EPSC Abstracts
Vol. 13, EPSC-DPS2019-1786-4, 2019
EPSC-DPS Joint Meeting 2019
© Author(s) 2019. CC Attribution 4.0 license.

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Near-infrared high-resolution solar spectrum from ACS NIR onboard TGO

Karim Gizatullin (1,2), Alexander Trokhimovskiy (1), Anna Fedorova (1), Jean-Loup Bertaux (1,3), Monique Spite (4), Alexander Lomakin (1,2), Andrey Patrakeev (1), Franck Montmessin (3), Oleg Korablev (1)
(1) Space Research Institute (IKI), Moscow, Russia, (2) Moscow Institute of Physics and Technology (MIPT), Dolgoprudny, Russia, (3) LATMOS/IPSL, UVSQ Université Paris-Saclay, UPMC Univ. Paris 06, CNRS, Guyancourt, France, (4) GEPI Observatoire de Paris, CNRS, Guyancourt, France (karimgizatullin@gmail.com)

Abstract

The Atmospheric Chemistry Suite (ACS) is Russian contribution to ESA-Roscosmos ExoMars 2016 Trace Gas Orbiter (TGO) mission [1, 2]. It arrived at Mars in October 2016. ACS is a package of three highly sensitive infrared spectrometers with high resolve power (>10,000) and covers from 0.7 to $17\mu m$ — the visible to thermal infrared range.

In this work, we present results for high-resolution solar spectra observed by ACS NIR instrument in the near-infrared range.

1 Spectrometer

The ACS NIR is a near-infrared spectrometer, extension of SPICAM-IR instrument family [3], the main concept of which relies on the combination of an acousto-optic tunable filter (AOTF) and an echelle diffraction grating [4]. This combination gives resolving power $\frac{\lambda}{\Delta\lambda} \approx 25,000$ in spectral range of $0.73 - 1.65\mu m$ that corresponds to the echelle diffraction orders from 48 through 105. This is the first instrument that can measure with such high resolution in near-infrared range outside the atmosphere. Here we present results that were obtained in June 2016 during Mid Cruise Checkout TGO Payload (MCC) observations of Sun.

2 Observations

In case of direct spectrum measurements, all specifics of the optical scheme should be taken into account. For ACS NIR, current instrument model includes the shape of AOTF function, blaze function, diffraction order overlapping, spectral variations, stray light and flat field correction for the detector.

A detailed spectrally resolved solar spectrum is important for line-by-line radiative transfer modeling in the near-IR. But it is still not well known due to the difficulties in ground-based measurements because of strong water vapor absorption in this spectral range. There are theoretical calculations of high-resolution spectrum in near-IR and the CAVIAR [5, 6] solar spectrum derived using the Langley technique applied to observations of ground-based high-resolution Fourier transform spectrometer (FTS) in atmospheric windows from 2000 to 10,000 cm^{-1} $(1 - 5\mu m)$. ACS NIR can provide more precise information in area $1 - 1.65\mu m$. An attempt to identify new, previously unobserved solar lines would be also shown.

Acknowledgements

ExoMars is the space mission of ESA and Roscosmos. The ACS experiment is led by IKI Space Research Institute in Moscow. The project acknowledges funding by Roscosmos and CNES. Science operations of ACS are funded by Roscosmos and ESA. K.G., A.T., A.F., O.K., A.L., J-L.B. acknowledge support from the Ministry of Education and Science of the Russian Federation, Grant 14.W03.31.0017.

References

[1] O. Korablev, A. Trokhimovsky, A. V. Grigoriev, A. Shakun, Y. S. Ivanov, B. Moshkin, K. Anufreychik, D. N. Timonin, I. Dziuban, Y. K. Kalinnikov, *et al.*, "Three infrared spectrometers, an atmospheric chemistry suite for the exomars 2016 trace gas orbiter," *Journal of Applied Remote Sensing*, vol. 8, no. 1, p. 084983, 2014.

[2] O. Korablev, F. Montmessin, A. Trokhimovskiy, A. A. Fedorova, A. V. Shakun, A. V. Grigoriev, B. E. Moshkin, N. I. Ignatiev, F. Forget, F. Lefèvre, K. Anufreychik,

I. Dzuban, Y. S. Ivanov, Y. K. Kalinnikov, T. O. Kozlova, A. Kungurov, V. Makarov, F. Martynovich, I. Maslov, D. Merzlyakov, P. P. Moiseev, Y. Nikolskiy, A. Patrakeev, D. Patsaev, A. Santos-Skripko, O. Sazonov, N. Semena, A. Semenov, V. Shashkin, A. Sidorov, A. V. Stepanov, I. Stupin, D. Timonin, A. Y. Titov, A. Viktorov, A. Zharkov, F. Altieri, G. Arnold, D. A. Belyaev, J. L. Bertaux, D. S. Betsis, N. Duxbury, T. Encrenaz, T. Fouchet, J.-C. Gérard, D. Grassi, S. Guerlet, P. Hartogh, Y. Kasaba, I. Khatuntsev, V. A. Krasnopolsky, R. O. Kuzmin, E. Lellouch, M. A. Lopez-Valverde, M. Luginin, A. Määttänen, E. Marcq, J. Martin Torres, A. S. Medvedev, E. Millour, K. S. Olsen, M. R. Patel, C. Quantin-Nataf, A. V. Rodin, V. I. Shematovich, I. Thomas, N. Thomas, L. Vazquez, M. Vincendon, V. Wilquet, C. F. Wilson, L. V. Zasova, L. M. Zelenyi, and M. P. Zorzano, "The atmospheric chemistry suite (acs) of three spectrometers for the exomars 2016 trace gas orbiter," *Space Science Reviews*, vol. 214, p. 7, Nov 2017.

[3] O. Korablev, J.-L. Bertaux, A. Fedorova, D. Fonteyn, A. Stepanov, Y. Kalinnikov, A. Kiselev, A. Grigoriev, V. Jegoulev, S. Perrier, *et al.*, "Spicam ir acousto-optic spectrometer experiment on mars express," *Journal of Geophysical Research: Planets*, vol. 111, no. E9, 2006.

[4] A. Trokhimovskiy, O. Korablev, Y. K. Kalinnikov, A. Fedorova, A. V. Stepanov, A. Y. Titov, I. Dziuban, A. Patrakeev, and F. Montmessin, "Near-infrared echelle-aotf spectrometer acs-nir for the exomars trace gas orbiter," in *Infrared Remote Sensing and Instrumentation XXIII*, vol. 9608, p. 960809, International Society for Optics and Photonics, 2015.

[5] K. P. Menang, M. D. Coleman, T. D. Gardiner, I. V. Ptashnik, and K. P. Shine, "A high-resolution near-infrared extraterrestrial solar spectrum derived from ground-based fourier transform spectrometer measurements," *Journal of Geophysical Research: Atmospheres*, vol. 118, no. 11, pp. 5319–5331, 2013.

[6] J. Elsey, M. D. Coleman, T. Gardiner, and K. P. Shine, "Can measurements of the near-infrared solar spectral irradiance be reconciled? a new ground-based assessment between 4,000 and 10,000 cm−1," *Geophysical Research Letters*, vol. 44, no. 19, pp. 10,071–10,080.