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Observation of intense kilometre-scale field-aligned currents: Evidence for an Alfvén resonator?

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Bursts of very intense kilometre-scale field-aligned currents (KSFACs) are observed quite frequently by the CHAMP satellite when passing through the auroral region. Typical scale sizes of these KSFACs are 1km. In extreme cases estimated current densities exceed 3 $\mathrm{mA/m^2}$. The low-Earth, polar orbiting satellite CHAMP allows assessing KSFACs down to scales of a couple of 100m based on its high-precision magnetic field vector data sampled at 50 Hz. Using data from 5 years (2001 - 2005) the details of these currents have be investigated. Our statistical study reveals that most of the KSFAC bursts and the strongest events are encountered in the cusp/cleft region. Significantly fewer events are found on the night side. There seems to be no dependence of the peak current intensity on the level of magnetic activity, Kp, sunspot number, solar flux level, F10.7 or solar zenith angle. On the other hand, the occurrence frequency is strongly dependent on all these indices. The KSFACs are generally part of strong large-scale FAC sheets, and they are predominantly associated with Region 1 currents. We propose an explanation of the KSFACs in terms of Alfvén waves trapped in a recently proposed resonator, which is initiated when a topside reflector is set up. Many properties of such a resonator are in agreement with our 'KSFAC' results, as for example the switch on/off behaviour, the association to strong large-scale FACs and the current density peak at the critical scale size.