Appendix A: Observations

In the course of searches for new molecules in IRC +10216 we have covered a large fraction of the λ = 3, 2, 1, and 0.8 mm spectrum with the IRAM 30 m telescope (see Cernicharo et al. 2015a). In the λ = 3 mm window, the data acquired over the last 30 years cover the 70−116 GHz frequency range with a very low noise level (T_A^* rms is 0.6−1.5 mK per 1 MHz channel). Some of these data have been published by Cernicharo et al. (2008, 2015a) and Agúndez et al. (2014). The oldest λ = 2 mm data come from the line survey of IRC +10216 carried out by Cernicharo et al. (2000), which have been complemented with additional observations obtained during the search for specific molecular species (see, e.g., Guélin et al. 2000, 2004; Fonfría et al. 2006; Agúndez et al. 2012; Cernicharo et al. 2015a) and from a series of new sensitive observations performed in January and April 2017. The λ = 2 mm merged data are also very sensitive (T_A^* rms is 0.6−1.3 mK per 1 MHz channel). The λ = 1 and 0.8 mm data were acquired from a variety of observations, including the searches cited above, a monitoring study of IRC +10216 to search for time variability that was begun in 2015, a line survey in the 290−355 GHz frequency range with the EMIR receivers in 2010 and 2011, and dedicated sensitive observations to observe lines of methyl silane in January 2017.

The observations carried out before 2010 used a filter bank or autocorrelator providing a spectral resolution of 1 MHz at frequencies below 280 GHz, while at higher frequencies we used two autocorrelators with 2 MHz of spectral resolution and 4 GHz bandwidth. The most recent observations used the new fast Fourier transform spectrometers, which cover a bandwidth of 2 × 16 GHz with a spectral resolution of ~200 kHz. In all observations the secondary mirror was wobbled by ±90″ at a rate of 0.5 Hz, which ensures flat baselines when combined with the dry weather conditions (sky opacity at 225 GHz was below 0.1 in most observations). The system noise temperature T_{sys} was ~100−400 K (depending on the frequency).

The selected observing method, with the off position located at 180″ from the star, provides reference data free from emission for all molecular species because their spatial extent is restricted to a region ≤20−30″ from the star (see, e.g., Guélin et al. 1993; Agúndez et al. 2015, 2017; Velilla Prieto et al. 2015; Quintana-Lacaci et al. 2016). Only CO has a larger spatial extent (see Cernicharo et al. 2015b). The antenna temperature T_A^*, was corrected for atmospheric absorption using the ATM package (Cernicharo 1985; Pardo et al. 2001). The main beam antenna temperature can be obtained by dividing T_A^* by the main beam efficiency of the telescope[1]. Calibration uncertainties during such a large observing period have been adopted to be 10%, 15%, 20%, and 30% at λ = 3, 2, 1, and 0.8 mm, respectively. Additional uncertainties could arise from the fluctuations of line intensities with time induced by the variation of the stellar infrared flux, an effect that has been recently discovered by Cernicharo et al. (2014). All data were analyzed using the GILDAS package[2].

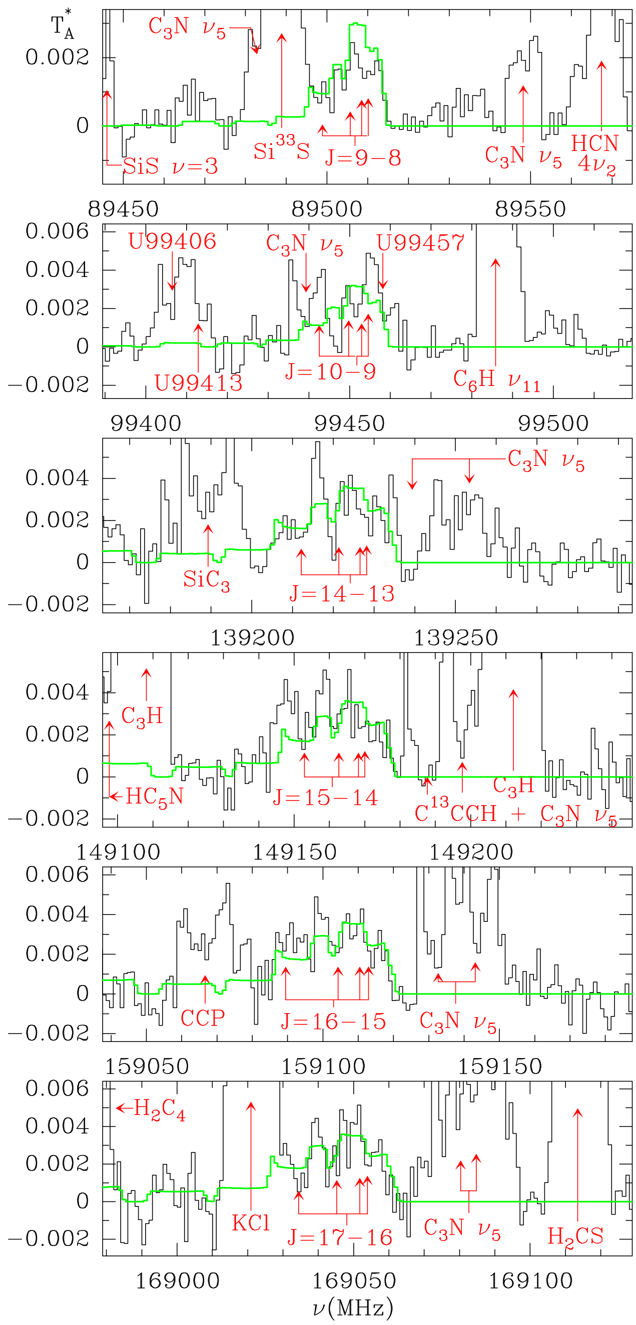

Fig. A.1. Observed rotational lines of silyl cyanide, SiH_3CN, toward IRC+10216. Spectral resolution is 1 MHz and the intensity scale is antenna temperature. Rest frequencies are indicated for an assumed LSR velocity of the source of −26.5 km s^{-1}. The arrows indicate the position of the K = 0, 1, 2, and 3 components of each $J \rightarrow (J-1)$ rotational transition. The identification of other features found in the spectra is indicated. Green lines correspond to the emerging line profiles calculated with the model discussed in the text.

[1] http://www.iram.es/IRAMES/mainWiki/Iram30mEfficiencies
[2] http://www.iram.fr/IRAMFR/GILDAS