INFORME CIENTIFICO-TECNICO INTERMEDIO

Proyectos de Generación de Conocimiento 2021

Modalidades: Investigación No Orientada e Investigación Orientada

Como paso previo a la realización del informe, se ruega lean detenidamente las instrucciones de elaboración de los informes de seguimiento científico-técnico de proyectos disponible al final de este informe.

Se recomienda leer atentamente la información solicitada en los distintos apartados del informe, revisar la memoria y el presupuesto solicitado inicialmente y justificar adecuadamente todas aquellas actividades o gastos que haya sido necesario realizar para la consecución de los objetivos y que no estuvieran previstos o suficientemente detallados en la memoria inicial.

A. Datos del proyecto

Relacione los datos actuales del proyecto. En caso de que haya alguna modificación, indíquelo en la casilla A2

A1. Datos del proyecto

REFERENCIA: PID2021-127727OB-I00

TITULO: Estudio de transiciones L-H y pedestal en modo H en tokamaks (L2HPED). Study of L-H transitions and H-mode pedestal in tokamaks (L2HPED)

Modalidad	
Área/Subarea	**Ciencias Físicas/Física y sus aplicaciones**
Prioridad temática*	http://orcid.org/0000-0002-5402-0127
IP1/PI1	Emilia Rodriguez-Solano Ribeiro (AKA Emilia R. Solano)
Código Orcid:	http://orcid.org/0000-0002-4815-3407
IP2/PI2(si procede)	Elena de la Luna Gargantilla
Código Orcid:	http://orcid.org/0000-0002-5420-0126
Entidad Beneficiaria	CENTRO DE INVESTIGACION ENERGETICA MEDIOAMBIENTAL Y TECNOLOGICA (CIEMAT)
Centro	Laboratorio Nacional de Fusión
Fecha de inicio	01/09/2022
Fecha final	31/08/2026
Duración	4 años
Total concedido (costes directos)	€90000

*Para modalidad Investigación Orientada

A2. Descripción de modificaciones en los datos iniciales del proyecto *(Cambio de IP, entidad, centro, modificación del periodo de ejecución…)*

Originally unplanned expense requested, approved and executed to obtain tomographic reconstruction of plasma radiation, see C.3, C.5, E.6.
No changes in research team.
Changes in the work team reported in B.2, C.3

B. Personal activo en el proyecto

*Tiene que relacionar la situación de **todo** el personal de las entidades participantes que haya prestado servicio en el proyecto en el periodo que se justifica, o que no haya sido declarado anteriormente, y cuyos costes (dietas, desplazamientos, etc.) se imputen al mismo.*

B.1. Equipo de investigación

Incluido en la solicitud original

	Nombre	NIF/NIE	Función en el proyecto	Fecha de baja	Observaciones
1	Emilia R. Solano	36036676T	IP1/PI1.L-H transition and pedestal MHD expert. Leads Objectives 1,2,4	-	active
2	Elena de la Luna	51377177F	IP2/PI2. Pedestal and ELMs physics expert. Leads the part of the project related to Objective 3	-	active

No incluido en la solicitud original

	Nombre	NIF/NIE	Función en el proyecto	Fecha de alta	Fecha de baja	Observaciones
1						

B.2. Personal incluido inicialmente en el Equipo de Trabajo, o incorporado posteriormente, que no cumpla alguno de los requisitos para formar parte del equipo de investigación

	Nombre	NIF/NIE	Función en el proyecto	Inicio	Fin	Observaciones
1	Nerea Panadero	NIF 51118543P	Expertise in pellet injection physics (data analysis and modelling)	1-09-2022		active
2	Carlos Silva	Passport PT CA006235	Expertise in edge and divertor physics studies, L-H transition, reflectometry data analysis	1-09-2022		active
3	Jon Hillesheim	Passport USA 566015825	Expertise in turbulence and transport, pedestal physics, L-H transition	1-09-2022	31-12-2022	Left. New job, no availability.
4	Paulo Rodrigues	ID Portugal 10061156	Expertise on MHD theory	1-09-2022		active
5	David Zarzoso	NIF 03129079K	Expertise on energetic particles physics, and turbulence	1-09-2022	23-06-2023	Left. Paternity leave, changed research focus.
6	Pietro Vincenzi	Passport IT 15CY44109	Expertise on transport modelling: edge transport barrier, L-H transition	1-09-2022		active
7	Jerónimo García	NIF AAK093076	Expertise on transport modelling: gyrokinetic theory, transport barriers, and turbulence	1-09-2022		active
8	Mattia Dicorato	Passport IT YB8097480	Pedestal stability analysis using gyrokinetic modelling (PhD student)	1-09-2022		active
9	Yan Camenen	Passport FR 15CY44109	Expertise on the transport modelling and gyrokinetic simulations	1-09-2022		active
10	Keith Burrell	Passport USA 506872937	Expertise in pedestal physics, QH-mode and EHO	1-09-2022		active
11	Xi Chen	Passport 566384620	Expertise in pedestal physics, QH-mode and EHO	1-09-2022		active
12	M.Vaz	PT 14845104	Master student (training) *M. Vaz works with C. Silva and has joined the project work team to carry out reflectometry analysis of dithering L-H transitions*	1-01-2024		new, active

Nota: Cree tantas filas como necesite.

La solicitud de "Altas" y "Bajas" de personal investigador en el **equipo de investigación** debe tramitarse de acuerdo con **las instrucciones de ejecución y justificación** expuestas en la página web de la convocatoria. La incorporación de personal que participe en el proyecto en el **apartado B.2** no necesita autorización por parte de la AEI, pero su actividad debe incluirse y justificarse en este informe.

C. Progreso y resultados del proyecto

C1. Desarrollo de los objetivos específicos planteados

Describa *los objetivos específicos y el grado de cumplimiento de los mismos (porcentaje estimado respecto al objetivo específico planteado y, en su caso, indique lo que queda por realizar en cada uno de ellos).*

Note: refereed publications marked in **[bold]**, conference presentations [not bold]

Objetivo 1: Experimental studies of L-H transition in JET	The objective is to characterise and understand L-H transition thresholds (P_{LH}) and their relation to local plasma profiles, with special emphasis on unique JET experiments in H, D, T, DT, He. L-H transition experiments were an important part of the JET isotope campaigns, led by the PI1 since 2019. Matching L-H datasets were obtained in Hydrogen, Deuterium, Tritium and Helium, including D+T, H+T, H+He mixtures. The PI1 continues to lead the JET L2H team (>50 people). In 2022-2023 new data was obtained in Helium, Tritium, DT and Deuterium. Up until JET experimental campaigns ended in December 2023 the PI1 gave this objective the maximum priority. Closure of JET means that analysis of JET results takes precedence over objectives 2 and 4, as JET experts drift away to different jobs. Analysis of v_{perp} and its dependence on divertor configuration in Deuterium plasmas shows no correlation between v_{perp} profiles, P_{LH} and divertor configuration **[D1.1]**. Analysis of v_{perp} before L-H transitions is done in DT and T, publication awaits analysis of corresponding kinetic profiles, greatly improved by recent validation techniques. Emphasis shifted to studies of v_{perp} dependency on density and detachment [D3.1], as well as analysis of dithering transitions (see personnel changes in C.3). Experiments on L-H transition and H-mode in Helium were carried out at JET. Analysis of H+He experiments moved to low priority now that ITER no longer plans a Helium campaign. in part due to our findings of poor H-mode quality in Helium **[D1.6]**, [D3.10]. Database of JET L-H transition experiments created and maintained by PI1, results published for H, D, DT and T plasmas, [D3.6], [D3.9], [D3.16], **[D1.3]** and for H+T mixtures **[D1.2]**. Critical kinetic profiles found to define access to L-H transition, independent of isotopic content, even if P_{LH} depends strongly on isotopic content (not always linearly) **[D1.2]**, further analysis to follow. Tritium content can increase impurity radiation, affecting the L-H transition [D3.4], and low Z impurities can raise P_{LH}, beyond the change in edge radiation [3.18]. Work is on-going to produce a new ITPA metal wall multi-machine scaling of P_{LH}. Rising interest in back-transition and automatic detection of H-L transitions will contribute to an H-L power threshold database, of great interest for devices with full W wall, as impurity seeding is expected to be used to avoid W sputtering, increased in T. Ion heat flux analysis of L-H transition in D and DT were carried out, D results published **[D5.1]**, DT results reported in **[D1.9]**, [D3.7], [D3.16], T analysis planned for 2025. **New task added**, T1.4: due to ITER re-baselining announcement in Oct 2023, the PI1 works towards reversing the EU and UK decision to terminate JET operation, proposing the installation of a W wall and 10 MW of ECRH in JET, and extension of its operation for 10 years. This would enable further and more fusion relevant experiments at JET in the next 10 years. Publication of research proposal [D3.15] ongoing.

