IMPROVING A SOUNDING ROCKET TECHNOLOGY DEMONSTRATOR FOR STUDENT EXPERIMENTAL ACTIVITIES

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Nimbus Project

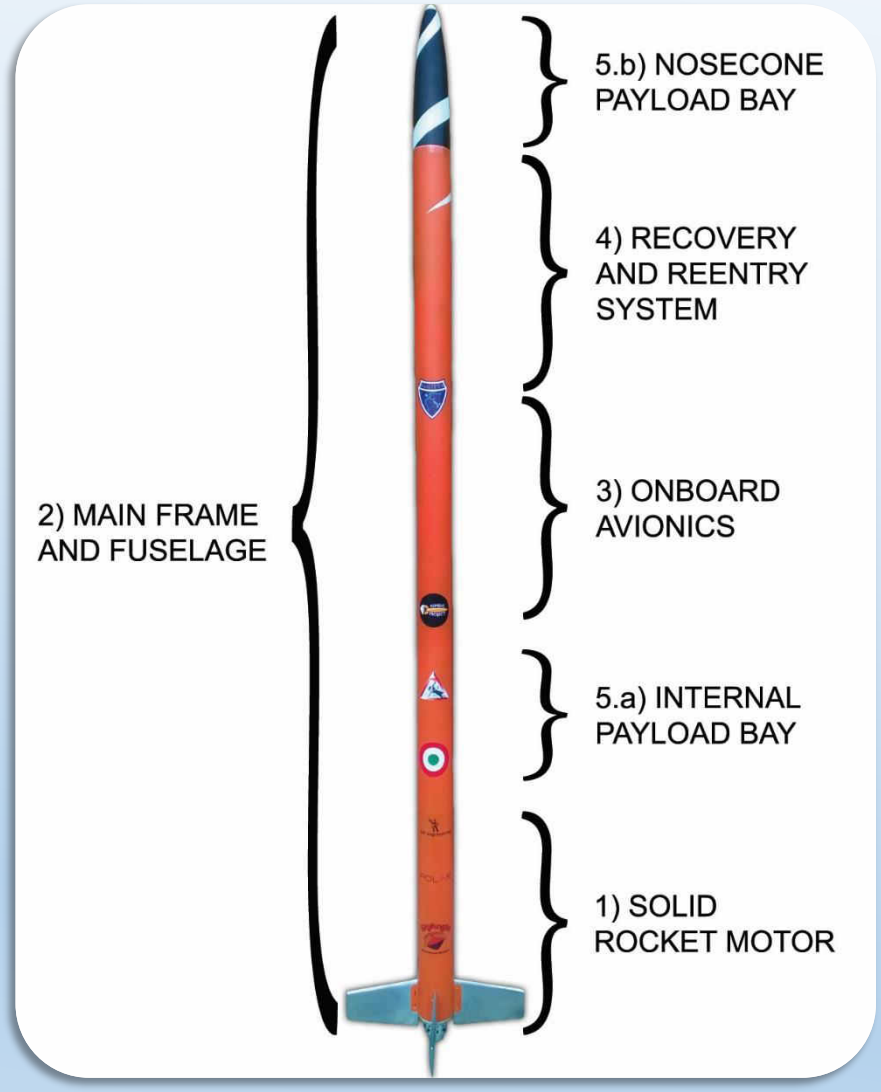
- Founded in 2012 by three students
- Now made of young engineers and students (all from University of Padova)
- Meetings are on every Saturday and during the week

The Sagitta system

Sagitta is designed, built and tested with:

- Modular main frame
- Composite materials
- COTS electronics
- Reusability approach

