Spectroscopic Study of *n*-Propyl Cyanide and Astronomical Detection of its Vibrationally Excited States

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We have recorded sensitive laboratory rotational spectra of *n*-propyl cyanide (*n*-PrCN) over a wide frequency range up to 500 GHz. Our recent publication (1) reports analysis in two spectral windows between 36 and 127 GHz of the ground state and the seven lowest vibrational states of the *anti*- and *gauche*- conformers. Also the identification of all the 8 vibrational states in ALMA spectra between 84.1 and 144.4 GHz of Sagittarius B2(N2). We are presently close to finishing the analysis up to 500 GHz. The aim of this work is to be able to include all these vibrational states in astrophysical models of the spectra of star-forming regions.

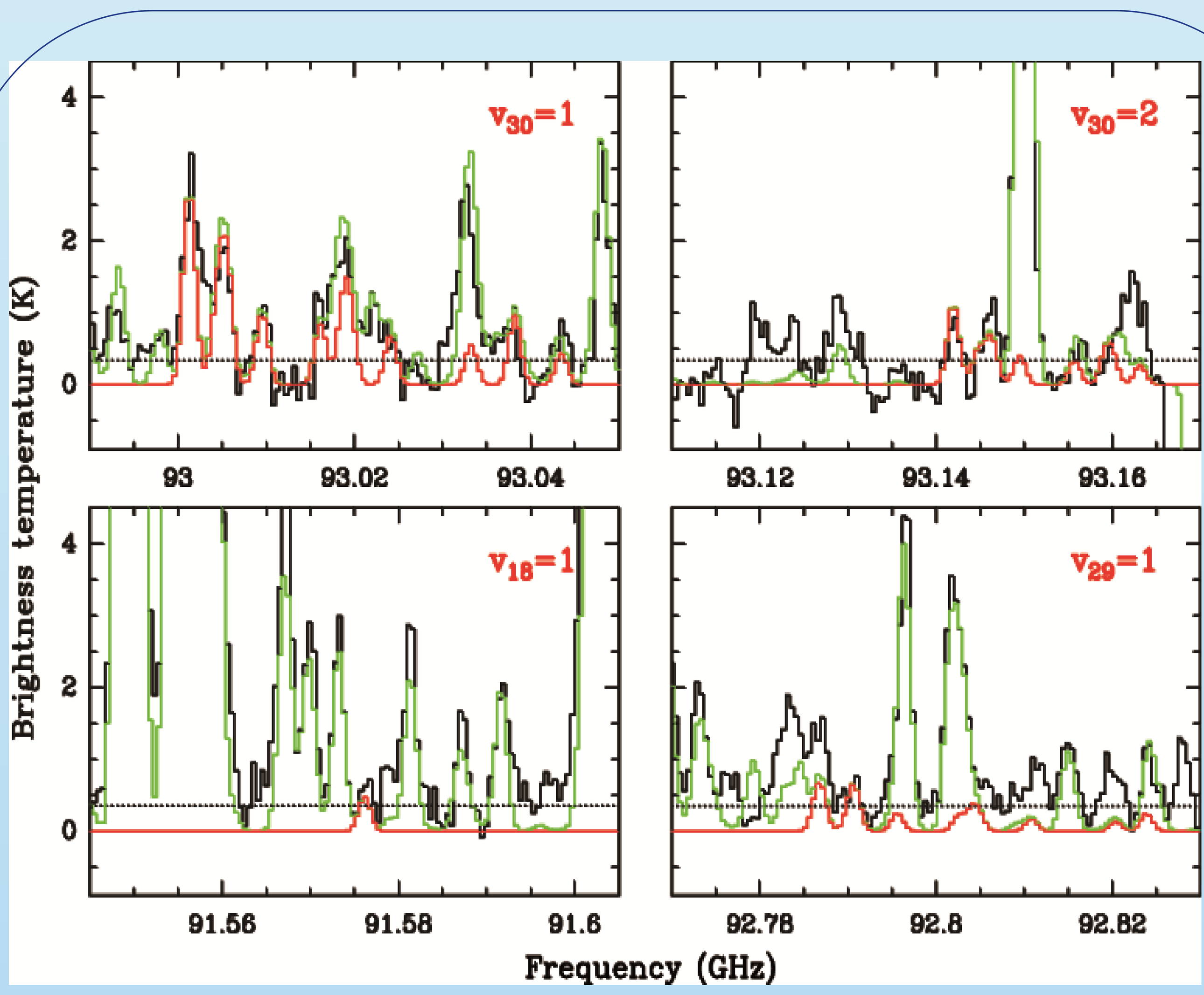


Fig.1 Identification of vibrational states of *gauche*-n-PrCN towards SgrB2(N2) EMoCA (2)

