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Seeing the Invisible: Educating the Public on Planetary Magnetic Fields and How they Affect Atmospheres

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Abstract. Magnetic fields and charged particles are difficult for school children, the general public, and scientists alike to visualize. But studies of planetary magnetospheres and ionospheres have broad implications for planetary evolution, from the deep interior to the ancient climate, that are important to communicate to each of these audiences. This presentation will highlight the visualization materials that we are developing to educate audiences on the magnetic fields of planets and how they affect the atmosphere. The visualization materials that we are developing consist of simplified data sets that can be displayed on spherical projection systems and portable 3-D rigid models of planetary magnetic fields.

1. Motivation

Since they are invisible, magnetic fields and charged particles are difficult to visualize. However, planetary magnetic field and charged particle environments (magnetospheres and ionospheres) are important to understanding planetary and atmospheric evolution. The presence or absence of an internally-generated planetary magnetic field reveals information about the conditions in the deep interior of the planet. Likewise, since magnetic fields can shield an atmosphere from erosion by the solar wind, the presence or absence of a planetary magnetic field has important implications for how planetary atmospheres can change over geologic time. Here, we describe our goals for this project and briefly highlight some of the visualization materials that we are developing.

This work will be carried out by scientists from the Space Sciences Laboratory (SSL) in collaboration with Education/Public Outreach specialists at the Center for Science Education at SSL (CSE@SSL) and the Lawrence Hall of Science (LHS) all at the University of California, Berkeley. This unique collaboration will ensure that high-

caliber educational products and material will be developed and will reach a large and diverse audience.[1]

2. Learning Objectives

The overarching goal of this project is to educate our audiences on the magnetic field of planets and how they affect atmospheres. We have a two-step strategy for achieving this goal: first, we will develop effective display products and presentation content that help people visualize magnetic fields near Mars and other terrestrial planets; then we will use these display materials in public and classroom settings to convey information to our audiences about planetary magnetic fields.

We have developed three "learning objectives" that encapsulate what the audiences will learn from these presentations:

1. Earth's magnetic field is generated in the deep interior; Mars' is "trapped" in surface rocks.
2. Magnetic fields influence climate evolution by shielding an atmosphere from the solar wind.
3. The configuration of the magnetic field help to determine the structure of the ionosphere.

These objectives provide the framework for the educational content we are developing.

3. Methodology

The visualization materials that we will construct consist of (1) portable, three-dimensional, rigid models of the Martian and other planets' magnetic fields; and (2) simplified data sets that can be displayed on spherical projection systems. Using these materials, we will develop presentation content for science museums and classrooms that relate fundamental information about the Martian magnetic field, how it differs from Earth's, and why the differences are significant.

We will build 3-D magnetic field models of the internal magnetic fields of Mars and Earth and of the magnetic field configurations of Mars, Earth, and Venus in the solar wind. These models will help the audience to visualize how the internal magnetic fields of the planets are different and how these differences manifest themselves in the planet-solar wind interaction.

The simplified data sets that we will develop will be used for presentations on the Science on a Sphere®(SOS), a six foot wide spherical display system used to display global scientific data, at the Lawrence Hall of Science. This easily updated exhibit is the center piece of LHS's efforts to interpret current scientific research to its visiting audience. These data sets will be directly tied to our "learning objectives." Possible

[1]As of September 2009, we have just received funding to carry out this work. Therefore, we haven't started the development of these materials, but we will very soon. Look for status updates in the coming years.

presentations include comparing and contrasting the intrinsic magnetic fields of Mars and Earth (#1), illustrating how atmospheres can be shielded by magnetic fields (#2), and showing the structure of the resulting ionosphere (#3). We are planning the development of these presentations to coincide with the opening of the *Facing Mars* exhibits at LHS in October 2009. This same content will used for traveling presentations and will be displayed on a smaller, portable Magic Planet®digital video globe at public and classroom venues.

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Darlene Mendoza at the SOFIA booth.