



STEAM: Education and Communication with **Art** at ATLAS and CMS

Pierluigi Paolucci (I.N.F.N. Napoli)




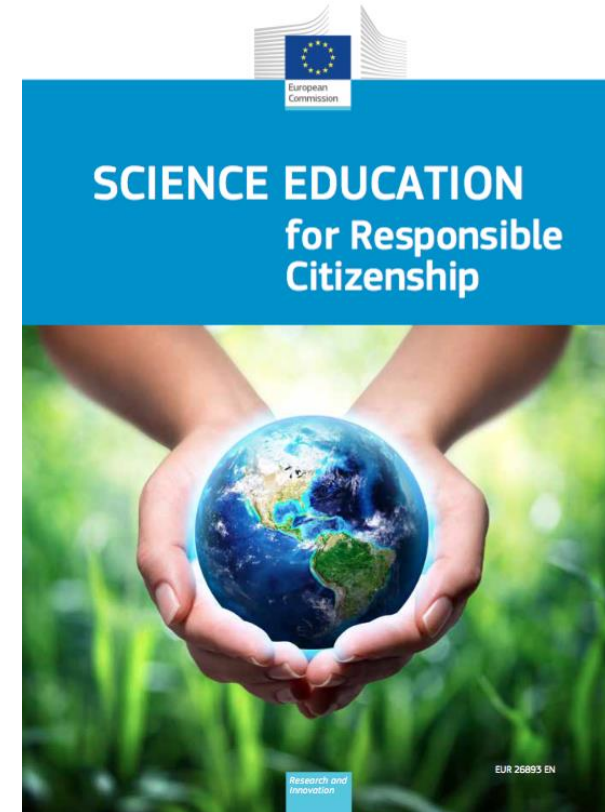
on behalf of ATLAS and CMS outreach groups

What is STEAM

STEAM is an educational and innovation framework bringing science, technology and engineering together with the arts/other disciplines and types of learners with the goal of being more engaging, creative and naturally successful for all members of any educational system.

Programme
for Science
Education
Research

 **4.2** Science education should focus on competences with an emphasis on learning through science and shifting from STEM to STEAM by linking science with other subjects and disciplines.



STEAM

is about

expanding STEM education

through

arts integration

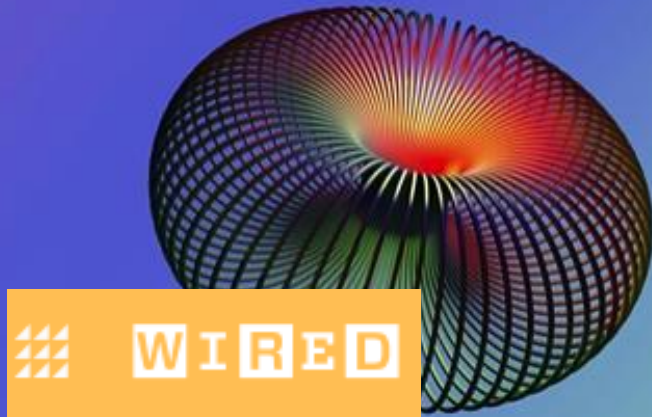
Students who are involved in the arts are:

4 times more likely to participate in a math & science fair

3 times more likely to win an award for school attendance

4 times more likely to be recognized for academic achievement

General interest about STEAM



Science Education Is Woefully Uncreative. That Has to Change

Is science a creative endeavor? Yes! However, most people don't think so, so our science classes are typically deficient in creativity.

WIRED.COM | BY RHETT ALLAIN

Scientific knowledge is the product of creative thinking (Osborne et al. 2003)



Arts Critical to STEM Learning Says Acting Secretary of Education

John M. Eger Van Deerlin Endowed Chair of Communications and Public Policy at San Diego State University (SDSU), was principal adviser to the President for...

