UNIVERSIDAD SERGIO ARBOLEDA

Antennas & Attitude Control of Libertad I.

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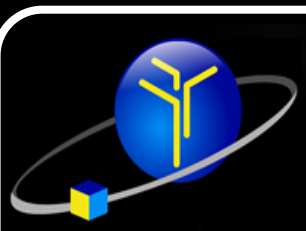
ASTRONOMICAL OBSERVATORY
SCHOOL OF ENGINEERING

4th annual CubeSat
Developers Workshop
The Boeing Company
Huntington Beach, CA.



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Objectives:

- Educational purpose.
- Transmit telemetric data.
- Test subsystems such as:
  Operating system.
  Energy supply.
  Attitude control.
  Antenna deployment.

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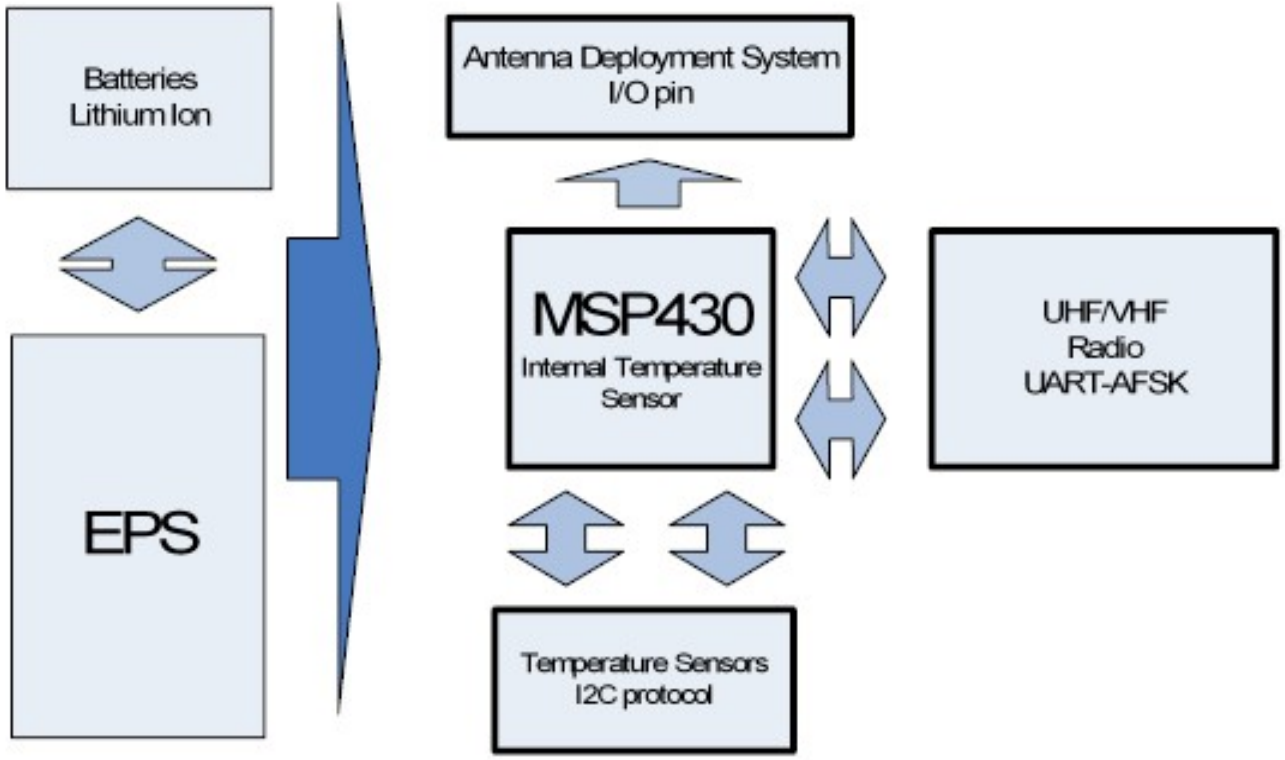
LIBERTAD I HARDWARE FEATURES

PC104 FORM FACTOR



Criteria and considerations

- Type of information.
- Uplink frequency: VHF downlink UHF
- 700 Km (LEO)
- CubeSat restrictions (P-Pod)
- Directivity

