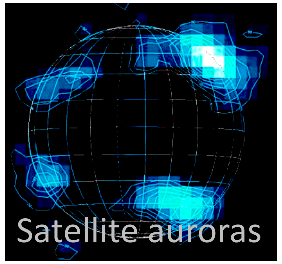
Time-varying UV auroras reveal magnetospheric processes











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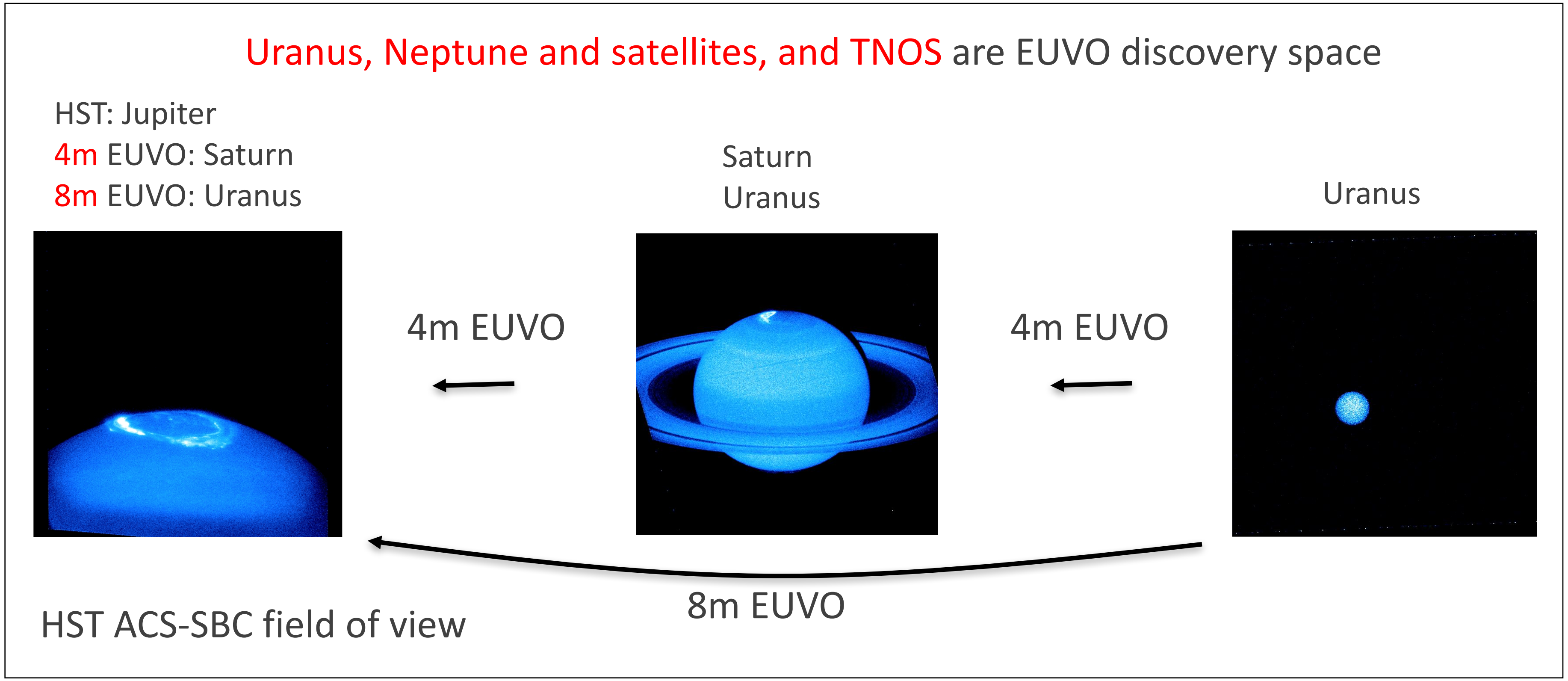
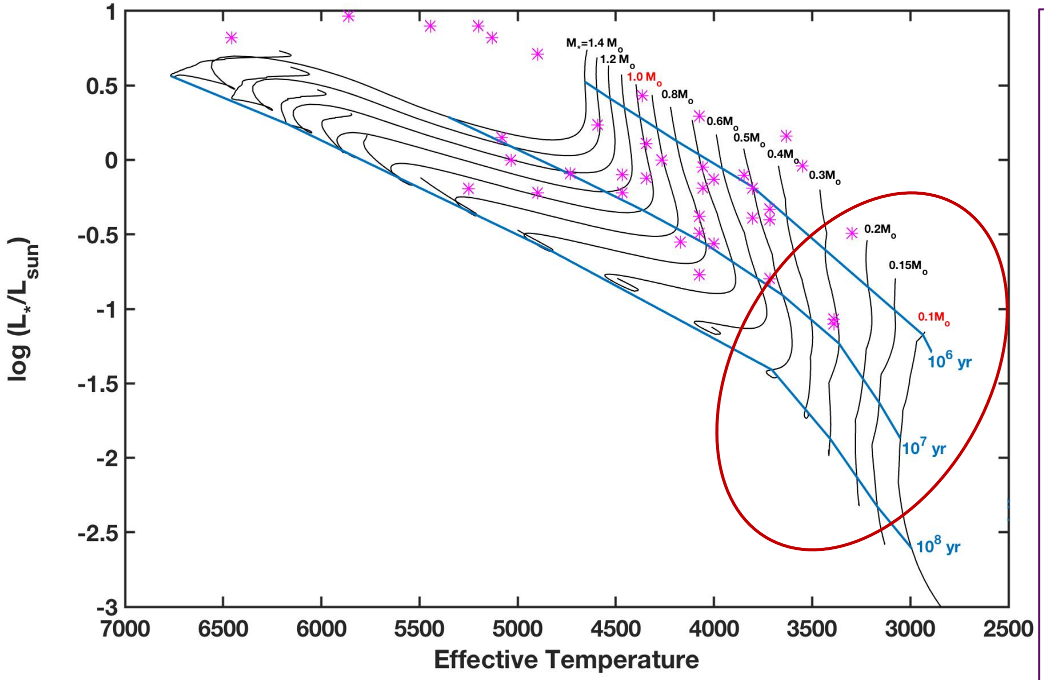
PLANETS: SOLAR SYSTEM



