

Da exploração do sistema solar aos videojogos

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Escola de Verão de Física

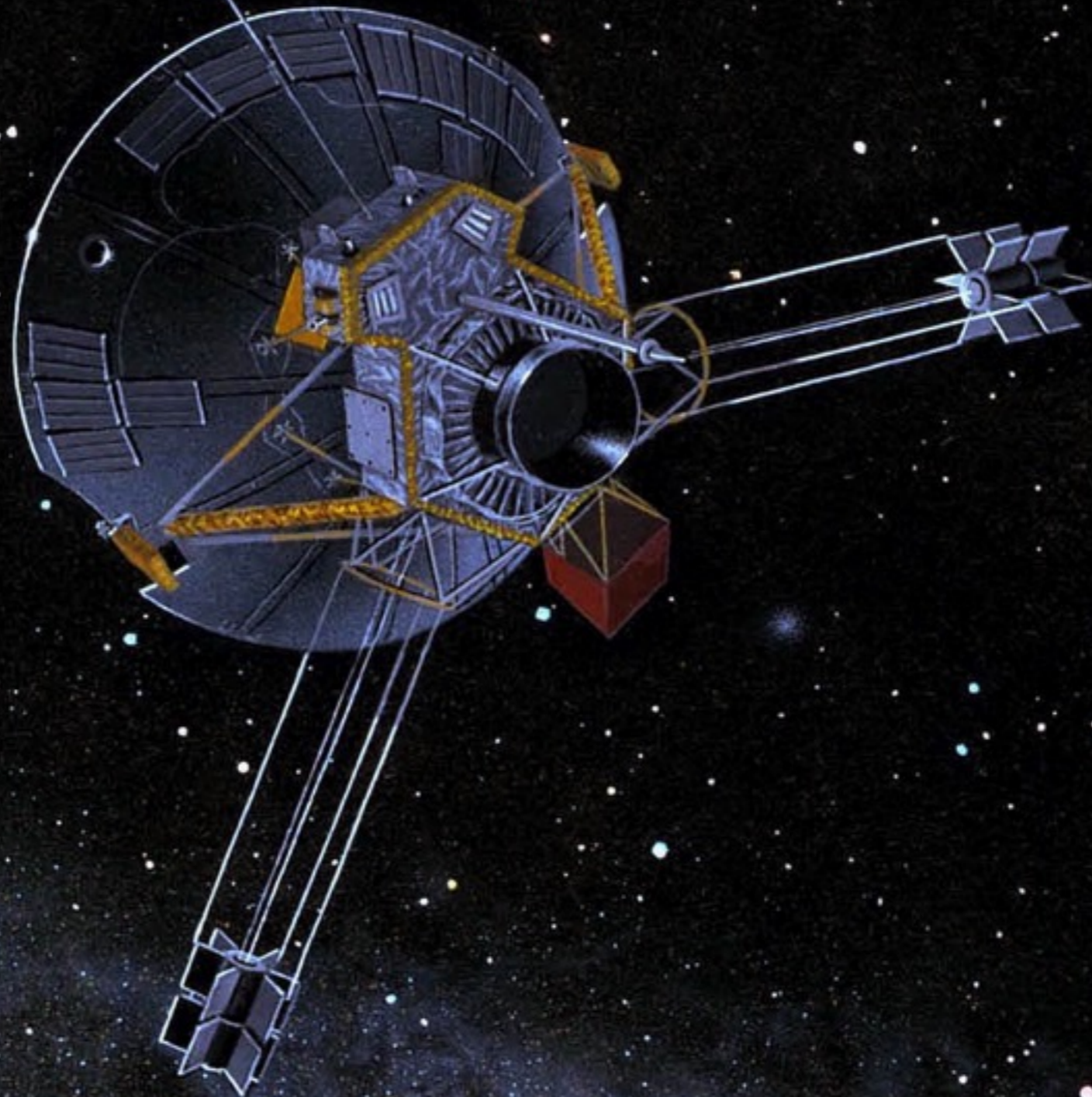
Faculdade de Ciências da Universidade do Porto

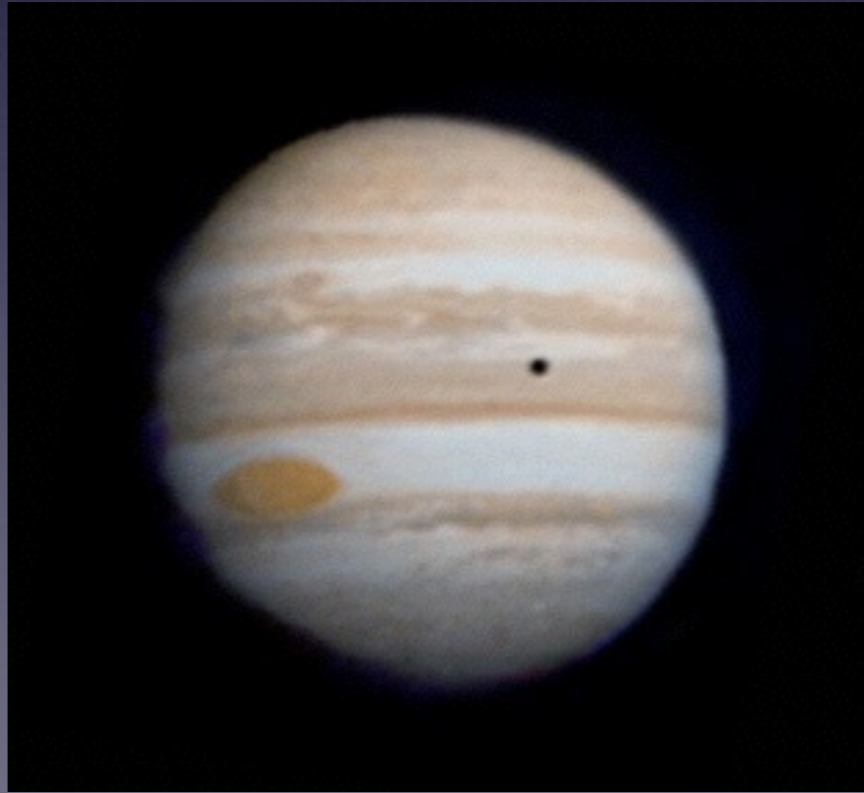
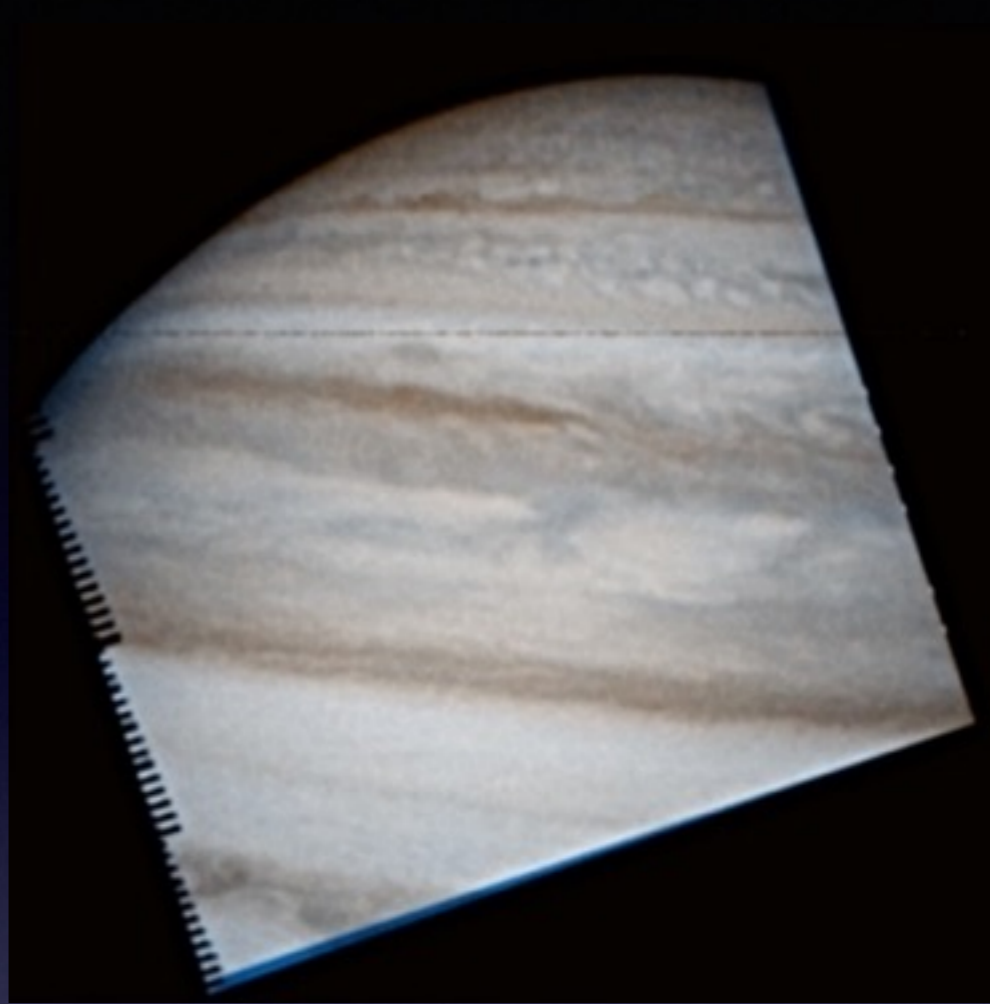
A Exploração do Sistema Solar

