INTELLIGENT SOLAR PANEL FOR CUBESAT

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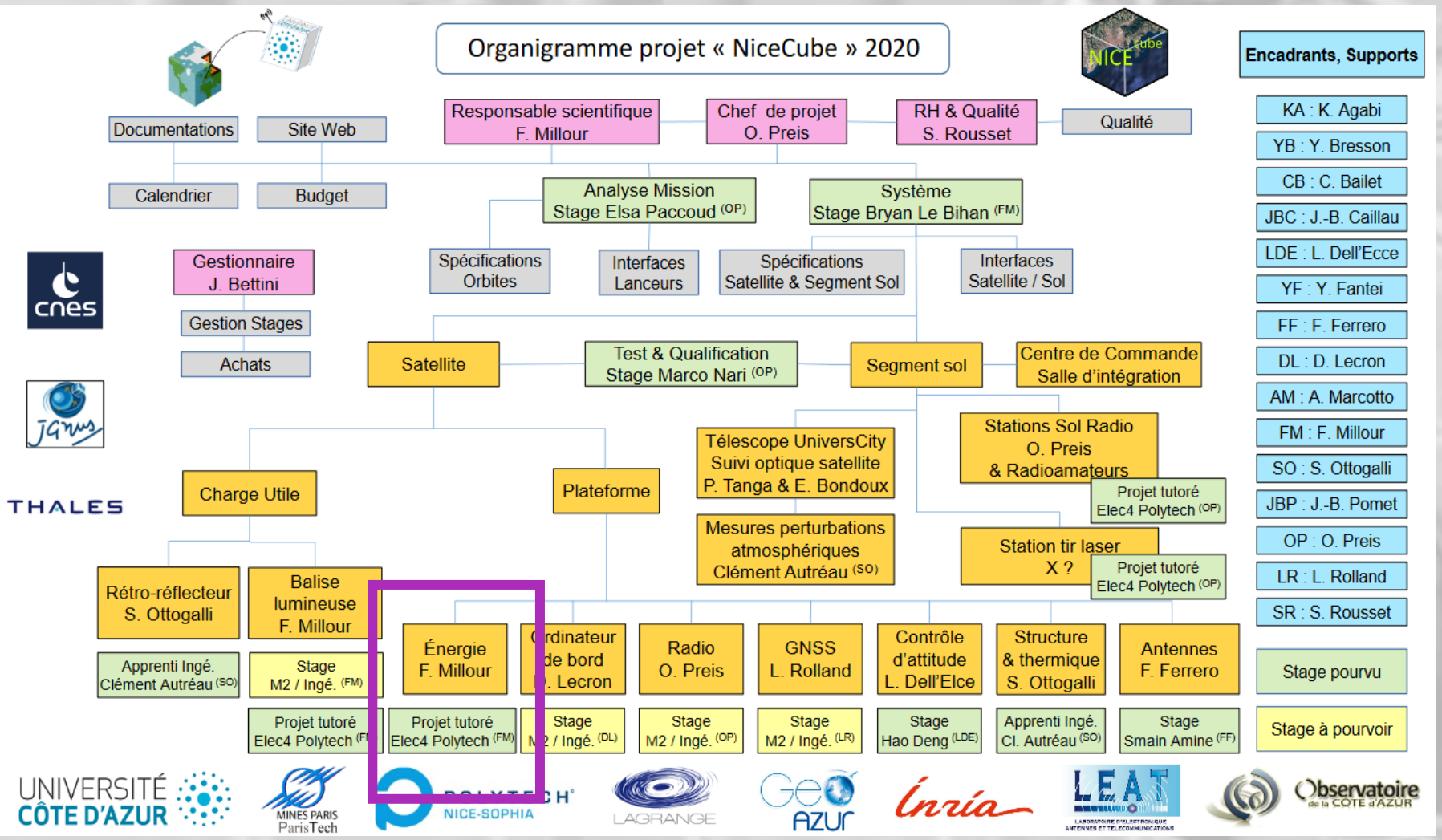
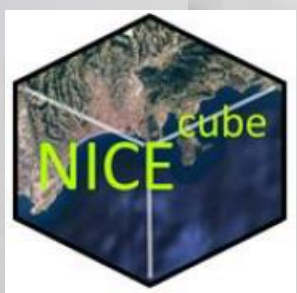
POLYTECH NICE-SOPHIA

SUMMARY

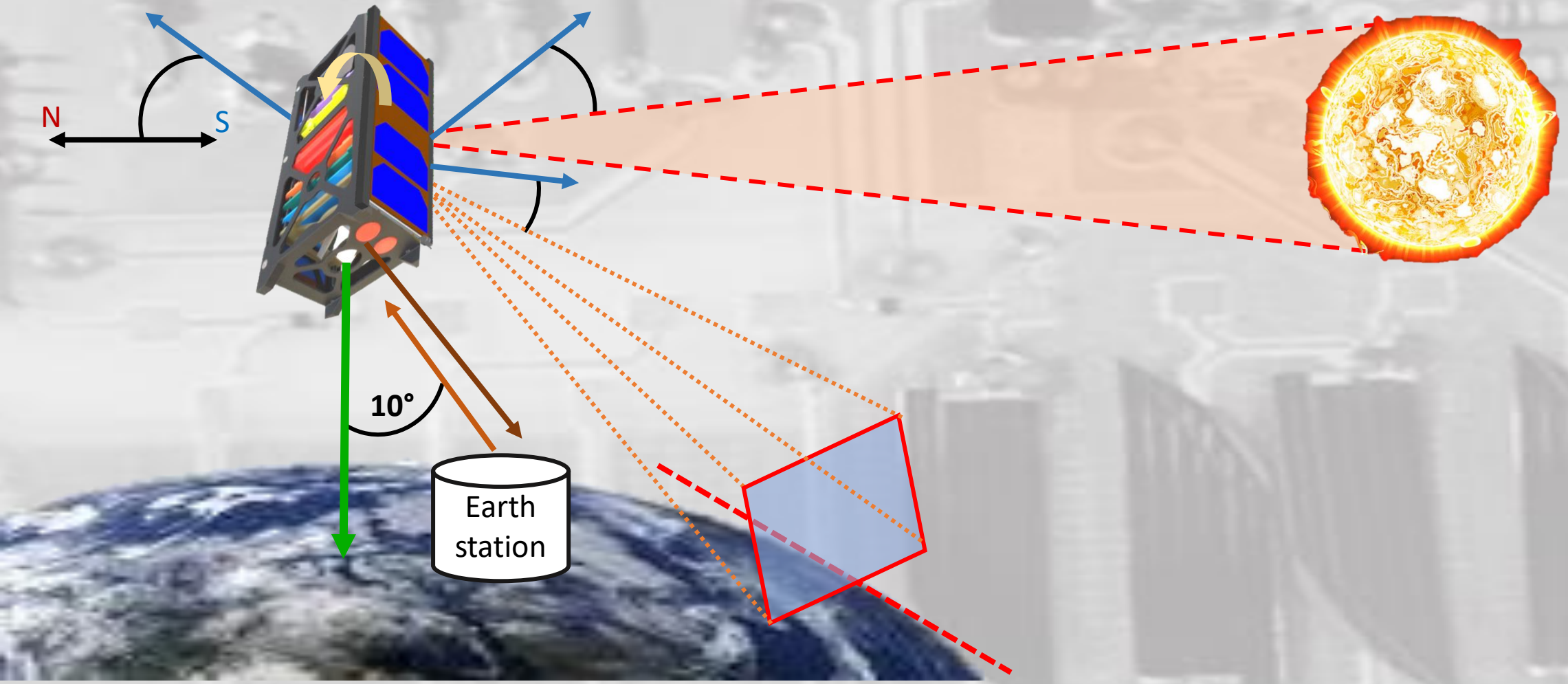
- Introduction
- Requirements
- Architecture
- Planning
- Development
- Setbacks
- Challenges
- Conclusion