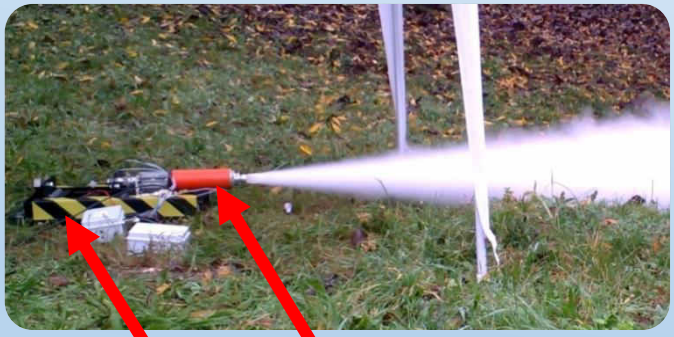
Dry mass: 3-3.5 kg
Propellant mass: 200-450 g
Total Impulse: 200-560 Ns
Max altitude: 1000 m

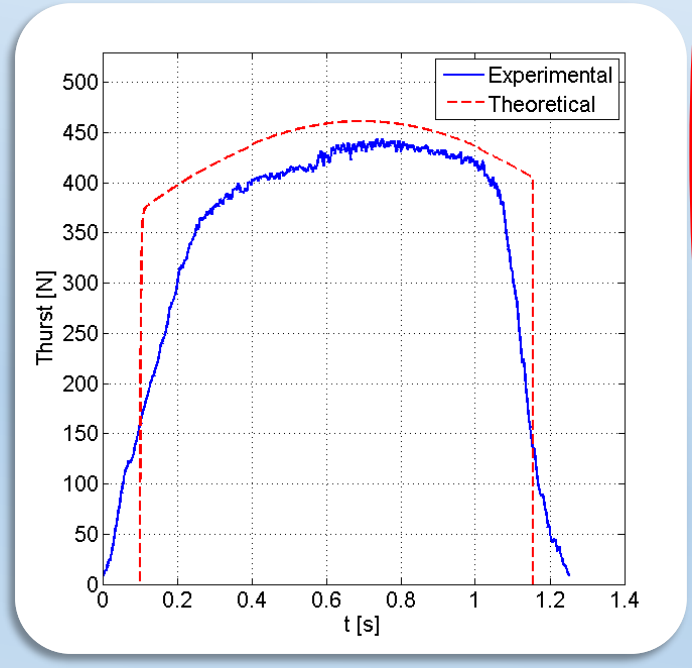


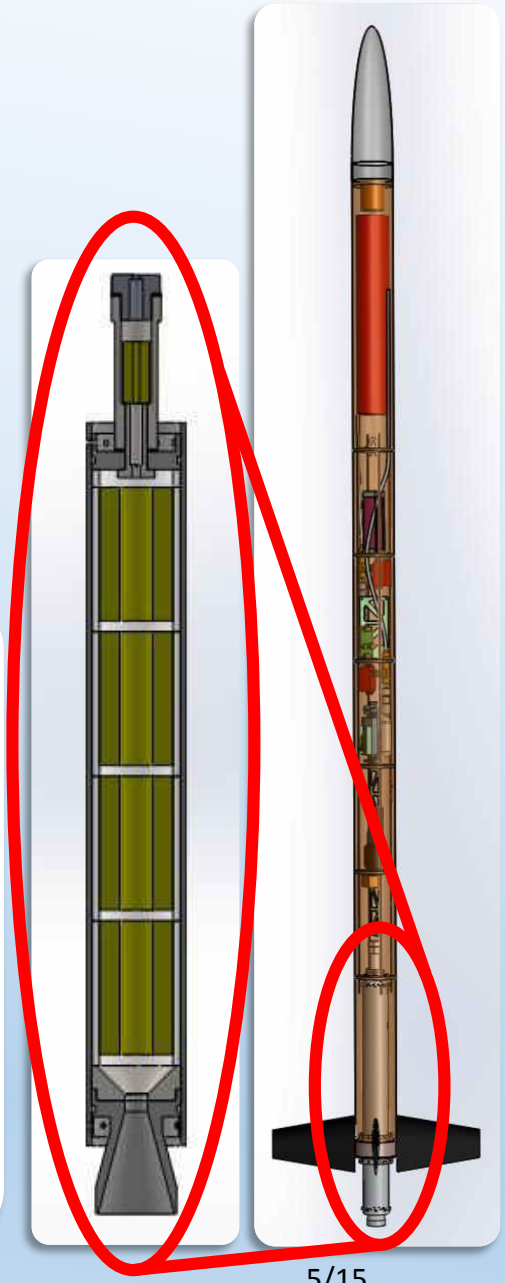
1) Propulsion system

Sagitta's solid rocket motor

- **Simple** and **cost-effective**
- **Reliable** and **repeatable**
- The propellant used is **stable**







