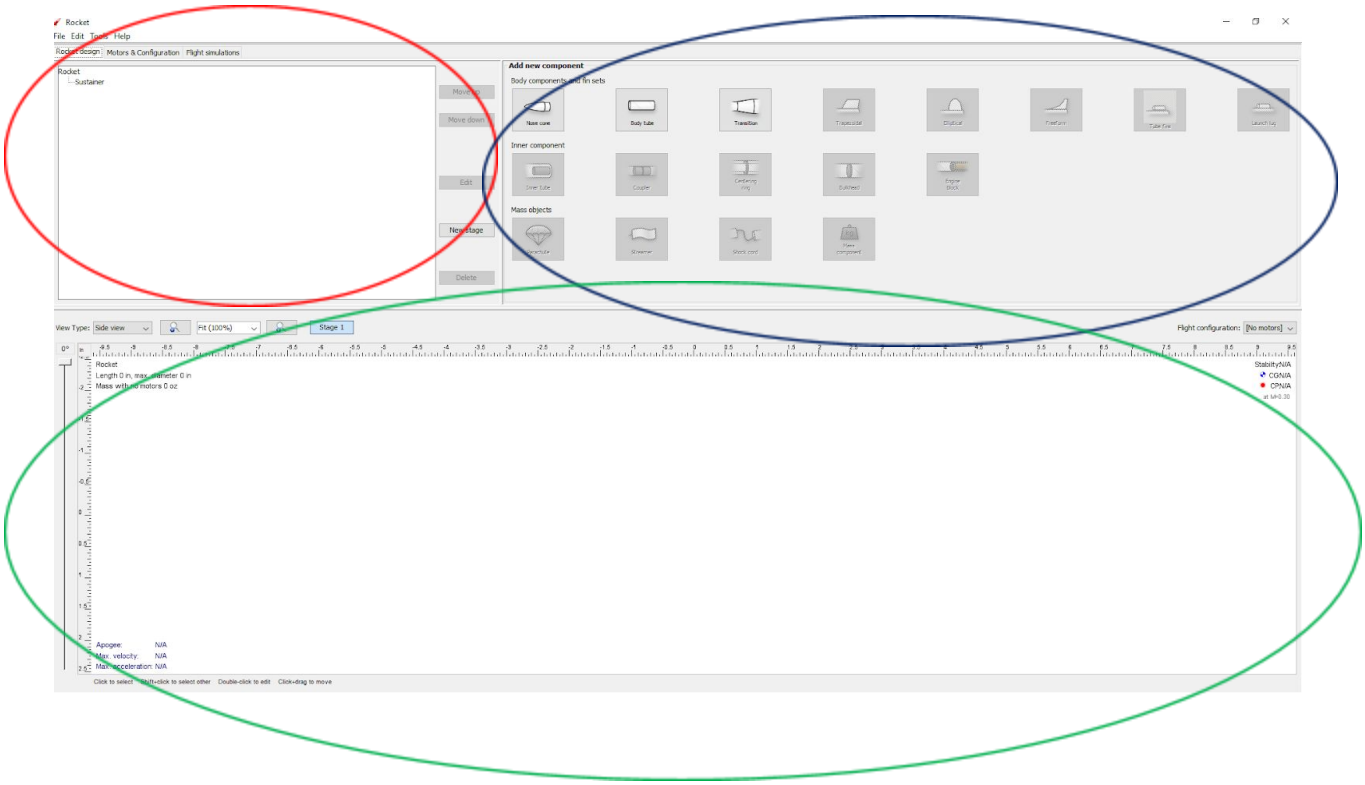
Eweek OpenRocket Tutorial

In this tutorial the basic functions of OpenRocket will be demonstrated in relation to the rules set up for this event. This should help you get started with the program and many items learned here can be used to design any other rocket you would like in the future! If you would like a video tutorial I have included a link to a YouTube tutorial that I found that is very short and covers a lot of the basics needed for this project
https://www.youtube.com/watch?v=egHbZUEr_Co

