Theoretical Particle Physics group

IPARCOS Scientific Advisory Board: Bi-Annual Review 2026

Clara Peset

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UNIVERSIDAD COMPLUTENSE MADRID

Group's Overview

Group Snapshot

- **Group Name & Principal Investigator (PI):** Theoretical Particle Physics group
  PI's: Felipe J. Llanes-Estrada, José Ramón Peláez, Ignazio Scimemi
- **Current Size:** Total members: 5 Staff, 5 Tenure Track, 2 Postdoc, 14 PhD students.

- **Key Personnel Changes:** Postdocs hired: Alejandro Bris Cuerpo, Sergio Leal-Gomez (Europe Excelence project)
  New PhD students: Diego Voces, Eric García Hemon, Arturo Arroyo Castro

Key Performance Indicators

- **High-Impact Publications:** 39 peer-reviewed papers (30 in Q1 journals / Letters) since March 2024
  Among them: 3 PRL, 12 JHEP, 1 JCAP, 9 PRD
- **Funding Secured:** Total new funding acquired in the last two years: 575211€
  - *HORIZON-INFRA-2025-01-SERV-03 (101292522) - UCM node 71.875*€, PI: Felipe LLanes-Estrada, European Commission
  - COST Action 24159 SHARP, Vice Chair: Ignazio Scimemi, European Commission
  - HEI, MCSA-Staff Exchange, 197.800€, IP Francesco Aprile
  - Europa Excelencia (EUR2023-143460) - 100 000 € - PI: Alexey Vladimirov, Ministry of Science and innovation
  - Research Consolidation Program, PI: Jacobo Ruiz de Elvira, 195.805,00 €, Ministry of Science and innovation

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Senior Members

Francesco Aprile

Ángel Gómez Nicola

Felipe J.Llanes-Estrada

José Ramón Peláez

20% female members

Clara Peset

Jacobo Ruiz de Elvira

Juanjo Sanz Cillero

Ignazio Scimemi

Alexey Vladimirov

Pía Zurita

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Postdocs

- Alejandro de Bris
- Sergio Leal-Gomez

PhD Students

- Alejandro Canoa Monsalve, (CAM)
- Juan J. Gálvez Viruet (FPU)
- Pablo Rabán Mondéjar (FPU)
- Alba Reyes Torrecilla (FPI)
- Óscar del Río (FPU)
- Sara Piloñeta (UCM)
- Arturo Arroyo-Castro (PID)
- Patricia Andrea Gutierrez Garcia (FPI)
- Daniel Díaz Fernandez (Talento)
- Javier Martínez (FPU)
- Diego Voces (UCM)
- Eric García Hemon

External:

- Adriana Bariego Quintana (U. Valencia)
- Guillermo Portela (U. Salamanca)

30% female members among PhD students

Many of them have been temporarily fundend by Iparcos

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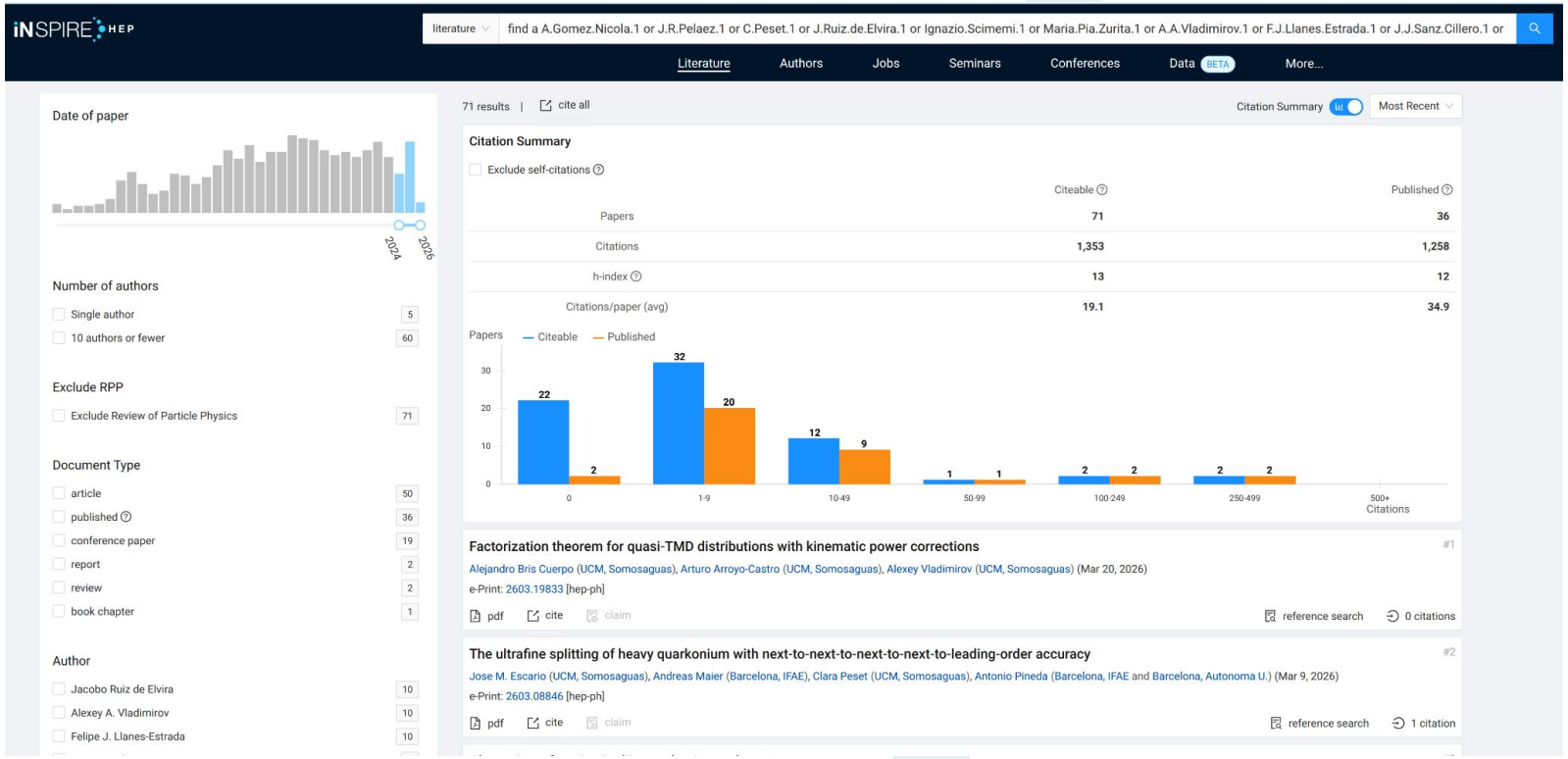
High impact publications



