EPSC Abstracts
Vol. 8, EPSC2013-1082, 2013
European Planetary Science Congress 2013

The science of EChO –Exoplanet Characterisation Observatory

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Abstract

It is now accepted that exoplanets are ubiquitous in our Galaxy. The planetary parameters mass, radius and temperature alone do not explain the diversity revealed by current observations. The chemical composition of these planets is needed to trace back their formation history and evolution, as was the case for the Solar System. Pioneering results were obtained through transit spectroscopy with Hubble, Spitzer and ground-based facilities, enabling the detection of a few, most abundant ionic, atomic and molecular species and to constrain the planet's thermal structure. With the arrival of EChO in the coming decade, planetary science will expand beyond the narrow boundaries of our Solar System to encompass our whole Galaxy. EChO will address the following fundamental questions:

– *Why are exoplanets as they are?*

– *What are the causes for the observed diversity?*

– *Can their formation history be traced back from their current composition and evolution?*

Spectroscopic observations from the visible to Mid-IR of a large, select sample of exoplanets, will allow us to use the chemical composition as a powerful diagnostic of the history, formation mechanisms and evolution of gaseous and rocky exoplanets. Our strategy is to balance statistical information, obtainable through a chemical survey of a large and diverse sample of objects – as it is traditionally done for stars – with deep, repeated observations of a more restricted, select sample of planets – a strategy that will enable the kind of science that was accomplished for Solar System planets.

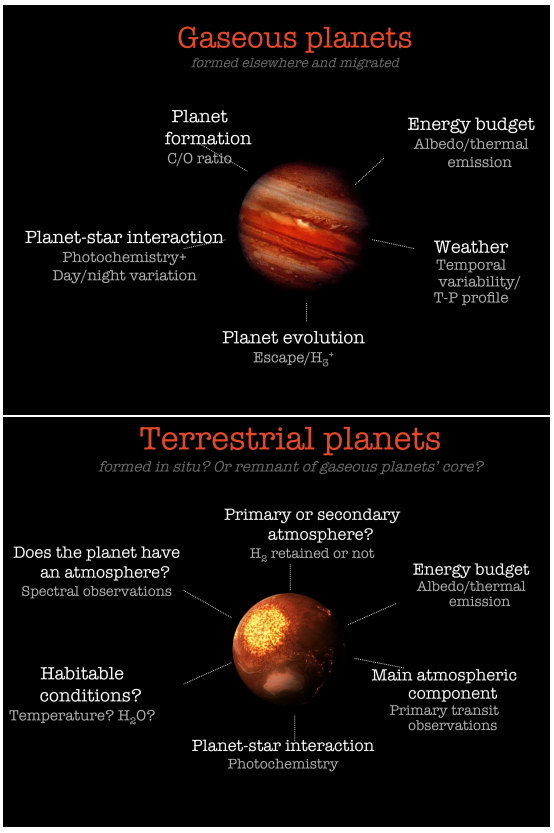

Figure 1: Key questions for gaseous and terrestrial planets that will be addressed by EChO

1. What is EChO?

The Exoplanet Characterisation Observatory (EChO) is a space mission dedicated to undertaking spectroscopy of transiting exoplanets over the widest wavelength range possible. It is based around a highly sta-

ble space platform with a 1.2 m class telescope. The mission is currently being studied by ESA in the context of a medium class mission within the Cosmic Vision programme for launch post 2020 [1]. The payload suite is required to provide simultaneous coverage from the visible to the mid-infrared and must be highly stable and effectively operate as a single instrument. An integrated spectrometer has been designed for EChO which will cover the 0.55 to 11 μm (goal 16 μm) wavelength band. The instrumentation is subdivided into 5 channels (Visible/Near Infrared, Short Wave InfraRed, 2 x Mid Wave InfraRed; Long Wave InfraRed) with a common set of optics spectrally dividing the input beam via dichroics.

EChO will be placed in a grand halo orbit around L2 The orbit will provide a high degree of visibility of the sky over the year and an ability to repeatedly observe several tens of targets whatever the epoch in the year.

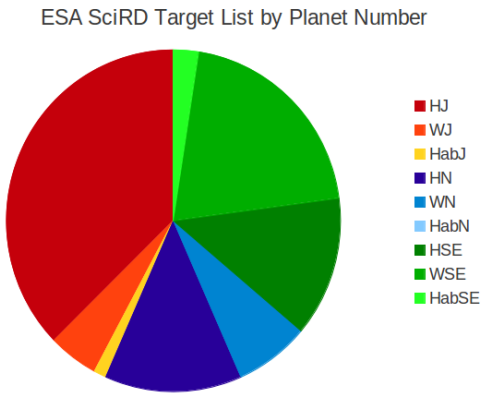

Figure 2: The list of targets considered by EChO includes hot, warm and temperate Jupiters, Neptunes and Super-Earths

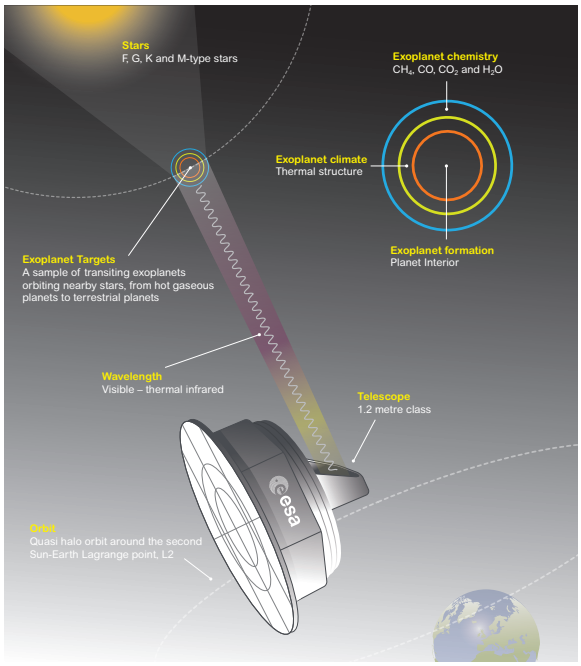

Figure 3: Artist view of the EChO mission concept

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[4] Swinyard, B. et al., *An integrated payload design for the Exoplanet Characterisation Observatory (EChO)*, Space Telescopes and Instrumentation 2012: Optical, Infrared, and Millimeter Wave. Proceedings of the SPIE, Volume 8442, article id. 84421G, 14 pp.