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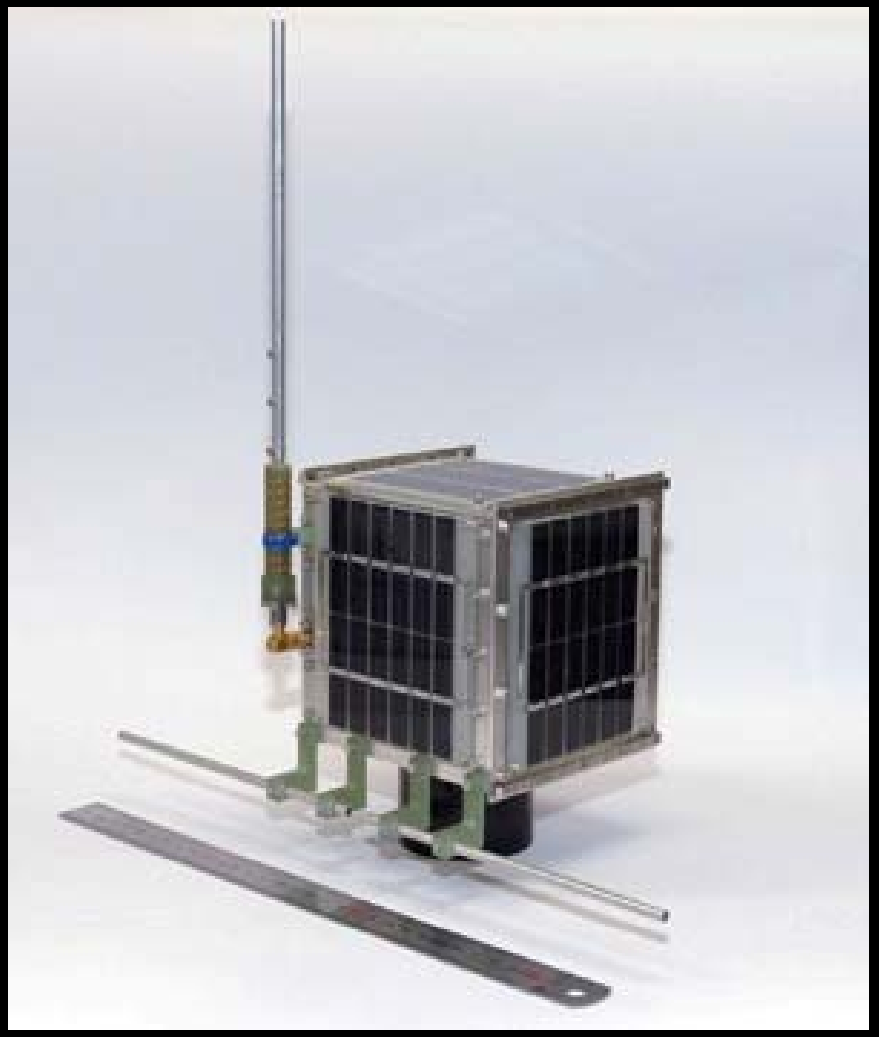
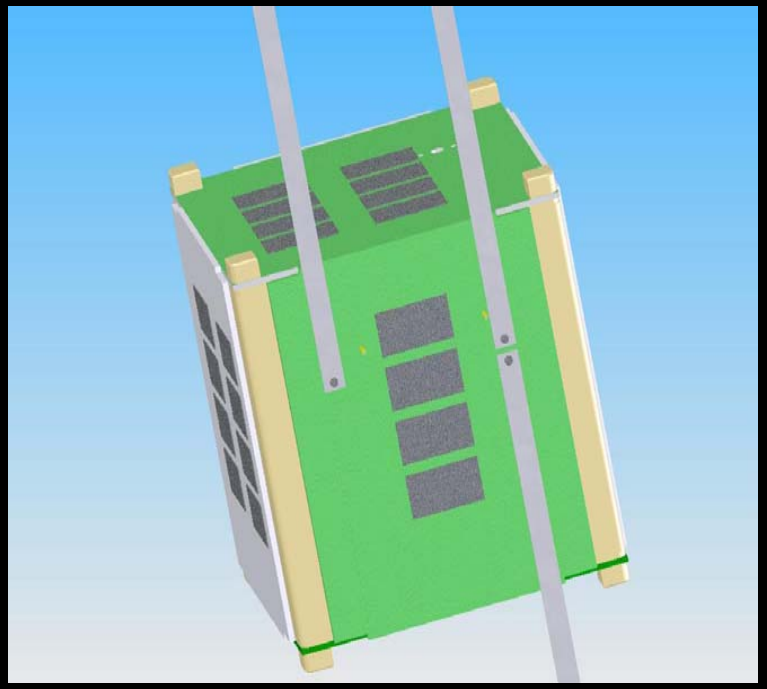
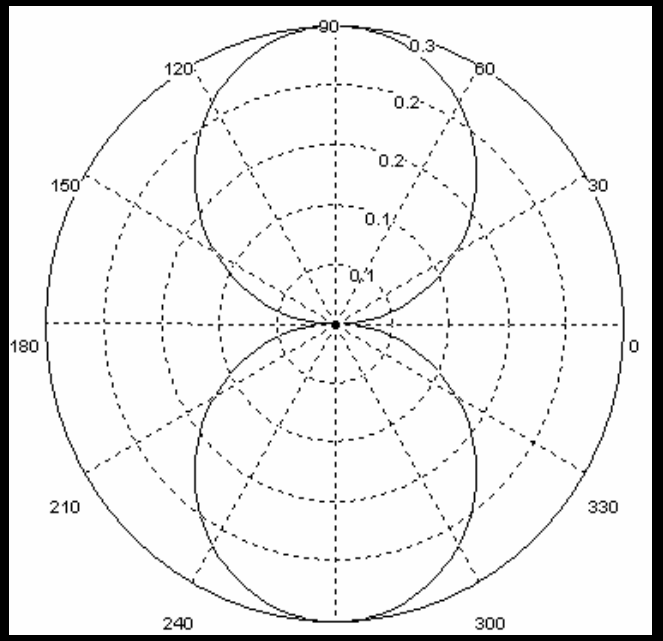


Hitsat

Alternatives





TX dipole
Rx monopole

Dipole vs Monopole

$I_{(0)M} = I_{(0)D}$ Current distribution

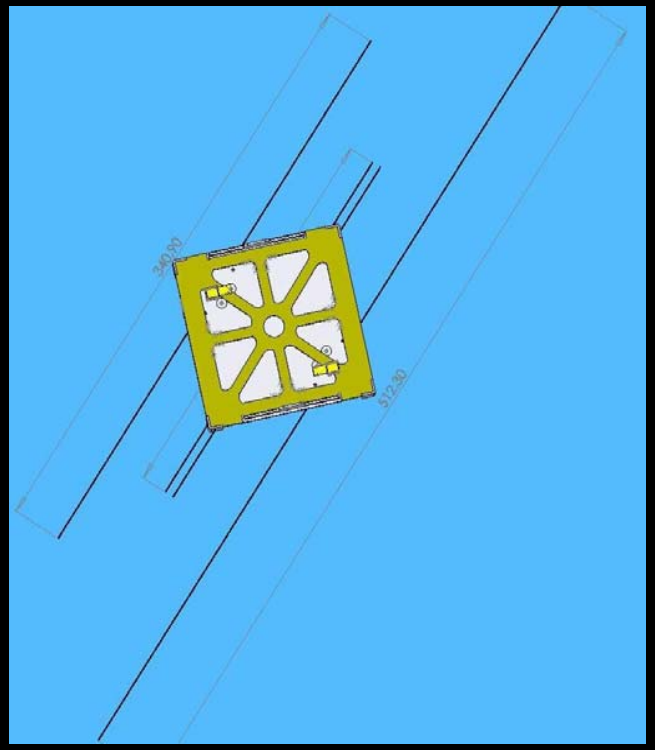
$P_{rM} = ½ P_{rD}$ Power of an adapted charge

