CURRICULUM VITAE

VARELA RODRIGUEZ, JACOBO (Institute for Fusion Studies)

NAME:	Varela Rodriguez, Jacobo
DATE OF BIRTH:	18/08/1982
NATIONALITY:	SPAIN
CURRENT APPOINTMENT:	Researcher, Universidad Carlos III de Madrid
ORCID	0000-0002-6114-0539
ACADEMIC DEGREE:	PhD Physics Sciences (29/04/2011)
FIELD:	Plasma Physics and controlled fusion
INSTITUTE:	University Carlos III Madrid (SPAIN)

HIGHER EDUCATION:

Name Institution	Location	Degree	Field	Period
University Carlos III	Spain	PhD. Physics Sciences	Plasma Physics and controlled fusion	04/2011
University Carlos III	Spain	Advanced Study certificate	Plasma Physics and controlled fusion	09/2007
University of Vigo	Spain	Graduate Physics Sciences	Applied Physics	07/2005

EMPLOYMENT:

Name Institution	Location	Position	Period
University Carlos III	Spain	Post PhD. Research (stage)	05/2011 – 01/2012
Quantemol Ltd. / University College	England	Post PhD. Research Marie Curie (stage)	01/2012 – 04/2012
University Carlos III	Spain	Post PhD. Research (stage)	04/2012 – 08/2012
Observatory Paris-Meudon	France	Post PhD. Research european project SHOCK	08/2012 – 08/2014
LIMSI-University Paris Sud	France	Post PhD. Research	08/2014 - 08/2015
CEA Saclay	France	Post PhD. Research european project SPACE INN	08/2015 - 06/2016
Oak Ridge National Laboratory	USA	Post PhD. Research	06/2016 - 05/2018
National Institute for Fusion Science	Japan	COE Researcher	05/2018 – 03/2020
University Carlos III	Spain	Project PI	03/2020 – 12/2023
University of Texas-Austin	USA	Staff researcher	01/2024 - ...

LANGUAGE SKILLS (5 excellent – 1 poor):

	Reading	Writing	Hearing	Speaking
Spanish	native	native	native	native
English	5	5	5	5
French	4	3	4	4
Japanese	3	3	4	4
Portuguese	3	3	3	3

ADDRESS: Plaza Hermanos Pinzón, n 2 4D, Leganes, 28911, Spain

TELF: 645770344

EMAIL: jvrodrig@fis.uc3m.es

ORCID: https://orcid.org/0000-0002-6114-0539

Master project: “Study of 3D systems confined by magnetic fields”
PhD. Thesis: “Internal disruptions and ballooning modes in the Stellarator LHD”

PROJECT LIST:

- DGICYT Project No. ENE2009-12213-C03-03 (researcher)
- E.C. FP7/2007-2013 CORINF project No. 264951 (researcher)
- E.C. FP7/2007-2013 SHOCK project No. 284515 (researcher)
- E.C. FP7/2007-2013 SPACEINN project No. 312844 (researcher)
- Labex PALM/P2I0/LaSIPS (VKStar grant No. 2013-02711) (researcher)
- U.S. Department of Energy Contract Number DE-AC05-00OR22725 (researcher)
- FY2019 NIFS NCP 'Effect of the resonant magnetic perturbation on MHD phenomena of toroidally magnetized plasma' (researcher)
- FY2019 NIFS NCPE 'Control of Energetic Particle driven MHD Instabilities using ECH/ECCD' (researcher)
- FY2019 'Study of the MHD and AE stability of JT60SA' (researcher)
- Project 2019-T1/AMB-13648 atracción de talento de la Comunidad de Madrid senior (PI): 300000 €
- Project EXOPLAWIN (multidisciplinary project UC3M-CM). (PI): 80000 €

AWARDS:

- Number one in the Physics Sciences Promotion (2005, University of Vigo, Spain).

- Advanced study certificate in the Master of Excellence: Plasma Physics and nuclear fusion, with the highest score (2007, University Carlos III, Spain).

- Cum Laude qualification in the PhD. Report and defend (2011, Carlos III University, Spain).

- Press release of publication: “Effects of turbulence, resistivity and boundary conditions on helicoidal flow collimation: Consequences for the Von-Kármán-Sodium dynamo experiment”, Physics of Plasmas 24, 053518 (2017).

- Top reviewer 2020 Nuclear Fusion journal.

My research career covers different fields of computational plasma Physics: nuclear fusion, astrophysics, industrial and experimental plasmas. I have 16 years of research experience modeling plasma in different regimes, participating as researcher in international projects as well as project PI. My research experience is supported by publications in reference journals (51 papers including 34 as first author as well as 72 congress contributions), keeping an active collaboration with all the research groups I participated, performing original studies as leading researcher. I keep common research lines with the next institutions in the following topics:

RESEARCH LINES:

NUCLEAR FUSION PLASMAS

In collaboration with the next researcher and institutions:

1. ORNL QPS and ITER: D. Spong, D. Del Castillo and Y. Ghai:
   - AE stability in Tokamaks and Stellarators.
   - FAR3D code developing.
   - Gyrokinetic (GTC) code bench-marking.
2. DIII-D: M. Van Zeeland, D. Pace, W.W. Heidbrink, X. Du and A. Wingen.
   - Negative triangularity discharges
   - Optimization of NBI operational regime for steady state operations.
   - AE stability of high poloidal β and reverse shear discharges in DIII-D plasma.
3. NIFS: K.Y. Watanabe, S. Ohdachi, Y. Todo, K. Nagaoka, Y. Narushima, T. Tokuzawa, Y. Takemura, K. Ida and R. Seki.
   - Optimization of LHD plasmas versus AE/EPM instabilities.
   - Bench-marking of the FAR3d code with the hybrid code MEGA.
   - EIC events.
   - Ballooning and interchange modes stability in LHD inward/outward shifted configurations.
   - MHD soft-hard transitions.
   - Effect of the ECCD, ECH and NBCD on the LHD plasma stability.
   - Shear flows and zonal currents induced by EIC and MHD burst.
4. CIEMAT: C. Hidalgo, A. Cappa and S. Melnikov..
   - AE activity in TJ-II plasma.
5. Kyoto University: K. Nagasaki.
   - AE activity in Helitron J plasma.
6. QST Naka: S. Yamamoto, K. Shinohara, A. Bierwage, J. Shiraishi and M. Honda.
   - EPM/AE activity in JT-60SA.
7. EAST and CFETR: J. Huang, J. Chen, V. Chan
   - EPM/AE activity in EAST NBI + ICRH plasma.
   - Prediction of EPM/AE activity in CFETR steady state plasma.

8. JET and University of Marseilles: S. Sharapov, J. Garcia, S. Mazzi and D. Zarzoso.
   - AE activity in JET D-T plasma.
   - Generation of zonal currents by fish-bones: saw-tooth events destabilization.
9. CFQS: A. Shimizu.
   - Prediction of the AE activity in CFQS plasma.
10. University of Seville and ASDEX: M. Garcia Muñoz and J. Rueda.
    - Analysis of the AE activity in ASDEX plasma.
11. Marseilles University: D. Zarzoso and H. Betar
    - EP transport.
12. KSTAR: J. Kim and J. Kang
    - AE stability and optimization.
13. W7-X: A. Knieps
    - AE stability and optimization.

Research main topics:

(a) MHD Stability of stellarator and tokamak devices: Analysis of ballooning modes and interchange modes stability in LHD inward and outward configurations, Transitions between soft and hard MHD regimes and studies of MHD turbulence (nonlinear simulations). See figure I.

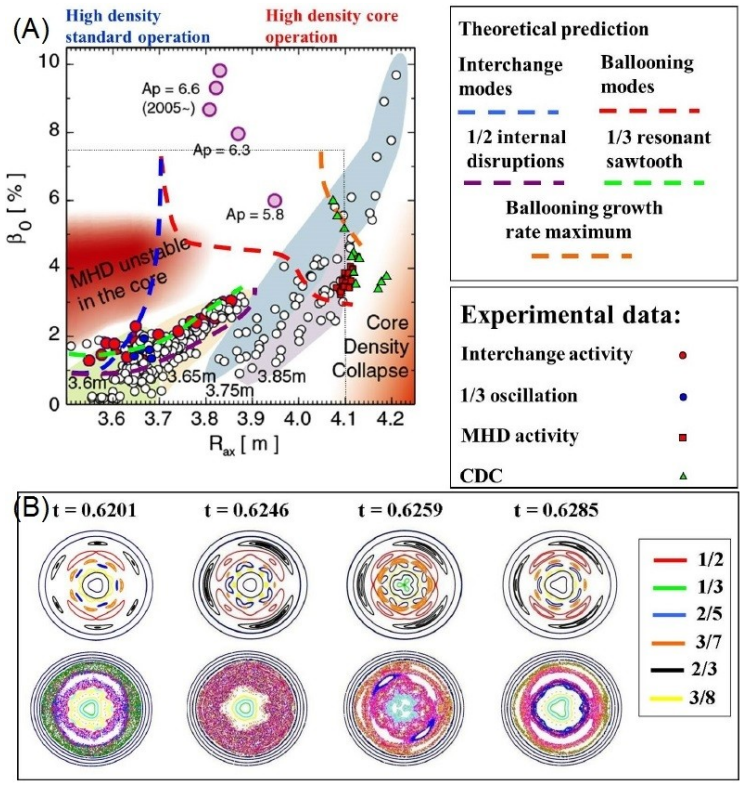

Fig. I. (A) Operation limits in the Large Helical Device versus MHD instabilities: interchange (blue) and ballooning modes (red), ½ internal disruptions (violet), 1/3 resonant sawtooth like events (green). Ballooning mode highest growth rate correlated with the Core Density Collapse events (orange). (B) Poincaré plots of the dominant modes magnetic island and stochastic regions during an internal disruption.

