Elemental Abundances of Noble Gases in Solar Wind Regimes Collected by GENESIS

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Genesis’ three regimes:
- Coronal Hole = “Fast”
- Interstream = “Slow”
- Coronal Mass Ejections = CME

Many noble gas data available for Bulk Solar Wind (SW) targets (e.g. refs. 1-8), but few from regime targets

This work:
- Elemental abundance data of Ar, Kr, & Xe in regimes
- Elemental and isotopic data of He, Ne, & Ar in all regimes, including CME

Xe in SW enhanced by a factor 2 - 2.5 relative to other noble gases

Key findings from earlier work (2, 5, 6, 9)
- Xe in SW enhanced by a factor 2 - 2.5 relative to other noble gases
- Isotopic fractionation between Fast and Slow SW: He>>Ne>Ar

Results and Discussion

Ar, Kr, Xe Fluxes

- Ar, Kr, Xe fluxes regime-dependent, Fast < Slow < CME. Expected since SW proton momentum flux ~invariant [11]
- He enhancement in Genesis CME lower than in Ulysses [14]: “Contamination” with normal SW
- Xe/Ar in SW higher than in Sun [10] and slightly (12%) higher in Slow SW than Fast SW
- Kr/Ar no clear differences
- Inefficient Coulomb Drag of Xe likely overcompensated by efficient ionisation of Xe in ion-neutral separation region. Xe behaves like a Low-FIP element (Low FIT)
- FIP effect of Xe in Fast SW less pronounced than in Slow SW, in agreement with regime data

Kr/Ar & Xe/Ar Elemental Ratios

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Speculation: Additional mechanism enhancing Xe in SW:
- resonant charge exchange between H and Xe (but not between H and Kr), similar to mechanism proposed by Zahnle et al. (2019) [15] to explain early Xe loss from terrestrial atmosphere [16]

He/Ar & Ne/Ar Elemental Ratios

- Problem: He (and Ne) in CME enhanced, but He & Ne isotopes inconspicuous (see top right)
- Conventional view: 4He and 22Ne (unfavourable Coulomb drag) enriched in lower corona and blown off during CMEs. Not observed!

References: