

Description of Funded Research Projects

1<sup>st</sup> Call for H.F.R.I. Research Projects  
to support Post-Doctoral Researchers



**H.F.R.I.**  
Hellenic Foundation for  
Research & Innovation

Research Project Title:  
**Quark-Gluon Plasma  
Thermalization and Plasma  
Instabilities in  
AdS/CFT**

**Principal Investigator:**  
**Dimitrios Giataganas**

**Popular Title:**

**Extreme State of Matter: The Quark- Gluon  
Plasma**

**Scientific Field:**

**Natural Sciences, High Energy Physics, Fundamental  
Sciences, Constituents of Matter**

**Host Institution:**

**University of Athens**



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Within theoretical physics, string theory is the most promising candidate for quantum theory of gravity. However, in the recent years it has grown as a rich mathematical structure and tool that has allowed outstanding applications to very different areas of physics and mathematics. One of its most striking achievements is that today we are confident that at least a variety of strongly coupled gauge theories have a dual description in terms of strings. A concrete realization of this connection became available with the famous gauge/gravity correspondence which is one of the most well studied topics in theoretical high energy physics.

Our research proposal attempts to answer fundamental questions in strongly coupled quantum physics using this correspondence. A direction of our research consists of the study of the Quark-Gluon Plasma, an extreme state of matter that existed during the very early stages of the creation of our universe and is currently created at the ALICE experiment in the Large Hadron Collider accelerator at CERN. The collision of heavy ions leads to the creation of the quark-gluon plasma, which then expands anisotropically while at the same time tends to return to the usual initial state of matter we experience in our everyday life.

The process that the plasma follows to return to thermal equilibrium, depends on its properties and the way that its constituents interact to each other. By studying the physics of the local thermalization for the plasma in the strong coupling limit and the possibility of the presence of Weibel instabilities due to the anisotropies, we will better understand this extreme phase of matter, at the same time obtaining information of the very first moments of universe creation. With our studies we will gain a deeper understanding of the fundamental quantum physics that describe the strong interactions of nature.

To increase awareness on a very new and fast developing research area of high energy physics which answers fundamental questions of nature, and is not yet widely known within society due to its novelty.

To contribute in reversing brain drain in Greece and even in brain gain in the long term, by forming an active and internationally recognized research group in theoretical high energy physics.

To allow the public and especially the graduate and undergraduate students to gain experience and motivate themselves for succeeding in sciences, by ensuring their interaction with international leaders of the field that will be invited to Greece for research collaboration and seminars.

To me, H.F.R.I. funding  
would mean...

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It is an excellent opportunity to build and lead an active research team in theoretical high energy physics in our home country.

*The Principal Investigator,  
Dimitrios Giataganas*

## Funding

Amount: **200,000 €**

Duration: **42 months**

Foundation: **H.F.R.I.**





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