

International Conference

# NEW PERSPECTIVE in SCIENCE EDUCATION

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Learning Astrophysics  
using STEM Educational  
Approach: Coding and  
Hands-on Activities at  
INAF OAS Bologna

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**INAF OAS Bologna**

# Introduction

- Educational activities offered by INAF OAS to students of the primary and secondary schools, to **promote Astrophysics using STEM** educational approach.
- The proposed activities made students enthusiastic about **science** and **technology**, giving them the opportunity to **get in touch with the research staff** who is daily involved in the proposed subjects.

# Introduction

- Students are helped developing:
  - skills related to science and technology by creating paper circuits, making instruments, and building paper models of space satellites
  - computational thinking through the Scratch software
  - educational robotics, which combines coding with creativity and technology

# Philosophy

- **Learning by doing** philosophy, which is the most suitable method for "*hands-on*" teaching.
- **Knowledge** is linked to **know-how** (abilities) and **knowing how to be** (intentional and conscious action).
- The emphasis is on the educational relationship, motivation, curiosity, participation, problem solving, scientific method, socialization, mutual support and team working.

# Educational activities

- **Classroom activities**
  - Let's light the constellations
  - Ghost hunting
  - The great adventure of Rosetta
  - Coding with Scratch
- **Activities during public events**

# Classroom activities

- Our proposals cover topics related to **astronomy**, **cosmology**, **physics**, and **space exploration**.
- The teaching tools used include multimedia presentations, making activities, and labs.
- We present some **hands-on activities** and **coding lab** we have successfully implemented, for free, in about **two-hundred classes** in the last **two years**.

# Let's light the constellations

- Maker experience that brings students closer to Electronics, using Astronomy as a common layer to create a final product with a great visual impact: a **paper circuit** in which the constellations light up, reproducing the brightness of the stars.

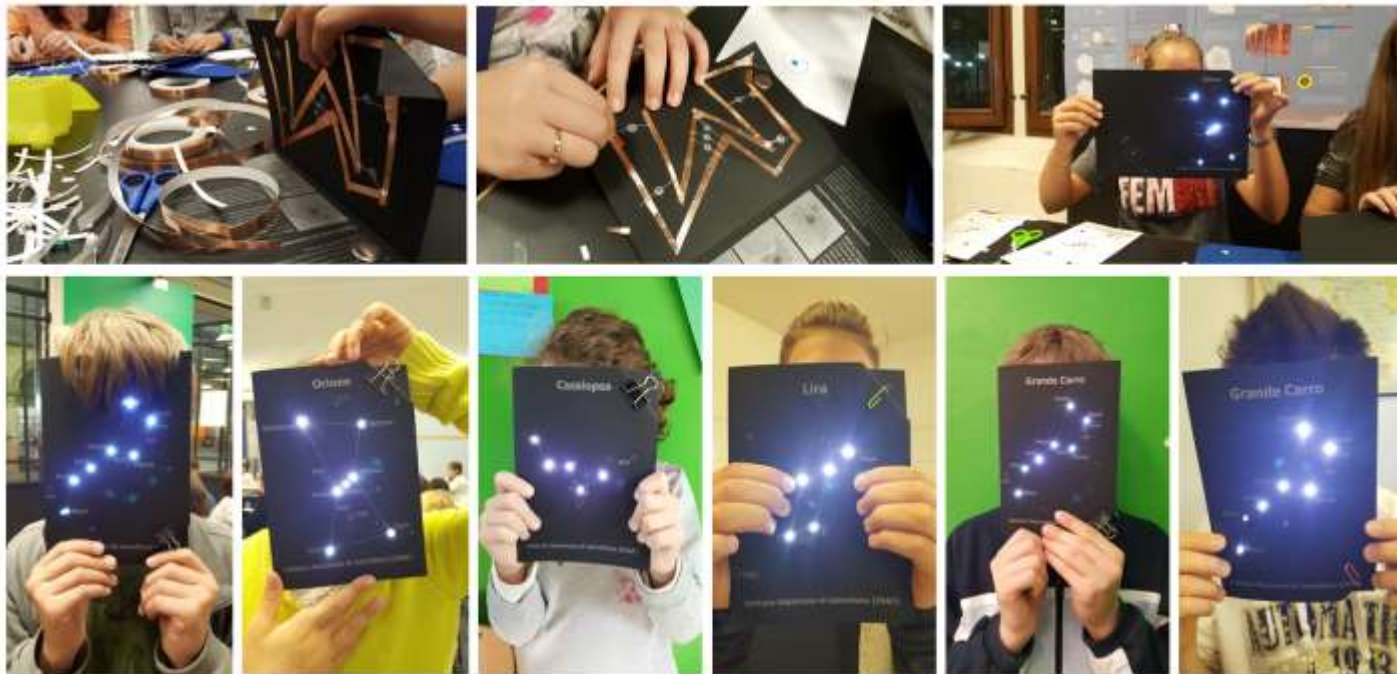


# Let's light the constellations

- In the first part of the laboratory, students are approached to the **constellations**: what they are, how they move in the sky and what is their usefulness in astronomy.
- In the second part of the lesson, students realize their **paper circuit**: a low-voltage electronic circuit created on a sheet of paper using a **conductive copper tape**, **LEDs** and a small **3V button battery**.
- Particular emphasis is placed on how to **identify and solve technical problems** that often occurs in this making activity.



# Let's light the constellations

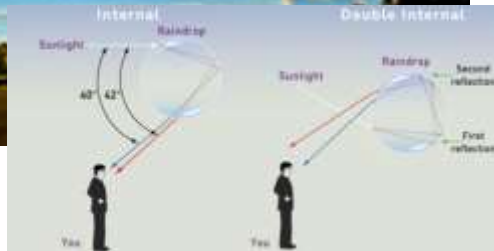
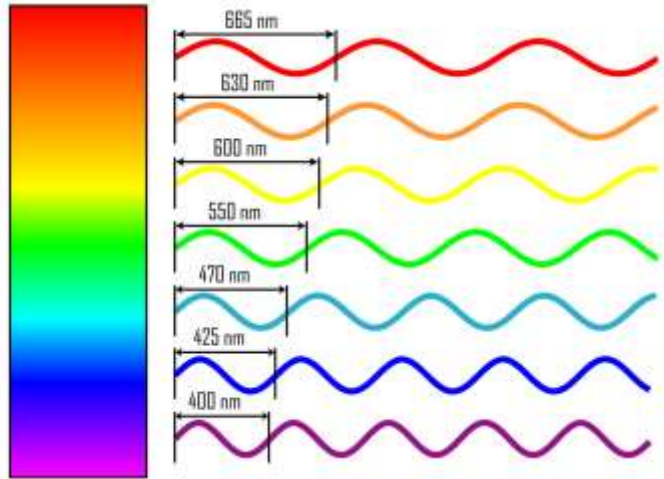
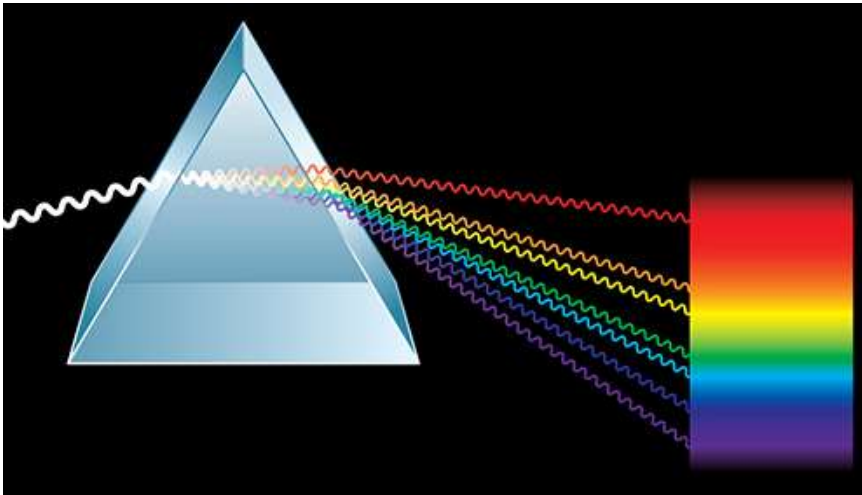


