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## Collision Analysis Update for ORS-1 Balloon Deployment June 15<sup>th</sup>, 2018

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# Overview

- The results presented here update the probability of collision analysis for ORS-1's balloon deployment due to a change in the spacecraft mass properties
  - Initial conditions: Falcon 9 (F9) Second Stage pre-separation orbit and attitude
  - ORS-1 inputs:
    - Mass = 3.296 kg  $\pm$  1.5%,  $C_d = 1.0$
    - Cross-sectional area:
      - Minimum = 1.97 m<sup>2</sup> (21.2 ft<sup>2</sup>)
      - Maximum = 28.98 m<sup>2</sup> (312 ft<sup>2</sup>)
- Note:** Use of minimum or maximum cross-sectional area was not observed to effect the probability of collision results
- Potential timing scenarios for ORS-1 were evaluated by Monte Carlo analysis (2500 runs each) of SSO-A's full mission separation sequence:
    1. Deployment of ORS-1 balloon 6 hours after separation from the LoFF (minimum recommended deployment time interval based on the previous 2.23 kg spacecraft mass properties)
    2. Deployment of ORS-1 balloon 10 hours after separation from the LoFF

# Results and Conclusions

- Scenario 1 (balloon deployment after 6 hours)
  - Higher mass means that ORS-1 deploys slower than the original analysis assumed
  - Separation from other spacecraft is correspondingly smaller
  - Observed probability of collision for ORS-1:  $4.8e-3$
- Scenario 2 (balloon deployment after 10 hours)
  - Allows more time for ORS-1 to drift away from other spacecraft before balloon deployment increases collision volume
  - Observed probability of collision for ORS-1:  $0.4e-3$
- Spaceflight recommends that ORS-1's balloon be deployed  $\geq 10$  hours after separation from the LoFF in order to reduce the risk of collision with other spacecraft on the SSO-A mission