PEAK OF FLIGHT NEWSLETTER

Issue 604 / July 18th 2023

APOGEE COMPONENTS
www.ApogeeRockets.com
4960 Northpark Dr, Colorado Springs CO 80918
Ph# 719-535-9335

In This Issue:

Learnings From The World SpaceModeling Championships 2023 - Part 1

https://www.apogeerockets.com/Model-Rocket-Kits/Skill-Level-2-Model-Rocket-Kits/Feathered-Flyer

PEAK OF FLIGHT NEWSLETTER

Issue 604 / July 18th 2023

Learnings From The World SpaceModeling Championships 2023 - Part 1

By Tim Van Milligan

My Trip to the World SpaceModeling Championships

This is a blog-type article that describes my experience at the World SpaceModeling Championships held near Austin, Texas. There will be a write-up of the event by actual contestants in a future issue of Sport Rocketry magazine, so in this article, I'll just give you my own personal perspective.

First of all, I was not a contestant. I was there as a supporter, and in particular a supporter of my daughter, Ashley, who was a contestant as part of Team USA.

But I have to also say that I was there as a general supporter of all the contestants. You see, rocketeers from around the world know about me from Apogee and the videos and newsletters that we produce here. Having said that, it still is really an odd sensation of being a small-time celebrity where people come up to me and recognize me. I feel a sense of awe that I've been able to help them out in a small way through our videos and that they come up to me and want to thank me. I really appreciate the gratitude and the referrals that they give to other modelers that they interact with. From my perspective, we're all in this together, trying to build up the hobby and make it grow.

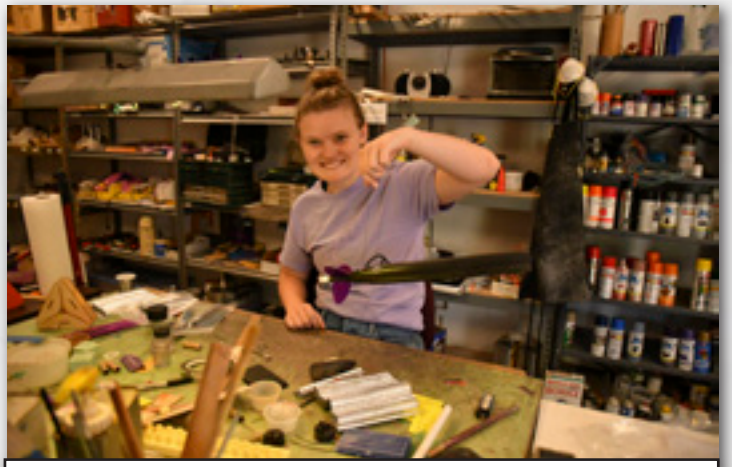
More people than I could count from around the globe stopped by to say hello. So from my perspective, it really was a friendly atmosphere.

Preparation for the Event

The US team is unique in that there is a rule that a single person is limited to flying just two events. The reason for this is to make sure that the team members have a narrow focus and are totally prepared for the events they are in. When she was a junior member in previous competitions, Ashey did four or five events. But as an adult, all of our efforts were focused on just two events that she was in. The focus is on winning "Team" medals, not medals for individual accomplishments. It is totally possible for the team to win a gold medal with none of the individuals taking a top spot on the podium. The result is that everyone on the team wins. Furthermore, it promotes camaraderie amongst the team, and that is what makes competition rocketry unique.

During the fly-offs last summer in Missouri, Ashley won a spot on three events, but had to drop one due to the two-events limit. The two she decided to keep were A-size rocket motor streamer duration (named: S6A) and A-motor Gyrocopter duration (named: S9A).

Ashley and I worked really hard to perfect our building techniques since last summer when she was selected for the team at the fly-offs. This is a team event, so having help is not cheating. It is encouraged. In fact, the team pushes for collaboration within the group. I would say that sharing information and techniques was one of the secrets of the success we had during this competition. My recollection is that there was more collaboration this time around than from previous World Championship events. And it paid off.



Ashley putting the final touches on her rockets before we headed to Texas for the big event.

