

ARES Workshop - OpenRocket

Part 1

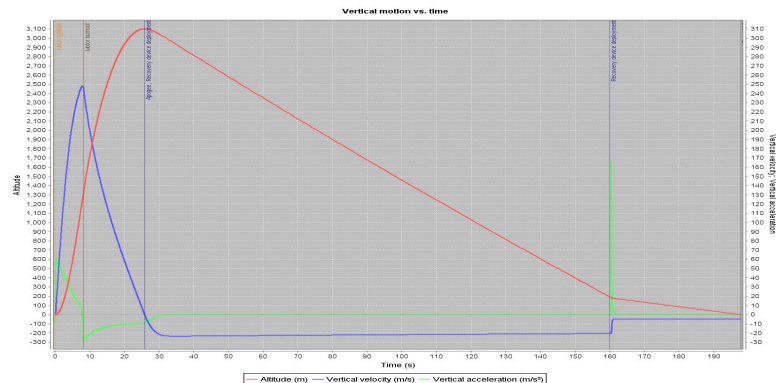
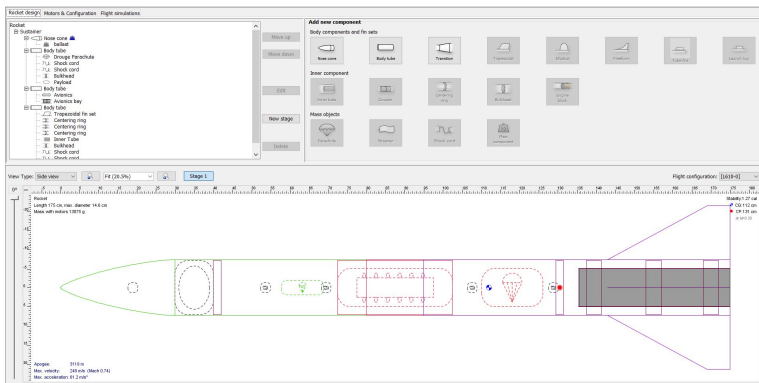
Cas Kent & Ann Phan



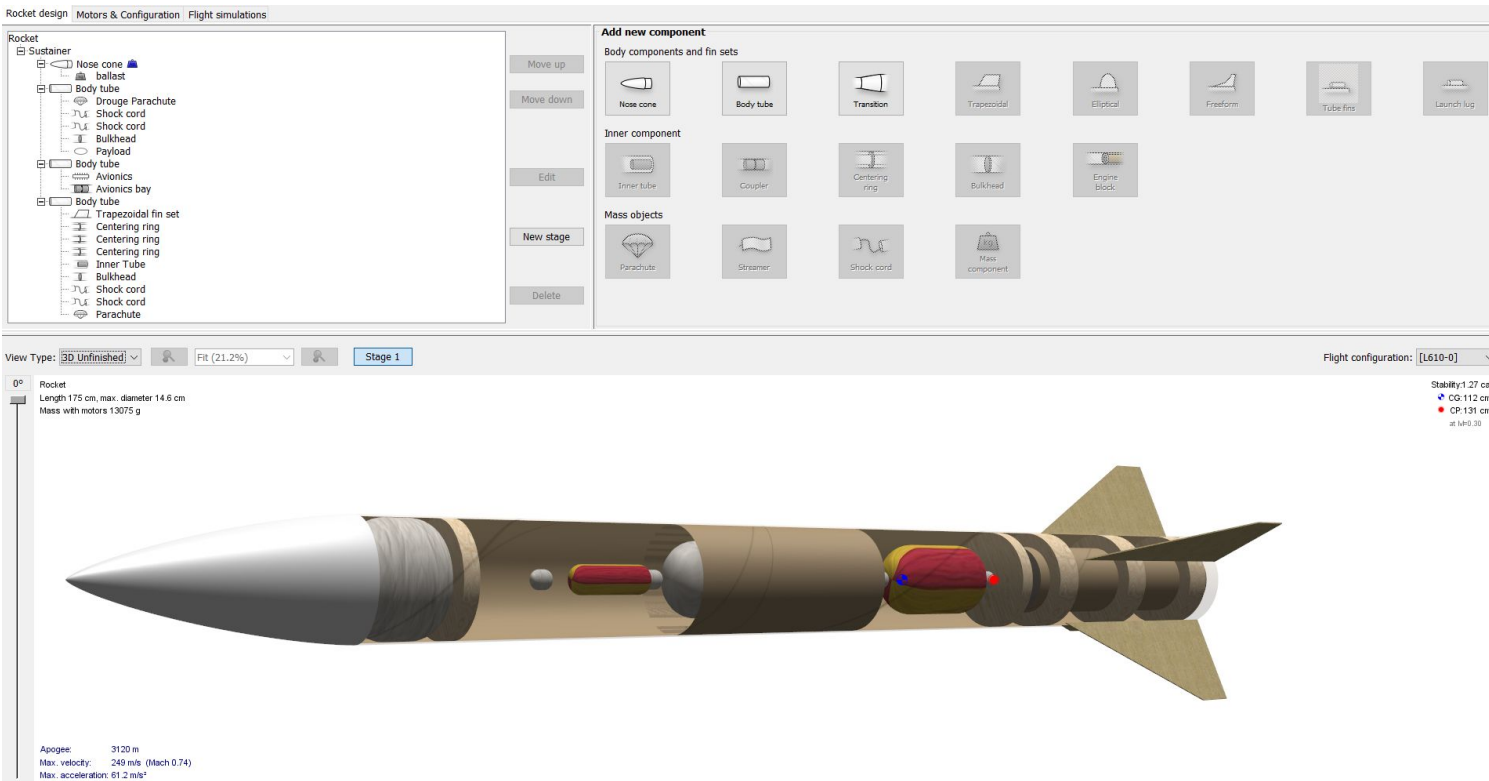
What is OpenRocket?



