



# PERSEI SPACE

## PERSEI SPACE: A New Company on Space Tethers

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TECHNISCHE  
UNIVERSITÄT  
DRESDEN

uc3m



**SENER**

Aeroespacial



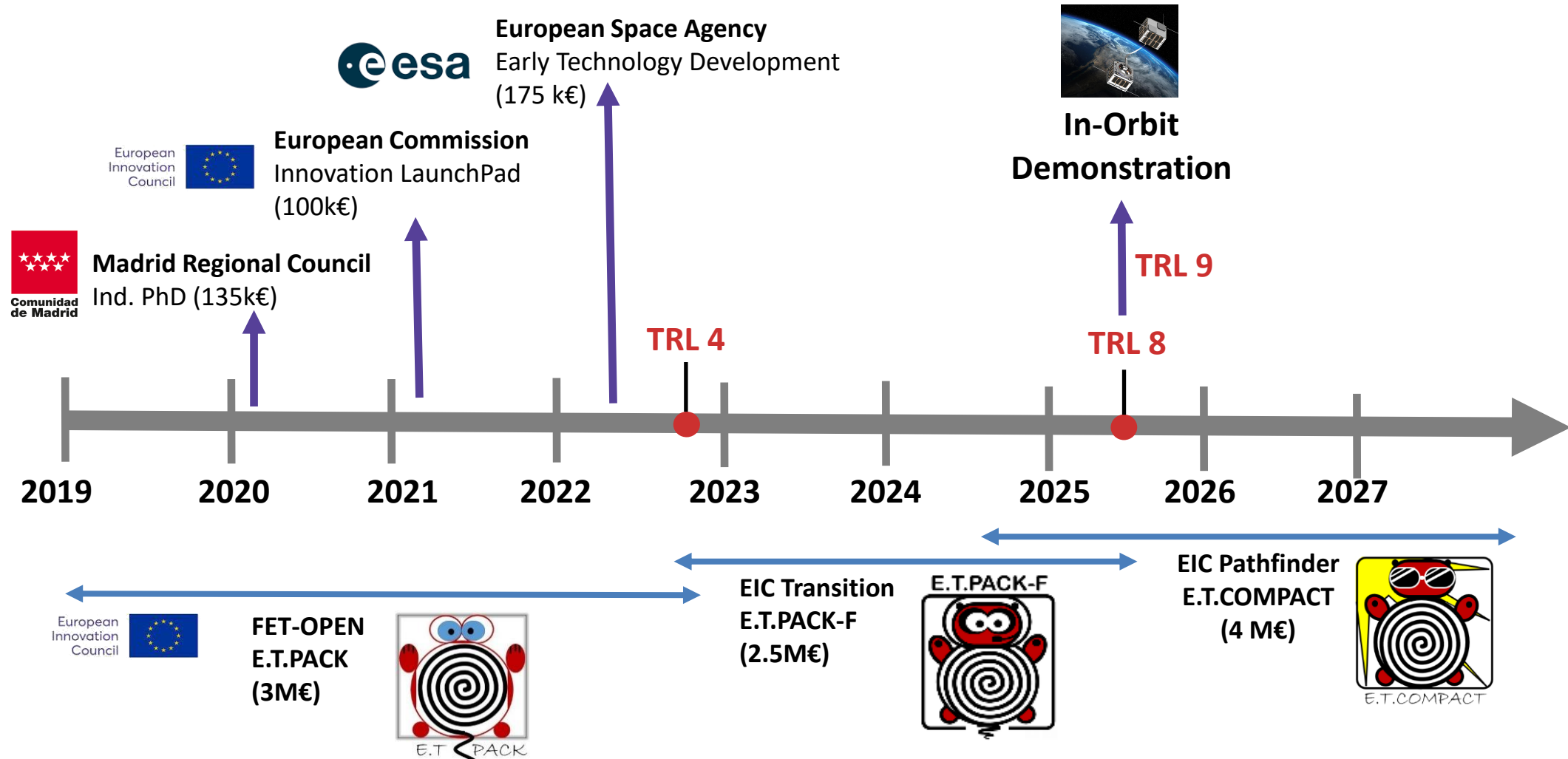
# The E.T.PACK Initiative

- 1 large company and 3 universities.
- Experience: 30 years on tethers, 50 years on space product development, 6 years working together on tethers.

