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LOCKHEED MARTIN

Space Systems Company

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Macelwane Medal Committee
c/o American Geophysical Union
2000 Florida Avenue, NW
Washington, DC 20009

Dear Colleagues:

My purpose in writing is to convey my strong endorsement of Prof. Robyn Millan of Dartmouth College as nominee for a 2008 James B. Macelwane Medal of the American Geophysical Union. She is an extremely productive young scientist and well deserves this high honor.

I first met Robyn Millan in July 2000 when she gave an excellent talk on "Observations of MeV Terrestrial X-ray Bursts with MAXIS" at Lockheed Martin's Space Physics Seminar here in Palo Alto. This was based on work for which she later received her PhD from UC Berkeley.

It has long been a puzzle in magnetospheric physics, as to why the measured near-equatorial intensity of MeV electrons in the outer radiation belt often decreases by a factor ~ 1000 during the main phase of a geomagnetic storm, only to recover to pre-storm levels or even higher as the currents associated with the storm itself decay.

One idea has been that the storm-associated diamagnetic ring current leads inevitably to an adiabatic energy loss for the representative MeV electrons, so that (for typically observed electron energy spectra) the counting-rate measured in a detector (sensitive to any specified range of high energies) decreases sharply with time as the ring current grows in strength. The other main idea has been that most of the geomagnetically trapped electrons that constitute the outer Van Allen radiation belt are themselves lost into the Earth's atmosphere as a result of scattering by waves in the stormtime magnetospheric plasma.

Comparative analysis of the above two hypotheses has been inordinately difficult. Previous efforts had involved searching for the waves that might scatter trapped MeV electrons, and/or estimating the amount by which stormtime MeV electron intensities would fall in consequence of adiabatic effects alone. Evaluation of the scattering hypothesis requires measurements of wave intensities and wave-normal distributions very near the magnetic equator (locus of minima in B along field lines), whereas evaluation of the adiabatic-response hypothesis requires measure-ments of electron energy spectra, pitch-angle distributions, and radial profiles at locations remote from where the strongest stormtime decreases in relativistic electron intensity are observed. A satellite in any particular orbit is typically not in position to make all the simultaneously required measurements.

Robyn Millan found a way to circumvent these difficulties. In her approach, the intensity of MeV X-rays emitted from the ionosphere provides a direct measurement of the rate at which relativistic electrons are lost from the outer radiation belt. Indeed, the rate of electron precipitation responsible for the MeV X-ray bursts Robyn observed during her January 2000 Antarctic campaign was enough to have emptied the outer radiation belt of its relativistic electrons within a few days (see Bob Lin's supporting letter). This was the work for which she received her PhD.

Robyn's result means that the magnetosphere must replenish its outer radiation belt with new relativistic electrons during the recovery phase of each geomagnetic storm, rather than rely on the reversibility of an adiabatic phenomenon. This is a very major finding in space research.

After this very promising start, Robyn has consistently exceeded all the high expectations we have held for the success of her professional career. By all accounts, she has been an outstanding teacher and mentor at Dartmouth. She is known for giving excellent talks and is continually in demand as an invited speaker at seminars and scientific conferences. She has become a leader of important experimental projects in space research, having won major funding from NASA and NSF for these efforts. Her work has had major impact already on space research, and she shows great promise of future accomplishments.

In summary, I would say that Robyn Millan's many significant contributions to magnetospheric and ionospheric research make her one of the world's leading young researchers in space physics. She is exceedingly well qualified to be a James B. Macelwane medalist of the American Geophysical Union and eminently deserving of this high honor.

Sincerely,

Michael Schulz

Michael Schulz
Senior Physicist & Group Leader