HEMPT-NG

DEVELOPMENT TO PROVIDE EUROPEAN COMPETITIVE EP SYSTEM FOR FUTURE SPACE MISSIONS

Ernst Bosch, Thales Deutschland GmbH

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The project HEMPT-NG receive funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 730020
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European Commission
Horizon 2020
European Union funding
for Research & Innovation

Outline

- HEMPT-NG
- HEMPT-NG Team
- Market needs and the relevant development steps
- Capability of HEMPT
- Where to go
- Conclusion

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Overview / Status of HEMPT-NG Project

- HEMPT-NG will develop an integrated EP system based on (Highly Efficient Multistage Plasma Thruster), including the fluidic management system and the power processing unit for different applications
- Start of project HEMPT-NG was on 01.01.2017
- Elaboration of Market Analysis, Business Cases
- Requirement definition for LEO and Telecom/Nav. applications on subsystem and satellite level
- Identification of cost drivers for the different applications
- Definition and specification of Power supply unit for LEO applications

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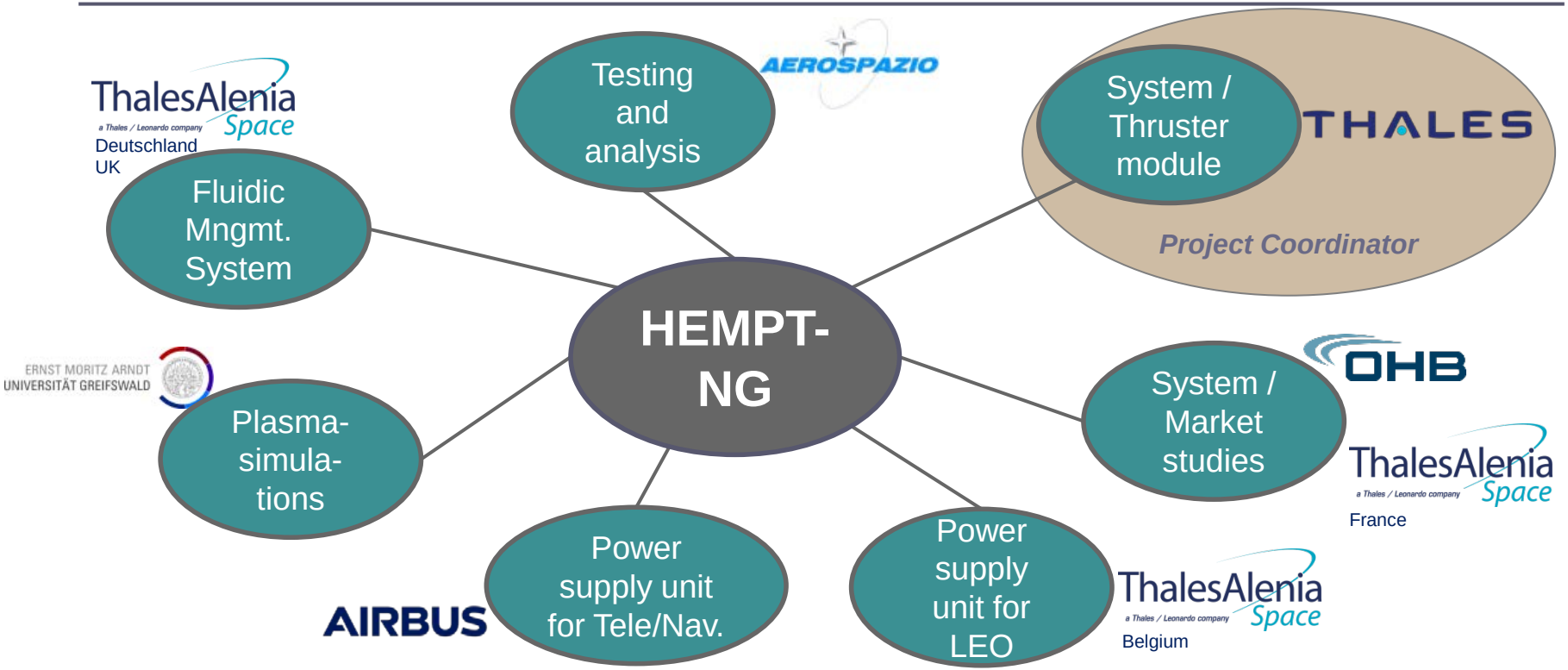
HEMPT-NG Consortium