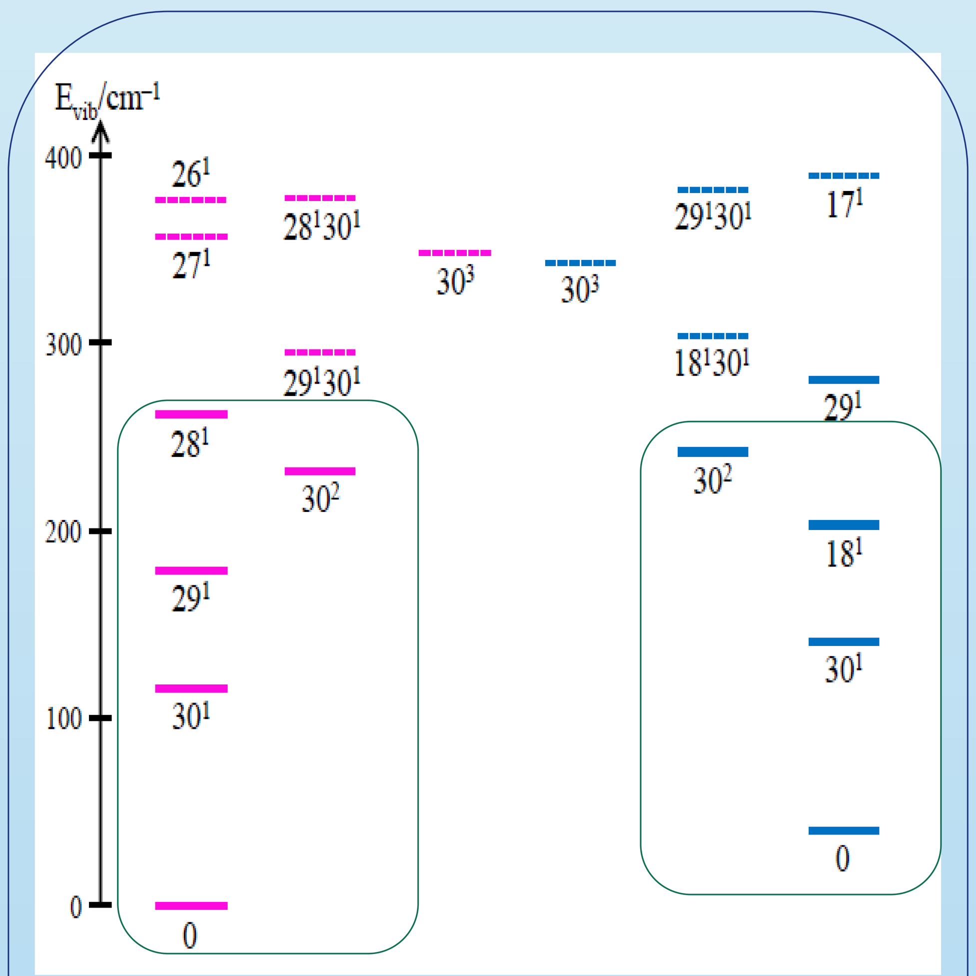
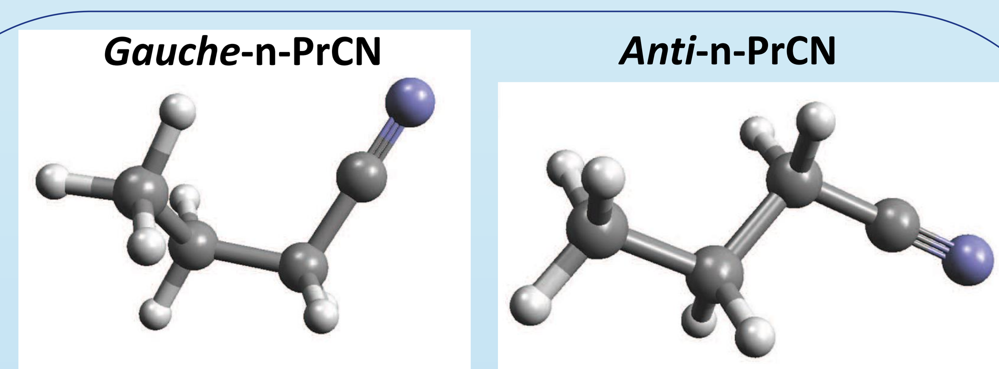


Fig.2 Vibrational states of normal-propyl cyanide up to vibrational enernies of 400 cm^{-1}.
The *gauche* states are shown on the left-hand side, those of *anti* on the right.