This contest was a bit different for me than the last one held in 2021. During that contest year, I learned a lot about how to build a carbon fiber airframe using a two-part mold. If you read newsletter issue #559 (**https://www.apogeerockets.com/Peak-of-Flight/Newsletter559**), I felt that I personally won the gold medal for all the new

Continued on Page 3

About this Newsletter

You can subscribe to recieve this e-zine FREE at the Apogee Components website www.ApogeeComponents.com, or by clicking the link here **Newsletter Sign-Up**

Newsletter Staff

Writer: Tim Van Milligan
Editor: Michelle Mason
Layout: Sky Luther

information I gained. This time around, I didn't learn nearly as much in the broad sense. But I felt it was deep information about a very narrow class of topics. For example, my success rate on making a body tube from carbon fiber was OK, but not what I was hoping for. By the end of June, I was getting nearly a 90% success rate because of the nuances I had learned this time around. I also significantly reduced the weight of the tubes, probably close to 30%. They went from around 3.4 grams per tube down to around 2.6 grams. I may have to update my video series on tube construction to include these new learnings that really help to improve quality and success. It is available on the Udemy website if you're interested (**https://www.udemy.com/course/make-ultra-lightweight-carbon-fiber-tubes-for-model-rockets/**).

Our approach was for me to build the component parts,

The piston launcher under the rocket, which is ready to be launched.

NEED A PARACHUTE?
APOGEE HAS THE ONE YOU'RE LOOKING FOR!
www.ApogeeRockets.com/Building-Supplies/

and then Ashley would do the assembly and the flying. So it was very much like a kit rocket that other competitors use. If you bought a Rotary Revolution (**https://www.apogeerockets.com/Rocket-Kits/Skill-Level-4-Model-Rocket-Kits/Rotary-Revolution**) kit for this competition, that is essentially doing the same thing. Someone makes the parts, and you do the assembly and flying. I did see a number of components from the Rotary Revolution on the contest range, which I was also very pleased to see.

And we practiced a lot this time around too. Whenever we could get a launch in, we'd go out and test the models we built.

The lighter weight tubes I was making created a problem that I didn't anticipate. The rockets were so lightweight that they were being blasted too fast by the piston launcher. They were coming out of the tower like a speeding bullet. Normally, this is great.

As an aside, if you are interested in learning more about piston launchers, there are many great reports on the NAR website at: **https://www.nar.org/members/rd-reports-in-chronological-order/** (you do have to be a NAR member to view them).

In our case, as soon as the rocket exited the piston and the launch tower, they were actually decelerating, even though the rocket motor was still creating thrust.

If you ever look at a velocity curve in RockSim after running a simulation, you'll see that for most motors, the peak speed is just "before" engine burnout, not "at" engine burnout. That is typical of most flights because the thrust tails off as it nears burnout. After peak speed, the rocket starts decelerating.

Because the rocket was so lightweight and the piston created such a great force, the effect was that we were moving that peak speed even closer to the ignition point of the rocket.

I had never had to think about this before. In fact, I didn't realize this was a big problem until Ashley destroyed three rockets in succession during testing the day before the contest. The rockets would blast out of the tower, and about 50 feet in the air, they would turn sideways and crimp in the middle.

Continued on Page 4

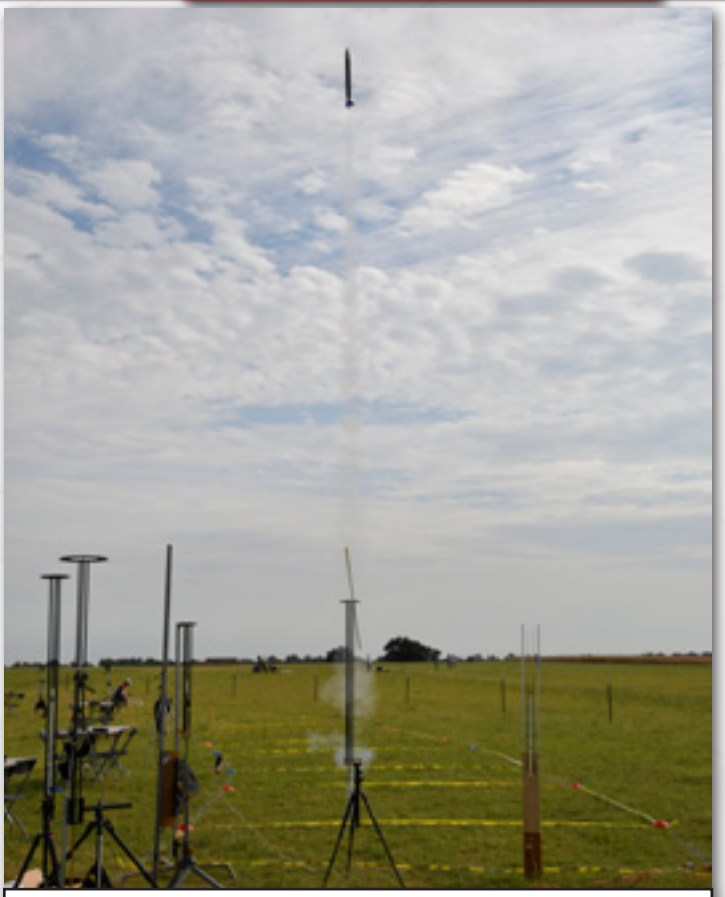
We had experienced this issue during our flight tests earlier