3 members of the group included in the [World's Top 2% Scientist]:

J. R. Peláez, I. Scimemi and A. Vladimirov

more than **1300 citations** in publications 2024-2026

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Additional Funding

- PRX22/00129 Visiting professorship grant, PI Jose Ramón Peláez, 9.731 €, Ministry of science and innovation

Ongoing Projects 2024-2026:

- PID2022-136510NB-C31, 195.625€. PI's: Ignazio Scimemi and Jose Ramón Pelaez, 1/9/2023 tol 31/08/2026, M. of Science
- PID2022-137003NB-I00, 66 300 €, PI: Felipe Llanes-Estrada and Antonio Dobado, 1/9/2023 tol 31/08/2026, M. of Science
  - Both to be renewed this year.
- STRONG2020, 27K€, PI's: Ángel Gómez-Nicola and Jose Ramón Pelaez, ended 2025, European Commission
- COST Action 22130 COMETA, PI: Ilaria Brivio, European Commission
- Effective field theories, particles and cosmology (GRFN24/24), 1.950,93 €, PI's: A.Dobado, A.Gómez Nicola, 01/24-12/24, UCM


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Buscar y encontrar Estudiar e investigar Bibliotecas y horarios Co

Portada / Grupos de Investigación / TEORÍAS EFECTIVAS, FÍSICA DE PARTÍCULAS Y COSMOLOGÍA

Grupos de Investigación

910309 - TEORÍAS EFECTIVAS, FÍSICA DE PARTÍCULAS Y COSMOLOGÍA

Centro:	F. CIENCIAS FISICAS www
Ámbito - Área AEI:	ÁREA DE EXPERIMENTALES - FÍSICA Y CIENCIAS DEL ESPACIO
Valoración :	EXCELENTE (91.00)
Acrónimo - E_Mail:	- dobado@fis.ucm.es
Director/es:	DOBADO GONZALEZ, ANTONIO ; GOMEZ NICOLA, ANGEL
Miembros:	ALVAREZ DOMINGUEZ, ALVARO ; ALVAREZ LUNA, CLARA ; APRILE , FRANCESCO ; ARRECHEA RODRIGUEZ, JULIO; ASOREY BARREIRO, JACOBO ; BARCELO SERON, CARLOS; BARCELOS NEVES, RITA; BORISLAVOV VASSILEV, TEODOR ; BOYANOV SAVOV, VALENTIN ; BRIS CUERPO, ALEJANDRO ; CASADO TURRION, ADRIAN ;

910309
Teorías efectivas
Física de partículas y cosmología

EXCELENTE (91.00)

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Group's Overview

Top 2-3 Scientific Highlights

- **Highlight 1:** *Understanding Large Localized CP Violation,* PRL136(2026)111901, L. Heuser, A. Reyes-Torrecilla, et al.
- **Highlight 2:** *Extraction of unpolarized TMDs* *JHEP* 05 (2024) 036 & *JHEP* 11 (2025) 134, I. Scimemi, A. Vladimirov, P. Zurita et al.
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Leadership, Internationalization & Impact

- **Major Roles:**
  - Iparcos Director (I. Scimemi) and Dean of the Faculty of Physics (A. Gómez-Nicola)
  - Reviewer of the Inclusive section of the ePIC Early Science Report (P. Zurita)
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- **Next Big Milestone:** Implementation of Machine Learning algorithms in LHC data analysis (J.J. Sanz-Cillero)
- **Next Big Milestone:** Inclusion of heavy quarks and quarkonia in the TMD formalism (I. Scimemi, C. Peset)

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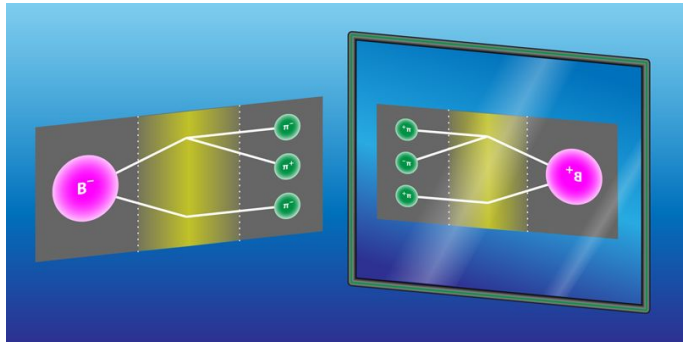
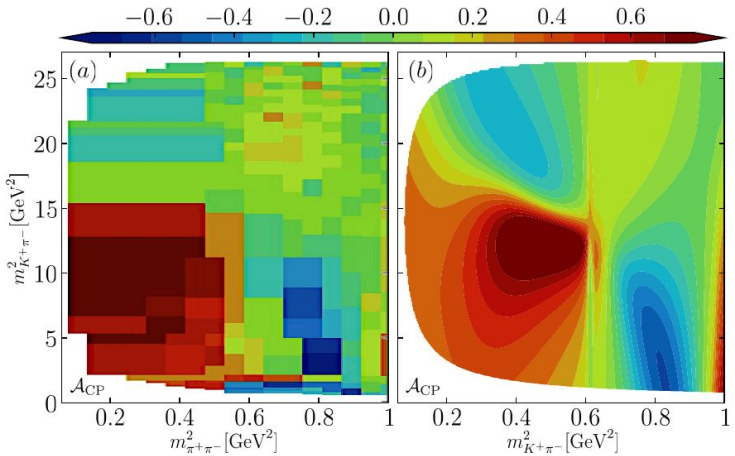
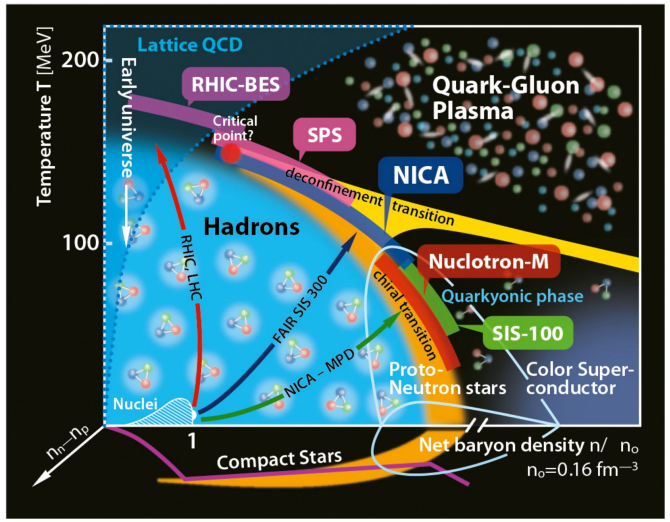
Scientific Highlight 1: hadron physics