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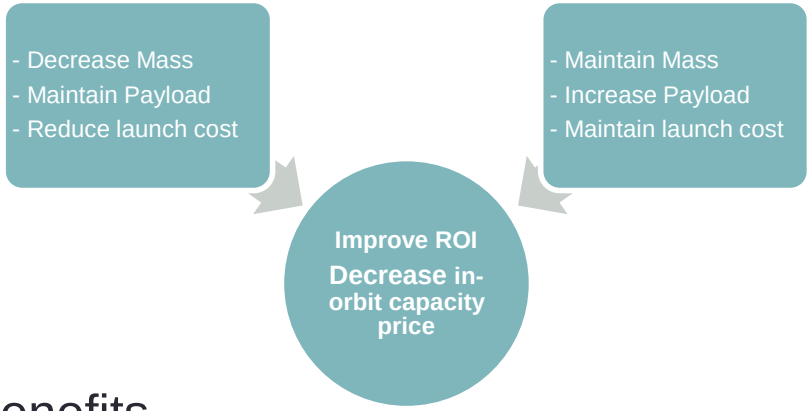
Why Electric Propulsion?

- The Satellite Industry is looking for cost-effective solutions



- Electric Propulsion's benefits
  - Lower CAPEX satellite, reduced Total Cost of Ownership and improved Return on Investment
  - Longer lifetime (18+ years)
- Benefits combined with longer transfer time will drive further adoption

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Answers through HEMP Technology – Advantages

Lowest system complexity due to the simplicity of the concept which will allow:

- maximal reduction of cost and mass,
- Long lifetime by erosion “free” operation
- Flexibility to provide high thrust operation and very precise low thrust operation with the same engine
- Operation of the same unit in different operating regimes (multiple voltage) featuring in orbit selectable ISP maximizing the propellant savings and giving flexibility for new failure recovery strategies.

High production capacity based on existing production line from TWTs which may reach hundreds of systems, which is today not existing at a comparable level in Europe

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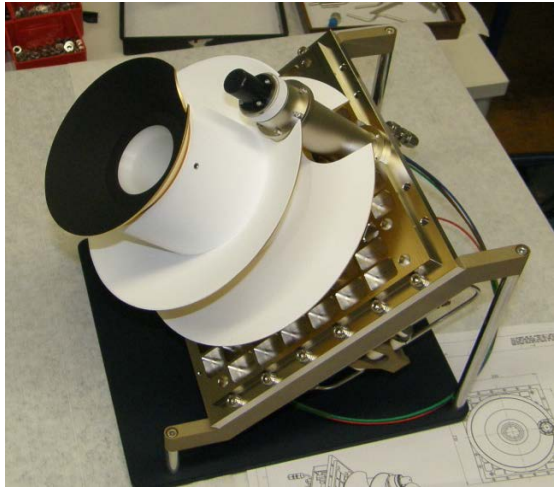
Advantages

Lowest system complexity due to the simplicity of the concept for maximum reduction of cost and mass



Design approach is based on Modules:

- Well-known and proven space materials and processes from TWT design (80%) – continues manufacturing
- Discharge channel of simple design
- *(Standard magnet systems out of permanent magnets)*
- Radiator based on TWT concept as support structure
- Neutralizer/cathode based on in orbit verified technology through TWTs (more than 920 Mio hours)
- Simple support structure (bracket) for the thruster and potential FCU