	Outlook: profile analysis, multi-machine P_{LH} scaling, H-L database, gyrokinetic analysis, ion heat flux of Tritium plasmas, JET extension. Completion status: 60% Deliverables: 5 refereed publications [**D1.1, D1.2, D1.3, D1.6**]+ 1 submitted [**D1.9**], many conference invited and oral presentations, [D3.5, D3.6, D3.9, D3.10, D3.13, D3.14, D3.15, D3.16, D3.18], posters [D3.4, D3.7, D3.19], and inclusion of results in overview talks and articles on JET DT results [D3.1, **D5.8**].
Objetivo 2: Theoretical model of pedestal MHD near the L-H transition: M-mode	The M-mode is an n=0 m=1 up-down MHD oscillation that appears with the L-H transition in many slow power ramp experiments. It has been shown to be similar to the I-phase reported in AUG. We aim to develop a theory-based model if this oscillation. An attempt to develop an analytical model of n=0 poloidal Alfvén stable oscillation in slab geometry failed to obtain low frequency solutions that might match the experiment. An alternate model of the M-mode as pressure relaxation limit cycle oscillations was tested against JET and AUG data, published **[D1.4]**. Outlook: return to analytical calculations introducing different approximations, but maintaining the n=0 constraint Completion status: 10% Deliverables: 1 refereed publication **[D1.4]**
Objective 3: Small ELMs scenarios in JET	This objective focuses on a newly identified H-mode regime that combines high energy confinement, stable density and radiation levels, and small ELMs, first observed in JET with the Be/W wall in 2019. Access to such a regime is enabled by using high NBI power on a low-density target at high plasma current (3 MA), achieved by completely removing the gas injection. We refer to this regime as the baseline small-ELM (BSE) regime, as it matches the ITER baseline scenario in terms of pedestal collisionality (~0.1), q_{95}(=3.2) and confinement targets (β_N = 1.8−2, H_{98} ~ 1). During the first phase of the project, we have focused on analyzing, data from the 2019 experiments, to better understand ELM behavior and pedestal stability in the unfuelled BSE regime The presence of smaller and more frequent ELMs in this case is correlated with a substantial reduction of the pedestal density and its gradient, exhibiting high-temperature pedestal profiles with an L-mode like density profile, similar to that observed in the I-mode. Pedestals are stable to peeling–ballooning modes, consistent with the lack of large ELMs. Our work also included comparisons with gas fuelled type I ELMy H-mode plasmas, divertor heat loads and ELM energy losses characterization, comparison with unfuelled JET-C operation, and impurity and turbulence transport analysis. Results summarized in **[D1.5]**, and presented in [D3.12]**.** Additional details are provided in section C2, where the tasks associated with Objective 3 are outlined. The 2019 discharges were transient in nature. Although density and radiation remained fairly constant during the high-performance phase, ion temperature and neutron rate continued to increase throughout. New experiments conducted in 2023 demonstrated that quasi-stationary conditions for density, ion and electron temperatures can be extended (up to 1.5 s). Description of these new experiments was presented in [D3.10].

	Completion status: 65% Outlook: ongoing tasks include detailed analysis of the data collected in the 2023 experiments, including the data from the new small ELMs scenario with dominant electron heating and I-mode-like pedestals, multi-machines study of the I-mode-like plasmas found in JET. Deliverables: 2 refereed publications [**D1.5, D1.7**] and several presentations in international conferences/meetings [D3.3, D3.8, D3.11, D3.12, D3.17].
Objective 4: Quiescent H-mode studies	Plasma operation regimes with hot pedestals and no ELMs are sought for future fusion devices **[D5.2]**. One promising candidate is the Quiescent H-mode (QH-mode). One of the characteristics of the QH-mode is the so-called Edge Harmonic Oscillation (EHO). The EUROfusion Work Package Tokamak Exploitation (WPTE) sponsors studies of no ELMs and Small ELM regimes in Research Topic RT-02, including QH-mode experiments. Analysis of transient EHOs observed in JET hybrid plasmas [D3.1] Outlook: future development strongly dependant on when proposed QH-mode experiments take place Completion status: 10% Deliverables: 1 conference presentation [D3.2], 1 journal article **[D5.2]**

Nota: Cree tantas filas como necesite

C2. Actividades realizadas y resultados alcanzados

Describa *las actividades científico-técnicas realizadas para alcanzar los objetivos planteados en el proyecto. Indique para cada actividad los resultados alcanzados y los miembros del equipo que han participado.* ***Extensión máxima 2 páginas***

Actividad	Miembros del equipo participantes*:
Objective 1: Experimental studies of L-H transition in JET	
Task 1.1: study of v_{perp} and grad(p) profiles in L-H transition experiments **Deuterium:** edge v_{perp} measured by DBS at the outer midplane shown to depend significantly on divertor configuration **[D1.1]** and density [D3.10]. ∇P profile tbd. Next we will study dithering transitions, with Master student added to team (see C.3). **Tritium and DT:** experiments done, ∇p profile analysis ongoing.	E.R. Solano, C. Silva, *+M. Vaz*
Task 1.2: execute/propose/analyze L-H transition threshold experiments in JET • L-H transition experiments proposed, selected, designed (especially tricky in Tritium and DT shots) and executed in He [D3.5], D, DT, T. P_{LH} dependence on isotopic content reported [D1.2], [D1.3], [D1.9]. It is found that the density at which P_{LH} is minimum ($n_{e,min}$) and $P_{LH,min}$ depend strongly on isotope, to the point that Ohmic L-H transitions are observed in Tritium. For fixed divertor configuration, $n_{e,min}$ is correlated with Greenwald density fraction. Helium studies show high P_{LH} and poor H-mode performance [D3.5], [D3.10], **[D1.6]**. • Develop /maintain JET L-H threshold database (ongoing), add H-L data. • For selected data sets, validation and evaluation of local plasma profiles far and near the L-H transition delayed. An improved analysis of electron density profiles implies we must revise now earlier profiles, as well as update analysis tools to read new signals. • Tomographic analysis of plasma radiation done now within the project due to JET termination and unavailability in UKAEA of reconstruction experts (details in C.3, E.6)	E.R. Solano, J. Hillesheim (until 12/2022), C. Silva, E. de la Luna
Task 1.3: study of ion heat flux model of $n_{e,min}$ Analysis of Deuterium 3T 2.5 MA P_{LH} dataset shows no relation between $n_{e,min}$ and electron-ion heat exchange in Deuterium **[D5.1]** or DT [D3.7]. Extrapolations to re-baselined ITER power requirements were made, based on the above analysis **[D3.16], [D1.9]** Analysis in pure Tritium dataset pending	E.R. Solano, P. Vincenzi
Task 1.4: JET continuation and upgrades (added task) petition to extend JET: started Oct 2023, >1000 signatures of fusion experts, Correspondence with fusion authorities: EUROfusion, UKAEA, IAEA, EU Commission. Develop and present a proposed research programme for JET facilities, assuming 10 years of operation, addition of 10 MW of ECRH and a W wall [D3.15] presented at EPS, chosen by participants as best poster of the conference.	E. R. Solano
Objective 2: Theoretical model of pedestal MHD near the L-H transition: M-mode	
Task 2.1: Develop model of M-mode as poloidal Alfven wave; Simple analytical slab model of n=0 MHD doesn't have low frequency solutions. To be tried again in 2025. Meantime alternate model published [D1.4], in part tested against our M-mode data in JET. Meeting with Spanish and French researchers organised at CIEMAT, including D. Zarzoso, E. Viezzer and colleagues (sponsored in part by this project). Discussion of numerical MHD studies of the M-mode, QH-mode and L-H transition, to be continued.	E.R. Solano, P. Rodrigues, D. Zarzoso (until 06/2023)
Objective 3. Small ELMs scenarios in JET	
Task 3.1: The validation of the HPI2 code (pellet ablation and deposition) using JET data is completed. Analysis focused on an existing database that includes type I ELMy H-mode plasmas with different pedestal and pellet injection parameters. Analysis of BSE discharges obtained with low gas and pellets is ongoing. Submission of article expected in 2025	N. Panadero E. de la Luna

