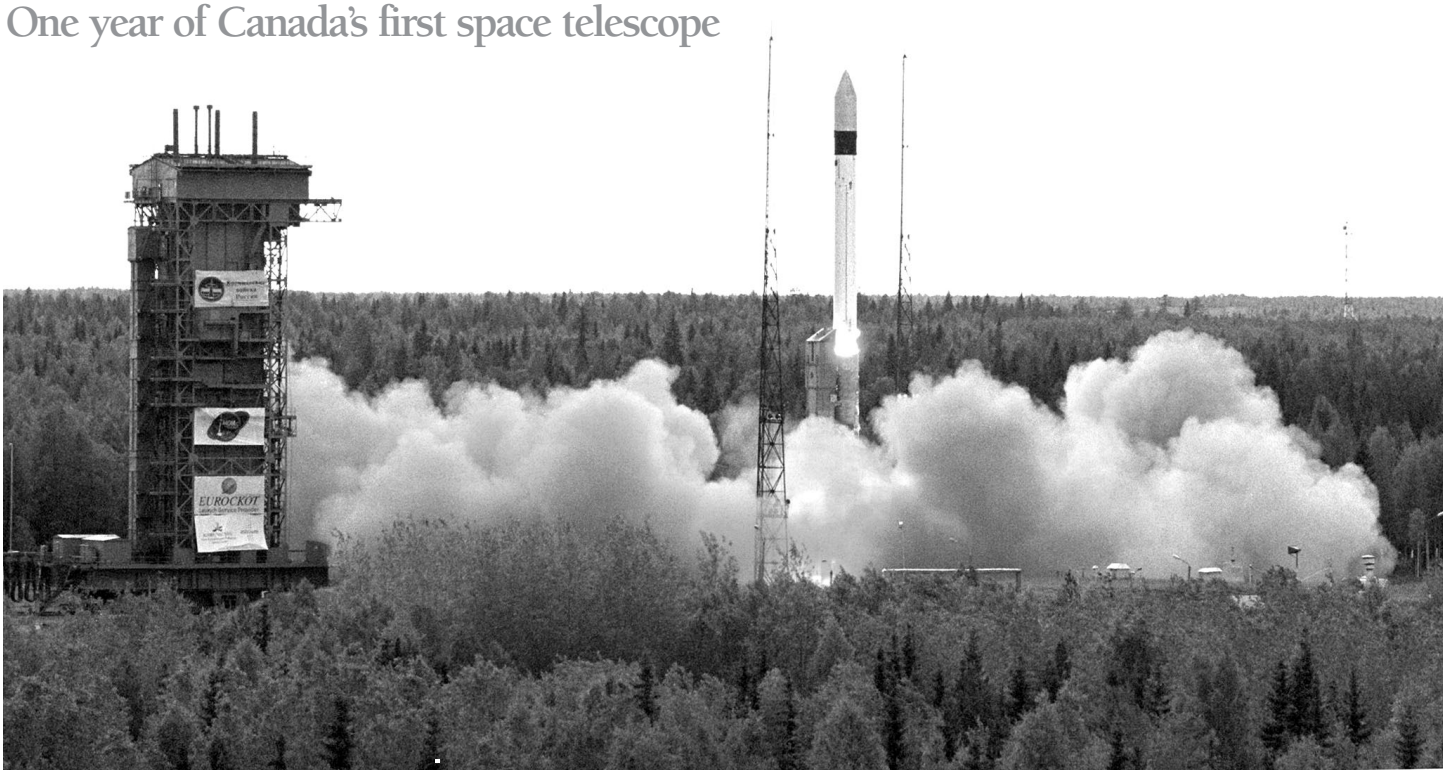
feature

Getting the most of MOST

One year of Canada's first space telescope



COURTESY OF EUROCKOT LAUNCH SERVICES

BY **MAGDA KONIECZNA**

In characteristic Canadian style, UBC's Jaymie Matthews is modest about his work. Although his instrument, dubbed the "humble space telescope," is about the size of a suitcase and costs a fraction of the normal price tag for a space telescope, the results he has to show just one year since launch are anything but modest.