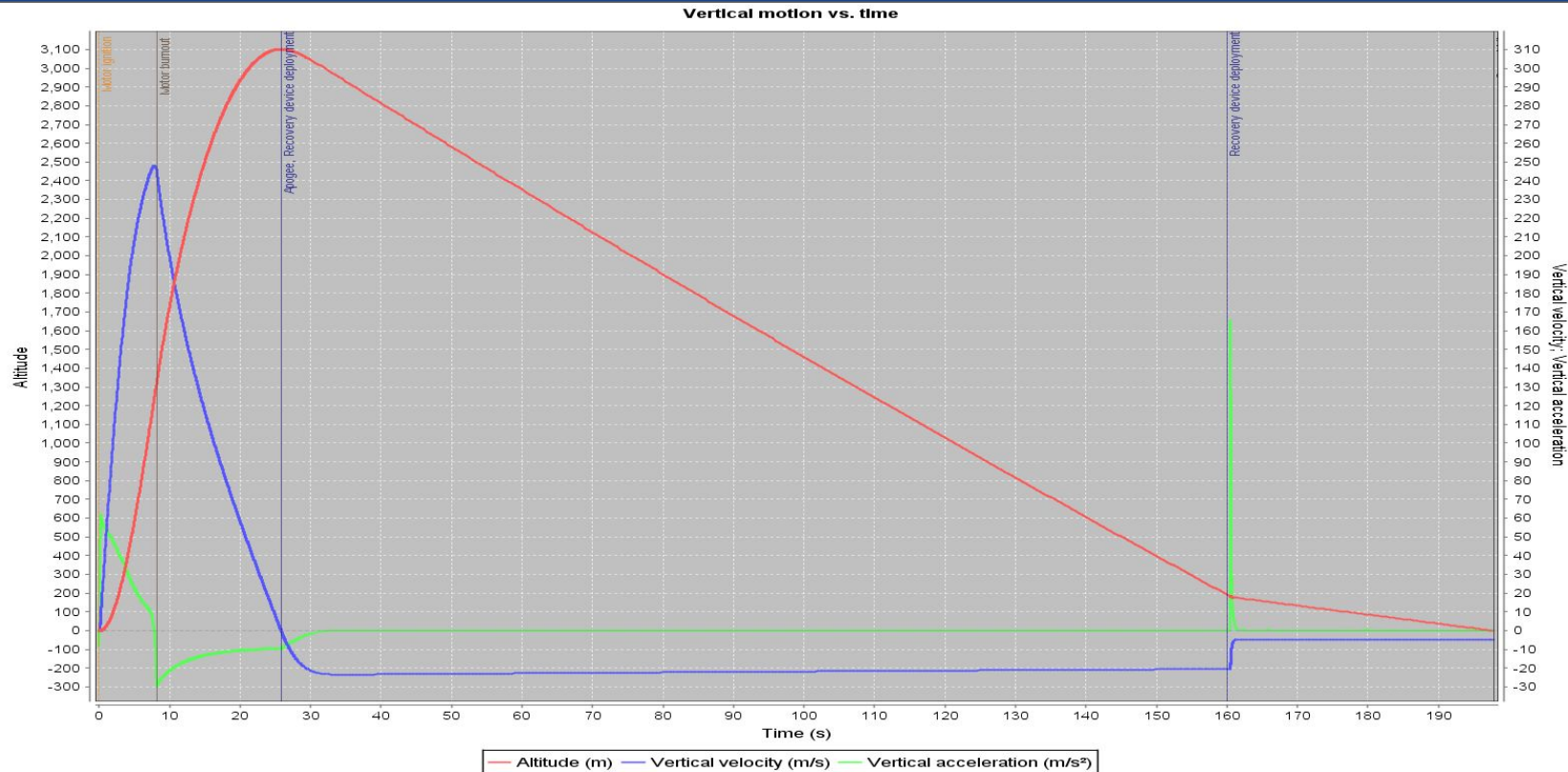
- Open-source rocket simulation software
- Optimise design and simulate various launch conditions
- Optimise various properties of the components and launch parameters



