ARES Workshop - OpenRocket Part 1

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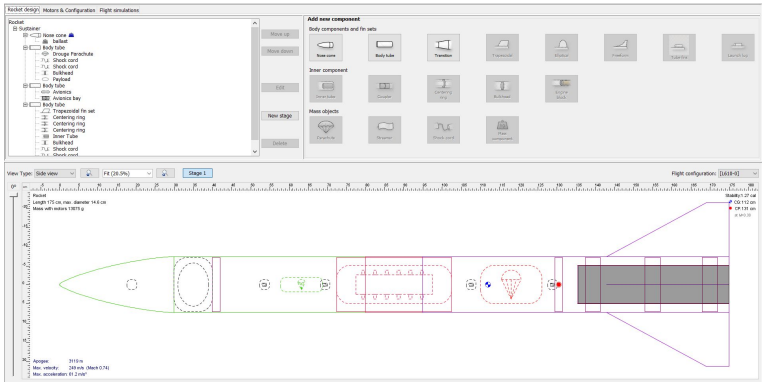
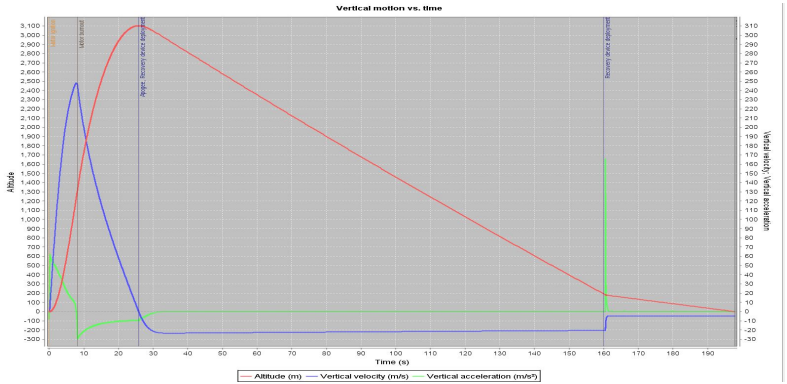
What is OpenRocket?

- Open-source rocket simulation software
- Optimise design and simulate various launch conditions
- Optimise various properties of the components and launch parameters





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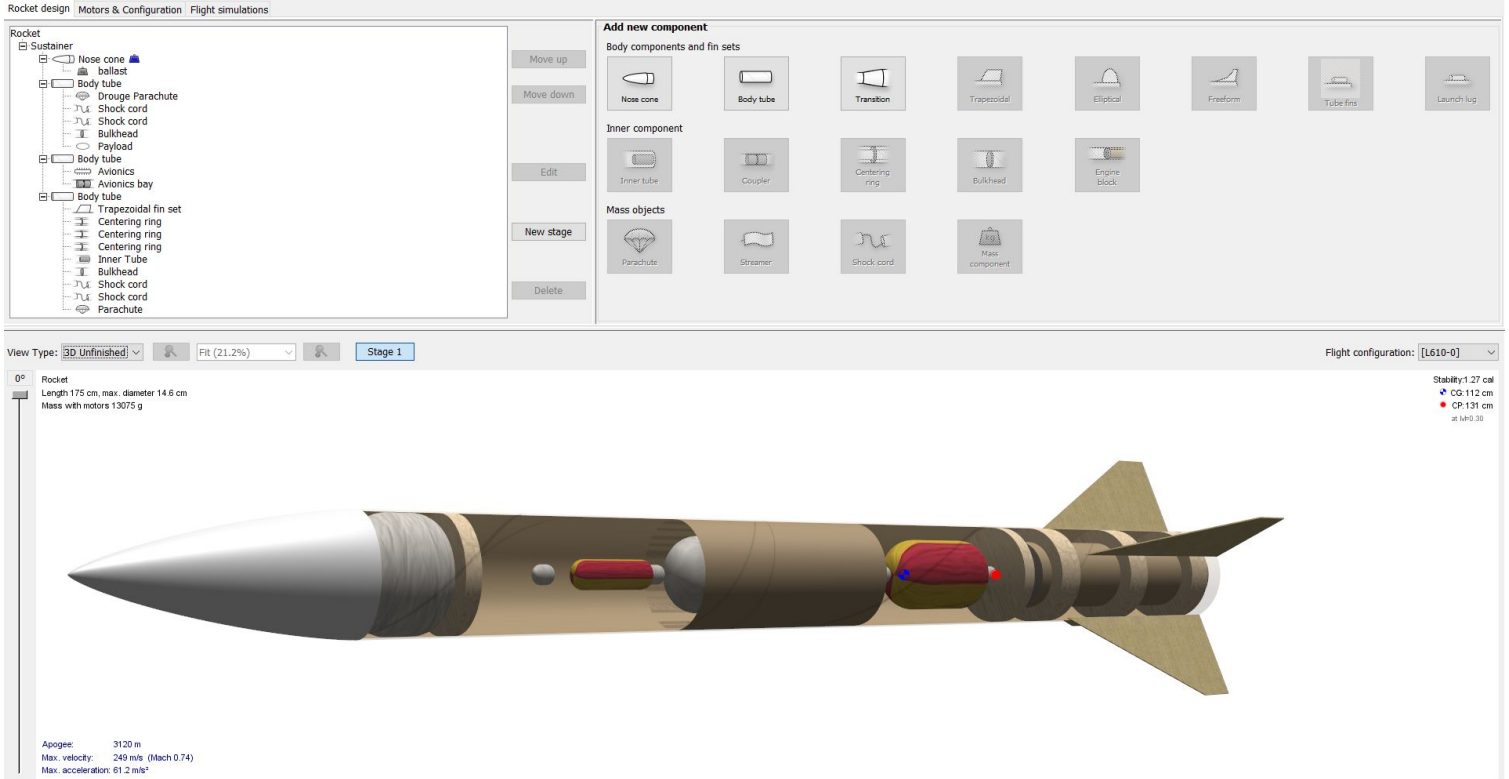