INTRODUCTION





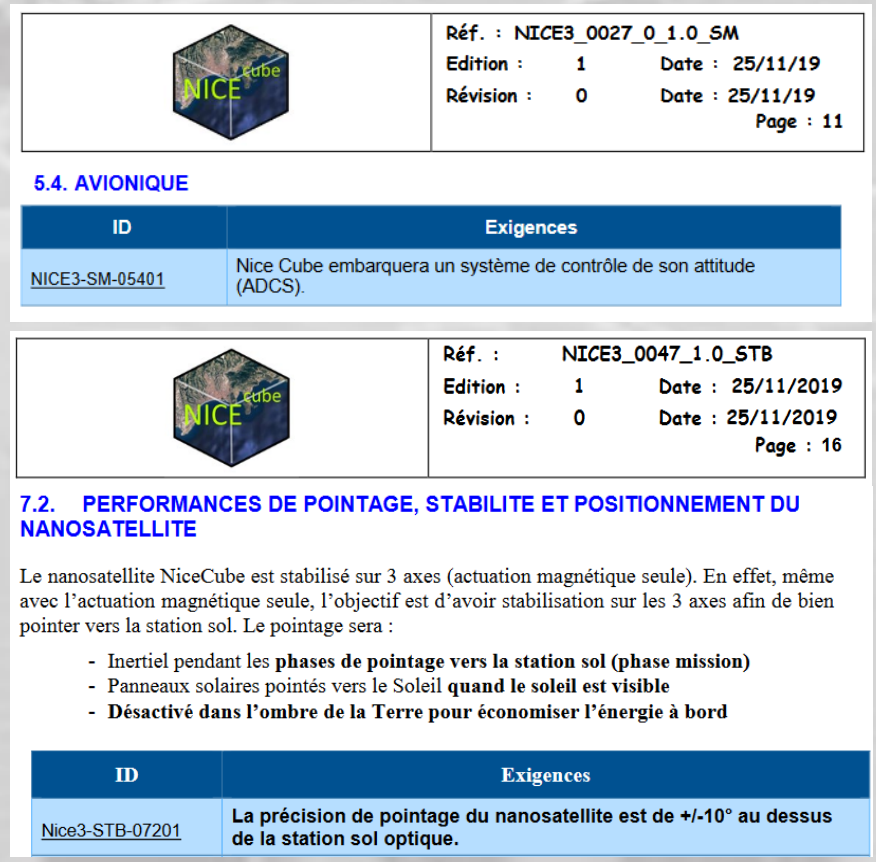
FULL SYSTEM OVERVIEW



REQUIREMENTS

- Design a solar panel that can power the satellite
- Design a power management system
- Perform measurements to determine the satellite's orientation
- Send the measurements to an on-board central unit

➢ Design a power efficient system



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Edition : 1 Date : 25/11/19
Révision : 0 Date : 25/11/19
Page : 11

5.4. AVIONIQUE

ID	Exigences
NICE3-SM-05401	Nice Cube embarquera un système de contrôle de son attitude (ADCS).

Réf. : NICE3_0047_1.0_STB
Edition : 1 Date : 25/11/2019
Révision : 0 Date : 25/11/2019
Page : 16

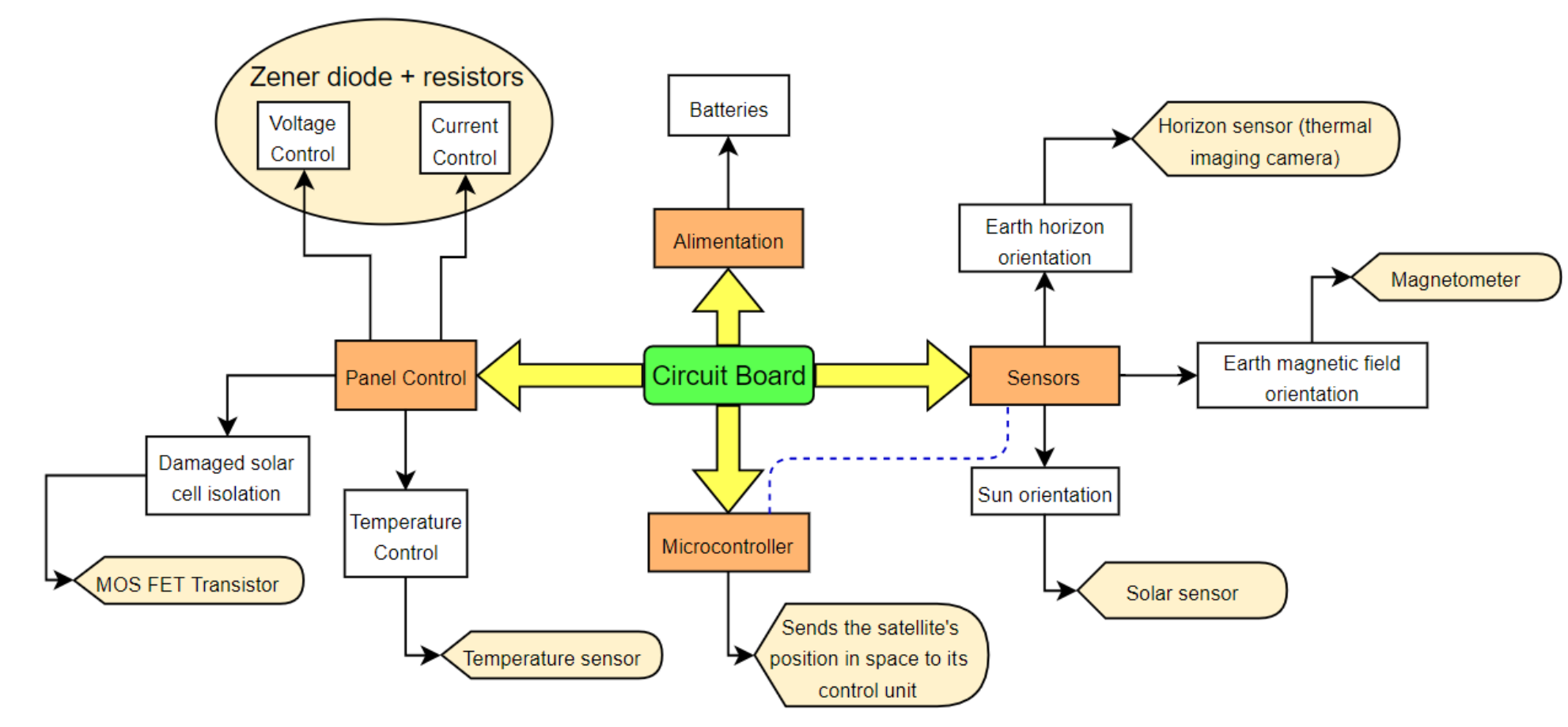
7.2. PERFORMANCES DE POINTAGE, STABILITE ET POSITIONNEMENT DU NANOSATELLITE

Le nanosatellite NiceCube est stabilisé sur 3 axes (actuation magnétique seule). En effet, même avec l'actuation magnétique seule, l'objectif est d'avoir stabilisation sur les 3 axes afin de bien pointer vers la station sol. Le pointage sera :