What is OpenRocket?



What is OpenRocket?



Downloading OpenRocket



Navigate to <http://openrocket.info>

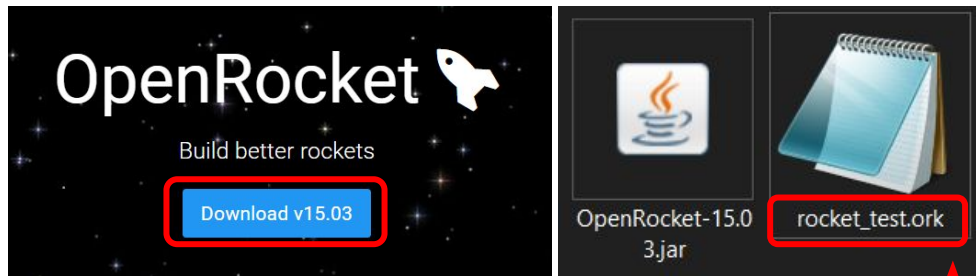
Open the .jar file to run the program.

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



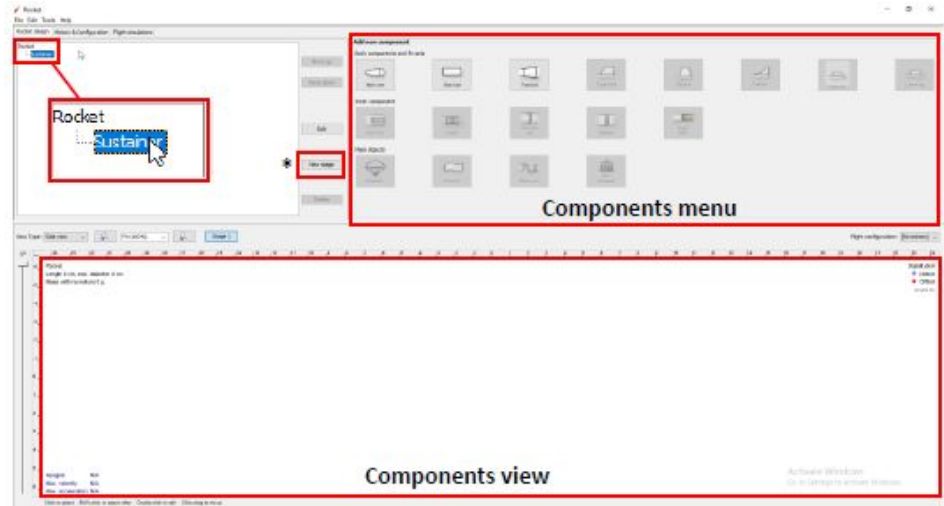
File>New

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.