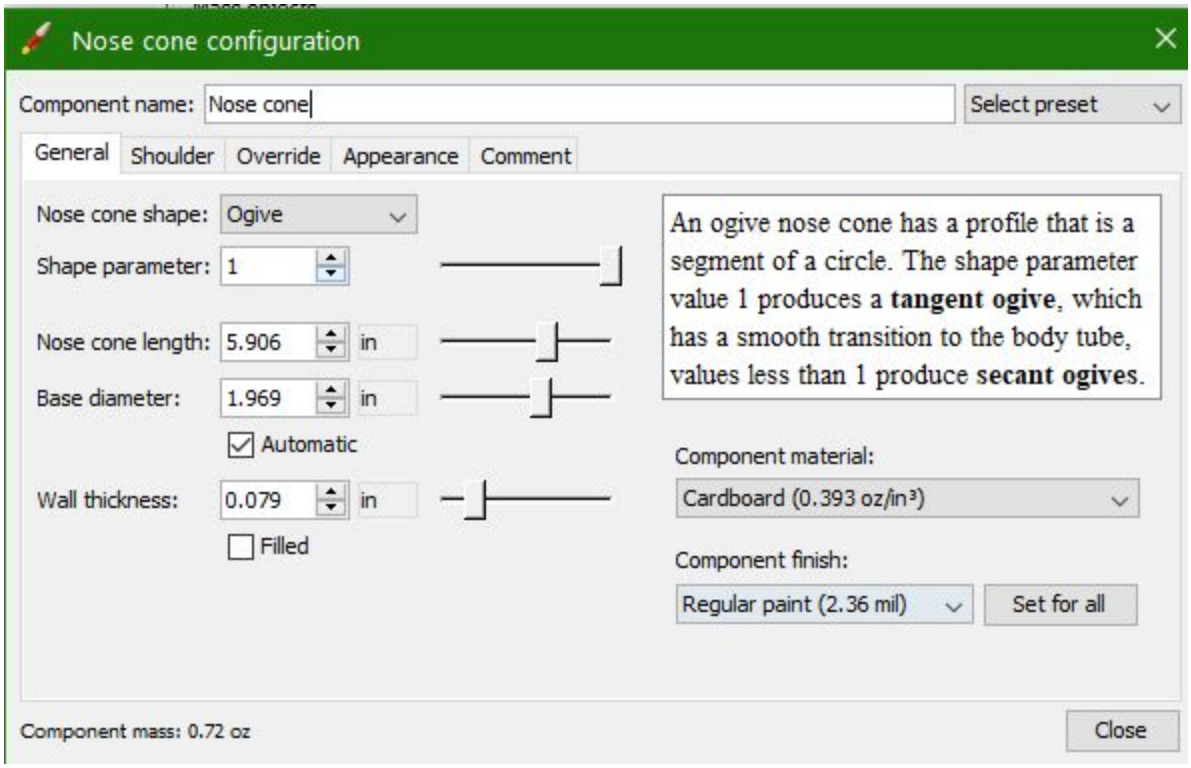
1. OpenRocket can be downloaded from here https://openrocket.info/ This is an executable jar file meaning as long as you have java already installed it will run when you open it without needing an installation.
2. After downloading and installing Java and the OpenRocket software, open the program. You will be greeted with a screen similar to the one below.



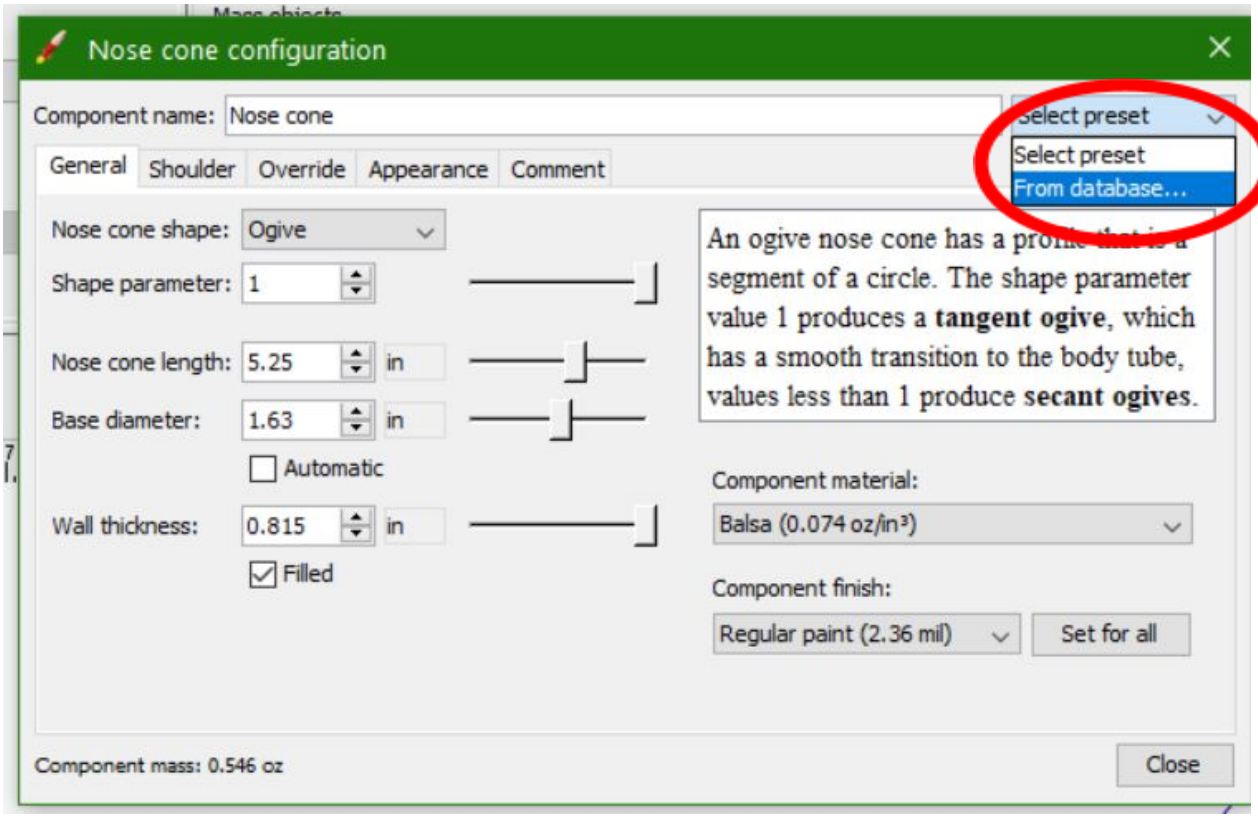
The region circled in red is the design tree. As you begin to build your rocket, all the components will be displayed here in a list format, showing their dependence on one another. In addition to this, once a component is created, its properties can be edited by double clicking on its icon. The region in blue is where you select components to add to the rocket. We will talk more about these icons later in this tutorial. Finally, the region in green shows a model of the rocket. From here we can visualize how the rocket will look, including all internal and external components. This region will also display Center of

