Atomos Mission Description - Gluon

Atomos Nuclear and Space Corporation (referred to as "Atomos"), based in Denver CO, is developing a fleet of orbital transfer vehicles (OTVs) with a mission to enable low-cost access to harder to reach orbits. In 2022, Atomos closed their Series A to fully fund their Mission-1 demonstration, secured $393M in signed LOIs from space operator and won three contracts under the U.S. Space Force Orbital Prime solicitation, providing an incredible opportunity to engage with government customers and end-users (including a meeting at the Pentagon). Atomos also presented at both of the National Space Council's sessions for In-space Authorization and Supervision Policy and responded to the Federal Communications Commission's (the "Commission") Notice of Inquiry for In-Space Servicing, Assembly and Manufacturing.

In Q1 2024, Atomos will launch two spacecraft (Gluon and Meson) on the SpaceX Transporter 10 Vehicle for its Mission-1 demonstration. In this application, Atomos seeks Part 5 Special Temporary Authority to operate one of the two spacecraft, **Gluon**.[1]

The two vehicles will launch mated together in the same slot and are expected to be deployed at approximately 515 km altitude in a sun-synchronous configuration. Once Gluon and Meson are safely separated from the launch vehicle and Atomos confirms that both spacecraft are operating nominally, Meson will lower both spacecraft approximately 15 km to a 500 km orbital altitude to further test the Meson's capabilities.

Once Meson has lowered the two spacecraft to the new orbit, approximately 500 km of altitude, Gluon and Meson will separate. After separation, Meson will perform a series of rendezvous and proximity operations (RPO) that will culminate in Meson and Gluon docking. At this point, Atomos's primary mission will be complete.

Once the docking procedure at the new orbit is complete, Atomos will test propellant transferring capabilities between Gluon and Meson. Depending on the resources available, Atomos may try additional separation, RPO, and docking tests. Finally, Atomos will use the remaining propellant to lower the altitude of both spacecraft and place them in an orbit that will speed reentry, and separate the two craft prior to reentry.

Please see below Figure 1 for a depiction of the various mission stages for Meson and Gluon.

[1] Atomos has filed an application for Special Temporary Authority for its Meson spacecraft. *See* File No. 0911-EX-ST-2023.