## Roles

- **UC3M**: Mission Analysis, software development and Coordination
- **SENER**: product developer
- **UNIPD**: Deployment Mechanism and tether dynamics.
- **TUD**: Electron Emitter

# PERSEI SPACE: a spinoff of the E.T.PACK Initiative



# Electrodynamic Tethers (EDTs)

Long conductors in orbit carrying an electric current and exchanging momentum and energy with a planet magnetosphere

Bare EDTs

Floating EDT

$$I(0) = I(L) = 0$$

**No coating:** simple but very low current.

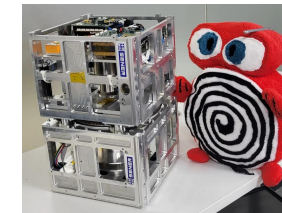
**Low-W coating:** Moderate current, but coating is not available yet.

EDT + Emitter

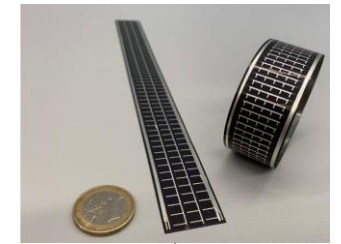
$$I(0) = 0 \text{ and } I(L) = I_c$$

**Hollow cathode:** High current, low power, but expellant.

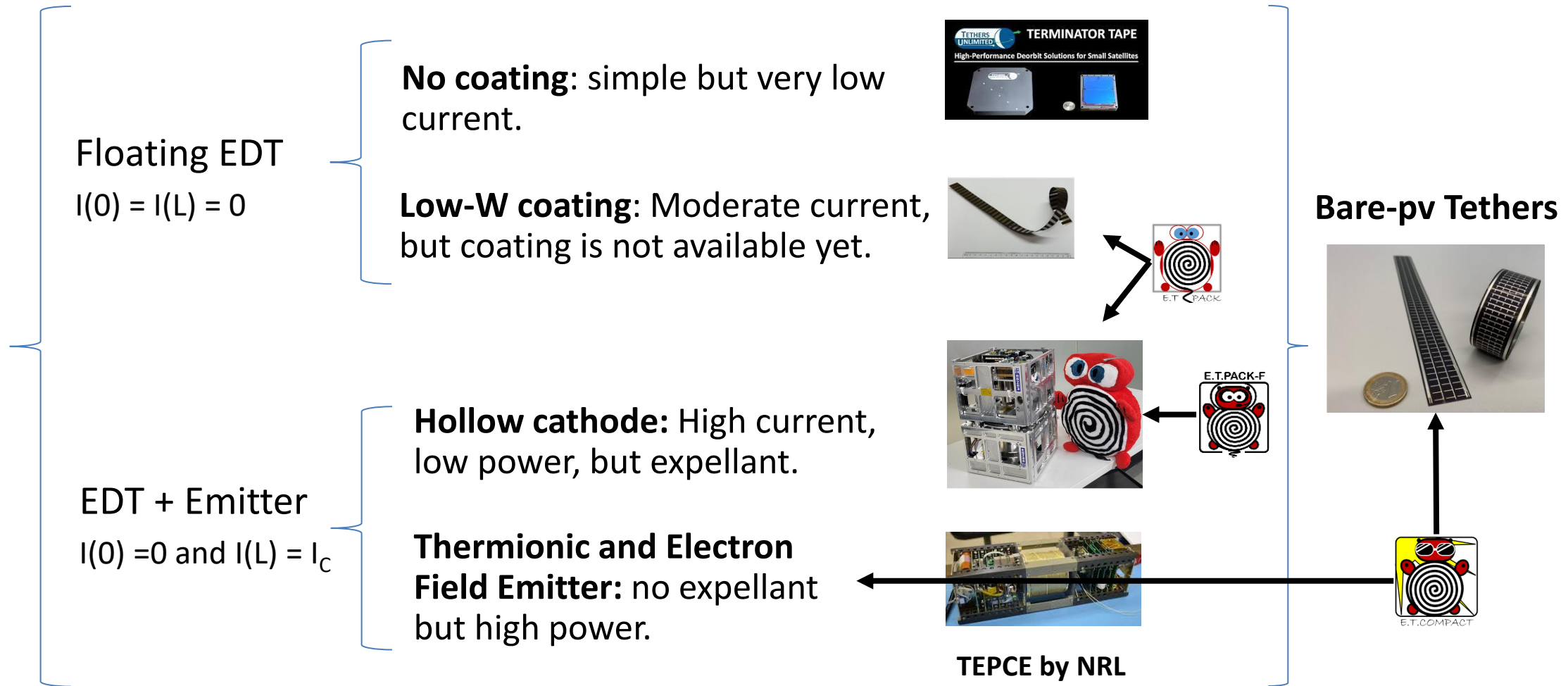
**Thermionic and Electron Field Emitter:** no expellant but high power.