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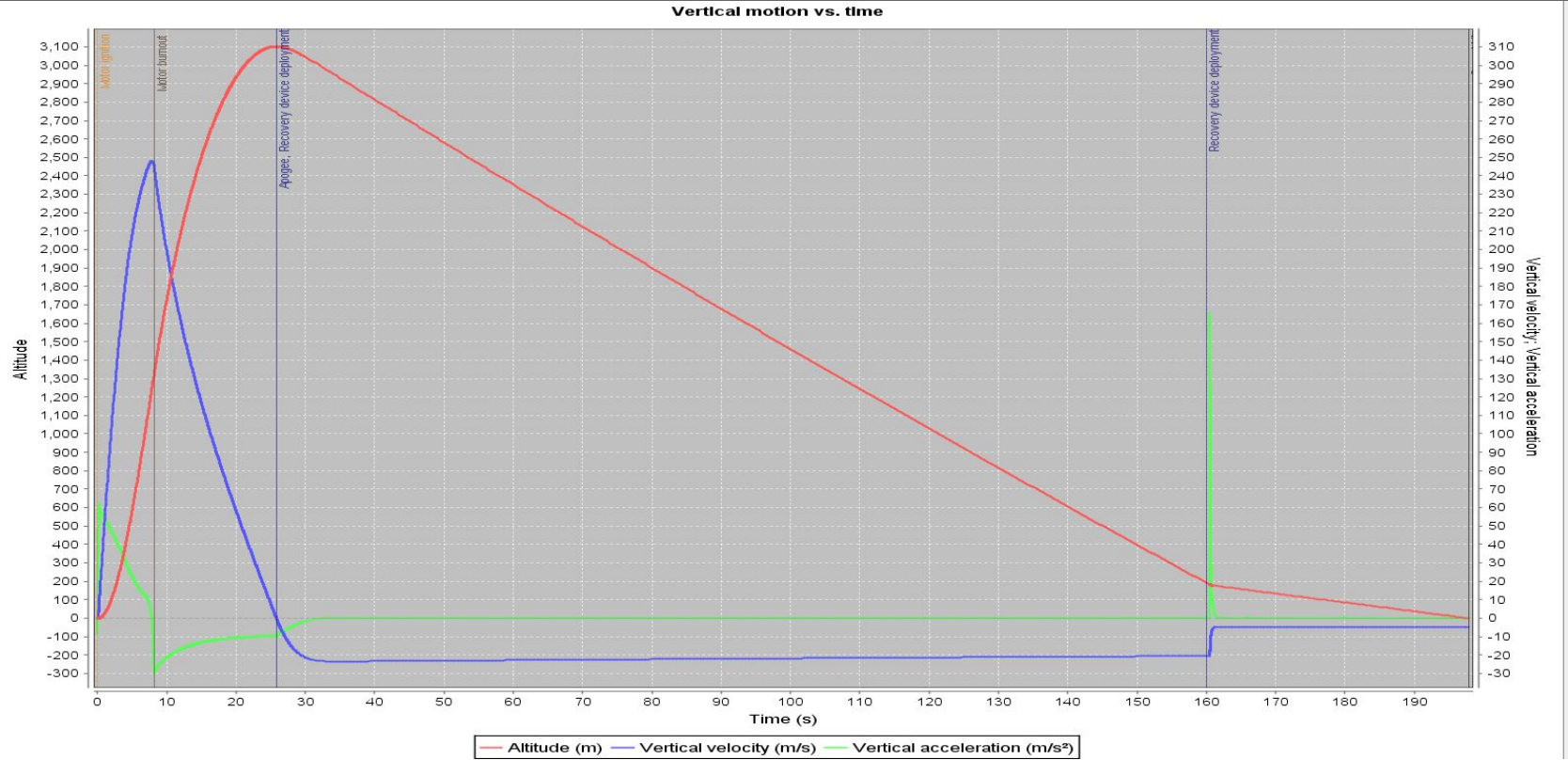


Downloading OpenRocket

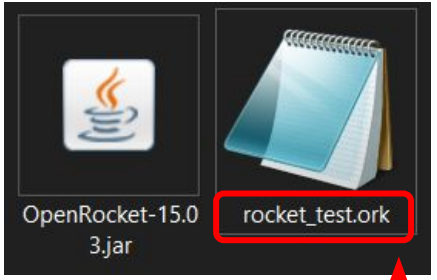
Navigate to **http://openrocket.info**

Open the .jar file to run the program.