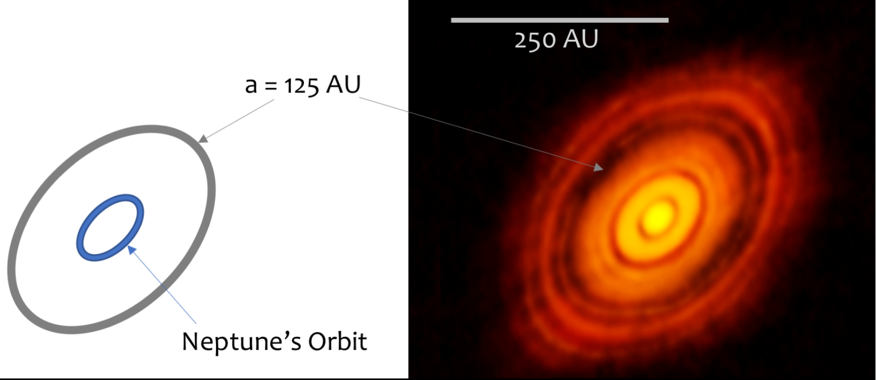
SCIENCE with EUVO

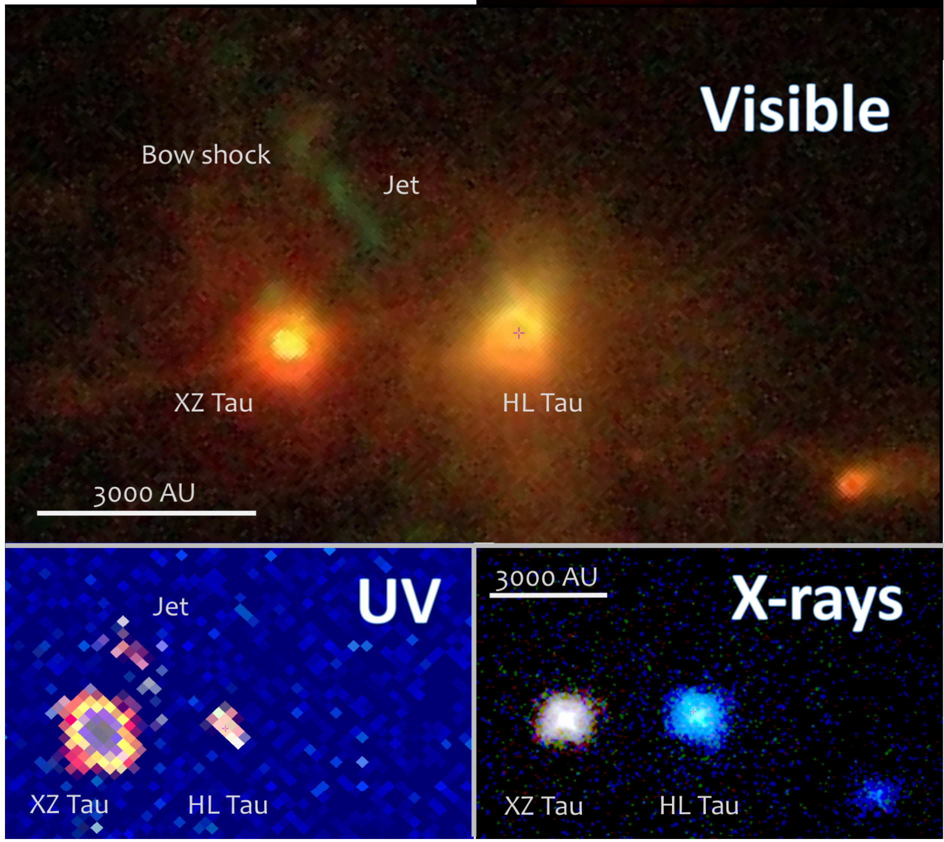
PLANETS: FORMATION OF PLANETARY SYSTEMS



Low mass end PMS stars ($M<0.2M_o$), precursors to the first Earth-like planets to be detected (orbiting M-type stars)

- Accretion physics: accretion shocks, magnetospheres
