Ceres Explorer Mission Architecture Overview

Mission Context and Objectives

The **Ceres Explorer** is a purpose-built, crewed deep-space exploration vehicle designed to conduct the first sustaine

The baseline mission spans approximately **3.2 years**, including outbound transit, an extended orbital operations phas

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Ceres Explorer Spacecraft Design

Overall Configuration

The Ceres Explorer is a **104-meter-long**, axially aligned spacecraft organized into three major sections: a forward c

At its core, the design combines:

* **High-Isp fusion propulsion** using water as reaction mass,
* **Passive radiation shielding** based on distance, geometry, and hydrogen-rich materials,
* **Exceptional habitable volume** to support crew health over multi-year duration.

Habitat and Crew Systems

The forward section houses a **30-meter-diameter cylindrical habitat** with ellipsoidal pressure heads, surrounded by a

Inside the habitat, a **rotating ring** provides variable artificial gravity between **0.1 and 0.6 g**, mitigating long

Radiation protection is layered and conservative: the water jacket provides continuous shielding, augmented by a dedica

Propulsion, Power, and Thermal Management

Propulsion is provided by a **deuterium-tritium fusion reactor** driving six magnetic nozzles, achieving an effective *

The fusion system operates in two modes: a high-power propulsion mode during burns and a lower-output electrical mode p

A distinctive feature is the **dual-purpose hydronic thermal system**, which circulates warm water through the habitat’

Structural and Control Philosophy

The spacecraft’s structural spine supports propellant tanks, logistics pallets, and two docked landers. Attitude contro

Minimal thrust vectoring from the magnetic nozzles compensates for small center-of-gravity shifts as propellant is expe

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Ceres Lander System

Role Within the Mission

Surface access is provided by **two identical, reusable Ceres Landers**, carried from Earth and operated throughout the

Lander Configuration and Crew Systems

Each lander centers on a **spherical pressure vessel** surrounded by a **0.5-meter-thick water radiation jacket**, prov

Internal volume is modest by necessity but sufficient for multi-day operations, with Earth-normal atmosphere, seated fl

Propulsion and Flight Performance

The lander uses a **pressure-fed hypergolic propulsion system** (NTO/MMH), selected for simplicity, storability, and ne

Despite its relatively low thrust, the lander is well matched to Ceres’ **0.029 g gravity**, achieving safe hover capab

Landing Gear and Surface Operations

Given Ceres’ low gravity and uncertain regolith properties, the lander employs a **wide-span, four-leg landing gear** w

Surface operations typically last **2–7 days per sortie**. Crews conduct EVAs, deploy instruments, collect samples, and

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Integrated Mission Concept

Together, the Ceres Explorer and its landers form a **coherent, conservative exploration architecture**. The mothership

The design philosophy is consistent throughout: prioritize passive safety, mature engineering solutions, generous margi