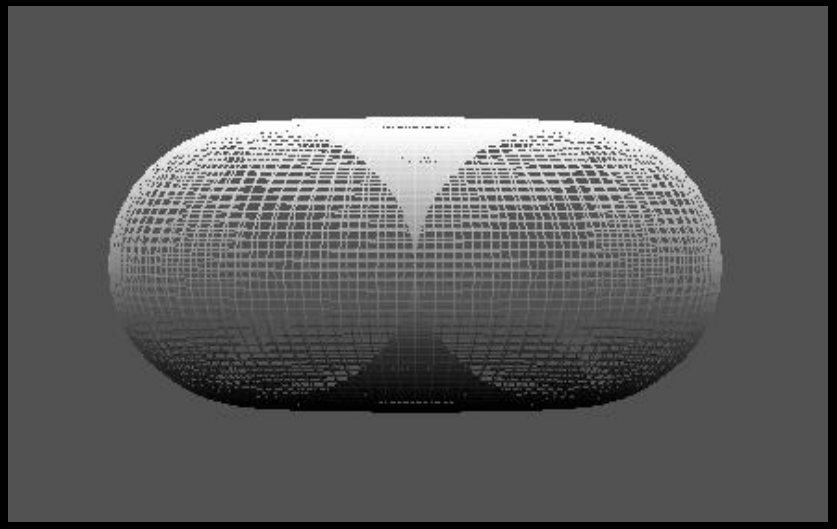
$D_M = 2D_D$ Directivity

$V_M = ½ V_D$

$A_{efM} = ½ A_{efD}$ Effective area

Alternatives





TX dipole
Rx dipole

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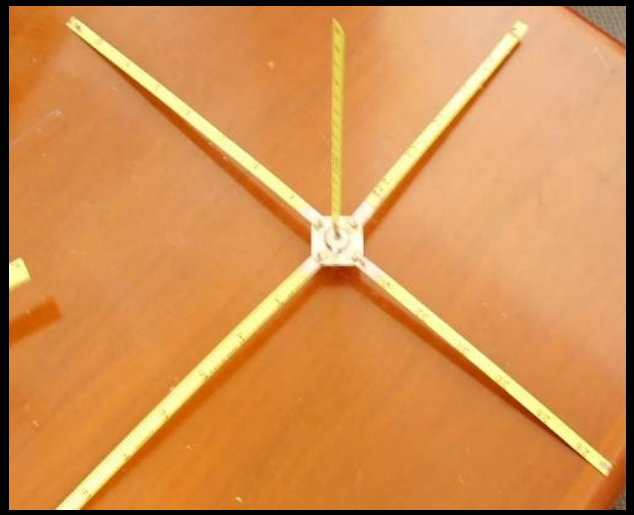
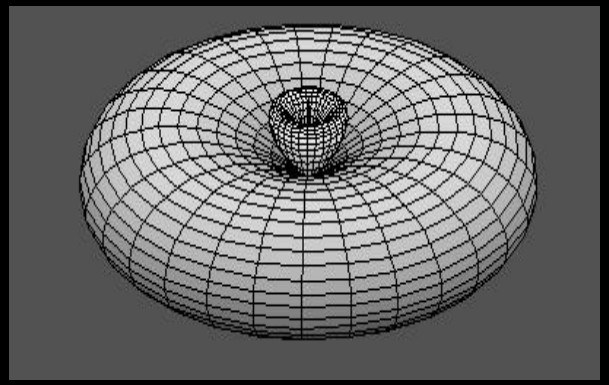
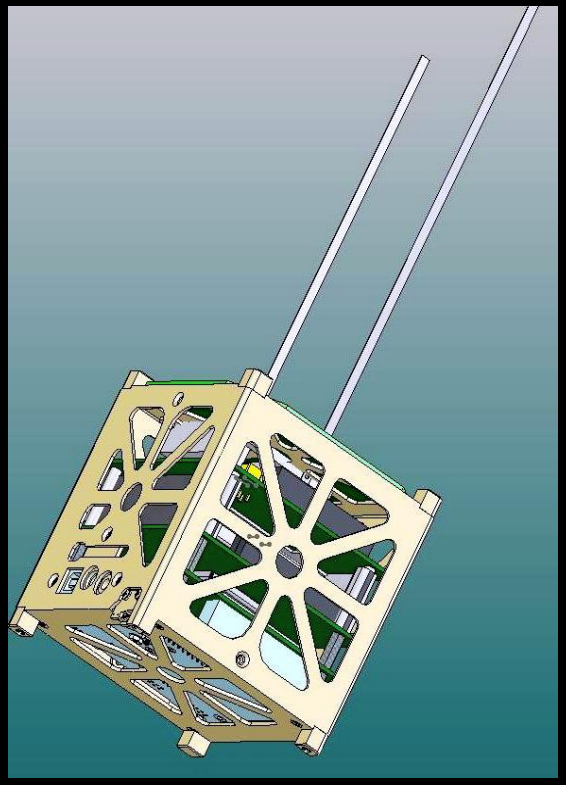
Antennas II

