

# Studies on photosynthetic organisms as a tool for improving the success of future space missions

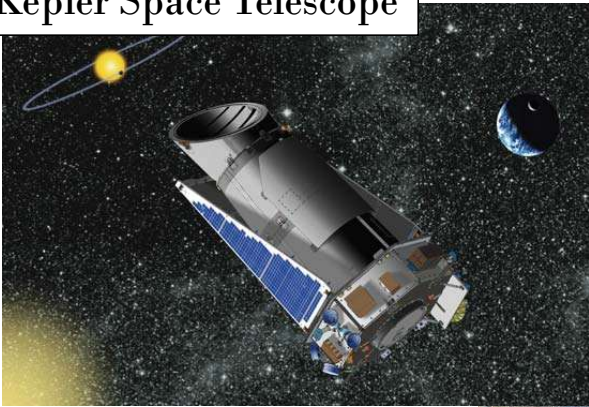
Mariano Battistuzzi, XXXIII th Ph.D cycle

12\_13/09/2019

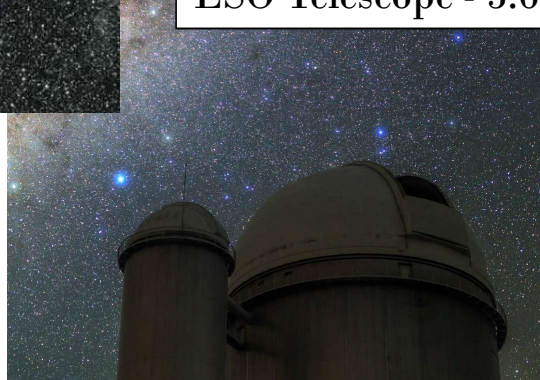


# Rocky planets **potentially habitable**

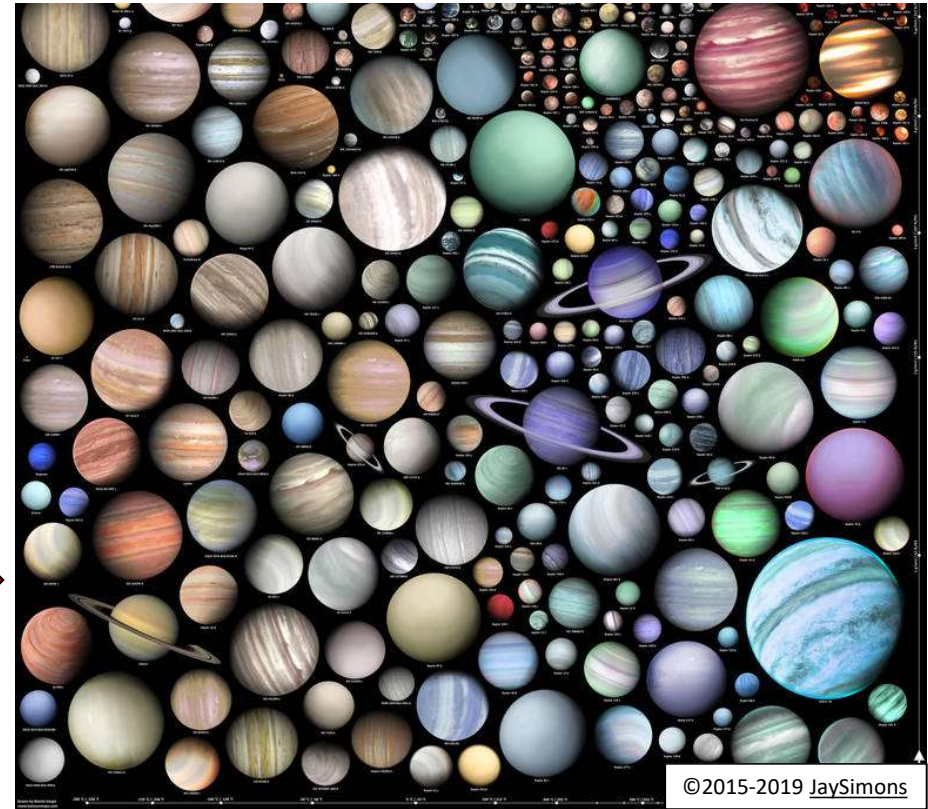
Kepler Space Telescope



ESO Telescope - 3.6 m



European Southern Observatory (ESO) La Silla, Chile



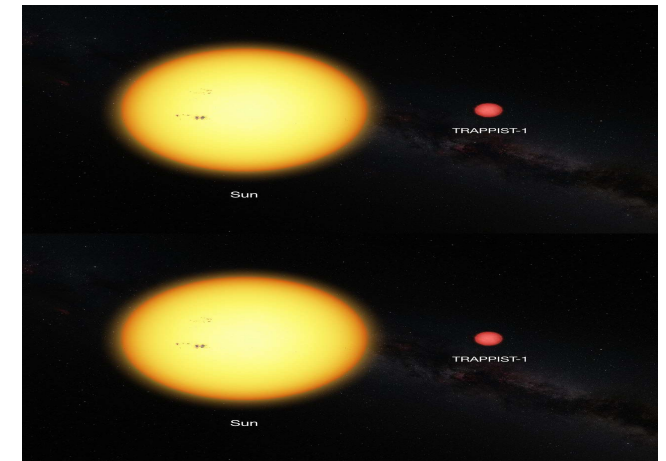
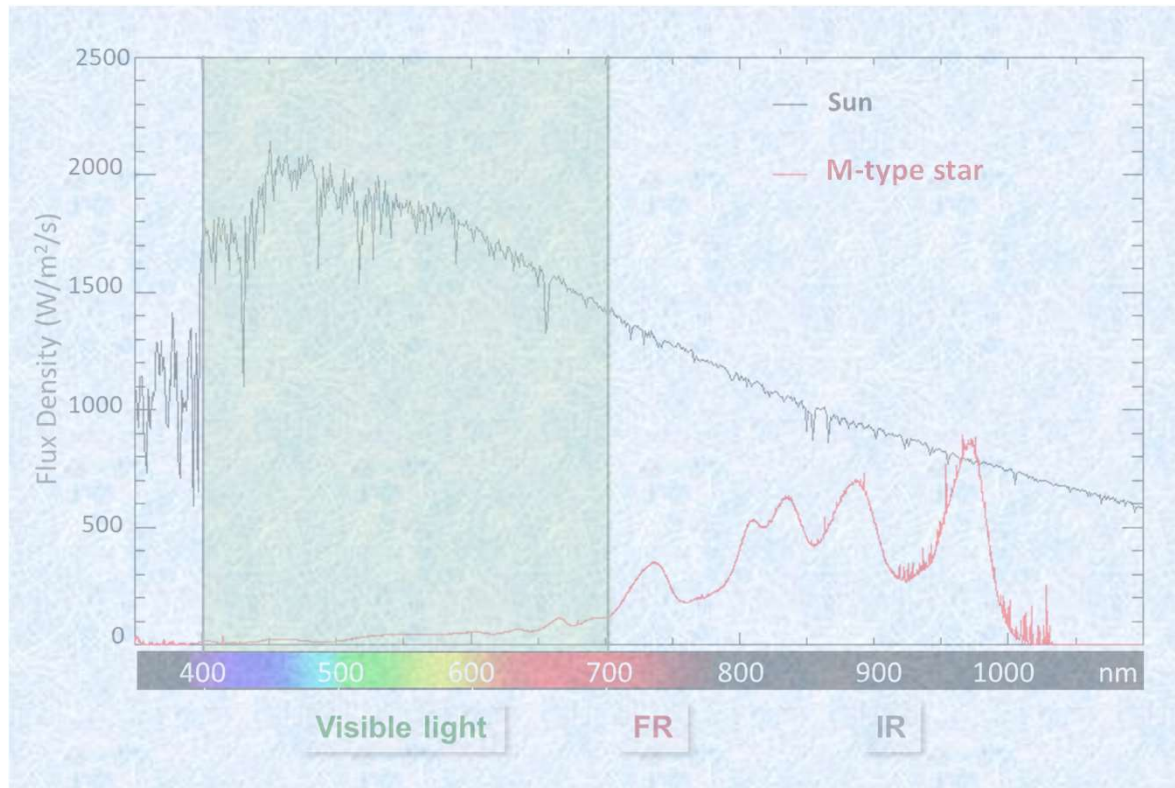
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On our galaxy found **about 4000**  
extrasolar **planets.**





# M-Type Stars are interesting for astrobiology



Most common stars in the Milky  
Way (76% of total stars)

Live long enough to sustain life  
evolution

10 times less luminous  
than G-type stars

Different light spectrum  
(Major component FR and IR)

## Biological Questions:

1

Could Oxygenic Photosynthetic organisms grow under M-type star light spectra?

2

Could Oxygenic photosynthesis be performed?

3

Could atmospheric biosignatures be generated by the activity of these organisms?