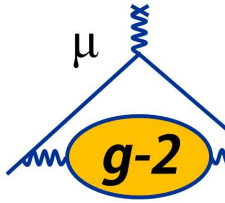


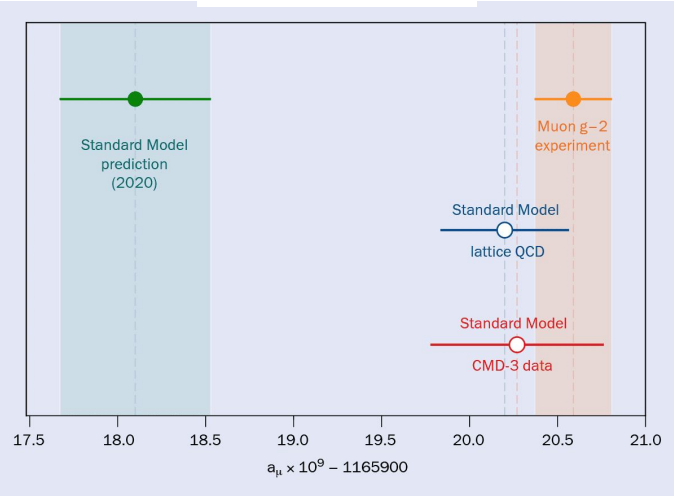
Large Localized CP Violation



Symmetry restoration in QCD at finite temperature

- non-zero chemical potential
- role of resonances





Muon g-2 tension

- Role of the hadronic vacuum polarization
- Muon g-2 Theory initiative

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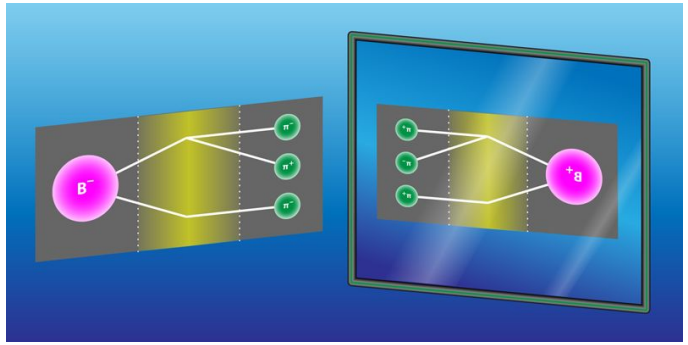
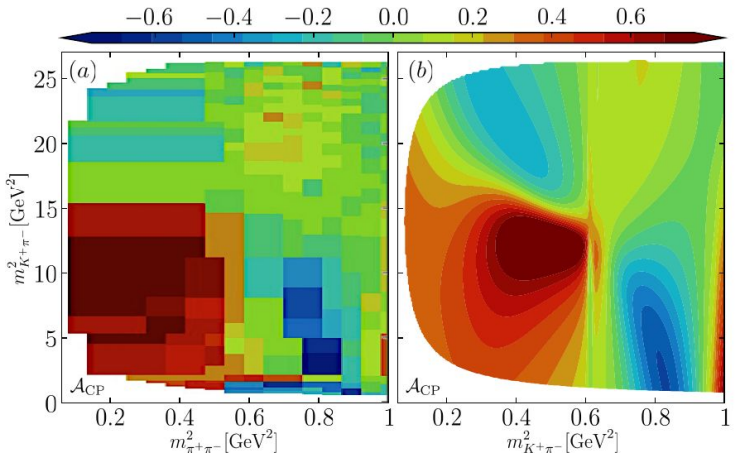
Scientific Highlight 1: hadron physics





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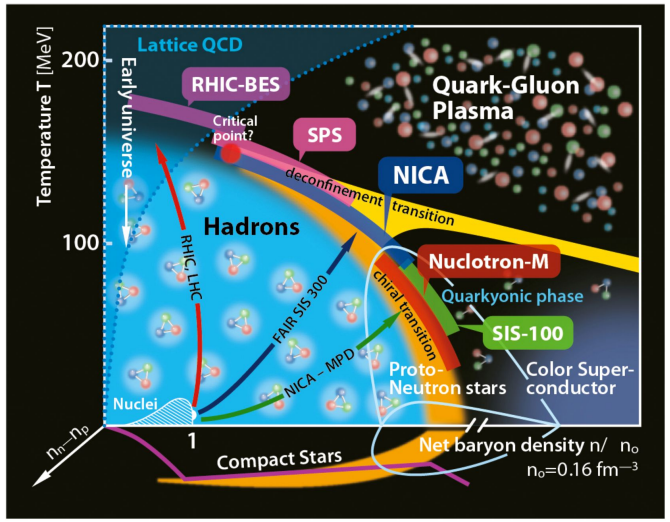

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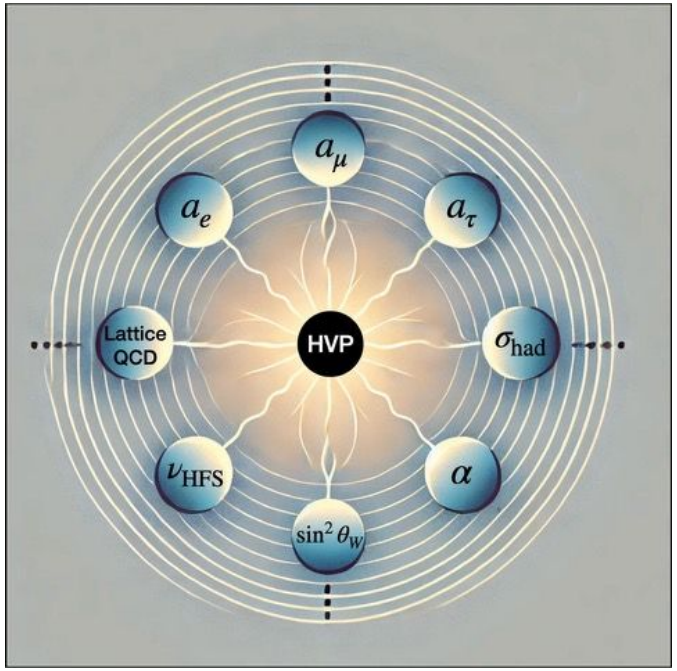

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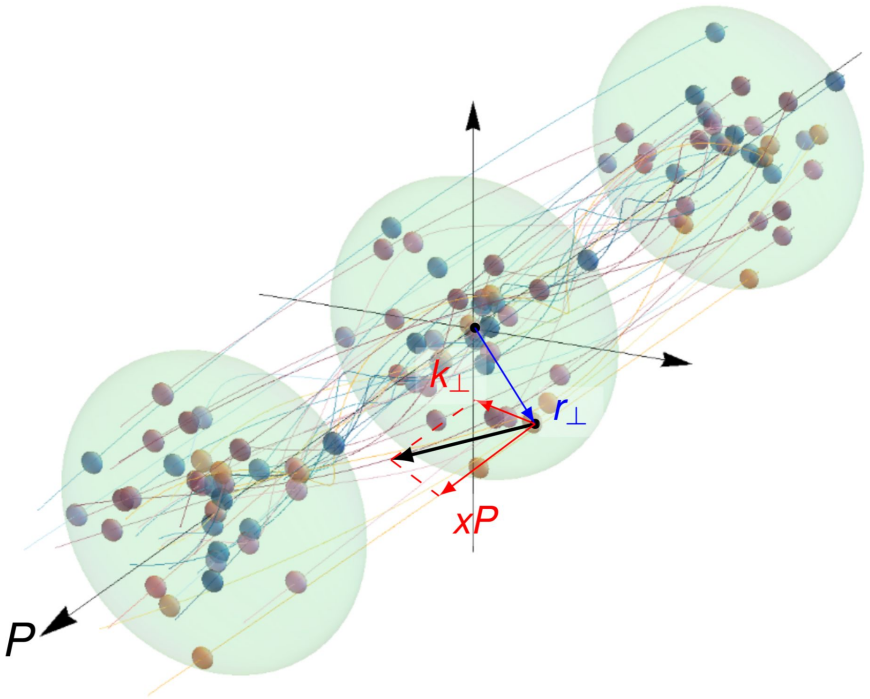
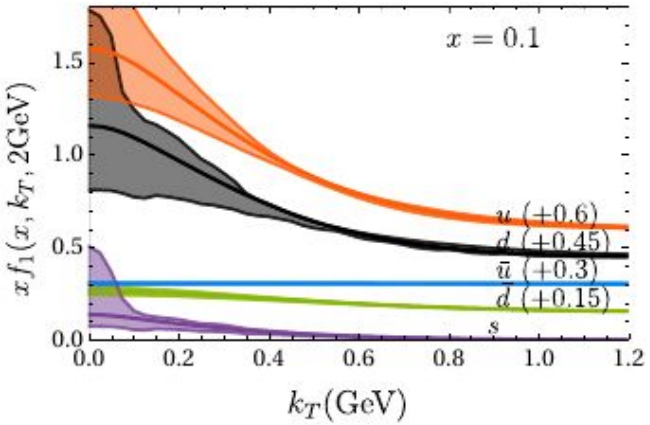
Scientific Highlight 2: Unpolarized TMDs

3-dimensional structure of hadrons





Example:
Proton structure functions

- Extremely accurate results N4LL
- first joined extraction of PDF and TMD from global data (junto con JLab collaboration, enviada a PRL

NEXT:
- systematic treatment of power correction and pt-dependent processes in complete kinematic range
- Simultaneous determination of collinear and TMD PDFs at NNLO

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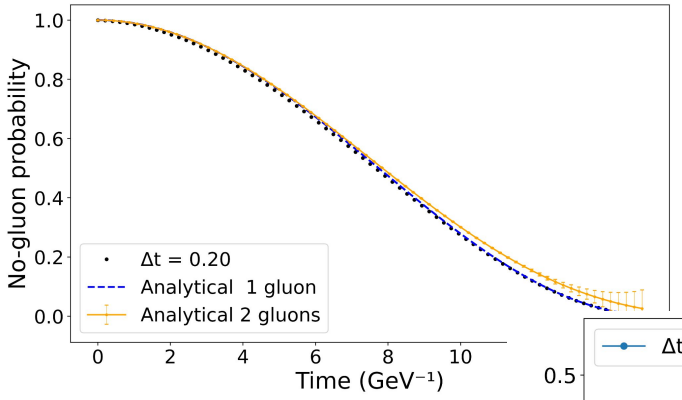
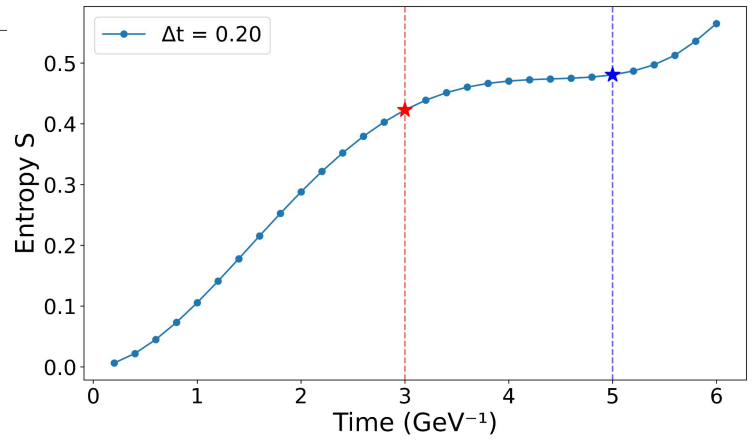
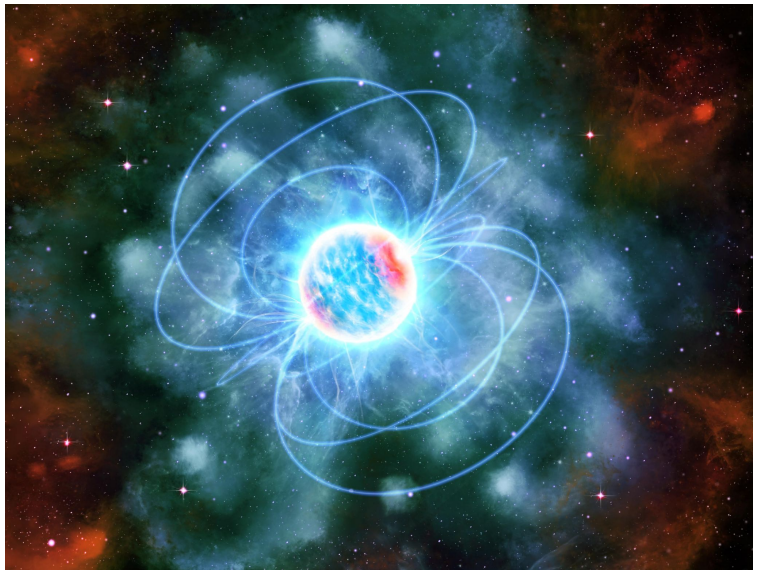
Scientific Highlight 3: Quantum computing

Hadron Fragmentation Functions in Light-Front QCD







NEXT: An algorithm to compute the equation of state of neutron stars on a quantum computer from QCD's Weyl gauge.