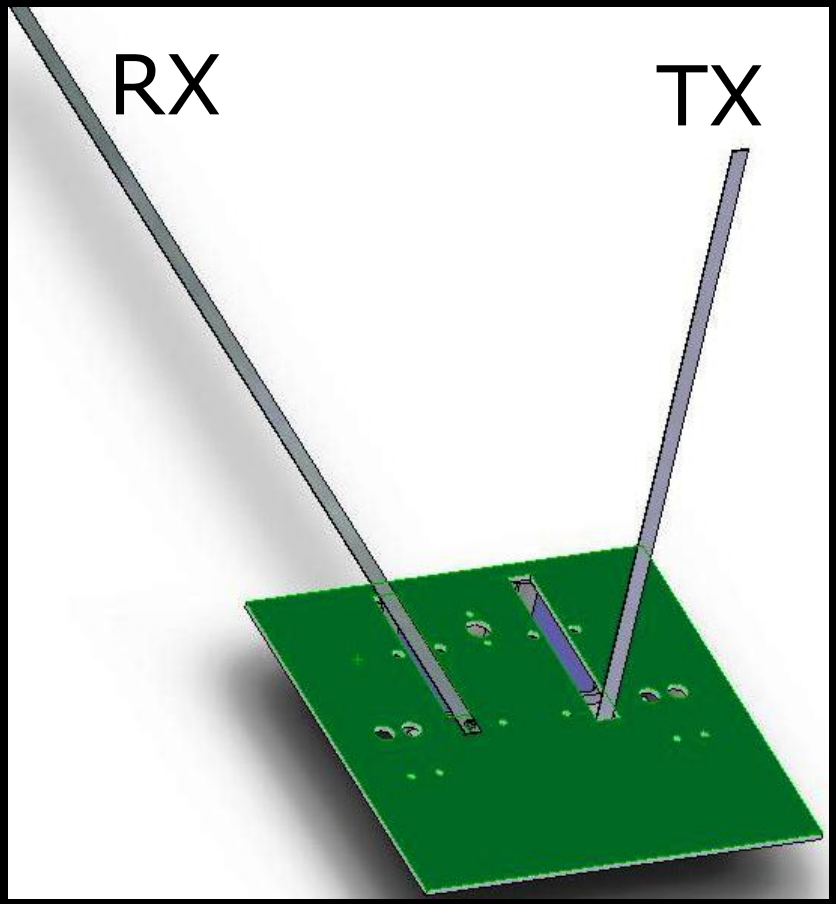
Alternatives

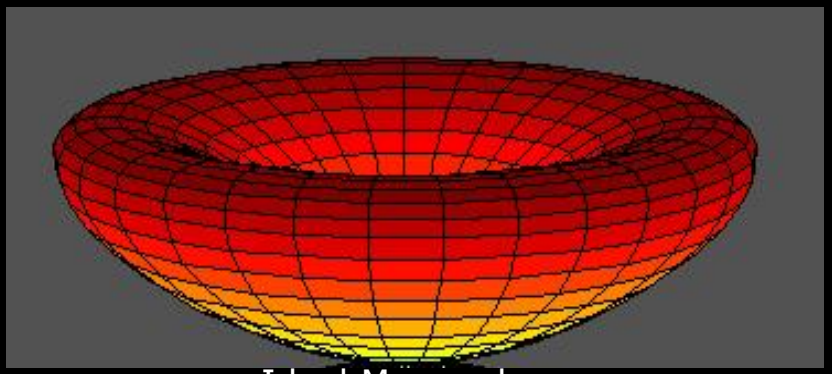




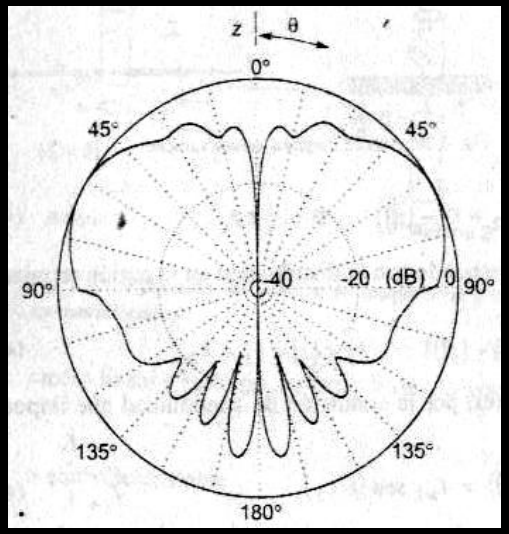


Alternatives





Ideal Monopole



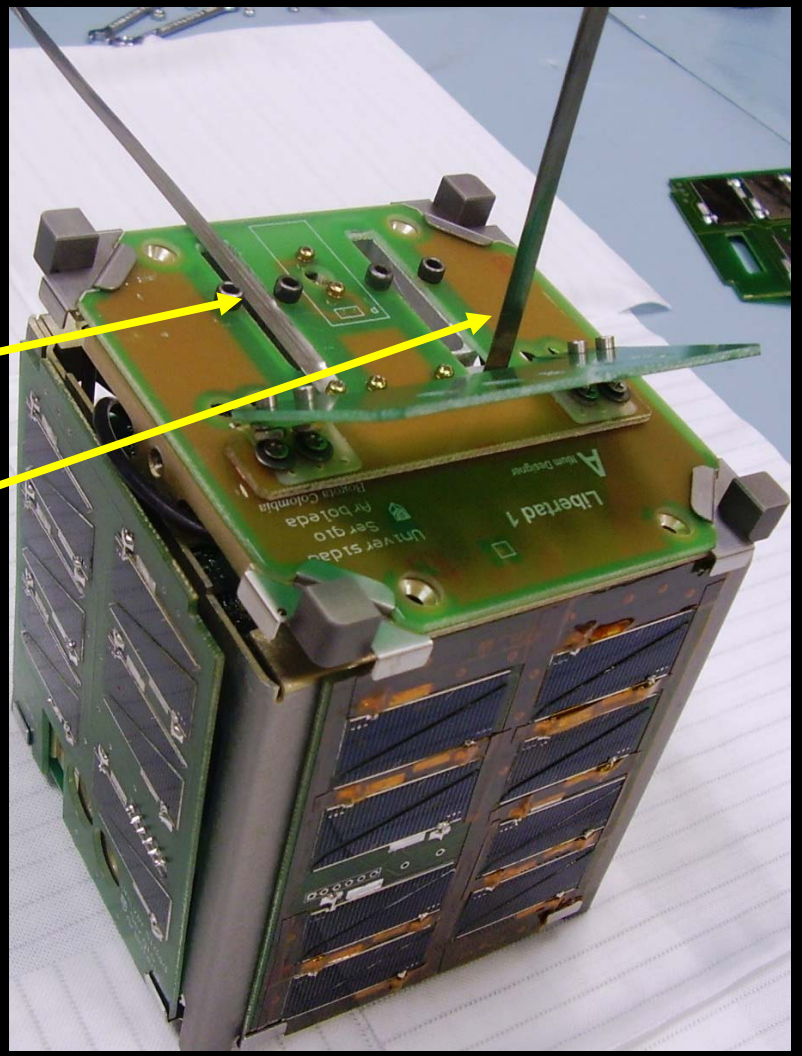
Monopole with a finite ground plane

Alternatives

90° out of phase monopole

Rx monopole 1/8λ

Tx monopole 1/8λ



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Antennas III

Ground Station

UHF: **Yagui 30 elements**

Rotor: **Yaesu G5500**

VHF: **yagui 14 elements**

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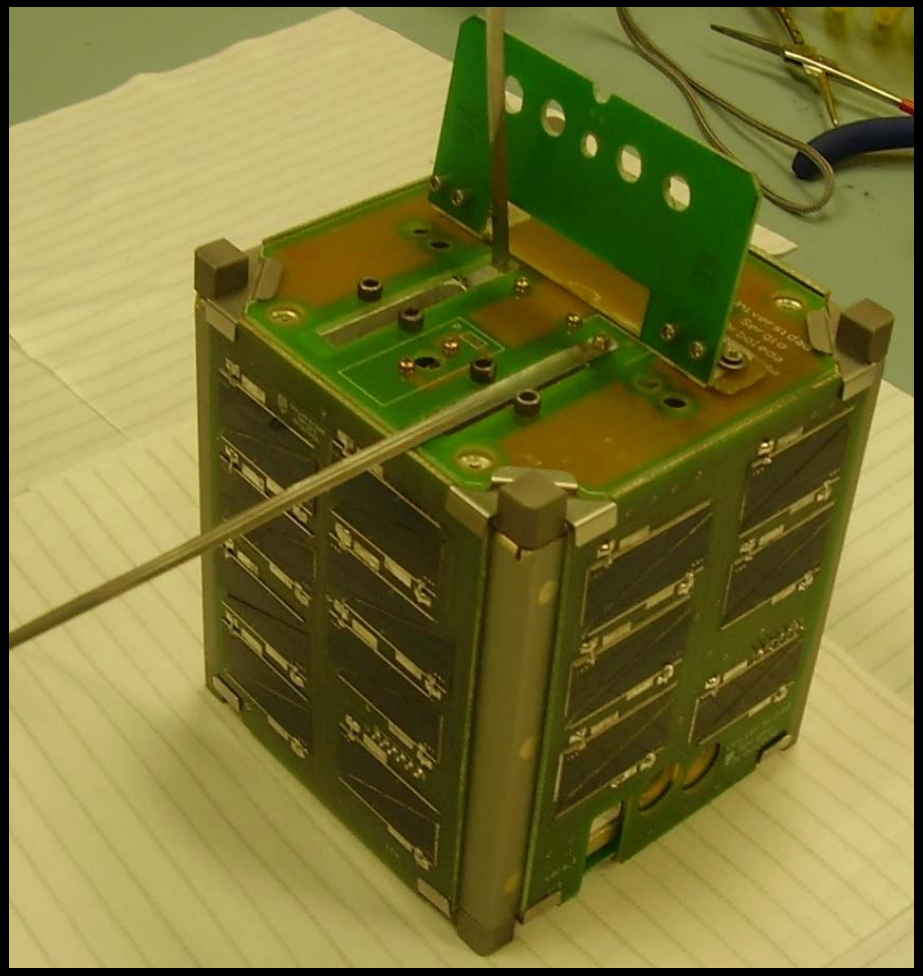
Deployment I

Criteria and considerations

- Simple and Robust.
- Safe for us and other CubeSats
- Energy Restrictions
- Reliable