Pressure (CP) and Center of Gravity (CG) distances measured from the nose of the rocket, as well as a stability margin value!

3. Select the nose cone option to get started. This will populate a nose cone into the design window and part tree and pull up a configuration window for the part.



We will use the preset parts in the program's database for this component. To do this click the dropdown circled in red on the top right



Checkmark the component you want to use, this adds it to the pull down menu **but does not apply the part**. Once you hit ok you need to use the pulldown select part menu again and the option you chose will be there to select. This process will be used for the nose cone, body tube, tube couplers, and inner tubes if needed in your design. Make sure the nose cone shoulder fits the inner diameter of the tube you select

4. To make fins, parachutes and other internal components of the body tube you must first select the tube in the parts tree or design window so that OpenRocket knows you want that component to be the parent. You will see that the part types that were greyed out before become active once you do this. There are three types of fins you can use, trapezoidal, elliptical, or freeform. Freeform will allow you to set custom geometry for the fins while trapezoidal is a standard shape defined by these parameters. It is up to you to

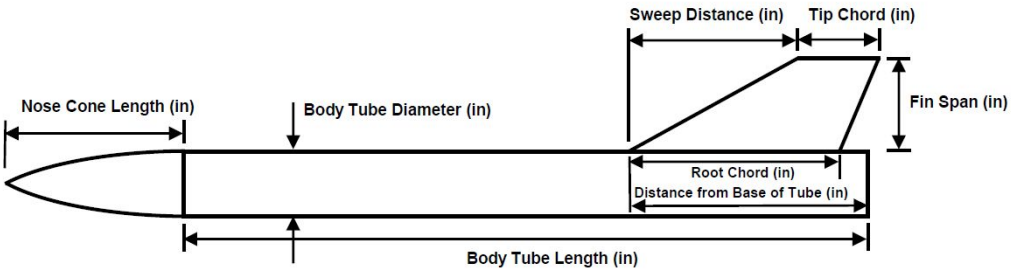
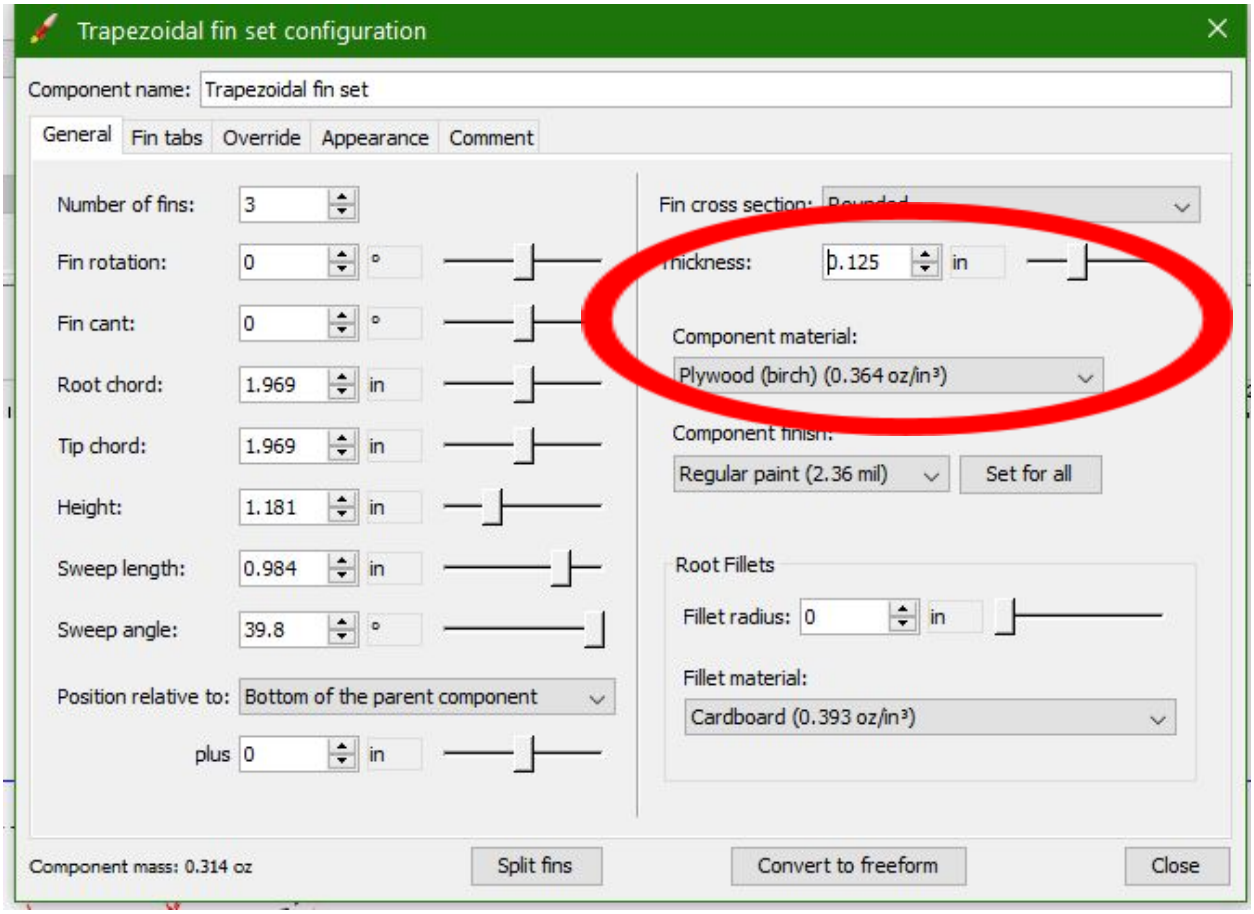


