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

Subject: **C O V E R S H E E T for Package to Nominate**
Robyn M. Millan for the AGU Macelwane Medal

Dear Committee Members:

Please find, attached to this cover sheet, the package to nominate Robyn M. Millan for the AGU Macelwane Medal. Robyn is 34 years old (born 17 September 1973).

The following materials are enclosed with this package:

1. Letter of Nomination from:
   - Mary K. Hudson [1, 2]

2. Robyn Millan's curriculum vita (CV), with abridged list of publications

3. Robyn Millan's bibliography (full list)

4. Six (6) Supporting Letters from:
   - Robert Lin [1, 3]
   - Richard Thorne [1]
   - Jerry Goldstein [1, 2]
   - Cynthia Cattell [1]
   - J. Bernard Blake [1]
   - Michael Schulz [1]

[1] *AGU Fellow* [2] *Macelwane Medalist* [3] *Member, National Academy of Sciences*

If there are any questions or problems with the enclosed package, please feel free to contact

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Thank you very much for considering Robyn's nomination.

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8 February 2008

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

Dear Macelwane Medal Committee:

It is a great pleasure to nominate Professor Robyn Millan for the AGU Macelwane Award. At 34 years old (born 17 September 1973), she is the most deserving space experimentalist of her generation. Robyn did her PhD research at the Space Sciences Laboratory at UC Berkeley on a balloon-borne X-ray/gamma ray instrument designed to study relativistic electron precipitation from the Earth's Van Allen radiation belts. Robyn served as the principal scientist on-site for an Antarctic long duration (~ 10 days) balloon experiment (MAXIS) in 2000, targeting radiation belt loss processes. This experiment identified an important new process which mediates relativistic electron fluxes in the magnetosphere during geomagnetic storm periods. Robyn showed that a new phenomenon, dusk side precipitation lasting minutes to hours, can account for most of the electron loss during active times (Millan et al., 2002). This loss process can quickly empty the entire outer radiation belt, putting severe constraints on source mechanisms.

The Van Allen radiation belts consist of omnipresent energetic electrons (and protons) trapped in the earth's magnetic field, whose flux and energy are highly variable and dangerous to space systems and astronauts. While much attention has focused on mechanisms for flux enhancements, Robyn's work addresses the equally important loss-mechanisms which determine steady-state flux levels. Specifically, her papers which are an outcome of her balloon-borne measurements, provide the first opportunity for quantitative tests by direct atmospheric precipitation measurements of theoretical models for scattering of relativistic electrons by electromagnetic ion cyclotron as well as whistler mode waves. These mechanisms which involve Doppler-shifted cyclotron resonance are thought to be primarily responsible for loss when fluxes are greatly enhanced during periods of high solar wind speed, mapping back to coronal mass ejections and coronal holes at the sun. Theories of electron flux limitation developed by Kennel and Petscheck, Thorne and co-workers, as well as energy sinks for the elevated fluxes of ring current ions which encircle the earth and perturb the ground magnetic field during geomagnetic storms, have not been well-tested, despite the fact that the radiation belts were the first discovery of the space age with Explorer 1, because of the paucity of direct measurements of precipitation into the atmosphere, simultaneous with in in-situ measurements in the magnetosphere. Robyn's research program addresses this objective.

Robyn came to Dartmouth in September, 2002, as the recipient of a NASA New Hampshire Space Grant Young Investigator Award, then joined the tenure track in 2005, thanks to support from the NSF Faculty Development in Space Sciences program. She is certainly a major success story of that program, developed to augment space physics faculty in the US, with the retirement of the first generation of the Space Age. Robyn has since received three additional NSF awards, one for data analysis from her Antarctic (MAXIS) balloon flight; one for modeling electron interaction with waves; and one for the instrument fabrication and flight from Ft. Churchill, Manitoba in winter 2005 of two small balloon payloads as part of the MINIS (Miniature Spectrometer) program. These complemented Antarctic flights of similar small payloads by her UC Berkeley colleagues to obtain spatially and temporally resolved measurements of radiation belt electron precipitation. Robyn's separately funded program to launch balloons from Ft. Churchill in winter was in itself noteworthy, and the campaign was an overwhelming success, occurring during a major solar event and yielding simultaneous measurements by three balloons (two in the southern hemisphere and one of Robyn's in the northern hemisphere) of prompt radiation belt electron precipitation associated with the arrival of a CME-generated interplanetary shock.