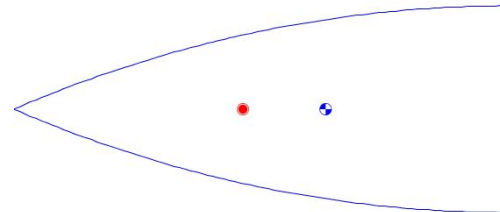
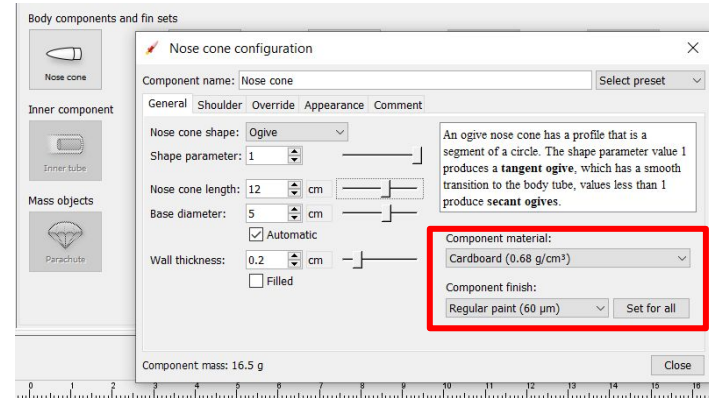
Subcomponents can be rearranged by dragging-and-dropping.

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

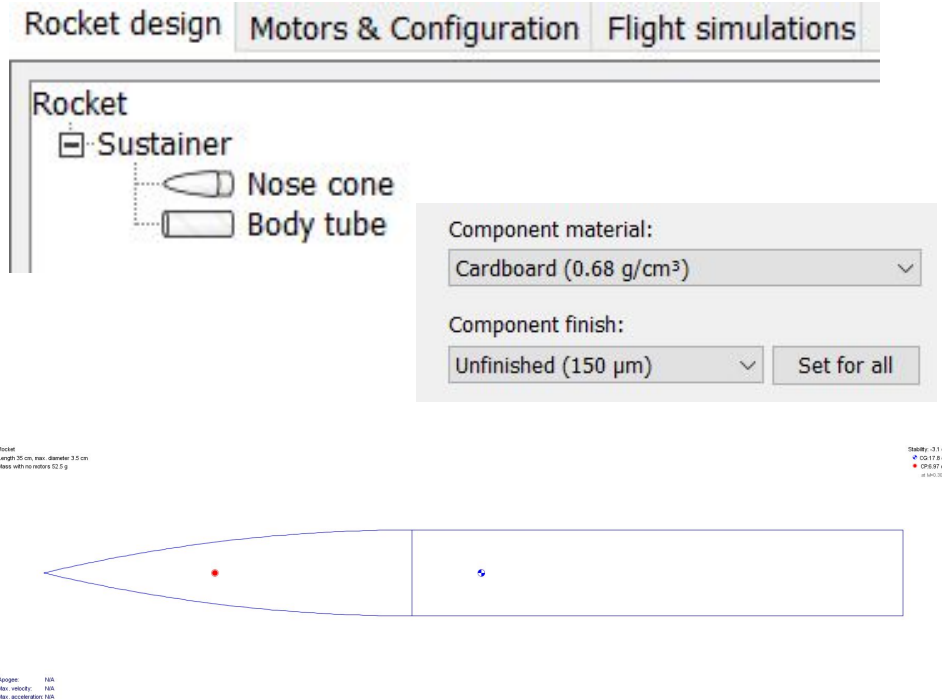


Drag and drop a body tube after the nose cone (middle body tube).

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.

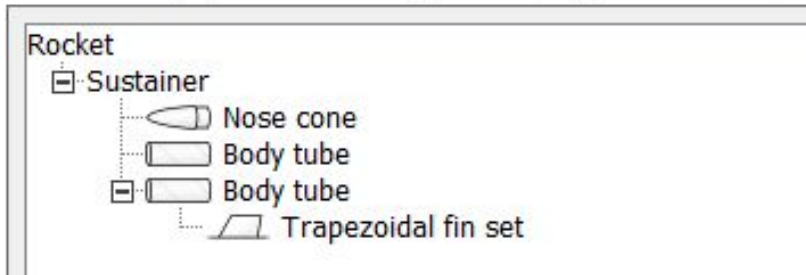
Set **rear body tube** and **fins** material to **Polycarbonate (Lexan)**. Set **finish** to unfinished (150 μ m).

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

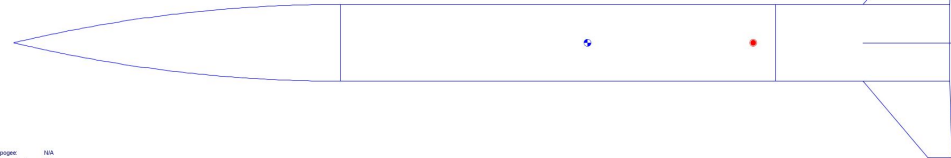
This rear component will be 3D printed and will house the motor.