Task 3.2: significant reduction in the ELMs size and the associated divertor heat loads found for the unfuelled BSE discharges. The ELM energy losses decrease by almost a factor of 4, from $\Delta W_{ELM}/W_{ped}$~10% (gas fuelled, type I ELMs) to ~ 2.6% (unfuelled, small ELMs). ELM energy losses found to be linearly correlated with the ELM energy fluence deposited in the divertor. Results published in **[D1.5]**	E. de la Luna
Task 3.3: The pedestal structure and stability of the unfuelled BSE discharges was evaluated using the code MISHKA. The presence of small ELMs is correlated with a substantial reduction of the pedestal density and its gradient. Pedestals in this operating regime are deeply stable for the peeling-ballooning modes, contrary to what usually happens with type I ELMs. Results published in **[D1.5].**	E. de la Luna, J. García
Task 3.4: Linear/local turbulence simulations for unfuelled BSE plasmas were performed using the gyrokinetic code GENE in a location above the pedestal top. This includes the preparation of the input data for the simulations. The confinement improvement is correlated with a reduction in the ITG turbulent transport (driven by the high T_i/T_e ratio, the impurity-induced reduction of turbulent at the plasma edge and the suppression of turbulence arising from the E×B shear flow). Results published in **[D1.5]**.	J. García, E. de la Luna M. Dicoratto, Y. Camenen
Task 3.5: Investigate the impact of the isotope plasma composition in small ELM regimes (in progress). No experiments using the unfuelled H-mode scenario with small ELMs were conducted during the DTE2 campaign. To explore the impact of the isotope in the access to small ELMs we will analyze data from the new small ELMs scenario described in section C3. Characterization of this regime has started. Initial pedestal analysis results published in **[D1.7]**	E. de la Luna, J. García, E.R. Solano
Task 3.6: Explore the operational space for H-mode operation with small ELMs in JET and in other devices: • Comparison to the unfuelled H-mode operation in JET-C (done). The lower 'natural' density in the unfuelled BSE plasmas found in JET-Be/W (reduced lower retention in the Be wall) points to the low density as the key parameter for the small ELMs onset. Results included in **[D1.5]** • Compare the new results from JET with existing small ELM regimes in other devices (in progress). This includes the wide Q-H mode, QCE and I-mode (Alcator C-mod, AUG). The initial results of such comparison are included in **[D1.5]** • Prepare and propose new experiments to be performed in JET (done). - Duration of the plasma phase in stationary conditions extended up to 1.5 s (> 6 τ_E). - L-H transition experiments at 3 MA/2.8T carried out in 2023, confirming operation in the low-density branch of the L-H transition. Initial results presented in [D3.10]. Data analysis is ongoing	E. de la Luna, J. García, E.R. Solano
Objective 4: Quiescent H-mode studies	
Task 4.1: QH-mode studies at JET. Spontaneous EHOS observed in JET hybrid plasmas, database collected, preliminary analysis presented at [D3.2], to be continued. Proposals for new experiments at JET not selected due to tight JET timeline.	E. R. Solano Xi Chen K Burrell
Tasks 4.2: QH-mode studies at AUG. Proposals developed and presented, jointly with E. Viezzer (leader of RT-02), not selected for late 2022. There was no operation in AUG in 01/2023-09/2024. The PI1 and E. Viezzer belong to the QH and WPQH-mode Research Group within the EU-US Joint Working Group on Small/no ELM regimes. Demonstrating stationary QH-mode in a metal environment is an objective for 2024-2025	E. R. Solano Xi Chen K Burrell
Tasks 4.3: QH-mode studies at DIII-D. Proposals developed and presented, not selected for 2023-24. The PI1, E. Viezzer and X. Chen belong to the QH and WPQH-mode Research Group (see 4.2).	E. R. Solano Xi Chen K Burrell

Notas: Cree tantas filas como necesite. En caso de incluir figuras, cítelas en el texto e insértelas en la última página
*Resalte en negrita las actividades realizadas por las personas que son IP.

C3. Problemas y cambios en el plan de trabajo

Describa las dificultades y/o problemas que hayan podido surgir durante el desarrollo del proyecto. Indique cualquier cambio que se haya producido respecto a los objetivos o el plan de trabajo inicialmente planteado, así como las soluciones propuestas para resolverlos. ***Extensión máxima 1 página***

As usual in experimental projects, proposals for experiments are presented, covering all aspects of the research project, but not all are selected or, even if selected, executed. The Deuterium-Tritium (DT) and Tritium campaigns were especially competitive, both experimental time and Tritium budgets set clear boundaries that could not be exceeded. Our experiment proposals were definitely less ambitious than usual, as we could not hope to obtain all the desired experiments. To save Tritium, we decided to settle in Objective 1 on a single divertor configuration (Horizontal Target), even knowing that results might be very different in other ones (Corner, Vertical Target).

We were relatively fortunate on executing experiments of Objectives 1 and 3 at JET. Objective 4 was down-selected by the EUROfusion Tokamak Exploitation Task Force Leaders and not granted experimental time yet, and AUG had no operation in 2023-2024. Objective 2 is less urgent, it does not require new experimental data, we hope to return to it in the next few years.

The closure of JET lead to the loss of various experts due to contractual issues. In order to carry out the tomographic analysis of plasma bolometry radiation measurements (essential for Objective 1). The solution to this problem was to sub-contract the analysis to the expert, no longer an UKAEA employee. The change of plan was requested via the proper procedure, and approved by the funding agency (Agencia Estatal de Investigación). The work was completed during the summer of 2024 (see items 4 and 5 in C.5, and E.6).

Regarding Objective 3, due to the closure of JET, the analysis work will focus on analyzing experiments conducted in 2019 and 2022-23. Analysis of the unfuelled H-mode plasmas in both JET-C and JET-Be/W has shown that the low density is the key parameter for the onset of small ELMs in the unfuelled BSE regime. Small or fully suppressed ELMs conditions were also observed in another low-density, high-performance JET scenario at lower (I_p=1.9-2.5 MA), with dominant electron heating by ICRH, explored in D and D-T plasmas. Both scenarios share an I-mode-like pedestal, where the temperature profile forms an H-mode-like pedestal, but the density profile gradient resembles that of L-mode. Investigating the similarities and differences between these different regimes might help to better understand the onset conditions for small ELMs and the underlying physics that independently controls the energy and particle transport channels. The analysis of this new regime is now included as part of the work within the tasks 3.4 and 3.5.

