

Larger Electric Structures Around Earth and Sun

Proposal for Study, 14-Oct-2015, Michael Clarage

Abstract

Most of the universe is made of matter in the plasma state, where matter is so energetic that positive and negative charges are free to move separately. First characterized by Irving Langmuir (Langmuir 1929), Electric Double Layers (EDL) exist naturally in plasma. The EDL is like a battery: positive and negative charges are separated and remain apart within the plasma. EDL are associated with electric currents, and both are commonly observed in the laboratory and in the Earth's magnetosphere. Yet contemporary astrophysical models assume that EDL and electric currents cannot encompass planets, stars, or galaxies. This Proposal for Study differs greatly from other research by assuming that EDL and electric currents exist at larger scales of the universe. Satellite data will be used to map out the EDL and electric currents that exist between the Sun and planets, and also surround the solar system as a whole. A successful analysis could radically change dominant cosmological models.

Proposal

EDL and electric currents in space plasmas were considered impossible for purely theoretical reasons: space plasmas were predicted to be perfect conductors, hence any charge separations would be instantly "shorted out". Large-scale electric fields and currents were predicted by Kristian Birkeland at the end of the 19th century, and by Hannes Alfvén in 1939 (Alfvén 1939), and were first measured *in-situ* around the Earth in the 1974 (P. A. Cloutier 1975). Even though EDL and electric currents are now known to play a major role in planets' magnetospheres, and even brown dwarf stars (G. Hallinan 2015), still no published research proposes that EDL and electric currents could encompass planets, stars, planetary-nebula, or galaxies. This Proposal for Study has two milestones. 1) Use available NASA, ESA, CFA satellite data to construct the picture of the larger electric fields and currents encompassing the Sun, Earth, Planets, and Moons. 2) Test the basic paradigm of EDL and electric currents against a much wider range of astronomical objects such as: comets, solar flares, sunspots, planetary nebula, and pulsar emissions.

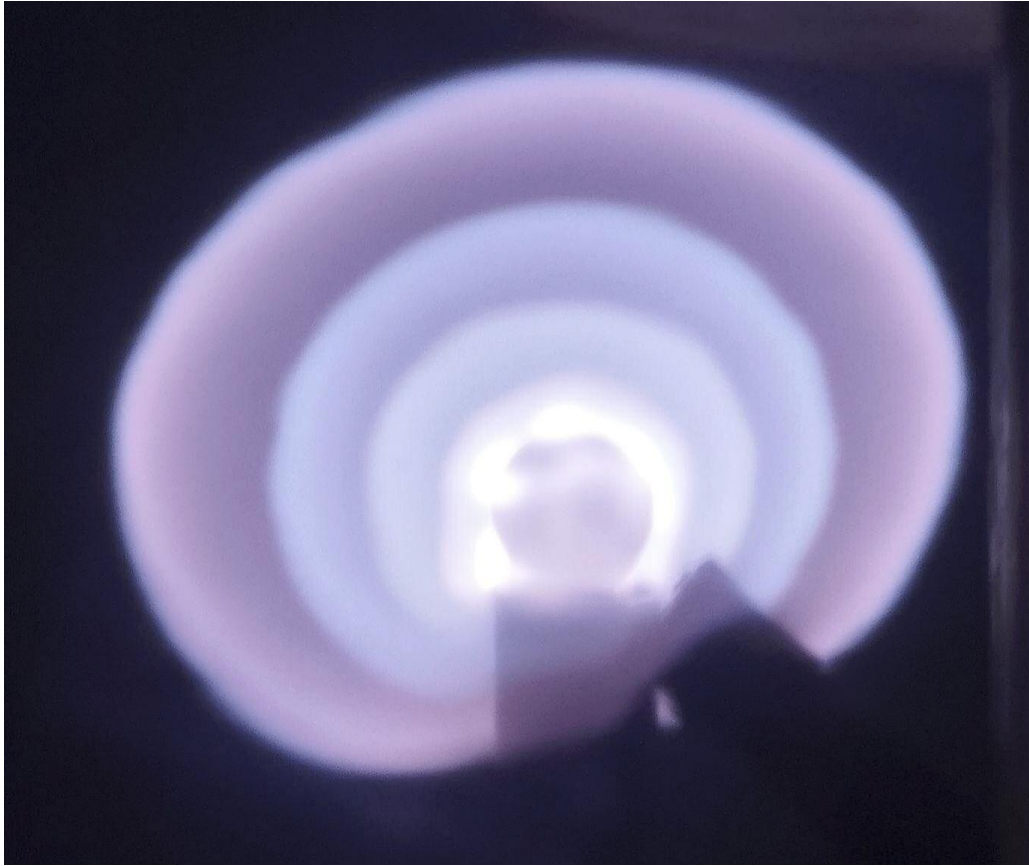


Figure 1 Laboratory spherical steady state electric discharge, from author's laboratory research (unpublished). Each glowing sphere is an electric double layer, with separated positive and negative charges and electric field between. Hydrogen, 1 Torr, 500V, 5mA. Center electrode ~1cm.