OpenRocket projects are saved as **.ork** files.

Download a test project from the ARES workshop **GitHub**: **github.com/ares-unimelb/ARES-Workshops-2021**

Use File>Open within the OpenRocket window to access the .ork file.



Week	Workshop	Method of Delivery
01	Meet & Greet	In-person at South Lawn
02	Phobos - Part 1	Online - See Recording
03	Phobos - Part 2	Online - See Recording
04	OpenRocket - Part 1	Online - Demo Rocket

Getting Started

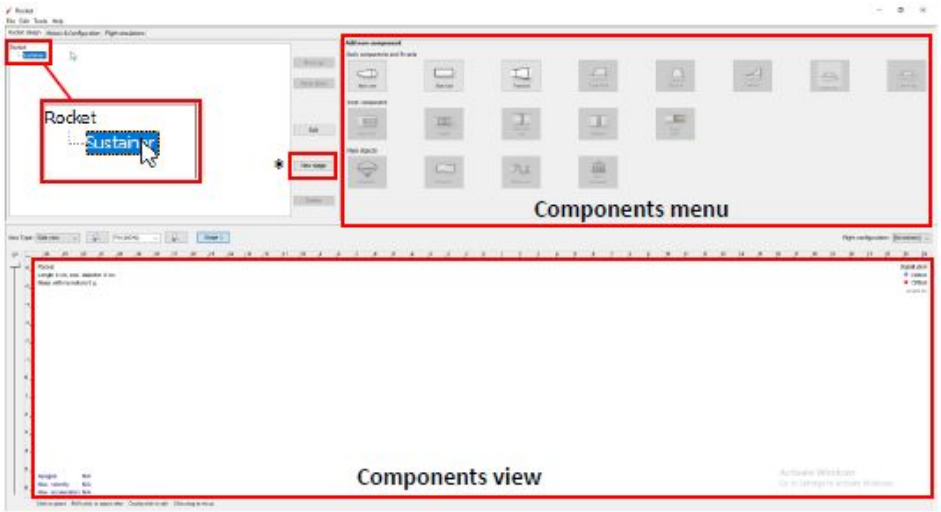
File>New

Launch the tool and ensure that sustainer is selected.

Sustainer refers to the stage that remains after previous stages have separated.

For a single-staged design, the “Sustainer” is the only stage.

For multi staged rocket select “New Stage”



Components Menu - Nose Cone

Drag **“Nose cone”** from the **Components menu** and drop it under the **Sustainer** branch.

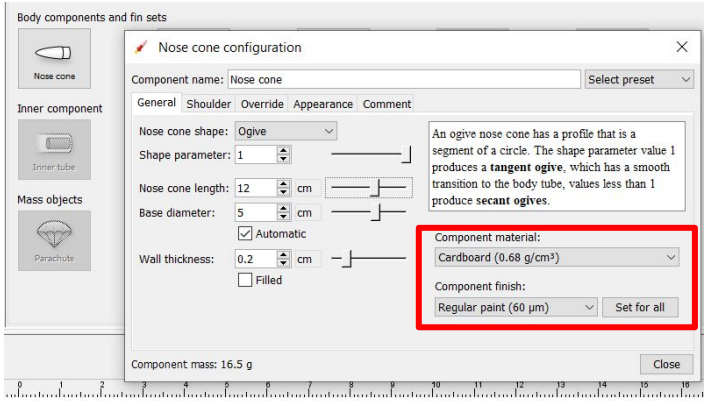
Subcomponents can be rearranged by dragging-and-dropping.

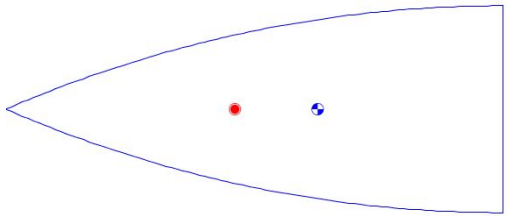
In the components view the nose cone will appear.

Double click to edit the properties.

Choose desired nose cone shape and dimensions, and change the **component material** to **Polycarbonate (Lexan).** This is the material closest in density to **PLA**, which is the material used by the 3D printers to print your nose cone.

Set **finish** to unfinished (150µm).