A substantial change in the overall work plan is associated to the closure of the JET facilities, where most of the experiments of both PIs take place. The official announcement of ITER re-baselining (Oct 2023) makes it clear that new data is needed with dominant electron heating (ECRH) and a W wall, both of which could be installed at JET, if it can be continued. Since October 2023 the PI1 co-leads a scientific and lobbying effort to revert the decision to decommission JET before the JET facilities are destroyed. We have included this as a new (high risk/high payoff) task within Objective 1.

Personnel changes:

J. Hillesheim (Objective 1) has left the project due to a change of job.

M. Vaz (Objective 1), graduate student of C. Silva, has joined the work team. Within this project he will analyse Doppler reflectometry data of dithering JET L-H transitions, using box-car averaging to improve the time resolution of v_{perp} and fluctuation measurements within the L and H phases of the dithers.

D Zarzoso (Objective 2) had a PhD student, E Zapata, look into automatic identification of M-modes, but the student's thesis eventually focused on results associated to high frequency Alfvén waves and the M-mode part of the study didn't progress. D. Zarzoso left the project after he received funding to pursue other interests. P. Rodrigues and E. Solano will continue that work.

Se recuerda que la aceptación de la propuesta de resolución implica el compromiso del cumplimiento de todos los objetivos planteados en la solicitud".

C4. Colaboraciones con otros grupos de investigación directamente relacionadas con el proyecto *Relacione las colaboraciones con otros grupos de investigación y el valor añadido que aportan al proyecto. Describa, si procede, el acceso a equipamientos y/o infraestructuras de otros grupos o instituciones.*

The participation of the investigating team members in the experiments conducted in the tokamak JET (until 2024) is coordinated through the global framework of the EUROfusion Consortium, funded by the European Commission's Euratom programme. JET operation was funded by UKAEA in 2022-2023. Both PIs have been actively involved in JET experimental campaigns since 2000, with their contributions reflected in their co-authorship on numerous scientific publications related to the JET tokamak over the past two decades.

It is worth emphasizing that the objectives of this project are well aligned with the priorities selected for the JET campaigns in 2022-2023 by the Task Force Leaders responsible for the Tokamak Exploitation Work Package (WPTE):

- PI1, E.R. Solano, leads the experimental, analysis and modelling work on JET L-H transition studies, being Scientific Coordinator of experiments M18-14 and M21-14, now within Research Topìc RT-11. She is also a team member of RT-02, which investigates the physics understanding of alternative to type-I ELMy regime, and supporting studies on small/no ELMs regimes at JET.
- PI2, E. de la Luna, leads the experiment focused on exploring the no-gas H-mode regime with small ELMs in JET. This scenario is part of the Research Topic 2 (RT-02).

The project has greatly benefited from the specialized expertise of key collaborators who are not members of this project but contribute considerably to it:

- Objective 1: The PI1 leads JET L-H transition studies, coordinating European research on this topic. Key collaborators are **G. Birkenmeier** (IPP, MPI, Germany), and **E. Delabie** (ORNL, USA). Birkenmeier was Deputy Scientific Coordinator in some of the L-H transition experiments at JET, published L-H transition results in Hydrogen+Tritium mixtures, and is now is our main link with gyrokinetic simulation teams at IPP; Delabie validates main ion CX data, leads the TC-26 working group of PEP ITPA to identify P_{LH} scaling in metal wall devices, and is responsible for combining our L-H transition power threshold data with data from C-Mod and AUG to make predictions for ITER.
- Objective 3: **M. Dunne*** (IPP-Garching, Germany), is a specialist in pedestal stability analysis; M. Faitsch* (IPP-Garching, Germany), provided critical divertor infrared analysis data; and S. Mazzi (CEA, France) contributed to the turbulent transport analysis.
- Objective 4: The PI1 works closely with **E. Viezzer*** (PSFT, Seville University, Spain), especially on QH-mode experiment proposals and data analysis in AUG and DIII-D.

*M.Dunne, M. Faitsch and E. Viezzer are Coordinators of RT-02

The stays at JET during the 2022-23 experimental campaigns and analysis meetings in 2024 are funded by EUROfusion WPTE. They are not included as expenses in this project, only counted as work stays.

C5. Colaboraciones con empresas o sectores socioeconómicos directamente relacionados con el proyecto. *Relacione las colaboraciones con empresas o sectores socioeconómicos y el valor añadido que aportan al proyecto.*

Tomographic reconstruction of radiation profiles was subcontracted to Bernardo Woods Solutions. It was essential for Objective 1. See E.6

C6. Actividades de formación y movilidad de personal directamente relacionadas con el proyecto
Indique las actividades de formación y movilidad de personal relacionadas con el desarrollo del proyecto. Describa, además, si procede, las actividades realizadas en colaboración con otros grupos o con actividades de formación en medianas o grandes instalaciones.

	Nombre	**Tipo de personal** (*becario/a, técnico/a, contratado/a con cargo al proyecto, posdoctoral, otros*)	**Descripción de las actividades de formación o motivo de la movilidad**
1	E.R. Solano	Scientific researcher (PI1)	*Several stays adding up to 175 calendar days in the 2 years between 01-09-2022 and 30-08-2024, to lead L-H transition experiments and analysis as Scientific Coordinator, as well as participate in general JET meetings. Training new Scientific Coordinators and JET team members on diagnostics (Reference Diagnostic Coordinator) and L-H transition, pedestal MHD, pedestal profile validation, etc.*
2	E. de la Luna	Scientific researcher (PI2)	*Short stay (4 weeks) at JET (Culham, UK) during the 2022 and 2023 experimental campaign (October) to carry out experiments as a scientific coordinator (SC) of the 'no-gas' H-mode regime.*
3	M. Vaz	Master student (training)	*M. Vaz is a Master student of C. Silva. He joined the project work team to carry out reflectometry analysis of dithering transitions. AT IST, he has taken various training courses related to this work: Plasma physics and technology, Plasma diagnostic techniques, Nuclear fusion, Digital signal processing.*

Nota: Cree tantas filas como necesite

C7. Actividades de internacionalización y otras colaboraciones relacionadas con el proyecto
Indique si ha colaborado con otros grupos internacionales. Consigne si ha concurrido, y con qué resultado, a alguna convocatoria de ayudas (proyectos, formación, infraestructuras, otros) de programas europeos y/o otros programas internacionales, en temáticas relacionadas con la de este proyecto. Indique el programa, socios, países y temática y, en su caso, financiación recibida.

The activities carried out in this project are very well integrated in the frameworks of EUROfusion and the International Tokamak Physics Activity (ITPA) topical groups activities, in particular the Edge Physics (PEP) and Transport and Confinement (T&C) Topical Groups.

PI1 has contributed to the ITPA T&C & PEP "Report on Open Issues in the new ITER Baseline with a W-wall", commenting on ITER Re-Baselining (ITER Research Plan within the Staged Approach). The report highlights the need to understand and predict both L-H and H-L transitions (including isotope and impurity effects), to acquire profile and turbulence measurements in different small ELM and no ELM regimes, and to document how tungsten impurities may affect these transitions and regimes.

Both PIs are included in the list of experts of the ITPA Pedestal and Edge Physics Topical Group. They have both contributed (as named co-authors) to two of the journal articles to be included in the Nuclear Fusion Special Issue presenting a summary of the work done within the ITPA topical groups since the publication of the *"Progress in the ITER Physics Basis*" Nuclear Fusion Special Issue in 2007. Both articles include results from experiments associated to this project.

PI2 is the JET representative in the ITPA joint activity carried out by the PEP and the DSOL (Divertor and SOL physics) topical groups devoted to understanding small ELM regimes and their applicability to ITER.