➡ **lead to cost effective design**

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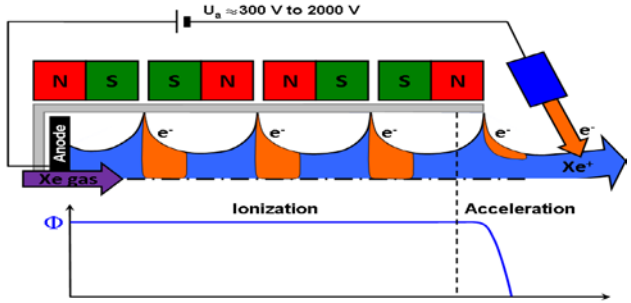
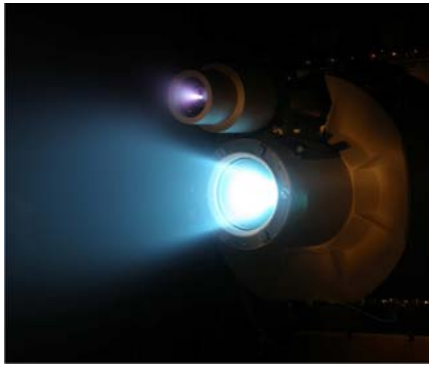
Advantages

Long lifetime by concept

- Electron confinement by magnetic mirror-cusp topology
- Strongly separated ionization and acceleration zones
- Exit cusp forms virtual acceleration grid
- Ion current ≈ anode current
- Separated ionization and acceleration zones cause most
- of the ions to be generated at anode potential



➡ High ion acceleration efficiency



Confirmed by excellent results in life test

- Mission factor 1 (TRL 8) reached in Sept 2017
- Endurance test with more than 9000 h

Large cathode experience for Cathodes

- More than 920 Mio operational hours with same technology concept

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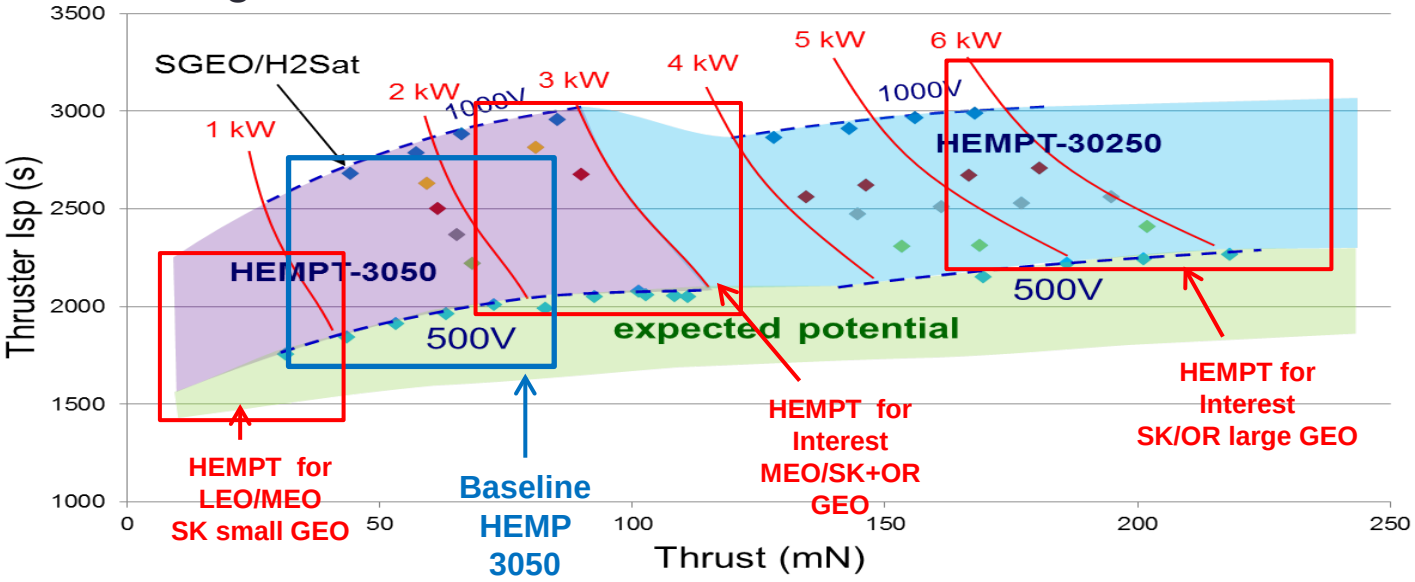
Advantages