Data Sources

The project will start by studying electrical double layers surrounding the Earth. The data will be taken primary from NASA CDAWeb, the NASA/Goddard Space Flight Center data portal, which supports interactive plotting of data from multiple instruments on multiple NASA/ESA investigations simultaneously (http://cdaweb.gsfc.nasa.gov/istp_public/).

Initially the Proposal for Study will look at the following

- Van Allen satellites: EFW, L2 and L3 electric field and velocity; RBSPICE Ion composition and flux
- Cluster, EFW, electric fields PEACE, RAPID, electron flux

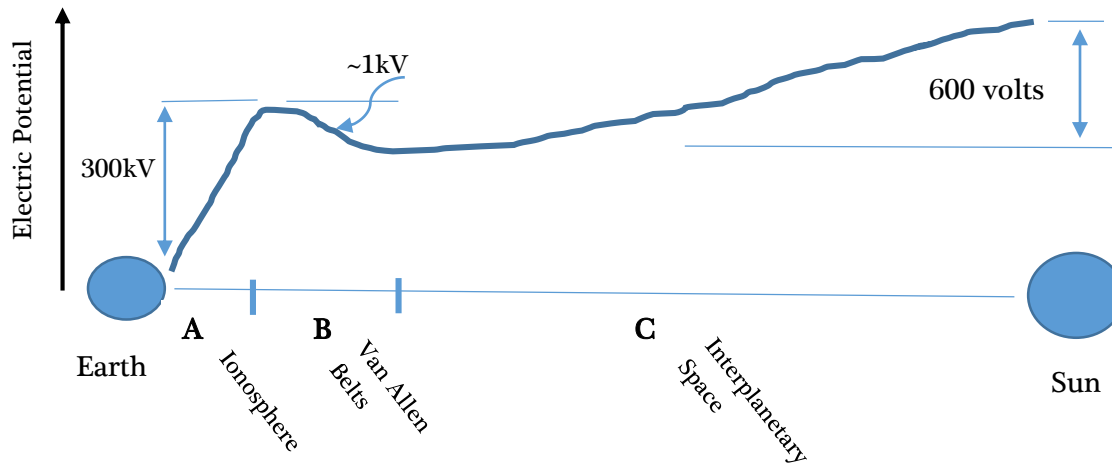


Figure 2: proposed main electric features surrounding Earth and Sun. See text for description.

Expected large-scale electric structure encompassing Sun and Earth

Figure 2 shows a sketch, not to scale, of the proposed main electric features surrounding Earth and Sun.

Section A: The electrical potential from the surface of the Earth to the ionosphere is already measured, and well-known, on the order of 300,000 volts. (Geophysics-Study-Committee 1986)

Section B: The change of potential through the Van Allen belts. This is now unknown, and is a major part of this Study. The general structure of the belts indicates a drop of potential moving away from the Earth. The author's initial analysis of RBSP data puts it in the range of 100-1,000volts.

Section C: There is very strong evidence for roughly a 600-1000 volt increase between the Earth and Sun (C. Salem 2003). Additional methods for remote detection of EDL will be explored from material in (Peratt 2015)

This Proposal starts from the assumption that larger electrical structures already encompass stars, planets, and moons. It is further assumed that such large-scale fields and currents are a fundamental, causal factor of much of the electro-magnetic activity on the surfaces of such bodies. If these assumptions are validated, the explanation for many phenomena will radically change. One example will be given – the explanation for lighting.

Example of new interpretation – Lighting

Lightning is generally described under the assumption that the surface of the Earth is electrically isolated from the vast reaches of space. The causes of lightning are looked for in local, ground conditions such as pressure, humidity, updrafts, etc. (Geophysics-Study-Committee 1986). It is further usually assumed that lightning causes the ionosphere to be 300,000 volts difference from the ground. This Proposal for Study assumes a very different causation, one in which lightning is an *effect*, or *response* of the Earth being connected to a much larger electric circuit. Lightning is only a single step within a series of electrical transformations that stretch all the way back to the Sun. Note that recent statistical studies have shown that the amount of lightning on Earth is directly correlated to the activity of the solar wind (C J Scott 2014). In the past two decades our understanding of lightning has changed through study of TLE (Transient Luminous Events) which are several distinct electrical discharge phenomena, associated with lightning, connecting the ionosphere and magnetosphere (Williams 2001). The author maintains that causal connections will remain unclear until larger electric structures are seen as causal.