Publications:

1A Yoshiro NARUSHIMA, K.Y. WATANABE, Ryuichi SAKAMOTO, Ichihiro YAMADA, Kazumichi NARIHARA, Yasuhiro SUZUKI, Satoru SAKAKIBARA, Satoshi OHDACHI, Hiroshi YAMADA and LHD experimental group, Wilfred A. COOPER and Jacobo VARELA RODRIGUEZ, "*MHD Stability Analysis of IDB Plasma in LHD*", Plasmas Fusion Res. SERIES, Vol 8, 1070 – 1074, 2009.

2A S. Ohdachi, R. Sakamoto, J. Miyazawa, T. Morisaki, S.Masuzaki, H. Yamada, K.Y. Watanabe, V.R. Jacobo, N. Nakajima, F. Watanabe, M. Takeuchi, K. Toi, S. Sakakibara, Y. Suzuki, Y. Narushima, I. Yamada, T. Mianami, K. Narihara, K. Tanaka, T. Toruzawa, K. Kawahata and LHD Experimental group, "*Density collapse events observed in the Large Helical Device*", Contrib. Plasma Phys. Vol 50, 552 – 557, 2010.

3A J.A. Mier, R. Sanchez, L. Garcia, J. Varela and D.E. Newman, "Recurrence quantification analysis of simulations of near-marginal dissipative-trapped-electronmode turbulence", Phys. Plasmas, 18, 062306, 2011.

4A J. Varela, K.Y. Watanabe, N. Nakajima, S. Ohdachi, L. Garcia, J.A. Mier, "*Ballooning modes instabilities in the outward LHD configurations*", Plasmas Fusion Res. 6, 1403013, 2011.

5A J. Varela, L. Garcia, S. Ohdachi, K.Y. Watanabe and R. Sanchez, "*Internal disruptions and sawtooth like activity in Large Helical Device*", Phys. Plasmas 19, 082501, 2012.

6A J. Varela, K. Y. Watanabe, and S. Ohdachi, "*The internal disruption as hard Magnetohydrodynamic limit of 1/2 sawtooth like activity in large helical device*", Phys. Plasmas 19, 082512, 2012.

7A J. Varela, K. Y. Watanabe, S. Ohdachi, and Y. Narushima "*Hard magnetohydrodynamic limit in 1/3 sawtooth like activity in LHD*". Phys. Plasmas 21, 032501, 2014.

8A J. Varela, K. Y. Watanabe, S. Ohdachi, and Y. Narushima "*Magnetic turbulence and pressure gradient feedback effect of the ½ mode soft-hard magnetohydrodynamic limit in large helical device*". Phys. Plasmas 21, 092505, 2014.

1B J. Varela and L. Garcia, "*Global modes in 3D systems*", in III Institute for Bio-computation and Physics of the Complex Systems meeting (BIFI), 2 March, 2007.

2B Luis GARCIA, Jacobo VARELA and Kiyomasa WATANABE, "*Resistive MHD stability studies for LHD configurations*", in Proc. Of Joint Conference of 17th International Toki Conference (ITC) and 16th International Stellarator/Heliotron Workshop, P1-044, 15-19 Oct. 2007, Toki.

3B Narushima Y.; Watanabe, K.Y.; Sakamoto, R.; Suzuki, Y.; Sakakibara, S.;Ohdachi, S.; Yamada, H.; LHD, experimental group; Cooper, W.A.; Jacobo, V.R., "*Characteristics of Magnetohydrodynamics of IDB plasma in LHD*", ICPP 2008 – Int. Congress on Plasma Physics, Fukuoka, Japan, September 8-12, 2008, CRPPCONF-2009-129.

4B J.A. Mier, R. Sanchez, M.A. Pedrosa, C. Hidalgo, L. Garcia, J. Varela and D.E. Newman, "*Recurrent quantification analysis of experimental turbulent plasma data series*", 37th EPS Conference on Plasma Physics, P1.1068, 21-25 June, Dublin, 2010.

5B J. Varela, L. Garcia, K.Y. Watanabe, S. Ohdachi, J.A. Mier, "*Internal disruptions and sawtooth like events in LHD*", in Abst. Of 38 th EPS Conference on Plasma Physics, P5.077, 27 June – 1 July, 2011, Strasbourg.

6B S. Ohdachi, K. Tanaka, K. Y. Watanabe, N. Nakajima, Y. Takemura, Y. Suzuki, J. Varela, S. Sakakibara, R. Sakamoto, J, Miyazawa, I. Yamada, K. Ida, M. Yoshinuma, K. Toi, T. Morisaki, LHD Experiment Group. "*Observation of localized mode in the bad curvature region at the core-density-collapse event in the Large Helical Device*", oral session, Dalian, China, 9-12 June, 2015.

(b) Destabilization of Alfven Eigenmodes by energetic particles: Optimization of nuclear fusion devices to minimize or avoid the destabilization of Alfven Eigenmodes driven by energetic particles (NBI, ICRF and alpha particles). See figure II.

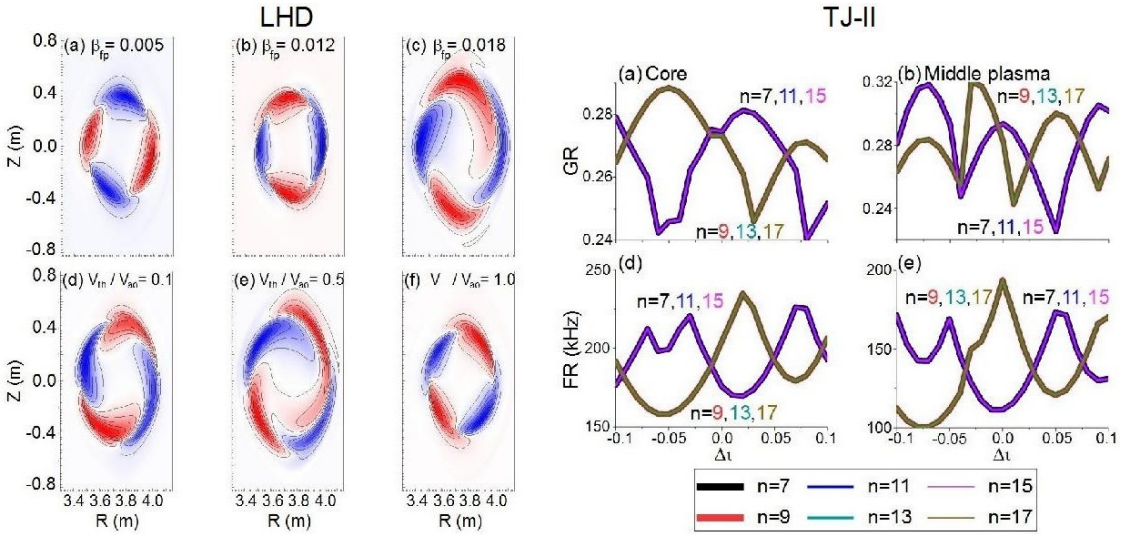

Figure II. (LHD) 2D plots of the n=1 EP instability for different EP beta (top) and velocity ratios (bottom). (TJ-II) Growth rate (top) and frequency (bottom) of HAE as the ι profile is displaced.

Publications:

1A J. Varela, D. A. Spong and L. Garcia "*Analysis of Alfven Eigenmodes destabilization by energetic particles in Large Helical Device using a Landau-closure model*", Nucl. Fusion, 57, 046018, 2017.

2A J. Varela, D. A. Spong and L. Garcia "*Analysis of Alfven Eigenmodes destabilization by energetic particles in TJ-II using a Landau-closure model*", Nucl. Fusion, 57, 126019, 2017.

3A D. C. Pace, M. E. Austin, L. Bardoczi, C. S. Collins, B. Crowley, E. Davis, X. Du, J. Ferron, B. A. Grierson, W. W. Heidbrink, C. T. Holcomb, G. R. McKee, C. Pawley, C. C. Petty, M. Podestà, J. Rauch, J. T. Scoville, D. A. Spong, K. E. Thome, M. A. Van Zeeland, J. Varela, and B. Victor, "*Dynamic neutral beam current and voltage control to improve beam efficacy in tokamaks*", Phys. Plasmas 25, 056109, 2018.