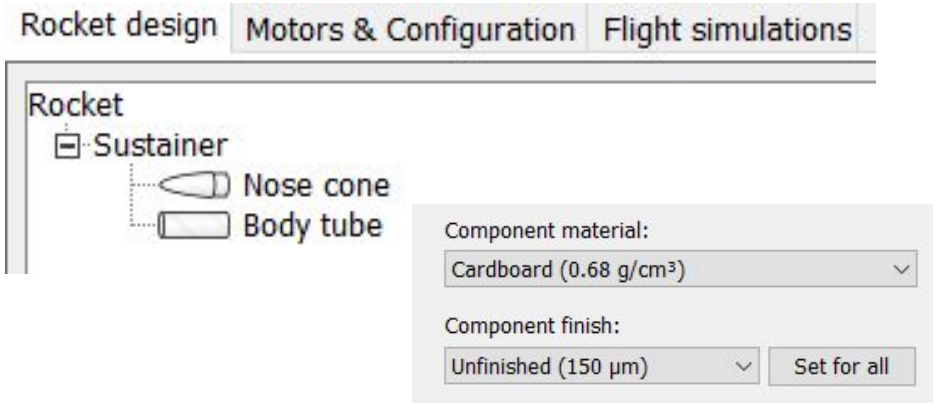
Components Menu - Body and Fins

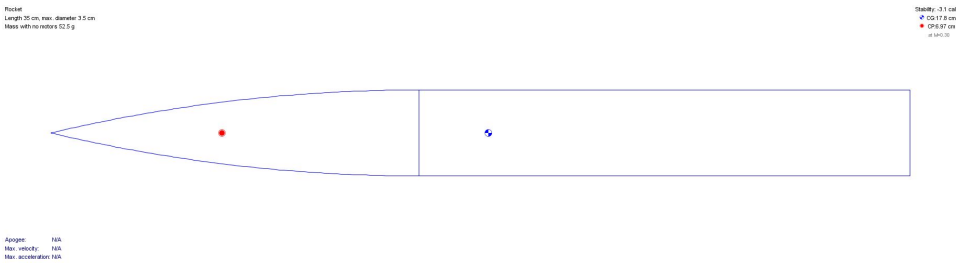
Drag and drop a body tube after the nose cone (middle body tube).

Set **body tube** material to **cardboard** or whatever material you would like to use from home! Set **finish** to unfinished (150µm).

Note:

- Fins can't be subcomponents of a nose cone
- Remember to change the material of each component you add





Components Menu - Body and Fins

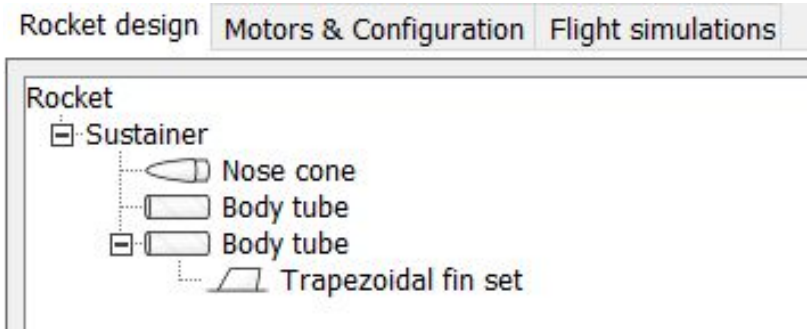
Drag and drop a second body tube (rear body tube) and a trapezoidal fin set.

Set **rear body tube** and **fins** material to **Polycarbonate (Lexan).** Set **finish** to unfinished (150µm).

Set length of rear nose cone to approx. **8cm**

This rear component will be 3D printed and will house the motor.

Try adjusting different fin settings.