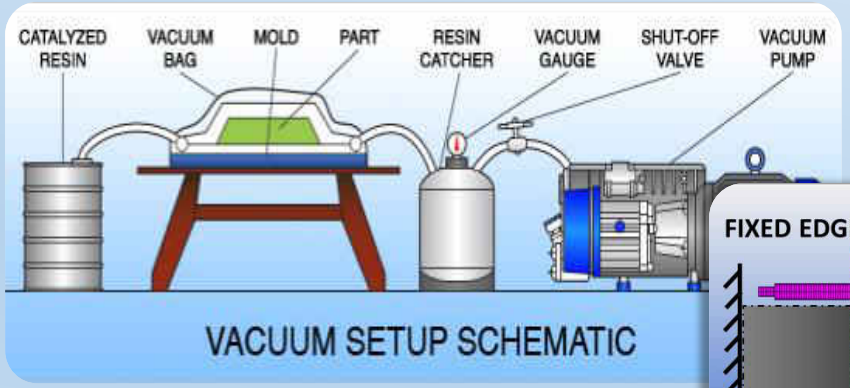
2) Fuselage and main frame

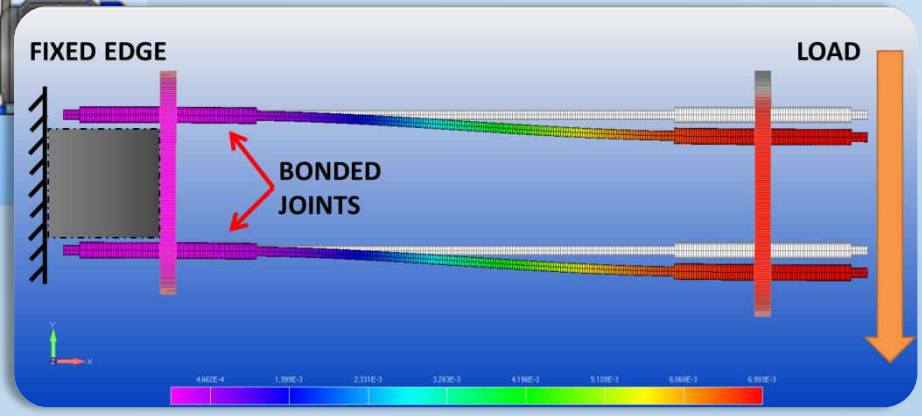
Fuselage

- Made of GFRP through a VA-RTM process
- Repeatable mechanical properties
- Cost-effective materials
- Good finishing

Modular main frame

- Composed of beams made of commercial CFRP and decks in GFRP
- Tested load: Compression 1200 N, Traction 1700 N
- FEA validation with bending load