The objectives of the project are priority research topics in ITER and DEMO (L-H transition and small/no ELMs regimes).

In 2024 a new EU-US joint activity was started devoted to the development of small/no ELMs tokamak scenarios (EU-US Joint Working Group to Develop Non-ELMing tokamak scenarios). This is an EUROfusion and U.S. DOE Fusion Energy Sciences collaborative activity, organized in five working groups, 2 of which are relevant to this project:

- Group1: Standard Quiescent H-Mode (QH) and Wide Pedestal Quiescent H-Mode (WPQH) Regimes (the EU lead is E. Viezzer, Univ. Seville, who leads QH-mode research in AUG).
  The PI1 is a member of this group, as is Xi Chen (leads WPQH mode research at DIII-D, working member of this Project)
- Group 2: I-mode Regimes: The PI2 is a member of this group, dedicated to multi-machines studies of I-mode plasmas characterized by a distinct pedestal structure: a steep gradient in temperature (H-mode-like) and wide, shallow pedestal density (L-mode-like).

This new collaboration framework facilitates coordinated experiment and analysis of Objectives 1, 3 and 4.

D. Difusión de los resultados del proyecto

Nota: Relacione **únicamente** los resultados derivados de este proyecto.

D1. Publicaciones científico-técnicas directamente derivadas de los resultados del proyecto.
Indicar publicaciones en revistas revisadas por pares, "open access", repositorios…

Autores/as, título, referencia de la publicación*…

[D1.1] C. Silva, **E.R. Solano,** J.C. Hillesheim, E. Delabie, G. Birkenmeier, L. Gil, C. Giroud, R.B. Morales, D. Nina and JET Contributors. "*Effect of the divertor configuration on the JET edge radial electric field".* Nuclear Fusion 62 126057 (Nov, 2022)

[D1.2] G. Birkenmeier, **ER Solano**, IS Carvalho, JC Hillesheim, E Delabie, E Lerche, …, J García, …, **E de la Luna** et al. "*The role of isotope mass and transport for H-mode access in tritium containing plasmas at JET with ITER-like wall".* Plasma Physics and Controlled Fusion 65 054001 (March, 2023)

[D1.3] ER Solano, G Birkenmeier, C Silva, E Delabie, JC Hillesheim, A Baciero…, **E de la Luna**, …, J García et al. "*LH transition studies in tritium and deuterium–tritium campaigns at JET with Be wall and W divertor".* Nuclear Fusion 63 112011(Oct, 2023)

[D1.4] O. Grover, P. Manz, A.Y. Yashin, D.I. Réfy, J. Seidl, N Vianello, G. Birkenmeier, **E.R. Solano**, et al. "*Experimentally corroborated model of pressure relaxation limit cycle oscillations in the vicinity of the transition to high confinement in tokamaks".* Nuclear Fusion 64 026001 (2024) (Dec, 2023)

[D1.5] E. de la Luna, J. García, M. Sertoli, P. Lomas, S. Mazzi, Z. Stancar, …, **E.R. Solano**, et al. "*Exploring the physics of a high-performance H-mode scenario with small ELMs at low collisionality in JET with Be/W wall".* Nuclear Fusion 64 (9) 096014 (July, 2024)

[D1.6] A. Hakola, M. Balden, M. Baruzzo, R. Brisson,…, **E.R. Solano** et al, *"Helium plasma operations on ASDEX Upgrade and JET in support of the non-nuclear phases of ITER".* Nuclear Fusion 64 096022 (July, 2024)

[D1.7] J. García, Y. Kazakov, R. Coelho, M. Dreval, **E de la Luna**, **E.R. Solano** et al. "*Stable Deuterium-Tritium plasmas with improved confinement in the presence of energetic-ion instabilities".* Nature Communications (submitted for publication, accepted in Sept 2024)

[D1.8] V.G. Kiptily, …, E. R. Solano,… *"Observation of alpha-particles in recent D–T experiments on JET"* et al Nuclear Fusion 64 (8), 086059 (2024)

[D1.9] P. Vincenzi, **E.R. Solano** et al, "*Non-linear dependence of ion heat flux on plasma density at the L-H transition of JET NBI-heated Deuterium-Tritium plasmas". Submitted to Nuclear Fusion in August 2024*

[D1.10] M. Yoshida (Chair Transport and Confinement (TC) Topical Group), R. M. McDermott, C. Angioni, Y. Camenen, J. Citrin, M. Jakubowski, …, **E.R. Solano** et al. *"Transport and Confinement Physics".* Submitted to Nuclear Fusion in August 2024*

[D1.11] M. Fenstermacher (Chair Pedestal and Edge Physics (PEP) Topical Group), P. Snyder, T. Osborne, S. Saarelma, …, **E. de la Luna, …** et al. *"Progress in Pedestal and Edge Physics".* Submitted to Nuclear Fusion in September 2024*

*The two PIs are co-authors of two papers within the Nuclear Fusion Special Issue presenting a summary of the work done by the ITPA topical groups since the publication of the *"Progress in the ITER Physics Basis*" Nuclear Fusion Special Issue in 2007. Both papers include results from experiments associated to this project.

D2. Patentes directamente derivadas de los resultados del proyecto. *Indicar si las patentes están licenciadas y/o en explotación.* **Indicar otras formas de protección de los resultados del proyecto, si las hubiera*
NA

*Resalte en negrita las realizadas por las personas que son IP.

D3. Asistencia a congresos, conferencias o workshops relacionados con el proyecto
Nombre del congreso, tipo de comunicación (invitada, oral, póster), autores/as….

[D3.1] 64th Annual Meeting of the APS Division of Plasma Physics, Spokane, Washington, USA (October, 2022, 17-21) [invited]
"Overview of Deuterium-Tritium results from JET-ILW experiments". **E. de la Luna** on behalf of JET contributors.

[D3.2] 64th Annual Meeting of the APS Division of Plasma Physics, Spokane, Washington, USA (October 17-21, 2022) [poster]
"Observation of Edge Harmonic Oscillations in JET-ILW Deuterium, Tritium and DT plasmas". **E.R. Solano**, P. Buratti, J.M. Fontdecaba, D. Brunnetti, E. Viezzer et al.

[D3.3] 64th Annual Meeting of the APS Division of Plasma Physics, Spokane, Washington, USA (October 17-21, 2022) [oral]
"Confinement in Mixed Isotope Plasmas with Constant ELM Frequency in JET-ILW". D. King, E. Viezzer, M. Baruzzo, **E. de la Luna**, J. García E. Delabie, …, J.C. Hillesheim et al

[D3.4] 49th EPS Conference on Plasma Physics, Bordeaux, France (July 3-7, 2023) [poster]
"Influence of impurity radiation loss on the LH transition power threshold". E. Pawelec, W. Gromelski, A. Chomiczewska, **E.R. Solano**, …, J.C. Hillesheim, et al.

[D3.5] 49th EPS Conference on Plasma Physics, Bordeaux, France (July 3-7, 2023) [Oral]
"ELMy H-mode Helium plasma at JET-ILW". M. Maslov, M. Dunne, L. Garzotti, R. Henriques, A. Loarte, C. Lowry**, E.R. Solano**, O. Sauter, P. Bohm, P Bilkova and JET Contributors

[D3.6] Plasma 2023 – International Conference on Research and Applications of Plasmas, Warsaw, Poland (18 September, 2023) [plenary invited]
"The L-H transition: new results from the JET Tritium and Deuterium-Tritium campaigns". **E.R. Solano** et al.

[D3.7] 20th European Fusion Theory Conference, Padova, Italy (October 2-5, 2023) [poster]
"Characterization of L-H transition density branches in JET D-T plasmas through a power balance analysis". P. Vincenzi, **E.R. Solano**, P. Carvalho, E. Delabie et al.

