## The science of LIFE: current status, open questions & ways to participate

#### Sascha P. Quanz (ETH Zurich)

For the LIFE team

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LIFE - virtual mini-workshop May 14, 2020







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# The LIFE Initiative



Large Interferometer For Exoplanets



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Why? - The scientific potential is really(!) compelling and none of the currently planned missions / concepts / projects (on ground or in space) will provide comparable data

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**Goal for today?** - (1) Get the word out that the LIFE initiative exists; (2) Bring you up to speed, where we are and what we do; (3) Trigger your interest in the project and invite you to participate!





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**Spectroscopy** is key and upcoming MIR characterisation missions will focus on hot / warm **transiting** exoplanets



"A long term scientific objective is to characterize the whole range of exoplanets, including, of course, potentially habitable ones. ARIEL would act as a pathfinder for future, even more ambitious campaigns." ARIEL Assessment Study Report (Yellow Book)



Image credit: NASA; ESA / UCL; NASA Mission Concept Study Report (OST)

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## The next step: a direct detection / spectroscopy mission



Exoplanets detected with SNR > 10 during 2.5-year search phase

Quanz et al. in prep.; cf. Kammerer & Quanz 2018; Quanz et al 2018

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## WORK IN PROGRESS Chospheric diversity - total planet yield in search phase

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#### LIFESim: A new simulator tool to create mock observations



#### Signal extraction of multi-planet systems and basic parameter from single epoch

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#### (2) Frequency of "habitable" planets - how rare is Earth?

#### Focus on terrestrial exoplanets (R = 0.5-1.5 R $\oplus$ ) in habitable zone (S<sub>0</sub>= 0.35 - 1.75 S $\oplus$ )

Hypothesis H<sub>0</sub>: "50% of such planets provide conditions for liquid water" How constraining is a null-result (i.e., not a single planet provides these conditions)?

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#### Focus on terrestrial exoplanets (R = 0.5-1.5 R $\oplus$ ) in habitable zone (S<sub>0</sub>= 0.35 - 1.75 S $\oplus$ )

Hypothesis H<sub>0</sub>: "20% of such planets provide conditions for liquid water" How constraining is a null-result (i.e., not a single planet provides these conditions)?

Confidence level rejecting  $H_0$ 



## (3) Atmospheric characterization potential and biosignatures



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#### **Retrieval study of an Earth-twin**



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## Other communities will appreciate such a mission





#### Summary

Free-flying mid-infrared (nulling) interferometer to detect thermal emission of (terrestrial) exoplanets

Wavelength range:  $\sim$ 3 - 20  $\mu$ m (tbc)

Spectral resolution: R ~ 20 - 100 (tbc)

Total mission lifetime (requirement) 5-6 years:

- search phase
- characterization phase
- other science

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Expected detection yield of hundreds of exoplanets

Unique science potential for atmospheric characterization