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Internationalization and transfer

International collaborations:

- EIC user group (I. Scimemi, A.Vladimirov, P. Zurita)
- pt/W working group at CERN (I. Scimemi, A.Vladimirov)
- Higgs working group at CERN (J.J. Sanz-Cillero)
- DFG research unit 2026 (DESY, Regensburg, Tübingen) (I. Scimemi, A. Vladimirov, P. Zurita)
- JAM collaboration at JLab (A.Vladimirov)
- EINSTEIN Telescope (Llanes-Estrada)
- MuAsti Iniciative (C. Peset)

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External collaborators: regular collaborations with Europe, North America, Asia and South America

Open software:

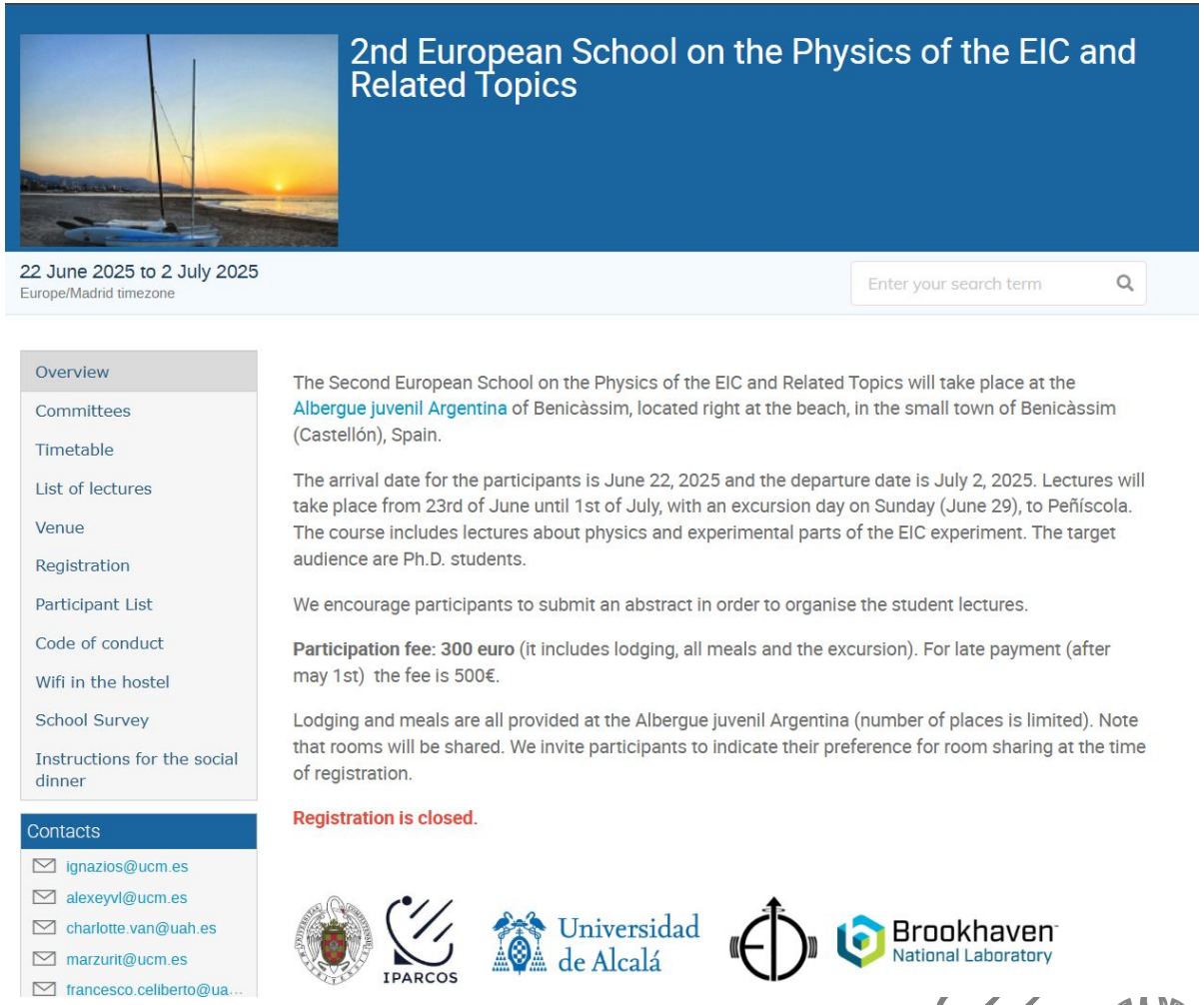
ARTEMIDE Multi-purpose code for phenomenology of transverse momentum(predictions, extractions, impact studies, analysis)

Outreach activities

beamline for schools
cern.ch/bl4s
powered by CERN & DESY

Search for the Muon Electric Dipole Moment
with RF-Phase Coherent Spin Analysis in SPS Secondary Muon Beams at CERN

- Maestro Matías Bravo Highschool (Madrid)
- Tutor: J.J. Sanz-Cillero



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Top 2-3 Scientific Highlights

- **Highlight 1:** *Understanding Large Localized CP Violation,* PRL136(2026)111901, L. Heuser, A. Reyes-Torrecilla, et al.
- **Highlight 2:** *Extraction of unpolarized TMDs* *JHEP* 05 (2024) 036 & *JHEP* 11 (2025) 134, I. Scimemi, A. Vladimirov, P. Zurita et al.
- **Highlight 3:** *Quantum Computing Hadron Fragmentation Functions in Light-Front QCD,* under revision in PRD, J.J.Gálvez-Viruet et al.