Bare-pv Tethers



TEPC by NRL



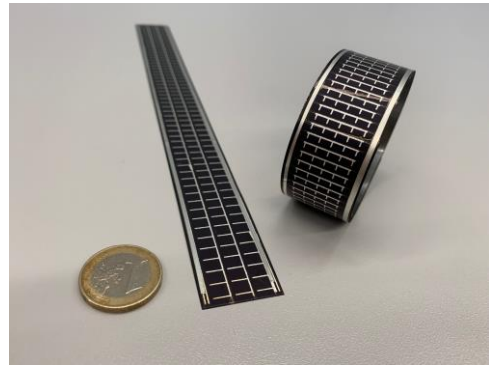
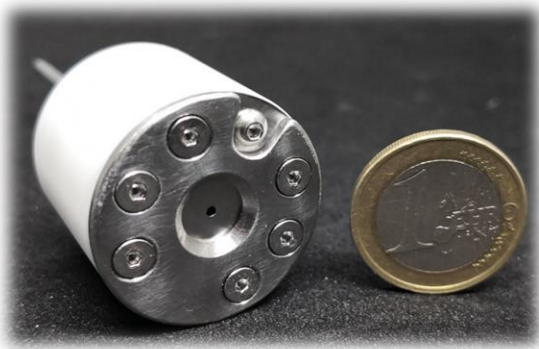
# The E.T.PACK Deorbit Device