## Ghost hunting

- The aim of this hands-on activity is to help students to better understand the light and the e.m. spectrum.
- The construction of a spectroscope allows them to discover the spectrum of the light and to appreciate the emission lines of the elements.

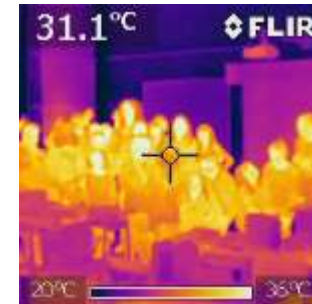
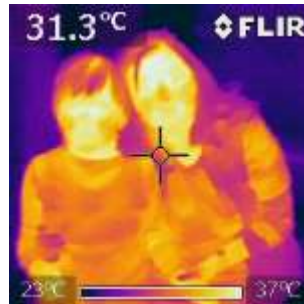
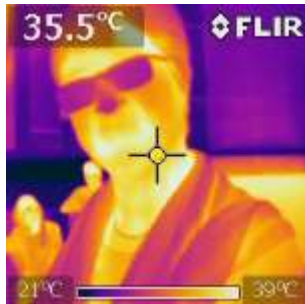


# STEM Education



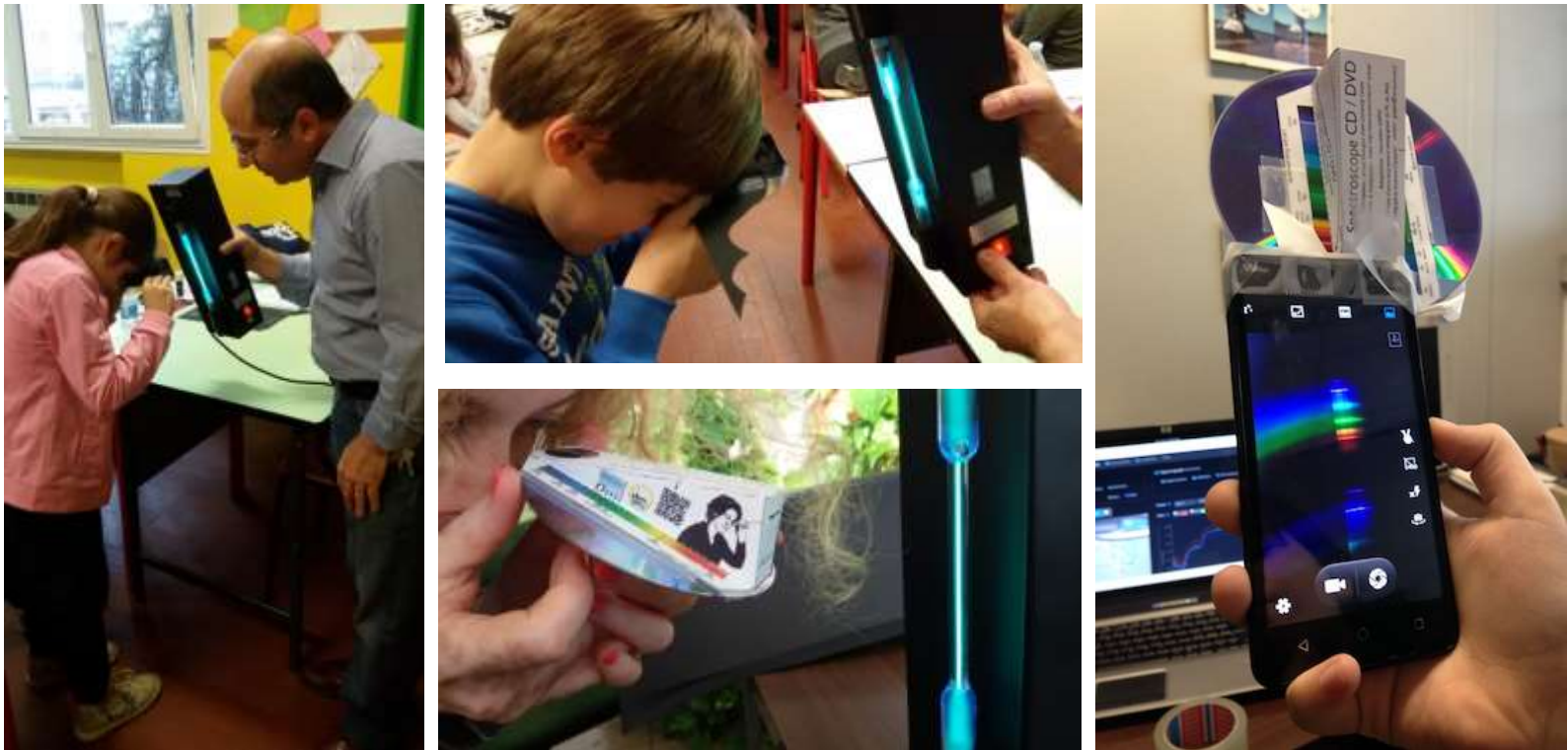
## Ghost hunting

- Students can see the spectra of different bulbs
- Continuum spectrum Vs line spectrum produced by atoms of a specific element.
- Discovery of the IR light using a thermo-camera





# Ghost hunting

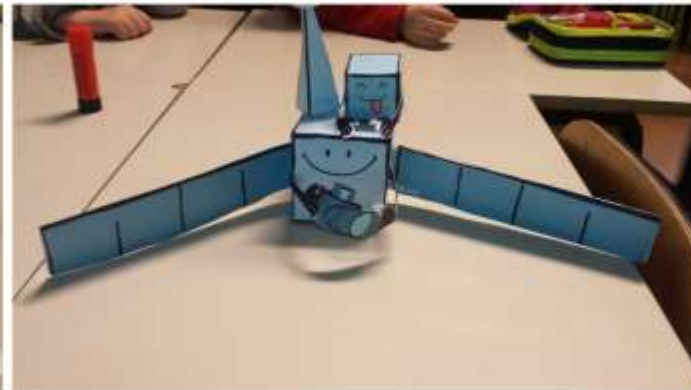
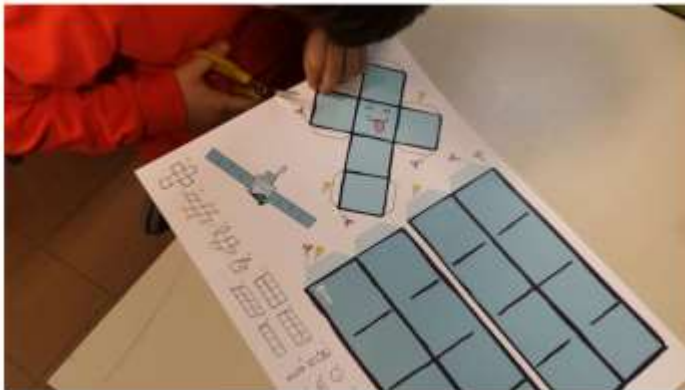
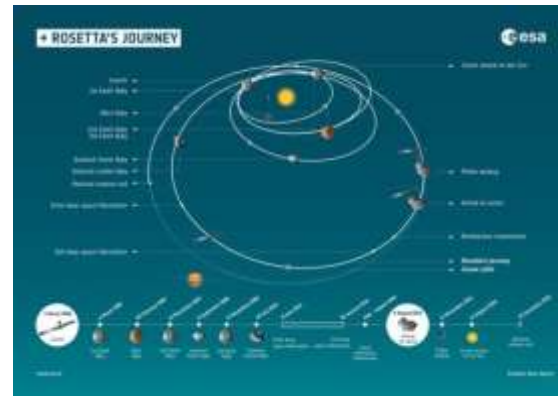
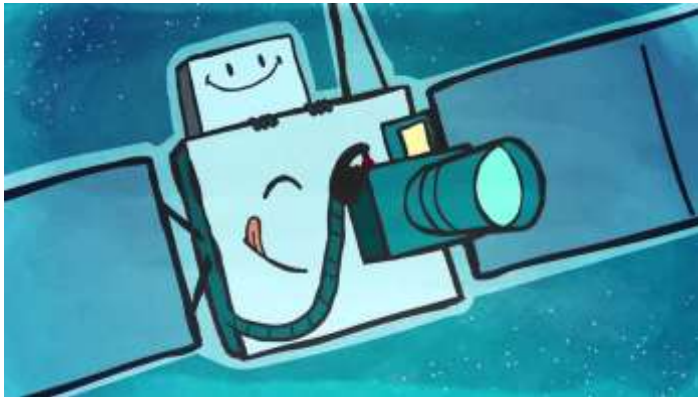