Example initial analysis of potential change through Van Allen belts

This section briefly presents one analysis done by the author, using RBSP-A data. The change in electric potential along a curve C is given by

$$V_E = - \int_C \mathbf{E} \cdot d\ell$$

Equation 1 change in electrical potential along a curve

Where E is the instantaneous Electric field along each point of the curve. As RBSP-A orbits the earth, the EFW L3 data can be used for the electric field strength in the off-axis Y-Z plane, as well as the satellite position. The change in electric potential in the Y-Z plane can be calculated purely from data with minimum assumptions. While not a measure of the full 3D electric potential, the satellite off-axis Y-Z plane can be used as a proxy for the overall potential changes. The slow precession of the satellite's perigee through day-side and night-side will be used to statistically average the satellite Y-Z plane into the full 3D torus of the Van Allen belts.

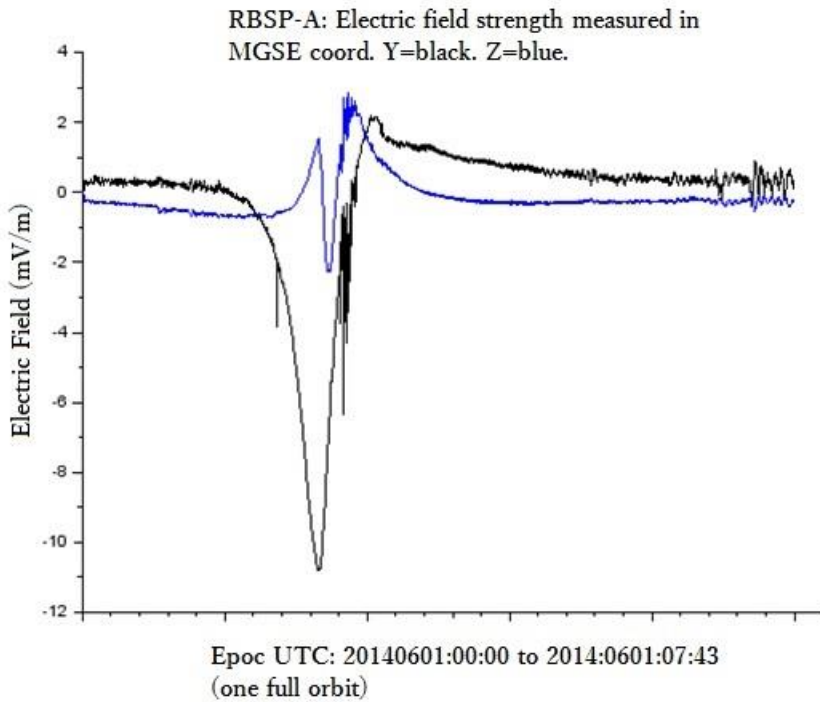


Figure 4 RBSP-A Electric field measured by EFW instrument in Y-Z satellite off-axis plane. Y=black. Z=blue. Time is one full orbit, from UTC 20140601:00:00 to 20140601:07:43. The major variations occur as the satellite comes closest to Earth, deep inside the inner Van Allen belt.

Figure 4 shows sample electric field data during one full orbit of RBSP-A.