PEAK OF FLIGHT NEWSLETTER

Issue 604 / July 18th 2023

Learnings From The World SpaceModeling Championships 2023 - Part 1

By Tim Van Milligan



This rocket blasted off so hard that it broke the piston. The piston tube can be seen coming out of the top of the launch tower.

this year, and we thought we licked the problem. At first, I thought it was a structural problem with the nose or body tube. The tubes were lighter weight, but they weren't much weaker. We just removed the dead weight of excess epoxy on the inside of the tube.

During testing, I narrowed the problem down to the fins of the rocket. Like everything else, I had been concentrating on making the fins as thin as I could, in order to reduce the weight and the drag. The lowest weight fins were basically 1/64 inches thick, made from a laminate of balsa wood covered with carbon fiber cloth skins to give them strength.

The problem was they were too thin. Even though they didn't break, they could still flutter like a fabric flag in the wind. That flutter would cause them to generate more drag, and snap off the rocket. Without fins, the rocket is unstable, which explains why the rocket flipped sideways at high speeds.

I made probably a couple hundred fins leading up to the contest trying to solve the problem of the rockets going unstable. I tried different materials and different construction techniques to find a solution that gave me stiffness, low weight, and good surface smoothness. I did settle on fins that had a thicker balsa core, and carbon fiber skins that had to be processed with two layers of epoxy in a vacuum bag.

This was a small sample of the fin experiments that I did over the last year. Each bundle of fins was made with a different technique or materials.

Before we left Colorado for the contest, we had several beautiful flights with the rockets. The fins were working just fine.

But when we got to the field in Texas and were doing some final practice flights the day before Ashley's first event, the streamer

Continued on Page 5

models were exhibiting the same problem all over again. Three flights in a row, the rockets went unstable about 50 feet into the air.

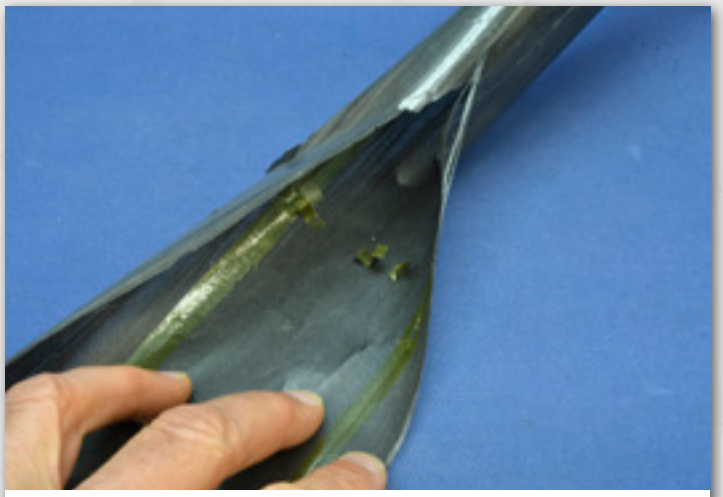
A million scenarios were going through my mind.

First of all, we were flying at a much lower altitude. Here in Colorado, our launch pad is over 5000 feet above sea level. In Texas, we were at about 400 feet. That means we were flying through denser air. Could it be that the higher forces from the denser air flowing over the fins were causing them to flutter again? That was certainly possible.

You can learn something from every flight if you examine the evidence afterwards. From these test flights we determined that there may have been a different problem. Looking at the wreckage from the first flight, we noticed that the internal standoffs inside the rocket were missing.