Distâncias

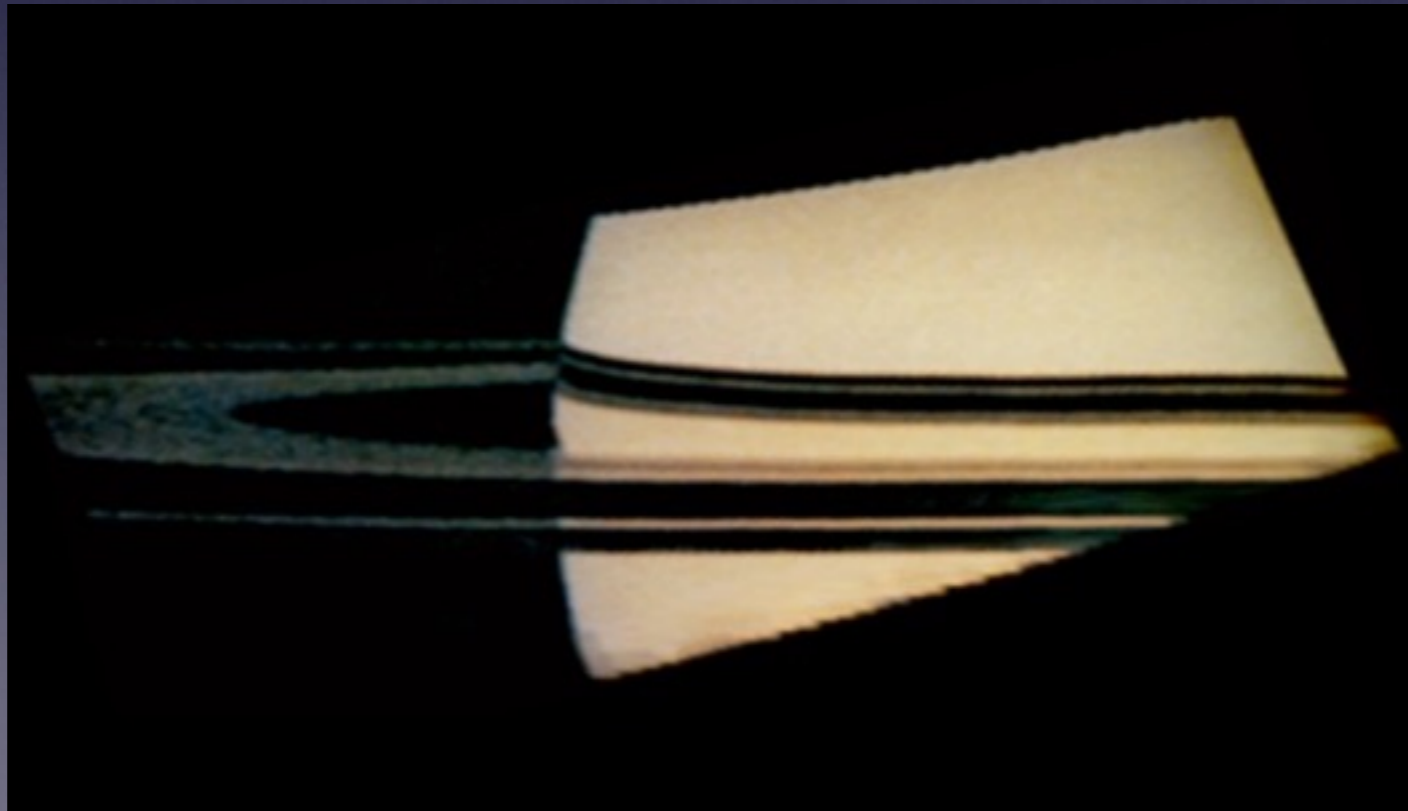
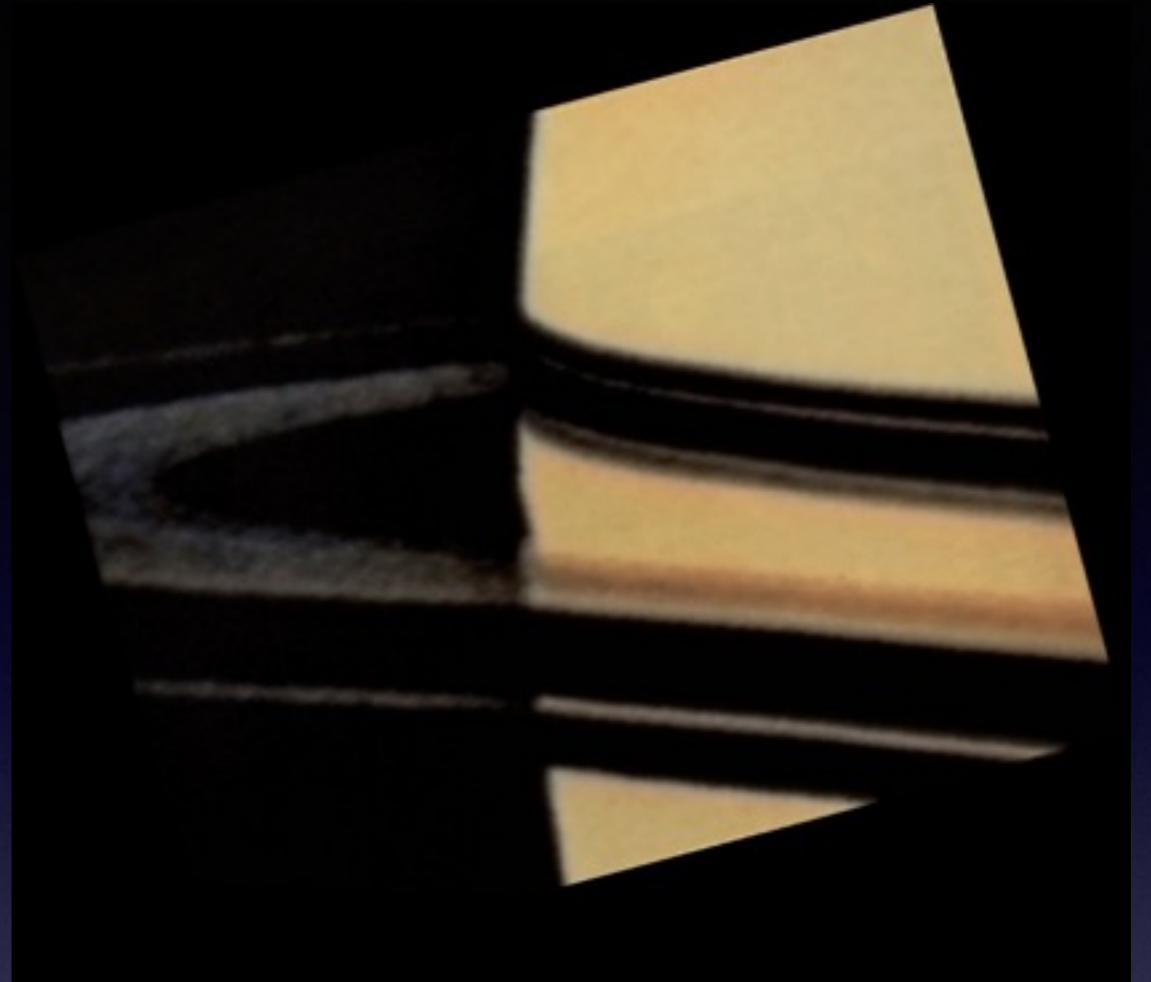
- Limiar do espaço: 100 km
- Órbita Baixa: 160 a 2000 km
- Terra - Lua: 380 000 km
- Sol - Terra: 150 000 000 km
- Sol - Saturno: 1 400 000 000 km

