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The 3.1 μm absorption feature on asteroids (24) Themis and (65) Cybele is not due to surface water ice

Laurence O'Rourke[1], Thomas G. Müller[2], Nicolas Biver[3], Dominique Bockelée-Morvan[3], Sunao Hasegawa[4], Ivan Valtchanov[5], Michael Küppers[1], Sonia Fornasier[3,6], Humberto Campins[7], Hideaki Fujiwara[8], David Teyessier[5], and Tanya Lim[5]

[1]European Space Agency, SRE-OD, Villanueva del Pardillo, Spain (lorourke@esa.int)

[2]Max-Planck-Institut für extraterrestrische Physik, Giessenbachstrasse 1, D-85748 Garching, Germany

[3]LESIA, Observatoire de Paris, Université PSL, CNRS, Université de Paris, Sorbonne Université, 5 place Jules Janssen, F-92195 Meudon, France

[4]Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 3-1-1 Yoshinodai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan

[5]Telespazio Vega UK Ltd. for ESA/ESAC, Urbanización Villafranca del Castillo, Villanueva de la Cañada, E-28692, Madrid, Spain

[6]Institut Universitaire de France (IUF), 1 rue Descartes, F-75231 Paris Cedex 05, France

[7]University of Central Florida, P.O. Box 162385, Orlando, FL 32816-2385, USA

[8]Subaru Telescope, National Astronomical Observatory of Japan, 650 North A'ohoku Place, Hilo, HI 96720, USA

Previous research on Asteroids (24) Themis and (65) Cybele have shown the presence of an absorption feature at 3.1 μm reported to be directly linked to surface water ice. We searched for water vapor escaping from these asteroids with the Herschel Space Observatory HIFI (Heterodyne Instrument for the Far Infrared) Instrument. While no H_2O line emission was detected, we obtained sensitive 3σ water production rate upper limits of $Q(H_2O) < 4.1\times10^{26}$ molecules s^{-1} for Themis and $Q(H_2O) < 7.6 \times 10^{26}$ molecules s^{-1} for the case of Cybele. Using a thermophysical model, we merged data from the Subaru/Cooled Mid-Infrared Camera and Spectrometer and the Herschel SPIRE (Spectral and Photometric Imaging Receiver) instrument with the contents of a multi-observatory database and thus derived new radiometric properties for these two asteroids. For Themis, we obtained a thermal inertia G = $20\ ^{+25}_{-10}$ J m^{-2} $s^{-1/2}$ K^{-1}, a diameter $192\ ^{+10}_{-7}$ km, and a geometric V-band albedo p_V=0.07±0.01. For Cybele, we found a thermal inertia G = 25^{+28}_{-19} J m^{-2} $s^{-1/2}$ K^{-1}, a diameter 282±9 km, and an albedo pV=0.042±0.005. Using all inputs, we estimated that water ice intimately mixed with the asteroids' dark surface material would cover <0.0017% (for Themis) and <0.0033% (for Cybele) of their surfaces, while an areal mixture with very clean ice (Bond albedo 0.8 for Themis and 0.7 for Cybele) would cover <2.2% (for Themis) and <1.5% (for Cybele) of their surfaces. Based on these very low percentage coverage values, it is clear that while surface (and subsurface) water ice may exist in small localized amounts on both asteroids, it is not the reason for the observed 3.1 μm absorption feature.