Try adjusting different fin settings.

Rocket design Motors & Configuration Flight simulations



Rocket
Length 43.1 cm, max. diameter 3.5 cm
Mass with no motor 88.3 g



Apogee: N/A
Max. velocity: N/A

Gravity 2.17 m/s²
Altitude 0.0004 m
Time 0.0000 s

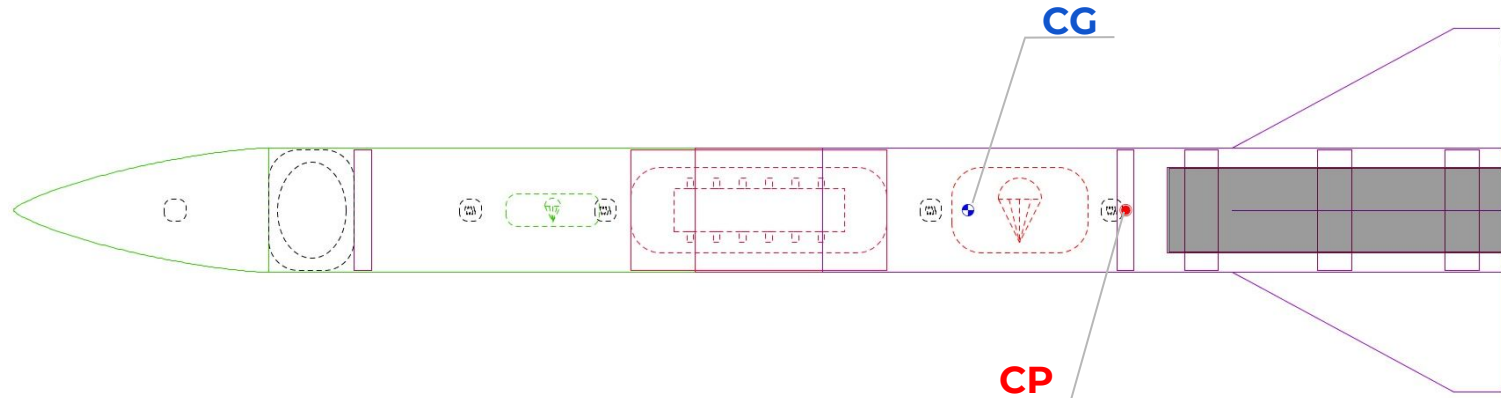
Revision - Flight Stability



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**.

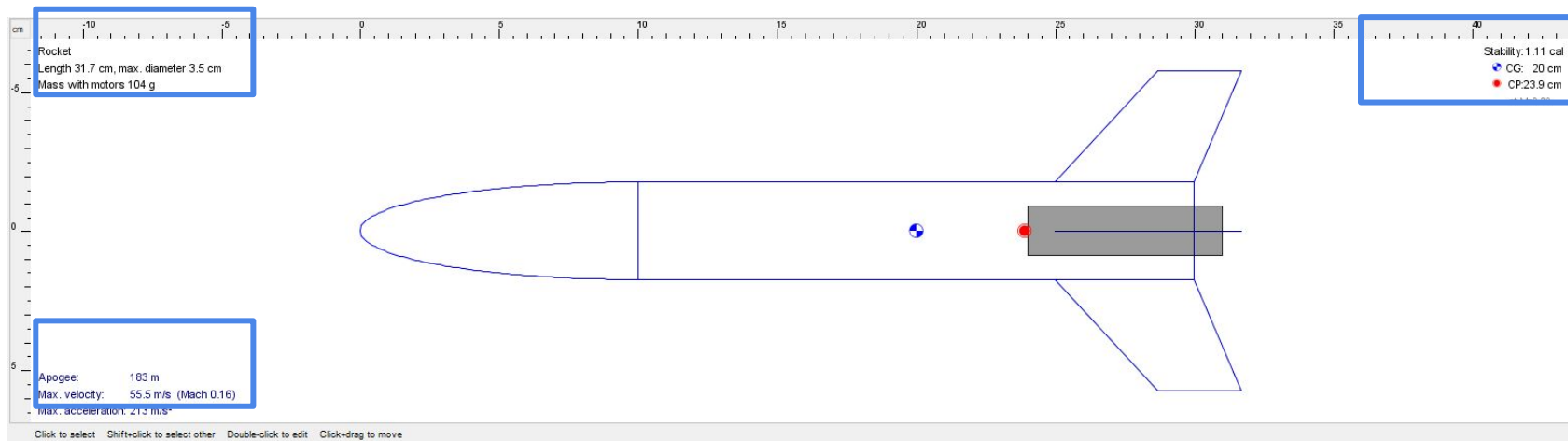


Components View



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**)