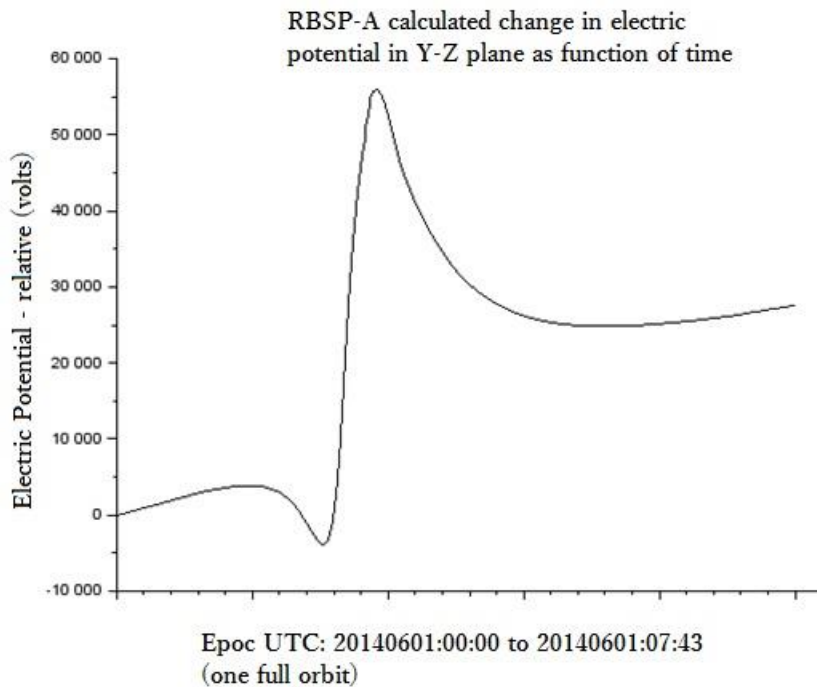


Figure 5 RBSP-A calculated electrical potential (in the Y-Z plane) as a function of time.

Figure 5 shows the calculated change in electrical potential in the Y-Z plane as a function of time. Figure 6 shows calculated electrical potential as a function of distance from the Earth. It is expected that the greater part of this potential rise is caused by RBSP-A travelling upstream through the dawn-side ring current. Further analysis is needed to isolate the potential change due to the large-scale EDL structure in the Van Allen belts.

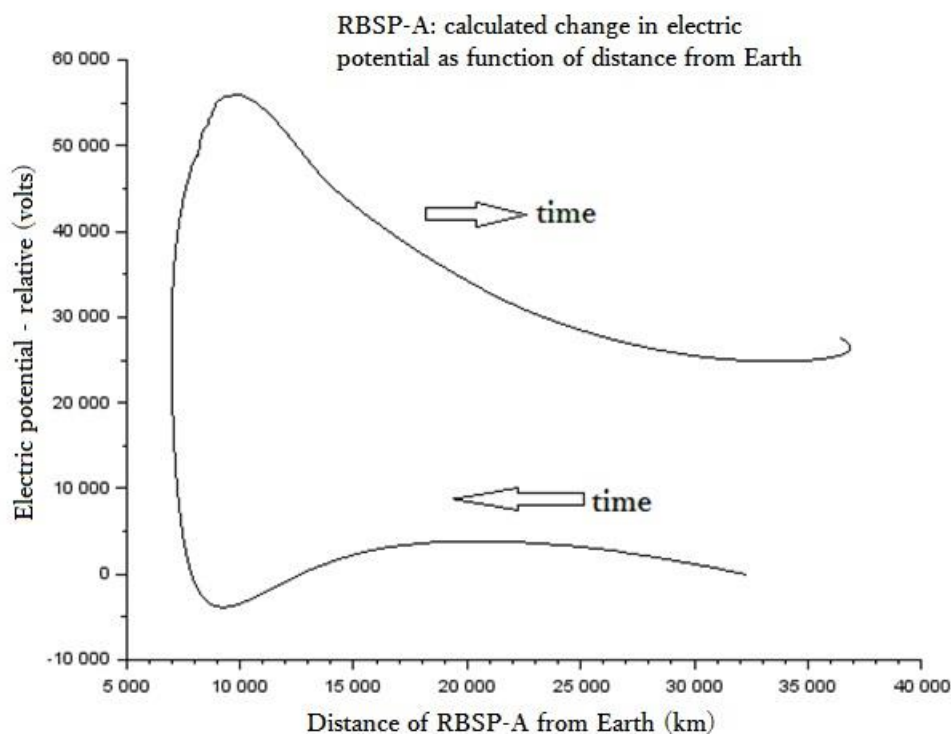


Figure 6 RBSP-A calculated change of electrical potential as a function of distance from the Earth.

Closing Statement

The author acknowledges the great body of published data concerning the complex electrical activities of the magnetosphere: Chapman-Ferraro current, Tail current and substorm current wedge, Region 1& 2 currents, etc. This proposal focuses instead on the large-scale electrical fields and currents that encompass the Sun and all the planets. This Proposal does not stipulate what are the origins or causes of such large scale electrical structures.

This Proposal for Study is suited to an interdisciplinary environment because of the potential paradigm shifts inherent in the study. The contemporary scientific cosmology is dominated by paradigms of disconnection and randomness, and has little meaningful

place for humans. This is affecting our literature, visual arts, religious understanding, norms of social responsibility, the dialog about climate change, and descriptions of our own history. This Proposal for Study is motivated by the wish to place our Earth and ourselves into a larger, meaningful context, and to provide the scientific analysis to support that larger context.

Thank you for your consideration,

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