Figure 10 – Rocket Body and Fin Inputs geometry definitions.

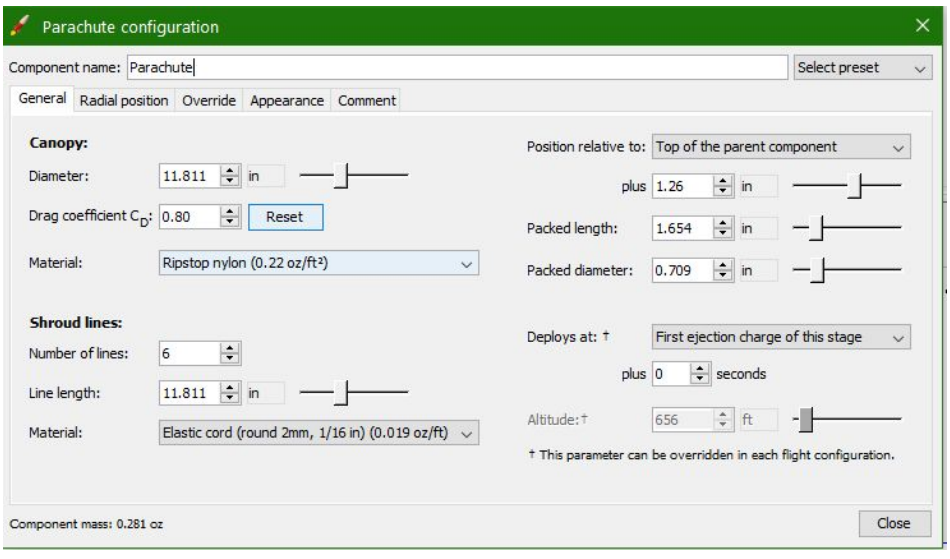
design this part however the material you specify must be either plywood(birch) minimum thickness of 1/8in, aluminum, or carbon fiber. The Component Material

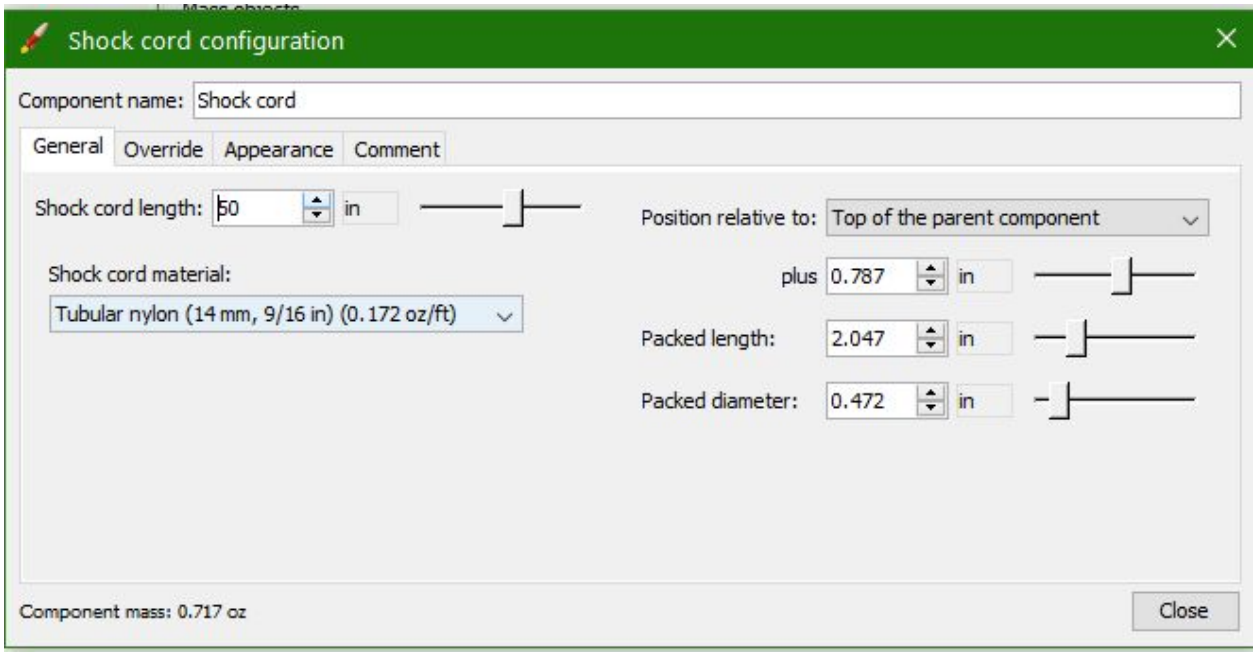
dropdown is where you can set this circled in red. Any bulkheads and centering rings