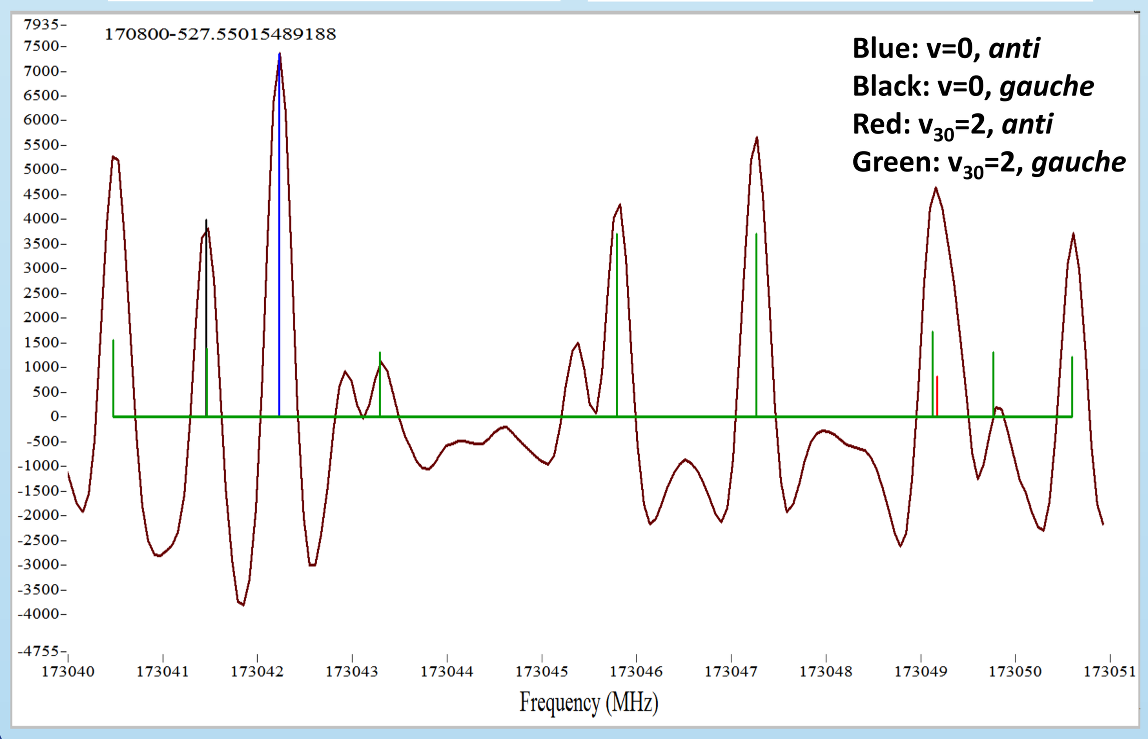


Fig.3 Extract of laboratory spectrum

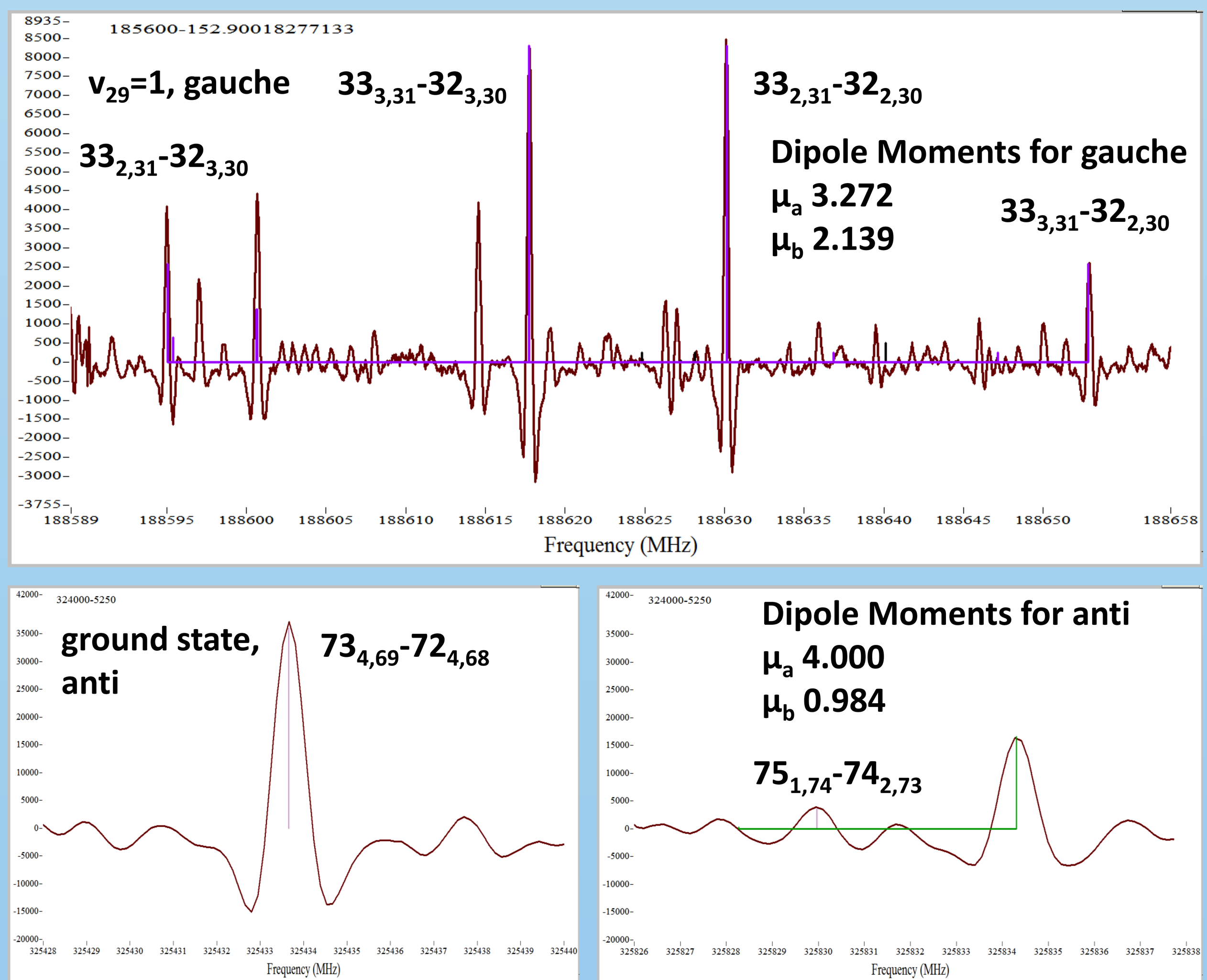


Fig.4 Both μ_a and μ_b