



Strategic Research Cluster on Space Electric Propulsion

2019 Call Text and Guidelines (Disruptive Technologies)

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MINOTOR

SRC EPIC Roadmap



Phase 1 SRC Call WP 2016 Phase 2 **SRC Call WP 2019 & 2020** H2020 COMPET-3-2016-a (IA) H2020 **SPACE-13-TEC-2019 (RIA)** Space Space 2016 Incremental Call & SPACE-28-TEC-2020 (IA) Call **Technologies**; Requirements refinement, definition of · EP complete system testing - main target **COMPET-3-2016-b (RIA)** specifications, Design, manufacturing, Integration and first tests - main target Qualification – possible target Incremental EP complete system testing - possible IOD/IOV preparation – possible target **Disruptive Technologies Technologies** Programme P1: HET? HET? SPACE-28-TEC-2020: Call for Call for Next GIE? Incremental [24] M€ (Indicative) P2: GIE? **PROPOSAL** Line **PROPOSAL** Work **HEMPT?** (IA) **COMPET-3-2016:** P3: HEMPT? Selected Selected 28,16 M€ EU support R&D on the concept, Requirements · Design, manufacturing, and specifications definition Integration and first tests -Design, manufacturing - possible main target **COMPET-3-2016 Disruptive OGs** Px follow on? **Technologies** P1: Transversal? Programme **CHEOPS** P2: Thruster? P... follow on? SPACE-13-TEC-2019: Call for Disruptive Call for Next **GIESEPP** P3: Thruster? 10 M€ (RIA) Line **PROPOSAL** P... (new)? **PROPOSAL HEMPT-NG** Work P4: Thruster? P... (new)? **GANOMIC** P5: Thruster? Selected Selected **HIPERLOC-EP**



SRC EPIC Roadmap



Disruptive Technologies:

- The Disruptive Technologies, are very promising EP thruster concepts or transversal EP technologies which <u>could disrupt the propulsion</u> <u>sector</u> by providing a radical improvement in performance and/or cost reduction, leading to become the preferred technology for certain applications; or enable new markets.
- <u>Promising EP thrusters</u> are for example: Helicon Plasma Thrusters
 (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma
 Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field
 Emission Electric Propulsion thrusters (FEEP), etc.
- <u>Transversal EP technologies</u> are for example radical innovations in Power Processing Units (PPU), magnetic nozzles, alternative propellants, etc.





SPACE-13-TEC-2019

SRC In Space electrical propulsion and station keeping / Disruptive Technologies / Guidelines to be published by EC

The **Disruptive Technologies**, are very promising EP thruster concepts or transversal EP technologies which could disrupt the propulsion sector by **providing a radical improvement in performance and/or cost reduction**, leading to become the preferred technology for certain applications; **or enable new markets**.

- **Promising EP thrusters** are for example: Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance plasma thrusters (ECR), Magneto Plasma Dynamic thrusters (MPD), Pulsed Plasma Thrusters (PPT), micropropulsion electric thrusters, etc.
- **Transversal EP technologies** are for example disruptive electric propulsion systems, such as power condition electronics, direct drive, magnetic nozzles, alternative propellants, testing techniques, materials, etc.

Reccomended project size
Indicative budget
Type of action

1 M€ for activities

starting from TRL<4

1 to 2 M€ for

activities starting

from TRL≥4

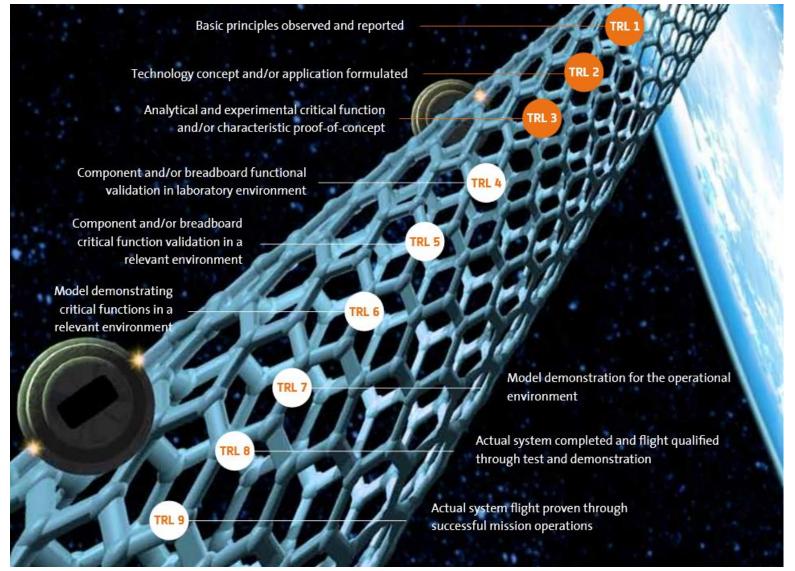
10 M€

Research and
Innovation Actions

Participation of industry, including SMEs, is encouraged







EPIC project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 640199 This presentation reflects only the EPIC Consortium's view. The EC/REA are not responsible for any use that may be made of the information it contains.