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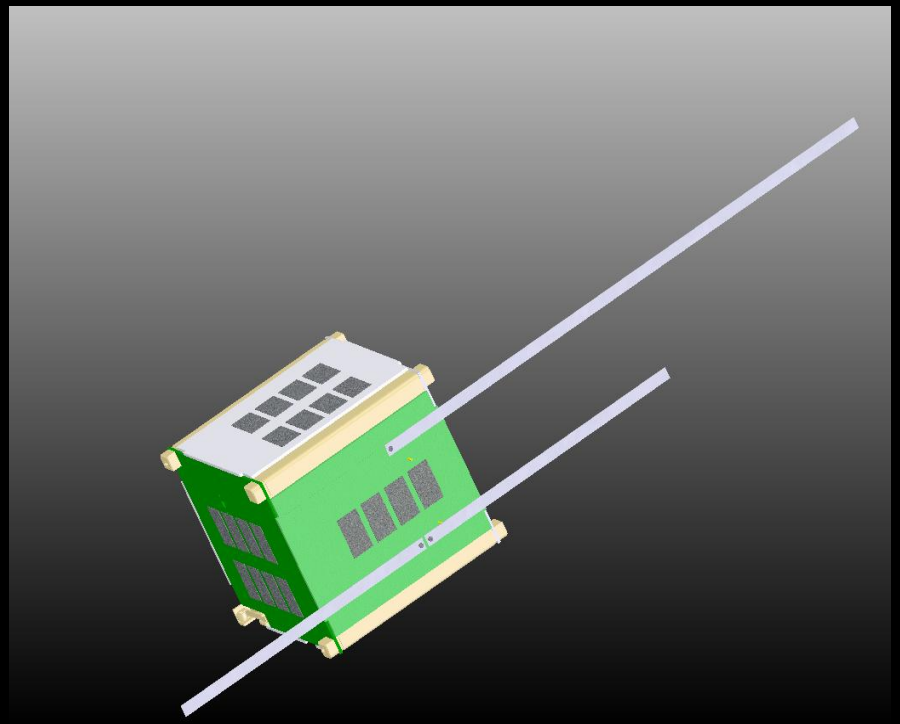
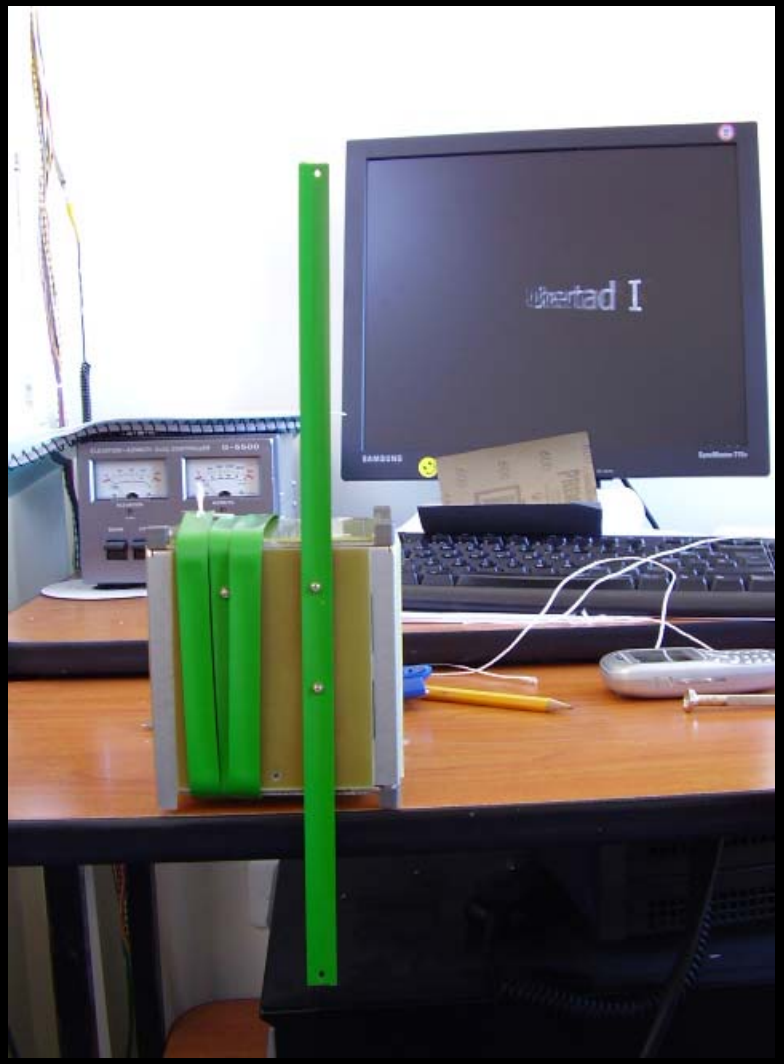
Deployment II

Alternatives





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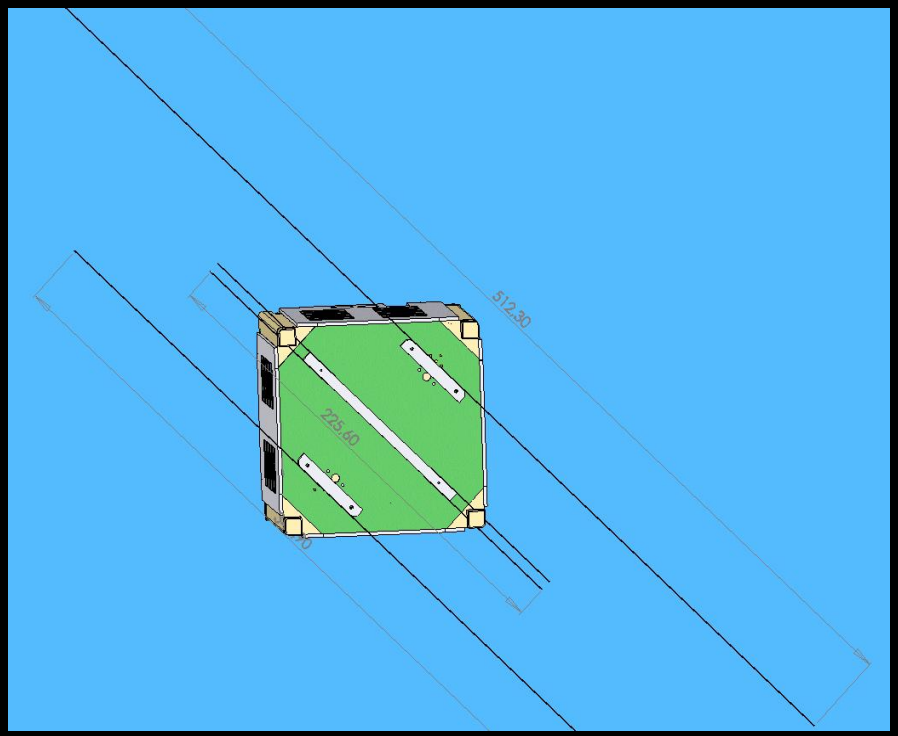