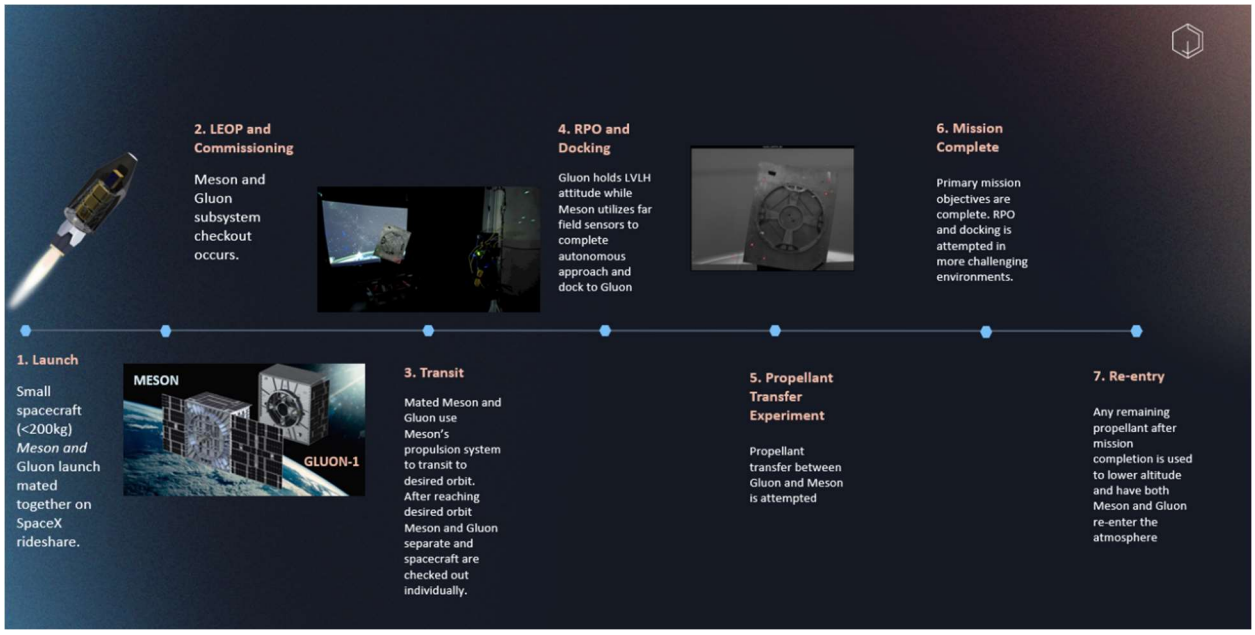

Figure 1: Mission 1 Timeline

Gluon Vehicle

Gluon will carry a fuel tank and have an experimental propulsive system on board. In addition to testing propellant transfer capabilities from Meson on orbit, Atomos will seek to test the propulsive system onboard Gluon but Gluon will not be able to conduct propulsive maneuvers as part of its operations. All residual propellant at the end of the mission will be used to lower the altitude of the Meson-Gluon stack and to accelerate de-orbiting.

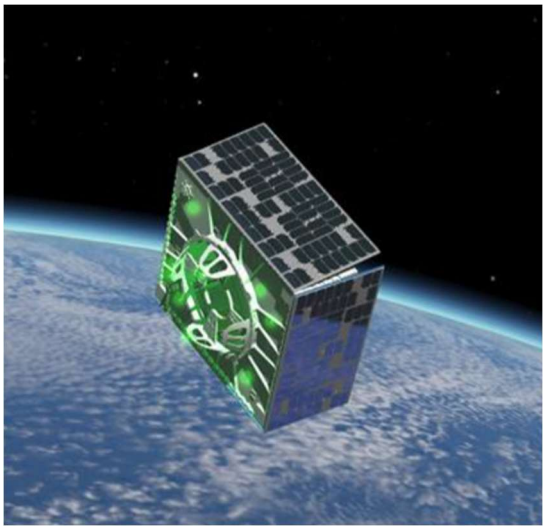

Figure 1: Gluon Spacecraft

The Gluon vehicle will also be equipped with a visible light camera, mounted in a fixed position to the Gluon spacecraft bus, used only for observation of Meson during separation and docking events, and will not be used for Earth imaging. The vehicle also has an attitude control system consisting of reaction wheels and torque rods.

Mission Operations

For this mission, Atomos will manage spacecraft operations via its U.S. based Mission Operations Center (MOC).

For Gluon, all communications including commanding and telemetry downlinking is performed via inter-satellite links between the Iridium (Near Space Labs) constellation using a Near Space Launch Eyestar-S4 radio. The radio will be used to beacon telemetry by transmitting real-time data, and will also be able to receive commands sent from the MOC via the Iridium network. All data will be encrypted to the AES-256 standard. Atomos will not deploy ground stations of its own, or work with an additional third-party ground station provider. Please see below for further information regarding the characteristics of communications between Gluon and the Iridium System.

Gluon will also be equipped with a Wi-Fi antenna for intersatellite communication with Meson during RPO. The Wi-Fi antenna will only transmit when the Meson and Gluon spacecraft are within 500 meters of each other.

To cease emissions, Iridium will send a command over the Iridium constellation that will be sent via the on-board Eyestar radios, to the Atomos vehicles.

The following frequency bands Gluon will be used during the Mission-1 demonstration.

Table 1. Gluon Spacecraft Frequency Summary

Band and Direction	Frequency Range (MHz)	Bandwidth (MHz) and Modulation	Usage
Iridium Eyestar	1618.75-1626 MHz	.035 and DQPSK	Crosslink between Gluon and the Iridium Constellation to relay communications with the MOC
Wi-Fi Link	2400 - 2500 MHz	20 and WiFi (802.11)	Crosslink between two spacecraft

NOAA Authorizations

All imaging sensors onboard Gluon are intended only for observation of Meson during RPO. Atomos has confirmed with NOAA that it does not require a NOAA license for its Gluon spacecraft.

Compliance with the Commissions Orbital Debris Mitigation Rules

The Gluon spacecraft will comply with 47 C.F.R. 5.64 of the Commission's Rules. Atomos has provided an Orbital Debris Assessment Report (ODAR) with this application and has also included debris mitigation strategies related to debris release, small debris, accidental explosions, collision risks with large objects, trackability, planned proximity operations and its post-mission disposal plans.