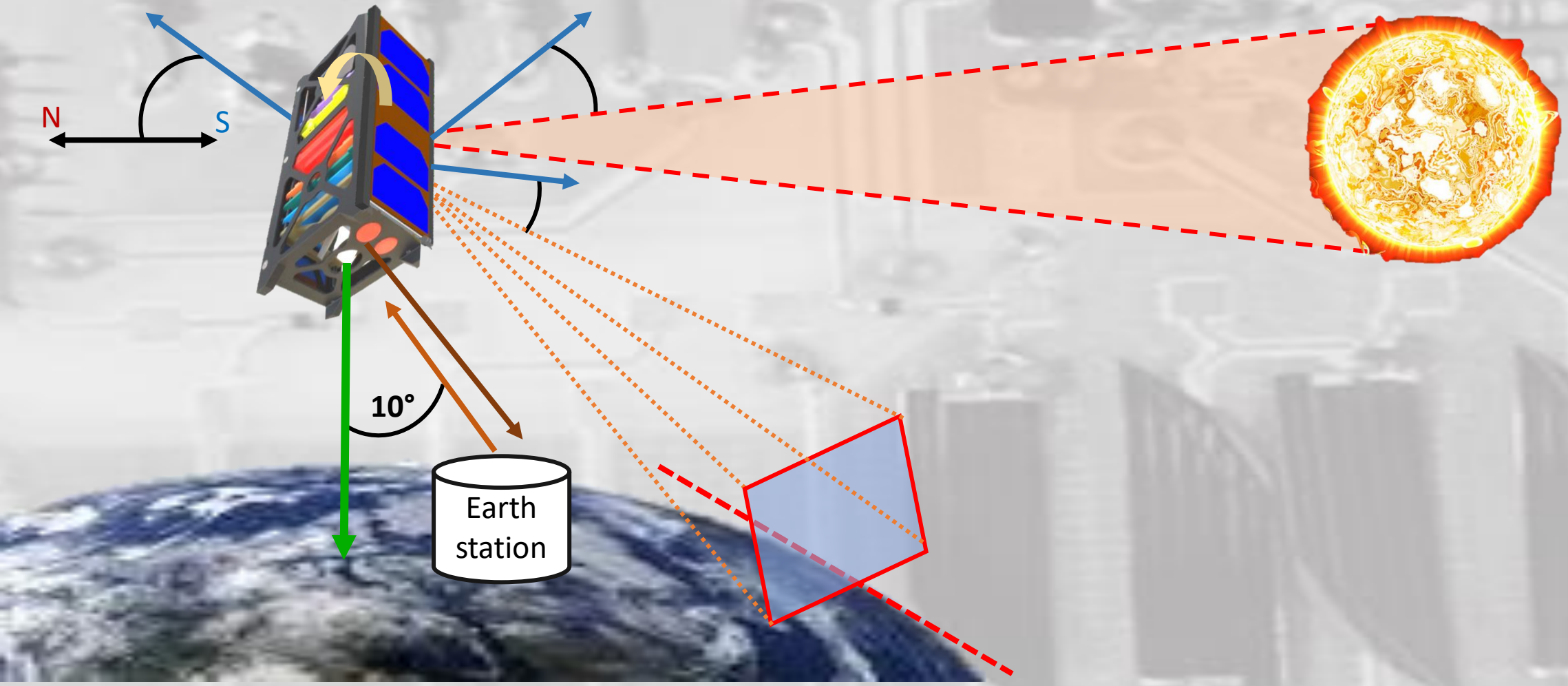
- Inertiel pendant les **phases de pointage vers la station sol (phase mission)**
- Panneaux solaires pointés vers le Soleil **quand le soleil est visible**
- **Désactivé dans l'ombre de la Terre pour économiser l'énergie à bord**

ID	Exigences
Nice3-STB-07201	**La précision de pointage du nanosatellite est de +/-10° au dessus de la station sol optique.**

