Close Approaches of Stars to the Solar System

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We have combined Hipparcos proper motion and parallax data for nearby stars with ground-based radial velocity measurements to find stars which may have passed (or will pass) close enough to the Sun to perturb the Oort cloud. Close stellar encounters could deflect large numbers of comets into the planetary region and raise impact rates on the planets and their satellites, with possible consequences for biological evolution on Earth. From the data analyzed to date, we find that the number N of close stellar approaches within a distance D from the Sun (measured in parsecs) is given by $N \approx 5\ D^2\ Myr^{-1}$, in agreement with previously predicted values (Weissman, 1980 *Nature* **288**, 242). Only one star, Gliese 710, is found with a predicted closest approach distance $< 10^5$ AU (0.5 parsecs), although several stars come within about 1 parsec during a ± 8.5 Myr interval. The predicted minimum distance for Gliese 710 is 53,000 to 71,000 AU, approximately 1.0 to 1.4 Myr in the future. Gliese 710 is a late-type dwarf star (dM1 or K7 V) with an estimated mass of 0.42 $M_\odot$, and is currently about 19 parsecs from the Sun. The star may be a binary. The absence of close stellar approaches in the recent past is consistent with analyses of the orbital element distributions of long-period comets by Weissman (1993 *BAAS* **25**, 1063) which determined that we are not currently in a cometary shower. The expected dynamical effects of the closest encounters on the Oort cloud will be discussed. In most cases the uncertainty in closest approach distance is dominated either by uncertainties in published radial velocity measurements or by uncertainties in the barycentric motion of binary systems. We have begun a program to obtain radial velocities for stars in our sample with no previously published values.

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