## Characteristics

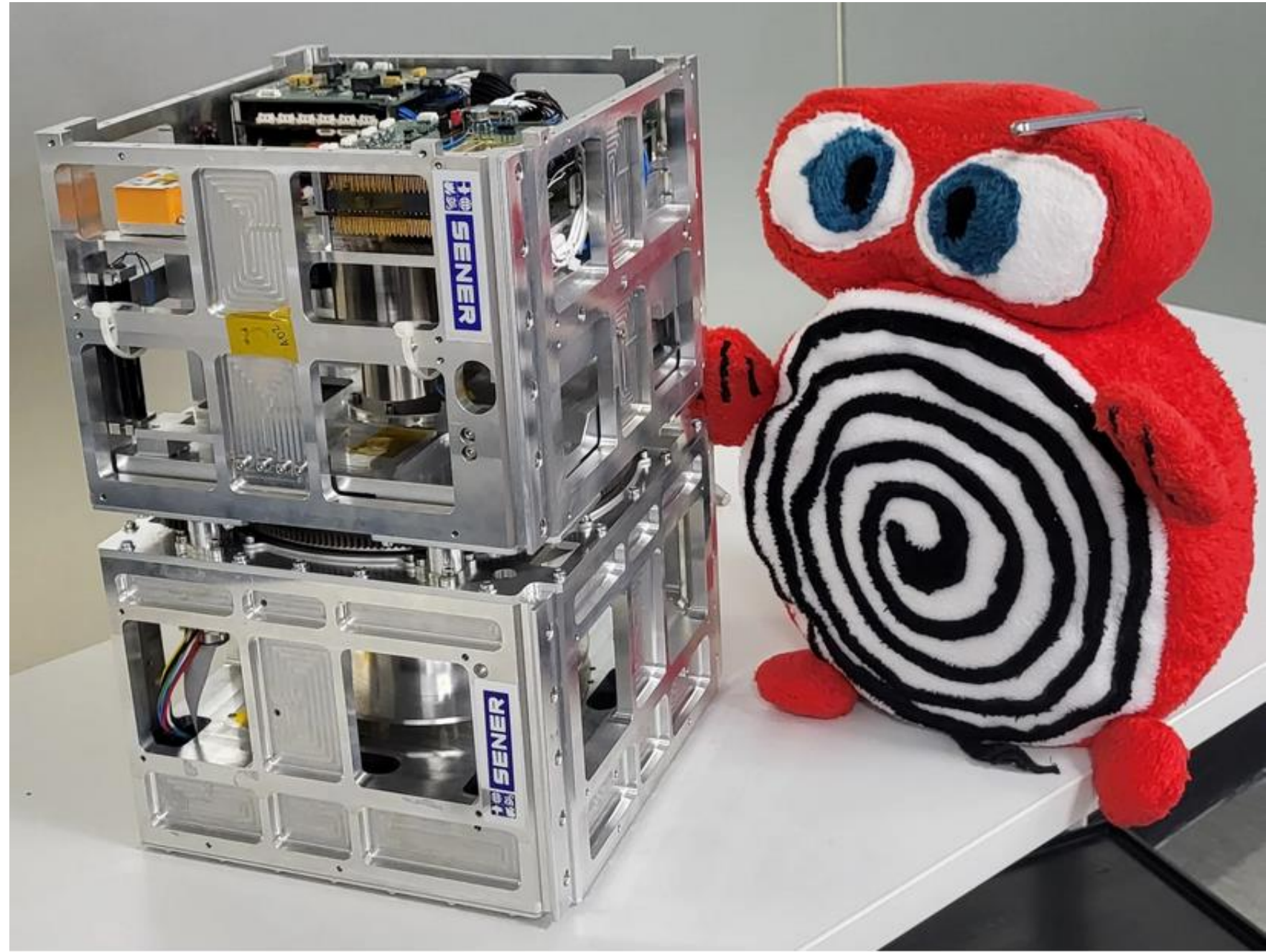
- 12 U and less than 24 kg
- Fully Autonomous
- 2.5 cm x 40 microns x 500 m bare tether.
- To be flown in 2025: flight opportunity selected by the European Commission and Launch Service Agreement under negotiation.

Video prepared in the E.T.PACK Project



**BETsMA**v2.0

Images courtesy of the E.T.PACK Consortium



# PERSEI SPACE

Spinoff company of the E.T.PACK Initiative aimed at moving the results of our EIC projects from the lab to the market

## ElectroDynamic Tethers (EDTs)

- Propellant-less Propulsion system.
- Energy-Reversible:
  - deorbiting + power generation.
  - Use onboard power for reboost.
- Scalable technology