The most exciting research project underway in Robyn's lab is the NASA-sponsored 'Balloon Array for RBSP Relativistic Electron Losses' (BARREL). This program is the only one of three Mission of Opportunity Phase A studies selected to complement the Radiation Belt Storm Probes satellite mission scheduled for launch in 2012, and will culminate over two Antarctic winters in the launch of 40 balloon payloads built at Dartmouth, primarily by students, in conjunction with the satellite program. UC Berkeley, UC Santa Cruz and University of Washington investigators are participating in this project, led by Robyn as Principal Investigator. The project includes a test campaign of five launches from Antarctica in the winter of 2009-10, from which scientific data will be collected in advance of the RBSP mission. Robyn has also provided the piggyback launch of her instrument on a larger payload from Kiruna, Sweden in summer 2006, a type of platform and location from which relativistic electron precipitation was first discovered (Foat et al., 1998). Finally, she is Project Scientist with the BARREL group of collaborators for the Terrestrial Relativistic Electron Belt Loss Explorers (TREBLE) Small Explorer satellite proposal submitted by UC Berkeley to NASA in January, 2008.

Robyn is also pursuing a second line of research, using ground-based receivers to detect X-rays produced by electrons accelerated to million electron volt (MeV) energies by lightning in the atmosphere. This is believed to contribute as a source mechanism for radiation belt electrons at low altitude. A PhD student is currently building the hardware to be deployed in New Mexico next summer (08).

Robyn is an extraordinary teacher and mentor, with two PhD students and one MS student this year, two senior honors thesis students, one Presidential Scholar and four Women in Science Program students to date, the latter two programs at Dartmouth designed to competitively fund undergraduate research at an early stage. Four undergraduates have received grant support to work in her lab during enrolled and off terms. So in total, a dozen students have been provided research opportunities in Robyn's lab in the relatively short time that she has been at Dartmouth, no doubt a factor in the selection of BARREL by NASA, because of her ability to involve students directly in space physics hardware development. There are few educational programs in the US that do so at this point, providing students with the opportunity for concept design, fabrication, launch participation and data analysis in their thesis projects. Two of her three graduate students are women, in addition to the numerous undergraduate women who have helped to build her payloads and analyze the post-launch results. The strength of her teaching reviews in introductory courses supports the conclusion that she is serving as a strongly positive role model at all levels in a field with ongoing gender disparity. She excels at teaching large introductory courses in both physics and astronomy, as well as development of a course now required of all our first year graduate students, to develop teaching skills before they serve as TAs. She is already leading the next generation of space physicists at an early stage in her career. As an outstanding example, her senior PhD student Leslie Woodger was the recipient of a highly competitive NASA Graduate Research Program fellowship, and will serve as scientific launch coordinator for one of the near term BARREL Antarctic campaigns.

In summary, I rank Robyn at the top of any list of young space physics investigators. The recent NASA announcement that the $9.3M BARREL balloon program has been selected for long term support is remarkable at Robyn's career stage. In terms of science impact, Robyn's research has demonstrated with the use of two types of stratospheric balloon platforms that the time scale for loss of the entire outer zone of the Van Allen radiation belt can be a matter of a day, putting severe constraints on source mechanisms, and that mechanisms first posed in the late sixties for controlling the peak flux of radiation belt electrons are indeed operative, but in ways not understood prior to her measurements of precipitation events via the X-rays they produce in the earth's atmosphere. Hers is a vigorous and exciting research program in experimental space plasma physics, and it is indeed my pleasure, as a former Macelwane Award recipient, to nominate her for this award.

Sincerely,

Mary K Hudson

Mary K. Hudson
Professor
Physics and Astronomy