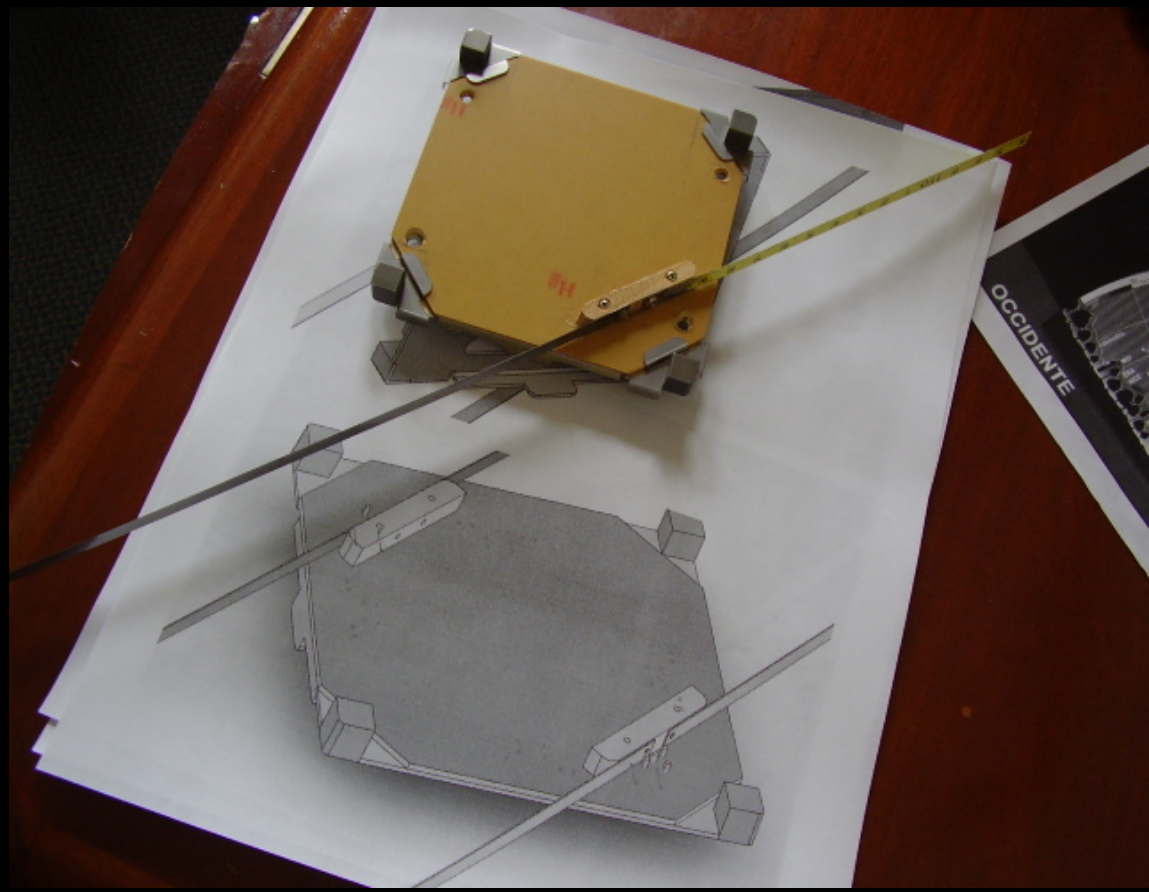

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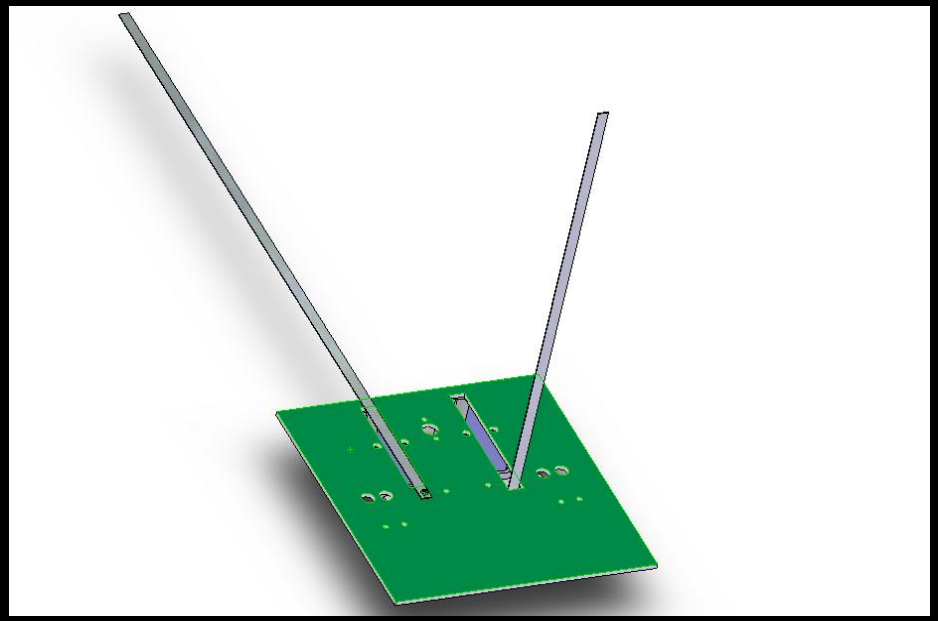
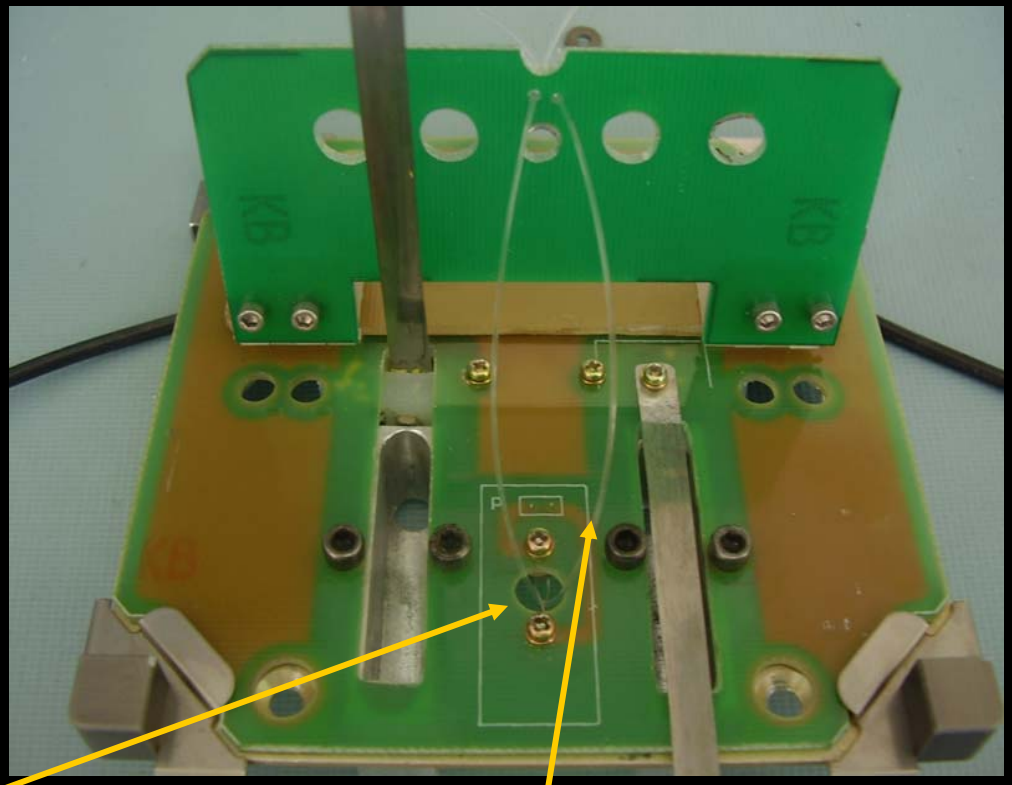