## Value Proposition

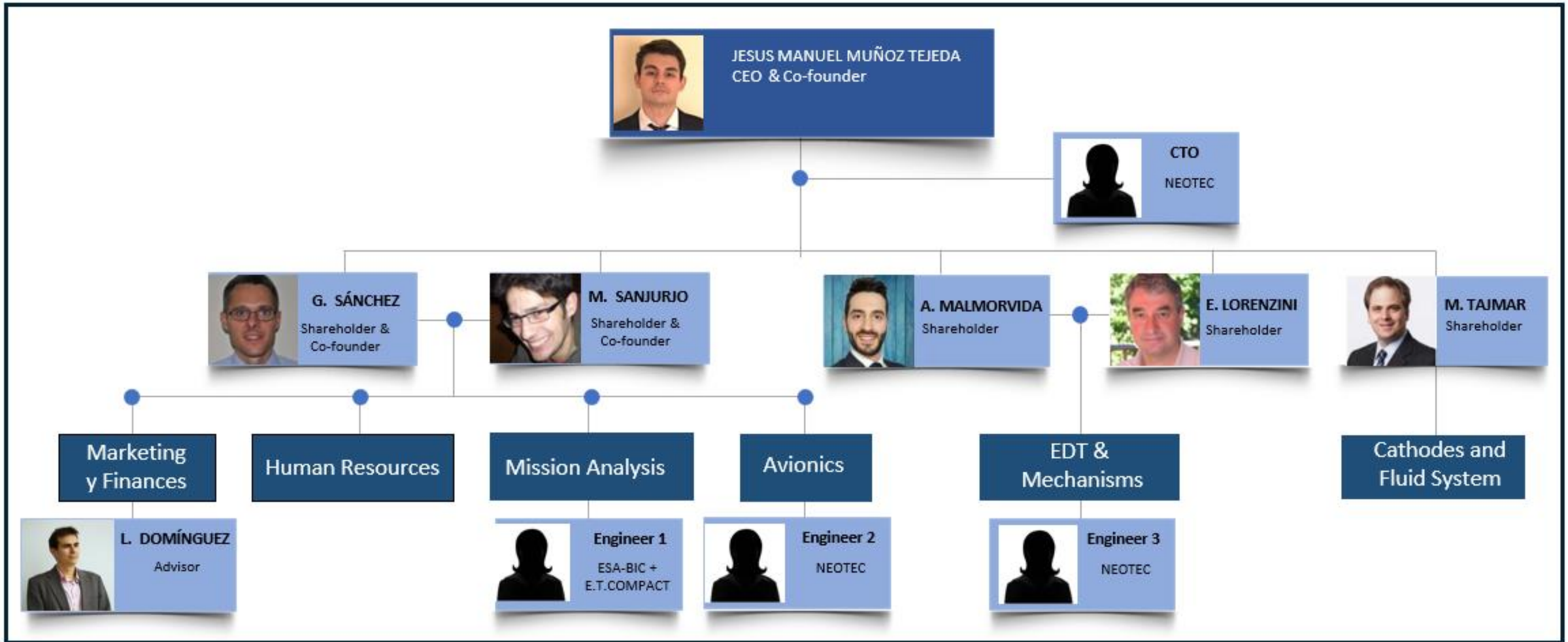
Propellant-less propulsion systems for deorbiting, reboost and station-keeping applications + power generation



Image courtesy of the E.T.PACK Consortium



# The Team





# Achieved Milestones since October 2023

## Fund Raised / Sales

- ESA-BIC.
- PRS will be part of the E.T.PACK-F and E.T.COMPACT projects
- First contract with a large satellite integrator.

## Proposal preparation and private investor

- NEOTEC proposal submitted.
- Innova S3 proposal under preparation.
- EIC Pathfinder on IoS to be submitted in October 2024.
- Open negotiation with a private investor.

## Other Milestones

- IP Transfer done (UC3M), negotiated (TUD), in progress (UNIPD and SENER).
- Zero Debris Chapter signed with ESA
- 3 new team members were identified and will start in 10/2024



# PERSEI's Products

## **BETsMA v2.0:** Mission Analysis software for EDT missions.

- Software already licensed by UC3M to PERSEI.
- First consulting service already sold to large satellite integrator.



## **Deorbit Device:**

- IP transfer from E.T.PACK Initiative in progress.
- Experiment to be done in orbit in 2025 by the E.T.PACK-F Initiative.
- First product expected in 2027.

