# Prisma User Experiment
# Short Facts & Description Document

The Swedish Space Corporation (SSC) has developed the Prisma system, Prototype Research Instruments and Space Mission technology Advancement, to demonstrate critical technologies for enabling various types of proximity operations: rendezvous, sustained formation flying, collision avoidance, and more. SSC is now actively seeking User Experiments with Prisma that involve both short term, commercial-based ventures, as well as longer-term commitments and cooperation based on a joint and mutual interest. This document provides a structured set of questions aimed at helping a potential customer to define their Prisma User Experiment.

To obtain important information on the background of Prisma, the spacecraft capabilities and the scope of the User Experiment process, please read the whitepaper – **"Stretching the Prisma Mission – an Invitation"**. The whitepaper is intended to give potential customers the initial information and guidelines necessary to determine whether the Prisma testbed is a good candidate for accomplishing their experiment objectives. It is available at: www.psatellite.com/prisma.php

Please return completed the completed form to the appropriate point of contact, listed below.

## CONTACT INFORMATION


**For non-US organisations**:

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**1 – Which Units are Needed?** ☒Mango ☒Tango

**2 – Will the Experiment Use Delta-V?** ☒Yes ☐No

If "Yes", how much Delta-V is required?
Between 1 and 3 m/s

**3 – Primary Sensor Systems**

Please indicate all sensor systems required for the experiment.

☒GPS Absolute ☒GPS Relative
☐VBS Long Range ☒VBS Short Range
☒Star Cameras ☒Rate Sensors
☒Accelerometers ☐Outreach & PR Telescope / Camera
☒Artificial Degradation using combination of above sensors
☐Other Please describe:

**4 – Experiment Timeline**

Duration of total experiment: between 2 and 6 weeks.
Percentage of time performing orbital maneuvers: 60 %.
Is there a requirement on the ground-track of the orbit: ☐Yes ☒No

**5 – Orbital Maneuvers**

Shortest Inter-Spacecraft Distance: 30 meters
Longest Inter-Spacecraft Distance: 1500 meters
Maximum Relative Velocity: meters / second

Maneuver Types (check all that apply):

☒Passive relative motion
☐Sustained forced-motion
☒Coarse relative orbit control (1-10 m)
☒Fine relative orbit control (1-10 cm)

**6 – GNC Software**

Please check one of these 3 options for the GNC software to be used during the experiment:

☐ Original: Prisma GNC only
☒ Augmented: Prisma GNC + Custom GNC
☐ Replaced: Custom GNC only (Prisma GNC not used)

Software-in-the-loop:

Run ☒onboard or ☐on the ground
☒ Run in the control loop in real-time.
☒ Run in parallel with Prisma GNC.
☐ Run offline and perform post-processing on the ground.

**Custom GNC Components:**

- ☐ **Attitude/Rate Estimation**
- ☐ **Attitude/Rate Shaping**
- ☐ **Attitude/Rate Control**
- ☒ **Relative Orbit Navigation**
- ☒ **Relative Orbit Guidance**
- ☐ **Relative Orbit Control**
- ☐ **Orbit Determination**

## 7 – Success Criteria

Provide a brief definition of success at the end of the Experiment. Typically 2 to 5 sentences. What key results would you need in order to state that the Experiment has been successful or not?

For success in the approach/rendezvous phase, Mango spacecraft should: 1) maneuver from a far-away distance to a desired relative position with respect to Tango, 2) have a sufficiently small terminal velocity, 3) avoid the virtual ISS structure around the Tango, and 4) use less than the prescribed delta-v limit. For success in the circumnavigation phase of the ISS structure, Mango should: 1) avoid the virtual ISS structure, 2) target the specified inspection points, 3) exit with a safe terminal velocity, and 4) uses less than the prescribed delta-v limit.

## 8 – Narrative Description

Please describe in 1-3 pages the expected sequence of events and activities for the Experiment. Provide illustrations and diagrams in a separate attachment if necessary.

The objective of this experiment is to validate an automated formation flying and rendezvous process that we propose to use for on-demand, rapid-turnaround ISS resupply missions. Tango will represent a point on the ISS with a surrounding virtual structure. Mango will represent the upper stage of the Space Rapid Transit TSTO launch vehicle. The proposed method of rendezvous is for the SRT to be captured by the ISS robotic arm. For the experiment, Mango will use custom guidance software to plan the approach, circumnavigation, and recede trajectories. The proposed sequence of events is summarized as follows:

1. Mango approaches Tango from a far-away (1-2 km) distance. The target rendezvous point is located some safe distance away from Tango. The initial relative motion of the approach will have minimal cross-track oscillation and fit within predetermined bounds on along-track closing speed and and radial oscillation.

2. Mango uses custom guidance software supplied by PSS to determine the approach trajectory. The approach phase terminates when Mango reaches a relative position and velocity within prescribed tolerance. This represents the point of assumed capture by the robotic arm.

3. Mango applies small along-track delta-vs to hold at the rendezvous point for a short time (e.g. 2-3 minutes).

4. Mango exits the rendezvous point and begins a circumnavigation of the ISS virtual structure for inspection. A series of prioritized inspection points are preloaded. The custom GNC software computes safe and fuel-efficient paths around and through the virtual structure, maintaining a safe separation distance from both the virtual structure and the actual Tango spacecraft.

5. Upon completion of the circumnavigation, Mango enters a recede trajectory to drift away from the Tango / ISS.