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ORIGIN OF WATER AND LIFE: WHAT ASTROPHYSICAL AND INSTRUMENTAL CHALLENGES FOR TOMORROW?

Reporting from the SF2A-2023 splinter session

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Understanding how giant and telluric planets form and evolve, their internal structure and that of their atmosphere, represents one of the major challenges of modern astronomy, and is directly linked to the ultimate search for life by 2050. However, several astrophysical (understanding the formation and physics of giant and telluric exoplanets), biological (identification of the best biomarkers) and technological (technical innovations for new-generation telescopes and instruments). We now know that rocky exoplanets are ubiquitous in the Milky Way, and very probably in the immediate vicinity of the Sun too. Detecting these closest planets, understanding the diversity (atmospheric) of other worlds, and the search for clues to habitability and biological activity, particularly that of water, are essential to understanding the origin of life. With this in mind, the coming decades will be rich in instrumental projects in space and on the ground, exploiting the various techniques for detecting and characterizing exoplanets in highly complementary ways. Within the next 10 years, major systematic surveys using velocimetry, transit, astrometry and imaging will provide a virtually complete census of exoplanetary systems in the near-solar environment. This will usher in an observational era dedicated primarily to characterizing the conditions conducive to the formation of habitable worlds, and to the physical and atmospheric characterization of known exoplanets, particularly temperate telluric planets suitable for the emergence of life. This phase, already initiated with Hubble and Spitzer, and with the first ground-based spectrographs, will intensify with the JWST, Roman and ARIEL space telescopes, and from 2028 with the new generation of extremely large telescopes that will offer unique spatial and spectral resolution, as well as versatile multi-decade instrumentation for characterization of giant and rocky planets and the search for the first clues of habitability and life activity. However, it is very likely that a systematic atmospheric study of dozens of Earth analogues and a quantitative assessment of their habitability and the possible existence of biomarkers will require large-scale, highly optimized space missions. Our goal with this SFE talk is to present here a brief summary of the background, objectives, presented talks, discussions and conclusions of the splinter session organized on June 20th and 21st, 2023 during the Journ ees 2023 de la Soci et e Fran ¸caise d'Astronomie & d'Astrophysique (SF2A). This session has been a nice op- portunity to be informed about current theoretical, observing and instrumental developments, initiate the discussion on how to organize and

structure the French community around these astrophysical themes, finally to initiate a coordinated response to the call of ideas of CNES 2023 to organize and structure our community with a proposed roadmap for 2024