4A J. Varela, D.A. Spong, L. Garcia, J. Huang, M. Murakami, A.M. Garofalo, J.P. Qian, C.T. Holcomb, A.W. Hyatt, J.R. Ferron, C.S. Collins, Q.L. Ren, J. McClenaghan and W. Guo "*Analysis of Alfven Eigenmode destabilization in DIII-D high poloidal β discharges using a Landau closure model*", Nucl. Fusion, 58, 076017, 2018.

5A J. Varela, D. A. Spong, L. Garcia, S. Ohdachi, K. Y. Watanabe and R. Seki "*Analysis of the MHD stability and energetic particles effects on EIC events in LHD plasma using a Landau-closure model*", Nucl. Fusion, 59, 046008 (2019).

6A J. Varela, D. A. Spong, M. Murakami, L. Garcia, E. D'Azevedo, M.A. Van Zeeland and S. Munaretto "*Subdominant modes and optimization trends of DIII-D reverse magnetic shear configurations*", Nucl. Fusion, 59, 046017 (2019).

7A S. Taimourzadeh, E.M. Bass, Y. Chen, C. Collins, N.N. Gorelenkov, A. Könies, Z.X. Lu , D.A. Spong, Y. Todo, M.E. Austin, J. Bao1, A. Biancalani, M. Borchardt, A. Bottino, W.W. Heidbrink, R. Kleiber, Z. Lin, A. Mishchenko, L. Shi, J. Varela, R.E. Waltz, G. Yu, W.L. Zhang and Y. Zhu "*Verification and validation of integrated simulation of energetic particles in fusion plasmas*", Nucl. Fusion, 59, 066006 (2019).

8A J. Varela, D. A. Spong and L. Garcia "*Study of Alfven Eigenmodes stability in plasma with multiple NBI driven energetic particle species*", Phys. Plasmas, 26, 062502 (2019).

9A J. Varela, D. A. Spong and L. Garcia "*Analysis of Alfven Eigenmode destabilization in ITER using a Landau closure model*", Nucl. Fusion, 59, 076036 (2019).

10A J. Varela, W. A. Cooper, K. Nagaoka, K. Y. Watanabe, D. A. Spong, L. Garcia, A. Cappa and A. Azegami "*Effect of the tangential NBI current drive on the stability of LHD plasma*", Nucl. Fusion, 60, 026016 (2020).

11A J. Varela, S. Ohdachi, K. Y. Watanabe, D. A. Spong, L. Garcia and R. Seki "*Theoretical analysis of EIC stabilization strategies using a Landau closure model*", Nucl. Fusion, 60, 046013 (2020).

12A S. Yamamoto, K. Nagasaki, K. Nagaoka, J. Varela, Á. Cappa, E. Ascasíbar, F. Castejón, J.M. Fontdecaba, J.M. García-Regaña, Á. González-Jerez, K. Ida, A. Ishizawa, M. Isobe, S. Kado, S. Kobayashi, M. Liniers, D. López-Bruna, N. Marushchenko, F. Medina, A. Melnikov, T. Minami, T. Mizuuchi, Y. Nakamura, M. Ochando, K. Ogawa, S. Ohshima, H. Okada, M. Osakabe, M. Sanders, J.L. Velasco, G. M. Weir and M. Yoshinuma "*Effect of ECH/ECCD on energetic-particle-driven MHD modes in helical plasmas*", Nucl. Fusion, 60, 066018 (2020).

13A J. Varela, K.Y. Watanabe , K. Shinohara, Y. Suzuki, A. Bierwage, J. Shiraishi, M. Honda, N. Aiba, D. Spong and L. Garcia *"MHD stability of JT-60SA operation scenarios driven by passing energetic particles for a hot Maxwellian model"*, Nucl. Fusion, 60, 096009 (2020).

14A J. Varela, K. Nagasaki, K. Nagaoka, S. Yamamoto, D. Spong, L. Garcia, A. Cappa, K.Y. Watanabe and A. Azegammi "*Modeling of the ECCD injection effect on the Heliotron J and LHD plasma stability*", Nucl. Fusion, 60, 112015 (2020).

15A J. Huang, A.M. Garofalo, J.P. Qian, X.Z. Gong, S.Y. Ding, J. Varela, J.L. Chen, W.F. Guo, K. Li, M.Q. Wu, C.K. Pan, Q. Ren, B. Zhang, L.L. Lao, C.T. Holcomb, J. McClenaghan, D. Weisberg, V. Chan, A. Hyatt, W.H. Hu, G.Q. Li, J. Ferron, G. McKee, R.I. Pinsker, T. Rhodes, G.M. Staebler, D. Spong and Z. Yan *"Progress in extending high poloidal beta scenarios on DIII-D towards a steady-state fusion reactor and impact of energetic particles"*, Nucl. Fusion, 60, 126007 (2020).

16A J. Varela, A. Shimizu, D. A. Spong, L. Garcia and Y. Ghai "*Study of the Alfven Eigenmodes stability in CFQS plasma using a Landau closure model"*, Nucl. Fusion, 61, 026023 (2021).

17A Á. Cappa, J. Varela, D. López Bruna, E. Ascasíbar, M. Liniers, L.G. Eliseev, J.M. Fontdecaba, J.M. García-Regaña, A. González-Jerez, N.K. Kharchev *"Stability analysis of TJ-II stellarator NBI driven Alfvén eigenmodes in ECRH and ECCD experiments",* Nucl. Fusion 61 066019 (2021).

18A L. Eliseev, A. Melnikov, E. Ascasibar, A. Cappa, M. Drabinskkiy, C. Hidalgo, P. Khabanov, N. Kharchev, A. Kozachek, M. Liniers, S. Lysenko, M. Ochando, J. Pablos, I. Pastor, S. Sharapov, D. Spong, B. Breizman and J. Varela, "*Experimental observation of the geodesic acoustic frequency limit for the NBI-driven Alfven eigenmodes in JT-II*". Physics of Plasma, 28, 072510 (2021).

19A J. Varela, D. Spong, L. Garcia, S. Ohdachi, K. Y. Watanabe, R. Seki and Y. Ghai. "*Theoretical analysis of the saturation phase of the 1/1 energetic-ion-driven resistive interchange mode*". Nucl. Fusion, 61, 126016 (2021).

20A D. Spong, M. Van Zeeland, W. Heidbrink, X. Du, J. Varela, L. Garcia and Y. Ghai "*Nonlinear dynamics and transport driven by energetic particle instabilities using a gyro-Landau closure model*". Nucl. Fusion, 61, 116061 (2021).

21A Y. Ghai, D. Spong, J. Varela, L. Garcia and M. Van Zeeland. "*Effects of negative triangularity shaping on energetic particle driven Alfvén eigenmodes in DIII-D*". Nucl. Fusion, 61, 126020 (2021).

22A M. Osakabe, H. Takahashi, H. Yamada, K. Tanaka, T. Kobayashi, K. Ida, S. Ohdachi, J. Varela, K. Ogawa, M. Kobayashi, K. Tsumori, K. Ikeda, S. Masuzaki, M. Tanaka, M. Nakata, S. Murakami, S. Inagaki, K. Mukai, M. Sakamoto, K. Nagasaki, Y. Suzuki, M. Isobe, T. Morisaki. "*Recent results from Deuterium experiments on the Large Helical Device and their contribution to fusion reactor development*", Nucl. Fusion, 62, 042019 (2022).

23A J. Varela, J. Huang, D. Spong, C. Jiale, V. Chan, L. Garcia, A. Wingen, Y. Ghai and Y. Zou "*Theoretical study of the Alfven Eigenmode stability in CFETR steady state discharges*" Nucl. Fusion, 62, 036005 (2022).

24A C. Hidalgo, E. Ascasíbar, D. Alegre, A. Alonso, J. Alonso, R. Antón, A. Baciero, J. Baldzuhn, J.M. Barcala, L. Barrera, E. Blanco, J. Botija, L. Bueno, S. Cabrera, A. de Castro, E. de la Cal, I. Calvo, A. Cappa, D. Carralero, R. Carrasco, B. Carreras, R. Castro, A. de Castro, L. Cebrián, A.A. Chmyga, M. Chamorro, P. Colino, F. de Aragón, M. Drabinskiy, J. Duque, L. Eliseev, F. J. Escoto, T. Estrada, M. Ezzat, F. Fraguas, D. Fernández-Ruiz, J.M. Fontdecaba, A. Gabriel, D. Gadariya, L. García, I. GarcíaCortés, R. García-Gómez, J. M. García-Regaña, A. González-Jerez, G. Grenfell, J. Guasp, V. Guisse, J. Hernández-Sánchez, J. Hernanz, A. Jiménez-Denche, P. Khabanov, N. Kharchev, R. Kleiber, F. Koechl, T. Kobayashi, G. Kocsis, M. Koepke, A.S. Kozachek, L. Krupnik , F. Lapayese, M. Liniers, B. Liu, D. López-Bruna, B. López-Miranda, U. Losada, E. de la Luna, S.E. Lysenko, F. Martín-Díaz, G. MartínGómez, E. Maragkoudakis, J. Martínez-Fernández, K.J. McCarthy, F. Medina, M. Medrano, A.V. Melnikov, P. Méndez, F.J. Miguel, B. van Milligen, A. Molinero, G. Motojima, S. Mulas, Y. Narushima, M. Navarro, I. Nedzelskiy, R. Nuñez, M. Ochando, S. Ohshima, E. Oyarzábal, J.L. de Pablos, F. Palomares, N. Panadero, F. Papoušek, F. Parra, C. Pastor, I. Pastor, A. de la Peña, R. Peralta, A. Pereira, P. Pons, H. Polaino, A.B. Portas, E. Poveda, F.J. Ramos, G.A. Rattá, M. Redondo, C. Reynoso, E. Rincón, C. Rodríguez-Fernández, L. Rodríguez-Rodrigo, A. Rosi, E. Sánchez, J. Sánchez, E. Sánchez-Sarabia, S. Satake, J.A. Sebastián, R. Sharma, N. Smith, C. Silva, E.R. Solano, A. Soleto, M. Spolaore, T. Szepesi, F.L. Tabarés, D. Tafalla, H. Takahashi, N. Tamura, H. Thienpondt, A. Tolkachev, R. Unamuno, J. Varela, J. Vega, J.L. Velasco, I. Voldiner, S. Yamamoto "*Overview of the TJ-II stellarator research programme towards model validation in fusion plasma*", Nucl. Fusion, 62, 042025 (2022).

