Space Weather

COSMO: The Coronal Solar Magnetism Observatory
Anticipating solar storm impacts

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I. Description

Society is becoming increasingly reliant on technologies that are susceptible to damage by so-called space weather events. These events are eruptions of high-energy radiation, energetic particles, and ejected mass from the Sun that affect critical systems on Earth and in space. Communication systems, GPS, power transmission grids, and human space flight are all vulnerable. Accurately measuring magnetic fields in the solar corona is difficult, yet crucial to understanding and predicting the Sun’s creation of space weather.

The Coronal Solar Magnetism Observatory (COSMO) is a proposed suite of complementary ground-based instruments designed to do just this—study magnetic fields and plasma conditions in the solar corona and allow for better predictions of their impact. The central instrument is a large, 1.5m-aperture coronagraph that will obtain daily measurements of the strength and direction of coronal magnetic fields over an unprecedented field of view. The supporting instrumentation in the suite also measures magnetic fields in the solar chromosphere and the density of electrons in the corona. Together, these provide new and invaluable predictive clues about these damaging solar events.

II. Stage of Research

The COSMO concept is proof-tested and based on similar technologies but executed at scale. When brought online it will

- drive understanding into the processes that lead to solar eruptions
- support the development of a real solar storm predictive capability
- provide real-time monitoring of eruptive events
- predict event geoeffectiveness—the likely impacts on Earth and near-Earth systems
The recent decadal survey sponsored by the National Academy of Sciences (Solar and Space Physics: A Science for a Technological Society, 2012) recommended that the COSMO project be funded. This reflects both the maturity of COSMO as a concept, as well as the critical need of society to understand and predict space weather.

III. Advantages

- The new capability offered by COSMO will provide measurement of the critical coronal field over an unprecedented 1 degree field of view.
- COSMO’s large-area coverage is needed because coronal structures are themselves so large.
- COSMO will boost the clarity and level of detail seen across this large field of view by offering much higher resolution than what is currently available.
- The small-scale features revealed by COSMO’s higher resolution will provide details needed to see the stresses in the magnetic fields that build up and lead to eruptions.
- Combining COSMO with satellite data will provide the ability for the first time to determine the likely geoeffective impacts of solar storms as much as 96 hours in advance, a factor of 60 or better improvement in lead time.

IV. Applications

Operators of the electrical grid, military and civilian satellites, and other valuable infrastructure need to know: When will eruptions happen? When they occur, are they directed toward Earth? If so, will they have the characteristics we know to be damaging?

Recent advances in measurement technology and computer modeling of the corona now make it possible to measure the corona’s magnetic fields and understand them through comparison with these state-of-the-art models.

The COSMO suite of instruments dramatically elevates these capabilities, finding its heritage in prototype instruments that have verified the feasibility of its technical approach. COSMO will provide unique observations that will not be duplicated by any current or proposed facility. In sum, it offers answers to the questions that critical infrastructure operators need to know.

V. Funding and IP Status

We are seeking $25 million for the complete build-out of the COSMO system.

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