



Heliogyro-Configured Solar Sail Spacecraft

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Solar Photons - Solar Sail Missions

Heliophysics Missions

Solar sails are not only able to balance at L_1, L_2, \dots, L_5 points but they are station-keeping at other regions in space without using fuel on board

De-orbit end of life satellites



Photons

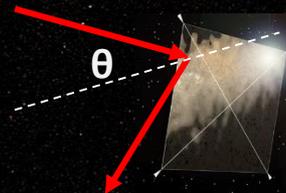


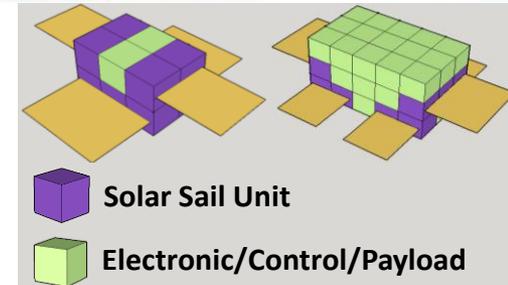
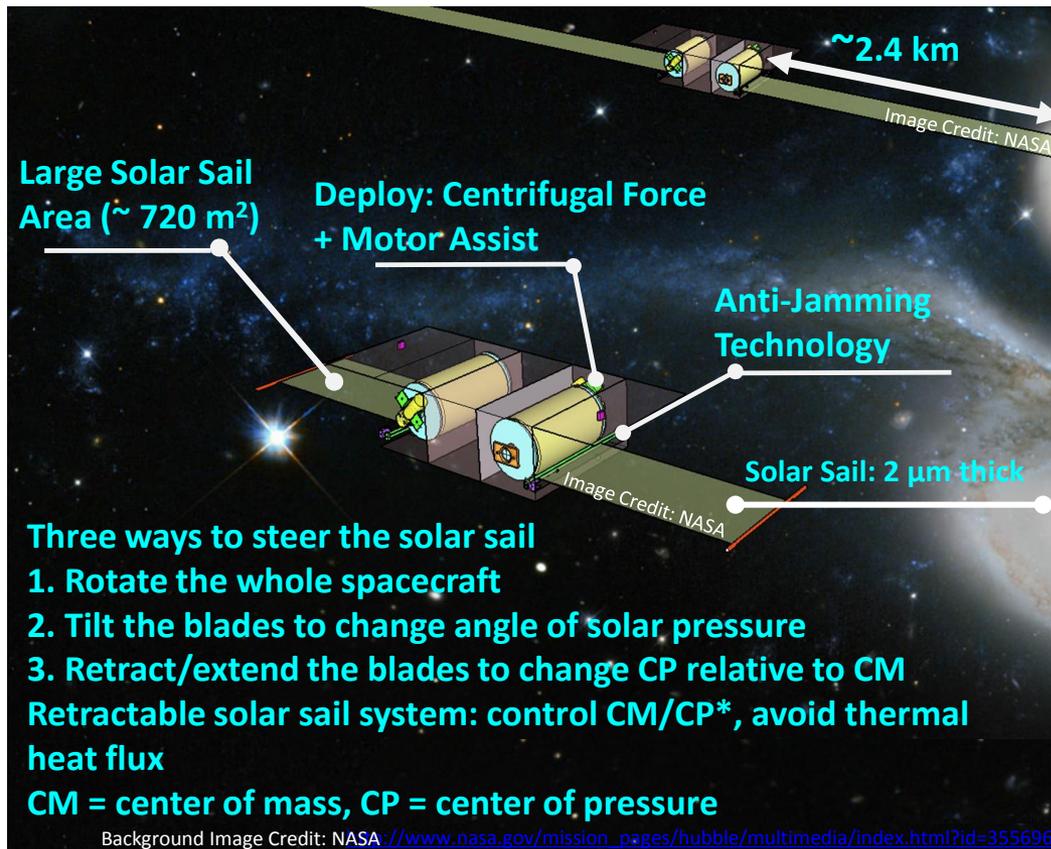
Image Credit:
Bong Wie, Iowa State University

Asteroid Mapping
Asteroid Redirect
Near Earth Object Monitoring

Background Image Credit: NASA http://www.nasa.gov/centers/marshall/images/content/112448main_solar_sail_sun_earth_frame0016_4000x3000.jpg

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2-Bladed Heliogyro Solar Sail



Heliogyro	Characteristic Acceleration [mm/s ²]	Sail Loading [g/m ²]	% of payload units to the whole spacecraft units
18U-4B(a)	0.85	9.68	33
18U-8B(a)	0.73	11.25	28
24U-4B(a)	0.75	10.94	41
24U-4B(b)	0.62	13.30	59
24U-4B(c)	0.64	12.90	50
30U-4B(a)	0.61	13.56	53
36U-4B(a)	0.58	14.13	56
42U-4B(a)	0.57	14.38	57
48U-4B(a)	0.56	14.58	58

28-41%
50-60%

> 55% of payload units → small accelerations
< 40% of payload units → large accelerations
Suggest: payload units < 40%, ~ 33% is the optimum

