TESTING THE LIMITS OF INTEGRATION TIME (AND OBSERVER PATIENCE): DETECTION OF INTERSTELLAR KCN

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KCN has been detected in the circumstellar envelope of IRC+10216, a late-type carbon star, with the Kitt Peak 12-meter radio telescope. KCN is a T-shaped, closed shell molecule with a typical asymmetric top spectrum. Five K_a = 0 components were detected in the λ = 2-3.5 mm wavelength range. All five lines were fit to a linear rotational diagram, indicating that the KCN emission results from a uniform rotational temperature of 27 K. The derived column density of KCN is ~ 1 x10^{12} cm^{-2}, corresponding to a fractional abundance of ~ 3 x10^{-10} relative to H_2. All of the lines observed had intensities of 1-2 mK, making them the weakest yet detected by mm-wave astronomy. In order to achieve 3σ detections, integration times for all lines were at least 50 hours, with some frequencies requiring over 100 hours to attain sufficient signal-to-noise. These observations demonstrate the stability of the 12-meter over long periods of time, and confirm the theoretical noise behavior as given by the radiometer equation:

$$T_{rms} = \frac{2T_{sys}}{\eta_{spec}\sqrt{\Delta\nu t_{scan}}}$$