# Nano Icy Moons Propellant Harvester (NIMPH)

Completed Technology Project (2018 - 2019)

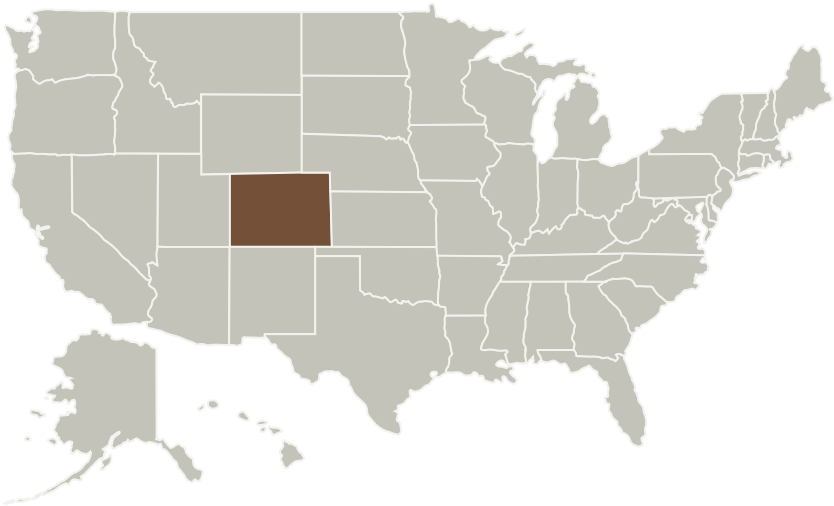
## Project Introduction

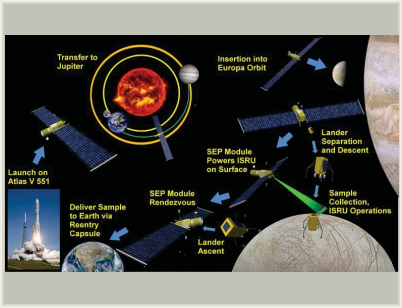
According to the decadal study, a key component of the next 10 years of exploration will be sample return missions. However, these missions are exponentially more expensive than traditional exploration missions because they need two times the delta-V, resulting in exponential growth of its initial mass due to the rocket equations. A key to offsetting this increased cost is through in-situ resource utilization and miniaturization. The NIMPH project develops a micro-ISRU system for producing LOX and LH2 for return propellant. The system takes advantage of developments in the cubesat arena to reduce the dry mass of the ISRU system by 90% compared to current systems. This will allow missions to refuel at their destinations, such as Europa, Mars and the Lunar poles, drastically reducing the size and cost of the mission.

## Anticipated Benefits

The NIMPH project develops a micro-ISRU system for producing LOX and LH2 for return propellant. The system takes advantage of developments in the cubesat arena to reduce the dry mass of the ISRU system by 90% compared to current systems. This will allow missions to refuel at their destinations, such as Europa, Mars and the Lunar poles, drastically reducing the size and cost of the mission.

## Primary U.S. Work Locations and Key Partners






Design Reference Mission - ExoTerra's DRM Accomplishes a Europa Sample Return at 10% of Current Cost Estimates of the Europa Clipper

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Completed Technology Project (2018 - 2019)

| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| ExoTerra Resource, LLC | Lead Organization | Industry | Littleton, Colorado |

| Primary U.S. Work Locations |
|---|
| Colorado |

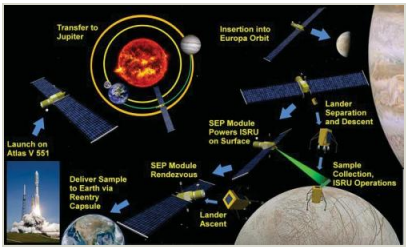
## Project Transitions

**May 2018:** Project Start

**November 2019:** Closed out

**Closeout Link:** https://www.nasa.gov/feature/nimph-nano-icy-moons-propellant-harvester

## Images




**Project Image**
Design Reference Mission - ExoTerra's DRM Accomplishes a Europa Sample Return at 10% of Current Cost Estimates of the Europa Clipper
*(https://techport.nasa.gov/image/102293)*

## Links

NASA.gov Feature Article
*(https://www.nasa.gov/feature/nimph-nano-icy-moons-propellant-harvester)*

## Organizational Responsibility

**Responsible Mission Directorate:**
Space Technology Mission Directorate (STMD)

**Lead Organization:**
ExoTerra Resource, LLC

**Responsible Program:**
NASA Innovative Advanced Concepts

## Project Management

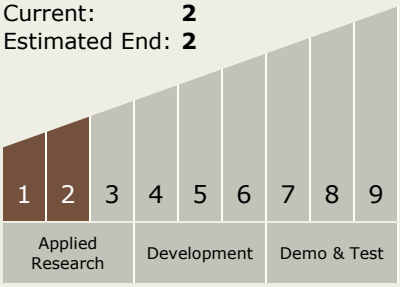
**Program Director:**
Jason E Derleth

**Program Manager:**
Eric A Eberly

**Principal Investigator:**
Michael Vanwoerkom

## Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



**Project Website:**

https://www.nasa.gov/directorates/spacetech/niac/index.html#.VQb6I0jJzyE

## Technology Areas

**Primary:**

- TX07 Exploration Destination Systems
  └ TX07.1 In-Situ Resource Utilization
    └ TX07.1.2 Resource Acquisition, Isolation, and Preparation

## Target Destination

Others Inside the Solar System