24A Y. Kamada, E. Di Pietro, M. Hanada, P. Barabaschi, S. Ide, S. Davis, M. Yoshida, G. Giruzzi, C. Sozzi and the JT-60SA Integrated Project Team "*Completion of JT-60SA construction and contribution to ITER*", Nucl. Fusion, 62, 042002 (2022).

25A J. Varela, D. A. Spong, Y. Todo, L. Garcia, Y. Ghai, J. Ortiz and R. Seki *"Simulation of the TAEs saturation phase in Large Helical Device device: MHD burst",* Nucl. Fusion, Nucl. Fusion, 62, 126020 (2022).

26A J. Varela, K. Nagasaki, S. Kobayashi, K. Nagaoka, P. Adulsiriswad, A. Cappa, S. Yamamoto, K.Y. Watanabe, D. A. Spong, L. Garcia, Y. Ghai and J. Ortiz *"Analysis of the ECH effect on the EPM/AEs stability in Heliotron J plasma using a Landau closure model",* Nucl. Fusion, 63, 026009 (2023)

27A J. Ortiz-Luengo, J. Varela, D. Spong, L. Garcia and Y. Ghai *"Study of the Alfvén Eigenmodes stability in Quasi Poloidal Stellarator (QPS) plasma using a Landau closure model",* Nucl. Fusion, 63, 056010 (2023)

28A J. Varela, D. A. Spong, L. Garcia, Y. Ghai, D. Zarzoso, D. del-Castillo-Negrete, H. Betar, J. Ortiz-Luengo, D. C. Pace, M. A. Van Zeeland, X. Du, R. Sanchez, V. Tribaldos and J. M. Reynolds-Barredo "*Effect of the neutral beam injector operational regime on the Alfven eigenmode saturation phase in DIII-D plasma*", PPCF, 65, 125004 (2023)

29A XH. Wang, J. Huang, J. Varela, HL. Zhao, D.A. Spong, LQ. Xu, W. Shen, JF. Chang, J. Fu, YX. Sun, C. Shi, SS. Wang and EAST Team "*Analysis of beam ion driven Alfven Eigenmode stability in EAST*", Nucl. Fusion 64 016028 (2024).

30A J. Varela, K. Nagaoka, Y. Takemura, K.Y. Watanabe, K. Ida, M. Yoshinuma, K. Nagasaki, A. Cappa, S. Sharapov, D. A. Spong, L. Garcia, Y. Ghai and J. Ortiz "*MHD stability trends and improved performance of LHD inward shifted configurations: the role of the neutral beam current drive and thermal plasma density*", Physics of Plasma, 31, 082504 (2024).

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32A J. Garcia, Y. Kazakov, R. Coelho, M. Dreval, E. Luna, E. R Solano, Z. Stancar, J. Varela, M. Baruzzo, E. Belli, P. J Bonofiglo, J. Candy, C. F Maggi, J. Mailloux, S. Mazzi, J. Ongena, M. Poradzinski, J. R Ruiz, S. Sharapov, D. Zarzoso *"Stable Deuterium-Tritium burning plasmas with improved confinement in the presence of energetic-ion instabilities"*, Nature communications, 15, 7846 (2024).

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3B D. A. Spong, J. Varela, D. del-Castillo, L. Carbajal, L. Baylor and S. Seal "*A new gyrofluid model for 3D systems and recent modeling of runaway electron suppression by pellet clouds*", oral 17th Meeting of the ITPA Topical Group on Energetic Particles, Kyoto, 2016.

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37B A. Cappa, E. Ascasibar, M. Liniers, D. López-Bruna, J. García-Regaña, J. Velasco, J. Varela, S. Mulas, M. Ochando, F. Medina and J. Fontdecaba "*NBI-driven shear Alfvén waves in the presence of ECR heating and EC driven current in the TJ-II stellarator*", poster ID 962, 28th IAEA FEC, 2021.

38B D. Spong, M. Van Zeeland, W. Heidbrink, X. Du, J. Varela, L. Garcia, and Y. Ghai "*Nonlinear dynamics and stability surveys of energetic particle instabilities*", poster ID 675, 28th IAEA FEC, 2021.

39B S. Ohdachi, J. Varela, K.Y. Watanabe, H. Nakano, H. Takahashi, Y. Suzuki, Y. Narushima, T. Bando, X. Du and T. Morisaki "*Suppression of the energetic particle driven interchange mode in the Large Helical Device*", poster ID 800, 28th IAEA FEC, 2021.

40B J. Varela, K. Nagasaki, K. Nagaoka, S. Yamamoto, D. Spong, L. Garcia , A. Cappa and K.Y. Watanabe "*Theoretical analysis of the ECH effect on the energetic particle driven modes stability in Heliotron J* ", poster ID 15692, 47th EPS, 2021.

41B Y. Ghai, D. A. Spong, J. Varela, L. Garcia and M. Van Zeeland "*Suppression of Alfvén eigenmodes with negative triangularity plasma shaping*", oral session, Sherwood meeting, 2021.

42B J. Varela, D. A. Spong, Y. Todo, L. Garcia, Y. Ghai and J. Ortiz "*Saturation phase of the Toroidal Alfven Eigenmodes in the Large Helical Device: MHD burst*", Oral session PO07.00011, 63rd APS meeting, November 8–12, Pittsburgh, PA, 2021.

43B Y. Ghai, D. A. Spong, J. Varela, L. Garcia and M. Van Zeeland "*Effects of negative triangularity shaping on energetic particle driven Alfvén eigenmodes*", Oral session PO07.00010, 63rd APS meeting, November 8–12, Pittsburgh, PA, 2021.

44B D. Spong, W. Heidbrink, M. Van Zeeland, Y. Ghai, J. Varela and L. Garcia "*Efficient evaluation of the EP-driven stability landscape and nonlinear states using Landau closure methods*", poster JP11.00072, 63rd APS meeting, November 8–12, Pittsburgh, PA, 2021.

45B J. Ortiz, J. Varela, D. A. Spong, L. Garcia and Y. Ghai "*AE stability of QPS configurations using a Landau closure model*", poster GP11.00040, 63rd APS meeting, November 8–12, Pittsburgh, PA, 2021.

46B D. Spong, M. Van Zeeland, W. Heidbrink, Y. Ghai, J. Varela and L. Garcia "*Simulation of EP-driven nonlinear collective effects using Landau closure methods*", oral session, 17th Technical Meeting on Energetic Particles and Theory of Plasma Instabilities in Magnetic Confinement Fusion (online), 6-9 December, 2021.

47B Y. Ghai, D. Spong, J. Varela, L. Garcia and M. Van Zeeland, "*Negative triangularity shaping effects on Alfvén eigenmodes in DIII-D plasma*", oral session, 17th Technical Meeting on Energetic Particles and Theory of Plasma Instabilities in Magnetic Confinement Fusion (online), 6-9 December, 2021.

48B F. Poli, J. Breslau, D. Spong, M. Podesta, A. Teplukhina, J. Varela, L. Garcia, Y. Ghai and JET contributors "*Feasibility of kinetic stability analysis in time-dependent simulations and applications for predictions and design of controlled plasma discharges*", oral session, 17th Technical Meeting on Energetic Particles and Theory of Plasma Instabilities in Magnetic Confinement Fusion (online), 6-9 December, 2021.

49B J. Varela, K.Y. Watanabe, Y. Takemura, K. Nagaoka, D. Spong, L. Garcia, J. Ortiz, Y. Ghai and LHD experimental group "Effect of the neutral beam current drive in the stability of LHD plasma: experimental results and numerical analysis", oral session, ISHW, 20-24 June, Warsaw, 2022.