- Jets and outflows
- Photoevaporative processes in young planetary disks
- Comets swarms
- Stellar dynamo stabilization





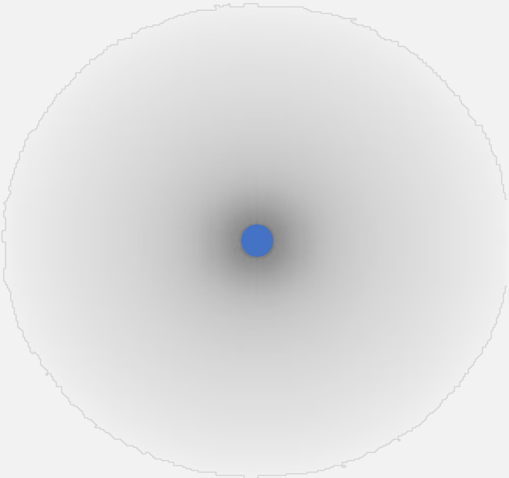
Let’s be humble!

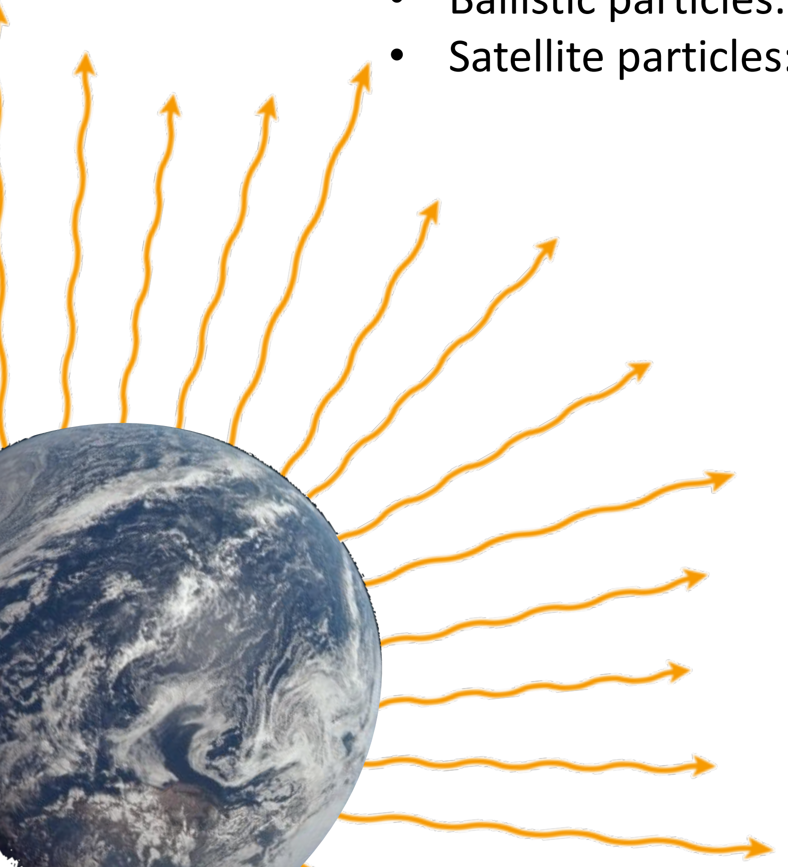
A simple example … detectability of Earth-like exo-planets

