

**CONTROL ID:** 2255358

**TITLE:** SOFIA/EXES detection of absorption by water vapor in a massive protostar

**ABSTRACT BODY:**

**Abstract Body:** Using the Echelon-Cross-Echelle Spectrograph (EXES) on the Stratospheric Observatory for Infrared Astronomy (SOFIA), we have detected ten absorption features of water vapor toward the massive protostar AFGL 2591. These features, detected in the 6.086 – 6.135  $\mu\text{m}$  spectral region, have been observed with a resolving power  $\lambda/d\lambda \sim 85,000$ , allowing individual rovibrational transitions to be cleanly separated from each other and from telluric lines. The observations provide an unequivocal detection of the 6.116  $\mu\text{m}$   $v_2 \ 1_{11} - 0_{00}$  line, Doppler-shifted out of its telluric counterpart, which probes the ground rotational state of para- $\text{H}_2\text{O}$  and demonstrates the potential of SOFIA/EXES to observe absorption by cold interstellar water toward bright 6  $\mu\text{m}$  continuum sources. EXES on SOFIA provides our first opportunity to observe the 6  $\mu\text{m}$  vibrational band of astrophysical water vapor since the Infrared Space Observatory (ISO) in the late-1990s, and provides a spectral resolution that is almost two orders of magnitude better than what had previously been possible with ISO. A simultaneous fit to the EXES-observed transitions toward AFGL 2591 yields an inferred  $\text{H}_2\text{O}$  column density of  $(1.3 \pm 0.3) \times 10^{19} \text{ cm}^{-2}$ , a source covering factor of 0.25, and a rotational temperature of  $640 \pm 80 \text{ K}$ .

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