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How steady is Saturn's main auroral oval?

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Saturn's "main auroral oval" is thought to be generated by magnetosphere-solar wind interaction, with flow shears between the outer magnetosphere and open field lines causing a steady upward directed field-aligned current. Due to Saturn's rapid rotation, this current would theoretically have to be asymmetric - strongest at dawn and weakest at dusk - as the difference in flow between solar wind plasma and magnetospheric plasma is greatest at dawn where the flows are oppositely directed and smallest at dusk where they flow in the same direction. This, in turn, should effect a brighter main auroral oval at dawn than at dusk.

Here we want to test this theory, so far based largely on snapshots of Saturn's aurora, with large sets of Cassini-UVIS imagery. The auroral images we use have short exposure times $\sim$ 15 min and offer continuous coverage for sometimes more than two full planetary rotations. By comparing the distribution of UV powers emitted in the dawn and dusk sectors, we find no noticeable asymmetry, challenging the model of a steady-state dawn arc and therefore the assumed origin of Saturn's main auroral emission.

We further consider keograms of the time periods investigated, and find that the bright emissions often observed at dawn are of a transient nature. They can likely be attributed to magnetotail reconnection events, injecting hot plasma into the inner magnetosphere and causing auroral patches which brighten as they subcorotate through dawn. Upon reaching noon local times, they are frequently seen to slow down or even stop, dimming slowly as hot plasma in the source region disperses. Frequent injection events whose associated auroral emissions are mostly confined to the dawn side of Saturn then let the dawn arc appear steady if only comparably few snapshots of the aurora are considered instead of long-term observations such as presented here.