

Rotational Spectra of the Silicon Isotopic Species of SiCC

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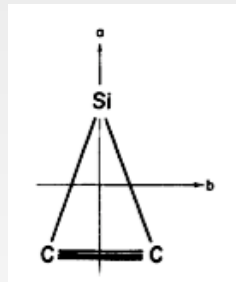
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- 1984 :

SiCC is a C_{2v} ring!

Michalopoulos *et al.*, *J. Chem. Phys.* **80**, 3556 (1984).

Thaddeus, Cummins, & Linke, *Atrophys. J. Lett.* **283**, L45 (1984).



- 1989 :

First laboratory rotational spectra

$$\nu_3 \sim 200 \text{ cm}^{-1}$$

Suenram, Lovas, & Matsumura, *Atrophys. J. Lett.* **342**, L103 (1989).

Gottlieb, Vrtilek, & Thaddeus, *Atrophys. J. Lett.* **343**, L29 (1989).

- Spectrum not well described by Watson Hamiltonian**

Silicon Isotopic Species of SiCC

- One transition measured in laboratory (1989) : $1_{0,1} - 0_{0,0}$

- Astronomical spectroscopy [single antenna] :

20 lines in IRC+10216

$\nu \leq 259$ GHz, $J \leq 12$, and $K_a \leq 8$

line widths : 13 – 36 MHz

$\sigma = 1 - 7$ MHz

- Constants derived from astronomical spectra

varied : 5

constrained : **13**

He, Dinh-V-Trung, Kwok, Müller, Zhang, Hasegawa, Peng, and Huang, *Astrophys. Journ. Suppl. Ser.*, **177**, 275 (2008).

- SMA observations in IRC+102116 :

a few lines of $^{29}\text{SiCC}$ and $^{30}\text{SiCC}$

$$\nu \leq 341 \text{ GHz}$$

$$J \leq 16 \text{ and } K_a \leq 4$$

$$E/k \leq 150 \text{ K}$$

- Spectroscopic motivation :

unambiguous identification of narrow lines

- Experiment

gas mixture : $\text{SiH}_4/\text{HCCH}/\text{Ar}$ in 3/1.5/1 ratio

discharge : 450 mA at 150 K

- Summary

35 transitions each isotopic species

$\nu \leq 360$ GHz

$J \leq 16$ and $K_a \leq 8$

RMS : ~ 30 kHz [$2\times$ measurement uncertainty]

$^{29}\text{SiCC}$ and $^{30}\text{SiCC}$: Laboratory vs. Astronomical

Species	K_a	Transition	This work	CDMS	$\Delta(\text{MHz})$
$^{29}\text{SiCC}$					
	0	$16_{0,16} - 15_{0,15}$	340,538.908(15)	340,537.9(30)	-1.0
	8	$14_8 - 13_8$	324,003.284(15)	324,004.5(30)	1.3
$^{30}\text{SiCC}$					
	0	$17_{0,17} - 16_{0,16}$	356,727.737(15)	356,737.4(61)	-0.3
	8	$15_8 - 14_8$	342,479.335(15)	342,472.9(18)	-6.4

- **Laboratory**

Spectroscopic constants of $^{29}\text{SiCC}$ and $^{30}\text{SiCC}$ determined to comparable accuracy as that of SiCC .

12 or 13 constants **(all varied)**

RMS : ≤ 30 kHz

Greater predictive power with newly determined constants

**Laboratory measurements at higher frequencies,
and $K_a > 8$ needed**

- **CDMS**

Realistic estimates of uncertainties

Cutoff frequencies