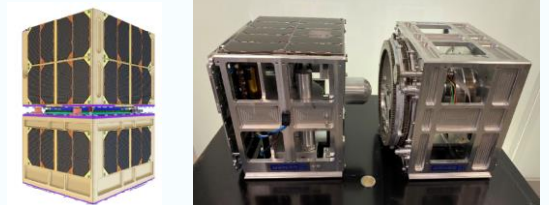
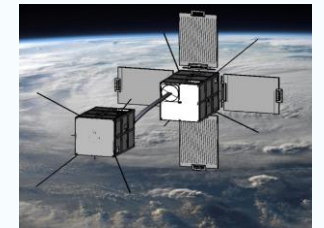


Image courtesy of E.T.PACK Initiative

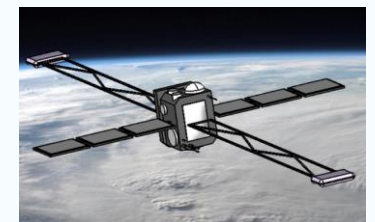
## **Propulsion system for satellites and upper stages:**

- Ultra-compact system base on bare tether + expellant-less cathode
- TRL 4 expected to be reached in E.T.COMPACT (starting in 1/10/2024)
- Thrust and drag capability.

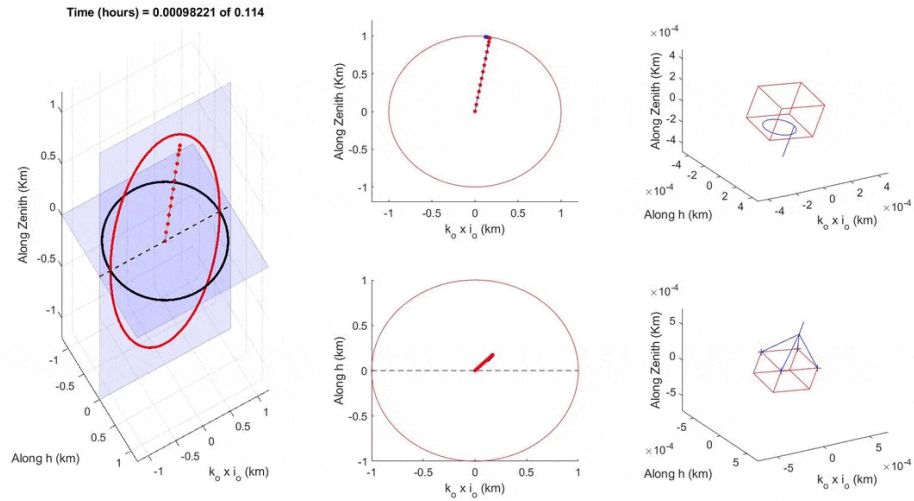


## **IoS Propulsion System:**

- High-Performance EDT product
- An EIC Pathfinder proposal will be submitted by 15/10/2024
- Actions to engage key partners are in progress.



# BETsMA V2.0



**SPACECRAFT A**

Mass (Kg)   $I_{A1}$      
 $I_{A2}$    $I_{A3}$    $I_{A4}$

Altitude On

$\Delta AQA$  (m) = (    )  
 $\Delta AP1$  (m) = (    ) L1(m) =   
 $\Delta AP2$  (m) = (    ) L2(m) =   
 $\Delta AP3$  (m) = (    ) L3(m) =   
 $\Delta AP4$  (m) = (    ) L4(m) =

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**SPACECRAFT B**

Mass (Kg)   $I_{B1}$      
 $I_{B2}$    $I_{B3}$    $I_{B4}$

Altitude On

$\Delta BQB$  (m) = (    ) RB (m) =

**TETHER SYSTEM PROPERTIES**

Type  Geometry   
Width (cm)  Thickness (microns)   
Absorp.  Emissivity   
Submode   $I_{max}$  (A)   
 $W_{max}$  (W)  Eclipse Avail   
Cur. Control

