

# Nanophotonic structures for lightsails

Admission to first year  
cycle XXXV

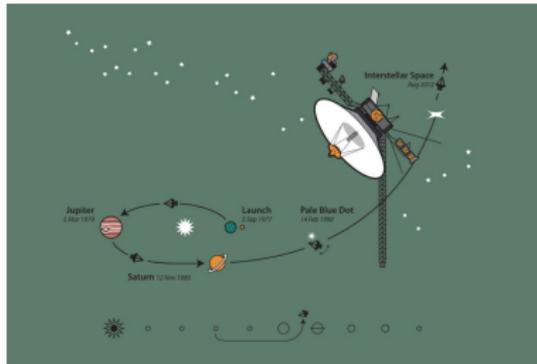
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# Introduction

Proposed by Kantrowitz in 1972, the idea of **photonic propulsion** is developing rapidly supported by an incredible technological improvement. The idea of interstellar explorations is not a dream any longer, but it requires a redefinition of the concepts of propulsion and spacecraft.



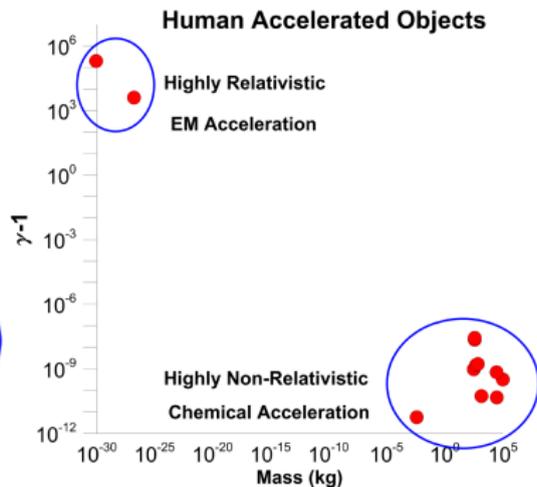
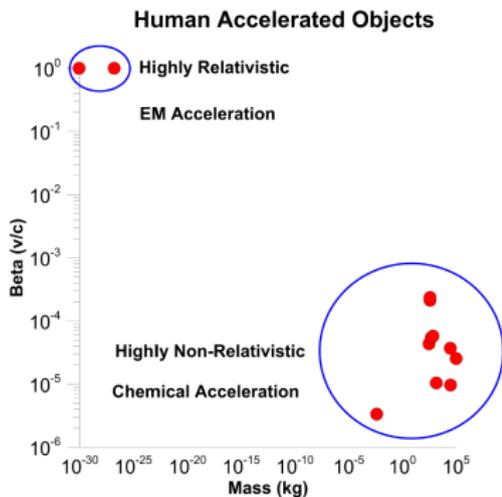
## Example (Voyager 1)

- launched in 1977
- left the solar system in 2012
- speed of 17 km/s  
( $\approx 0.006\%c$ )

⇒ Time needed to reach the nearest star is about 100.000 years

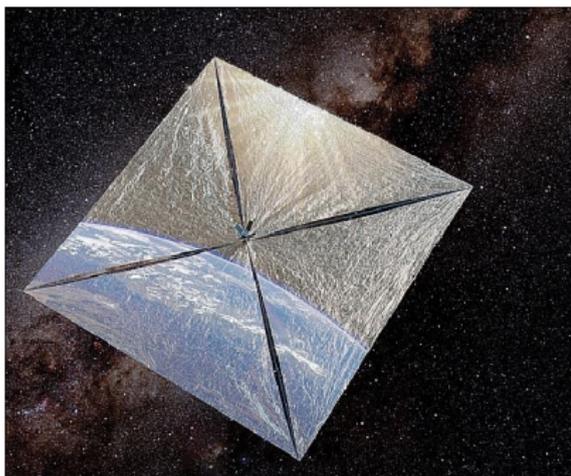
# Electromagnetic acceleration

There is a profound difference in what we have been able to do in accelerating objects via chemical or electromagnetic propulsion systems. This difference in speeds achieved is dramatically illustrated if we compare the beta ( $\beta = v/c$ ) and gamma ( $\gamma = 1/\sqrt{1 - \beta^2}$ ) factors achieved.



# Sate of the art

Current research is pushing toward the realization of a gram-scale spacecraft, named **nanocraft**, to be accelerated through laser propulsion to a speed of approximately  $0.2c$ .



## Design parameters:

- Lightsail
- Propulsion System
- Payload

# PHD project

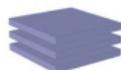
The final goal of this project is to design and characterize a lightsail prototype for photonic propulsion. Main objectives are:

## Objectives

- 1 Material selection
- 2 Production and test of lightsail samples
  - one dimensional (1D) structure
  - two/three dimensional (2/3D) structure
- 3 Laboratory test



Single slab



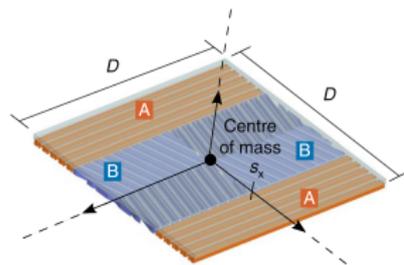
Multilayer stack



PhC pillar slab



PhC hole slab



# Design and Methods

## Research Design

### ⇒ Bibliographic Research

- International Papers

### ⇒ Materials selection and numeric simulations

- optical constants, absorption coefficients, mass density
- TFCalc software (1D)
- COMSOL/CST software (2D/3D)

### ⇒ Fabrication and characterization

- At CNR institute or other companies
- Spectrum response (Ellipsometer, Cary 5000, Cary 630 FTIR)
- Morphological aspects (SEM, TEM, FEM, XRD)

### ⇒ Laboratory test (to be discussed)



Thanks for your attention!  
Any question?