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# EPIC Lecture Series 2017



## Lecture series roadmap and conclusions

26<sup>th</sup> October 2017  
CDTI, Madrid (Spain)

Jorge Lopez Reig



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# EPIC Lecture Series objectives



Fist of all: many thanks to our guest invited Lecturers!!

- José GONZÁLEZ DEL AMO, **ESA**: Electric propulsion in space missions
- Vincent JACOD, **AIRBUS DS**: All-electric-propulsion satellites
- Javier PALENCIA, **CRISA**: Electronics for Electric Propulsion
- Luis CONDE, ETSIA – **UPM**: Multiprobe plasma flow diagnostics for space propulsion: a practical approach
- Jaime PEREZ LUNA, **QINETIQ Ltd.**: Gridded Ion Engines  
Gridded
- Eduardo AHEDO, **UC3M**: Hall Effect Thrusters
- Denis PACKAN, **ONERA**: RF plasma sources for electric propulsion
- Mario MERINO, **UC3M**: Magnetic nozzles for electric propulsion



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# EPIC Lecture Series objectives



- EPIC Lecture Series is an important **EDUCATION** activity of the Horizon 2020 Electric Propulsion SRC activities funded by the EU.
- Its objective is to provide science and engineering university students (bachelor, master, PhD) with a selection of lectures on Space Electric Propulsion, from the basic technology and concepts to the latest developments.
- With the aim to promote space EP talent and interest at university educational level, and therefore prepare the new generation of EP professionals



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# EPIC Lecture Series objectives



## Important aspect covered today!

- Electric propulsion thruster technologies and types: Arcjet, HET, GIE, PPT, HPT, ....(depend on the mission and application)
- Figures of merit: specific impulse (Isp), efficiency, thrust/power ratio, life time, exhaust velocity..
- ESA missions (technology, science, Artemis, GOCE, SMART-1, BEPI, LISA, NEOSAT, ELECTRA...)
- EP in GEO telecom satellites (high Isp, low thrust, longer time to reach GEO (3-6 months).
- EP in GEO telecom: station keeping and orbit raising. Configuration options: chemical, vs Hybrid-EP, vs Full-EP. Goal to save mass/cost!



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# EPIC Lecture Series objectives



## Important aspect covered today!

- Plasma physics and characterization of plasma with probes, detectors, etc...
- Maneuvers possible with EP: station keeping (N-S, E-W), orbit raising (GTO-GEO), deorbiting, drag compensation, interplanetary missions, precise thruster variation, formation flying,....
- PPU's functions and elements: control, thruster supplies, neutralizer supplies, FCU supplies,...
- PPU key design factors: high voltage, cost,...
- GIE "basic" principles and processes: ionization (DC discharge, Kaufman, ring cusp, RF, MW,..); acceleration (grids) and neutralization (cathode)



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# EPIC Lecture Series objectives



## Important aspect covered today!

- HET "basic-complex" principia (all processes mixed) and historic development
- HET thrust explanation, erosion issues, lifetime
- HET-GIE comparison and merits
- Simulation codes trying to simulate the HET
- RF plasma source for EP
- RF Thrusters: RIT, ERC, HPT,... (neutralizer not needed, simpler design, lower cost..), but performances still TBC. ERC-resonance in detail
- Thruster types by (E, B) topology fields and thrust direction
- Magnetic nozzles: types and how they work...



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# EPIC Lecture Series 2017



## Conclusions

- EPIC Lecture Series has been proven a great mean of EP education and dissemination; covering from basics to missions, from subsystems to new concepts or even business aspect..
- We had a great audience today from Madrid university students and researchers
- Organization in collaboration with local universities (UC3M) is a key factor for success!
- Advantage of EPIC Workshop concurrence with EPIC Lecture Series (top experts in Europe)
- Dissemination impact of having the Lectures and presentations ON the EPIC web: [epic-src.eu/](http://epic-src.eu/)



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# EPIC Lecture Series Roadmap




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**EPIC**

EPIC Lecture Series 2017  
Space Electric Propulsion  
Strategic Research Cluster H2020

**October 26 2017**

CDTI Centro para el Desarrollo Tecnológico Industrial

Centro para el Desarrollo Tecnológico Industrial  
CDTI  
Madrid, Spain  
Organized by:  
EPIC (PSA of the EP SRC H2020) and  
University Carlos III Madrid (UC3M)

**Calendar of Events**

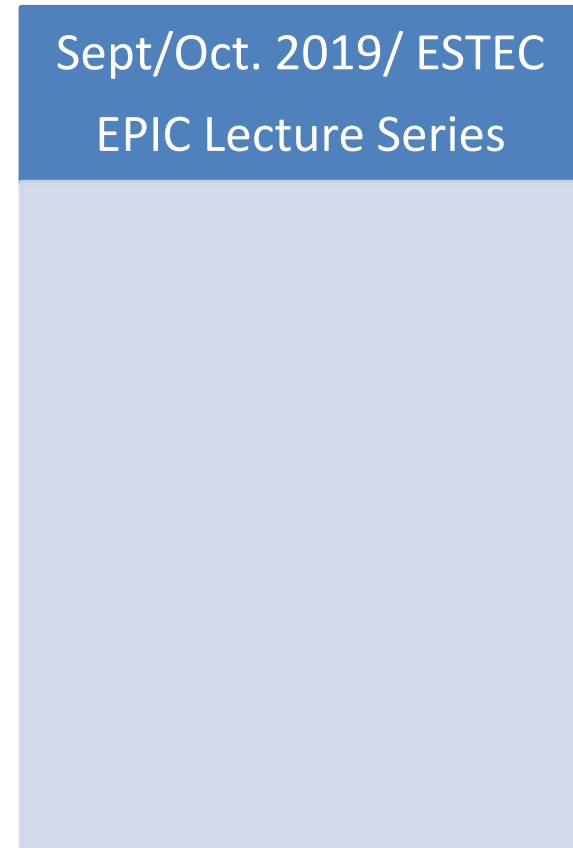
- Preliminary programme publication 15<sup>th</sup> July 2017
- General registration opens 11<sup>th</sup> September 2017
- General registration closes 7<sup>th</sup> October 2017
- Final program publication 15<sup>th</sup> October 2017
- Lecture Series date 26<sup>th</sup> October 2017

**Register on the EPIC website:**  
[epic-src.eu/lectureseries2017/](http://epic-src.eu/lectureseries2017/)



Oct. 2018/ London  
EPIC Lecture Series

**KEEP CALM AND WELCOME TO LONDON**



Sept/Oct. 2019/ ESTEC  
EPIC Lecture Series





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# EPIC Lecture Series presentations & videos



EPIC and partners education activities and material are available on our EPIC web

[epic-src.eu/](https://epic-src.eu/)

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Many thanks for your attention,...