# The great adventure of Rosetta

- The aim of this activity is to present our Solar System, especially **comets**, telling them the beautiful and compelling story of the Rosetta probe (ESA).



## The great adventure of Rosetta



## Coding with Scratch

### Coding at school: How do EU countries compare?


Digital competences and ICT skills are seen as key for young people to integrate in the job market. Today, 90% of all jobs are expected to require at least a basic level of ICT skills.

By 2020, Europe is expected to see a shortage of more than 800,000 professionals with computing skills.

More and more countries or regions are now including computer programming as part of school curricula.

### CODING AT SCHOOL

A recent survey has shown that 15 EU countries have already integrated coding in their school curriculum.





**Legend:**

- Already integrated:** Austria, Bulgaria, the Czech Republic, Denmark, Estonia, Hungary, Ireland, Lithuania, Malta, Poland, Portugal, Slovakia and the UK (England).
- Recently integrated:** France, Spain, have recently integrated coding in the curriculum recently (2016-2018).
- Finland (will integrate coding in 2016)**
- Belgium (Flanders) is currently debating whether to integrate coding at school.**

### AT WHICH LEVELS?

9 EU countries already integrate or will integrate coding at primary school level soon.

12 EU countries already integrate or will integrate coding at upper secondary school level in general education.

Primary school	Secondary school
	

**Legend:**

- already integrate**
- will integrate**



# Coding with Scratch

- In the last two years, our schools registered an increasing demand of activities aimed to develop **computational skills** and **problem solving attitude**.
- Since these are two aspects very important also in our research activities, we decided to **support schools in this new path**.
- Coding is a **horizontal competence**
- Coding is a **new language**
- Coding is a **universal language** (like math, or music, or painting)

# Coding with Scratch

- We introduce coding using **Scratch**, a free visual programming language developed by the Lifelong Kindergarten group at the MIT Media Lab (ages 7 – 17)
- Scratch involves not only the computational and logical-mathematical thinking but also the emotional and expressive sphere.
- Visual games, mathematical, and geometrical projects.
- Students learn how to draw, generate, reproduce and use sounds, and how they can create stories (digital storytelling).

# Coding with Scratch



## Activities during public events



- Participation at annual relevant events such as:
  - European Week of Astronomy
  - European Researchers' Night
  - Light in Astronomy week
- Making laboratories
- Exhibits:
  - planetary weight scale
  - planetary bicycle
  - educational robotics



# STEM Education



# Conclusion

- The presented activities made students enthusiastic about science and technology
- During the classroom activities, we created a **collaborative synergy between kids, teachers and researchers**
- This synergy represents an **added value** of our activities, compared to the classic STEM Lab
- We are creating a **bridge between school and research world** that allows students to acquire knowledge and experience of the researcher closely involved in national and international research projects.

# Enjoy with astrophysics!

