



Release of helium from closed field regions of the Sun

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We have modelled the dynamics of previously closed coronal flux tubes that open, allowing plasma to be expelled from the corona, to determine whether the opening of flux tubes may provide a source of helium-rich material for the solar wind, as has been occasionally observed. In a closed flux tube we find that the helium abundance decreases rapidly with altitude, caused by the collisional coupling between α -particles and protons leading to a small α -particle scale height. The lower part of the flux tube may then become helium rich. When the flux tube is rapidly opened, protons escape from the Sun immediately. The coronal α -particles leave the corona only much later, 10–20 hours after the protons, when the collisional coupling to protons has eased, allowing their temperature to become sufficiently high for them to escape. The model thus illustrates how the very different energy balance between open and closed magnetic field configurations has a large impact on the release of plasma.