In fact, the telescope's most recent observations, published in the journal *Nature* on 1 July 2004, contradict 20 years of theory and observations of Procyon, one of the most studied stars in the sky. This has left astrophysicists rethinking many long-accepted stellar theories and reconsidering plans for future space missions.

Procyon had long been considered a "poster child" for stellar seismology, the process of probing the structure and age of stars by examining the vibrations of gases within them. In the same way that we can learn about a bell by hitting it and listening to the sound it produces – a smaller bell creates a higher-pitched sound – we can "listen" to the "sounds" produced by stars to obtain information about their size, mass, age, and constituent materials.

That's where Matthews's instrument, called MOST (**M**icrovariability and **O**scillations of **S**tars), comes in. The vibrations observed in stellar seismology – fluctuations of starlight caused by pressure waves in the gases within a star – are so minor that they are difficult to observe through the turbulence of Earth's atmosphere. These fluctuations are comparable to the difference between observing the Empire State Building when fully lit up, and observing it after one blind in one window has been lowered by 3 cm. For this reason, and because Earth-based observations are limited to the time when the Earth is not blocking a given star, stellar seismology is better done from a space telescope than from the surface of the Earth.

In the past, such a space telescope would have carried a tremendous price tag – on the order of $100-million compared to MOST's modest $10-million – because of the stability required to focus on a single star despite the effects of solar wind, air molecules and gravity. MOST, however, makes use of vastly improved attitude control technology built by the Canadian automation and robotics company Dynacon Inc., which allows for better pointing accuracy, and therefore lighter weight. Without this new technology, trying to focus MOST on a particular star would be similar to observing a star using binoculars on a dinghy in a stormy ocean, Matthews says.

MOST's unprecedented 32-day observation of Procyon found that, contrary to existing theories and Earth-based observations, Procyon's vibrations are very minor, if not non-existent. These observations were a big surprise – scientists expected significant vibrations, providing information about the structure and age of the star. These observations are already affecting the planning of the next telescope to study stellar seismology, the French COROT, set to launch in 2006.

The primary science goal for MOST is to tell us more about our own Sun. It is generally accepted that models of the Sun are inaccurate. For instance, the so-called "faint Sun paradox" predicts that our Sun only got warm enough to thaw the Earth's oceans about a billion years ago, while rock records show this was not the case. Part of resolving this paradox, Matthews says, is looking beyond our own solar system to other Sun-like stars at various stages of their lives, yielding information about our own Sun. Matthews hopes that MOST's capability to probe the structure and state of other stars

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will provide this information.

Now that MOST has proven to be fully functioning, Matthews's team is working to get as much data from it as possible. They have found that, by updating the onboard software, the capabilities of the satellite have exceeded what was expected. "We could announce new results every few weeks," Matthews says. "As long as it operates, we'll never run out of things to do and all are brand new."

And it seems this fruitfulness could continue for some time. "It's a robust little beast," Matthews says. Without moving parts to deteriorate, the satellite could yield results for another five to ten years, eventually being worn down by cumulative radiation damage. Any information gathered in the second year would be bonus, he says, and in the third year, observing time on the satellite would be opened up to amateur astronomers, and high school and university students.

Undergraduate students work in the MOST lab throughout the year, writing software and analyzing data. Contact Jaymie Matthews at (604) 822-2696 or e-mail him at *matthews@astro.ubc.ca* for more information.