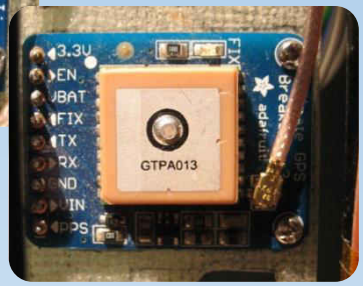


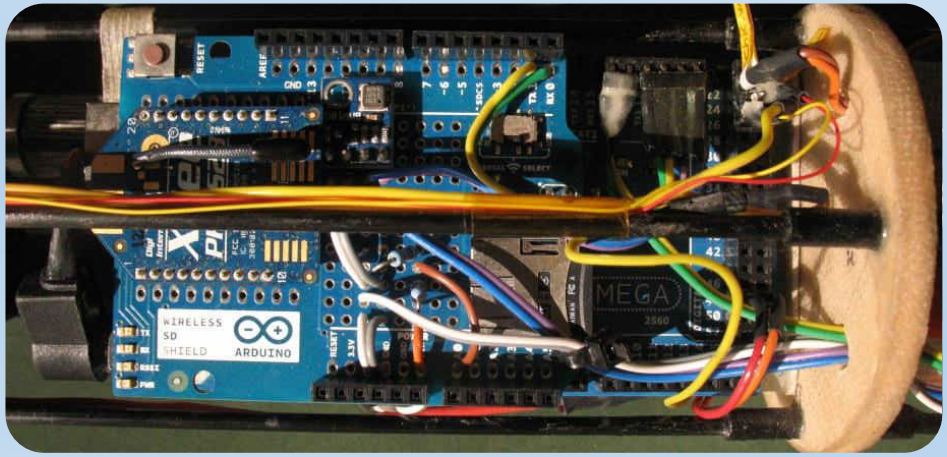


3) Electronics

Open-source, COTS platform (**Arduino**) has been chosen to control the flight segment

- Easy to interface
- Low-cost, mass, volume and power consumption
- Performaces tailored to the needs
- Ground segment is composed of a PC with a custom GUI and HGA





4) Re-entry system
&
5) Payloads

SkyAngle™
Rocket Recovery Redefined

The **re-entry system** is composed by:

- A standard round parachute
- A NON-pyrotechnic system for parachute ejection

The **payloads** are:

- An atmospheric measurement unit with temperature, pressure and humidity sensors in the nose cone
- IMU in the internal bay

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System improvements

ALREADY DONE

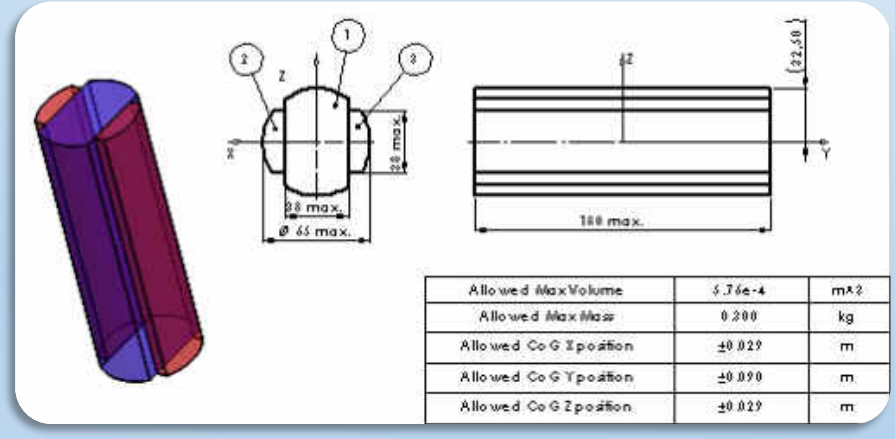
- **Software**: safer, faster
- **Compacted electronics**: less volume and mass
- **Fuselage**: 14% mass saved

IN DEVELOPMENT

- **Motor ignition system**: saving 7% in mass and 3% in volume
- **Payload bay**: third party payload