ARCHITECTURE

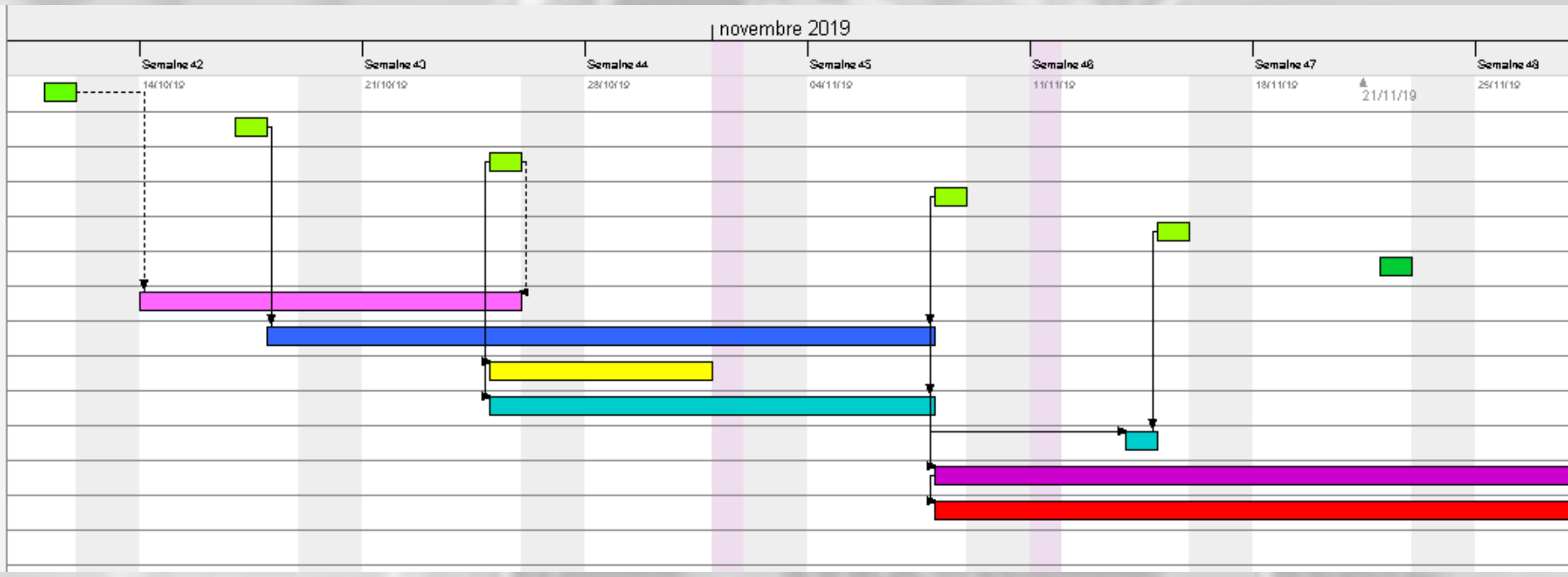


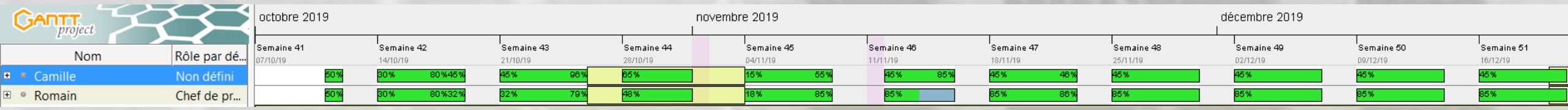
SYSTEM INTERACTION WITH ENVIRONMENT



PLANNING – FIRST SEMESTER

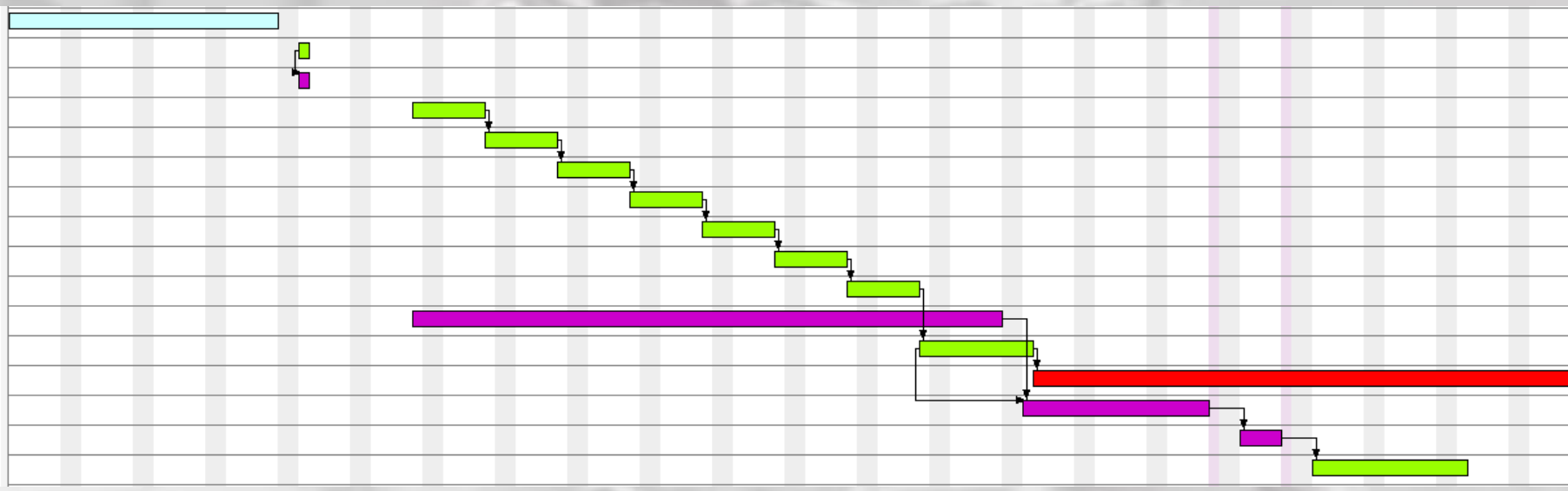
Nom	Date d...	Date de fin
Comprendre le sujet	11/1...	11/10/19
Définir les tâches	17/1...	17/10/19
Se répartir le travail	25/1...	25/10/19
Définir l'architecture	08/1...	08/11/19
Définir la BOM	15/1...	15/11/19
Sortie à l'observatoire	22/1...	22/11/19
Budget	14/1...	25/10/19
Schémas fonctionnel	18/1...	07/11/19
Circuit panneaux solaires	25/1...	31/10/19
Choix du microcontrolleur	25/1...	07/11/19
Choix des autres capteurs	14/1...	14/11/19
Cahier des charges	08/1...	20/12/19
Rapport S1	08/1...	20/12/19