Pioneer 10 & 11





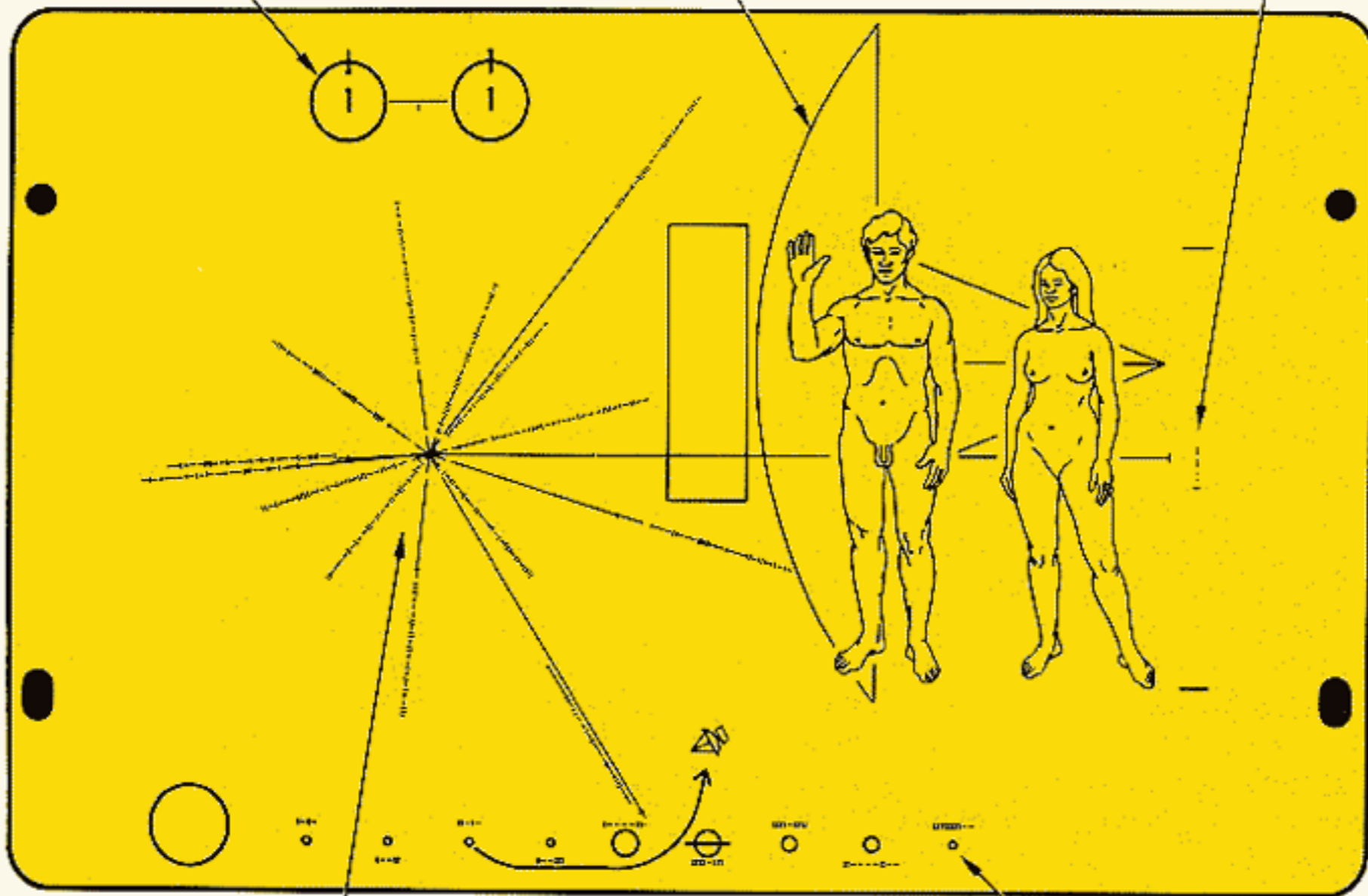




HYPERFINE TRANSITION OF
NEUTRAL HYDROGEN

SILHOUETTE OF
