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*Thomas Metcalf Travel Awards -
follow up report*

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*IAUS 327: Fine Structure and Dynamics of the Solar Atmosphere,
Cartagena de Indias (Colombia), October 9-13, 2016*

Research

I am finishing my PhD at Nordita and Stockholm University (Sweden), under the supervision of Prof. Dr. Axel Brandenburg. Currently, I am also working as support astronomer at the Nordic Optical Telescope, in La Palma (Spain).

The main focus of my thesis is the study of magnetic flux concentrations and formation of sunspots and active regions in the Sun. I am studying an alternative theory, called Negative Effective Magnetic Pressure Instability (NEMPI), and their solutions through simulations to explain such magnetic concentrations. From an observational approach, I am also using helioseismology to try to infer some properties of sunspots and active regions.

Contribution to the Symposium: oral presentation

Title: Formation of sunspots: theory and observations.

Sunspots are of basic interest in the solar studies, ranging from magnetic field theory, as activity counter, to source of coronal mass ejections, flares, and motor of space weather. Still their formation is an unresolved problem in nowadays solar physics. Surface observations depict a 2D structure of the spots at the surface, but it is under debate how to infer deep structures and properties from local helioseismology. From the theoretical point of view, flux tubes theory manages to explain some of the observations, but with some drawbacks, like the magnetic field storage mechanism or the survival of a tube rising in a turbulent media.

In this talk I will present another theoretical approach to the formation of sunspots: the negative effective magnetic pressure instability, which is able to concentrate magnetic fields in a turbulent stratified medium. This instability is able to suppress turbulence and increase the gas pressure, which drags and concentrates the magnetic fields within. In this framework, sunspots ultimately form within the outermost layers of the Sun. From the observational point of view, I will also present some results and approaches from local helioseismology, where we use Hankel analysis to study the pre-emergence phase of sunspots and try to constrain their deep structures and formation mechanism.

The Symposium.

I would like to thank the Thomas Metcalf Travel Awards for the opportunity to attend the IAUS meeting and being a Metcalf Lecturer.

Within the framework of this meeting, I could present and discuss my research with a number of scientists. The Symposium also gave an overall picture of the latest observational results on sunspots and active regions, including high energy events, like flares and coronal mass ejections. Also, it was extremely useful the studies of star-spots and the latest achievements on spectro-polarimetry results on these stars. The Symposium was also fruitful on getting in contact and establishing collaborations with other participants.