NOVEL METHODS FOR QUALIFYING ROVERS - IN-ORBIT DEMONSTRATION & VARIFICATION OF MOON ROVERS

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INTRODUCTION

ADVANCING & AUTONOMOUS SYSTEM

NEUROSPACE primarily focuses on the development of autonomous mobile systems for planetary exploration, with a particular emphasis on lunar rovers. The electronics of these rovers must be qualified for the harsh conditions of the space environment, including the lunar surface.

Our HiveR Rover, based on the CubeSat standard, follows a tiered development path—from educational use Tier 1 to space-qualified systems Tier 4.

QUALIFICATION ENVIRONMENT

The HiveR Rover is an autonomous mobile platform developed through a tiered engineering approach, enabling operation in both terrestrial and extraterrestrial environments.

The ongoing qualification campaign aims to perform multiple experiments annually, contingent upon the availability of relevant mission opportunities. The objective is to incrementally validate and qualify all rover subsystems across progressively advanced operational Tiers.

In the following, we present the three most critical experiments within this qualification framework.
I. VULCANO Experiment
II. HEMERA Mission
III. TACHELES Mission

HEMERA MISSION

Mission Concept

In partnership with **The Exploration Company** (TEC) a European firm developing reusable space capsules, NEUROSPACE will fly a 12U experimental payload aboard TEC's Mission Possible demonstrator. This mission, scheduled for mid-2025 aboard a SpaceX Falcon 9, aims to prequalify systems for a future crewed capsule by conducting tests with scientific experiments.

Experiment Objectives

The HEMERA experiment will test critical HiveR Rover subsystems under real spaceflight conditions. A simplified HiveR prototype featuring mechanical suspension and deployment mechanisms will be flown inside TEC's capsule to assess subsystem performance in microgravity.

Key Features and Setup
Prototype dimensions: 12U

Mass: 6 kg (including housing and mounting)

Subsystems tested: Suspension, drivetrain, on-board electronics

Testing conditions: Zero gravity, launch vibrationsradiation exposure

Activation: Two robotic suspension systems will be deployed via unlocking mechanisms during microgravity

Data Logging: Continuous recording of performance and housekeeping data

Mission Timeline & Recovery

The capsule will complete multiple Earth orbits during a ~3-hour flight.

All systems will be re-secured before atmospheric re-entry and ocean landing.

The splashdown serves as a high-impact stress test for mechanical systems.

After recovery, detailed analysis will assess subsystem integrity and performance.

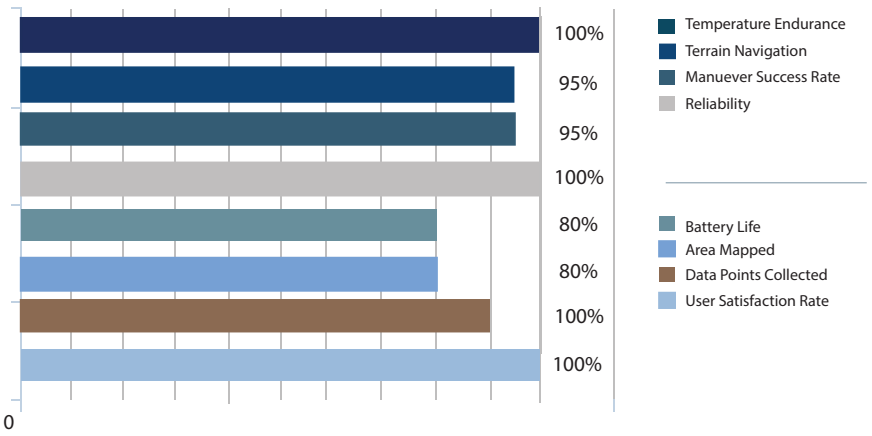
Results will guide rapid design iterations and mechanical improvements.

LAUNCH DATE : JUNE 2025

VULCANO EXPERIMENT

VERIFICATION

Objective: Verfiy the robustness and reliability of the HiveR platform in an extreme environment



Enviromental Performance
- **Temperature Endurance:** Successfully operated in temperature ranging from 30°C to 120°C without failure (100% operational under tested condition)
- **Terrain Navigation:** Successfully navigated 95 % of the steep tracks up to 30° inclinatoion without operational issues.

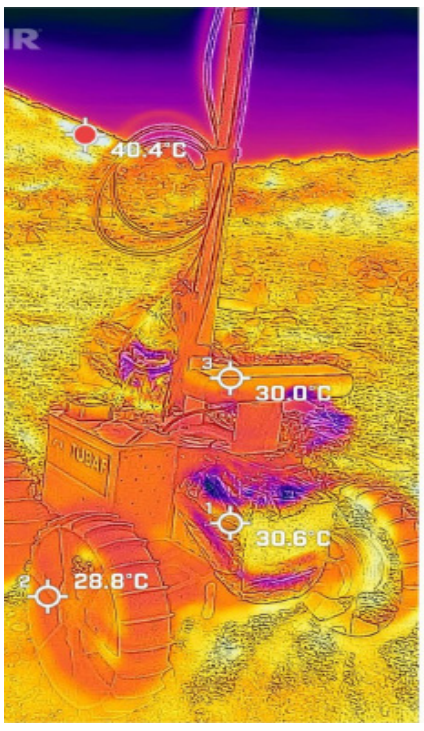
Operational Metrics
- **Manuever Success Rate:** Completed 95% of planned maneuvers around La Fossa with minimal deviation from intended paths.
- **Measuremnet Accuracy:** Magnetic field measurements achieved an accuracy of + /- 5%, with data collected from 95 % of target areas.