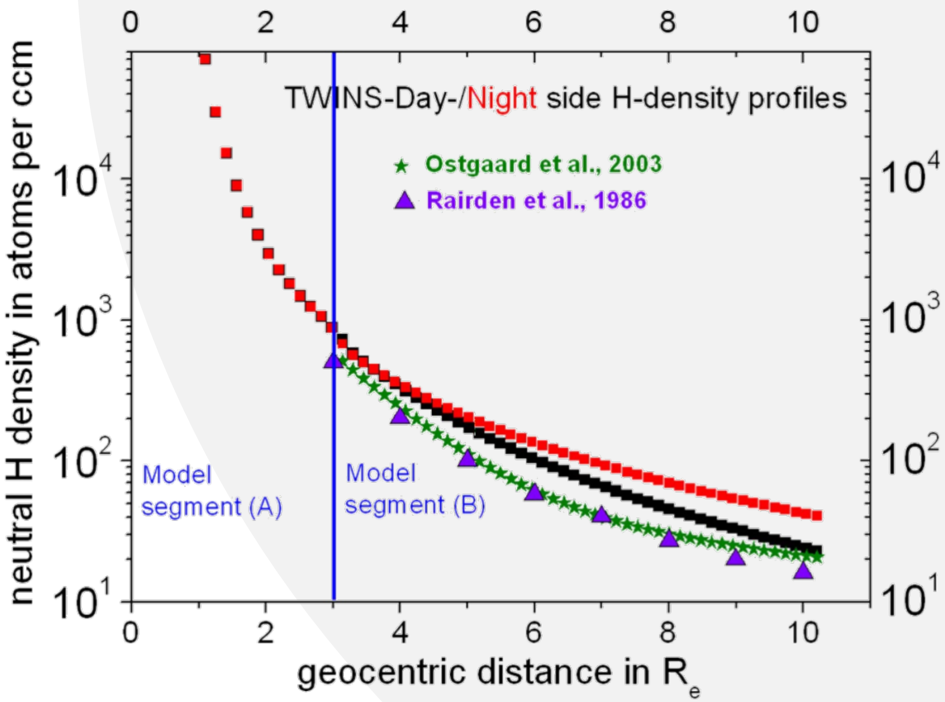
Basic parameters for the modelling of the expected signal included: atmospheric model plus planetary outflow and escape
Results: low atmospheric layers (20-100 km) detectable at optical and infrared wavelengths with LUVOIR A
Ozone layer absorption at UV wavelengths

There are three basic types of particles in the exosphere:

- Escaping particles: planetary escape
- Ballistic particles: reach a maximum altitude and fall down
- Satellite particles: **orbiting the planet** – never cross the exobase