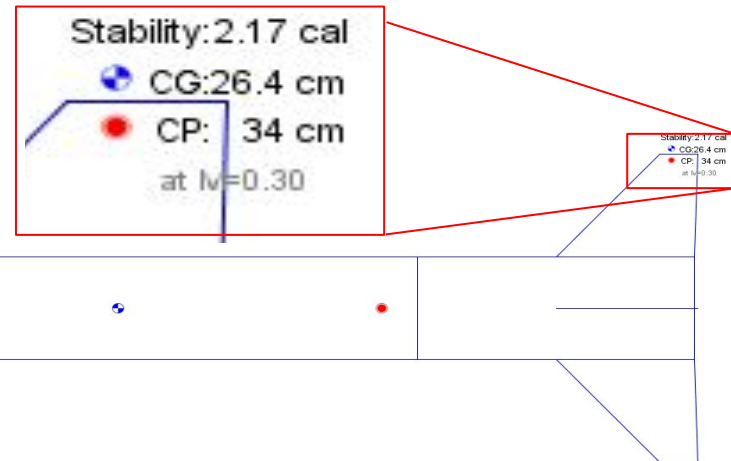
Components View



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

Rocket
Length 43.1 cm, max. diameter 3.5 cm
Mass with no motors 85.3 g



Apogee: N/A
Max. velocity: N/A

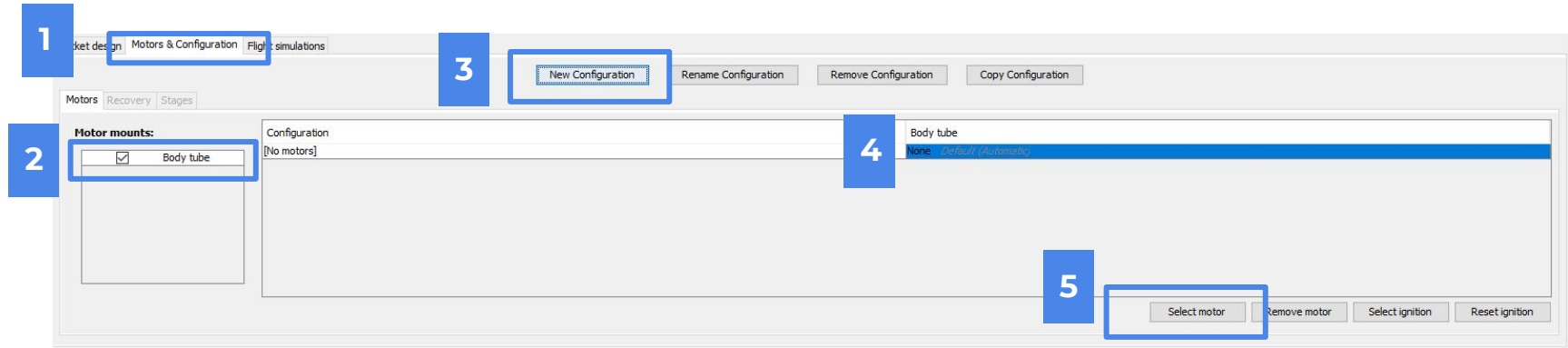
Motor Configuration



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**.

The screenshot shows a software window titled "Select a rocket motor". It has a search bar at the top with "C6" entered. Below the search bar, there's a dropdown for "Ejection charge delay" set to "5". A table lists various rocket motors with columns for Manufacturer, Curve, Total Impulse, Type, Diameter, and Length. The "WECO Feuerwerk C6" motor is highlighted. To the right of the table is a "Filter Motors" section with a list of manufacturers and checkboxes. Below that is a "Total Impulse" scale from A to O, with a marker at C. At the bottom right, there's a "Motor Dimensions" section with input fields for diameter and length, both set to 0 mm. The "OK" and "Cancel" buttons are at the bottom right.