Robotic System Performance
- **Reliability:** The HiveR platform operated continuously for 100% of the testing duration, indicating high reliability in harsh conditions.
- **Battery Life:** The rover maintained operational for 7 hours on a single battery charge on average, demonstrating effective energy management.

Data Collection Efficiency
- **Area Mapped:** Successfully mapped a total area of 2 square kilometers at Moon Lake, achieving a coverage rate of 80% of the designated region.
- **Data Points Collected:** Captured over 1200 individual magnetic field data points throughout the operational period.

Collaboration and Networking
- **Engagement:** Participated in 5 collaboration discussions with representatives from 3 different institutions regarding future research applications and interest in the HiveR Rover System.

User Feedback
- **Satisfaction Rate:** Feedback from participants indicated a 100% satisfaction rate regarding the demonstration and performance of the HiveR platform.

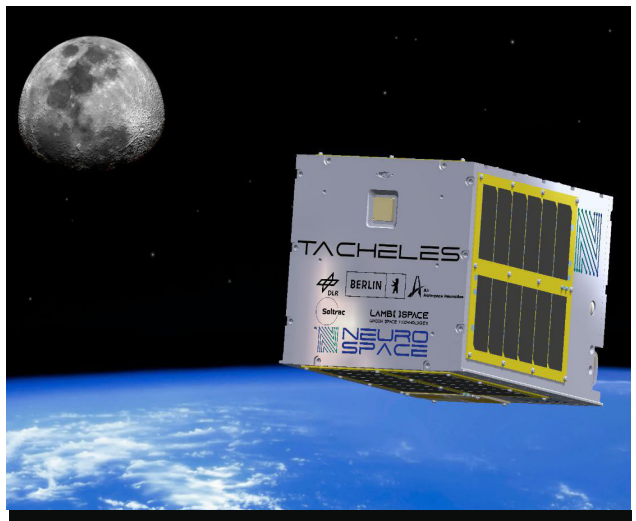


NEUROSPACE supported Dr. Jana Börner (TU Bergakademie Freiberg), who acquired a HiveR system. They supervised the system and monitored the mechanical, electrical as well as the software-based conditions of the rover. Dr. Börner carried out geophysical measurements regarding magnetic fields.

PARTNER

DLR · NASA · ARTEMIS · BERLIN PARTNER for Business and Technology · Soltrac · The Exploration Company · EAH Jena · LAMB SPACE

TACHELES MISSION



TACHELES – Developed by NEUROSPACE, based on the SolTrac satellite bus and features a modular design with built-in redundancy to meet tight development timelines and ensure reliable in-orbit performance.

TACHELES is a 12U CubeSat developed for scientific experimentation in deep space. It is scheduled for deployment from a dispenser within the Orion Stage Adapter (OSA) aboard NASA's Space Launch System (SLS) as part of the Artemis II mission.

This mission represents a milestone collaboration with NASA, offering a unique opportunity for NEUROSPACE to become the first European company to participate in such a remarkable crewed space mission.
One of the primary objectives is the functional validation of the rover's on-board electronics under diverse radiation conditions,specifically within & beyond the Van Allen radiation belts. This test will provide critical insights into system reliability for future deep-space and planetary exploration missions.

Satellite Architecture
Power Control Unit (PCU)
4 solar panels and a battery pack ensure efficient power generation and distribution.
On-Board Computer (OBC)
Designed & built in-house, the OBC controls all satellite operations and manages data handling in real time.
Attitude Control System (ACS)
Stabilization and orientation provided by 3 reaction wheels, a star tracker, and the Attitude Control Computer (ACC).
Communication System (COM)
S-band transceiver and antenna enable command uplink and telemetry downlink.
Propulsion System
Supports orbit-raising maneuvers and maintains satellite stability during extended missions.

SCIENTIFIC PAYLOADS

Payload Data Handling (PDH): Manages and logs experimental data onboard.

SELDOM Instruments (×3): Tests radiation-hardened electronics in a deep-space environment.

HiveR Subsystem: Demonstrates core technologies for mobile surface exploration platforms.

Dosimeter: Measures radiation exposure throughout the mission.

Deployment Context

Launch Vehicle: Space Launch System (SLS)

Launch Site: Kennedy Space Center

Deployment Location: Orion Stage Adapter (OSA)

Mission Duration: TBD (approximately 2 years)

LAUNCH DATE: APRIL 2026

Explore Our Journey with HiveR
Scan the QR code to watch our performance video of our groundbreaking HiveR model.

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