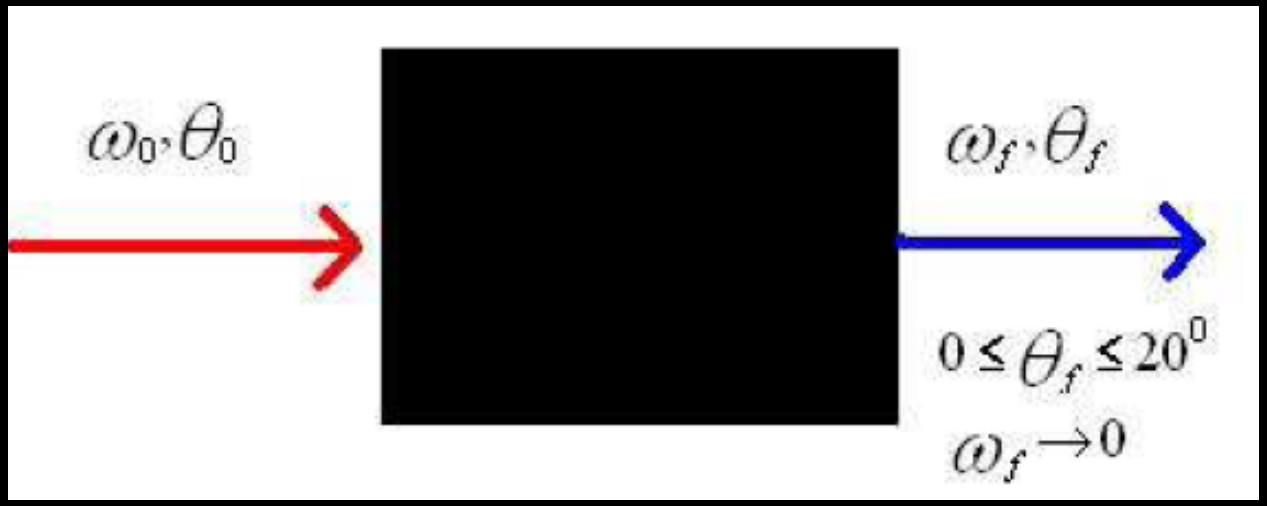
Iron-nickel

Fishing Line

Orientation I

Justification

- Antenna must be oriented because it is not omni directional. It must be "tangential" to the earth surface.

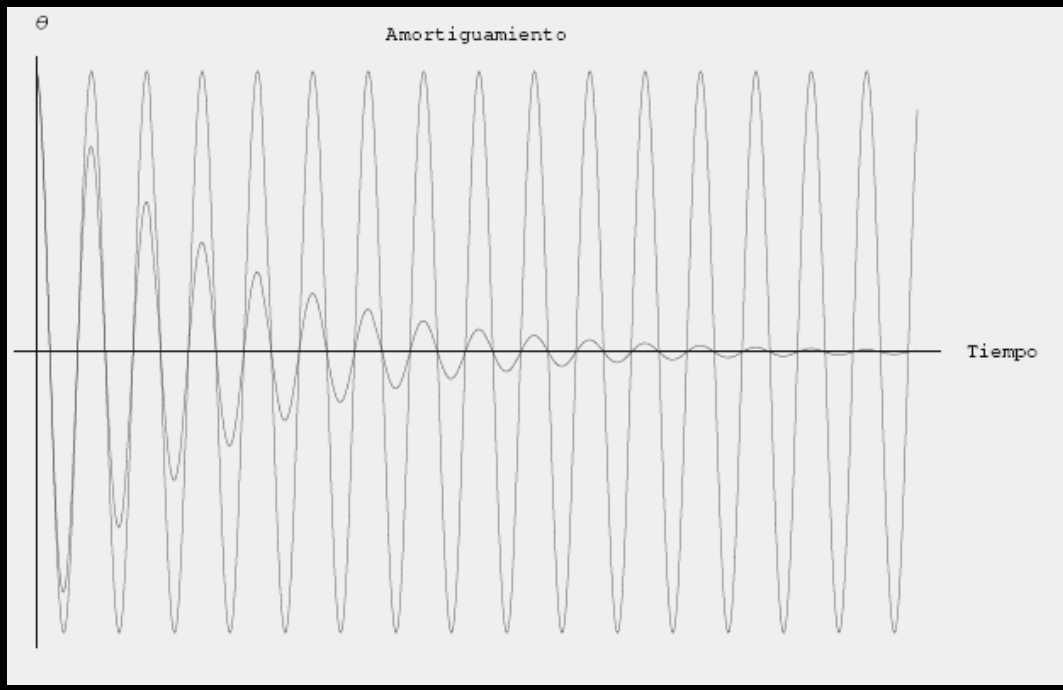


Alternatives

- Active control system.
- Gravitational gradient.
- Use of a magnet.
- Magnet & Hysteresis rods