transitions can be observed

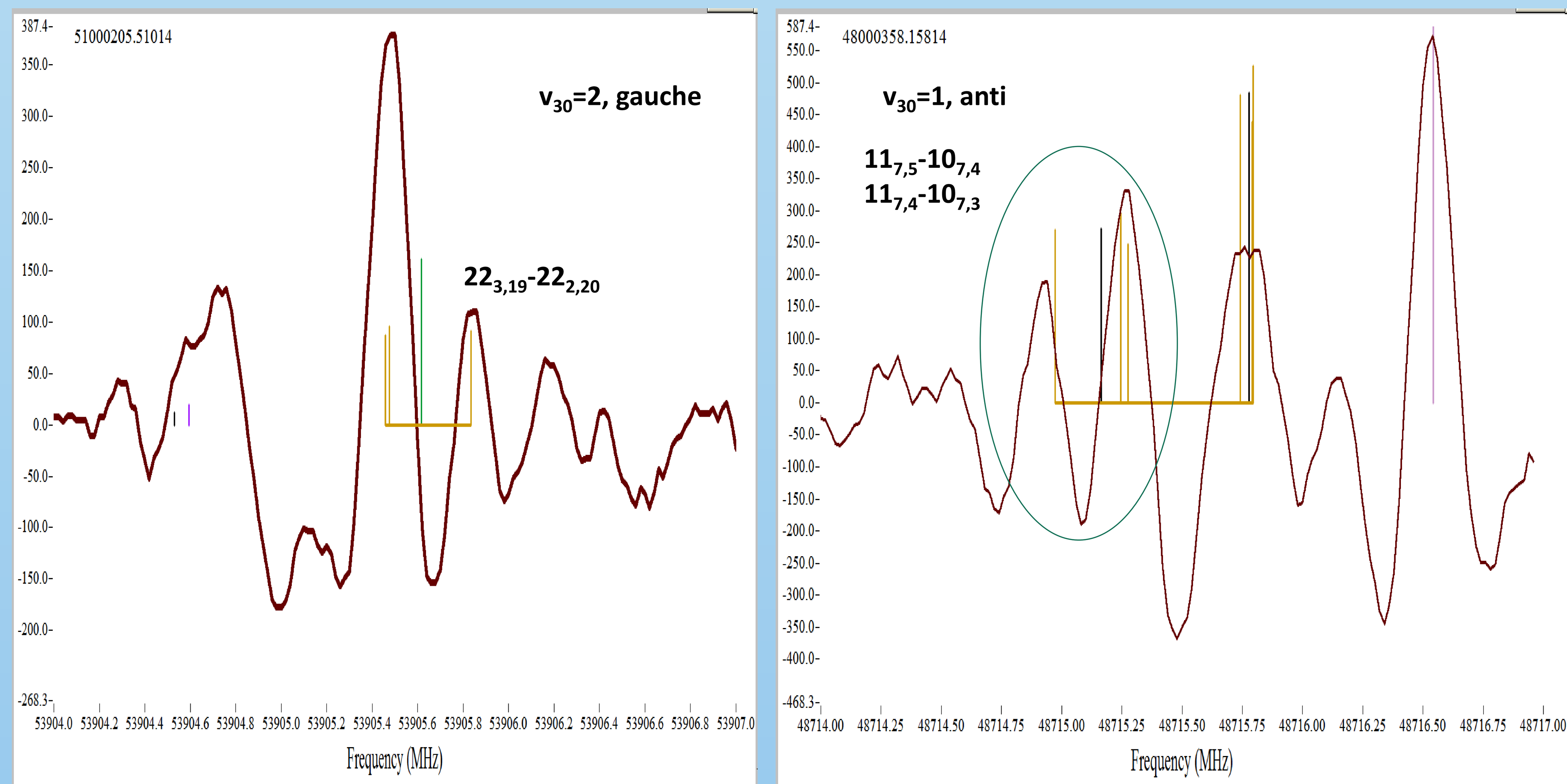


Fig.5 Hyperfine structure

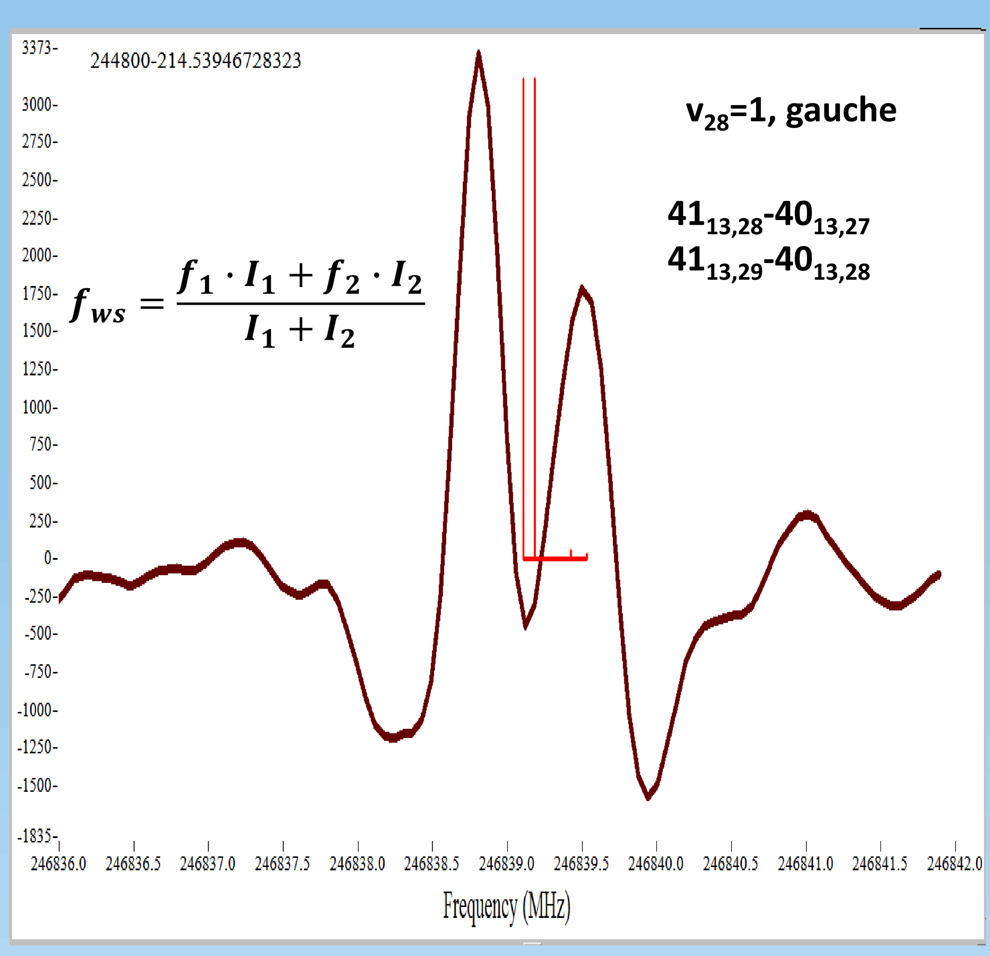


