



ΕΚΤΑΚΤΗ ΟΜΙΛΙΑ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

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CERN

*« Developing bleeding-edge ML tools to
search for New Physics »*

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ZOOM Link

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* Ο κ. **Καραθανάσης** είναι υποψήφιος για τη θέση Επίκουρου Καθηγητή με γνωστικό αντικείμενο "Πειραματική Φυσική Υψηλών Ενεργειών"

ΠΕΡΙΛΗΨΗ

My name is **Georgios Karathanasis**, and I am currently a **research fellow at CERN**, affiliated with the **Compact Muon Solenoid (CMS)** experiment. In this talk, I will present the work I have carried out during my **PhD and Postdoctoral research**, which spans two main areas: **physics analysis** and **detector development**.

During my **PhD at the National and Kapodistrian University of Athens**, I worked on both **physics analyses** and the **hardware trigger (L1T)** of CMS. My early research focused on **searches for new physics** in events with **soft leptons and missing transverse energy (MET)**. In 2018, I began leading the **lepton flavor universality (LFU)** test in $b \rightarrow s\ell\ell$ transitions, a study that culminated in the measurement of R_K , defined as the ratio of branching fractions $B \rightarrow eeK / B \rightarrow \mu\mu K$. To perform this test, we developed a novel **triggering strategy**—known as **B-Parking**—which enabled the collection of approximately **10 billion B decays**.

As a **Postdoctoral researcher at the University of Colorado**, I continued to lead the **R_K measurement**, finalizing the analysis and launching a new search for **direct lepton flavor violation** using **Z boson decays**. I also supervised **PhD students** working on the next iteration of the R_K measurement.

On the **detector side**, during my PhD, I contributed to the **Barrel Muon L1T trigger**, where I developed the **emulator** and performed performance studies. During my Postdoc, I continued L1T work, focusing on the **Phase-2 upgrade**, including **track jet reconstruction improvements** and the design of **novel algorithms** to trigger on **rare decays** such as $W \rightarrow 3\pi$. Currently, as a **CERN Fellow**, I am involved in two analyses:

1. The **measurement of $\sin(2\beta)$** of the **CKM matrix**, and
2. A **search for new physics** in events with **multiple soft b-jets**.

In addition, I am leading an initiative to **integrate Large Language Models (LLMs)** as new tools at CERN to enhance both **document editing** and **code development**. This project is already underway, and we have achieved our **first promising results**.

Within the CMS collaboration, I have served as both **convener** and **sub-convener** of the **Physics Object Muon Group**, and I am currently the **B-Physics Analysis Group Convener**, following my previous role as **sub-convener of the Violation of Fundamental Symmetries subgroup**.