anisms. Choosing a time during the growth of the pulsations when the amplitude was so small (semi-radius amplitude: $\delta R/R_0 < 10^{-3}$) that the oscillations were essentially linear, the equation of state and the opacity variations were altered in such a fashion as to eliminate first the γ mechanism and in a separate calculation the κ mechanism. The subsequent behavior of the models was followed in time. In each case the models were now stable with a decay of the pulsations. Details of the method used to eliminate the mechanisms as well as a comparison with the linearized calculations are presented.

A Theoretical Study of the Calcium II *H* and *K* Lines and Infrared Triplet in the Solar Chromosphere. JEFFREY LINSKY, *Smithsonian Astrophysical Observatory and Department of Astronomy, Harvard University*.—Statistical equilibrium equations have been formulated for a model calcium II ion consisting of four discrete levels (3^2S , 3^2D , $4^2P_{1/2}$, $4^2P_{3/2}$) and a continuum. These equations have been solved iteratively, on the basis of the approach of Avrett and Loeser to yield non-LTE source functions for the *H* and *K* lines as well as for each of the lines in the infrared triplet (8498Å, 8542Å, and 8660Å) under a range of physical conditions appropriate to the solar chromosphere. A computer program has been written to solve for these source functions and non-LTE ionization equilibria and to calculate emergent profiles on and off the disk as well as for heights and optical depths corresponding to features in these profiles.

Comparison of a number of computed profiles with the data of Goldberg, Mohler, and Muller (*Astrophys. J.* **129**, 119, 1958) suggests the following preliminary conclusions: (1) The emission features *H*₂ and *K*₂ correspond to heights 600–900 km above the photosphere and optical depths 10^3 to 10^5 in the center of the *K* line. (2) A natural consequence of chromospheric temperature distributions is that the *K*-line residual intensities are larger than those for the *H* line. (3) An upper limit of about 5 km/sec for the turbulent velocities in the region of formation of *H*₃ and *K*₃, 1000–3000 km is established by the visibility of the emission features corresponding to the relative maxima in the source functions. (4) Computed *K*-line profiles for the chromospheric models of Bohm-Vitense (*Z. Astrophys.* **36**, 145, 1955) and Thomas and Athay (*Physics of the Solar Chromosphere*) and for the Utrecht reference model (*Bull. Astron. Inst. Neth.* **17**, 442, 1964) yield *K*₂ and *K*₃ features that are between a factor of 5 and 10 larger than those observed. Unless the gas and electron densities are factors of 30 to 100 too high in these models for the low chromosphere, an electron

temperature minimum of 4000°K and temperature less than 5000°K at 1000 km are required. (5) When either the 3^2D level or the $4^2P_{1/2}$ level is ignored, the resultant source functions differ at most by a factor of 2, and the residual intensities by 1% of the continuum from those computed, including all these levels.

Observations of Venus, Jupiter, and Saturn at 20 μ . FRANK J. LOW, *University of Arizona*.—The first observations of the planets at 20 μ were reported by Low (*Lowell Obs. Bull.* **128**, 184, 1965). Using the same radiometer, which cuts on at 17.5 μ and is uniformly sensitive to about 25 μ , further observations have been made with angular resolutions between 4 and 35 arcsec. Under the assumption that Mars radiates as a blackbody, its brightness temperature at 20 μ was taken as $225^\circ \pm 5^\circ\text{K}$, the value measured for the disk at 10 μ . This yielded a temperature for Venus at 20 μ of $248 \pm 10^\circ\text{K}$, significantly above the 10- μ value of $221 \pm 10^\circ\text{K}$ but in good agreement with solar heating. Using Mars and Venus as standards, it was possible to observe Saturn with angular resolutions both large and small compared to its disk. Correcting for the obscuration of the rings, which were found to be much colder than the planet, the mean disk brightness temperature was $95 \pm 3^\circ\text{K}$, quite close to the measured value of 93°K at 10 μ (Low, F. J., *Astron. J.* **69**, 550, 1964). Scans of Jupiter show a hot equatorial band, $150 \pm 5^\circ\text{K}$, covering about half the disk; the poles are about 130°K . Although the equatorial scans show significant limb darkening, the east and west limbs are equal in temperature to within the accuracy of measurement.

The total amount of energy Jupiter receives from the sun is less than the observed radiation between 10 and 25 μ and would produce an effective temperature of only 105°K . Thus an internal supply of energy must be present. The Jovian temperature measured at 1 mm is $155 \pm 15^\circ\text{K}$ (Low, F. J., and Davidson, A. W., *Astrophys. J.* **142**, 1278, 1965). If the brightness temperature between 25 μ and 1 mm does not drop below 140°K , the total power radiated by Jupiter is more than 3 times the insolation. A similar conclusion may be drawn for Saturn; however, since only a small fraction of its total energy is observed, its excess brightness temperature at 20 μ may be caused by a greenhouse effect.

Interplanetary Scintillations at Decametric Wavelengths from a Small Source in the Crab Nebula. HARRIET H. MALITSON AND ROBERT G. STONE, *NASA Goddard Space Flight Center*, AND WILLIAM C. ERICKSON, *University of Maryland*.—