STEAMCONNECT.ORG

Art is an excellent tool to help students learn science (Ashley, 2011; Merten, 2011)



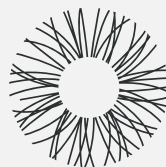
STEAM in CMS

- **Art@CMS** is a collaboration between the CMS scientific community, art communities, and science education communities
- The aim of the program is to reach out to **as wide a range of people as possible in order to interest them in** and inspire them to want to discover more about **science, and in particular particle physics.**
- The program is comprised of 2 complementary modules, the **Art@CMS exhibitions** and the **Science&Art@School.**

40 exhibitions and 12 workshops done from 2012 to 2016

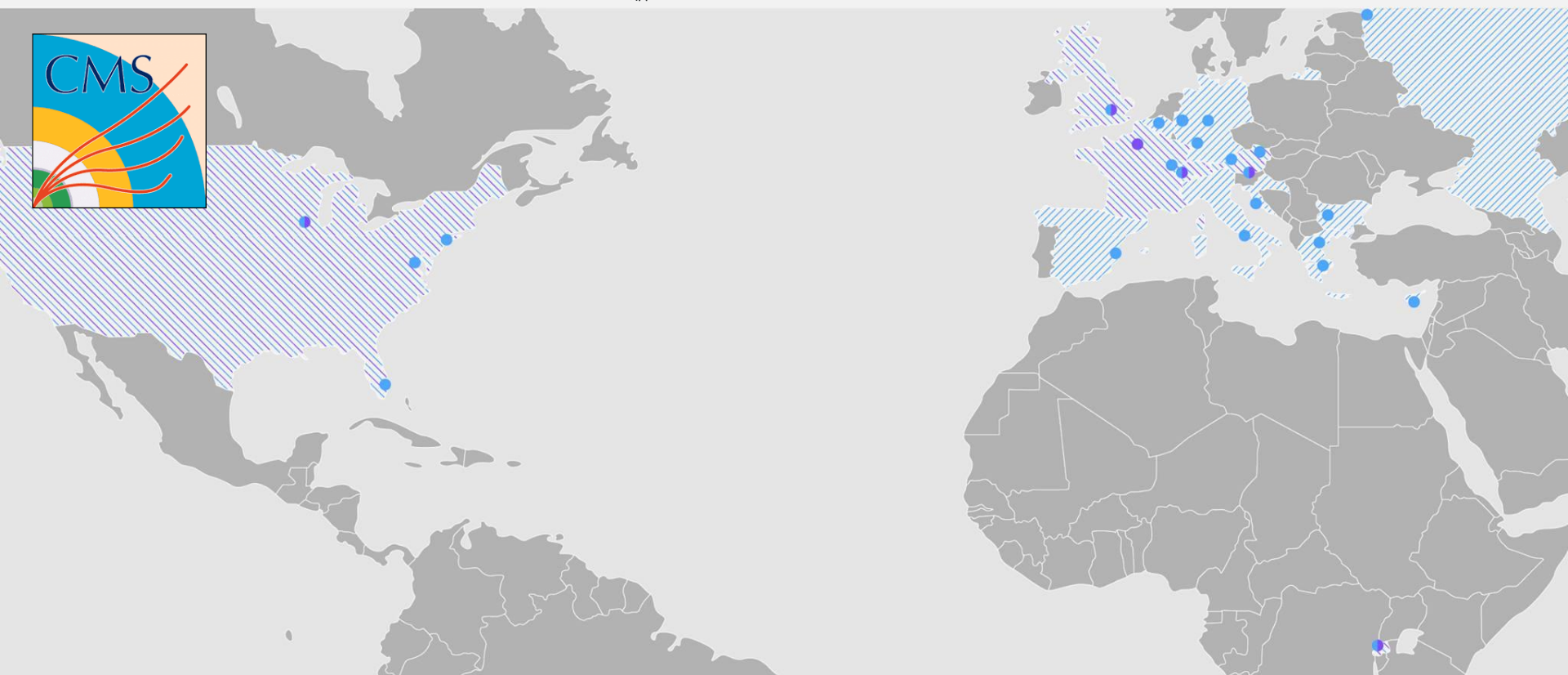
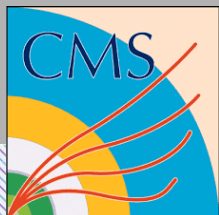
ACTIVITIES MAP 2012-2016

(As of 10 April 2016)



art@CMS

art of science
beauty in creation



art@CMS exhibitions are the outcome of collaboration between artists, art institutes, scientists and CMS institutes and act as catalysts for promoting public interest in and understanding of science.