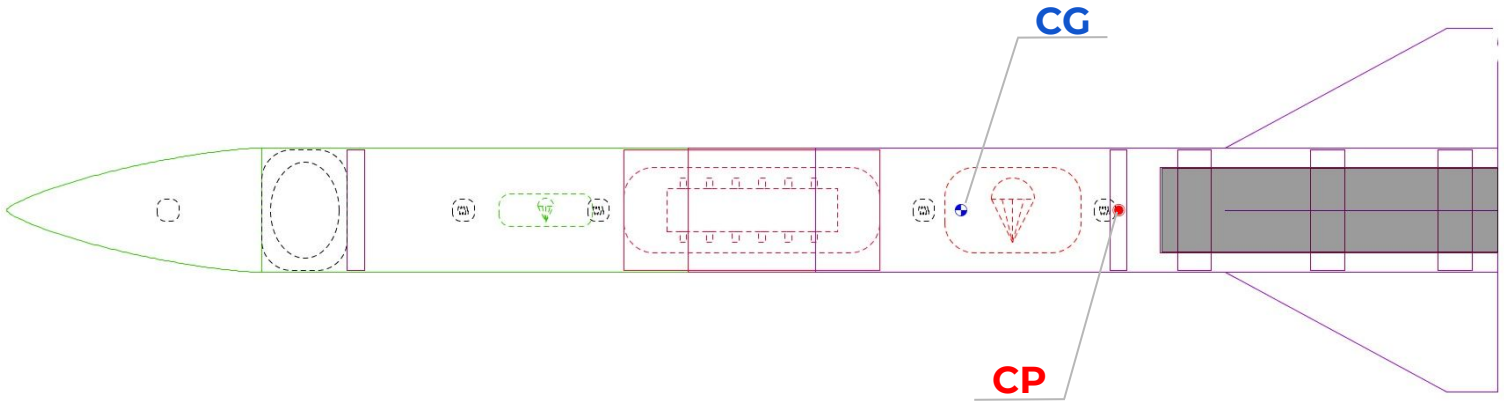


Revision - Flight Stability

Centre of Pressure (CP) - the point on the rocket upon which the sum of all aerodynamic forces act.

Centre of Gravity (CG) - the weighted centroid of all distributed mass. This is the point to which a force may be applied to cause a linear acceleration without an angular acceleration.

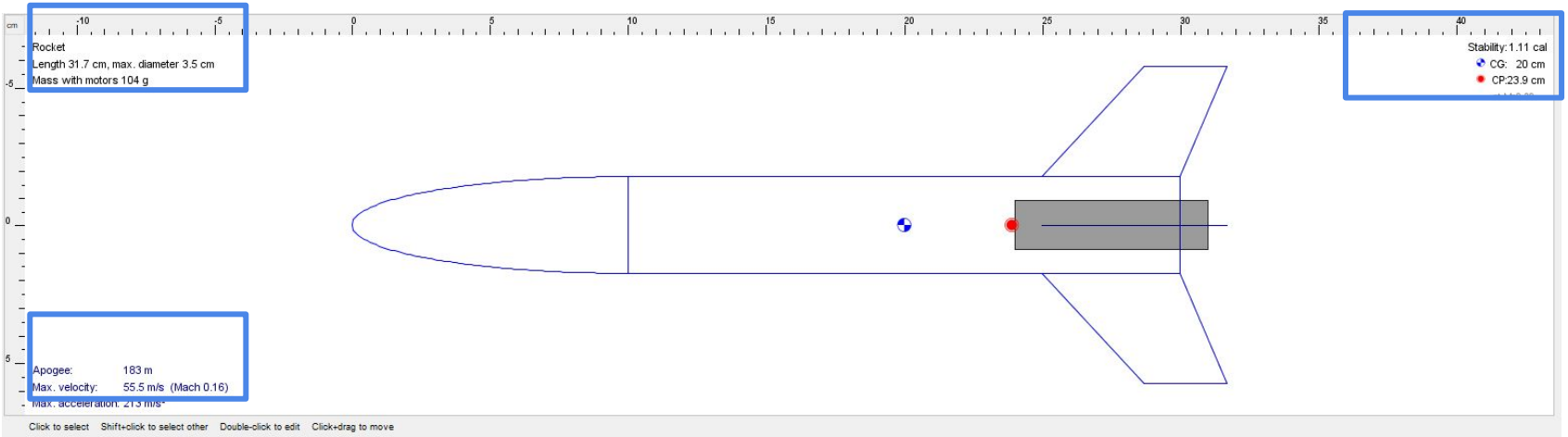
Rule of thumb - **CP should be 1-2 calibres** (body tube diameters) **aft of the CG.**



Components View

The “Components view” tells you some important things such as:

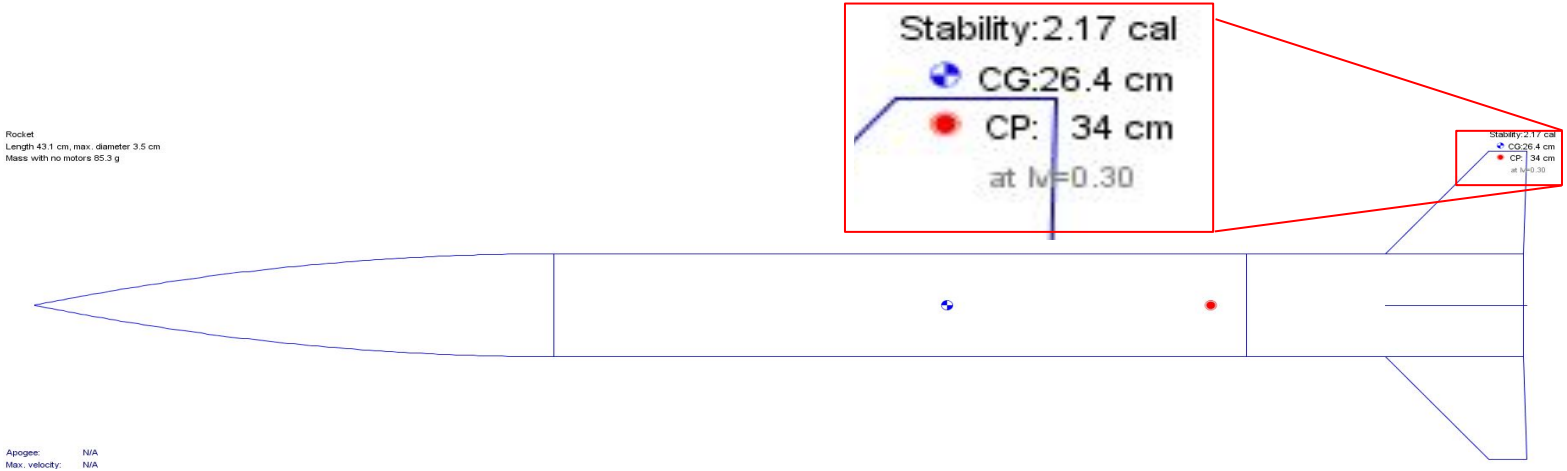
- The apogee of the rocket,
- maximum velocity, its maximum acceleration,
- Centre of gravity **(CG – blue dot)** and centre of pressure **(CP – red dot)**



