Concept and Feasibility Analysis for the SphereSpace Project

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Document:	***Concept and Feasibility Analysis for the SphereSpace Project***
Date:	2024-10-31
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1.2.1 Abstract

The SphereSpace Project aims to create a rotating, self-sustaining space station designed for interstellar and interplanetary travel, as well as for long-term habitation in space. This study presents a comprehensive overview of the structural and dynamic specifications of the SphereSpace, based on the latest calculations. With a diameter of 127 meters and a design that generates artificial gravity through rotation, the SphereSpace intends to provide a stable environment for up to 112 residents. Here, we analyze the geometric and dynamic properties of the decks, along with updated technical challenges and cost estimates.

1.2.2 Introduction

The SphereSpace is conceptualized as a spherical space station that generates artificial gravity through rotation. The goal is to create a long-term habitable, self-sustaining environment that can be used for research, production, and interplanetary exploration. With a planned capacity of approximately 112 people, the SphereSpace will integrate comprehensive life support systems, hydroponic gardens, and recycling facilities.

1.2.3 Specifications and Structure of the SphereSpace

1.2.3.1 General Dimensions and Layout

- **Overall Diameter**: 127 meters.
- **Number of Decks**: 16 concentric decks, numbered from Deck 0 (central area) to Deck 15 (outer deck).
- **Total Volume**: The SphereSpace has an effective total volume of 852,661 m^3, allocated for habitation, life support, and propulsion systems.

1.2.3.2 Geometry and Gravity Distribution on the Decks The rotation of the SphereSpace generates artificial gravity, increasing radially outward. A detailed list of all deck data can be found in the appendix. Key parameters for selected decks are summarized below:

Deck	Inner Radius (m)	Net Outer Radius (m)	Net Deck Height (m)	Rotational Velocity (m/s)	Centrifugal Acceleration (m/s^2)	Net Space Volume (m^3)
0	0.0	10.0	10.0	5.00	2.50	39,332.96
8	35.0	38.0	3.0	19.00	9.81 (Earth gravity)	71,605.67
15	59.5	62.5	3.0	31.25	15.63	26,328.88

This table shows the increasing gravity from 2.5 m/s^2 on Deck 0 up to 15.63 m/s^2 on Deck 15. Deck 8 is designed for a gravity of 9.81 m/s^2, equivalent to Earth's gravity, and serves as the main residential and working area.

1.2.3.3 Deck Configuration and Spatial Volume

- **Deck Height and Ceiling Thickness**: Most decks have a net height of 3 meters, allowing comfortable mobility.
- **Net Space Volume**: Net space volumes vary from approximately 39,000 m^3 on Deck 0 to about 26,000 m^3 on Deck 15.
- **Total Hull Surface Area**: The outer hull has a surface area of 50,670 m^2 and is 0.5 meters thick.

1.2.4 Operational Cost Analysis

1.2.4.1 Construction and Development Costs (Adjusted) Based on updated volume and mass data, the following adjusted cost estimate is derived for the construction and launch of the SphereSpace:

- **Design and Engineering**: €165 million
- **Manufacturing and Assembly**: €655 million, including new structural requirements
- **Transportation and Launch**: €8.7 billion (based on 100-ton segments at optimistically estimated launch costs)

1.2.4.2 Annual Operating Costs Despite the self-sustaining architecture aimed at minimizing operational costs, there remain ongoing expenses:

- **Personnel Costs**: €5.6 million for 112 crew members
- **Life Support and Maintenance**: €10 million to keep systems operational
- **Energy and Propulsion**: €5 million for energy needs and minor course adjustments
- **Communication and Data Transmission**: €2 million
- **Emergency Supplies**: €3 million for unexpected stock replenishments

1.2.4.3 Long-Term Maintenance and Upgrades Major maintenance and potential upgrades will be required every decade to ensure long-term usability. Estimated cost: **€500 million per decade**.

1.2.5 Technical Challenges and Feasibility

1.2.5.1 Rotational and Gravity Stability The rotation of the SphereSpace must be carefully controlled to ensure a consistent gravity distribution. The challenge lies in ensuring structural integrity at high speed while integrating mechanisms for fine-tuning rotation.

1.2.5.2 Life Support and Closed-Loop Systems The hydroponic gardens and recycling facilities on decks with Earth-like gravity require continuous monitoring and maintenance. Integrating these systems on Deck 8 balances spatial utilization with energy consumption.

1.2.5.3 Thermal and Radiation Shielding The outer hull, with a thickness of 0.5 meters, provides basic protection against radiation and thermal fluctuations. Additional shielding may be required to protect the crew from cosmic radiation and solar storms.

1.2.6 Cost Estimation and Financing

Considering all phases (development, construction, launch, operation, maintenance), the total estimated cost for a 10-year operational period of the SphereSpace is approximately **€10.3 billion**.

Phase	**Estimated Cost (EUR)**
Design and Development	€165 million
Manufacturing and Construction	€655 million
Transportation and Launch	€8.7 billion
Operating Costs (over 10 years)	€256 million
Decade Maintenance and Upgrades	€500 million
Total (10 Years)	**€10.3 billion**

1.2.7 Conclusion and Outlook

The SphereSpace represents an ambitious concept for the future of space exploration. The detailed deck data demonstrate that a rotating space station with variable gravity levels is technically feasible. However, the high costs and technical challenges necessitate significant investment and technological advancements. This model could form the basis for future interstellar missions and represents a valuable step toward long-term space exploration.

1.2.8 Appendix: Complete Deck Listing

Below is the full list of geometric and dynamic properties for each deck:

Deck	Inner Radius (m)	Net Outer Radius (m)	Net Deck Height (m)	Rotational Velocity (m/s)	Centrifugal Acceleration (m/s^2)	Net Space Volume (m^3)
000	0.0	10.0	10.0	5.00	2.50	39,332.96
001	10.5	13.5	3.0	6.75	3.38	27,970.05
002	14.0	17.0	3.0	8.50	4.25	35,669.84

Deck	Inner Radius (m)	Net Outer Radius (m)	Net Deck Height (m)	Rotational Velocity (m/s)	Centrifugal Acceleration (m/s²)	Net Space Volume (m³)
003	17.5	20.5	3.0	10.25	5.13	43,009.37
004	21.0	24.0	3.0	12.00	6.00	49,894.60
005	24.5	27.5	3.0	13.75	6.88	56,222.27
006	28.0	31.0	3.0	15.50	7.75	61,876.47
007	31.5	34.5	3.0	17.25	8.63	66,723.71
008	35.0	38.0	3.0	19.00	9.81	71,605.67
009	38.5	41.5	3.0	20.75	10.38	73,327.77
010	42.0	45.0	3.0	22.50	11.25	74,639.80
011	45.5	48.5	3.0	24.25	12.13	74,200.54
012	49.0	52.0	3.0	26.00	13.00	71,504.71
013	52.5	55.5	3.0	27.75	13.88	65,702.69
014	56.0	59.0	3.0	29.50	14.75	54,984.62
015	59.5	62.5	3.0	31.25	15.63	26,328.88

1.2.9 Sources

No external sources used.