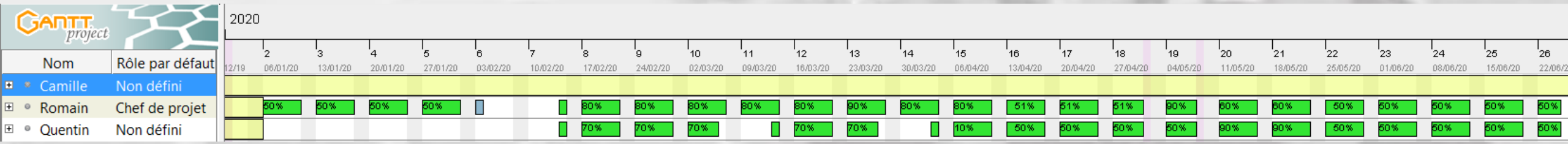




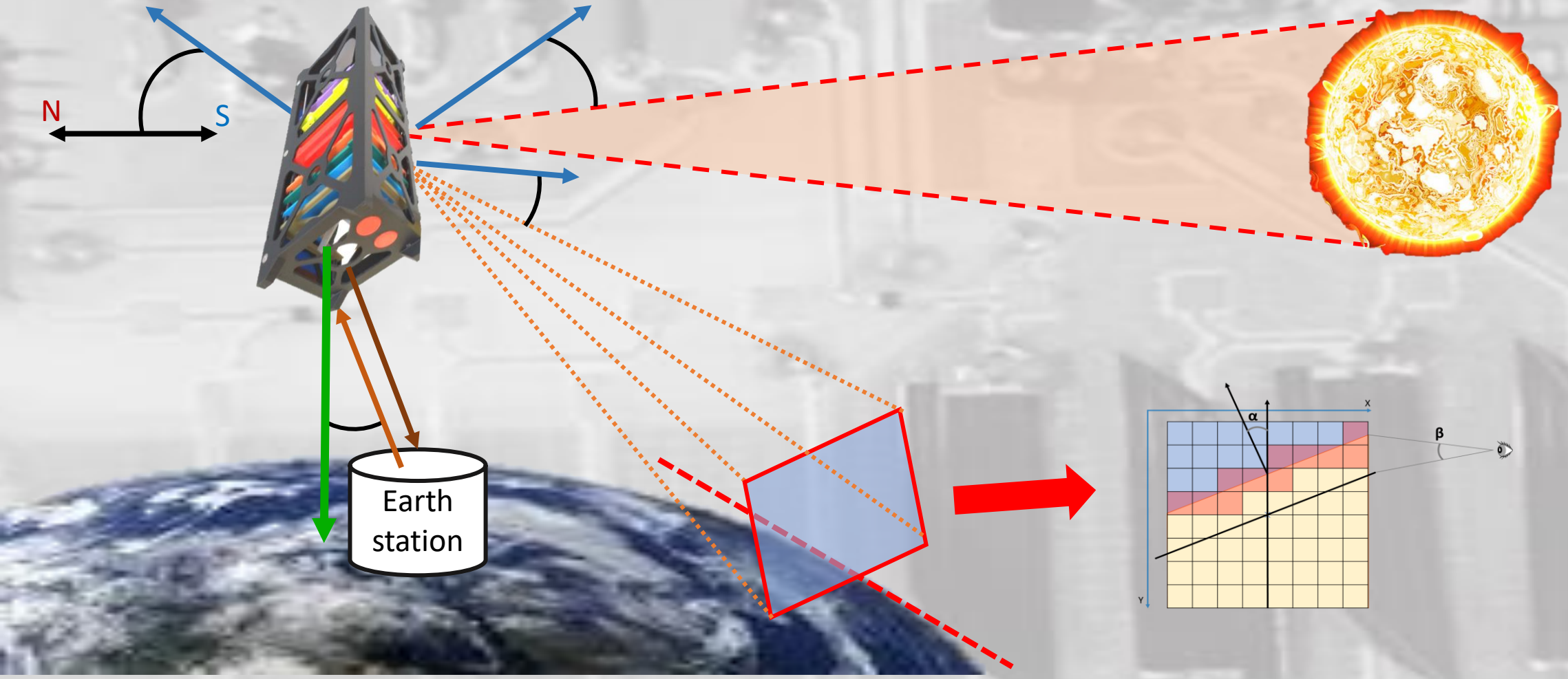
PLANNING – SECOND SEMESTER

PCB panneaux solaires	06/01/20	31/01/20
Réception du matériel	03/02/20	03/02/20
Inventaire	03/02/20	03/02/20
Test microcontrôlleur	14/02/20	20/02/20
test magnétomètre	21/02/20	27/02/20
Test sensor solaire (lampe halogène)	28/02/20	05/03/20
Test sensor horizon (à voir en fonction météo)	06/03/20	12/03/20
Test cellules solaires (lampe halogène)	13/03/20	19/03/20
Tests capteurs séance de marge	20/03/20	26/03/20
Assemblage + test fonctionnel	27/03/20	02/04/20
Routage (design de la carte)	14/02/20	10/04/20
Finir les tests	03/04/20	13/04/20
Rapport	14/04/20	24/06/20
Commande du PCB	13/04/20	30/04/20
Soudure CMS	04/05/20	07/05/20
Test prototype	11/05/20	25/05/20

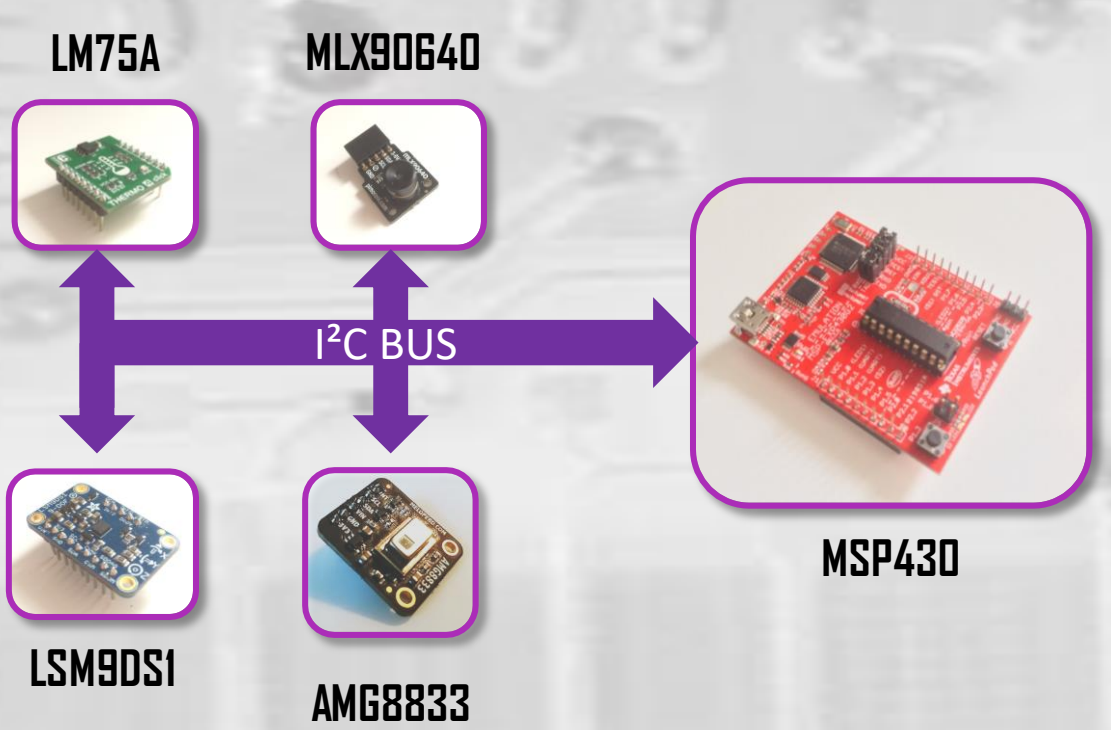




SENSORS SPECIFICATIONS



DEVELOPMENT – SENSOR NETWORK



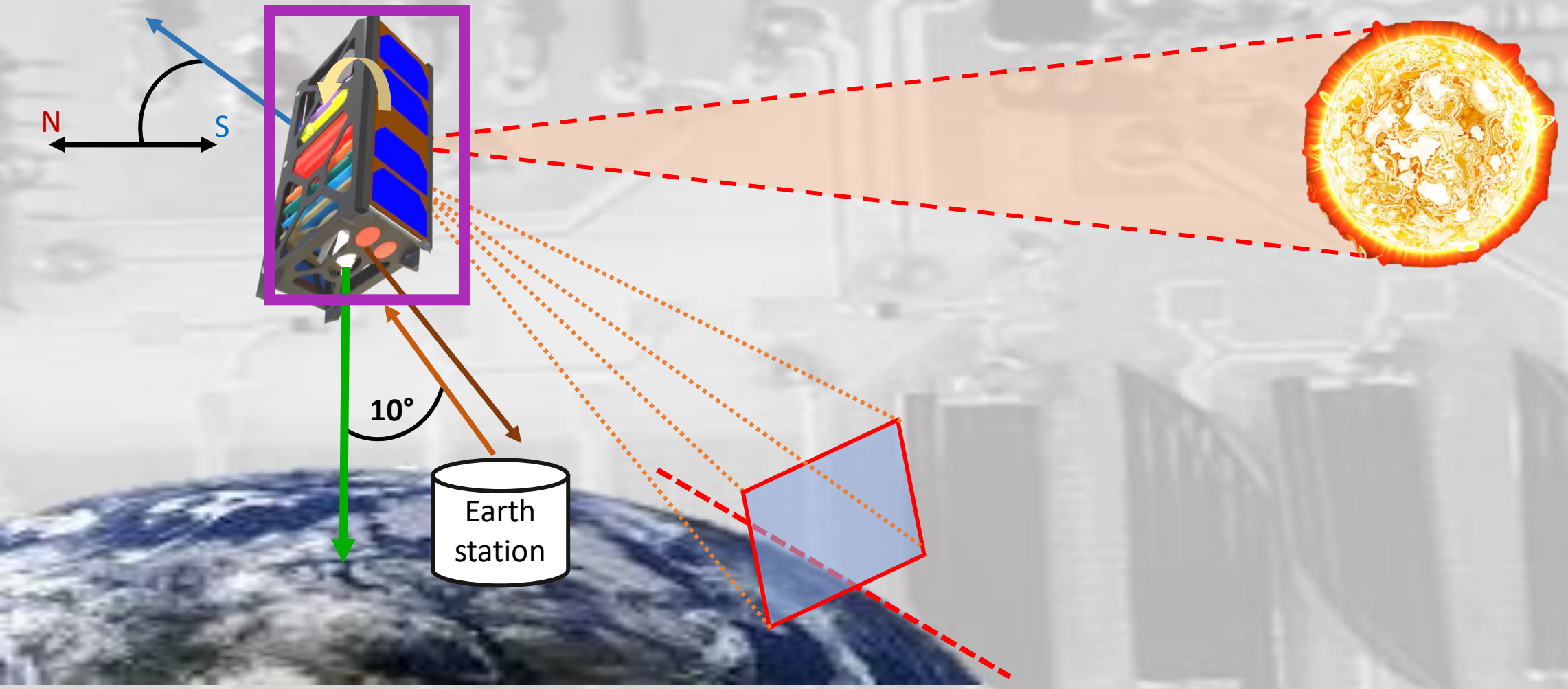
ENERGIA IDE with "Wire" library:

- High level, hides hardware detail
- Not very optimized

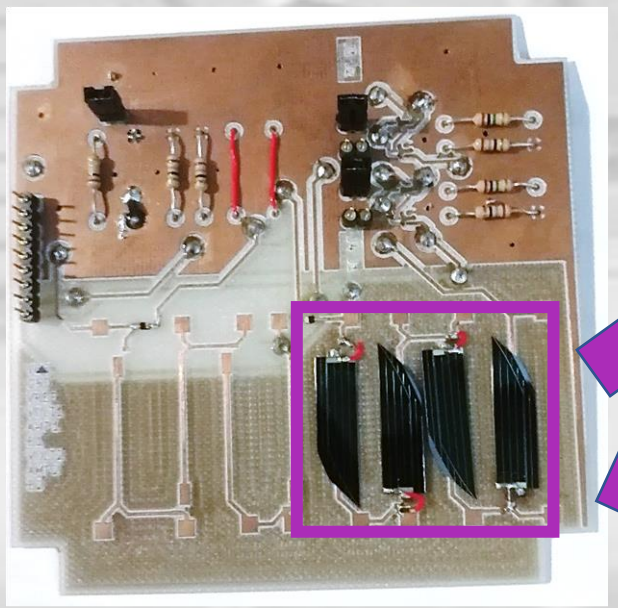
Code Composer Studio with firmware:

- Highly efficient, more control over hardware
- Few libraries, longer development time