Flexibility to provide high thrust operation and very precise low thrust operation with the same engine



Based on measurement data

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Advantages and Capabilities

High production capacity based on existing production experience from Travelling Wave Tubes

- **Design and production** of traveling wave tubes, space amplifiers and ion thrusters
- **24 000 m²** of industrial surface, including **1 400 m²** of clean rooms
- EN/AS 9100, ISO 9001, ISO 14 001, OSHAS 18001
- **525** employees (31.01.2017)
- **35** patents
- Capacity for 1100 TWTs + ground based TWTS

SPACE AMPLIFIER

TRAVELING WAVE TUBES

ION THRUSTER

WORLD #1 FOR SPACE TUBES
EUROPEAN #1 FOR DEFENSE TUBES

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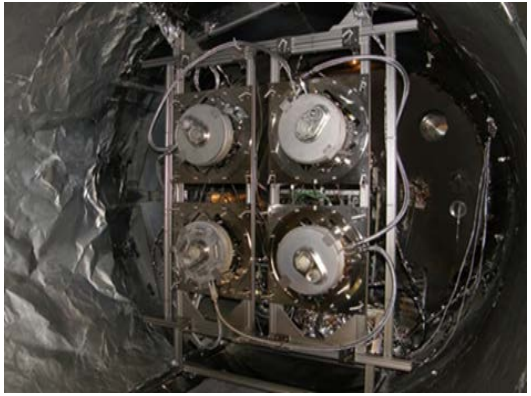
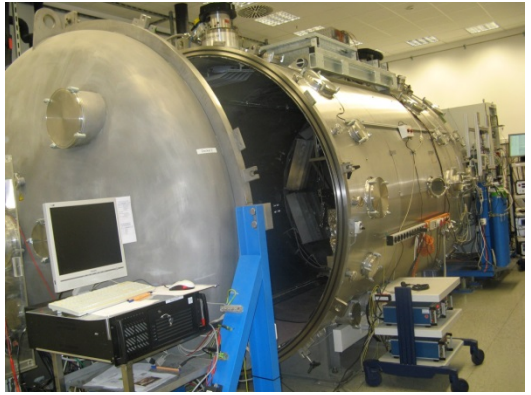
Advantages and Capabilities

Availability of qualified test and verification capabilities based on existing experience from life time testing of electrical propulsion systems.





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HEMP Technology offer important value for customers

HEMPT-NG

FLEXIBILITY
Design & operational

- Down-scaling capability with a same engine
- Excellent ability for throttling
- Mounting flexibility: panels or mechanics
- Modular Architecture

RELIABILITY
Design & MIS heritage

- MIS space heritage and TWT expertise
- MIS testing facility and manufacturing capacity
- High-reliable cathode

COST-EFFECTIVNESS
Design

- Inherent technology competitiveness
- Mono cathode design
- High ISP for short operation time
- Power supply simplification
- Simple and modular architecture

