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A new concept for exploiting solar wind momentum

Electric Sail Propulsion
does

Not only magnetic field affects plasma, also electric field

Electric sail?

pressure, so this would be just solar sail
Solar radiation pressure 5000 times larger than solar wind

Solid obstacle

Discussed in another presentation today ("WIPi" project)

Magnetic field forms obstacle for solar wind

Magnetic propulsion

Exploit solar wind for propulsion
Electrons “pumped” out e.g. with electron gun/guns
Few micrometre wire thickness
Few metre mesh spacing, size tens or hundreds of kilometres
Solar wind protons repelled
Wire mesh kept at positive potential (some kilovolts)
If solar sail is feasible, perhaps electric sail is tool and material, say.

pe unit area, much more lightweight than a solid surface (it both have similar thickness radiation pressure. But this is more than compensated by the fact that a wire mesh is, comparison with solar sail; SW dynamic pressure is ~ 5000 times smaller than ) 200 – 500 km.

Removing electrons does not take too much power unless system size is really huge

\[
\begin{array}{cccccc}
\% & \text{183 km/s} & 1 \text{ kW} & 1.11 \text{ W/m}^2 \text{ at} 200 \text{ km} & 0.7 \text{ km} \\
\% & \text{183 km/s} & 0.8 \text{ W} & 0.11 \text{ W/m}^2 \text{ at} 60 \text{ km} & 0.63 \text{ W} \\
\% & \text{91 km/s} & 0.4 \text{ W} & 0.27 \text{ W/m}^2 \text{ at} 30 \text{ km} & 0.63 \text{ K} \\
\% & \text{80 km/s} & 0.0 \text{ W} & 0.07 \text{ W/m}^2 \text{ at} 30 \text{ km} & 0.25 \text{ K} \\
\%
\end{array}
\]

\[\frac{d}{dx} p_{\alpha} + \frac{\partial}{\partial m} \Phi_{\alpha} = \frac{\partial}{\partial m} f_{\alpha} \]

Tentative theoretical performance

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Electron thermal current from plasma to wire should be estimated more accurately.

Electron thermal current from plasma to wire should be simulated.

Likewise, needed potential and mesh spacing should be determined in different solar wind conditions from the simulations.

Are solar wind protons really repelled?

Needs to be studied, but should not be big problem.

What about electron gun?

(Of course, no one has yet built a serious solar sail either...)

And thinner (thin sheet replaced by wire mesh)

Take technology from solar sails, but scale everything bigger.

What about deployment?

Is it feasible?
Conclusions

Without fixed targets, thus navigation not easy, best suited for missions.

As in all solar wind based methods; solar wind variances.

Technology sharing with solar sails.

No magnetic field or exotic technology required.

Electric sail might work.