More free volume

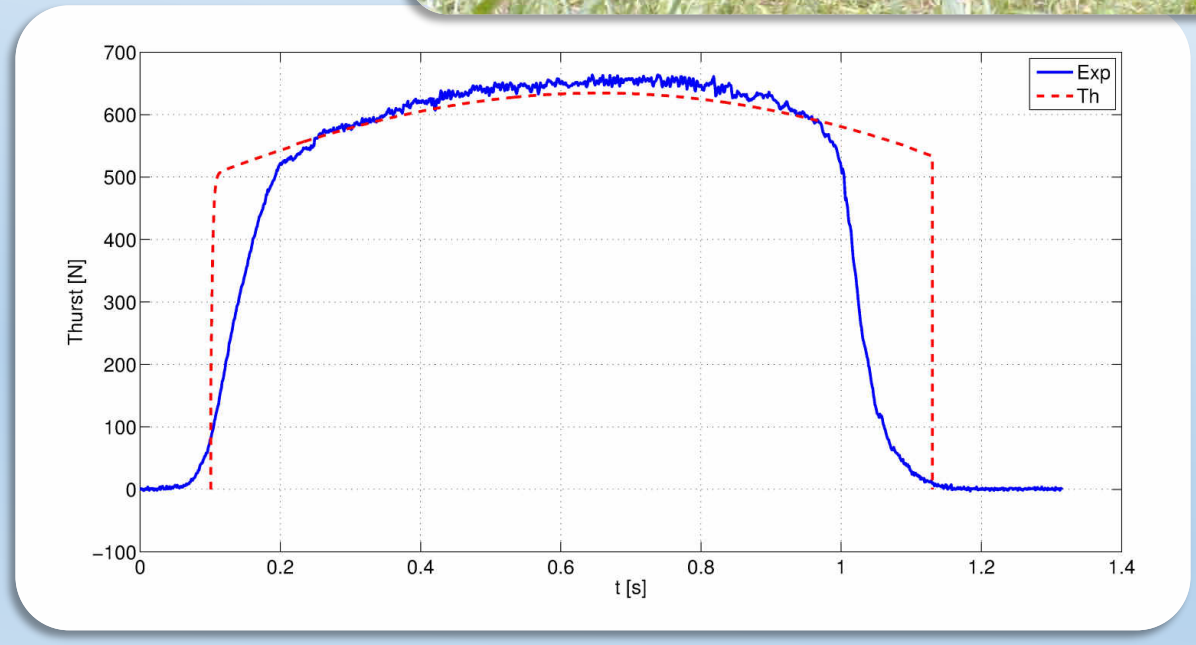
Payload bay for students' experiments



Allowed Max Volume	5.76e-4	m^3
Allowed Max Mass	0.200	kg
Allowed CoG X position	±0.029	m
Allowed CoG Y position	±0.090	m
Allowed CoG Z position	±0.029	m