We put simple "W" shaped stand-offs on the inside of the rocket to keep the streamer up near the nose cone of the rocket. The outer legs of the "w" were curved and conformed to the inside walls of the tube, and so there was a "V" shaped portion that projected towards the center of the tube. There were three of them positioned around the circumference of the tube to keep the streamer from sliding rearwards in the rocket.

The streamer event is one where the streamer's weight is what moves the CG far enough forward in order to keep the rocket stable. The streamer weighs about 6 grams, so it is a significant portion of the entire weight of the model.

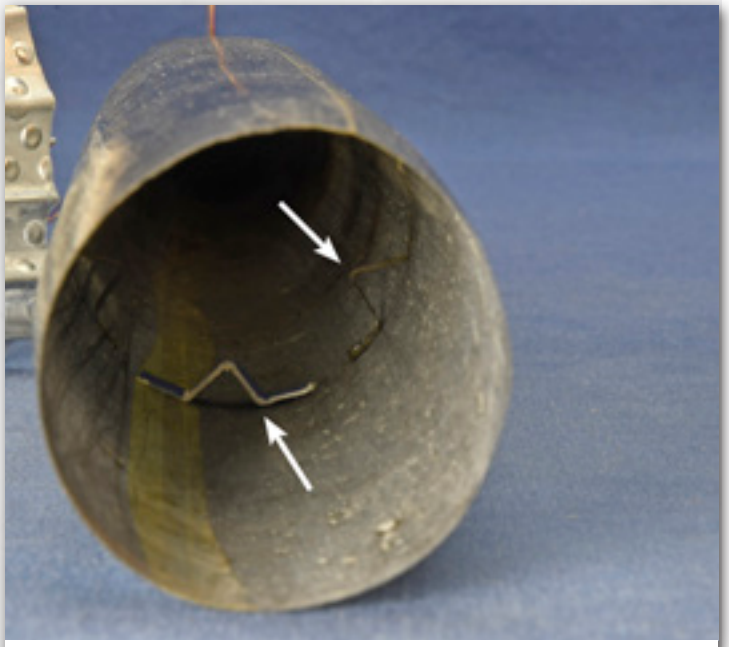


On a failed rocket that was already split down the side, we noticed that the standoffs were broken or missing. These standoffs prevent the streamer from sliding rearwards in the rocket.

If the streamer were to shift backwards in the rocket, that would explain why it went unstable. You can't allow the CG in any rocket to move backwards.

Looking at the wreckage of the first test flight, we noticed that the standoffs were missing. It was entirely possible that due to the high acceleration of the rocket coming off the piston launcher, that the standoffs weren't strong enough to hold the extra weight of the streamer and they snapped off. Newton's 2nd law of motion applies here: F=ma. The mass was constant, but the acceleration was massive. It could have been 50 G's (or more). So the force needed to hold up the streamer would be 50 times greater too.

The consensus from our teammates was to increase the number of standoffs inside the rocket holding up the streamer and prevent it from sliding rearward. And it was an easy fix. Ashley made some new standoffs from the cardstock of an engine package, and glued them inside the rocket.



Additional cardstock standoffs (the white "W" shaped piece on the left) were added inside to the tube to provide additional strength to prevent the streamer from sliding rearwards.

Then we tested the rocket again. It was our last rocket that we could dedicate for test flights. The remaining rockets we brought with us needed

Continued on Page 6

JOIN TRIPOLI.ORG
Mention Apogee Components

to be saved for the actual competition.

You guessed what happened… For a third time, the rocket went unstable. Fortunately, it didn't destroy itself. It was still flyable. In fact, the fins were intact. That fact eliminated the possibility that fin flutter was the issue.

Looking inside the tube, we saw that all the standoffs were still in place. That indicated that the streamer did not shift rearwards, and the CG did not move backwards.

What stumped us was why the rocket was still going unstable?

While Ashley was pushing the button to launch the rocket, I was snapping lift-off pictures with my camera. It takes about 10 frames a second in burst mode. I was extremely lucky, as in one of the photos we saw the problem.

While the photo was extremely blurry because of the speed of the rocket, we could see that the issue was that the nose cone was coming off the rocket as it ascended.

As soon as the rocket exited the tower, the nose cone was slightly tilted (left). Once the nose was off, the rocket went unstable.

NEED A PARACHUTE? APOGEE HAS THE ONE YOU'RE LOOKING FOR!
www.ApogeeRockets.com/Building-Supplies/Parachutes

The crazy thing was, from the photograph, we could see that the motor was still burning.