SPACECRAFT

BINARY EQUIVALENT
OF DECIMAL 8

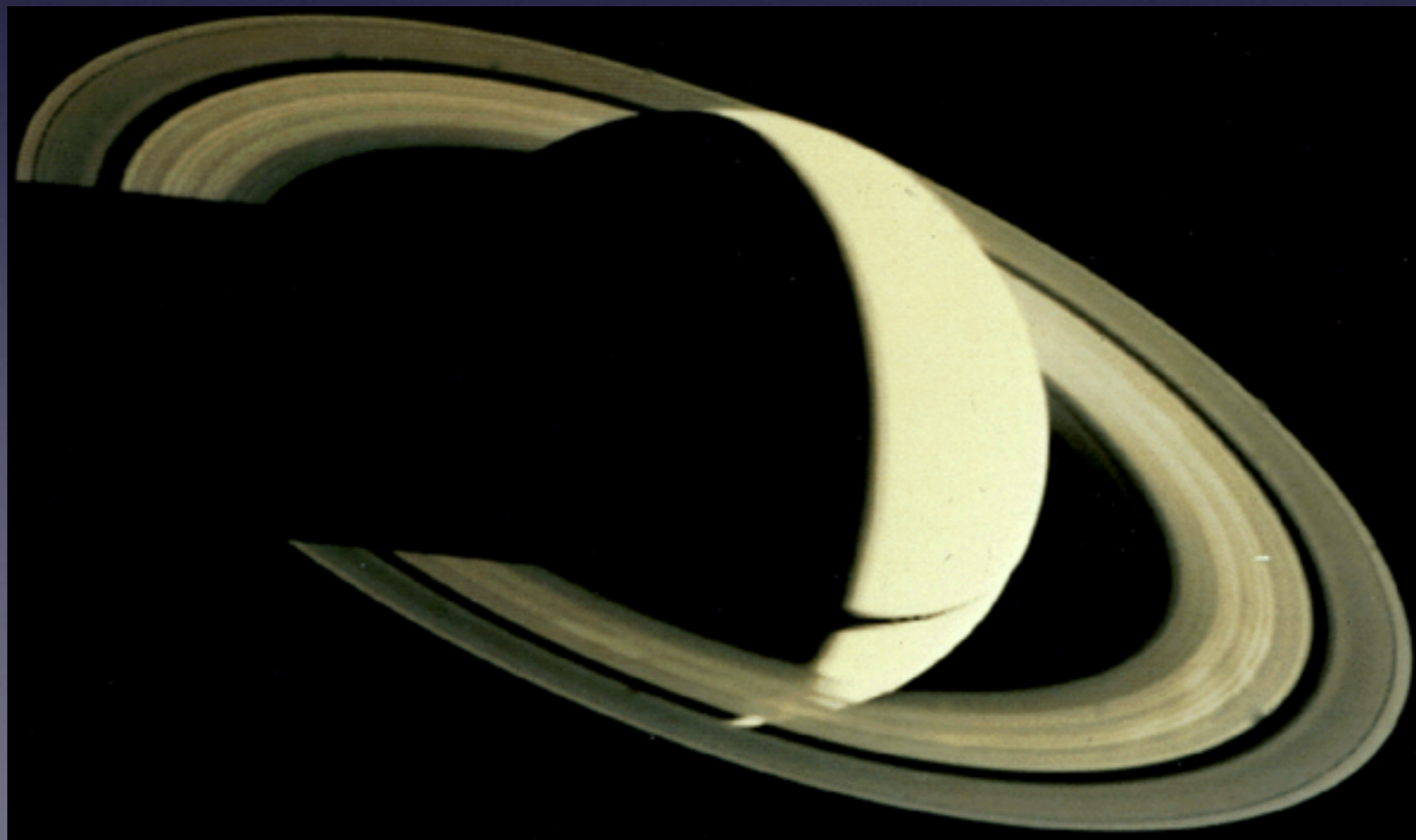
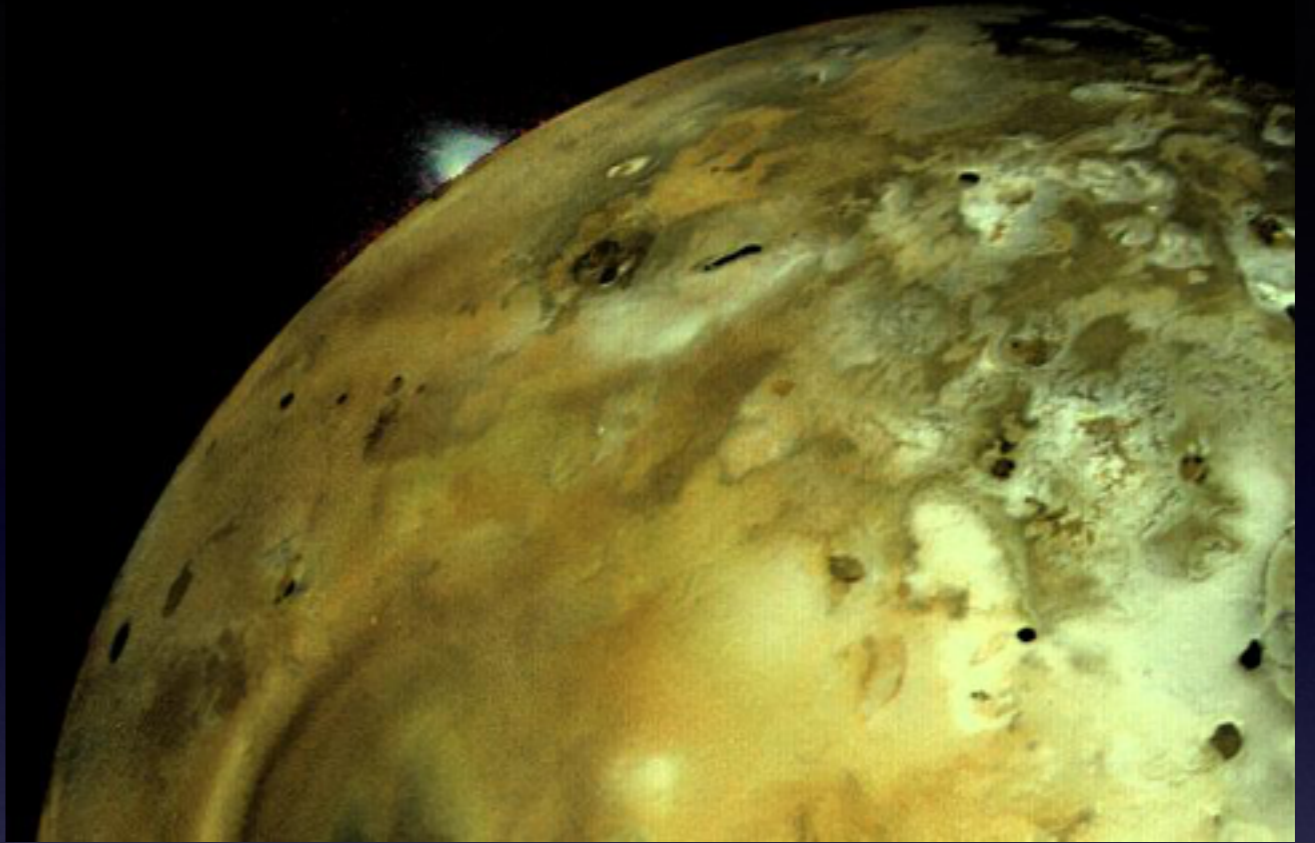