SPACE-13-TEC-2019

To be kept in mind:

- Proposals may target any part of the technology readiness levels (TRL) scale, in particular: Breakthrough technologies starting at low or very low TRL (<4); Promising technologies starting at higher TRL (≥4).
- Proposals shall include a market analysis detailing the targeted applications and the specific key advantages of the proposed technology.
- Proposals **shall not be based on technology lines mentioned in the call topic COMPET- 3-2016-a** for incremental EP technologies (HET, GIE, HEMPT).
- Requesting contribution from EU of EUR 1 million for activities starting from TRL < 4
 and of EUR 1 to 2 million for activities starting from TRL ≥ 4.
- Type of Action: Research and Innovation Action (RIA)
- Indicative budget: EUR million 10.0
- Opening: 16 Oct 2018; Deadline: 12 Mar 2019





SPACE-13-TEC-2019 To be kept in mind:

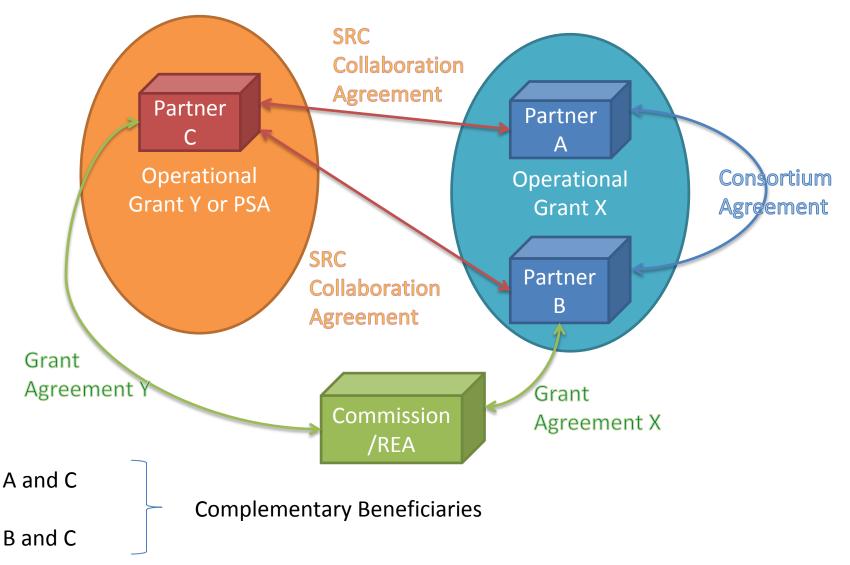
- Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme. The following exceptions apply:
 - No beneficiaries of the grant agreement EPIC (640199) will participate in consortia of proposals submitted under this topic of the call for proposals, with the exception of the DLR research institutes, Eurospace and SME4Space VZW.
 - A maximum of two projects for transversal technologies shall be selected for funding
- **Grant Conditions:** Grants awarded under this topic will be complementary to each other and complementary to grants awarded under topic COMPET-3—2014, sub-topic COMPET-3-2016-a and sub-topic COMPET-3-2016-b ("complementary grants"). In order to ensure a smooth and successful implementation of this Strategic Research Cluster (SRC), the beneficiaries of complementary grants ("complementary beneficiaries") shall conclude a written **"collaboration agreement".**

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SRC Collaboration Agreement



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SRC Grants Guidelines & Requirements

1. INTRODUCTION This paper presents the specific guidelines for the applicants to topic SPACE-13-TEC-SPACE-13-TEC-2019: GUIDELINES FOR STRATEGIC RESEARCH CLUSTER ON IN-SPACE ELECTRICAL PROPULSION AND STATION KEEPING - HORIZON 2020 SPACE CALL 2019 1 INTRODUCTION 2. OVERVIEW OF THE SRC ON IN-SPACE ELECTRICAL PROPULSION AND STATION KEEPING 2.1. Objectives of the document..... 2.2 The roadman of the SRC 2.2.1. Roadmap for disruptive technologies....... 2.2.2. SRC roadmap evolution DISRUPTIVE LINE... ACRONYMS & ABBREVIATIONS November 2017 on européenne/Europese Commissie, 1049 Bruxelles/Brussel, BELGIQUE/BELGIÉ - Tel. +32 22991111