Leadership, Internationalization & Impact

- **Major Roles:**
  - Iparcos Director (I. Scimemi) and Dean of the Faculty of Physics (A. Gómez-Nicola)
  - Reviewer of the Inclusive section of the ePIC Early Science Report (P. Zurita)
  - International committee member: Humboldt Foundation and Swiss national Foundation (I. Scimemi), Board Strong2020 (Llanes-Estrada)
  - Honorific member of the official Spanish Physical Association (A. Gómez-Nicola)
- **Recognitions:**
  - Invited plenary talks: ICHEP2026 (J.R. Peláez), 11th Int.Workshop of Chiral Dynamics (J. Ruiz de Elvira), QNP2024 (Vladimirov), ePIC 2025 (Zurita)
- **Tech Transfer / Outreach:**
  - Conference and workshop organization: QCD evolution 2026, SCET2024, Bridging TMD frameworks (ECT*), Perturbative QCD for EIC (MITP) Neutron Star workshop (UAH), QICPP (UCM), Excited QCD 2026 (UGR), QNP2024 (UB)
  - Organization of The Second European School on the Physics of the EIC and Related Topics (2025)

The Horizon

- **Next Big Milestone:** Implementation of Machine Learning algorithms in LHC data analysis (J.J. Sanz-Cillero)
- **Next Big Milestone:** Inclusion of heavy quarks and quarkonia in the TMD formalism (I. Scimemi, C. Peset)

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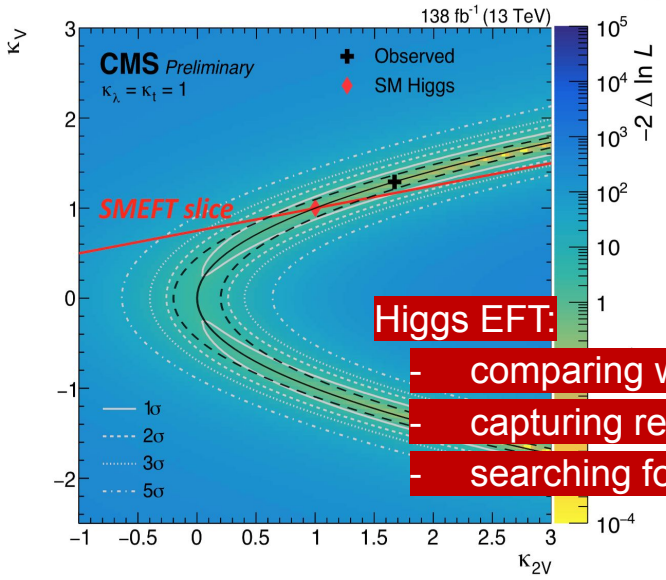
Next big milestone: ML algorithms @ LHC

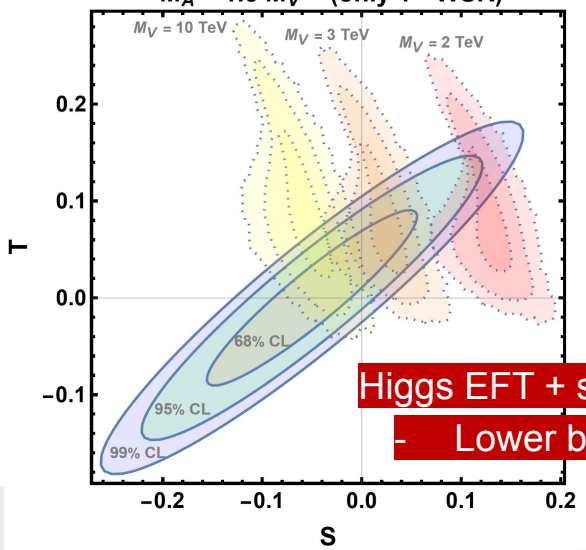


Higgs EFT:

- comparing with LHC data;
- capturing relevant correlations;
- searching for SM deviations

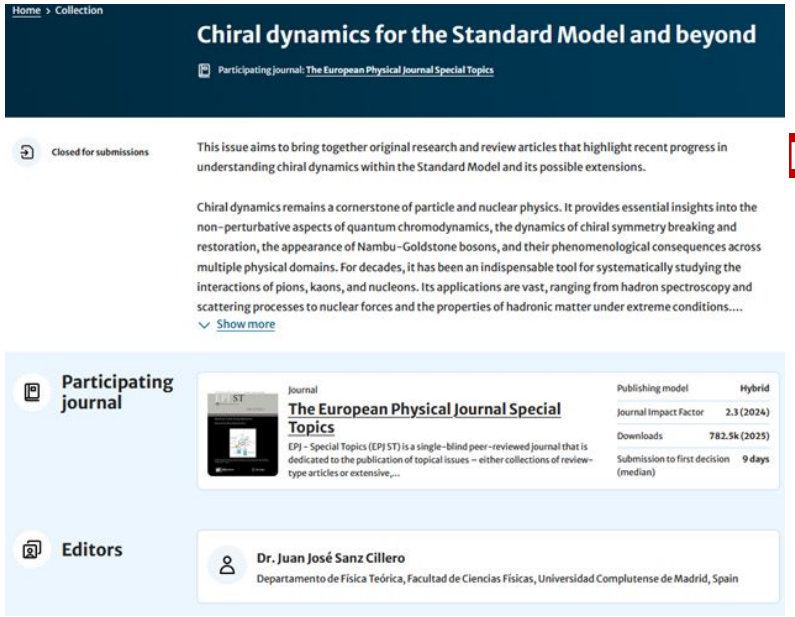
Approach B [P–odd/even]:

$M_A = 1.5\ M_V$ (only 1st WSR)



Higgs EFT + spin-1 + EWPO:

- Lower bounds on new BSM vectors



EPJ ST Volume: Chiral Dynamics for SM and Beyond

CEPCreports: Chinese Higgs e+e- Factory

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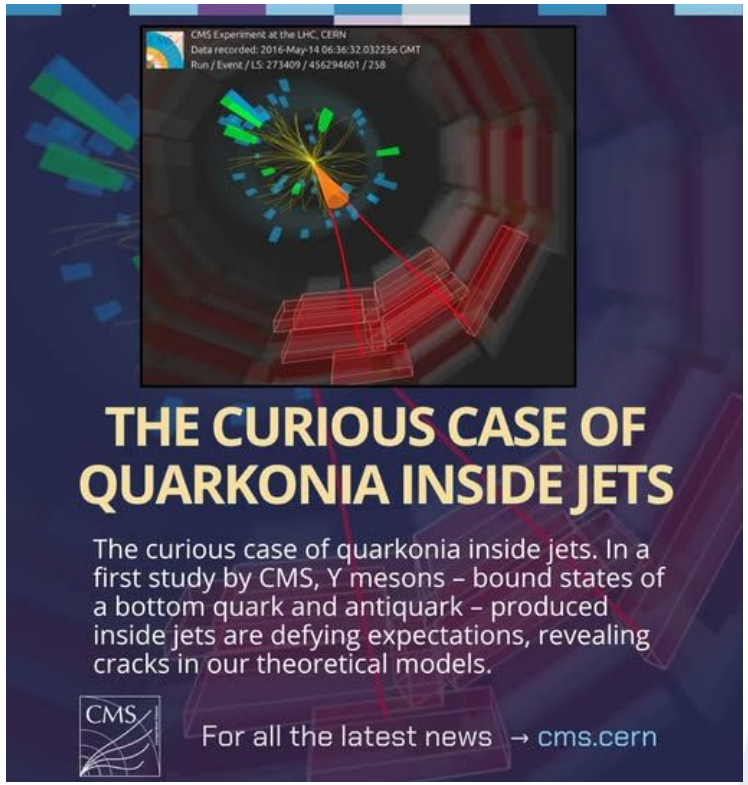
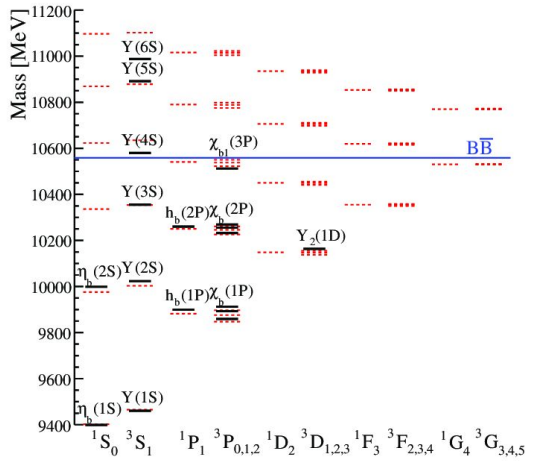
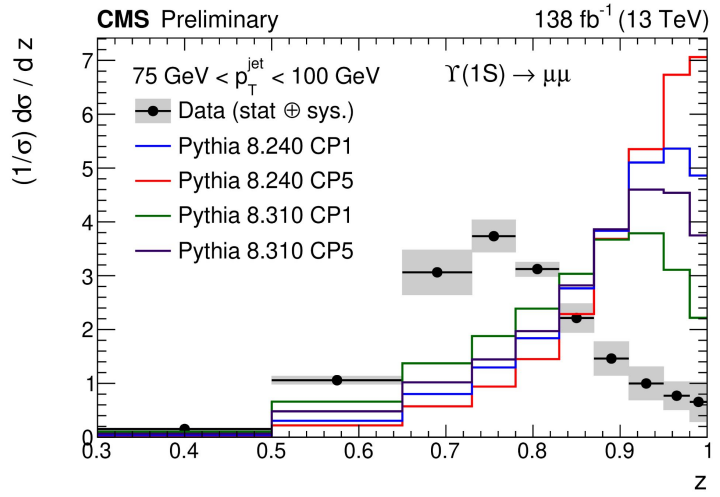
Next big milestone: TMDs and heavy quarks







- Understand polarization in heavy quarkonium
- Phenomenology of hadron in jet at higher perturbative order in polarized processes

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Thank you!