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Electron Emitter  VC (V)   
Real   $I_{min}$  (A)

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Bare	Length (km)	# Particles	Material
<input type="text" value="0.450"/>	<input type="text" value="9"/>	<input type="text" value="0"/>	<input type="text" value="Al"/>
<input type="text" value="0.000"/>	<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value=""/>
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	<input type="text" value="eV"/>
<input type="text" value="0.050"/>	<input type="text" value="1"/>	<input type="text" value="Peek"/>	<input type="text" value=""/>

**MISSION DEFINITION**

User Type   
Mission Goal   
Stop Condition   
Time (days)   
Mission Requirements  
Duration (Days)   
Cut Probability (%)

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**MODELS**

Tether Dynamics  RPM   
Planet   
B Field   
Current   
Air drag   
Integrator   
Harmonics   
Debris

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**RESULTS**

Run   
Type   
Plot

BETsMA State: Ready a = 6978. km  
T = 0.0 days

**PERSEI SPACE offers several types of services based BETsMA v2.0 like access to simulation and mission analysis.**



## BETsMA v2.0 is an ideal tool for

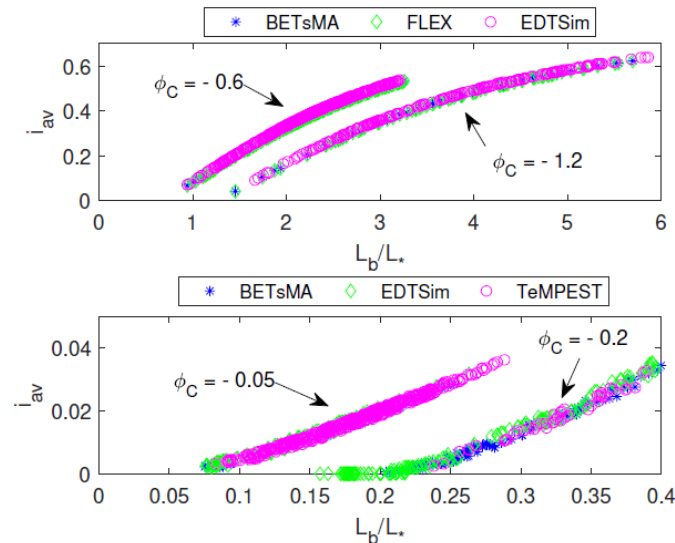
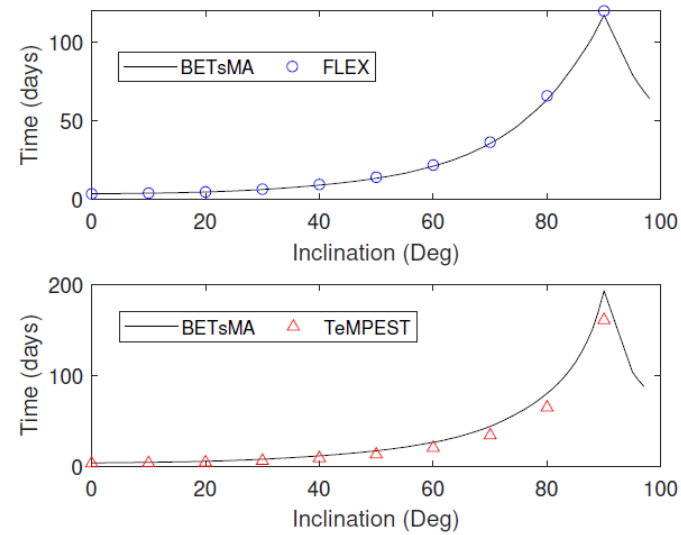
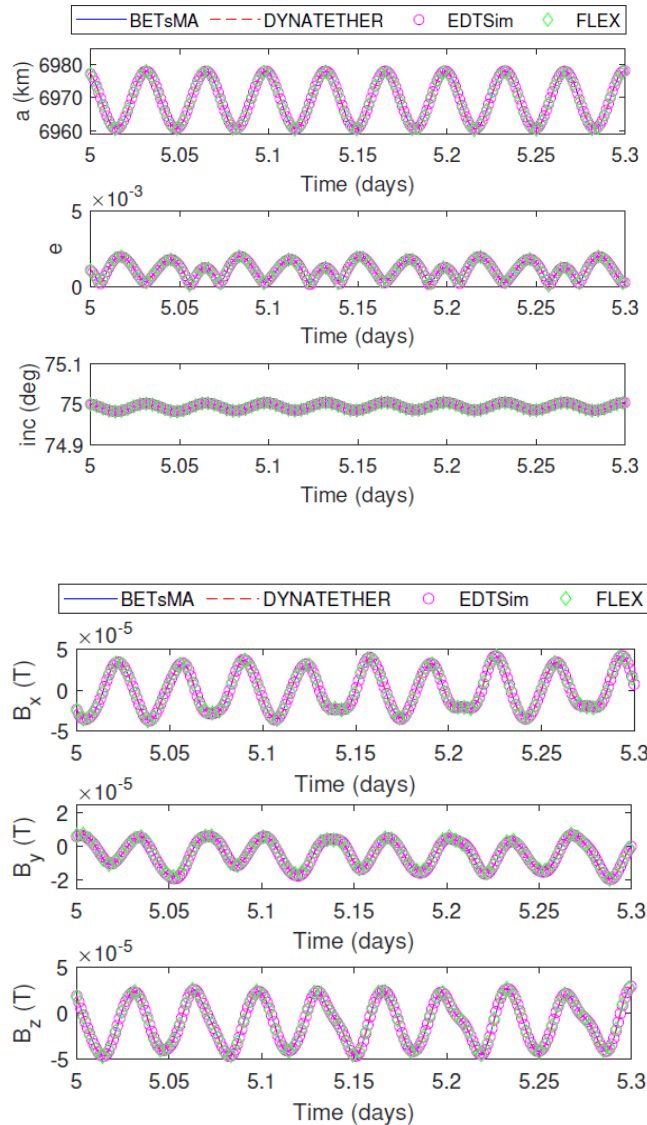
- **Space companies:** evaluate EDT performance in commercial scenarios.
- **Space agencies:** understand EDT technology and prepare development roadmap.
- **Research groups:** carry out research and prepare publications on a plethora of tether-related topics that include
  - EDT performance
  - Dynamic and control
  - Optimal mission design
  - Tether-risk evaluation
  - New concepts (Low-W tether and bare-photovoltaic tether)