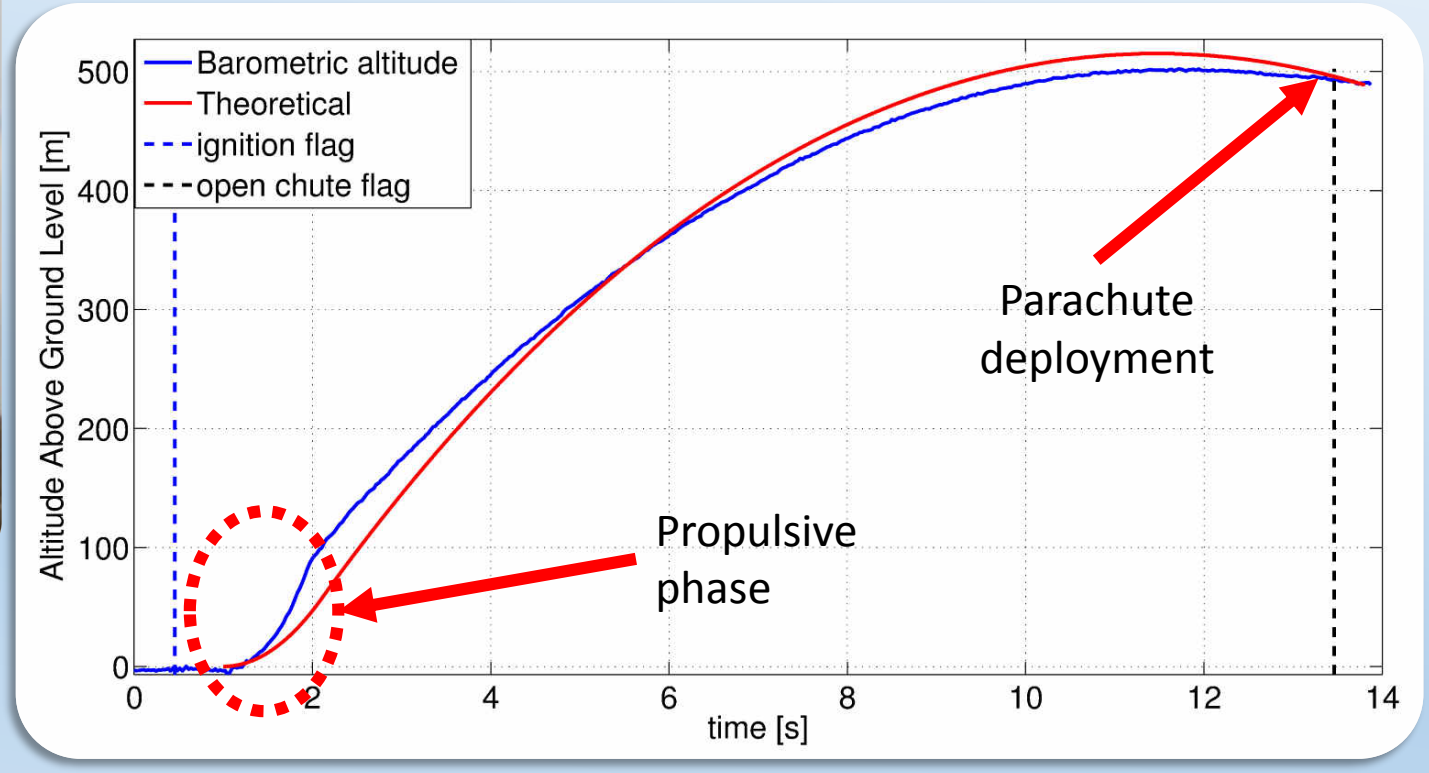
High power motor configuration

- Max thrust: 650 N
- Propellant mass: 450 g
- Total Impulse: 560 Ns



Second flight

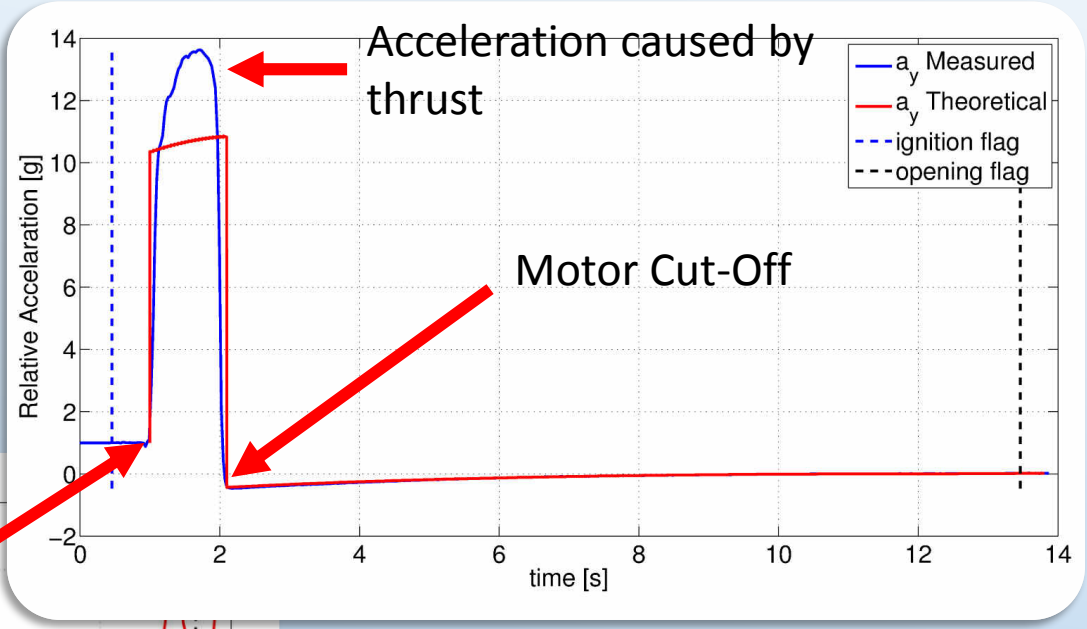
- Max altitude: 504 m
- Mass at launch: 3.8 kg
- Propellant mass: 360 g
- Payload mass: 200 g
- Total Impulse: 400 Ns