[D3.8] 20th European Fusion Theory Conference, Padova, Italy (October 2-5, 2023) [poster]
"Gyrokinetic Simulations of JET pedestal top plasmas in different regimes". M. Dicorato, M. Muraglia, Y. Camenen, J. García**,** X. Garbet, et al

[D3.9] 29th IAEA Fusion Energy Conference. London, UK (October 16-29, 2023) [oral and poster]
"L-H transition physics results from recent Tritium and Deuterium-Tritium campaigns at JET".
E.R. Solano et al.

[D3.10] 29th IAEA Fusion Energy Conference. London, UK (October 16-29, 2023) [oral and poster]
"Helium plasma operations on ASDEX Upgrade and JET in support of the non-nuclear phases of ITER"". A. Hakola, …, **E.R. Solano**, et al.

[D3.11] 29th IAEA Fusion Energy Conference. London, UK (October 16-29, 2023) [poster]
"Experimental conditions to access high-performance H-mode plasmas with small ELMs at low collisionality in JET-ILW". **E. de la Luna**, M. Dunne, P. Lomas, C. Reux, **E.R. Solano**, J. García et al.

[D3.12] International Tokamak Physics Activities (ITPA) Edge Plasma and Pedestal Physics Topical Group meeting (23 – 26 Octubre, 2023) [oral].
"Overview on high-performance plasmas with small ELMs at low collisionality in JET-ILW".
E. de la Luna et al.

[D3.13] International Tokamak Physics Activities (ITPA) Edge Plasma and Pedestal Physics Topical Group meeting (23 – 26 Octubre, 2023) [oral].
"L-H transition results from recent tritium and deuterium-tritium campaigns at JET".
E.R. Solano et al.

[D3.14] 31st European Fusion Programme Workshop – *"Tungsten as First Wall Material*: *From ITER Towards Fusion Power Plants",* Prague, Czech Republic (29 Jan – 1 Feb, 2024) [invited, plenary]
"Impact of W on H-mode access". **E.R. Solano** et al.

[D3.15] 50th EPS Conference on Plasma Physics, Salamanca, Spain (July 8-12, 2024) [poster, winner of the People's Choice Award to the best poster, voted by conference participants.
"Potential research programme for JET with W wall and ECRH". **E.R. Solano**, J. Ongena and JET petition contributors. Voted best poster of the conference by the participants.

[D3.16] 50th EPS Conference on Plasma Physics, Salamanca, Spain (July 8-12, 2024) [Invited]
"Connecting recent JET isotope LH transition studies to ITER H-mode access in new baseline scenarios." P. Vincenzi, A. Loarte, M. Schneider, **E.R. Solano**, G. Birkenmeier et al

[D3.17] 50th EPS Conference on Plasma Physics, Salamanca, Spain (8 July 8-12, 2024) [oral]
"Turbulent transport at the pedestal top of small-ELM plasmas at JET: key mechanisms and their impact". M. Dicorato, M. Muraglia, Y. Camenen, J. García, X. Garbet, D.R. Hatch, G. Merlo, **E. de la Luna** and JET Contributors

[D3.18] 50th EPS Conference on Plasma Physics, Salamanca, Spain (July 8-12, 2024) [oral]
"Impact of nitrogen injection on LH transitions in JET with Be/W wall". C.F. Maggi, C. Bourdelle, E. Delabie, A. Chankin, P. Drewelow, N. Hawkes, H. Meyer, **E.R. Solano** and JET Contributors

[D3.19] 50th EPS Conference on Plasma Physics, Salamanca, Spain (July 8-12, 2024) [poster]
"Er measurements in JET L-mode plasmas for a wide range of densities – from the low recycling regime up to the density limit". C. Silva, … **E.R. Solano** et al

D4. Tesis doctorales directamente relacionadas con el proyecto
Indique si están (en marcha) o finalizadas

Nombre del doctor/a, director/a de tesis, título, calificación, organismo…

Mattia Dicorato (Milan, Italy).
Supervisors: X. Garbet, M. Muraglia, Y. Camenen and J. García
Title: *"Mode competition and turbulent electron heat transport in tokamaks"*
University: Aix-Marseille University, CEA, Marseille
In progress: September 2021-current

This PhD is based on the non-linear/local turbulence analysis of the BSE plasmas from JET using the gyrokinetic code GWC, including the unfuelled case that is the focus of the Objective 3 in this project.

D5. Otras publicaciones derivadas de colaboraciones mantenidas durante la ejecución del proyecto y que pudieran ser relevantes para el mismo, así como artículos de divulgación, libros, conferencias…

Autores/as, título, referencia de la publicación…

[D5.1] P Vincenzi, E.R. Solano *et al* "*Power balance analysis at the L-H transition in JET-ILW NBI-heated deuterium plasmas",* Plasma Phys. Control. Fusion *64 124004 2022*

[D5.2] E Viezzer, ..X Chen … ER Solano et al. *"Prospects of core–edge integrated no-ELM and small-ELM scenarios for future fusion devices"*. Nuclear Materials and Energy 34 101308 (2023). Prospects for QH-mode as an operational regime in future devices such as ITER and DEMO are described here.

- In 2021 JET carried out the second major JET deuterium-tritium campaign (DTE2), almost 25 years after DTE1, exploiting JET's unique capability to operate with tritium (T) and D-T fuel and with an ITER-like Be/W wall. The two PIs have contributed as co-authors to several papers included in the Nuclear Fusion Special Issue presenting results from the DTE2 campaign, as well as more recent ones.

[D5.3] J. Hobirk, CD Challis, A Kappatou, E Lerche, D Keeling, …, J García, …, E de la Luna, …, ER Solano et al. *"The JET hybrid scenario in Deuterium, Tritium and Deuterium-Tritium".* Nuclear Fusion 63 112001 (2023)

[D5.4] M. Maslov, E. Lerche, F. Auriemma, E. Belli, C. Bourdelle, …, J. García, …, E. de la Luna, …, E.R. Solano et al. *"JET D-T scenario with optimized non-thermal fusion".* Nuclear Fusion 63 112002 (2023)

[D5.5] L. Frassinetti, C. Perez von Thun, B. Chapman-Oplopoiou, H. Nystrom, M. Poradzinski, J.C. Hillesheim, …, E.R. Solano et al. *"Effect of the isotope mass on pedestal structure, transport and stability in D, D/T and T plasmas at similar β_N and gas rate in JET-ILW type I ELMy H-modes".* Nuclear Fusion 63 112009 (2023)

[D5.6] M. Faitsch, I. Balboa, P. Lomas, S.A. Silburn, A. Tookey, D. Kos, A. Huber, E. de la Luna, D. Keeling, A. Kappatou ***and JET contributors***. *"Divertor power load investigations with deuterium and tritium in type-I ELMy H-mode plasmas in JET with the ITER-like wall".* Nuclear Fusion 63 112013 (2023)

[D5.7] M.J. Mantsinen, P. Jacquet, E. Lerche, D. Gallart, K. Kirov, …, E. de la Luna, …, J. García,…, ER Solano et al. *"Experiments in high-performance JET plasmas in preparation of second harmonic ICRF heating of tritium in ITER".* Nuclear Fusion 63 112015 (2023)

- An overview publication from the JET DTE2 campaign included results directly related with this project, in particular the influence of the isotope mass on the L-H transition.