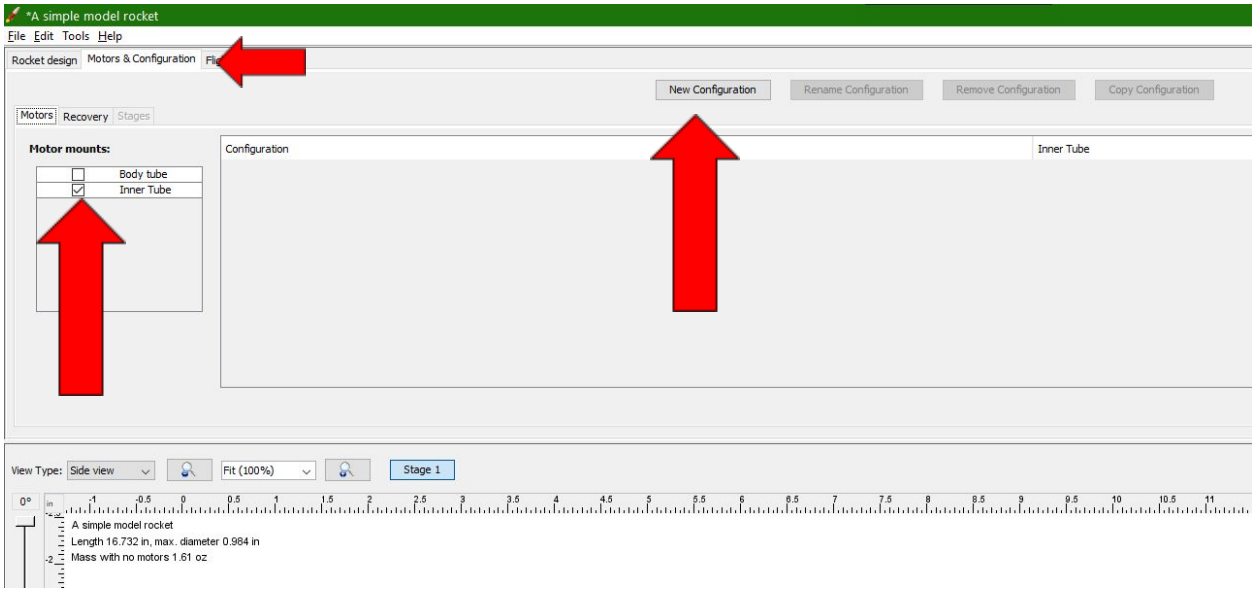
added must also follow these same material selection parameters.

5. Next add the parachute and shock cord to the main body tube. The sizing of the parachute will need to be changed based on the results of the simulations that will be run later. Do not change default ripstop nylon and drag coefficient. Shroud lines can be left at default values for simplicity. Shock cord should be made out of 14mm Tubular Nylon and be 3x the total length of the rocket.





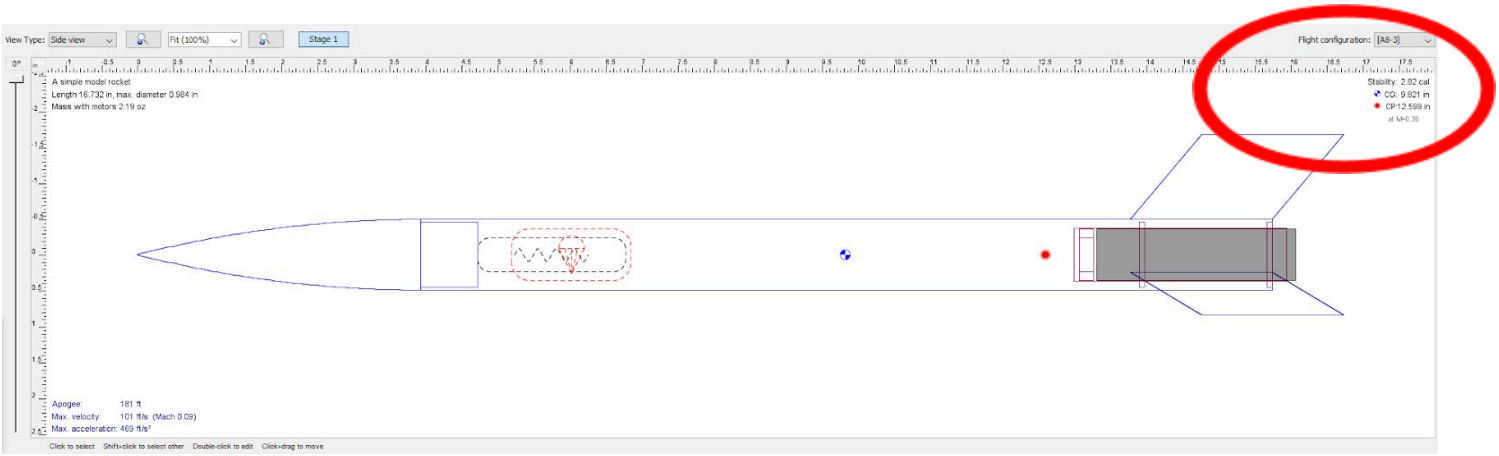
6. Next a motor needs to be selected. Click on the Motors & and Configuration tab on the top of the screen. Then on the side where it says motor mount select the tube that will hold the motor. The New Configuration button will then become active, click it then



