EPSC Abstracts
Vol. 16, EPSC2022-1071, 2022, updated on 07 Nov 2022
https://doi.org/10.5194/epsc2022-1071
Europlanet Science Congress 2022

Pre-perihelion high resolution optical spectroscopy of the long period comet C/2017 K2 (PanSTARRS) with UVES at the VLT

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The long-period comet C/2017 K2 (PanSTARRS) was discovered in 2017 at a large heliocentric distance of 16 au (Wainscoat et al. 2017). Pre-discovery images from 2013 show that K2 was even active at a record distance of ~24 au from the Sun (Jewitt et al. 2017) well beyond the snow line, indicating that, most probably, CO and CO2 ices - the most abundant species after water - might drive its activity. CO was indeed detected in K2's coma in the sub-mm range at a heliocentric distance of 6.7 au (Yang et al. 2021) and K2 was claimed to be a CO-rich comet.

Detecting comets at such large distances is becoming more frequent, but it is still a rare occasion to study a well preserved comet surface coming directly from the Oort Cloud or on a several million years orbit, and especially if it is of a rare type.
K2 will reach its perihelion on 2022 December 19 (Rh=1.8 au, Δ=2.5 au) and become a bright target in automn with good observing conditions from the Southern hemisphere. We have started an observing campaign on May 8 (Rh=3.2 au), 2022 with UVES at the ESO VLT to obtain high resolution and good SNR optical spectra to characterize the detailed coma composition of its daughter species before and after K2 perihelion. We report here about the first epochs before perihelion.

UVES was setup with a slit width of 0.45" (length of 10") to provide a resolving power of 80.000, and we selected two different settings (DIC#1 346/580 and DIC2 437/860) to cover the whole optical range (304-1040 nm) at each epoch in only two long exposures on the same night. These spectra will allow us to compare K2 - characterized by its unusual distant activity - to other well studied comets in the optical and particularly using the same instrument since 20 years by the Liège comet team. These spectra will allow us to measure the detailed composition of its coma: the production rates of the daughter species (OH, CN, C2 etc.) to check among other things if the comet is a C-chain depleted or normal comet (A'Hearn et al. 1995), to link those production rates with those from the parent species observed in the IR (see CRIRES+ poster by Lippi et al.), to search for CO+ and CO2+ lines to check if K2 is a CO-rich comet like the unique CO-N2-rich blue comet C/2016 R2 (PanSTARRS) (Opitom et al. 2019), to measure the ratio of the [OI] lines to estimate the CO/H2O ratio (Decock et al. 2015), and if the comet is bright enough to measure the isotopic ratios of the light elements (12C/13C and 14N/15N from the CN isotopologues), to measure the ortho- to para- ratio of NH2, and search for faint FeI and NiI lines which are a new and puzzling component of the cometary coma (Manfroid et al. 2021).