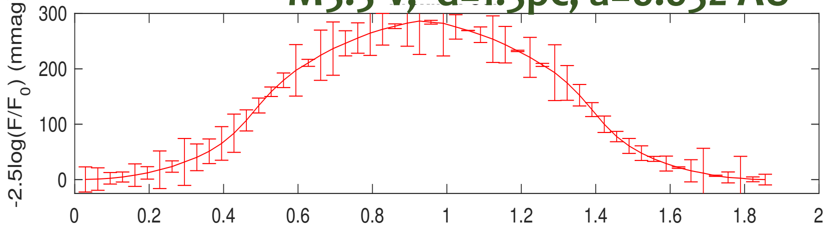


DATA from NASA’s Earth observation missions:
IMAGE/GEO
TWINS

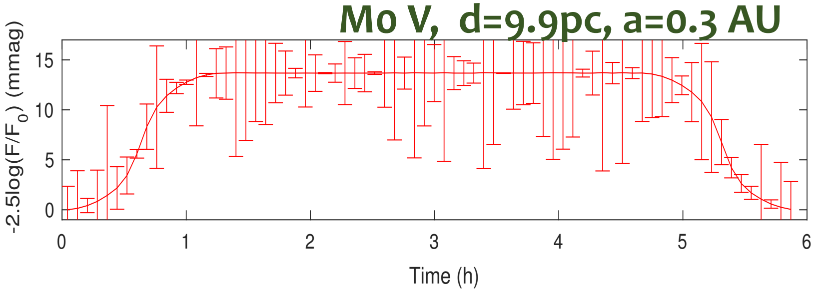
Zoenchen et al. 2011; Beth et al. 2015

Lyman – α predicted light curves
4-m primary & 2% throughput

M5.5 V, d=1.3pc, a=0.032 AU



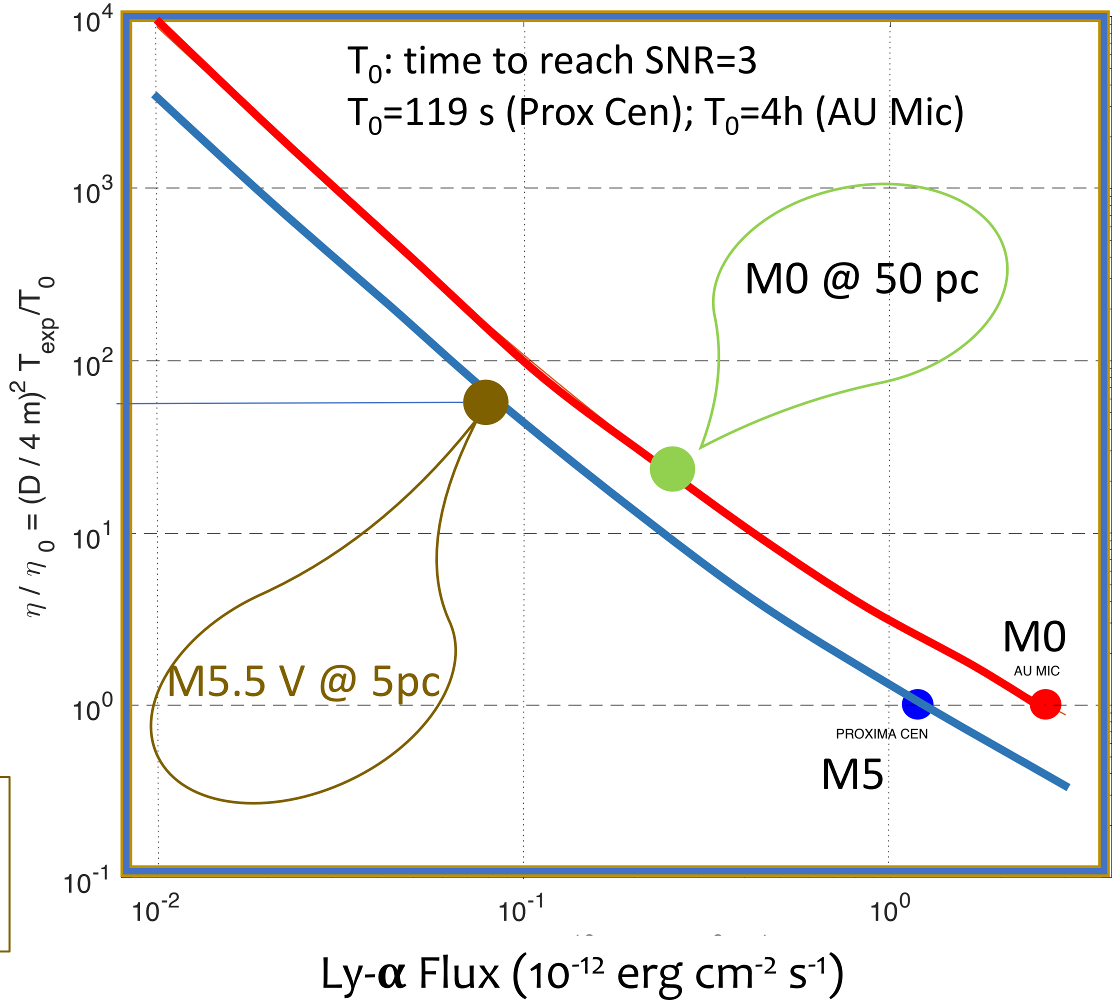
M0 V, d=9.9pc, a=0.3 AU



Gómez de Castro et al. 2018

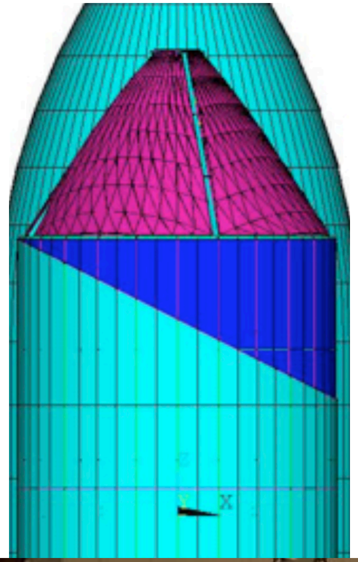
4-m telescope requires Texp=3.3 d to detect the transit at 3σ
8-m telescope requires 20 h
15-m telescope requires 5.8 h

$$\frac{\eta}{\eta_o} = 20$$

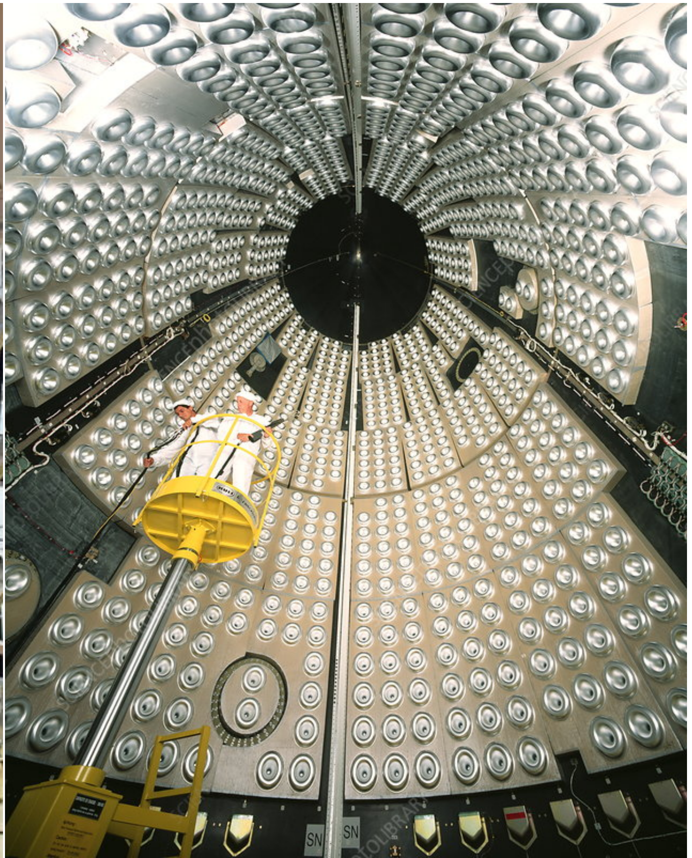


$$\frac{\eta}{\eta_o} = 50$$

4-m telescope requires Texp=99 minutes to detect the transit at 3σ
8-m telescope requires 25 minutes
15-m telescope requires 423 s



What does it fit into an Ariane V launcher?



Configuration	Increase in collecting surface with respect to HST
Folded 6.5 m (JWST)	7.3
Circular standard - 6 m	6.3
Circular standard - 8 m	11.0
Elongated 8 m x 4 m	5.6
LUVOIR B (8 m)	11.0
LUVOIR A (15 m)	39.1

To summarize

- The euvo community is ready and willing to support our US colleagues initiative on LUVOIR (STDT members, National Agencies, CNES funded proposal, …).
- euvo is back in the ESA system to support this activity.
- euvo perceives an 8-m primary size telescope, equipped with instruments suitable for many areas of astrophysical research as a reasonable technological compromise for 2035.
- euvo / ESA community would like to provide a principal instrument to that Observatory.