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Analysis and Interpretation of CCD data on P/Halley and Physical Parameters and Activity Status of Cometary Nuclei at Large Heliocentric Distance

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Strategy

The scientific objectives of this work are: (1) To construct a well sampled photometric time-series of comet Halley extending to large heliocentric distances both post- and pre-perihelion passage and derive a precise ephemeris for the nuclear spin so that the physical and chemical characteristics of individual regions of activity on the nucleus can be determined; (2) To extend the techniques developed in the study of Comet Halley to the study of other cometary nuclei and to obtain new observational data.

Progress and Accomplishments

In the current year we have succeeded in determining the spin state of comet Halley, demonstrated that the nucleus has five major regions of activity, constructed the first accurate map of the locations of active regions on the surface of the nucleus, shown that one of the active regions is characterized by properties that are distinct from those of the others, and demonstrated that the interior density distribution of the nucleus is observationally constrained to emulate that of a homogeneous distribution. The spin state is found to be energetically excited with the nucleus rotating in a long-axis mode. The total spin vector is characterized by an average period of 2.84 days and it precesses, inclined at an angle of 21.4°, around the angular momentum vector once every 3.69 days. Unlike previous models that have been published, this solution for the spin state simultaneously satisfies the VEGA/GIOTTO imaging data and ground-based data on time dependent jet structures, photometric time-series, and episodic production of CN-shells in the comet's coma.

In addition to the above work we have made progress, but not yet completed, the interpretation of our post-perihelion CCD observations. Dr. Mueller has also obtained observing time on the KPNO 4m telescope to observationally extend our Halley work to the study of other cometary nuclei at large heliocentric distance.

In related work, partially supported by this grant, the principal investigator has worked with Dr. K. Meech and proposed a novel model for the structure of Chiron's dust coma that invokes the relatively large mass of this object as an essential element in explaining the "slow" outbursts of episodic activity that characterize it.

Investigation: Analysis and Interpretation of CCD data on P/Halley etc.

Publications

Belton, M.J.S., W.H. Julian, A.J. Anderson, and B.E.A. Mueller 1991, "The Spin State and Homogeneity of Comet Halley's Nucleus," *Icarus*, in press.

Meech, K.J., and M.J.S. Belton 1990, "The Atmosphere of 2060 Chiron," *Astron. J.* **100,** 1323-1338.