Convective transport in the scrape-off-layer by non-thermalized spinning blobs *

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A blob, or blob filament, is a localized region of enhanced density (and possibly temperature) which convects coherently in the scrape-off-layer (SOL).[1] Blobs, which typically have spatial scales ~ 1 cm perpendicular to B and are highly elongated along B, are especially important for describing SOL transport. Here, 2D models of blob propagation in the SOL are generalized to include the internal temperature profile of the blob, $\nabla_\perp T_e$. For blobs that are connected in the parallel direction to sheaths, this generalization provides a mechanism for blob internal spin and enables consideration of SOL energy transport. Solutions with aligned density and temperature contours satisfying the "hot blob" equations are considered. It is shown that spin increases blob coherence, prevents the formation of extended radial streamers or fingers, reduces the radial convection velocity by mixing of the curvature-induced charge polarization, and provides a new mechanism for poloidal motion of the blob. Additionally, spinning blobs are shown to survive as coherent objects in the presence of weak externally sheared flows, and have blob speeds that depend on the sign of the spin relative to the external sheared flow. Hot blobs are subject to (secondary) instability drives that do not impact thermalized blobs: (i) rotational instability that can cause the blob to shed its outer layers[2] and (ii) the $\nabla_\perp T_e$ sheath term.[3] Because of the sensitivity of blob transport to spin, the results provide motivation for investigating the physics of parallel disconnected blobs,[4,5] and the relationship of spin and disconnection physics to ELM propagation and the density limit.

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