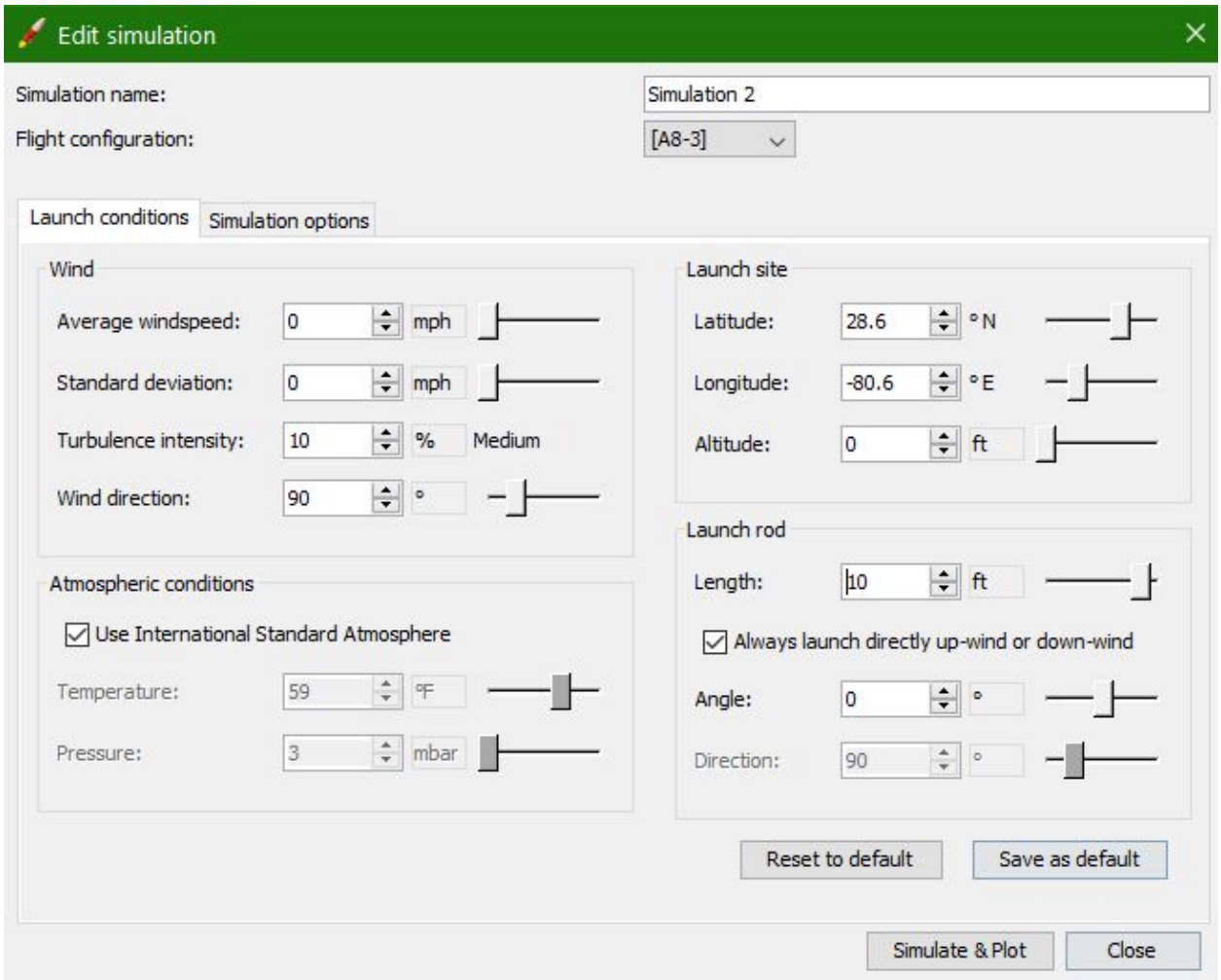
double click on the new line it creates where it says none highlighted in blue.

