



MIRMIS – The Modular Infrared Molecules and Ices Sensor for ESA’s Comet Interceptor.

Neil Bowles¹, Antti Näsilä², Tomas Kohout³, Geronimo Villanueva⁴, Chris Howe⁵, Patrick Irwin¹, Antti Penttilä³, Alexander Kokka², Richard Cole², Sara Faggi⁴, Aurelie Guilbert-Lepoutre⁶, Silvia Protopapa⁷, and Aria Vitkova¹

¹University of Oxford, Department of Physics, United Kingdom of Great Britain – England, Scotland, Wales

(neil.bowles@physics.ox.ac.uk)

²VTT, Espoo, Finland

³University of Helsinki, Finland

⁴Goddard Space Flight Center, Greenbelt, Maryland, US

⁵STFC RAL Space, UK

⁶University of Lyon, France

⁷Southwest Research Institute, Boulder, Colorado, USA

Introduction: This presentation will describe the Modular Infrared Molecules and Ices Sensor currently in final assembly and test at the University of Oxford, UK and VTT Finland for ESA’s upcoming Comet interceptor mission.

The Comet Interceptor mission: The Comet Interceptor mission [1] was selected by ESA as the first of its new “F” class of missions in June 2019 and adopted in June 2022. Comet Interceptor (CI) aims to be the first mission to visit a long period comet, preferably, a Dynamically New Comet (DNC), a subset of long-period comets that originate in the Oort cloud and may preserve some of the most primitive material from early in our Solar System’s history. CI is scheduled to launch to the Earth-Sun L2 point with ESA’s ARIEL [2] mission in ~2029 where it will wait for a suitable DNC target.

The CI mission is comprised of three spacecraft. Spacecraft A will pass by the target nucleus at ~1000 km to mitigate against hazards caused by dust due to the wide range of possible encounter velocities (e.g. 10 – 70 km/s). As well as acting as a science platform, Spacecraft A will deploy and provide a communications hub for two smaller spacecrafts, B1 (supplied by the Japanese space agency JAXA) and B2 that will perform closer approaches to the nucleus. Spacecrafts B1 and B2 will make higher risk/higher return measurements but with the increased probability that they will not survive the whole encounter.

The MIRMIS Instrument: The Modular InfraRed Molecules and Ices sensor (MIRMIS, Figure 1) instrument is part of the CI Spacecraft A scientific payload. The MIRMIS consortium includes hardware contributions from Finland (VTT Finland) and the UK (University of Oxford) with members of the instrument team from the Universities of Helsinki, Lyon, NASA’s Goddard Space Flight Center, and Southwest Research Institute.

MIRMIS will map the spatial distribution of temperatures, ices, minerals and gases in the nucleus and coma of the comet using covering a spectral range of 0.9 to 25 microns. An imaging Fabry-Perot interferometer will provide maps of composition at a scale of ~180 m at closest approach from 0.9 to 1.7 microns. A Fabry-Perot point spectrometer will make observations of the coma and nucleus at wavelengths from 2.5 to 5 microns and finally a thermal imager will map the temperature and composition of the nucleus at a spatial resolution of 260 m using a series of multi-spectral filters

from 6 to 25 microns.

Figure 1: (Top) The MIRMIS instrument for ESA's Comet Interceptor mission. (Bottom) The MIRMIS Structural Thermal model under test at University of Oxford.

The MIRMIS instrument is compact (548.5 x 282.0 x 126.8 mm) and low mass (<8.8 kg) and has single mechanical and electrical interface to the spacecraft, making the design also suitable for remote sensing mission from small satellites in LEO or other targets in the Solar System.

References:

[1] Snodgrass and Jones, 2019, Nature Comms. 10, 5418. [2] Tinetti et al. 2018, Exp. Astron. 46, 135-209.

Acknowledgments: Thanks to ESA's Comet Interceptor mission team, the UK Space Agency for funding the UK contributions to the instrument