40 exhibitions
23 cities
15 countries
140k visitors

Countries

Austria, Belgium, Bulgaria, Croatia, Cyprus, France, Germany, Greece, Italy, Russia, Rwanda, Spain, Switzerland, United Kingdom, United States.

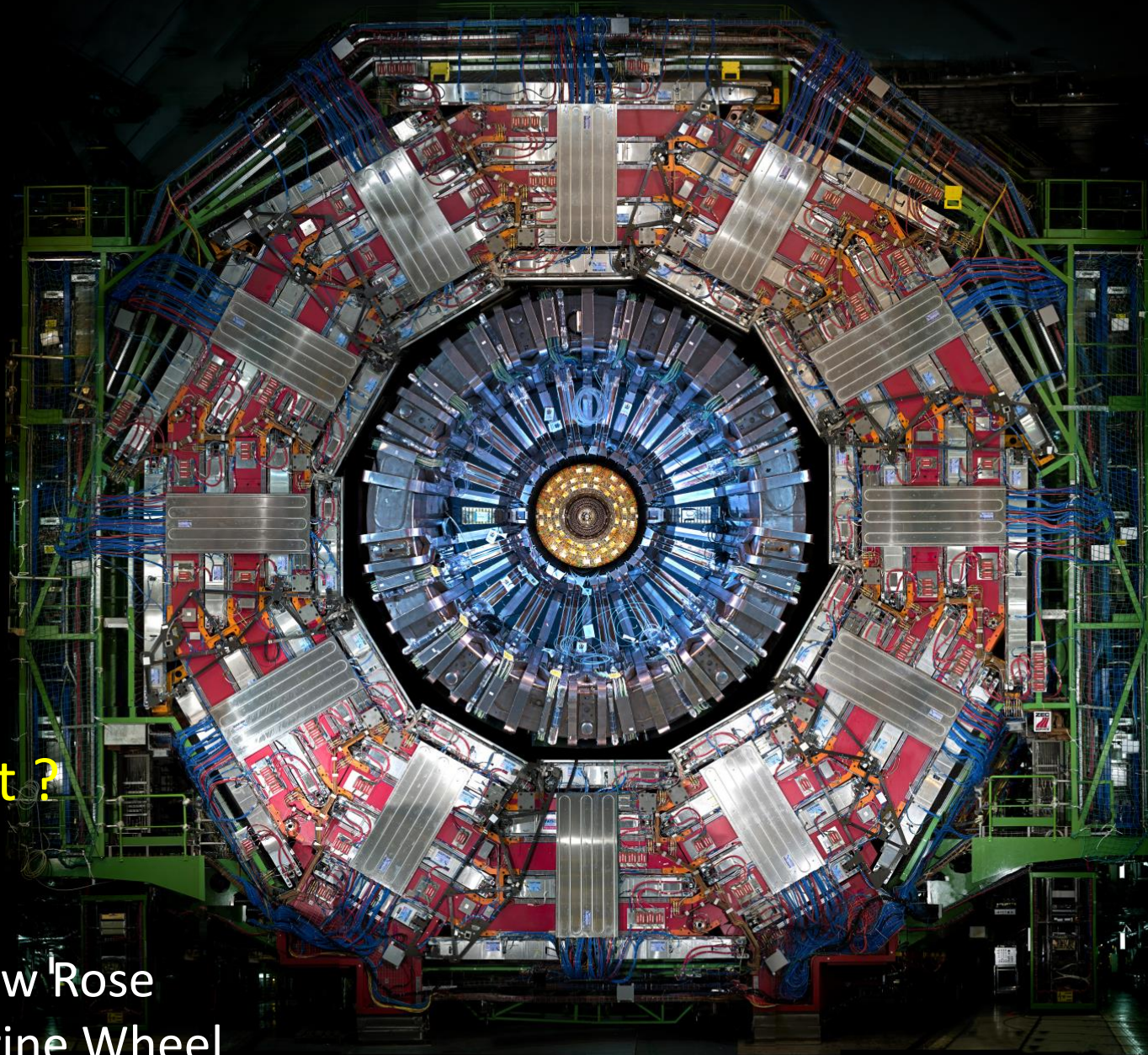


Interdisciplinary in their nature, science & art workshops enable young people to gain a better understanding of science, to be inspired and encouraged, and to develop skills that are critical to the challenges of the 21st century.

