

THE ROTATIONAL SPECTRUM AND STRUCTURE OF Si₃

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The rotational spectrum of a pure silicon cluster, the Si₃ trimer, has been observed for the first time. From the rotational constants of the normal and the ²⁹Si and ³⁰Si isotopic species, a precise geometrical structure has been derived: the trimer is an isosceles triangle with a bond to the apex Si of length 2.165(7) Å and an apex angle of 78.1(4)°. The substantial inertial defect and fairly large centrifugal distortion suggest that the molecule possesses a shallow bending potential. Si₃ is a good candidate for astronomical detection because radio lines of comparably massive silicon molecules (e.g., SiC₂, SiC₄, and SiS) are readily observed in at least one astronomical source: the circumstellar shell of IRC+10216. In excess of 10¹³ silicon trimers are produced per gas pulse in our molecular beam, implying that the rotational spectra of Si₆, Si₉, and even larger polar silicon clusters may be detectable with the present technique, as well as similar germanium clusters.