Now the question was: "why is the nose cone coming off the rocket while the motor is still producing thrust?" Shouldn't the acceleration of the rocket make the nose cone heavier (remember F=ma) and push it tighter onto the tube?

Then it hit me… we weren't accelerating at this point. The rocket was decelerating. It was slowing down, even though it was still under thrust. If it was slowing down, then the streamer inside the rocket was shifting forward, not backwards. Its momentum carried it forward, and it pushed the nose cone off the tube of the rocket.

That explained what we were seeing.

The rocket, because it was so lightweight, was accelerating off the piston launcher faster than we ever expected. The reason was that the piston tube itself was exerting a massive accelerating force on the rocket. But as soon as the rocket left the piston tube, it would begin to slow down. But the inertia of the streamer allowed it to slide forward inside the rocket's tube, and pushed the nose cone off the rocket. Once the nose came off, the whole aerodynamic shape of the rocket changed, and it immediately went unstable.

With this new theory, we went back to the launch pad one last time. The fix we made was to increase the amount of friction on the nose cone, so it couldn't come off so easily as it did before.

And it worked! The rocket blasted off perfectly straight and everything worked great.

But there was more to this story… which would bite us in the actual competition and cost the team a medal. But I'm getting ahead of myself. So let me tell you more about my other experiences.

The Launch Site

The launch site selected for the World SpaceModeling Championships was the "Apache Pass" field of the Austin Area Rocketry Group (AARG) {https://www.aarg.org/}. This is a fairly flat launch field, and if you look at it on any map software, it looks like it is free of obstacles. That is deceiv-

Continued on Page 7

ing, as all the satellite photos must have been taken in the fall or winter when there weren't any crops in the neighboring fields. This time of year, the fields are full of 6 foot high corn plants. That made rocket recovery during the week a major challenge.

For the duration events, where the models had large recovery devices, our recovery team did an outstanding job of getting the rockets out of the corn fields. We had the advantage of a huge USA team, with lots of eyeballs that could triangulate on where the rocket landed. The "duration" rockets are intended to fall slowly, which is ideal for tracking, because you can move to a better location that is free of visual obstacles that could interfere with a good line of sight.

For the altitude events that occurred later in the week, the situation was different. On those models, the recovery device was always a streamer. Streamers save weight in the rocket versus a parachute, and are easier to deploy so the risk of a DQ is lower. And many of the competitors reduced the size of the streamer to the bare minimum. They would fall fast, and were difficult to see. That put a lot of pressure on the recovery crew, and unfortunately, a few models were lost.

Notice the corn fields in the background. They are fertilized by rockets.

The biggest obstacle of all though, was probably the weather. It was hot and humid. That took a toll on everyone. You'd sweat so much that the sunscreen on your face would mix in with the sweat and get in your eyes and sting them pretty good. By the end of the day, everyone was wiped out. By the second day of the week-long event, the joke was how it felt like you'd already spent a couple of weeks on the field.

There were two massive pavilions (seen in the background) on the field for prepping rockets and for eating lunch.

There were two giant pavilions set up on the field for everyone to get some shade from the sun. In previous championship events, every country had their own separate Easy-Up style canopies where they would set up and prepare their rockets. This time, it was very communal. So the British team set up right next to the Americans, and the Canadians were next to them. I personally liked the way that we all interacted with each other. You could walk through the pavilion and see what everyone was working on, and say hello to people you met. It made for a very relaxed atmosphere.

Continued on Page 8

The second pavilion was supposed to be used for the lunch cafeteria, but that really didn't happen. People would grab their boxed lunch, and take it back to their prep area instead of sitting in the food tent. So from my perspective, the 2nd pavilion probably wasn't needed, even though it was nice to have around. Because both pavilions were open sided, and the ceiling height was quite ample, they were great places to stay cooler and get out of the hot Texas sunshine.

Under the pavilion, you could prep rockets with friends from other countries. Here the team from Estonia was set up.

The sleeping accommodations weren't bad either. We all stayed in the dorms at Southwestern University in Georgetown, Texas. It is a small liberal arts university that claims to be the oldest university in Texas, established in 1840. But the buildings were pretty modern, so the campus was pleasant. The dorm for our family was nice - it had bunk beds in the two bedrooms, two full-size bathrooms, a kitchenette with a sink, fridge and microwave, a large common lounge area, and a walk-out balcony. If it wasn't for the bunk beds, I'd say it was as nice as any hotel room in the area. And the wi-fi was excellent, no matter where you were on the campus, so it didn't bother our family that there was no TV in the room.