7. In the motor selector limit the total impulse to H or below. Using a motor higher than H will be disqualified in this competition. The motor must also match the diameter of the tube that you used as your motor mount. A motor block will be needed above the motor to stop it from shooting through the rocket when ignited
8. Once a motor is selected it should poluate in the design window. If it is not there use the Flight Configuration drop down on the right. With a motor in place you will need to adjust

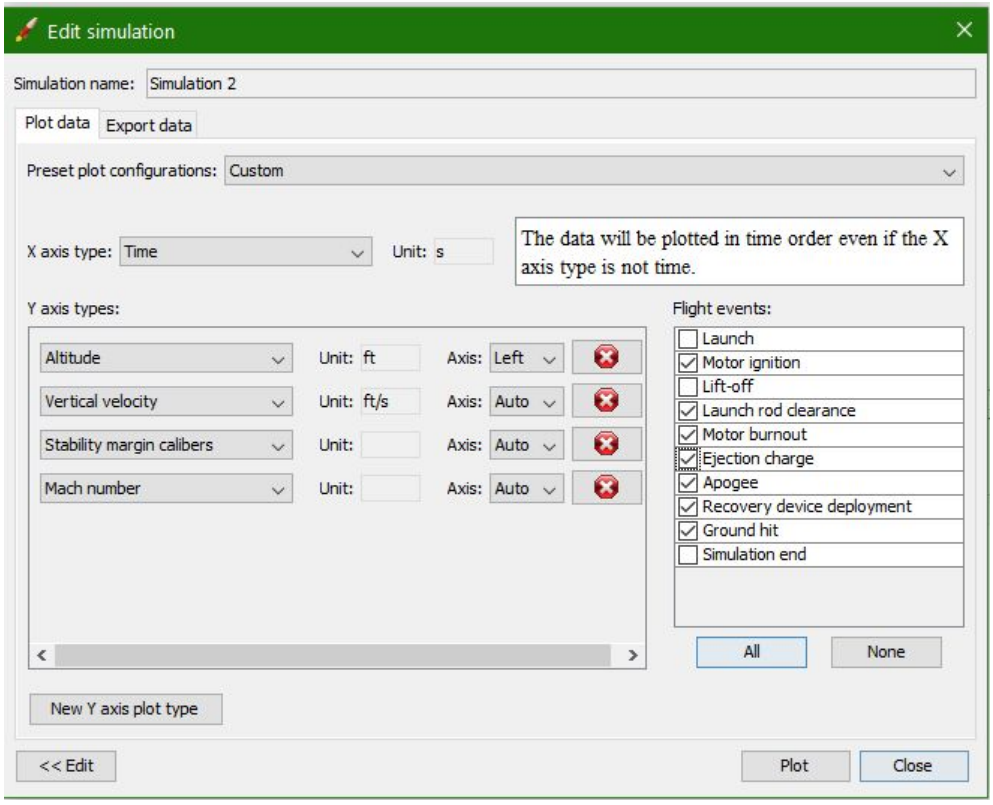
the size and shape of the rocket and fins until you find a configuration with a stability margin of 1.3 or higher. The rough estimate of this can be found on the right of the screen circled in red however this is for .3 mach and may not be the critical stability margin needed at rail departure. This will be assed in the simulation plots later.



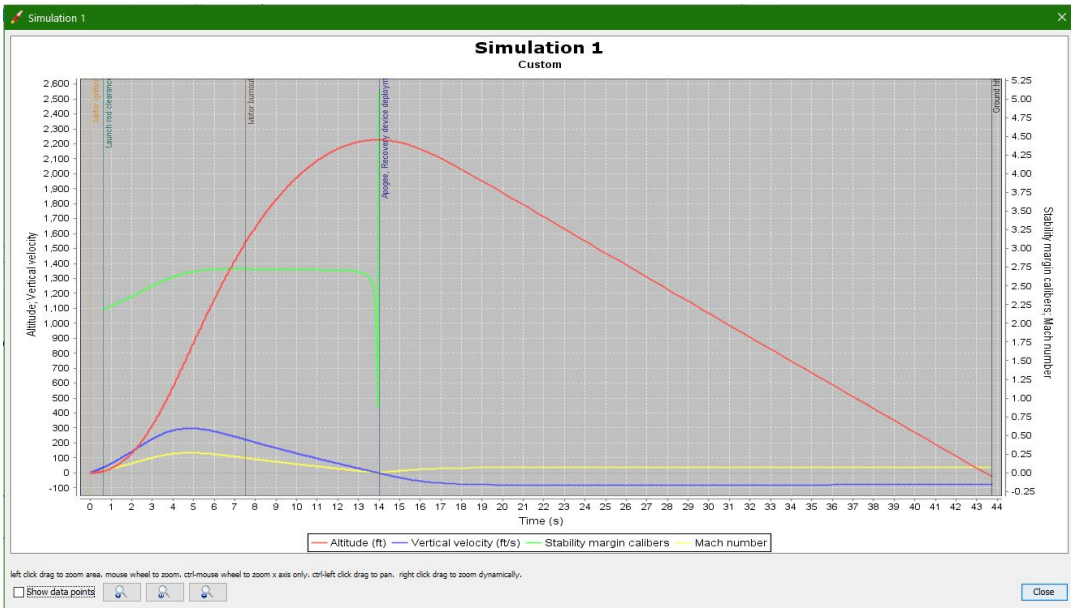
9. Once you have a design you like go to the third tab on the top, the flight simulations tab. Click new simulation and enter the values as follows for launch conditions:



10. Hit simulate and plot and set up the plot with these parameters, they will help you in refining your design to meet the mission requirements

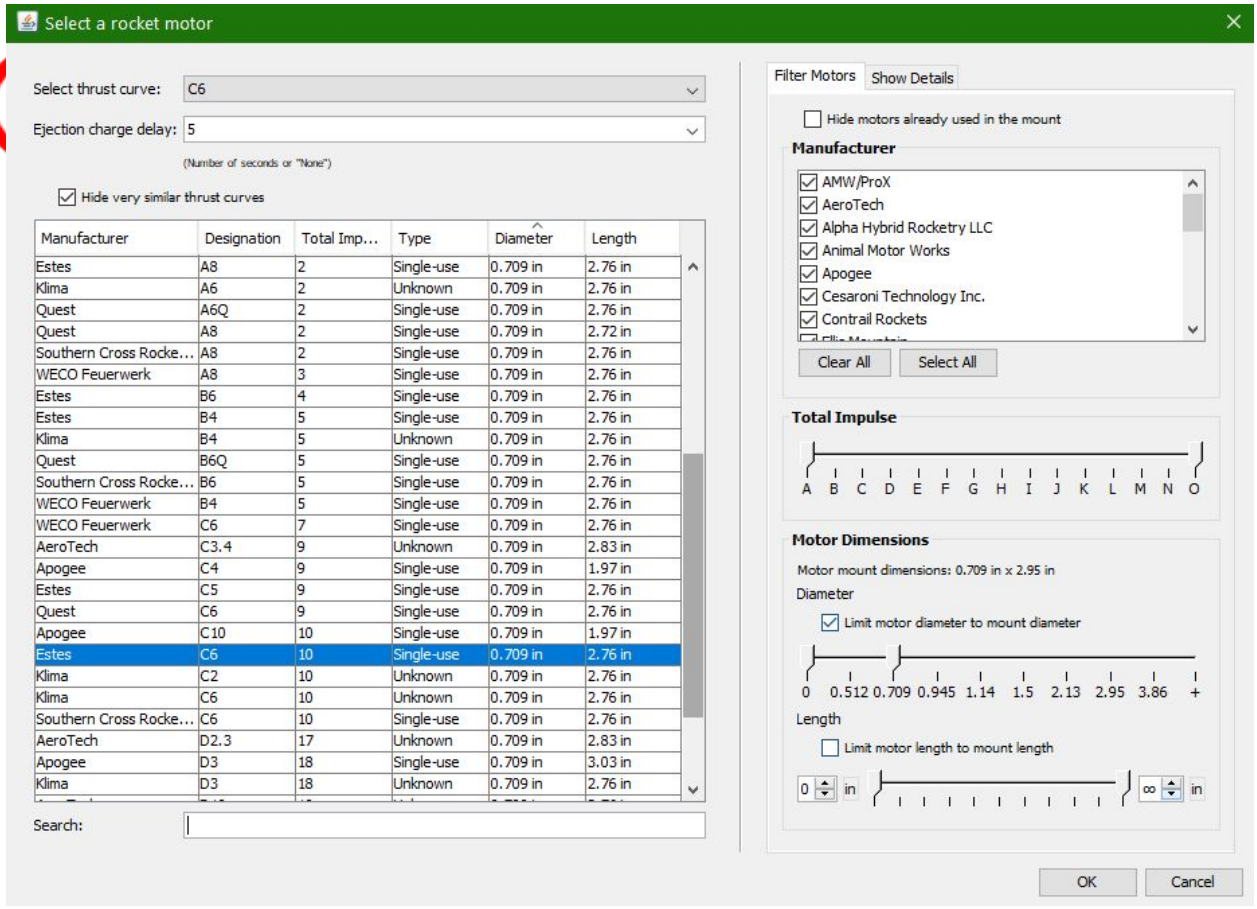


11. Your simulation will look something like this example. From this plot you will need to assess your stability margin based on what it is at launch rail clearance. For parachute sizing look at the vertical velocity after apogee or use the ground hit velocity in the



simulations page. Additionally you will need to select the ejection delay so that it occurs near apogee and at a low velocity. You can zoom in the plot by creating a selection box

with your mouse where you want the new view to include. The simulations page will tell you a time to apogee you can use to adjust the value. Ejection charge time is set in the



motor selection window as shown

12. From there iterate on your design until it follows all the rules and have fun! If you need help you can join the UB SEDS Discord:https://discord.gg/gU5RCXHXnB and use the eweek-design-challenge-help channel. Your final OpenRocket file must be submitted using the following name scheme FirstName_LastName_ClubYouRepresent to william.elliott@ubseds.org by Thursday 8am.