Manufacturer	Curve	Total Impulse	Type	Diameter	Length
WECO Feuerwerk	C6	7	Single-use	18 mm	70 mm
AeroTech	C3.4	9	Unknown	18 mm	72 mm
Apogee	C4	9	Single-use	18 mm	50 mm
Estes	C5	9	Single-use	18 mm	70 mm
Quest	C6	9	Single-use	18 mm	70 mm
Estes	C11	9	Single-use	24 mm	70 mm
Apogee	C6	10	Single-use	13 mm	83 mm
Apogee	C10	10	Single-use	18 mm	50 mm
Estes	C6	10	Single-use	18 mm	70 mm
Klima	C2	10	Unknown	18 mm	70 mm
Klima	C6	10	Unknown	18 mm	70 mm
Southern Cross Rocketry	C6	10	Single-use	18 mm	70 mm

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”.

Rocket
Length 431 cm, max. diameter 3.5 cm
Mass with motors 102 g

Apogee: 143 m
Max. velocity: 50.1 m/s (Mach 0.15)
Max. acceleration: 105 m/s²

Select a rocket motor

Select thrust curve: C6

Ejection charge delay: 5

☒ Hide very similar thrust curves

Manufacturer	Thrust Curve	Total Impulse	Type	Diameter	Length
WECO Feuerwerk	C6	7	Single-use	18 mm	70 mm
WECO Feuerwerk	C6	8	Single-use	15 mm	95 mm
AeroTech	C3.4	9	Unknown	18 mm	72 mm
Apogee	C4	9	Single-use	18 mm	50 mm
Estes	C5	9	Single-use	18 mm	70 mm
Quest	C6	9	Single-use	18 mm	70 mm
Estes	C11	9	Single-use	24 mm	70 mm
Apogee	C6	10	Single-use	13 mm	83 mm
Apogee	C10	10	Single-use	18 mm	50 mm
Estes	C6	10	Single-use	18 mm	70 mm
Klma	C2	10	Unknown	18 mm	70 mm
Klma	C6	10	Unknown	18 mm	70 mm
Southern Cross Rocketry	C6	10	Single-use	18 mm	70 mm

☐ Hide motors already used in the mount

Manufacturer

- ☒ RATT Works
- ☒ Roadrunner Rocketry
- ☒ Rocketvision
- ☒ Sky Ripper Systems
- ☒ Southern Cross Rocketry
- ☒ WECO Feuerwerk
- ☒ West Coast Hybrids

Clear All Select All

Total Impulse

A B C D E F G H I J K L M N O

Motor Dimensions

Motor mount dimensions: 31 mm x 200 mm

Diameter

☐ Limit motor diameter to mount diameter

Length

☐ Limit motor length to mount length

OK Cancel

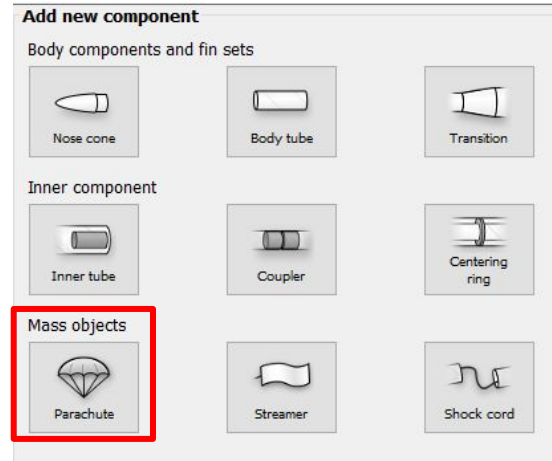
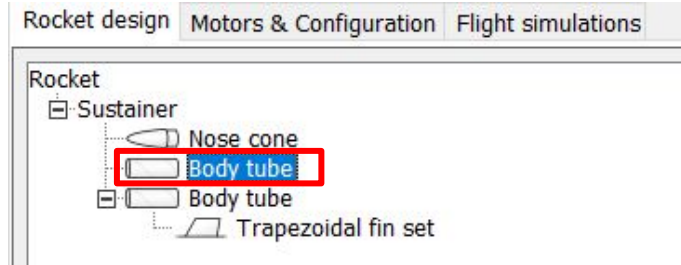
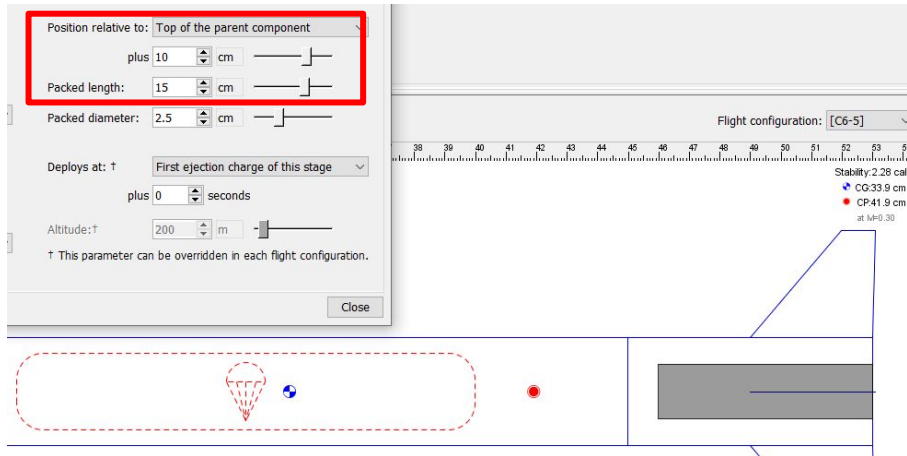