My only complaint about the dorm room was that the mattress had a plastic liner (I suppose to protect it from bed-wetters or other human secretions that couples do at night). But the plastic made it feel uncomfortable when you slept on it at night.

Check out our Facebook page
www.facebook.com/ApogeeRockets

The dormroom where we stayed was quite comfortable. Here Ashley is adding the cardstock standoffs to her streamer rockets.

The organizers had given us all a set of towels, sheets, a blanket and pillow for the week. That was sufficient, except it still felt like you were sleeping on plastic. I ended up putting my towels under the sheet to insulate my skin from the sticky plastic.

We ate breakfast and dinner together in the cafeteria on campus. Surprisingly, the food was good. The cafeteria was undergoing summertime renovations, so I don't know if they were actually cooking it in the kitchen. But the food service workers did a great job keeping the trays full.

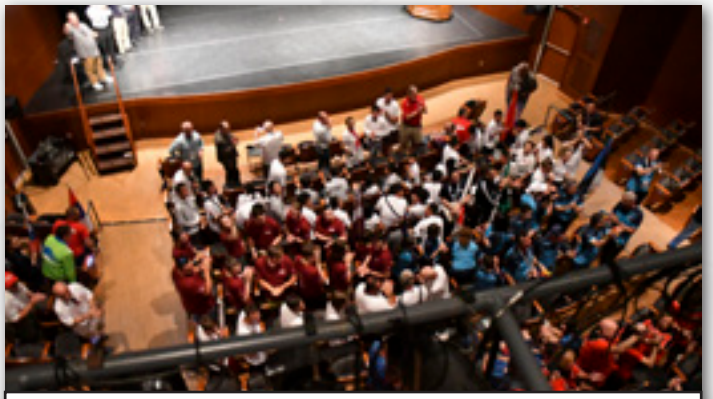
In the cafeteria on the campus of Southwestern University. The food was good, and the conversations were relaxing.

In retrospect, mealtime is where you interact more with people from other countries since you're standing in line with them as you pick up your food.

Continued on Page 9

For lunch, there were box lunches that consisted of a large wrap along with chips and a cookie. It was adequate, but by the end of the week, we were tired of the monotony of eating wraps.

The other facility on the university campus that we used was the theater. That was where the opening ceremonies and awards were presented. In the past, all of that was done outdoors. So while it was different from the previous World Championships that I've attended, I would have to say that due to the heat and humidity outside, doing everything indoors in comfortable chairs and cool air conditioning was a treat. As a supporter though, we couldn't sit with the team on the main floor of the theater. We watched from up on the balcony.



Inside the theater where the opening ceremony happened and awards were presented. Supporters and guests sat upstairs in the balcony.

Conclusion of Part 1

This has been the first part of a two-part article describing my own personal perspective on the 2023 World SpaceModeling Championships near Austin, Texas. It is my hope that it offered a captivating glimpse into the thrilling world of rocketry competition, from the intense challenges faced by the contestants to the camaraderie and collaboration within the team.

In the second part in the next issue of the Peak-of-Flight Newsletter, I'll tell more about the actual flights and the results that we had. I'll also describe what my duties were as a team supporter.

About The Author:

Tim Van Milligan (a.k.a. "Mr. Rocket") is a real rocket scientist who likes helping out other rocketeers. He is an avid rocketry competitor and is Level 3 high power certified. He is often asked what is the biggest rocket he's ever launched. His answer is that before he started writing articles and books about rocketry, he worked on the Delta II rocket that launched satellites into orbit. He has a B.S. in Aeronautical Engineering from Embry-Riddle Aeronautical University in Daytona Beach, Florida, and has worked toward an M.S. in Space Technology from the Florida Institute of Technology in Melbourne, Florida. Currently, he is the owner of Apogee Components (**http://www.apogeerockets.com**) and also the author of the books: Model Rocket Design and Construction, 69 Simple Science Fair Projects with Model Rockets: Aeronautics and publisher of the "Peak-of-Flight" newsletter, a FREE e-zine newsletter about model rockets. You can email him by using the contact form at **https://www.apogeerockets.com/Contact**.

Tim Van Milligan