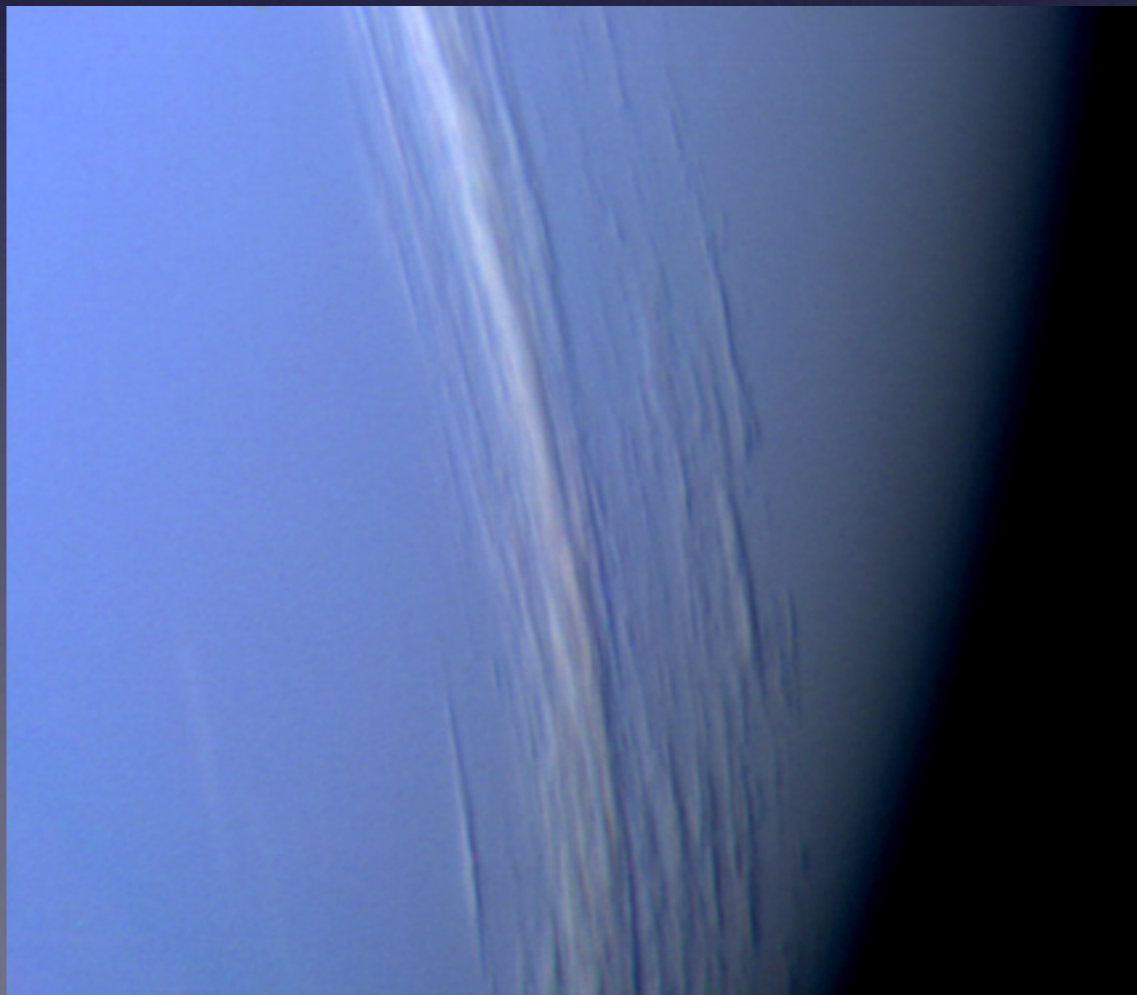
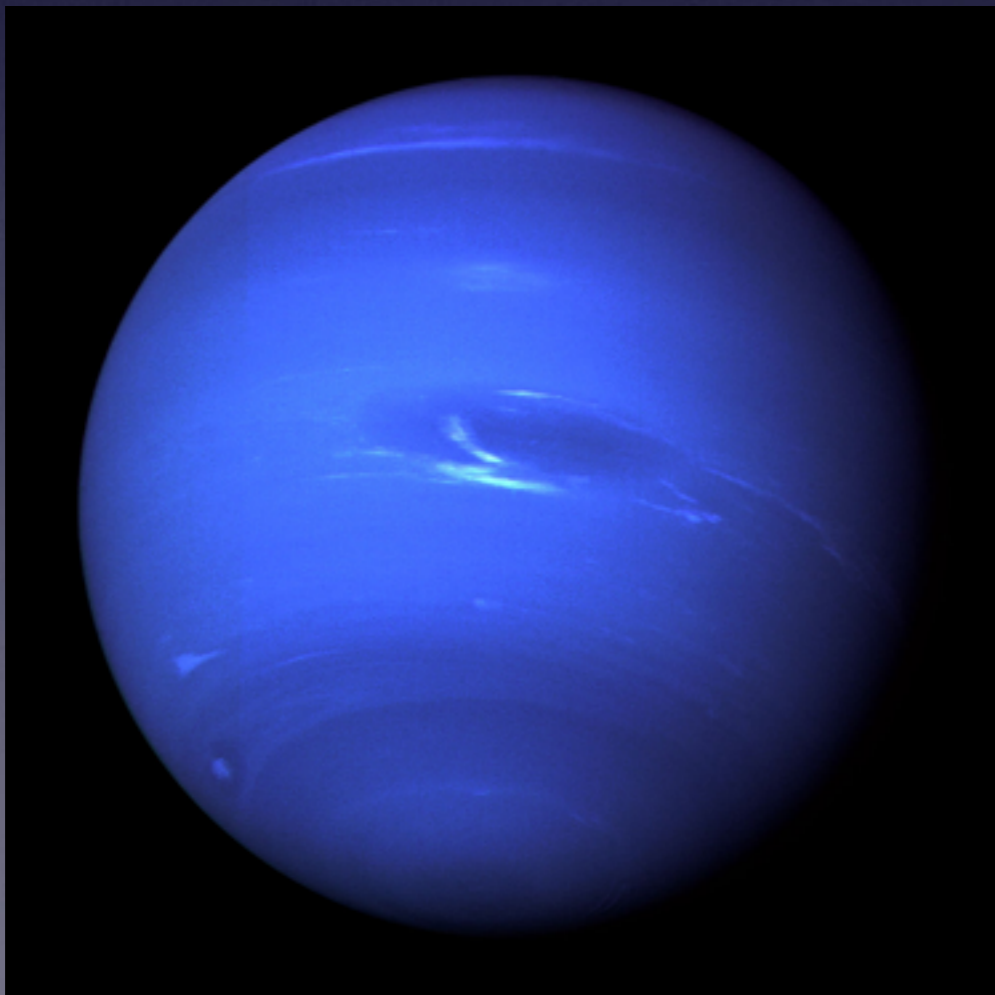
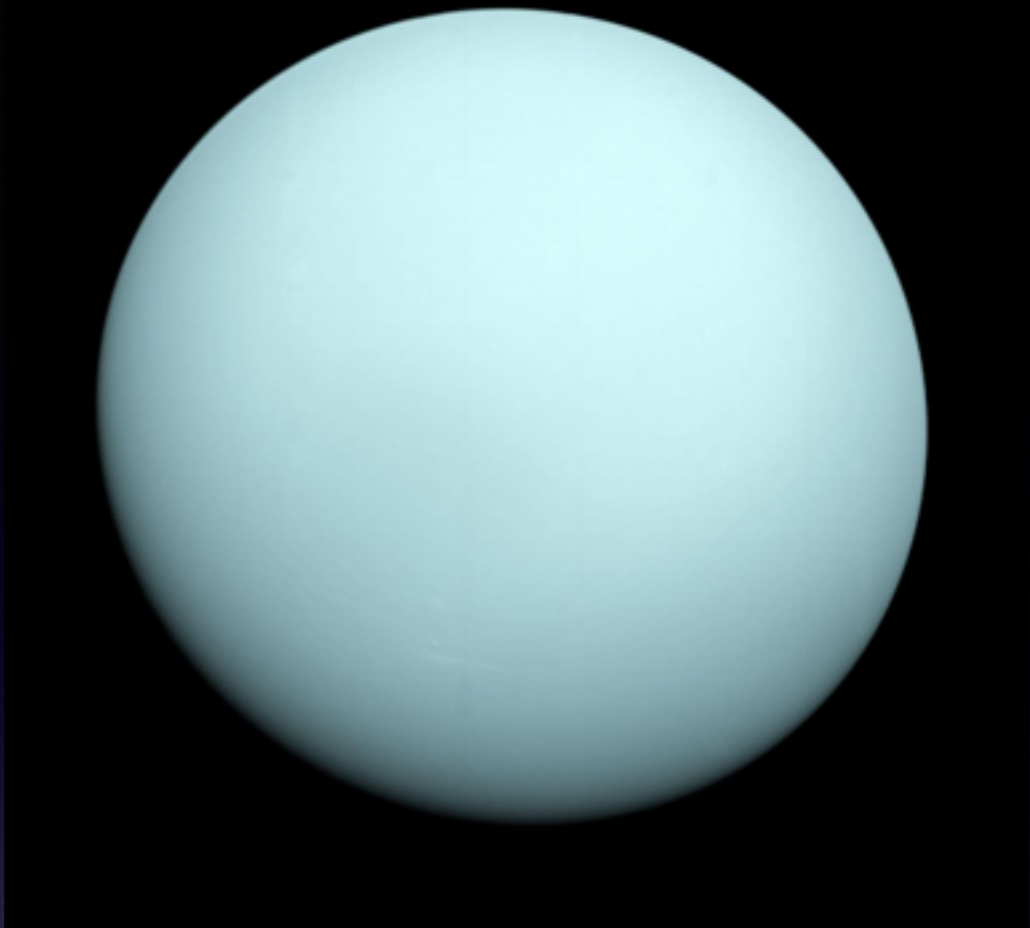
POSITION OF SUN
RELATIVE TO 14
PULSARS AND THE
CENTER OF THE GALAXY