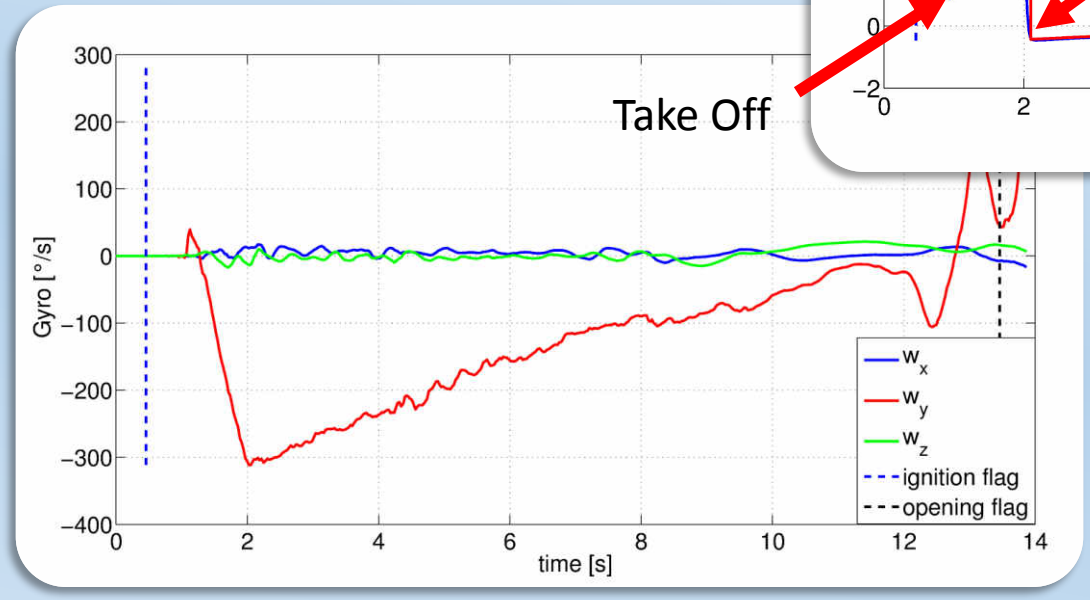


Payload results

Data from IMU housed in the internal bay

- Max acceleration: 13.5 g
- Min acceleration: -0.46 g
- Mean angular vel: 300°/s





Conclusions

- **Students**, taking part in the project, have improved their skills working on Sagitta.
- **Two graduation theses** have been produced, with the collaboration of some university professors.
- Sagitta can be used for carrying **students' payloads** or used as a platform for other **educational activities**.
- A technology demonstrator has been developed to show the concept of a **reusable, cost-effective sounding rocket**.
- Two **successful launches** proved the effectiveness of the technology demonstrator and showcased its performance.

QUESTIONS?

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