50B J. Varela, K.Y. Watanabe, Y. Takemura, K. Nagaoka, D. Spong, L. Garcia, J. Ortiz, Y. Ghai "Optimization of pressure gradient driven modes and Alfven Eigenmodes stability by the neutral beam current driven in LHD plasma", Poster P4a.107 , EPS 2022, 27 June to 1 July, online, 2022.

51B K. Nagasaki, S. Ohshima, S. Kobayashi, T. Minami, S. Kado, S. Inagaki, Y. Nakamura, A. Ishizawa, S. Konoshima, T. Mizuuchi, H. Okada, D. Qiu, A. Iwata, P. Zhang, M. Luo, C. Wang, Y. Kondo, A. Miyashita, C. Feng, N. Kenmochi, G. Motojima, P. Adulsiriswad, J. Varela, N. Marushchenko "*Control of 3-D Magnetic Configuration for Confinement and Transport in Heliotron J*", Invited talk, ICPP 2022, 27 November - 2 December, Gyeongju, Korea , 2022.

52B. D. Spong, Y. Ghai, J. Varela and L. Garcia "*Nonlinear Alfvén instability analysis for ITER regimes*", oral session YO03.00014, 64rd APS meeting, October 17–21, Spokane, WA, 2022.

53B. J. Varela, D. Spong, L. Garcia, Y. Ghai, D. Zarzoso, H. Betar, J. Ortiz, D. C. Pace, M. A. Van Zeeland and X. Du "*Effect of the NBI operational regime on the AE saturation phase in DIII-D plasma*", Invited talk, Sherwood theory meeting, Knoxville, USA, May 8-10, 2023.

54B. J. Ortiz, L. Herrera, J. Varela, L. Garcia, F. Papousek, B. Milligen, M. Ochando, C. Hidalgo, Á. Cappa, P. Pons-Villalonga, D. A. Spong, Y. Ghai "*Analysis of the AE activity in the TJII periphery using Landau closure model*", Poster, 49th EPS, Bordeaux, France, July 3-7, 2023.

55B. K. Nagaoka, A. Azegami, H. Yamaguchi, R. Seki, K. Ogawa, M. Isobe, M. Osakabe, Y. Fujiwara, S. Kamio, J. Varela "*External control of stiff energetic-ion-profile with Alfven eigenmode activities*", Poster, 29th IAEA FEC, London, UK, October 16-21, 2023.

56B. J. Garcia, P. Bonofiglio, R. Coelho, M. Dreval, R. Dumont, M. Fitzgerald, Y. Kazakov, D. Keeling, V. KiptiliI, E. de la Luna, 5 C. Maggi, J. Mailloux, P. Mantica, S. Mazzi, M. Nocente, M. Podesta, S. Sharapov, Z. Stancar, A. Tinguely, J. Varela and D. Zarzoso "Alpha particle and fast ion studies in JET DTE2 plasmas", Poster, 29th IAEA FEC, London, UK, October 16-21, 2023.

57B. D.A. Spong, Y. Ghai, J. Varela and L. Garcia "*Nonlinear Alfvén instability analysis and nonlocal EP transport in ITER*", Poster, 29th IAEA FEC, London, UK, October 16-21, 2023.

58B. J. Varela, K. Nagaoka, K.Y. Watanabe, Y. Takemura, L. Garcia, Y. Ghai, K. Ida, K. Nagasaki, D. A. Spong, S. Sharapov and M. Yoshinuma "*Optimization of the MHD stability in inwards shifted LHD plasmas: neutral beam current drive, plasma density and NBI operational regime*", Poster, 29th IAEA FEC, London, UK, October 16-21, 2023.

59B. J. Varela, C. Hidalgo, T. Tokuzawa, K. Nagaoka, K. Nagasaki, S. Ohdachi, K. Ida, A. Cappa, S. Sharapov, D. Zarzoso, D. Spong, L. Garcia, Y. Ghai and J. Ortiz "*Shear flows induced by AE / EPM in LHD plasma*", Invited talk, AAPPS-DPP2023, Nagoya, Japan, November 12-17, 2023.

60B J. Varela, J. Garcia, S. Mazzi, Y. Kazakov, Ž. Štancar, M. Baruzzo, J. Ongena, D. Spong, L. Garcia, Y. Ghai, D. Zarzoso, J. Ortiz, M. Poradzinski, C. Hidalgo, T. Tokuzawa, K. Nagaoka, K. Tanaka, K. Nagasaki, S. Ohdachi, K. Ida, X. Du, A. Cappa, S. Sharapov, B. Breizman, F. L. Waelbroeck, JET contributors and EUROfusion Tokamak Exploitation team "*Analysis of the shear flows induced by Alfven eigenmodes and energetic particle modes in D-T JET and LHD experiments*", Oral session, 31st ITPA EP, 16 - 18 April, Daejon, South Korea, 2024.

61B J. Varela, J. Garcia, S. Mazzi, Y. Kazakov, Ž. Štancar, M. Baruzzo, J. Ongena, D. Spong, L. Garcia, Y. Ghai, D. Zarzoso, J. Ortiz, M. Poradzinski, JET contributors and EUROfusion Tokamak Exploitation team "*Analysis of the shear flows induced by Alfven eigenmodes and fish-bones in D-T JET experiment*", Poster, Sherwood meeting, 06 - 08 May, Missoula, USA, 2024.

62B D. A. Spong, Y. Ghai, J. Varela and L. Garcia, "*Nonlinear Alfvén instability simulation and EP transport for the ITER reversed shear (steady-state) regime*", Poster, Sherwood meeting, 06 - 08 May, Missoula, USA, 2024.

63B J. Varela, J. Garcia, S. Mazzi, Y. Kazakov, Ž. Štancar, M. Baruzzo, J. Ongena, D. Spong, L. Garcia, Y. Ghai, D. Zarzoso, J. Ortiz, M. Poradzinski, JET contributors and EUROfusion Tokamak Exploitation team, "*Analysis of the energetic particle transport in D-T JET experiment: multi species non linear simulations*", Oral, EPS 50th, 8 - 12 July, Salamanca, Spain, 2024.

64B J. Varela, K. Nagasaki, Y. Zhong, S. Kobayashi, K. Nagaoka, P. Adulsiriswad, A. Cappa, S. Yamamoto, K.Y. Watanabe, D.A. Spong, L. Garcia, Y. Ghai, J. Ortiz and F. Waelbroeck, "*Analysis of the ECH effect on EPM/AE stability in Heliotron J plasma using a Landau closure model*", Poster, ISHW 24th, 9 - 13 September, Hiroshima, Japan, 2024.

65B J. Varela, J. Garcia, S. Mazzi, Y. Kazakov, Ž. Štancar, M. Baruzzo, J. Ongena, D. Zarzoso, B. Breizman, F. Waelbroeck, D. Spong, L. Garcia, Y. Ghai, R. Fitzpatrick, S. M. Mahajan, D. Hatch, J. Ortiz, M. Poradzinski, JET contributors and EUROfusion Tokamak Exploitation team, "*Effect of multiple energetic particle populations in burning plasma: consequences on JET D-T campaign and ITER*", Oral, APS 66th, 7 - 11 October, Atlanta, USA, 2024.

66B D. Spong, Y. Ghai, J. Varela and L. Garcia , *"Nonlinear Alfvén instability simulation of the ITER reversed shear regime "*, Poster, APS 66th, 7 - 11 October, Atlanta, USA, 2024.

67B Y. Ghai, D. Spong, J. Varela, L. Garcia, J. Ortiz, W. Dayok , "*Surrogate model of energetic particle transport in reactor-relevant fusion devices* ", Poster, APS 66th, 7 - 11 October, Atlanta, USA, 2024.

ASTROPHYSICAL PLASMAS

In collaboration with the next researcher and institutions:

1. Observatory of Paris: F. Pantellini, M. Moncuquet and P. Zarka.
   - Analysis of the Hermean magnetosphere: MESSENGER and BepiColombo missions.
   - Slow modes in the Herman magnetosphere
   - Solar wind interaction with planetary magnetospheres.
   - Exoplanet radio emission.
2. CEA Saclay, LDEE group, S. Brun and A. Strugarek.
   - Convective dynamos in solar-like stars.
   - Space weather.
   - Earth habitability among the Sun main sequence.
3. SMILE project, A. Samsonov.
   - MHD simulations of the Earth magnetosphere
4. German Aerospace center, I. Fernández.
   - MHD simulation of the solar wind interaction with the Earth magnetosphere during CME events.
5. Institute of Astrophysics of Granada and the CARMENES observatory: M.. Pérez-Torres.
   - Space weather and radio-emission from Proxima Centauri exoplanets.
6. Nicolaus Copernicus Astronomical center: M. Cemeljic.
   - Space weather effects on exoplanets around neutron stars.
   - Interaction of the stellar wind with the magnetosphere of the exoplanet HD189733b.

Research main topic:

(a) European project SHOCK (Stellar wind interaction with the Hermean magnetospheres): Solar and Heliospheric Collisionless Kinematics, Seventh Framework Programme FP7 of the European Commission (see http://project-shock.eu/blog/) at Observatory of Paris. The aim of the research was to simulate the interaction between the solar wind and the magnetosphere of Mercury with MHD codes (PLUTO and VAC). See figure III.