PLANETS OF SOLAR
SYSTEM AND BINARY
RELATIVE DISTANCES

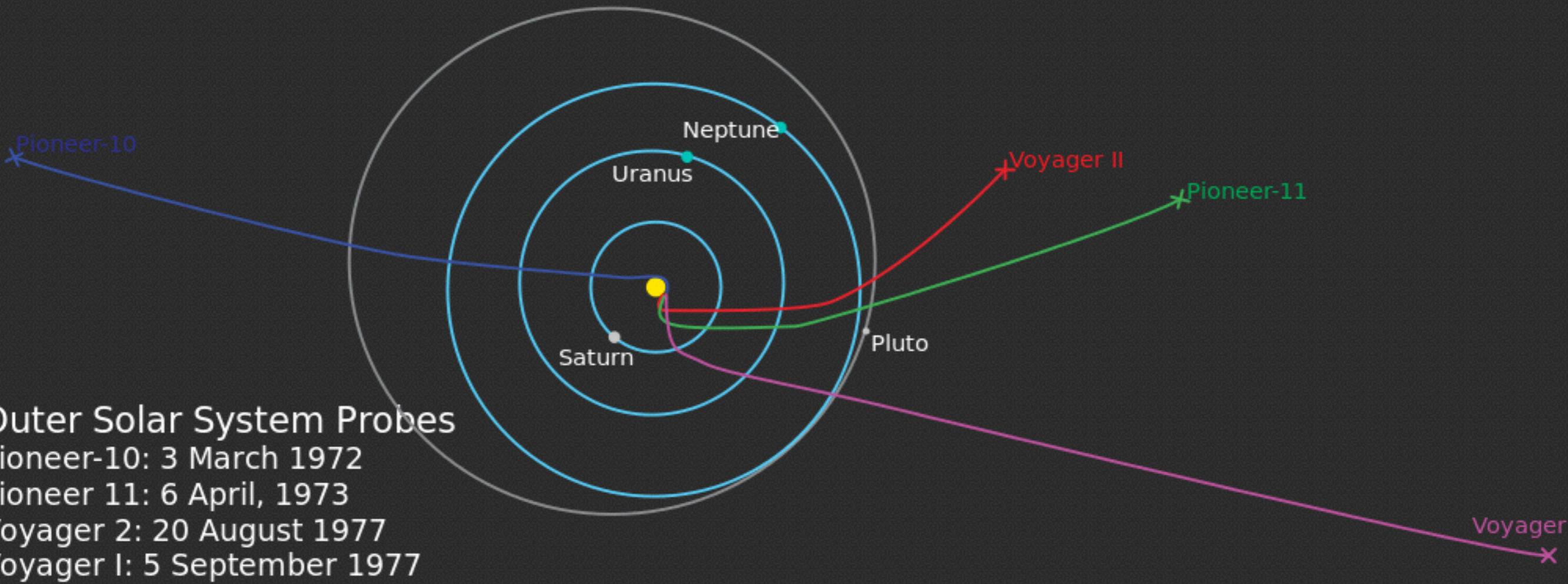
Voyager 1 & 2











Cassini



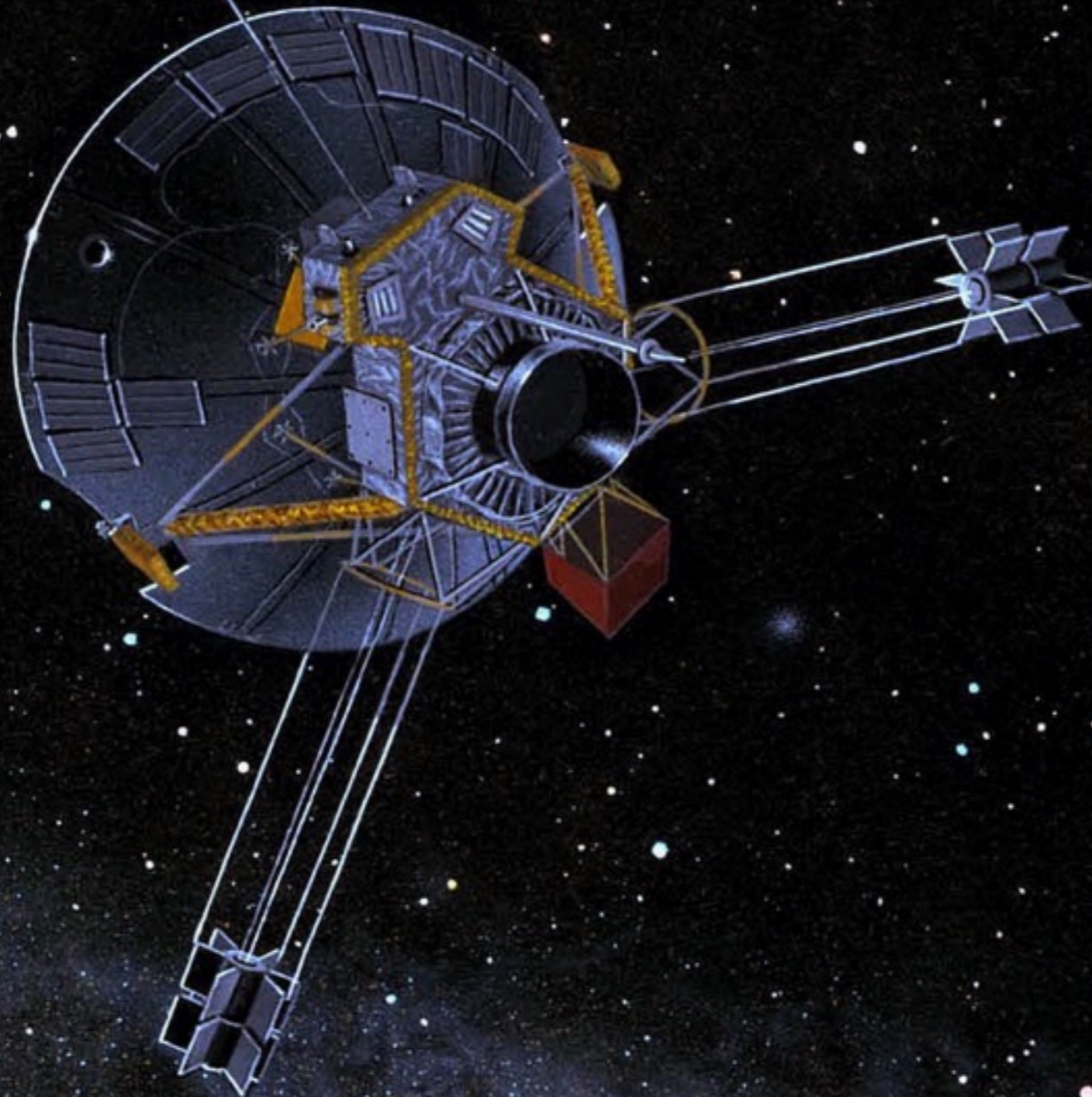


New Horizons





Pioneer 10 & 11



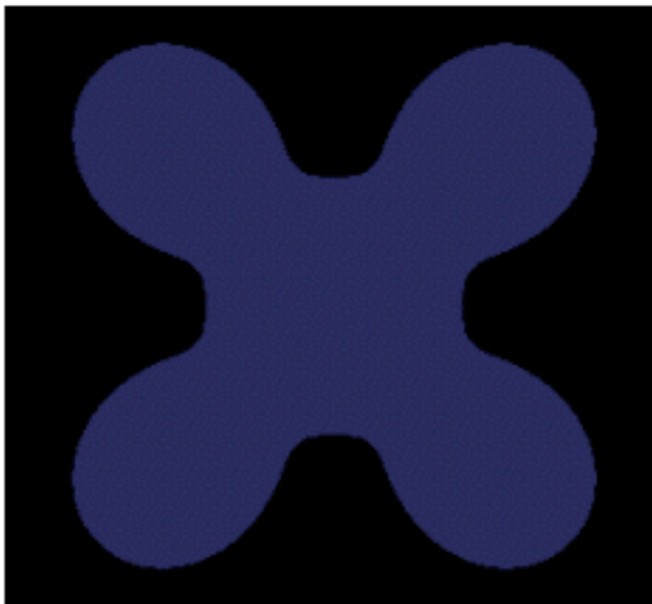
A Anomalia das Pioneer

Explicações?

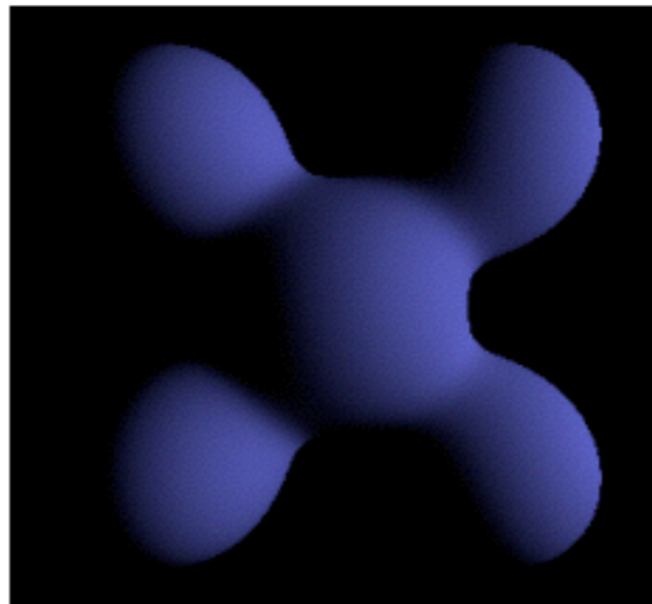


Modelo de Reflexão de Phong

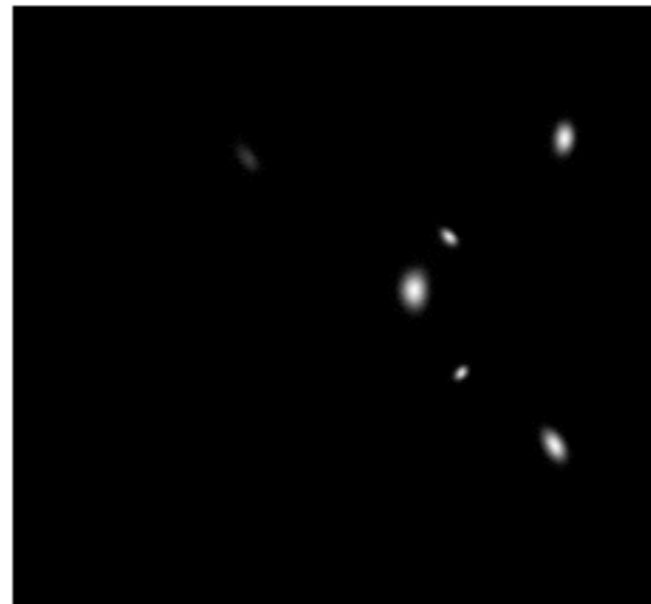
$$I_p = k_a i_a + \sum_{m \in \text{lights}} [k_d (\mathbf{l}_m \cdot \mathbf{n}) i_d + k_s (\mathbf{r}_m \cdot \mathbf{v})^\alpha i_s]$$



