Tiny Instrument Makes Giant Difference

Upon first walking into the office of Jeff Percival—Distinguished Senior Scientist in the Department of Astronomy—one will quickly notice a small device, dressed with microchips and circuits, gently resting atop a bed of pink bubble wrap.

This is his latest project, the next generation of the Star Tracker 5000.

ST5000—which Percival helped bring into the world at the turn of the millennium—is a guidance system capable of steering scientifically equipped suborbital rockets with unprecedented accuracy and speed.

When Percival first recognized the broader need for a high-quality suborbital rocket guidance system, he knew it would be possible to build with the help of the talented people within the UW Astronomy Instrumentation Lab.

First, there is Kurt Jaehnig, an invaluable expert in instrument design. Next, there is Sam Gabelt, an electronics technician whose skill borders on artistry. And finally, there is Don Michalski, whose long experience with analog electronics is increasingly rare today.

As Percival said, “The Star Tracker 5000 could literally not have been invented anywhere else, and it’s due to the rich environment and history of instrumentation in this department.”

Unlike earlier suborbital rocket guidance systems—which could take up to a minute to calculate a rocket’s orientation—the ST5000 is able to determine flight information in merely a second.

And while earlier devices were limited to an accuracy of about a hundredth of a degree, the ST5000 is over 10 times as precise.

Because the duration of many suborbital rocket missions is less than ten minutes, the added speed and precision of the ST5000 makes it a crucial enabling technology for many modern astronomical missions.

Ranging from analyzing the tails of comets to studying the atmosphere of Earth, there are many ways the ST5000 has been employed. For instance, the device has even been used to help guide high-altitude balloon missions.

Yet, with all the attention usually focused on the decade-long, multi-billion dollar, space-based missions, it is easy to forget about the importance of suborbital rocket missions.

According to Percival, one of the most important advantages of suborbital versus orbital missions is the fact that suborbital missions are astonishingly more affordable.

As Percival explained, “they provide a means to cheaply test equipment planned for use in future space-based projects.”

Furthermore—unlike orbital projects—suborbital projects can be proposed, funded, carried out, and analyzed within the time it takes to complete a typical graduate program. This makes them ideal for maintaining a steady pipeline of talented, experienced investigators for future space missions.

Because of this, Percival strongly believes that astronomy departments with instrument development programs offer valuable opportunities to graduate students that departments with fewer possible specializations do not.

UW’s Department of Astronomy—in harmony with the Wisconsin Institute for Discovery theme which resonates throughout the Madison campus—focuses on exposing graduate students to a variety of different disciplines to help broaden their knowledge base and ultimately produce unexpected results.

As Percival said, “the strength of an instrumentation program, like UW Astronomy has had for many decades, is that it is, in a sense, greater than the sum of the parts.”

(Pictured from left to right) Brian Tibbetts, Jeff Percival, and Cliff Murphy stand in front of a rocket equipped with the ST 5000. The Suborbital Local Interstellar Cloud Experiment (SLICE) was launched on April 21, 2013 to study how interstellar gas streaming through the Solar System affects the Sun’s solar wind, and indirectly the Earth’s climate and biology.