Characteristic	BETsMA v20
<b>User Mode</b>	Beginner Advanced Expert
<b>Tether Type</b>	Bare Tether + Emitter Low-Work-Function Tether BarePhotovoltaic Tether
<b>Tether Dynamic Model</b>	Local Vertical Spinning Bar-based Model Particle-based Model
<b>Missions</b>	Deorbiting Reboost Station Keeping Mission Planning





# BETsMA V2.0



## BETsMA v2.0 is a verified code

- BETsMA v2.0 was cross-verified against FLEX (UNIPD), EDTSim (JAXA), TeMPEST (Penn State and Univ. Mich.), and DYNATETHER (York Univ).
- Find results in the article Gabriel Borderes-Motta et al, Cross-Verification and Benchmarking Analysis of Electrodynamic Tether Simulators, Acta Astronautica, 208, 381-388, 2023.
- Dataset available in doi:10.21950/FL2DG6.

# Conclusions

- PERSEI SPACE, founded in October 2023, is the spinoff company of the E.T.PACK Initiative that will make an in-orbit demonstration of a deorbit device in 2025.

- PERSEI SPACE is aimed at developing and commercializing space products based on EDTs to address the new needs of the space sector.

- The company can provide consultancy service and simulation access to space companies, space agencies and research groups.





# PERSEI SPACE

Thank you for your attention

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