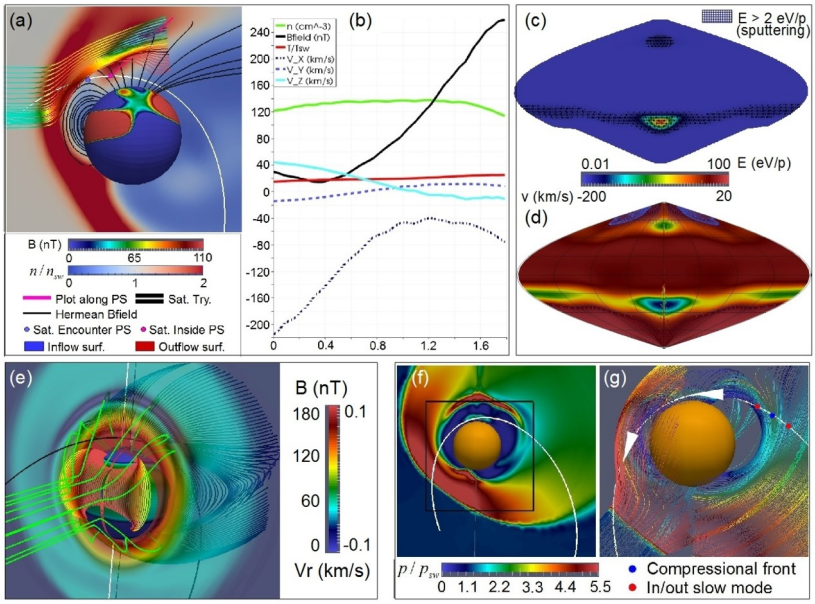

Fig III. (a) Density distribution, inflow/outflow regions on the planet surface and |B| along solar wind stream lines. The black lines (Hermean magnetic field), white line (satellite trajectory) and pink line (plot figure b). (b) Plot of density, |B|, temperature and velocity. (c) Energy load and sputtering regions on the planet surface. (d) Radial velocity and open B field lines on the planet surface. (e) Solar wind leaks in the inner magnetosphere toward the reconnection región. (f) and (g) show the slow mode and compressional front in the Hermean magnetosphere.

Publications:

1A F. Pantellini, L. Griton and J. Varela, "*Rarefaction and compressional standing slow mode structures in Mercury's magnetosheath: 3D MHD simulations*", PSS. 112, 1, 2015.

2A J. Varela, F. Pantellini and M. Moncuquet "*The effect of interplanetary magnetic field orientation on the solar wind flux impacting Mercury's surface*", Planetary and Space Science, 119, 264, 2015.

3A. J. Varela, F. Pantellini and M. Moncuquet "*Parametric study of the solar wind interaction with the Hermean magnetosphere for a weak interplanetary magnetic field*", Planetary and Space Science, 120, 78, 2016.

4A J. Varela, F. Pantellini and M. Moncuquet "*Plasma streams in the Hermean dayside magnetosphere: solar wind injection through the reconnection region*", Planetary and Space Science, 122, 46, 2016.

5A J. Varela, F. Pantellini and M. Moncuquet "*Slow modes in the Hermean magnetosphere: effect of the solar wind hydrodynamic parameters and IMF orientation*", Planetary and Space Science, 125, 80, 2016.

6A J. Varela, F. Pantellini and M. Moncuquet "*Effect of interplanetary magnetic field orientation and strength on the Hermean magnetosphere*", Planetary and Space Science, 129, 74, 2016.

7A J. Varela, V. Reville, S. Brun, F. Pantellini and P. Zarka "*Radio emission in Mercury magnetosphere*", A&A, 595, A69, 2016.

8A J. Varela and F. Pantellini "*Slow-mode rarefaction and compression fronts in the Hermean magnetosphere: From MESSENGER insights to future BepiColombo observations*", A&A, 675, A148 (2023).

1B J. Varela and F. Pantellini, "*MHD simulations of the solar wind interaction with the magnetosphere of Mercury*", poster in the EGU Assembly, Vienna, PS5.1/ST4.3 EGU2014-2216, 27 April to 02 May 2014.

2B J. Varela, F. Pantellini and M. Moncuquet "*Simulation of the solar wind interaction with the magnetosphere of Mercury*", oral in the PNST, Sète, France, 02 to 04 Feb 2014.

3B J. Varela, F. Pantellini and M. Moncuquet "*The effect of the interplanetary magnetic field orientation in the Hermean magnetosphere structure*", oral session in the Star-Planet Interactions and Habitable Zone,, Saclay, France, Novermber 18-21 2014.

4B J. Varela, F. Pantellini and M. Moncuquet "*Viscous and resistive heating in the night side of the Hermean magnetosphere*", poster in the EGU Assembly, Vienna, PS5.1/ST4.3 EGU2015-9425, 12-17 April 2015.

5B J. Varela, F. Pantellini and M. Moncuquet "*Structures in the Hermean magnetosphere day side for MESSENGER low altitude polar orbits*", poster in the EGU Assembly, Vienna, PS5.1/ST4.3 EGU2015-9564, 12-17 April 2015.

6B J. Varela, and F. Pantellini "*Indirect measurements of slow modes in the Hermean magnetosphere*", poster P5.413, EPS, Belfast, 2017.

(b) Space weather effects on the habitability and radio emission on planetary magnetospheres: MHD simulation dedicated to study the effect of the stellar wind and interplanetary magnetic field on planetary magnetospheres. The effect of the space weather conditions during regular and CME-like conditions were analyzed for the Earth and exoplanets. The radio emission is calculated applying the radio-magnetic Bole´s law. See figure IV:

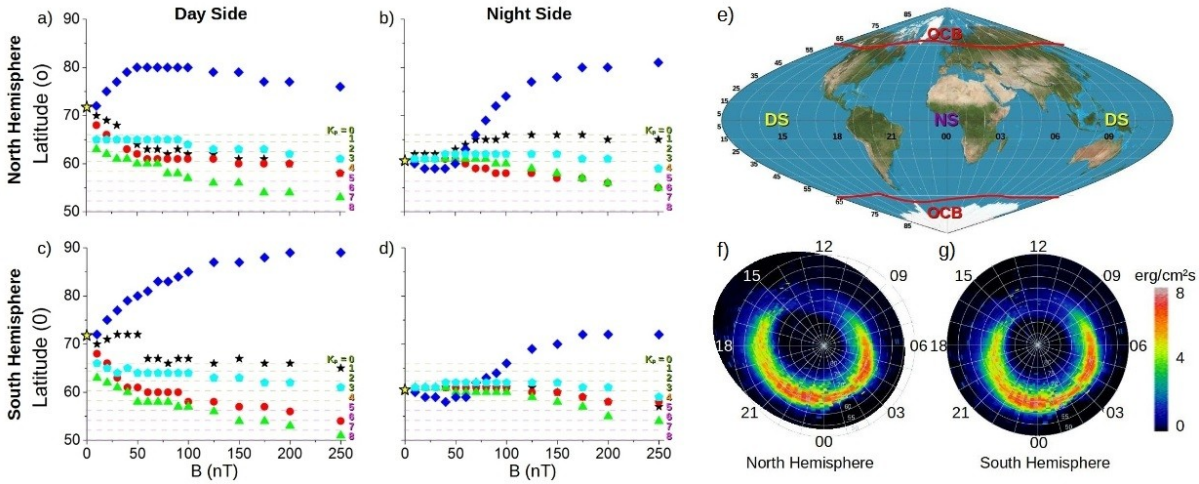

Fig IV. OCB latitude with respect to the IMF orientation and jBIMFj calculated in the North Hemisphere (a) DS (0o longitude) and (b) NS (180o longitude), South Hemisphere (c) DS and (d) NS. Fixed Pd = 1:2 nPa and Tsw = 1:8 105 K. The dashed horizontal lines indicate the Kp index. The yellow star indicates the OCB latitude if jBIMFj = 0. IMF direction: Sun-Earth (black star), Earth-Sun (red circle), northward (blue diamond),southward (green triangle), and ecliptic ctr-clockwise (cyan pentagon). (e) OCB line calculated from the 27=05=2017 ICME simulation. Energy flux calculated by Ovation prime simulations at the (f) North Hemisphere and (g) South Hemisphere. Ovation prime data are provided by the iSWA

Publications:

1A J. Varela, V. Reville, S. Brun, P. Zarka and F. Pantellini "*Effect of the exoplanet magnetic field topology on its magnetospheric radio emission* ", A&A, 616, A182 (2018).

2A J. Varela, S. Brun, A. Strugarek, V. Reville, P. Zarka and F. Pantellini. "*MHD study of the planetary magnetospheric response during extreme solar wind conditions: Earth and exoplanet magnetospheres applications*" Astronomy and Astrophysics, 659, A10 (2022).

3A J. Varela, A. S. Brun, P. Zarka, A. Strugarek, F. Pantellini, V. Reville "*MHD study of extreme space weather conditions for exoplanets with Earth-like magnetospheres: On habitability conditions and radio-emission*", Space Weather, 20, e2022SW003164 (2022).