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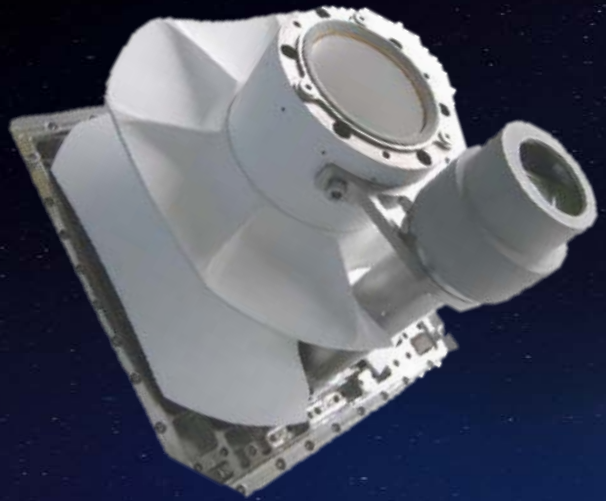
AEROSPAZIO AIRBUS ERNST MORITZ ARNDT UNIVERSITÄT GREIFSWALD OHB THALES ThalesAlenia Space European Commission

High Efficiency Multistage Plasma Thruster – Baseline for HEMPT-NG: HEMPT 3050



HEMPT 3050

- 1500 W Ion Propulsion System for satellites
- Small GEO – station keeping
- LEO - orbit raising and station keeping
- Thrust 50 mN
- Life time test with mission factor 1 and endurance test >9000 hours of operation demonstrated
- Selected for H2Sat

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Thales HEMPT- NG Competitive EP System Solution

HEMPT 3050

- **Markets**
  - LEO OR and SK
  - Small GEO SK
- **Technical key elements**
  - Thrust: 8-60mN
  - Power: 200W - 1.5kW
  - Operating Voltage 400V - 1050V
  - ISP: 800s - 2400s
  - Total Impulse: 1.47MNs
  - Life test >9000 h operation, qualified

HEMPT LEO System

- **Markets**
  - VLEO/ LEO/ MEO
  - OR and SK
- **Technical key elements**
  - Thrust: up to 25mN
  - Power: 200W - 600W
  - Operating Voltage 400V - 1050V
  - ISP: 500s - 1500s
  - *Total Impulse: >0.6MNs*

HEMPT Nav/Geo System

- **Markets**
  - LEO, MEO, small GEO
  - OR and SK
  - Telecommunication and Navigation Systems
- **Technical key elements**
  - Thrust: 250mN
  - Power: up to 5kW
  - Operating Voltage 400V - 1050V
  - ISP: up to 3000s

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Way Go Ahead Current – HEMPT !!

- **Life test on HEMP 3050 exceed successful life factor 1 according expectation**

  ➡ **no significant erosion !!!**

- **Life test on HEMP 3050 life factor 1,3 for begin 2018 – no change expected**
- **In-orbit verification on H2Sat moving foreword- H2Sat contract signed**
- **High interest on current design**

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Way Go Ahead HEMPT- NG !!

- EPIC – HEMPT-NG- running as scheduled
- LEO requirement Meeting successful passed
- NAV/GEO requirement meeting scheduled
- Based on actual progress - HEMPT Technology well prepared for the next phase in EPIC-Qualification of HEMPT Technology for Leo/ MEO and NAV applications including GEO

Project details can be followed on:
www.hempt-ng.eu or www.hemptng.eu

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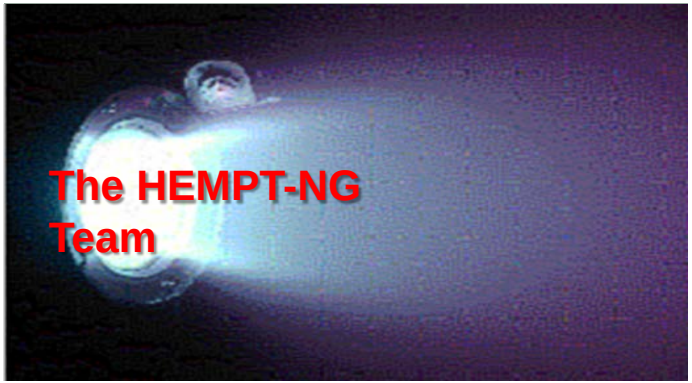

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