[D5.8] C.F. Maggi et al. "*Overview of T and D–T results in JET with ITER-like wall"* Nuclear Fusion 64 112012 (2024)

- The PI1 participated on the Vision4Fusion panel discussion held at EPS 2024 in Salamanca, 10th July 2024 (min 2:11 to 5:00) Question/comment by PI1 on the value of continuing JET to the fusion knowledge pipeline

E. Gastos realizados hasta la mitad del periodo de ejecución del proyecto

Debe cumplimentarse este apartado **independientemente** de la justificación económica anual enviada por la entidad. Se deben incluir los principales conceptos de gastos con su importe, no el desglose de las facturas del proyecto, para valorar su adecuación a los objetivos y actividades realizadas en el proyecto. Es **indispensable** especificar si el gasto estaba previsto en la solicitud original.

E1. Gastos de personal (indique número de personas, situación laboral y función desempeñada en el proyecto)

	Nombre	Situación laboral	Función desempeñada	Importe	Previsto en la sol. original (S/N)
1					
2					
Total gastos de personal:					

Nota: Cree tantas filas como necesite

E2. Material inventariable (describa el material adquirido)

	Equipo	Descripción del equipo	Importe	Previsto en la sol. original (S/N)
1	Monitor	Acquisition of a 27 inches monitor	147,67	S
2				
Total gastos material inventariable			**147,67**	

Nota: Cree tantas filas como necesite

E3. Material fungible (describa el tipo de material por concepto o partida, p. ej., reactivos, material de laboratorio, consumibles informáticos, etc.)

	Concepto	Importe	Previsto en la sol. original (S/N)
1	Acquisition of an Adobe Illustrator license (to support publications) (2022)	164,6	S
2	Acquisition of an Adobe Illustrator license (to support publications) (2023)	164,6	S
Total gastos material fungible		**329,2**	

Nota: Cree tantas filas como necesite

E4. Viajes y dietas (describa la actividad del gasto realizado y **las personas que han realizado la actividad)**. Debe incluir aquí los gastos derivados de la asistencia a congresos, conferencias, colaboraciones, reuniones de preparación de propuestas relacionados con este proyecto, etc.)

	Concepto	Relación con el proyecto	Importe	Nombre del participante	Previsto en sol. original (S/N)
1	Attendance at the 18th workshop on H-mode physics and transport barriers (part-I) (HMW-2022)	Total	3.760,01	E. de la Luna	S
2	Registration fee (HMW-2022)	Total	252,22	E. de la Luna	S
3	Registration fee for the 64th Annual Meeting of the APS Division of Plasma Physics (APS 2022)-remote attendance	Total	627,27	E.R. Solano	S
4	Registration fee for the 64th Annual Meeting of the APS Division of Plasma Physics (APS 2022)-remote attendance	Total	627,27	E. de la Luna	S
5	Attendance at the 29th IAEA Fusion Energy Conference (FEC 2023)	Total	1.443,86	E.R. Solano	S
6	Attendance at the ITPA Edge Plasma and Pedestal Physics (PEP) Topical Group meeting (Oct-2023)	Total	460,70	E.R. Solano	S
7	Attendance at the 29th IAEA Fusion Energy Conference" (FEC 2023) and the ITPA-PEP meeting (Oct-2023)	Total	3.506,98	E. de la Luna	S
8	Attendance at the Plasma-2023, Conference on Research and Applications of Plasmas	Total	1.125,29	E.R. Solano	S
9	Attendance at the 31st European Fusion Program Workshop (EFPW 2024)	Total	632,78	E.R. Solano	S
10	Registration fee (EFPW 2024)	Total	720	E.R. Solano	S
11	Attendance at the 31st European Fusion Program Workshop (EFPW 2024)	Partial	613,31	E. de la Luna	N
12	Registration fee (EFPW 2024)	Partial	720	E. de la Luna	N

13	Attendance at the event to commemorate the closure of the JET tokamak (Feb-2024)	Partial	713,52	E.R. Solano	N
14	Attendance at the event to commemorate the closure of the JET tokamak (Feb-2024)	Partial	774,95	E. de la Luna	N
15	Attendance at the 50th EPS Conference on Plasma Physics (EPS-2024)	Total	560,40	E.R. Solano	S
16	Registration fee (EPS-2024)	Total	515,65	E.R. Solano	S
17	Attendance at the Program Committee meeting of the 50th EPS Conference	Partial	314,92	E.R. Solano	N
18	Attendance at the 50th EPS Conference on Plasma Physics (EPS-2023)	Total	596,35	E. de la Luna	S
19	Registration fee (EPS-2024)	Total	558,62	E. de la Luna	S
20	Registration fee for the 21st Congress on Plasma Physics (2024)	Total	600	E.R. Solano	S
21	Registration fee for the 19th International Workshop on H-mode Physics and Transport Barriers (HMW-2024)	Total	352,75	E. de la Luna	S
Total viajes y dietas			**19.476,85**		

Nota: Cree tantas filas como necesite

E5. Otros gastos (describa la actividad del gasto por concepto, y si procede, las personas que han realizado la actividad)

	Concepto	**Relación con el proyecto**	**Importe**	**Nombre del participante**	**Previsto en la sol. original (S/N)**
1	Scientific publication costs (2023) **[D1.3]**	Total	2320	E.R. Solano	S
2	Scientific publication costs (color figures) (2024) **[D1.3]**	Total	2320	E.R. Solano	S
3	Scientific publication costs (2024) **[D1.5]**	Total	2.236,82	E. de la Luna	S
4	Tomographic reconstruction of plasma radiation for the discharges under investigation in the project (1)	Total	3.119,7	E.R. Solano	N
5	Tomographic reconstruction of plasma radiation for the discharges under investigation in the project (2)	Total	3.119,7	E.R. Solano	N
6	Coffee service for an experts meeting held in CIEMAT (March-2023)	Total	95,42	E.R. Solano E. de la Luna D. Zarzoso	S
Total otros gastos			**13.211,64**		

Nota: Cree tantas filas como necesite

E6. Descripción de gastos no contemplados en la solicitud original (si ha realizado algún gasto no contemplado en la solicitud original, **justifique** la necesidad de su ejecución en este apartado)

Gasto	**Justificación**
Attendance at the Program Committee (PC) meeting of the EPS Conference (2024) (E.R. Solano)	E.R Solano was nominated member of the PC for the EPS conference in 2023, after the proposal's submission. The involvement of the PI1 in this committee of one of the more relevant conferences in the field benefits the project by bringing a broad perspective and valuable insights into the activities conducted by the international community.

Attendance at the event to commemorate the closure of the JET tokamak, held in Culham (UK) on the 28th of February 2024 (E. de la Luna, E.R. Solano)	Both PIs were invited to the event due to their long-standing contributions to the JET project since 2000. As JET data forms the foundation of this project's research, attendance was beneficial for the project, giving the PIs the opportunity to meet with key collaborators and experts, and gaining insights into the project's broader impact as JET experiments concludes and analysis carries on.
Attendance at the 31st European Fusion Program Workshop (EFPW-2024) (E.R. Solano, E. de la Luna)	The EFPW is an annual meeting focused on discussing the European scientific strategy for the EUROfusion Fusion Science program, each year centred on a specific topic. This year's topic, 'Tungsten as First Wall Material: From ITER Towards Fusion Power Plants,' is highly relevant for this project. Both PIs attended, with E.R. Solano delivering an invited talk. Their participation enabled direct discussions with leading experts and strengthened the project's alignment with European and international research efforts.
Tomographic reconstruction of plasma radiation for the discharges under investigation in the project	The closure of JET led to the loss of various experts due to contractual issues. In order to timely carry out the tomographic analysis of plasma radiation by bolometry (essential for L-H threshold studies) it became necessary to sub-contract it to an expert who was no longer an UKAEA employee. The change of plan was requested via the proper procedure and it was approved by the funding agency (Agencia Estatal de Investigación). The work was completed during the summer of 2024.

Nota: Cree tantas filas como necesite

E7. Total ejecutado (costes directos únicamente)	
Importe total concedido	**90.000**
Importe total ejecutado durante el periodo	**33.165,36**

Condiciones específicas para la ejecución de determinados proyectos.