## Experimental Work:

1

**Simulate** M-type light spectrum and other environmental parameters (e.g. atmospheres)

2

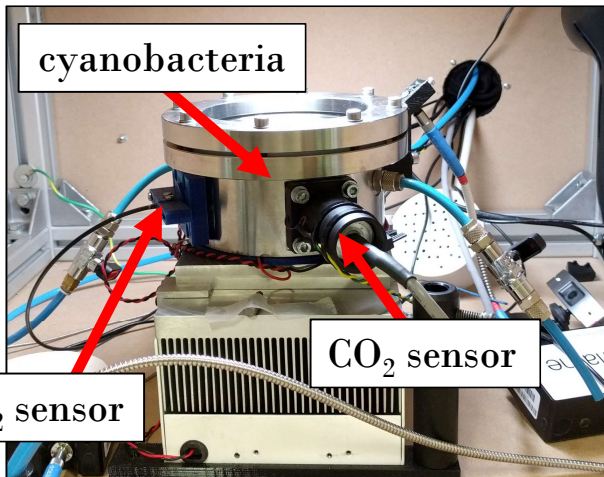
**Test** cyanobacteria survival and photosynthetic activity

3

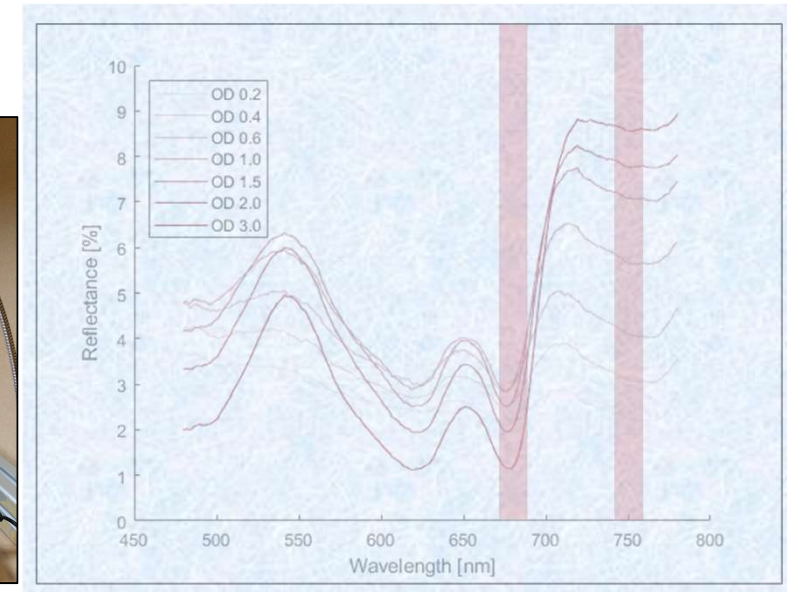
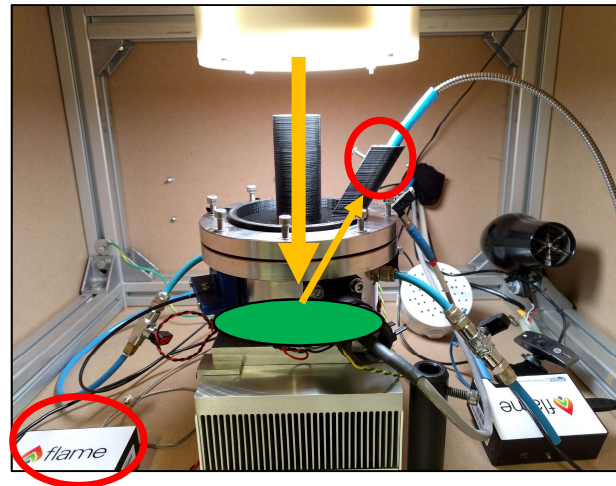
**Evaluate** impact on atmospheres e.g. lacking O<sub>2</sub>

