

Ancient Chinese Observations and Modern Cometary Models

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Ancient astronomical observations by Chinese, Japanese, and Korean observers represent the only data source for discerning the long-term behavior of comets. The primary source material is derived from Chinese astrologers who kept a vigilant celestial watch in an effort to issue up-to-date astrological forecasts for the reigning emperors. Surprisingly accurate records were kept on cometary apparitions with careful notes being made of an object's position, motion, size, color, and tail length. For comets Halley, Swift-Tuttle, and Tempel-Tuttle, Chinese observations have been used to model their motions over two millennia and to infer their photometric histories. One general result is that active comets must achieve an apparent magnitude of 3.5 or brighter before they become obvious naked-eye objects. For both comets Halley and Swift-Tuttle, their absolute magnitudes and hence their outgassing rates, have remained relatively constant for two millennia. Comet Halley's rocket-like outgassing has consistently delayed the comet's return to perihelion by 4 days so that the comet's spin axis must have remained stable for at least two millennia. Although its outgassing is at nearly the same rate as Halley's, comet Swift-Tuttle's motion has been unaffected by outgassing forces; this comet is likely to be ten times more massive than Halley and hence far more difficult for rocket-like forces to push it around. Although the earliest definite observations of comet Tempel-Tuttle were in 1366, the associated Leonid meteor showers have been identified as early as A.D. 902. The circumstance for each historical meteor shower and storm have been used to guide predictions for the upcoming 1998-1999 Leonid meteor displays.