



1. DATOS BÁSICOS DEL TFG:

Título: Searching for fractals at the LHC

Descripción general (resumen y metodología):

Self-similarity is a ubiquitous feature in Nature. Examples of self-similar structures, or fractals, are snowflakes, romanesco broccoli, coastlines or branches of trees. A fascinating feature of fractals is that they have a non-integer dimension. This project aims to investigate self-similar properties of the strong force, a fundamental interaction of Nature that binds together subatomic particles of matter by acting at femtoscopic distances. High-energy particle colliders, like the Large Hadron Collider (LHC) at CERN, provide an excellent opportunity to probe self-similarity at such small scales.

This project is of interdisciplinary nature and will combine theoretical ingredients of particle physics and fractal geometry. The student will perform state-of-the-art simulations of proton-proton collisions [1,2] and explore different ways of characterising scale-invariant aspects [3] of the strong force. As an example, the student will work on defining the fractal dimension of jets, collimated bunches of particles that are observed in almost every event at the LHC.

Tipología: Estudio de casos, teóricos o prácticos, relacionados con la temática del Grado.

Objetivos planteados:

- Learn about fundamental properties of the strong force at quantum level.
- Simulate high-energy proton-proton collisions using Monte Carlo event generators.
- Compile different mathematical definitions of the fractal dimension.
- Apply concepts of fractal geometry to high-energy particle physics.

Bibliografía básica:

[1] SciPost Phys.Codeb. 2024 (2024) 31

[2] SciPost Phys.Codeb. 2022 (2022) 8

[3] S. Thurner, R. Hanel, and P. Klimek. Introduction to the theory of complex systems. Oxford University Press, 2018

Recomendaciones y orientaciones para el estudiante:

Given the interdisciplinary nature of the proposed project we encourage the candidates to follow the courses on Física de los Sistemas Complejos and Teoría de Campos y Partículas. Basic knowledge of C++ and Python is also recommended.

Plazas: 1

2. DATOS DEL TUTOR/A:

Nombre y apellidos: ALBA SOTO ONTOSO

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3. COTUTOR/A DE LA UGR (en su caso):

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4. COTUTOR/A EXTERNO/A (en su caso):

Nombre y apellidos:

Correo electrónico:

Nombre de la empresa o institución:

Dirección postal:

Puesto del tutor en la empresa o institución:

Centro de convenio Externo:

5. DATOS DEL ESTUDIANTE:

Nombre y apellidos:

Correo electrónico: