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# Palomar 5 and its tidal tails: New observational results

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**Abstract.** Sloan Digital Sky Survey data for the field of the cluster Pal 5 reveal the existence of a long massive stream of tidal debris spanning an arc of 10° on the sky. Pal 5 thus provides an outstanding example for tidal disruption of globular clusters in the Milky Way. Radial velocities from VLT spectra show that Pal 5 has an extremely low velocity dispersion, in accordance with the very low mass derived from its total luminosity.

## 1. Extended tidal tails unveiled by the Sloan Survey

Pal 5 is a sparse low-mass halo cluster with peculiar structure and stellar content. Using wide-field multicolor data from the Sloan Digital Sky Survey (SDSS, see York et al. 2000) we recently found clear direct evidence for strong mass loss from Pal 5, showing that this cluster is in the process of being tidally disrupted (Odenkirchen et al. 2001, Rockosi et al. 2002). At the current stage the SDSS covers a 6° to 8° wide band across Pal 5 (see Fig.1). This enabled us to extend our search for tidal debris to larger distances from the cluster. The data were filtered by applying an optimized smooth color-magnitude dependent weight function. We thus found out that the tidal tails of Pal 5 extend over at least 10° on the sky (Fig.1), corresponding to a length of 4 kpc in space. The leading tail (southwest of Pal 5) is visible over 3.°5 down and most likely continues beyond the border of the field. The trailing tail (northeast of Pal,5) is traced out to 6.°5 from the cluster. The stellar mass seen in the tails adds up to 1.2 times the mass of stars in the cluster. The location and curvature of the tails provide unique information on the local orbit of the cluster. The clumpiness of the stream suggests that the process of tidal mass loss has been episodic, probably triggered by disk shocks. The orbit and the mass and geometry of the tails yield an estimate of the mean mass loss rate of about 5 $M_\odot$/Myr.

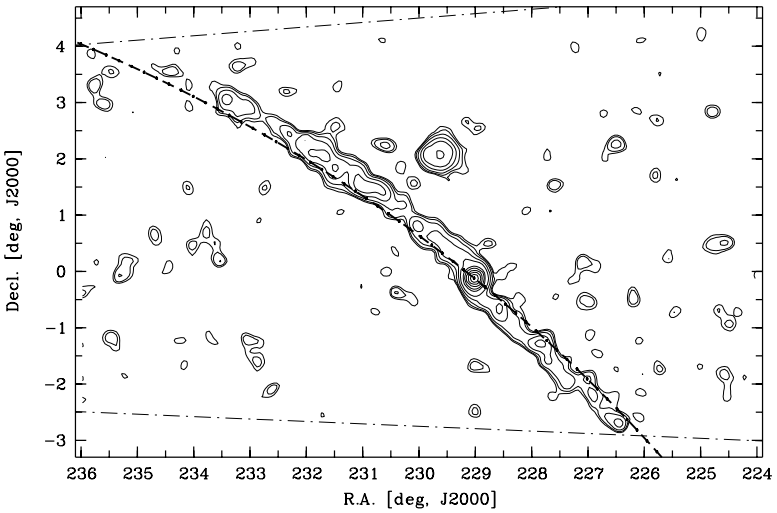


Figure 1. Map of the weighted stellar surface density showing the tails of Pal 5 (contours drawn at $1.5\sigma$, $2\sigma$ and $3\sigma$ and higher). The thick dashed line shows the best-fit orbit of the cluster. The feature at (230°.6,+2°.1) is due to the cluster M 5 and hence not related to Pal 5.

## 2. The velocity dispersion of the cluster

In order to investigate the internal kinematics of Pal 5 we obtained high resolution spectra of 18 of its red giants using the UVES spectrograph on the VLT (Odenkirchen et al. 2002). One of the stars has a velocity offset of 14 $\mathrm{km\,s^{-1}}$ and is suspected to be a binary with rapid orbital motion. The others have highly coherent velocities, with an overall dispersion of 1.1 $\mathrm{km\,s^{-1}}$. By accounting for the influence of binaries on the measured velocities in a statistical way we conclude that the dynamical line-of-sight velocity dispersion in Pal 5 is probably in the range from 0.12 to 0.41 $\mathrm{km\,s^{-1}}$. The upper end of this range is found to be compatible with the cluster's surface density profile and luminosity.

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## References

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