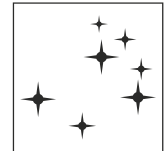


## **FINAL PUBLISHABLE SUMMARY REPORT**



**Marie Curie International Reintegration Grant No.268245**  
**SoME-UFo – Solar Magnetic Eruptions: Understanding and Forecasting**

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**Host Institution:** Research Center for Astronomy and Applied Mathematics (RCAAM) of the Academy of Athens  
**Period of Performance:** 1 November 2010 – 31 October 2014  
**Project website:** [http://astro.academyofathens.gr/people/georgoulis/SOME\\_UFO](http://astro.academyofathens.gr/people/georgoulis/SOME_UFO)

### **THE HOST INSTITUTION:**

The Research Center of Astronomy and Applied Mathematics (RCAAM) is one the fourteen (14) Research Centers and Offices of the Academy of Athens. The RCAAM was founded in 1959 and was upgraded into a Center in 1966. Since its establishment, RCAAM continuously performs solar physics research, which is also the main research area of the fellow. In addition, RCAAM tackles forefront research topics in Galactic Dynamics and Galactic Morphology, Nonlinear Dynamics and Chaos Theory, Magnetohydrodynamics, Cosmology and Gravitation.

A new fellow (Dr. E. Georgoulis) was appointed in September 2008 and formally joined the RCAAM personnel in September 2009, following his repatriation from the USA. It was judged that the fellow's demonstrated theoretical, modeling, and observational experience in solar magnetism was lacking not only from Greece, but also from Europe, to a significant extent.

### **THE PROJECT AND ITS OBJECTIVES:**

The SoME-UFo project aimed to (1) understand solar eruptions and (2) help build a future capacity to predict them. As solar eruptions are primarily magnetic eruptions, the project encompassed four top-level objectives, namely: (i) achieve a thorough understanding of solar atmospheric magnetism, (ii) develop a physical insight into the triggering of solar eruptions, (iii) precisely calculate crucial physical parameters of solar eruptions and their host active regions, and (iv) help build prediction- and geoimpact-assessment capabilities of solar eruptions.

### **PROJECT ACCOMPLISHMENTS:**

I am pleased to certify that the project systematically and successfully tackled all four key science objectives, thus promoting both our understanding of solar eruptions, the primary source of space weather, and our forecasting capability of them. The fellow defined a project that:

- laid the foundations for a novel nonlinear force-free equilibrium technique developed to model the unknown magnetic field of the solar corona;
- provided valuable physical insight into solar eruptions, such as their gradual buildup via the combined action of the Lorentz force and shear, the instrumental role of magnetic helicity into eruption initiation, the precise, self-consistent calculation of current-carrying (free) magnetic energy and magnetic helicity and their monotonic interrelation, the finding of specific free-energy/helicity thresholds above which active regions tend to erupt at least once, the physical distinction between solar active regions and quiet-Sun magnetic fields leading to clues about the formation of both, and the first joint calculation of magnetic energy and helicity budgets of solar

eruptions, that led to the first method to actually calculate the near-Sun axial magnetic field of coronal mass ejections, among other findings.

- expanded on previous work of the fellow on solar flare prediction, enhanced the statistics of prediction on a certain prediction parameter, called the effective connected magnetic field strength, and laid the foundations for the parameter's routine operational use.

It should be further emphasized that:

- the project largely contributed to attracting multiple new research grants. In the most important of them, the fellow now serves as (a) the Project Manager of a recently launched ESA project coined *A-EFFort: Athens Effective Solar Flare Forecasting* (PoP: 12 months; ending September 2015) aiming to provide the first official ESA prediction of solar flares achieved by an entirely automated prediction method, and (b) the Project Coordinator of a consortium-based Horizon 2020 project coined *FLARECAST: Flare Likelihood and Eruption Region Forecasting*, also on solar-flare prediction (PoP: 3 years; ending December 2017). The latter project is the first of the new Framework Programme devoted to space weather and protection of humanity's assets in space (PROTEC-2014-1).
- given the above overall performance, the fellow was promoted to a Senior Researcher at RCAAM, which is a permanent position, in October 2012.
- besides working on the project, the fellow attained multiple other affiliations, such as National Delegate for Greece (ESA/SPC), Member of the Greek National Astronomy Committee (GNCA), Vice-President and then President of the European Solar Physics Division (ESPD) and Vice-President of the Hellenic Astronomical Society (HEL.A.S.)

#### POTENTIAL SOCIO-ECONOMIC IMPACT:

From the above, namely the fellow's participation in important national committees and his leadership of national and European Societies, it becomes evident that, in the course of his reintegration, the fellow has served, and diligently continues to serve, the root causes of Astronomy and Space Science in Greece and Europe. Diverse dissemination activities also demonstrate the fellow's attention to increasing public awareness on the adverse consequences of space weather, while the attraction of important further research grants indicate that the project has not only been successful, but it has also led to substantial additional financial support.

The RCAAM of the Academy of Athens consistently supported the project, creating a project logo (attached) and including it in its website ([www.astro.academyofathens.gr](http://www.astro.academyofathens.gr)). As the RCAAM Academic Supervisor, I wholeheartedly thank the European Commission and its REA unit for allowing us this opportunity to host a Marie Curie fellow and pledge to continue supporting pertinent research that contributes to the European cause.