Components View

The “Components view” tells you some important things such as:

- **Stability** value (how far behind COG is COP?)
- Aim for a stability of around **1.3-2.5**
- Adjust **fins** and **body tube geometry** to improve stability

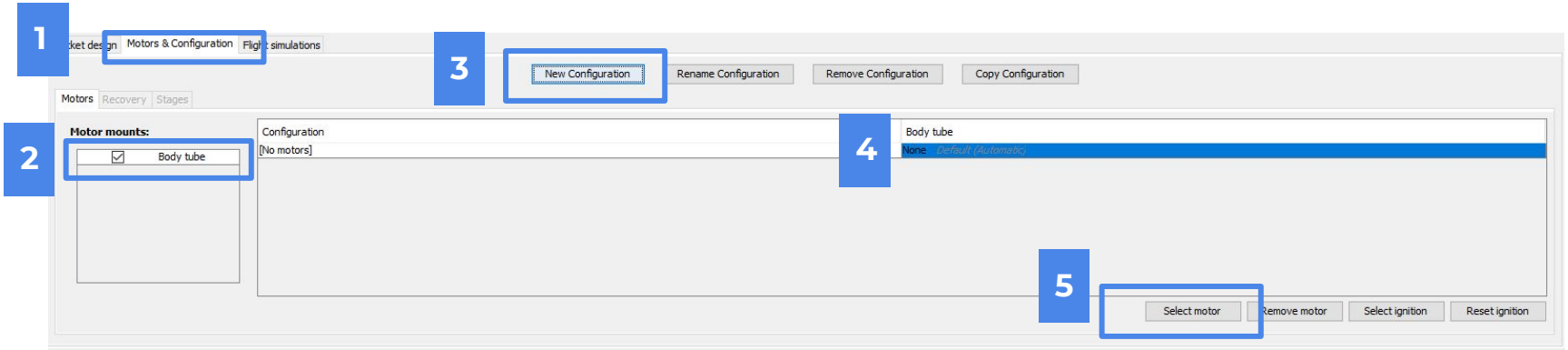


Motor Configuration

Select the “Body tube”, then click on the “**Motors & Configuration**” tab in the top toolbar

Select “Body tube” under “Motor mounts” and click “New Configuration” at the top.

Now click “Select motor”

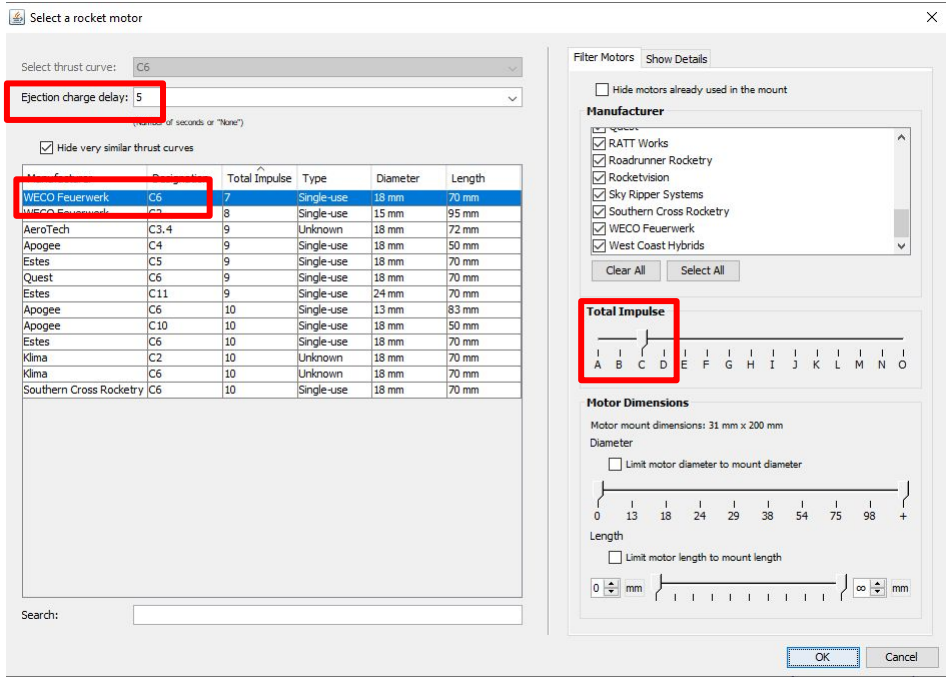


Motor Configuration

We will provide you with **C6-5 rocket motors**!

- "C" refers to the **thrust class** of the motor
- "6" refers to the **average thrust** in Newtons,
- "5" refers to the delay before the **ejection charge**

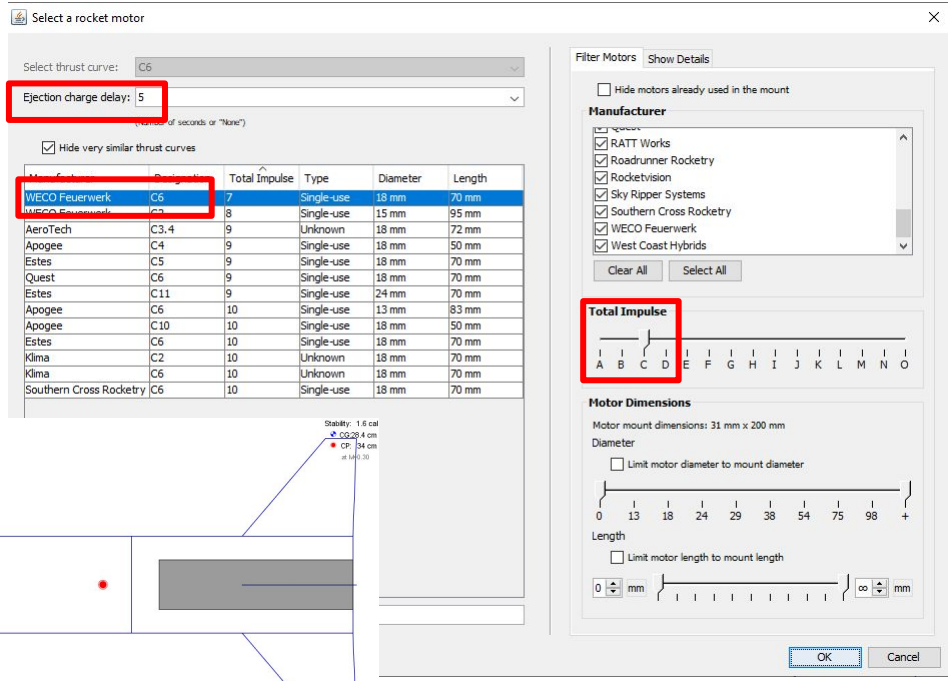
The engine thrusts, coasts for approx. 5 seconds and then a small charge in the opposite direction will fire through the inside of the body tube to pop the nose cone off and **release the parachute**.



Motor Configuration

To select a “C6-5” motor, drag the Total Impulse bar to “**C**”, select a “**C6**” motor and under Ejection charge delay select “**5**”

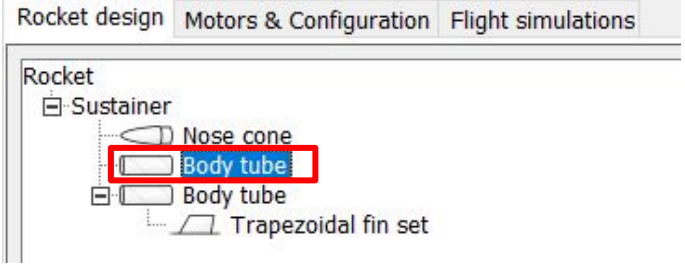
Click “OK”.