# Experimental Setup

## SLS & ASC

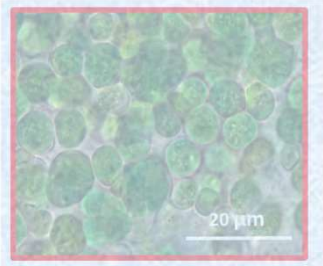


## Reflectivity Detection System

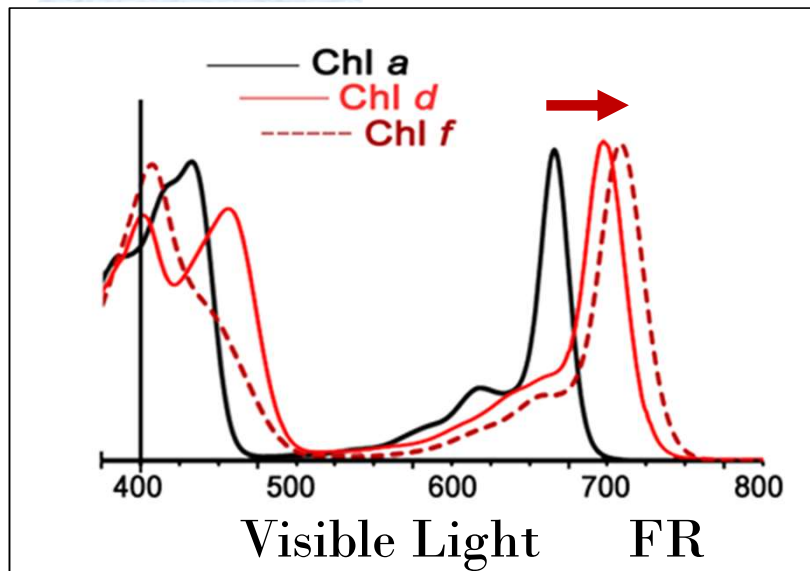


$$NDVI = \frac{Ref(745\text{ to }755\text{nm}) - Ref(675\text{ to }685\text{nm})}{Ref(745\text{ to }755\text{nm}) + Ref(675\text{ to }685\text{nm})}$$

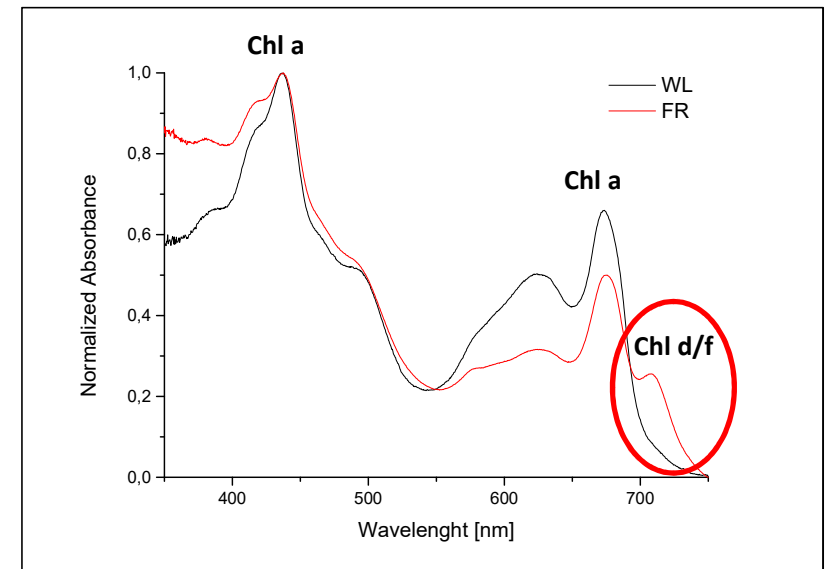
# Some cyanobacteria species can use FR light



*Chlorogloeopsis fritschii* PCC6912



*In vivo* absorption spectrum



Chl a/d/f = chlorophylls a/d/f

**Gan et al., 2014 *Science***  
**Gan and Bryant., 2015**



## Contributions to national and international congresses

M. Battistuzzi; L. Cocola; R. Claudi; E. Alei; L. Poletto; T. Morosinotto; N. La Rocca; *“Calibration and validation of an experimental setup to study by remote sensing cyanobacteria responses under exo-Earth simulated environments”* General Assembly of the European Astrobiological Institute – Liblice, Czech Republic, 28-30 May 2019;

M. Battistuzzi; L. Cocola; R. Claudi; E. Alei; L. Poletto; T. Morosinotto; N. La Rocca; *“An innovative setup to investigate by remote sensing growth and photosynthetic performances of cyanobacteria exposed to exo-earths simulated environments”* XV Congresso Nazionale di Scienze Planetarie – Firenze, Italy, 4-8 February 2019;

M. Battistuzzi; R. Claudi; L. Cocola; E. Alei; L. Poletto; N. La Rocca; *“An experimental setup to study by remote sensing analyses cyanobacteria growth and photosynthetic performances under non-terrestrial simulated environments”*, EANA2018 – Berlin, Germany, 24-28 september 2018.



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**Thanks For  
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