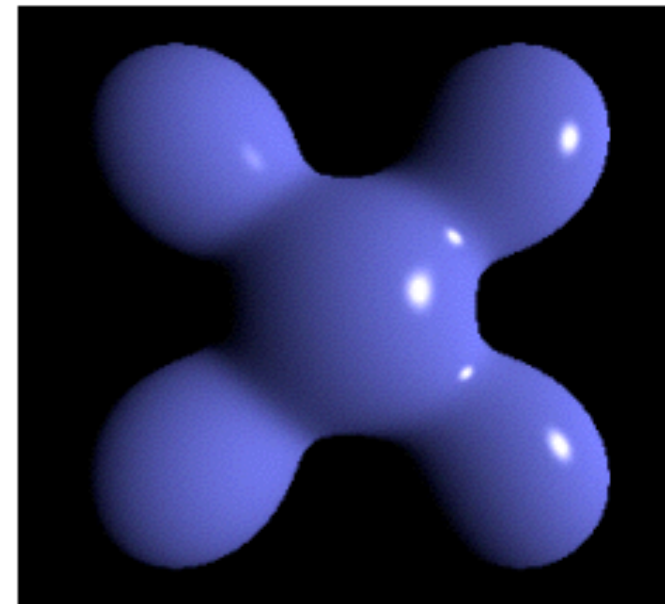
Ambient



Diffuse



Specular



Phong Reflection

+

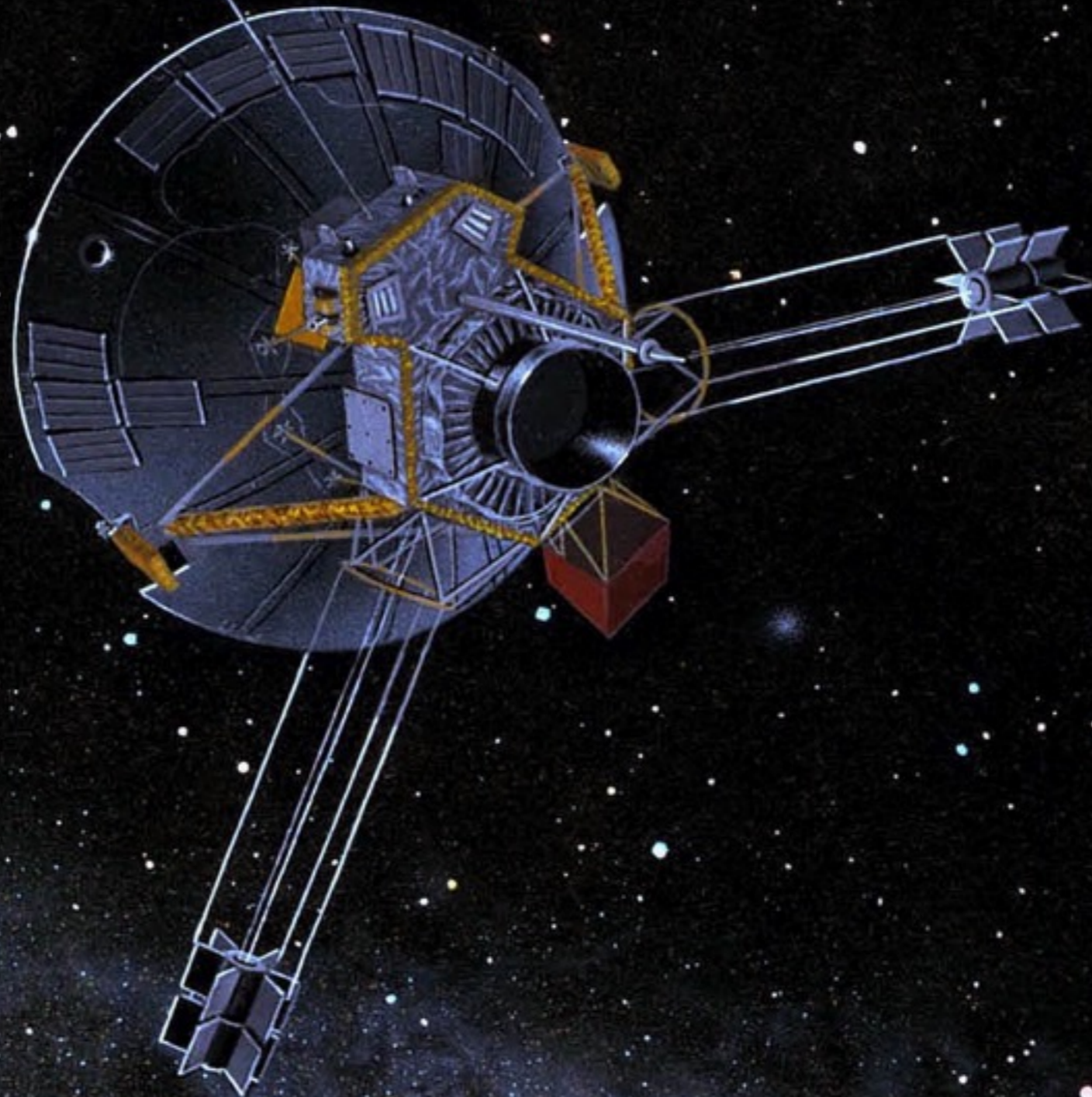
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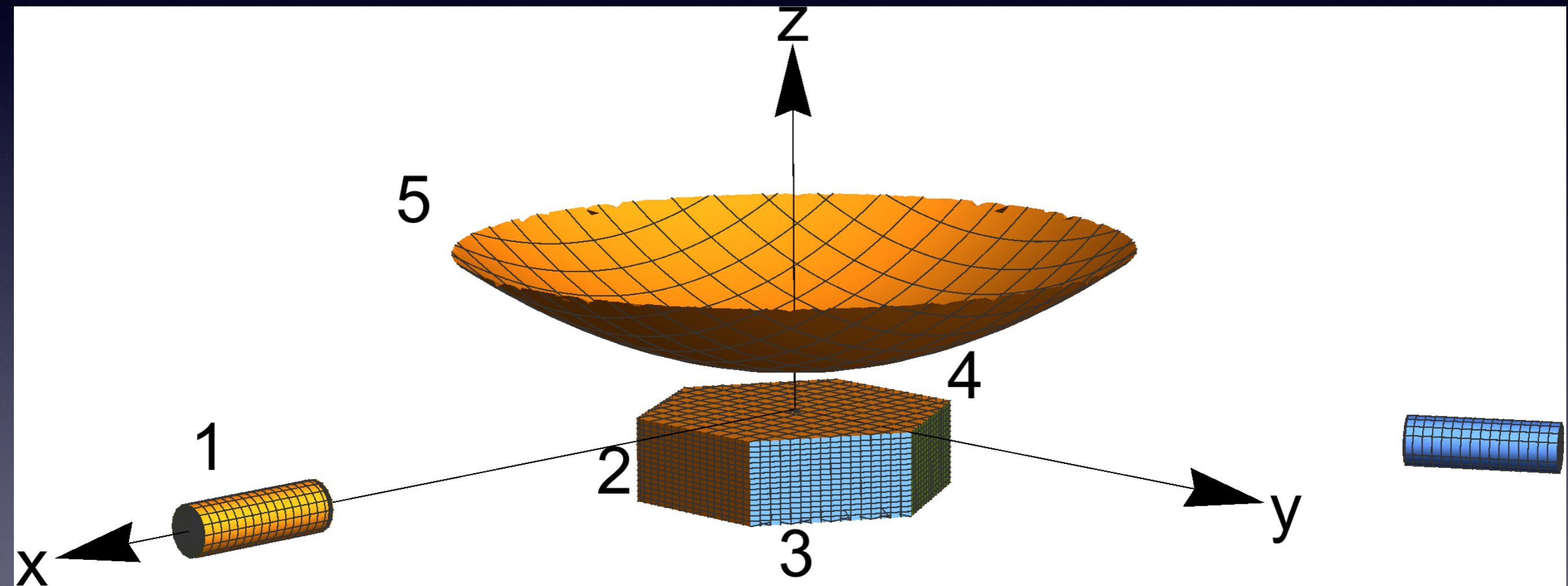


