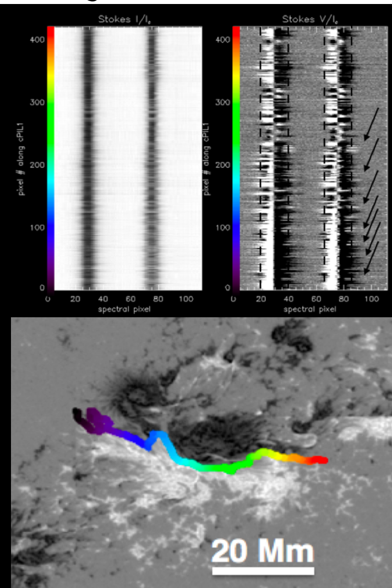
THOMAS R. METCALF SPD TRAVEL AWARD 2019 – CONTRIBUTION REPORT FOR Hinode-13 / IPELS 2019: "Fundamental Plasma Processes in the Sun, Interplanetary Space, and in the Laboratory", 2-6 September 2019, Tokyo, Japan

Georgios Chintzoglou completed his PhD in Physics in 2016 at George Mason University and at the Naval Research Lab in Washington DC, under the supervision of Prof. Jie Zhang and Dr. Angelos Vourlidas. He has been a three-year recipient of NASA's Earth and Space Science (NESSF) Fellowship. His PhD work has determined that magnetic structures associated with energetic solar eruptions, the *magnetic flux ropes*, could form in the low solar atmosphere as early as 12 hours before their subsequent eruption as CMEs. The fact that such magnetic structures can exist so well prior to their eruption encourages the efforts in successfully predicting extreme space weather, which can threaten our advanced technological civilization.

Right after completing his PhD he joined the SDO/AIA and IRIS Science & Instrument Teams as a post-doc and then as a Project Scientist at Lockheed Martin Solar and Astrophysics Lab (LMSAL) in Palo Alto, California, and at the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado. Using observations from the SDO/AIA and IRIS instruments in combination with advanced numerical simulations he continues his work in understanding the critical physical mechanisms that lead to extreme solar activity.

Invited Talk: "Detection of Strong Photospheric Downflows Accompanying Magnetic Cancellation in Collisional Polarity Inversion Lines of Flare- and CME-Productive Active Regions"

Individual events of cancellation of small magnetic features in the quiet Sun seen in photospheric magnetogram observations can be attributed to either the submergence of Ω-loops or the emergence of U-loop structures through the solar photosphere. As the opposite polarities of these small features converge and cancel, they form very compact polarity inversion lines (PILs). In Active Regions (ARs) cancellation of such small opposite polarity features is typically seen to occur during the decay phase of ARs. However, compact PILs can form earlier in an AR's lifetime, e.g. in complex and developing multipolar ARs, as a result of the collision between at least two emerging flux tubes nested within the same AR. This process is called "collisional shearing" to emphasize that the shearing and flux cancellation develop owing to the collision. High spatial and temporal resolution observations from the Solar Dynamics Observatory for two emerging ARs, AR11158 and AR12017, show the continuous cancellation at the collisional PIL for as long as the collision persists. The flux cancellation is accompanied by a succession of solar flares and CMEs, products of magnetic reconnection along the collisional PIL. Here, we use high spatial resolution magnetograms and Doppler observations from HINODE/SP to confirm that the cancellation is consistent with the submergence of Ω-loops, also resulting to a twisted magnetic flux rope in the corona. Such confirmation from HINODE/SP is important to elucidate the role of the collisional shearing process on the formation of magnetic flux ropes. This finding has implications in our understanding of extreme solar activity.



Stokes I (top left) and Stokes V (top right) profiles revealing plasma downflows along the collisional PIL path (shown with rainbow color) for the extremely flare- and CME-productive NOAA AR11158.

Acknowledgements

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