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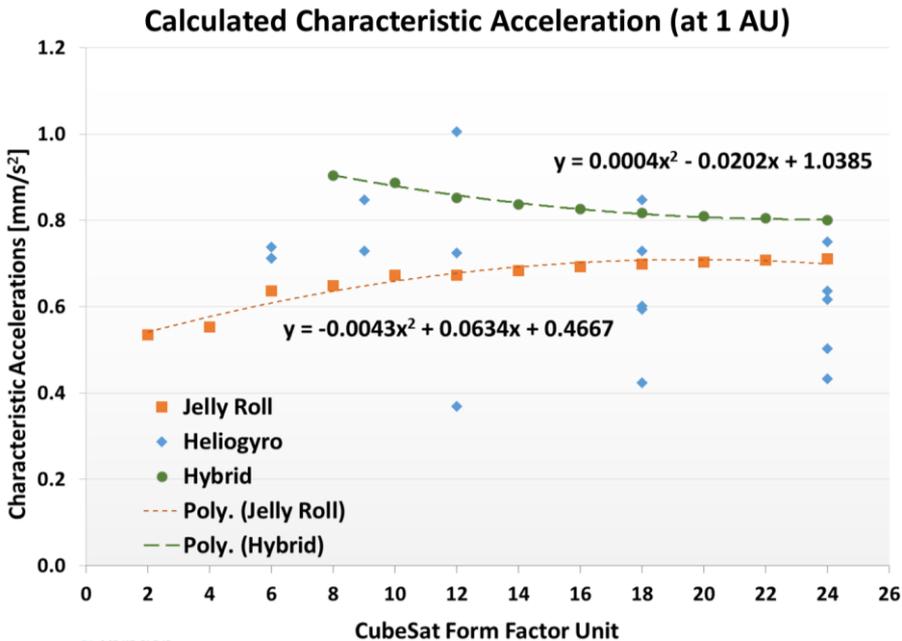
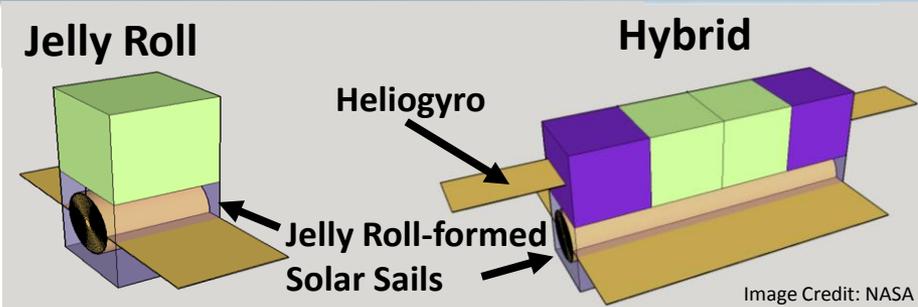
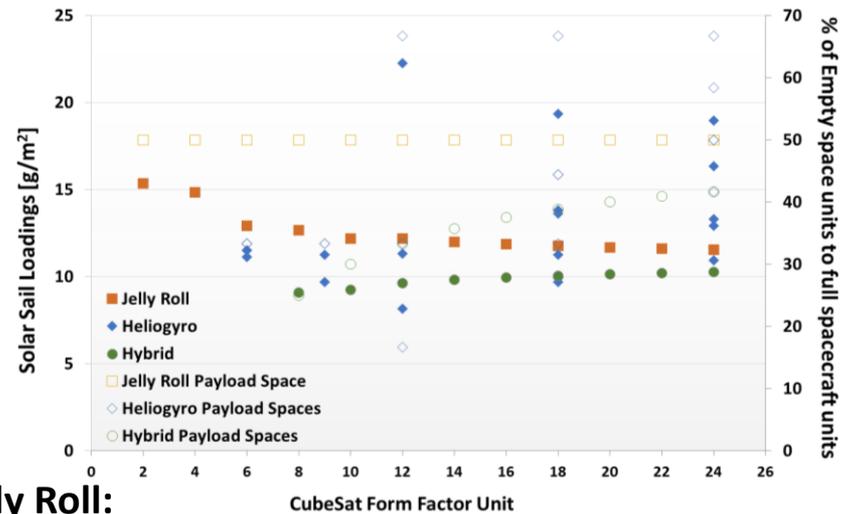


Image Credit: NASA

Solar Sail Loading vs % of Payload Spaces



Jelly Roll:

≤12U → low to mid-range characteristic accelerations compare to Heliogyro configurations.

Hybrid:

Accelerations stay in the high range of Jelly Roll and Heliogyro with insignificant decreases in accelerations as the size increases.

The hybrid's sail loading does not dramatically increase with size.

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Summary

Heliogyro:

Large accelerations ($> \sim 0.7 \text{ mm/s}^2$), suggest $< 40\%$ of payload units, **$\sim 33\%$ is the optimum**

Jelly Roll and Hybrid (Combination of Jelly Roll and Heliogyro)

Suggest: payload space $\sim 30 - 40\%$ of the payload space to produce $> 0.8 \text{ mm/s}^2$.

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