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# Volatile composition and coma spatial associations in 46P/Wirtanen as revealed by iSHELL at the NASA-IRTF

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## Abstract

The 2018 perihelion passage of comet 46P/Wirtanen afforded an extraordinary opportunity for ground-based observations to measure the volatile composition and coma spatial associations in a Jupiter-family comet with nearly mission-scale sensitivity during its closest approach to Earth. We conducted near-infrared spectroscopic observations of 46P/Wirtanen using iSHELL [6,7] at the NASA-IRTF on UT 2018 December 18. We sampled fluorescence emission from a suite of volatiles, including $H_2O$, $CH_3OH$, $C_2H_6$, HCN, $C_2H_2$, and $NH_3$. Our measurements were conducted simultaneously with observations using the newly upgraded NIRSPEC-2 [3,4] instrument at the Keck 2 telescope.

## 1. Introduction

The much anticipated 2018 perihelion passage of comet 46P/Wirtanen featured a highly active comet passing within ~30 Lunar distances from Earth (0.077 AU), resulting in a worldwide observing campaign [8], including an allocation of 150 hours of telescope time at the NASA/IRTF. In support of this campaign, we targeted 46P/Wirtanen with iSHELL, a high-resolution infrared spectrometer at the IRTF, on six dates in December near its closest approach to Earth. We accumulated very long on-source integration times in multiple settings (see presentation by N. Dello Russo et al.). The goal of this investigation is to characterize the volatile composition and the coma spatial associations between volatiles in 46P. Here we report observations on UT 2018 Dec. 18, carried out simultaneously with observations using the newly upgraded NIRSPEC-2 spectrograph at the Keck 2 telescope.

## 2. Results

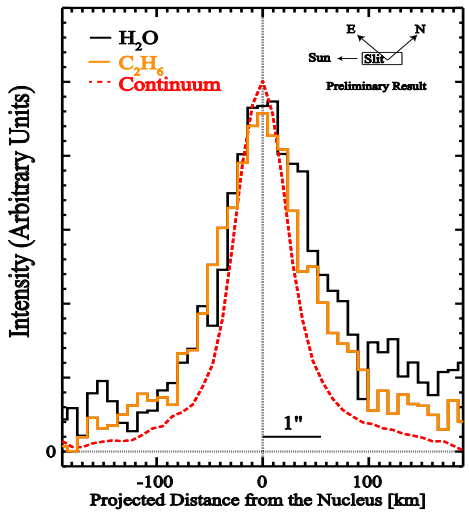


Figure 1. Spatial profiles of $H_2O$, $C_2H_6$, and continuum at ~3.3 μm in 46P/Wirtanen near closest approach to Earth using iSHELL.

We sampled fluorescence emission from multiple volatiles, including $H_2O$, $CH_3OH$, $C_2H_6$, HCN, $C_2H_2$, and $NH_3$. We will present rotational temperatures, production rates (or stringent upper limits), and abundance ratios for each species. Additionally, our long-slit near-IR spectroscopic measurements afforded the opportunity to study the coma spatial associations of the targeted species through their derived column densities along the slit. These measurements can reveal whether each species is associated with common sources on the nucleus, and provide clues for how volatiles are associated or segregated in nucleus ices [1,2,5]. Owing to the close passage of 46P/Wirtanen to Earth, our measurements featured high spatial resolution (~19 km $pix^{-1}$), and sampled the inner coma (within ~200 km from the nucleus) in exceptional detail.

Additionally, our measurements were carried out simultaneously with observations using NIRSPEC-2 at the 10 m Keck 2 telescope (see presentation by B. Bonev et al.). These simultaneous observations are highly complementary, and afford a rare opportunity to compare highly sensitive measurements of coma composition and spatial distributions as revealed at near-infrared wavelengths.

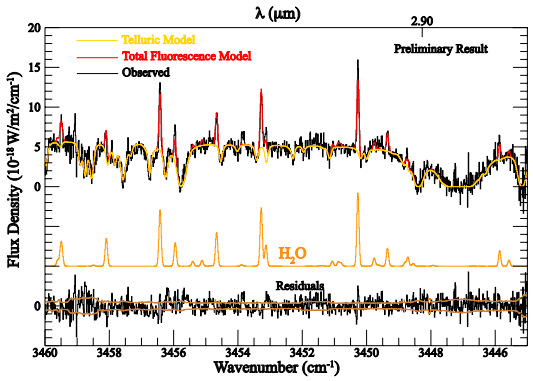


Figure 2. Sample spectrum showing detection of $H_2O$ in 46P/Wirtanen with iSHELL on UT 2018 December 18. Overplotted are the best fit telluric (yellow) and $H_2O$ fluorescence models (red).

## Acknowledgements

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[8] See http://wirtanen.astro.umd.edu/; Comet Wirtanen Campaign Page, hosted by the University of Maryland.