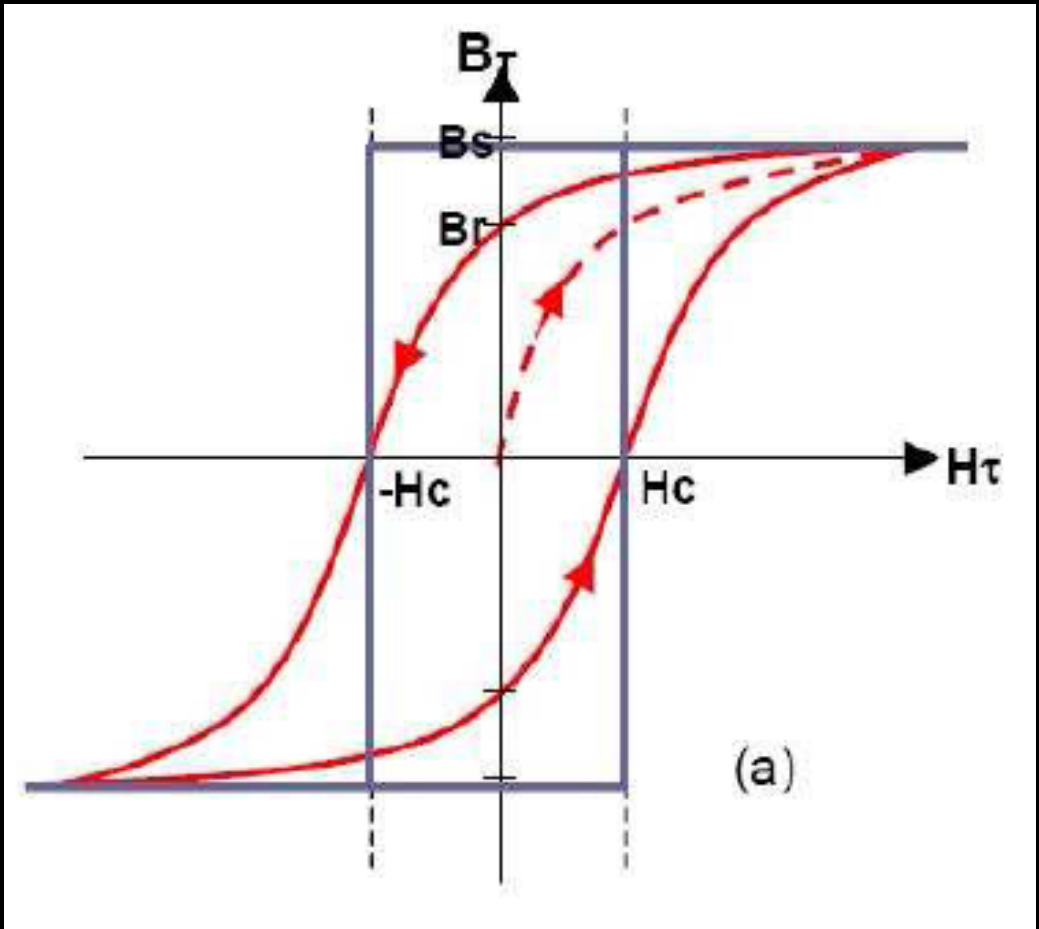
Alternatives

- Active control system.
  Energy restrictions.
- Gravitational gradient.
  Dimensions too small.
- Use of a magnet.
  No dissipative force.
- Magnet & Hysteresis rods



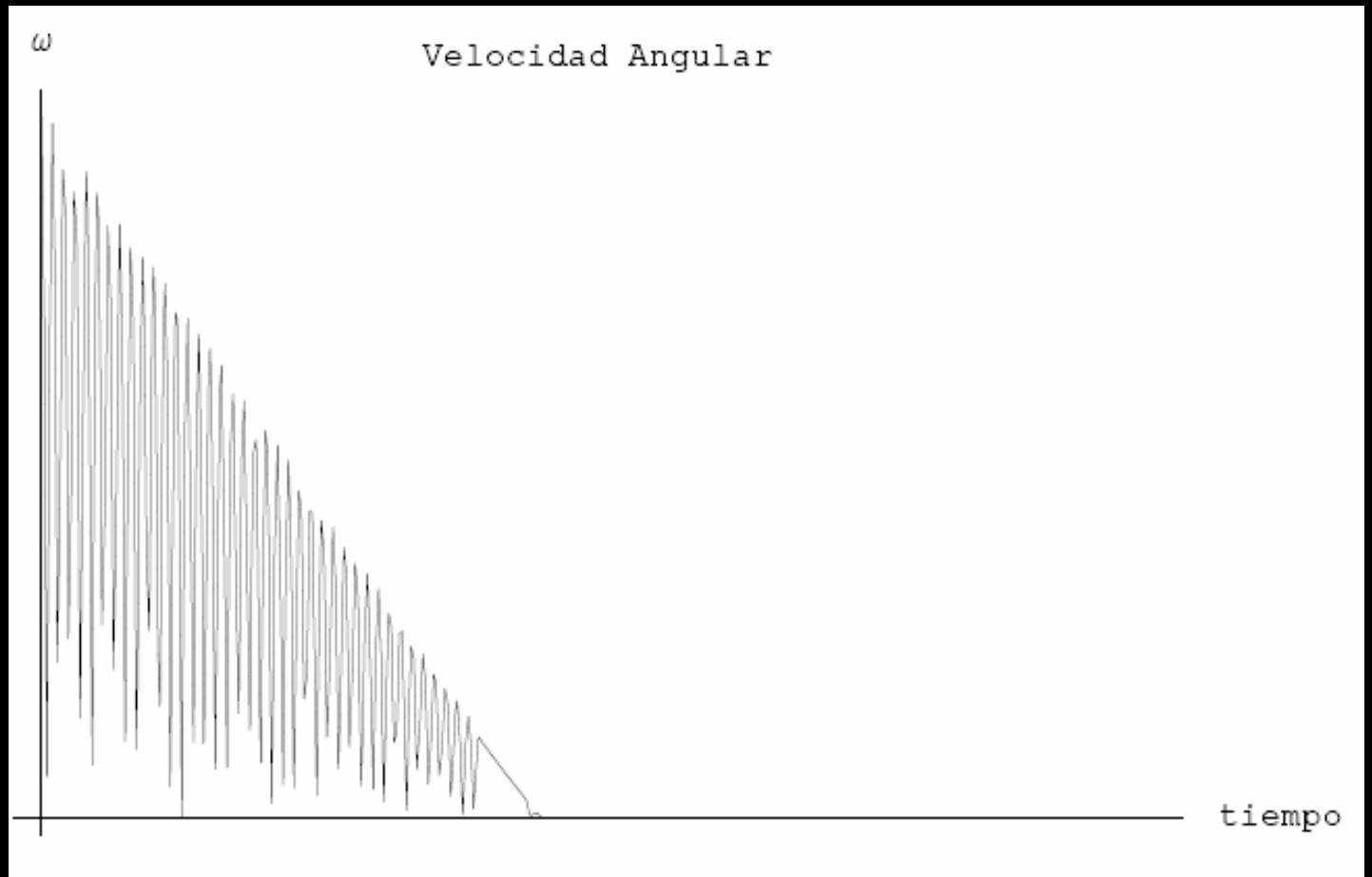
Hysteresis

- Phenomenon related to the magnetic memory of certain materials.
- Molecular “friction” acts as an energy dissipater.
- Hysteresis rods can act as rotation dampers



Result

Explicit solution for the damping time as a function of the initial angular velocity and the amount of hysteresis material.



Final remarks:

- Produced a "ground-working" satellite.
- Made small innovations in each subsystem.
- "Everything" is a payload.

"In theory, theory and practice are the same. In practice they are not."
A. Einstein

TEAM:

- Raúl Joya.
- Iván Luna.
- César Valero.
- Andrés Alfonso.
- Paul Nuñez.
- Miguel Ariza.
- Liza Pinzón.
- Josiph Toscano.
- Mercy Corredor.

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Jordi Puig.
Lori Brooks.
Roland Coelho.
Calpoly Team.

It Works!