Further analyse the impact of the thruster on the whole EP system. Technical Annex nabling DISRUPTIVE LINE types This section provides additional information in order to clarify what is expected from the proposals to be submitted in response to SPACE-13-TEC-2019: SRC - In-Space electrical propulsion and station keeping (Disruptive Technologies). ECR-This section for the disruptive line is composed by one table (Table 1) providing guidance for the proposals to be submitted and requirements for the technologies or PS (i.e. concepts to be developed. 5-01C -) and Information is provided on the content and scope that is expected including specific targets for TRL and performances. under s, as Table 1 - Disruptive Technologies The SPACE-13-TEC-2019 also covers a number of alternative thruster concepts that d state eloped are emerging or have already gained some maturity. If these disruptive technologies can be identified early enough, accelerating the development of those technologies would help to sustain advances in performance and identifying new markets/applications. This topic focuses on promoting the Research, Technology and Development (RTD) of very promising and potentially disruptive concepts in the field of Electric Propulsion, in order to increase the currently low TRL (<4) and higher project $TRL \ge 4$ of potentially breakthrough thruster concepts and transversal technologies legree of which in the long term could change the EP landscape. cturing Electric Propulsion thrusters not part of the Incremental line of the SRC, shall be the main focus of this Disruptive Technology line. Proposals are expected for concepts further such as Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters to reach (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters ine. A (PPT), Field Emission Electric Propulsion thrusters (FEEP), micro-propulsion electric thrusters, or other innovative thruster concepts not identified here. The activities proposed shall include modelling, development and testing beyond the ourse of current state of the art in order to: ing met Understand fundamental physical processes and their impact on performance. shall be · Improve current thruster performances (thrust, specific impulse, power/thrust ratio, magnetic thrust vectoring, throttability, efficiency, lifetime, noise, etc.). Progress the development of associated cathodes/neutralisers, if applicable to a Investigate alternative propellants to Xenon and/or non-conventional propellants, understood as gases constituting the atmosphere of a planet, such as oxygen, nitrogen and combinations in the case of the Earth, with consideration to potential





SRC Grants Guidelines & Requirements

The roadmap for disruptive technologies is based on currently known low and medium TRL concepts such as Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field Emission Electric Propulsion thrusters (FEEP), micro-propulsion electric thrusters, and any other innovative electric thruster concepts, **but other thruster types are by no means excluded from it**. A specific topic to be addressed also by disruptive technologies could also be micro-propulsion for scientific applications (but not the ones based on HET, GIE and HEMPT technology).

Additional to thruster technologies, projects dealing with **transversal disruptive technologies** are welcomed. A transversal technology development could address elements which could be common to several thrusters. These are, for example concepts such us:

- direct drive enabling technologies,
- radical innovations in PPU.
- magnetic nozzles,
- alternative propellants,
- testing techniques,
- new materials,
- modelling and simulations codes,
- new PPU and electrical system architecture for EP,
- hybrid solution to drive different types of EP thrusters,
- any other promising and potentially disruptive concept not specifically mentioned, not necessarily related to the technology if is used in a disruptive way,



EPIC

SRC Grants Guidelines & Requirements

Table 1 - Disruptive Technologies

Description and needed Action

The SPACE-13-TEC-2019 also covers a number of alternative thruster concepts that are emerging or have already gained some maturity. If these disruptive technologies can be identified early enough, accelerating the development of those technologies would help to sustain advances in performance and identifying new markets/applications. This topic focuses on promoting the **Research, Technology and Development (RTD) of very promising and potentially disruptive concepts** in the field of Electric Propulsion, in order to increase the currently low TRL (<4) and higher $TRL \ge 4$ of potentially breakthrough thruster concepts and transversal technologies which in the long term could change the EP landscape.

Electric Propulsion thrusters not part of the Incremental line of the SRC, shall be the main focus of this Disruptive Technology line. Proposals are expected for concepts such as Helicon Plasma Thrusters (HPT), Electron Cyclotron Resonance Thrusters (ECRT), Magneto Plasma Dynamic Thrusters (MPDT), Pulsed Plasma Thrusters (PPT), Field Emission Electric Propulsion thrusters (FEEP), micro-propulsion electric thrusters, or other innovative thruster concepts not identified here.

