THE ROTATIONAL SPECTRUM AND STRUCTURE OF Si_3

M. C. McCARTHY and P. THADDEUS, *Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, and Division of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138*.

The rotational spectrum of a pure silicon cluster, the Si_3 trimer, has been observed for the first time. From the rotational constants of the normal and the ^{29}Si and ^{30}Si 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. Si_3 is a good candidate for astronomical detection because radio lines of comparably massive silicon molecules (e.g., SiC_2, SiC_4, and SiS) are readily observed in at least one astronomical source: the circumstellar shell of IRC+10216. In excess of 10^{13} silicon trimers are produced per gas pulse in our molecular beam, implying that the rotational spectra of Si_6, Si_9, and even larger polar silicon clusters may be detectable with the present technique, as well as similar germanium clusters.