4A J. Varela, A. S. Brun, A. Strugarek, V. Reville, P. Zarka and F. Pantellini, *" On Earth's habitability o v er the Sun's main-sequence history: joint influence of space weather and Earth's magnetic field evolution",* MNRAS 525, 4008–4025 (2023).

5A R. Mishra, M. Cemeljic, J.Varela and M. Falanga *"Auroras on planets around pulsars ",* ApJ, 959, L13 (2023).

6A A. Canet, J. Varela and A. I Gomez de Castro *"Stellar wind impact on early atmospheres of unmagnetized Earth-like planets"*, MNRAS, 531 2626 (2024).

7A L. Peña-Moñino, M. Torres and J. Varela *"Magnetohydrodynamic simulations of the space weather in Proxima b: Habitability conditions and radio emission"*, A&A, 88, A138 (2024).

1B J. Varela, A. S. Brun, A. Strugarek, V. Réville, P. Zarka, F. Pantellini "*3D MHD study of the Earth magnetosphere response during extreme space weather conditions*", PICO presentation EGU21-1684 , EGU, 2021.

2B J. Varela, A. S. Brun, A. Strugarek, V. Réville, P. Zarka and F. Pantellini "*3D MHD study of the Earth magnetosphere response during extreme space weather conditions: applications to exoplanets*", poster, WHPI workshop (online), September 13-17, 2021.

3B J. Varela, A. S. Brun, P. Zarka, A. Strugarek, F. Pantellini and V. Réville "*MHD study of extreme space weather conditions for exoplanets with Earth-like magnetospheres: On habitability conditions and radio-emission*", Poster, Cool Stars 2022, 4 - 8 July, Toulouse, 2022.

4B J. Varela, A. S. Brun, P. Zarka, A. Strugarek, F. Pantellini, and V. Reville "*Effect of the space weather on exoplanet habitability conditions and magnetospheric radio-emission*", Poster, SEA 2022, 5 - 9 September, Tenerife, 2022.

5B J. Varela, A. S. Brun, P. Zarka, A. Strugarek, F. Pantellini and V. Réville "*MHD study of extreme space weather conditions for exoplanets with Earth-like magnetospheres: On habitability conditions and radio-emission*", Poster, Cool Stars 2022, 4 - 8 July, Toulouse, 2022.

6B J. Varela, A. S. Brun, P. Zarka, A. Strugarek, F. Pantellini, and V. Reville "*Effect of the space weather on exoplanet habitability conditions and magnetospheric radio-emission*", Poster, SEA 2022, 5 - 9 September, Tenerife, 2022.

7B M. Perez-Torres, J. Varela and L. Peña-Moñino "*Simulating the habitability conditions of an Earth-like magnetosphere in Proxima b* ", Poster, EAS, 10 - 14 July, Krakow, Poland, 2023.

8B A. Rabuñal Gayo, J. Navarro Cavallé and J. Varela, " Analysis of an artificially generated magnetosphere using plasma thrusters", ESWW23, Poster I-750, November 20-24, Toulouse, France, 2023.

9B Samsonov, A., Milan, S., Sun, T., Buzulukova, N., Varela, J., and Forsyth, C. , "Reproducing the magnetospheric response to southward turnings in MHD simulations ", EGU2024, Poster EGU24-1968 , November 14-19, Vienna, Austria, 2024.

10B L. Peña-Toñino, M. Perez-Torres, J. Varela and P. Zarka "*Habitability conditions and radio*

emission under calm space weather around Proxima b", Oral session, Bcool, 09 - 11 April, Astron, Neatherlands, 2024.

11B J. Varela, A. S. Brun, A. Strugarek, V. Reville, P. Zarka and F. Pantellini, "*On Earth's habitability over the Sun's main-sequence history: joint influence of space weather and Earth's magnetic field evolution*", Poster, CoolStar 22th, 24 - 28 June, San Diego, USA, 2024.

11B J. Varela, A. S. Brun, A. Strugarek, V. Reville, P. Zarka and F. Pantellini, "*Exploring Exoplanet ´s habitability: the role of the space weather conditions and magnetosphere radio-emission* ", Invited talk, COSPAR 45th, 13 - 21 July, Busan, South Korea, 2024.

(c) Project SPACEINN (Convective dynamo in solar-like stars and *Kepler* KOI analysis), (Exploitation of Space Data for Innovative Helio- and Asteroseismology), Seventh Framework Program FP7 of the European Commission (see https://www.spaceinn.eu/) at CEA Saclay, DSM//IRFU/SAP/LDEE. The purpose of this task was to model, as accurately as possible, the convective dynamo of solar like stars using the MHD code ASH, analyzing the effect of the magnetic fields in the star differential rotation. We compared the model results with Asteroseismology data, in particular *Kepler* KOI (*Kepler* object of interest). See figure V:

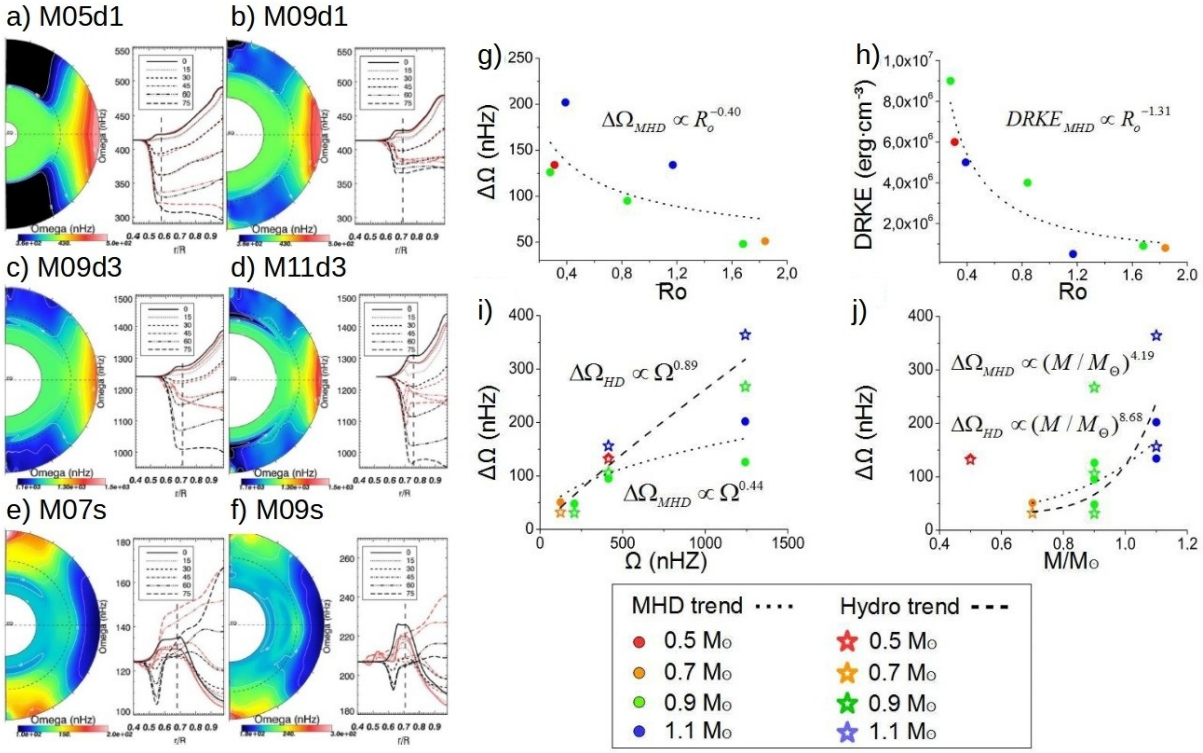

Fig V. (a to f) Temporal and longitudinal averaged of the angular velocity profiles during $10\tau_c$ and radial cuts from the equator to the latitude 75° each 15° (black lines are the hydro cases and the red lines the MHD cases) between 0.4 and 0.96 r/r_O (r/r_O = 0.4 is not necessarily $r = r_{bcr}$). The long dashed vertical line on the right hand side panel of each cases shown the basis of the convective layer. Absolute value of the differential rotation between the equator and 60° latitude (g) and differential rotation kinetic energy versus Ro (h). Differential rotation versus rotation (i). Differential rotation versus mass (j). MHD data are the solid circles and hydro data are the empty circles. The dotted (dashed) line shows the linear fit of the MHD (Hydro) data. The data sets of the graphs are fitted to power equations $A = a+\alpha B^{\beta}$ (α, β and a parameters are tted).

Publications:

1A J. Varela, A. Strugarek and S. Brun, "*Characterizing the feedback of magnetic field on the differential rotation of solar-like stars*", Advances in Space Research, 58, 1507, 2016.

2A S. Brun, A.Strugarek, J. Varela, S. P. Matt, K. C. Augustson, C. Emeriau, O. L. DoCao, B. Brown and J. Toomre "*On differential rotation and overshooting in solar-like stars*", ApJ, 836, 192, 2017.