COURTESY OF THE CANADIAN SPACE AGENCY

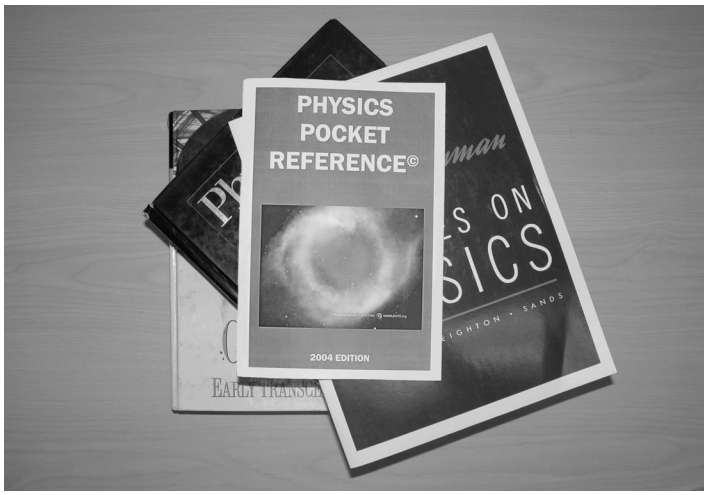
OPPOSITE: The launch of the MOST space telescope atop the Russian Rockot from a pad at the Plesetsk Cosmodrome.

ABOVE: Jaymie Matthews poses with MOST.

The UVic physics handbook

A physics student society discovers new way to fundraise

BY **MIKE FROESE**



JOHN LINDNER

If you've ever been stuck trying to remember a trig identity or the value of the Josephson Frequency-Voltage Ratio while finishing an assignment late at night, we've got the book for you. The Physics and Astronomy Student Society (PASS) at the University of Victoria (UVic) has recently completed a student physics handbook that has proven to be both useful and profitable. As UVic is the host of the Canadian Undergraduate Physics Conference (CUPC) this November, PASS is taking the opportunity to include a complimentary handbook in every CUPC 2004 delegate package.

The brainchild of last year's PASS president, Ginny Bishop, the handbook project was headed by its editor, Melanie Gendre. The first edition was compiled over the course of several semesters with the collaboration of twelve PASS members, who each received a free copy of the handbook afterwards. According to Jennifer Barker, current PASS president and CUPC 2004 project coordinator, "we chose what went in based upon the formulas we found ourselves using in our classes. The accuracy was checked by the editor when she put it together, and a couple profs were asked to go over various parts specific to their area [of research]."

Full of formulas and constants, this indexed resource is useful for all undergraduate courses, from first-year mechanics to fourth-year quantum. The book is divided into physics, math, and astronomy sections. The physics section includes all basic undergraduate topics, from Newton's laws to solutions to Einstein's field equations. The section on astronomy is rather short and, like astronomical papers, full of acronyms, but it does contain comprehensive tables listing, for instance, the mass of the Sun and the orbital radius of Jupiter. Finally, the mathematics section covers basic geometry, calculus, and vector algebra but is a little sparse on more advanced topics like complex analysis and tensors.

Since this was a combined effort of many writers, some sections are more thorough than others, both in terms of the topics covered and the accompanying explanations for formulas. Barker says that the second edition, now nearing completion, takes "into account the feedback we got from our purchasers with regards to mistakes." It promises to include diagrams to clarify certain concepts. These diagrams will be original to avoid copyright and intellectual property issues.

Barker indicated that "lots of first-year students take physics, and they feel sort of lost and like to buy everything they possibly can to help them out." As such, the target market for the first edition was the approximately 750 students taking a first-year physics course at UVic. Marketed via posters and announcements in classes, the handbook was sold for $12. The proceeds from the first edition, now sold out, are being directed towards CUPC. While complimentary handbooks will be given to all CUPC 2004 delegates, order forms for additional copies will also be included. According to Barker, the price has not yet been finalized but will be in the range of $12 to $15 per copy.

Canadian physics societies take note! While putting together such a handbook is obviously a large investment of time and money, it offers a continuous source of fundraising once completed. Updates can be done regularly, ensuring the handbook always contains current information about both the student society that produced it and the university. Periodic updates also would encourage first-year students to buy the new version, instead of finding an older copy in a second-hand bookstore. Even if your university doesn't have many physics or astronomy students, it only takes a few dedicated students to compile a handbook of this quality.

Or, you can do as Barker says, and "just buy ours; it'll save you time and worry."

—WITH FILES FROM
JOHN LINDNER