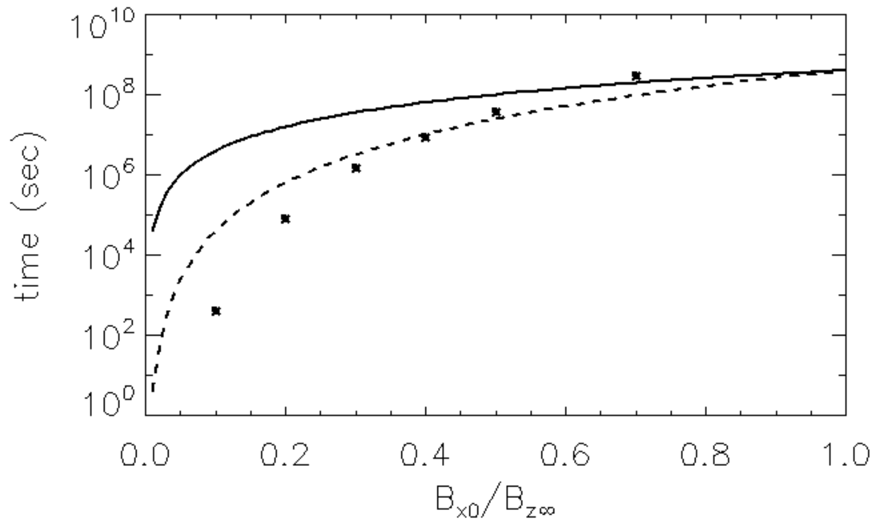
Evolution of the Kippenhahn-Schlüter Prominence Model Magnetic Field under Cowling Resistivity

Observations of quiescent prominences show the there is an observable drift between the ionised plasma and the nuetral gas. Such ion-neutral drift is known to be important for reconnection processes and could result in a significant loss of material over the prominence lifetime. To study this we performed 1.5D diffusion simulations of the Kippenhahn-Schlueter prominence model magnetic field evolution under the influence of the ambipolar terms of Cowling resistivity. We show that initially the evolution is determined by the ratio $B_{x0}/B_{z\infty}$, giving current sheet thinning (thickening) when $(B_{x0}/B_{z\infty})^2 \ll 1.0$ $((B_{z\infty}/B_{x0})^2 \leq 1.0)$ and a marginal case where a new characteristic current sheet length scale is formed, $L_{BX} \approx LB_{x0}/B_{z\infty}$. After approximately $t = \tau_C$ the current sheet thickens at the rate $L_{BX} \propto t^{1/2}$. These results imply that when Cowling resistivity is included in the model, the tearing instability time scale is significantly reduced where $B_{x0}/B_{z\infty} \leq 0.2$. This could be important to explain the observations of bright blobs of prominence material that propagate with/against gravity using the tearing instability as the mechanism for creation.



Plot of the of tearing time scale against t(sec) for different initial values of $B_{x0}/B_{z\infty}$. The solid line is for the original K-S model, the dashed line show the tearing timescale based on the linear estimate of the current sheet width under Cowling resistivity and the stars denote the tearing timescale for the current sheet width found from simulations of thinning under cowling resistivity at $t = \tau_C$

Reference: Hillier, A., Shiabata, K., Isobe, H., 2010, PASJ, 62, 1231

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