3A S. Brun, A. Strugarek, Q. Noraz, B. Perri, J. Varela, K, Augustson, P. Charbonneau and J. Toomre. "*Powering stellar magnetism: Energy transfer in convection dynamo of Sun-like stars*", Astrophysical Journal, 926, 21 (2022).

1B J. Varela, and S. Brun "*Differential Rotation and Dynamo Action in Solar-like Stars*". Oral session at SOLARNET III / HELAS VII / SpaceInn Conference, Freiburg, August 31-September 4, 2015.

LABORATORY AND INDUSTRIAL PLASMAS

In collaboration with the next researcher and institutions:

1. University of Saclay, LIMSI and AIM, CEA/CNRS: C. Nore and D. Berengere.
   - MHD simulations of the turbulent dynamo in the VKS liquid metal dynamo.
2. University Carlos III and thermofusion consortium: M. A. Monge.
   - Analysis of the PbLi flows in the DLCC blanket module.
3. University Carlos III aerospace division: J. Navarro.
   - Experimental study of the solar wind interaction with planetary magnetospheres using plasma engines and magnetized targets.
4. Quantemol Ltd (University college of London): J. Tennyson.
   - Industrial plasmas applications: plasma sterilization and semiconductor etching.

Research main topic:

(a) Project VKStars (Liquid metal experimental dynamos): Study performed at CEA Saclay DSM//IRAMIS/SPEC/SPHYNX group and University Paris-Saclay LIMSI group. MHD numerical simulations using the code PLUTO to explore in a simplified geometry the liquid sodium flow structure in the Von-Karman-Sodium (VKS) experiment in the vicinity of the multi-blades impeller. The VKS is a metal dynamo experiment to study several regimes of astrophysical or geophysical interest. We performed parametric studies to foreseen the effect of the impeller geometry, remnant magnetic field orientation and intensity, blade material, turbulence level and impinging large scale flow in the dynamo loop. Dynamo loop features study using mean field theory. See figure VI.

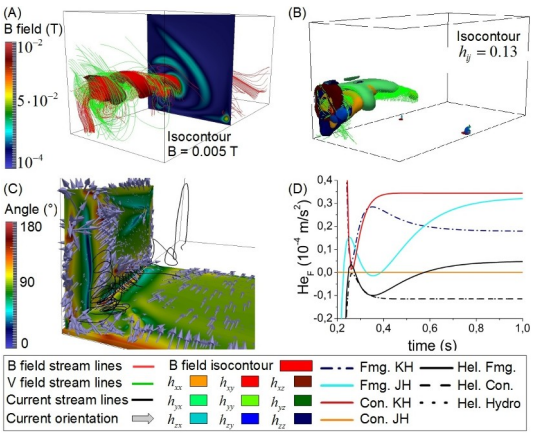

Fig VI: (A) Magnetic (red) and velocity (green) field stream lines for a perfect ferromagnetic material. Isocontour of the magnetic field (B = 0.005 T). (B) Isocontour of the normalized helicity tensor (hij = 0.13). (C) Angle between the current and the unitary surface vector for a perfect ferromagnetic material. The arrows indicate the orientation of the current on the blades and the black lines are current stream lines nearby the upstream blade. (D) Fluctuation helicity for a perfect ferromagnetic and conductor materials.

Publications:

1A J. Varela, S. Brun, B. Dubrulle and C. Nore "*The role of boundary conditions on helicoidal flow collimation: consequences for the Von-Karman-Sodium dynamo experiment*", Phys. Rev. E 92, 063015, 2015.

2A J. Varela, S. Brun, B. Dubrulle and C. Nore, "*Effects of turbulence, resistivity and boundary conditions on helicoidal flow collimation: consequences for the Von-Karman-Sodium dynamo experiment*", Physics of Plasmas, 24, 053518, 2017.

3A J. Varela, "*Parametric study and optimization trends for the Von-Kármán-sodium dynamo experiment*", Phys. Plasmas 25, 053501, 2018.

1B J. Varela, C. Nore, B. Dubrulle and S. Brun "*The alpha effect in the Von-Karman-Sodium experiment: influence of the whirl magnetic field orientation and boundary conditions*", poster in the BIFD congress, Paris, 15-17 July 2015.

(b) PbLi flows in the DLCC blanket module: Simulate the flow of the liquid metal PbLi and the heat removal in a nuclear fusion blanket (fig. VII).

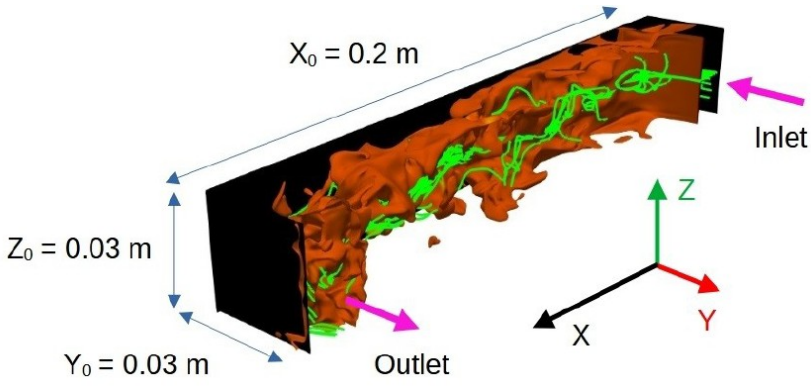

Fig VII: PbLi flows along the extenal pipe of a DCLL blanket. Red isocontour indicates the module of the velocity and the green stream lines the velocity field.

Publications:

1B J. Varela, J. M. Reynolds-Barredo, V. Tribaldos and M. A. Monge "*Modelling of the PbLi flow for different operational regimes of the DCLL blanket module*", Poster P2-2F01, ITC 2022, 8 - 11 November, online, 2022.

(c) Synergy project EXOPLAWIN-CM-UC3M: experimental analysis of the solar wind interaction with planetary magnetospheres using an artificial source of plasma, reproducing similar conditions compared to the astrophysical conditions (fig. VIII).

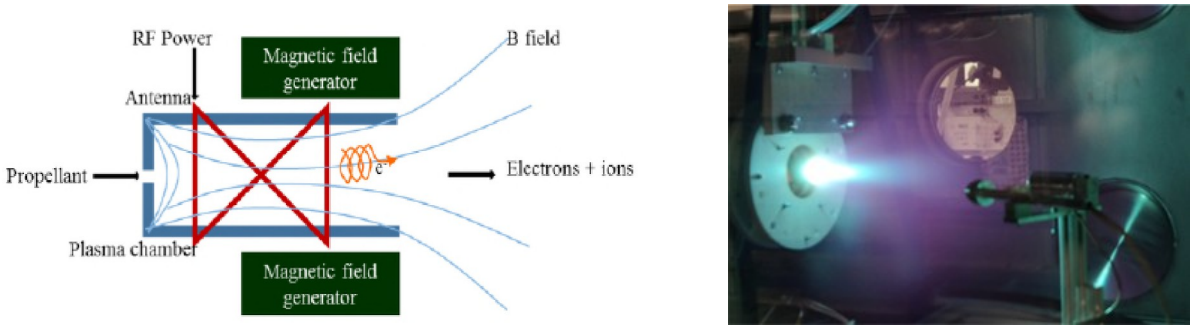

Fig VIII: (left) Simplified scheme of a plasma engine type Helicon. (right) Plasma ejected by the engine and slectrostatic proves required for the plasma properties characterization.

(d) European project CORINF (Industrial plasma applications) (Correlated Multielectron Dynamics in Intense Laser Fields) Marie Curie Training Network funded by the Seventh Framework Programme FP7 of the European Commission (see http://www.corinf.eu/) at University Collage of London. The aim of the task was to perform numerical simulations using the hybrid code (HPEM) and MHD code (ELMER) to study industrial plasmas, plasma etching in the semiconductor industry and plasma sterilization for sanitary applications.

TEACHING EXPERIENCE:

UNDERGRADUATE LEVEL:

225 hours teaching electromagnetism theory and laboratory in different engineer bachelor groups:

- Industrial technologies.
- Aerospace.
- Electronics and industrial applications.
- Informatics.
- Mechanics.
- Biomedical.

POSTGRADUATE LEVEL:

Seminar sessions in the European Eramus Mundus Master Nuclear Fusion and engineering Physics.

MASTER STUDENTS TUTORING:

- Xihui Wang (Institute of Plasma Physics, Chinese Academy of Sciences, Hefei, Anhui, China University of Science and Technology of China, Hefei, China):

Analysis of beam ion driven Alfven Eigenmode stability in EAST

- Luis Herrera (University Carlos III of Madrid, Spain):

Optimization of the AE stability in TJ-II plasma with respect to the NBI operational regime.

- Andrés Rabuñal (University Carlos III of Madrid, Spain):

Analysis of the plasma flow interaction with magnetized objects.

PhD STUDENTS TUTORING:

- Juan Ortiz (University Carlos III of Madrid, Spain):

Study of the Alfven Eigenmodes stability in CFQS plasma using a Landau closure model

Analysis of the AE activity triggered by the helical coils ripple in TJ-II plasma.