Rellenar solo en Proyectos que utilicen recursos genéticos españoles o extranjeros y conocimientos tradicionales asociados a los recursos genéticos, cubiertos por el Reglamento (UE) nº 511/2014 del Parlamento Europeo y del Consejo, de 16 de abril de 2014, relativo a las medidas de cumplimiento de los usuarios del protocolo de Nagoya

Número de Registro:	

Nota: número de registro que justifique la presentación, a través de la sede electrónica del Ministerio para la Transición Ecológica, de la declaración de diligencia debida de conformidad con el artículo 14.1 del Real Decreto 124/2017, 24 de febrero

Instrucciones para la elaboración de los informes de seguimiento científico-técnico de proyectos de Generación de Conocimiento 2021.

Modalidades: Investigación No Orientada e Investigación Orientada

Para el seguimiento científico-técnico de las convocatorias de **Proyectos de Generación del conocimiento 2021, modalidades Investigación No Orientada e Investigación Orientada debe** presentarse:

- Un **informe de seguimiento científico-técnico de progreso intermedio**, cuando se cumpla la mitad del período de ejecución del proyecto.
- Un **informe científico-técnico final** a la finalización de la ejecución del proyecto.

Los informes de justificación científico-técnica deberán contener la siguiente información:

- Desarrollo de las actividades realizadas, cumplimiento de los objetivos propuestos en la actuación, así como el impacto de los resultados obtenidos evidenciados, entre otros, mediante la difusión de resultados en publicaciones, revistas científicas, libros, presentaciones en congresos, acciones de transferencia, patentes, internacionalización de las actividades, colaboraciones con grupos nacionales e internacionales y, en su caso, en la formación de personal investigador.

- Cualquier cambio que se haya producido respecto a los gastos contemplados en el presupuesto incluido en la solicitud inicial del proyecto, justificando adecuadamente su necesidad para la consecución de los objetivos científico-técnicos del proyecto.

- La composición del equipo de investigación, indicando aquellas modificaciones que se hayan producido en la composición y/o dedicación del equipo de investigación. Estos cambios deben haber sido previamente autorizados por la Subdivisión de Programas Temáticos Científico-Técnicos.

- La composición del equipo de trabajo, así como cualquier modificación que se haya producido en la composición del equipo de trabajo respecto al inicialmente previsto en la memoria científico-técnica del proyecto. **Estos cambios no necesitan autorización previa por parte de la Subdivisión de Programas Temáticos Científico-Técnicos.**

- Cualquier modificación que se haya producido en los objetivos propuestos en la solicitud de la ayuda, detallando justificadamente los motivos que han llevado a ello.

Se debe rellenar los distintos apartados de acuerdo con la modalidad de la convocatoria (Investigación No Orientada e Investigación Orientada) y el tipo de proyecto: A, B y RTA

En el caso de proyectos coordinados, se deberá presentar **un informe independiente** por cada uno de los subproyectos.

Elaboración del Informe intermedio científico-técnico

Apartado A. Se debe indicar los datos actuales del proyecto. Si ha habido alguna modificación en los datos iniciales del proyecto debe indicarlo en el Apartado **A2.** Los proyectos que estén dirigidos por dos investigadores/as principales deberán rellenar También la casilla correspondiente IP2.

Apartado B. Debe relacionar la situación de **todo** el personal que haya realizado actividades en el proyecto en el periodo que se justifica, tanto si forma parte del equipo de investigación como del plan de trabajo.

Apartado C. Se reflejará el progreso de las actividades del proyecto y el cumplimiento de los objetivos propuestos, desarrollándolos en los siguientes apartados:

C1. Debe describir el grado de cumplimiento de los objetivos planteados en el proyecto.

C2. Debe describir las actividades científico-técnicas desarrolladas para alcanzar los objetivos planteados en el proyecto indicando las personas del equipo que han participado en cada una de las actividades, remarcando las realizadas por las personas que son IP.

Se debe informar sobre el progreso y la consecución de todos los objetivos inicialmente planteados con el detalle suficiente para poder valorar el grado de cumplimiento, así como las actividades realizadas y los resultados alcanzados. ***Se recuerda que una vez aprobado el proyecto no es posible modificar los objetivos del mismo en relación a la solicitud inicial***

C3. Debe reflejar las dificultades o problemas que hayan podido surgir en el desarrollo del proyecto, así como su repercusión para el proyecto en su conjunto. Si se hubieran propuesto soluciones para superar dichas dificultades, también es necesario reflejarlas en este apartado.

Se entiende que estas situaciones son inherentes a la propia actividad científica, pero se debe informar y ayudar a valorar su alcance.

C4. y C5. Se deben relacionar en el apartado correspondiente las colaboraciones con otros grupos de investigación que tengan **relación directa** con el proyecto y las colaboraciones con empresas o sectores socioeconómicos.

Las actividades de colaboración deben detallarse y justificarse adecuadamente, especialmente cuando hayan implicado gasto o cuando no estuvieran contempladas en la solicitud original.

C6. Debe detallar las actividades de formación y movilidad del personal que participa en el proyecto.

C7. Debe describir las actividades de internacionalización y otras colaboraciones relacionadas con el proyecto.

Apartado D. Se reflejará la difusión de los resultados del proyecto.

D1. Deben relacionar **únicamente** las publicaciones derivadas directamente del presente proyecto, remarcando las realizadas por las personas que son IP.

D2. Se debe relacionar las patentes indicando si están licenciadas y/o en explotación.

D3. Debe relacionar la asistencia a congresos, conferencias o workshops relacionados con el proyecto con indicación del título de la ponencia, nombre del congreso/conferencia y de las personas del equipo que hayan asistido.

D4. Debe indicar las tesis doctorales relacionadas directamente con el proyecto

D5. Debe indicar otras publicaciones relacionadas con la temática del proyecto o fruto de colaboraciones **durante la ejecución del proyecto y que pudieran ser relevantes para el desarrollo del mismo**.

Apartado E. Se detallarán los gastos realizados hasta la mitad del periodo de ejecución del proyecto.

Se pretende poder relacionar el gasto realizado en el proyecto con el presupuesto solicitado inicialmente y valorar su adecuación a los objetivos y actividades realizados en el proyecto. En el caso de que el gasto no estuviera previsto inicialmente, deberán justificarse detalladamente las razones de dicho gasto.

En cada uno de sus apartados: **E1.** Personal, **E2.** Material inventariable, **E3**. Material fungible, **E4.** Viajes y dietas; y **E5**. Otros gastos, se deben mencionar los principales gastos realizados agrupados por tipo de gasto. Se trata de conocer los principales conceptos de gasto, **no** el desglose de todas las facturas del proyecto.

En el apartado **E6.** Gastos no contemplados en la solicitud original, es **importante** que se detalle las necesidades de su adquisición en el desarrollo del proyecto.

En el apartado **E7.** Indique el importe total ejecutado durante este periodo.

Condiciones específicas para la ejecución de determinados proyectos

Aquellos proyectos que utilicen recursos genéticos españoles o extranjeros y conocimientos tradicionales asociados a los recursos genéticos, cubiertos por el Reglamento (UE) nº 511/2014 del Parlamento Europeo y del Consejo, de 16 de abril de 2014, relativo a las medidas de cumplimiento de los usuarios del Protocolo de Nagoya, deberán cumplimentar, **en el informe de seguimiento intermedio**, el número de registro que justifique la presentación, a través de la sede electrónica del Ministerio para la Transición Ecológica y el Reto Demográfico, de la declaración de diligencia debida de conformidad con el artículo 14.1 del Real Decreto 124/2017, 24 de febrero, relativo al acceso a los recursos genéticos procedentes de taxones silvestres y al control de la utilización.