Parachute



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**.

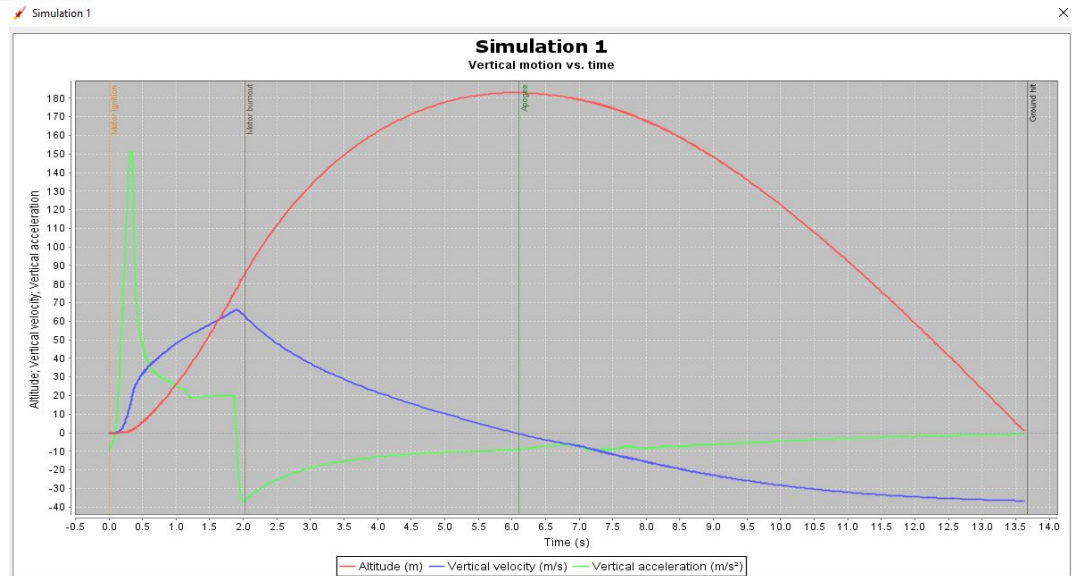
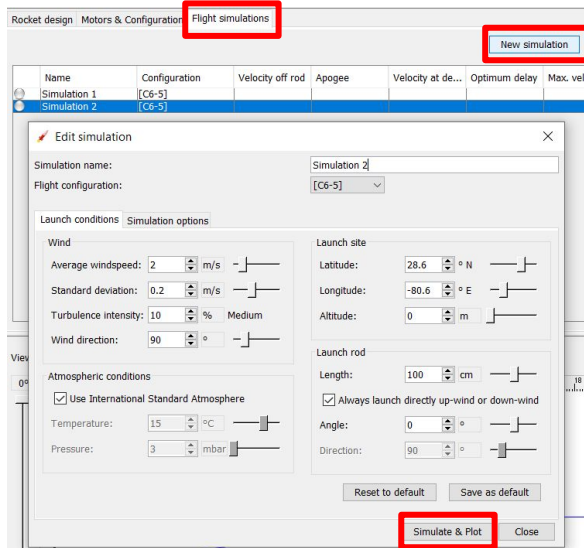


Flight Simulation



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! :)