BMW M3 Coupé

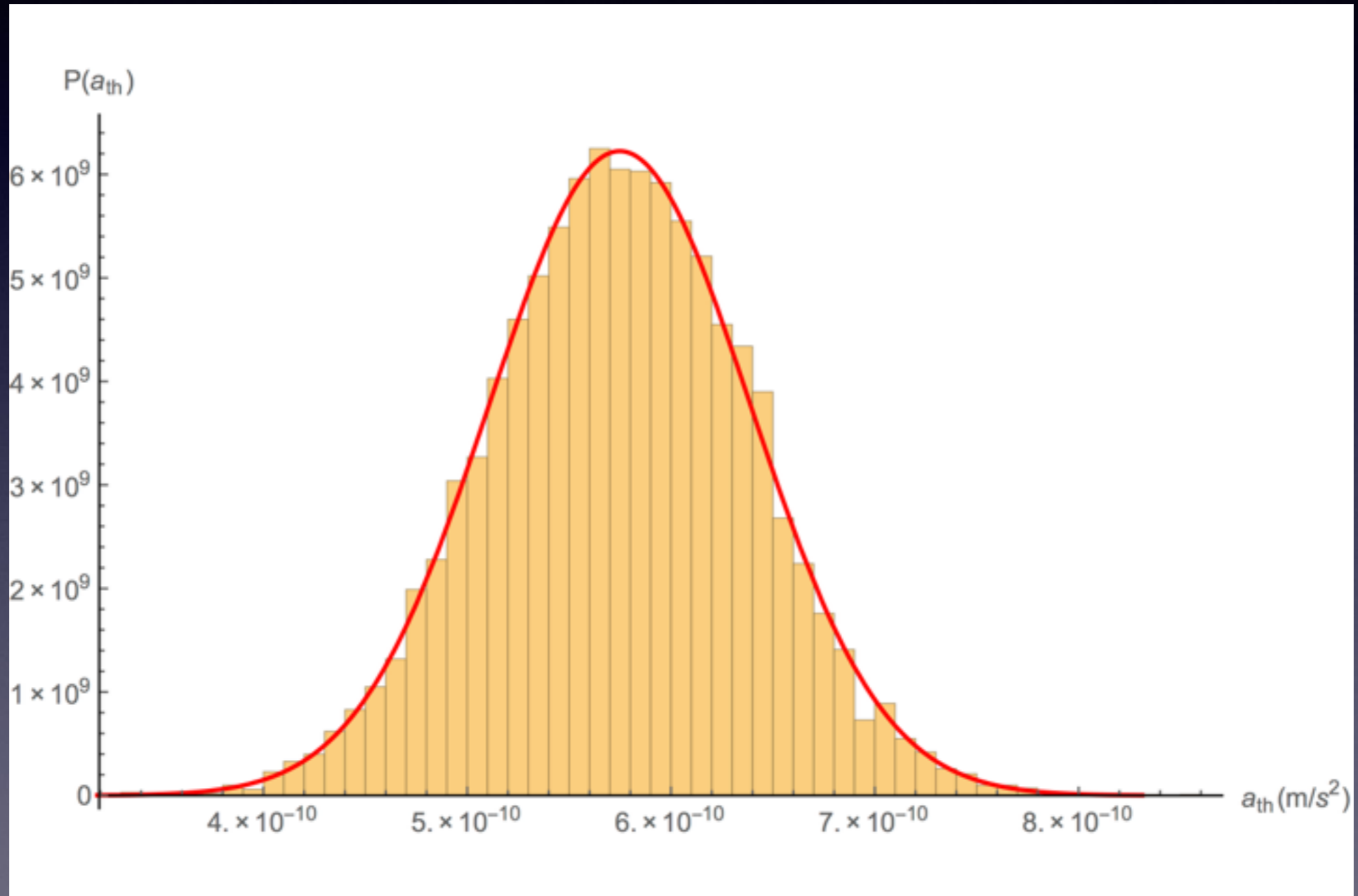
A Anomalia das Pioneer



Modelo Matemático

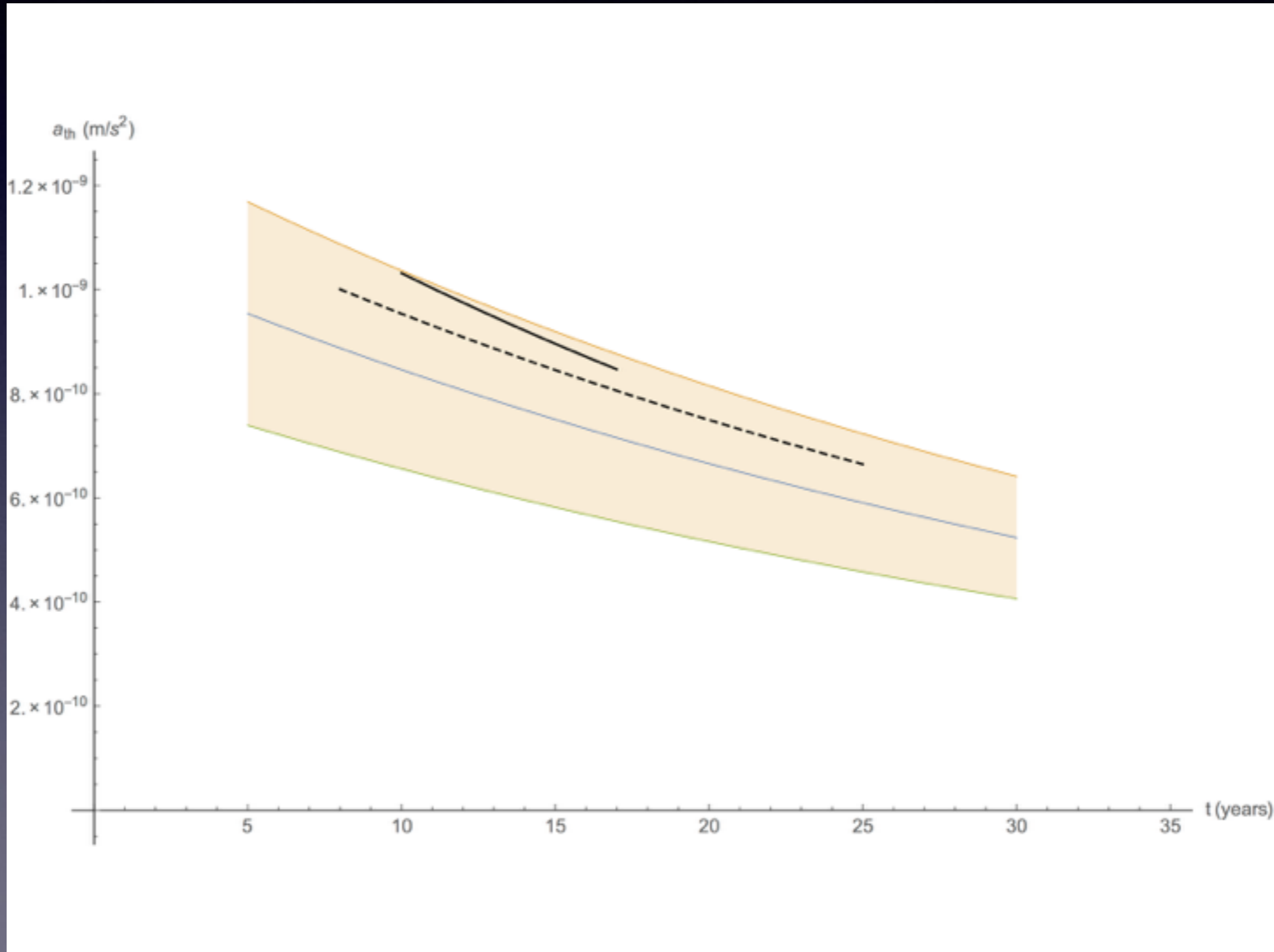


Método Estatístico



$$a_{th}(26) = (5,8 \pm 1,3) \times 10^{-10} \text{ m/s}^2$$

Assinatura Temporal



Anomalia da Cassini?



O que nós sabemos...