Fig.6 weighted (internal rotation) spliting

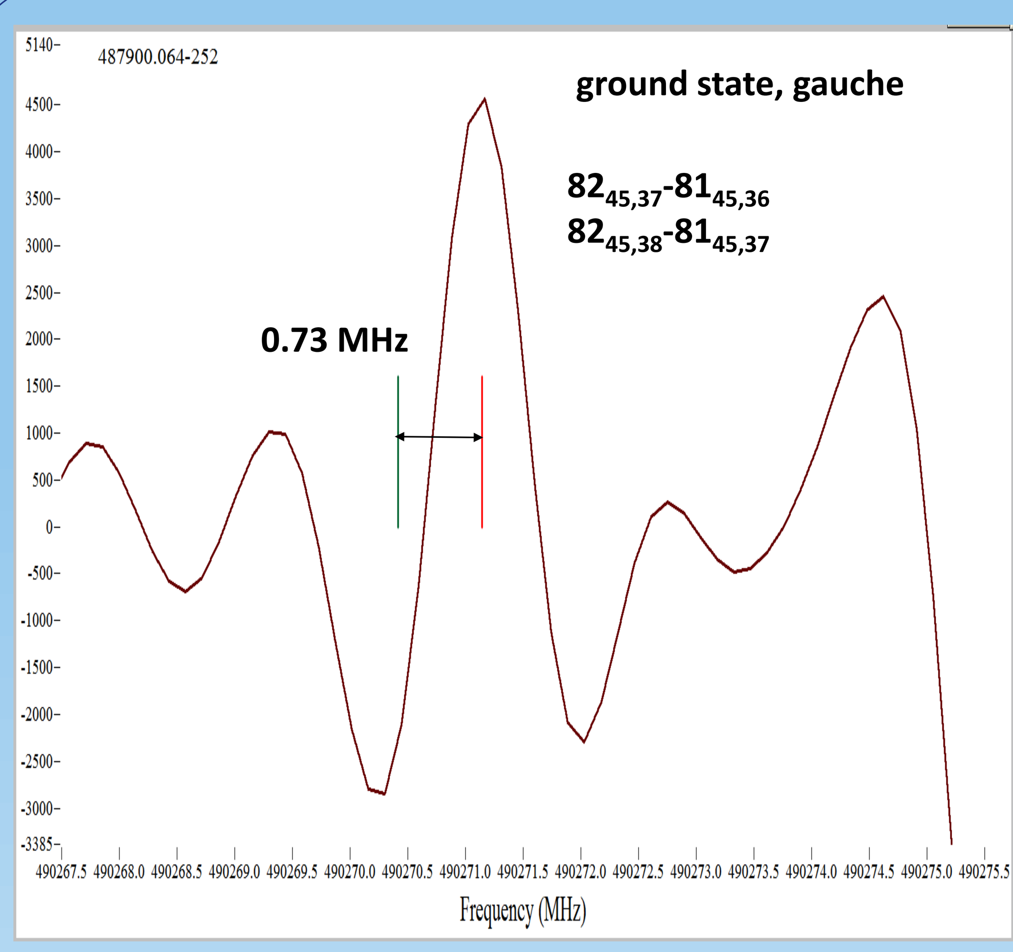


Fig.7 Old (green) and new (red) predicion

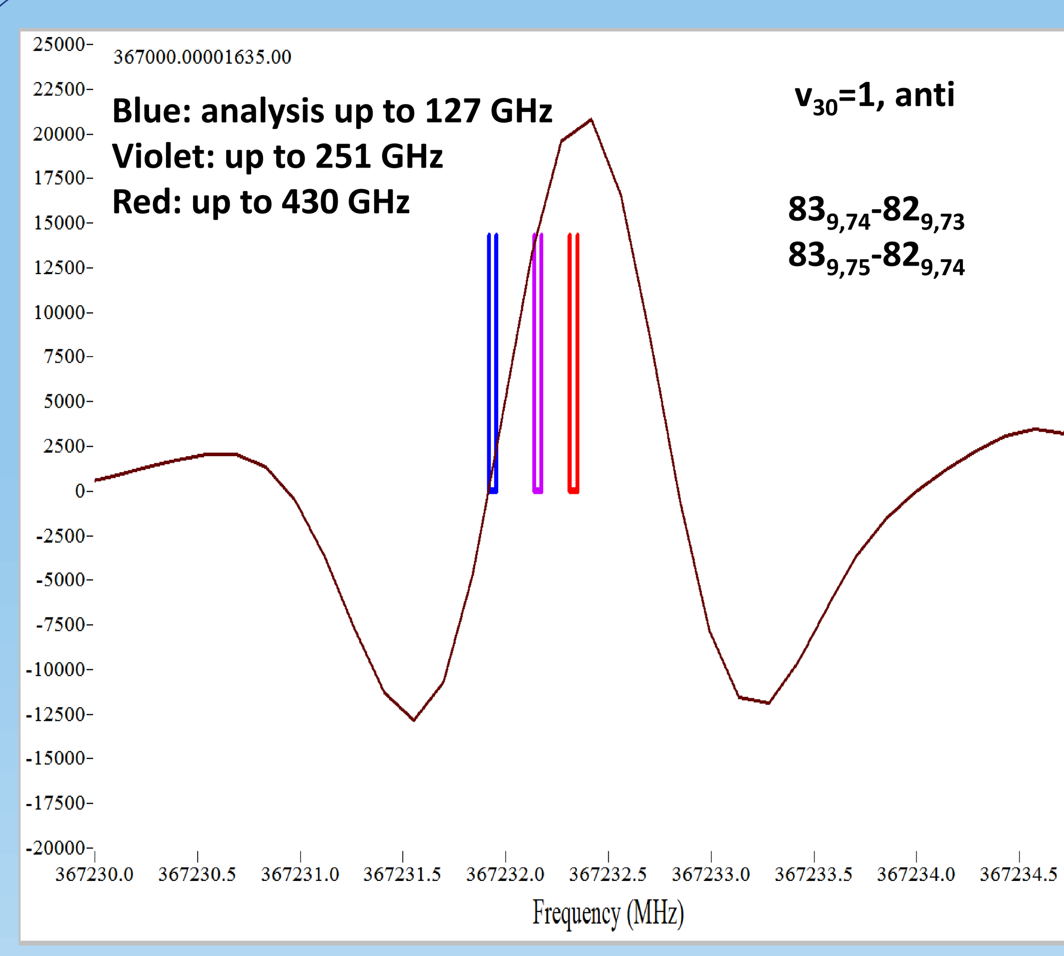


Fig.8 Prediction shifts at higher frequency

(1) H. S. P. Müller, Adam Walters, Nadine Wehres, Arnaud Belloche, Olivia H. Wilkins, Delong Liu et al. *A&A* 595, A87 **(2016).**
(2) EmoCA-Exploring molecular complexity with ALMA. A. Belloche et al. *A&A* 587, A91 (**2016**).