The activities proposed shall include modelling, development and testing beyond the current state of the art in order to:

- Understand fundamental physical processes and their impact on performance.
- Improve current thruster performances (thrust, specific impulse, power/thrust ratio, magnetic thrust vectoring, throttability, efficiency, lifetime, noise, etc.).
- Progress the development of associated cathodes/neutralisers, if applicable to a thruster
- Investigate alternative propellants to Xenon and/or non-conventional propellants, understood as gases constituting the atmosphere of a planet, such as oxygen, nitrogen and combinations in the case of the Earth, with consideration to potential

applications.

• Further analyse the impact of the thruster on the whole EP system.

It is important to acknowledge that there might be other elements in the EP system, aside from the thruster, with the ability to provoke a radical disruption. For example, new Power Processing Unit (PPU) concepts or architectures could substantially decrease the overall cost of the system. It is therefore also important and expected some proposals exploring the potential for breakthrough innovation of **Transversal Disruptive technologies**, such as: radical new PPU architectures, direct drive enabling technologies, highly innovative magnetic nozzles, alternative propellants, testing techniques, new materials, simulations codes, hybrid solutions to drive different types of EP thrusters, testing techniques, or any other new concept belonging to the Transversal Disruptive EP technology category not specifically mentioned here.

Proposals for thrusters in the Disruptive line should not be based on HET, GIE or HEMPT technologies, or its variants (e.g. micro-HET, micro-GIE, dual-HET, ECR-GIE, etc.).



EPI

SRC Grants Guidelines & Requirements

References	Relevant ECSS Standards (www.ecss.nl) for the different elements of the Elecss-E-ST-35C Rev.1 – Propulsion General Requirements, ECSS-E-ST-3: Liquid and electric propulsion for spacecraft, ECSS-E-ST-10-03C - Testing for the relevant milestone documentation (ECSS-E-ST-10C). Proposers are invited to consult other EPIC public documentation available www.epic-src.eu (EPIC website)	5-01C -) and Deliverables Deliverables
Proposals indicative content	Proposals shall include an initial work package dedicated to the requirement well as an analysis of the different potential impacts. Proposals shall go beyond the present state of the art, preferably the expecte of the art at the time of completion if alternative technologies are being develoutside Europe. Proposals shall explain and be ready to demonstrate how the proposed concernets the disruptive definition proposed in this call topic and what is it the expected impact of the development in the EP landscape, including the time Persistent monitoring of the state of art within the EP sector throughout the will be important, and developments should ideally be planned with some deflexibility in order to be responsive to innovations not currently foreseen whe could have a potential impact on EP systems (e.g. new materials or manufactechniques).	Technical Specification, System Disserting and Development plants. Technical Specification, System Disserting and Development plants. Effame. Project egree of nich Technical Specification, System Disserting and Development plants. KPIs report (yearly), Cost Assessment (development plants and educational purpapers and articles presented, photoand educational movies; and Project website.
	Proposals shall demonstrate the readiness and interest to carry developments on through future calls, by including a long-term development plan aiming the higher TRLs in 2023-2024 targeted in the EPIC Roadmap Disruptive Litarsk in the project should be dedicated to this topic.	to reach ne. A
	Proposals shall also include a validation and verification plan, including mil and one or more validation and verification methods to apply through the counterproject, which would allow to verify how the development targets are be and how the landscape disruption shall take place in the future. These plans	ourse of eing met

analysed in depth through a dedicated work package within the project.

Proposals shall seek synergies while avoiding duplications with already existing or planned developments by other entities in Europe, such as ESA, EU-FP, EU-H2020, National Space Programmes and commercial initiatives.
 At least the following Deliverable documentation has to be provided according indication provided in ECSS-E-ST-10C and include but it's not limited to:

 Business Plan including Market Analysis,
 SRR, PDR, and CDR (if applicable depending on the TRL) data packages including Technical Specification, System Design, Preliminary Design Report including justifications, Design and Development Plan, Test and Verification Plans, Test and Verification Reports, according to the relevant ECSS Standards.
 Risk Assessment and Contingency Analysis report (yearly),
 KPIs report (yearly),
 Cost Assessment (development phases),
 Dissemination and educational public material: Activity and results presentations, papers and articles presented, photos, posters, videos, professional communication and educational movies; and

 Project website





Many thanks for your attention

For more information on Horizon 2020 Space:

https://ec.europa.eu/programmes/horizon2020/en/h2020-section/space

For more information on the EPIC PSA activities: www.epic-src.eu

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