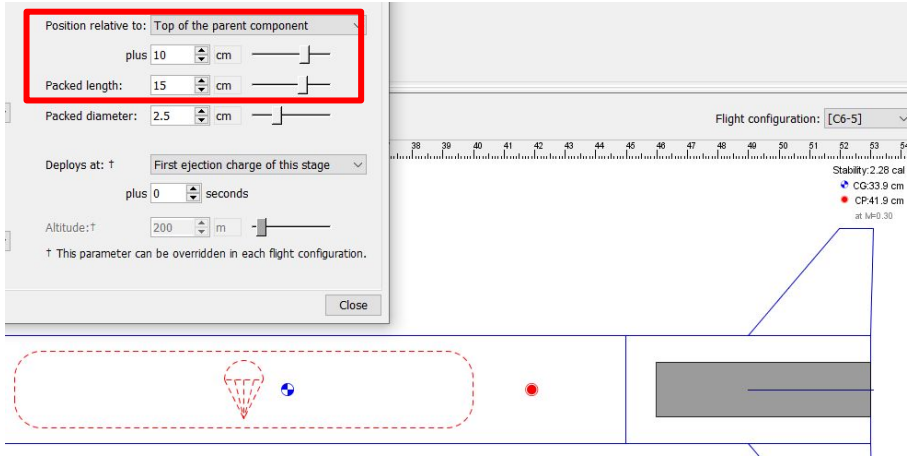


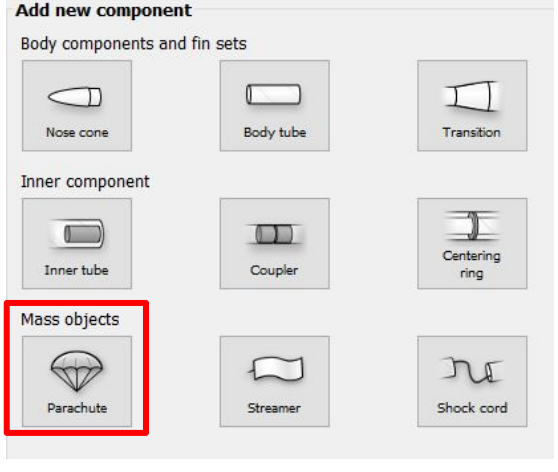
Parachute

Time to add a parachute to the **middle** body tube.

Put the parachute roughly in the middle of the tube and set length to **15cm**.



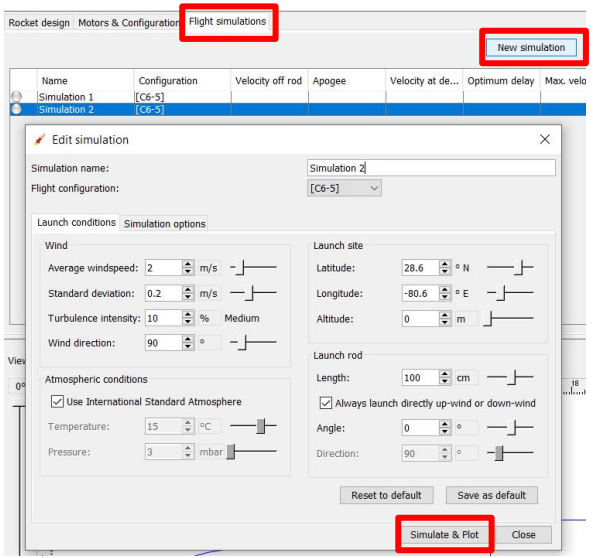


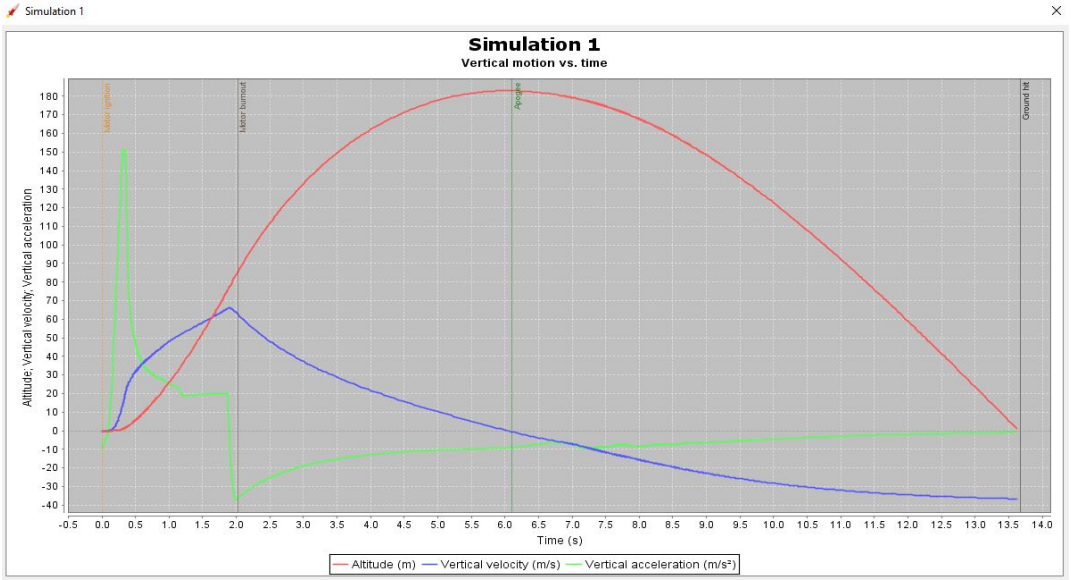


Flight Simulation

Now, let's run a simulation.

Click on "Flight simulations" in the top left toolbar and click "New simulation", "Simulate & Plot" then "Plot".





Tips

A rule of thumb is that the CP should be 1-2 calibres (body tube diameters) further aft (below) than the CG.

Design for stability of 1.3 to 2.5

Questions to think about...

What will the internal and external diameters of my body tube be?

What nose cone shape is the best?

How many fins should I have?

Will my parachute be deployed when the rocket reaches its apogee?

Next week - Advanced OpenRocket

See you next week! :)