DEVELOPMENT – SOLAR PANEL



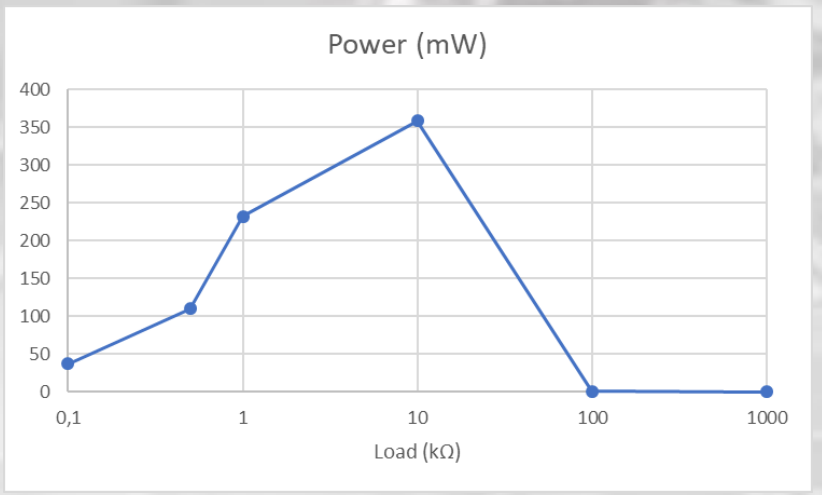
DEVELOPMENT – SOLAR PANEL

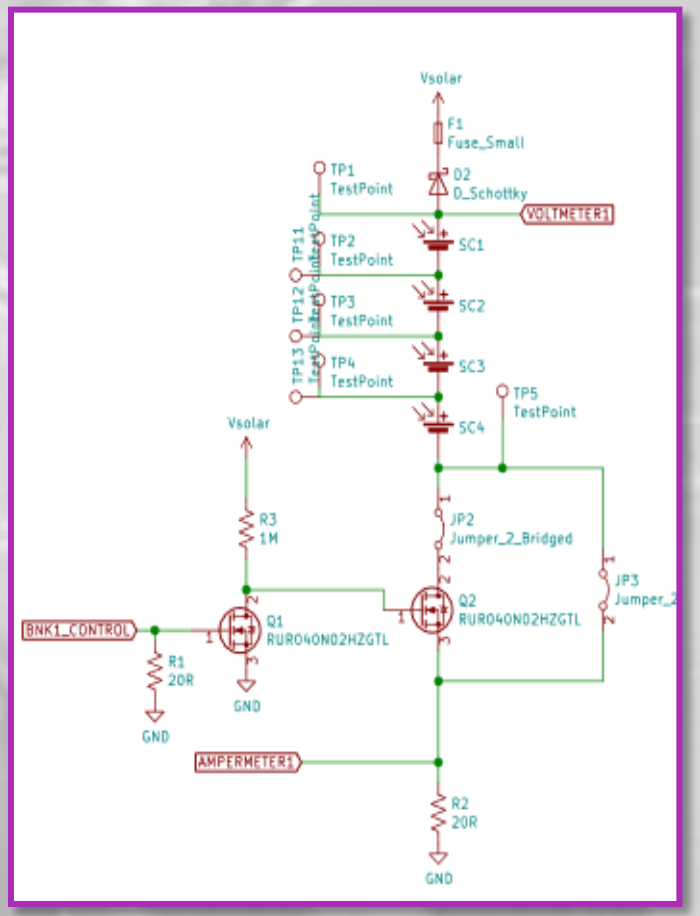


Prototype #1

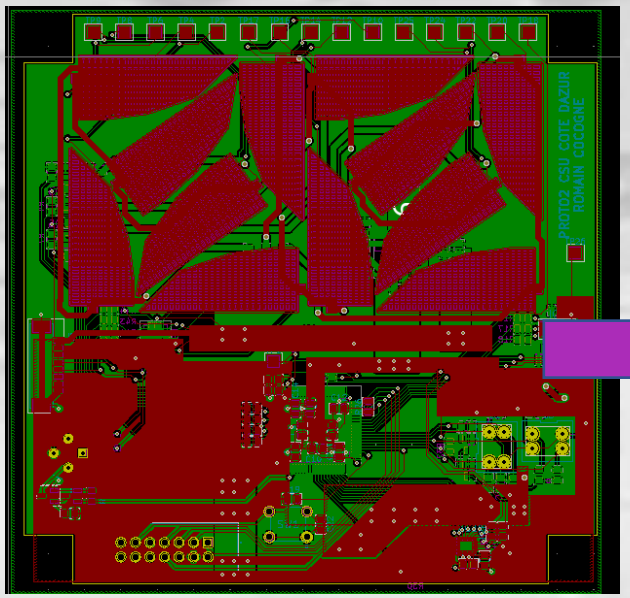
10kΩ

8,2V



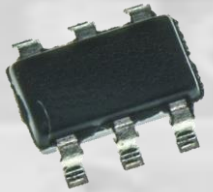


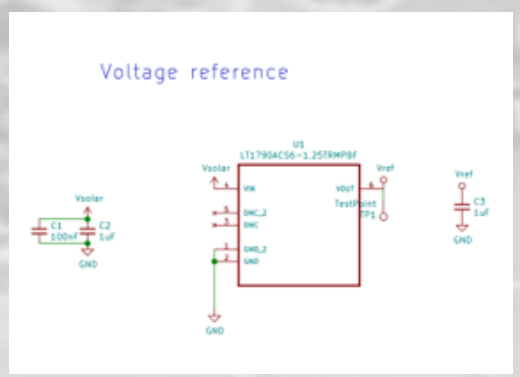
DEVELOPMENT – UNPLANNED MODIFICATIONS



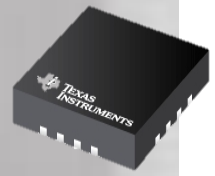
Prototype #2

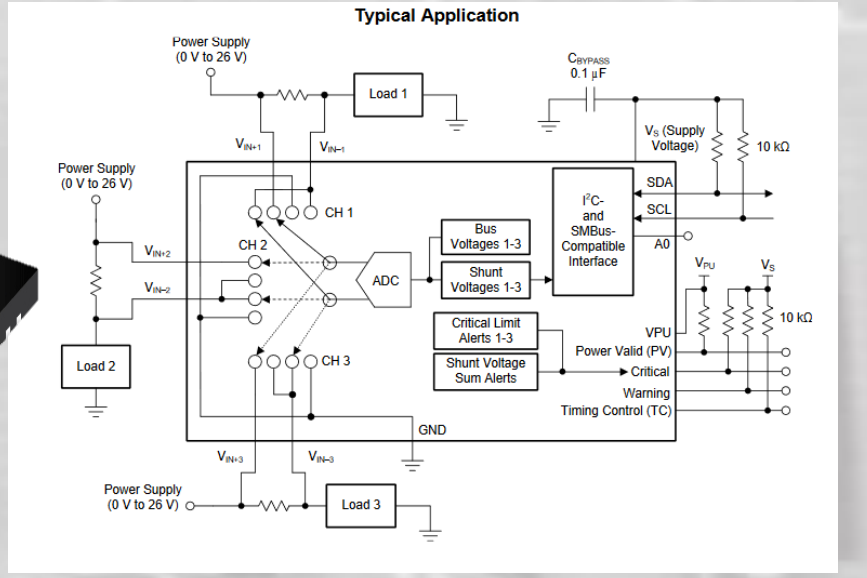
Zener diode → LT1790ACS6-1.25





Shunt resistor → INA3221

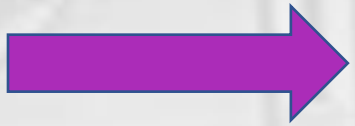




TECHNOLOGICAL CHALLENGES

- Setting up an efficient progrmaming environment

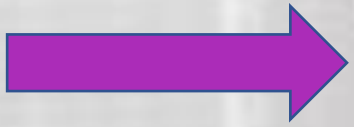
ENERGIA

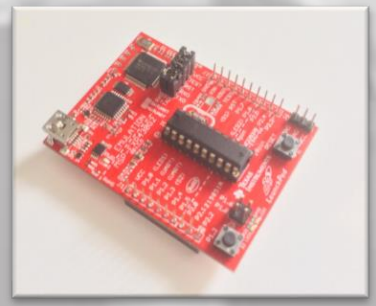


CODE COMPOSER STUDIO

- Adapting to a change of microcontroller

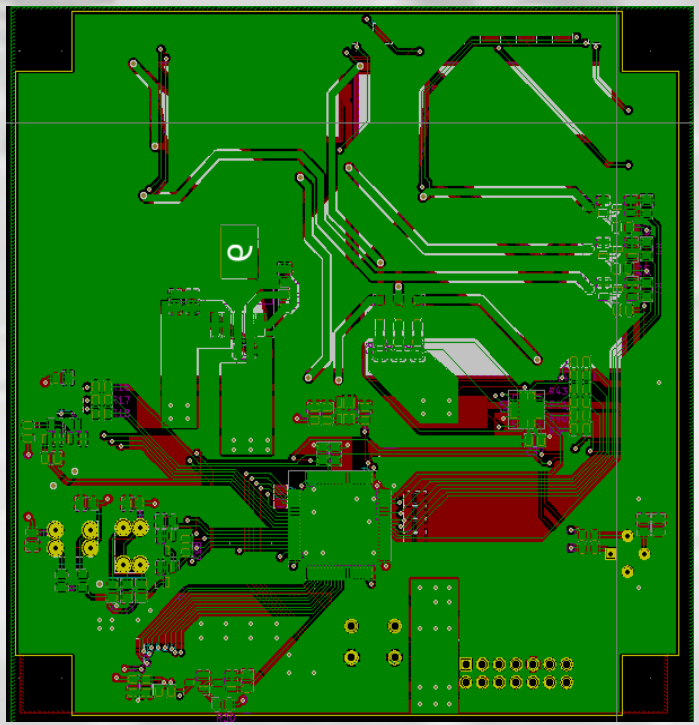
MSP-EXP430FR5739

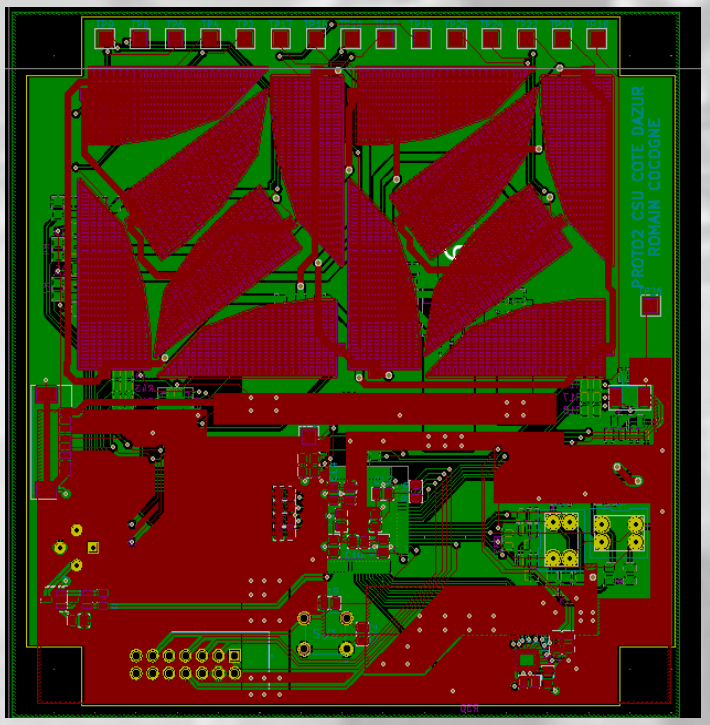


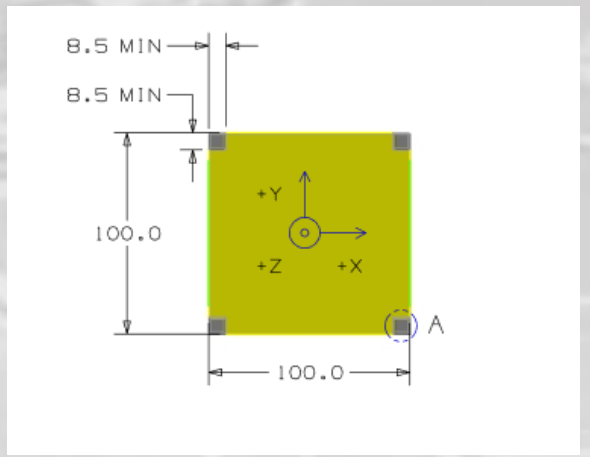


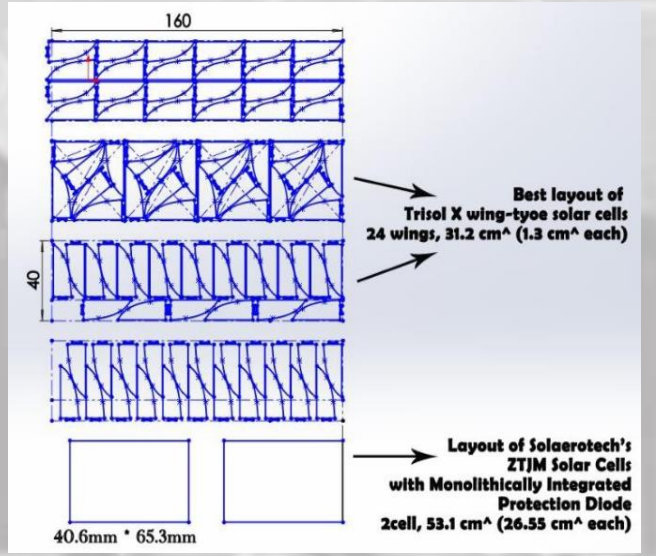
MSP-EXP430G2

TECHNOLOGICAL CHALLENGES



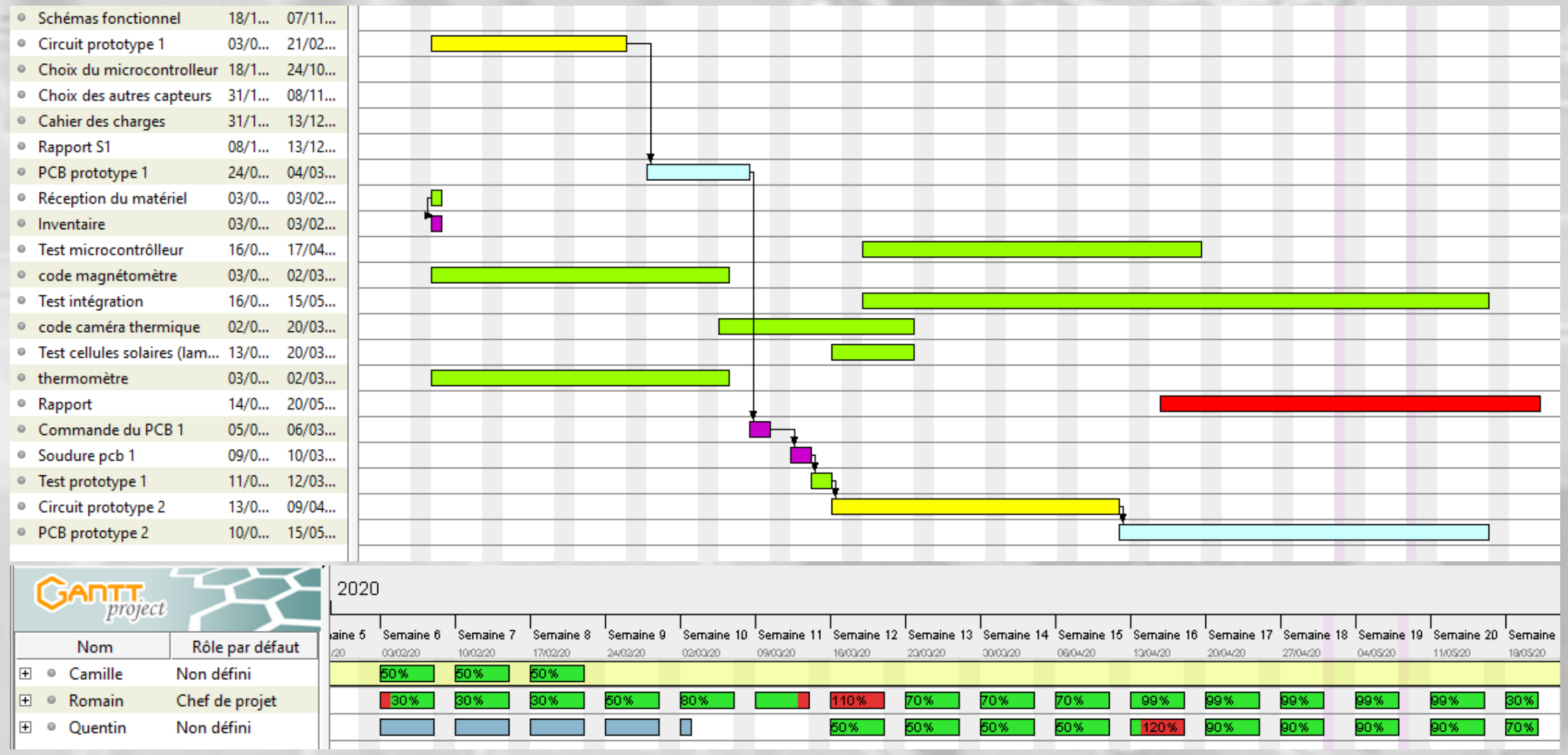






SETBACKS – CONSEQUENCES OF COVID-19

SETBACKS – CHANGE OF PLANS



CONCLUSION – THE PROJECT SO FAR

- Design a solar panel that can power the satellite
- Design a power management system
  - Cut-off system → Simulated
  - Current and Voltage measurements → Missing components
  - Temperature measurements
- Perform measurements to determine the satellite's orientation
  - Magnetic sensor integration
  - Thermal Camera integration → Need to adapt the algorithm
  - Solar sensors integration
- Send the measurements to an on-board central unit

CONCLUSION – FURTHER WORK

- Learn to exploit the low-power capabilities of the microcontroller
  - Use Code Composer Studio (CCS) tools
- Rework the algorithm for the thermal camera
  - Make it work with the 32x24 camera.
- Work with the solar sensor
  - Groundwork done with other sensors
- Make a prototype with the full network of sensors
  - Performance analysis of the full system

SOURCES

- http://univ-cotedazur.fr/en/idex/academies/space-environment-risk-and-resilience/contents/projects/a-satellite-for-the-uca
- https://www.ti.com/tool/CCSTUDIO
- https://scienceprog.com/msp-exp430fr5739-board-have-just-arrived/