12 workshops
6 cities
6 countries
650 students

Countries

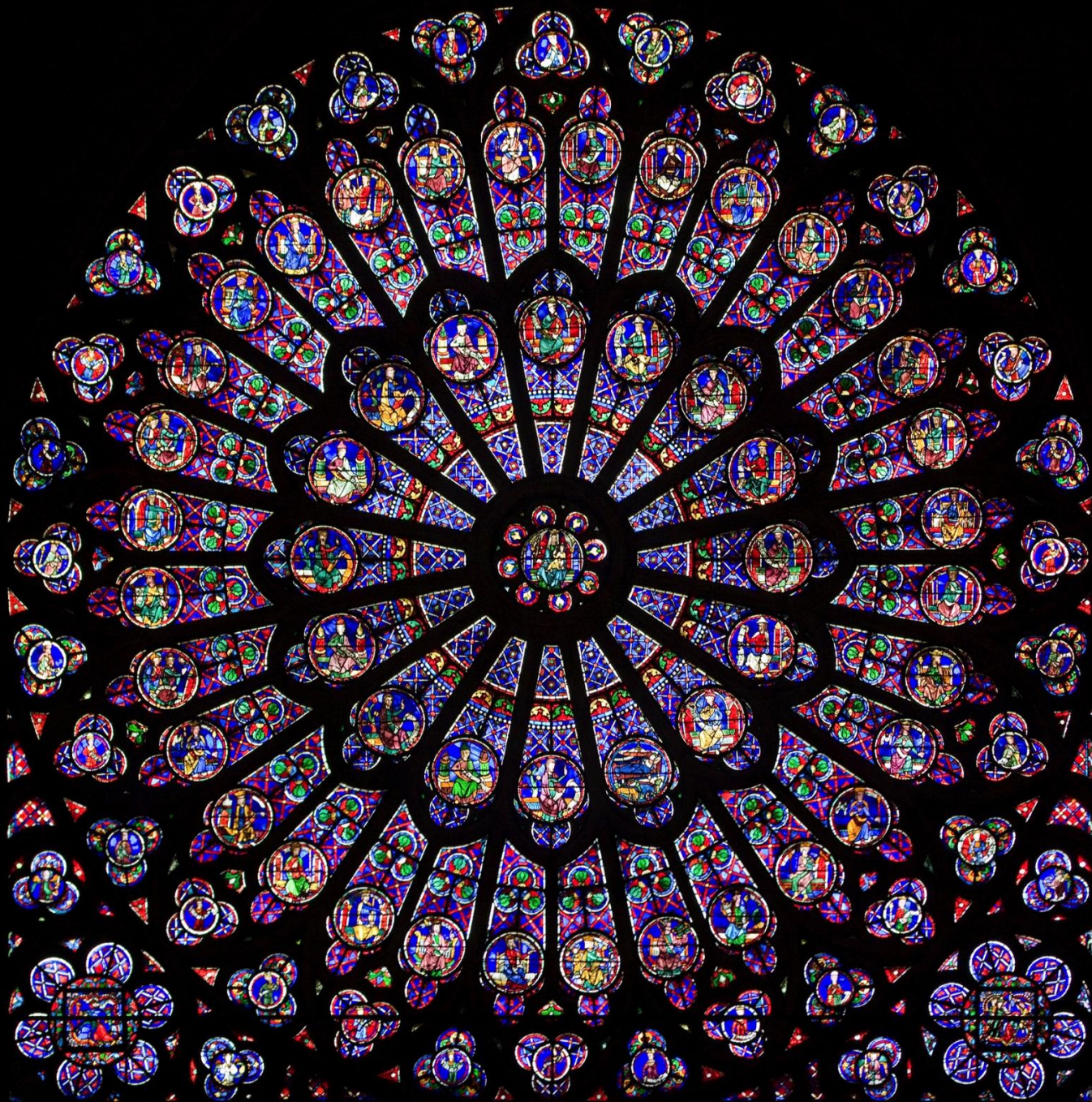
Austria, France, Rwanda, Switzerland, United Kingdom, United States.



What is it ?

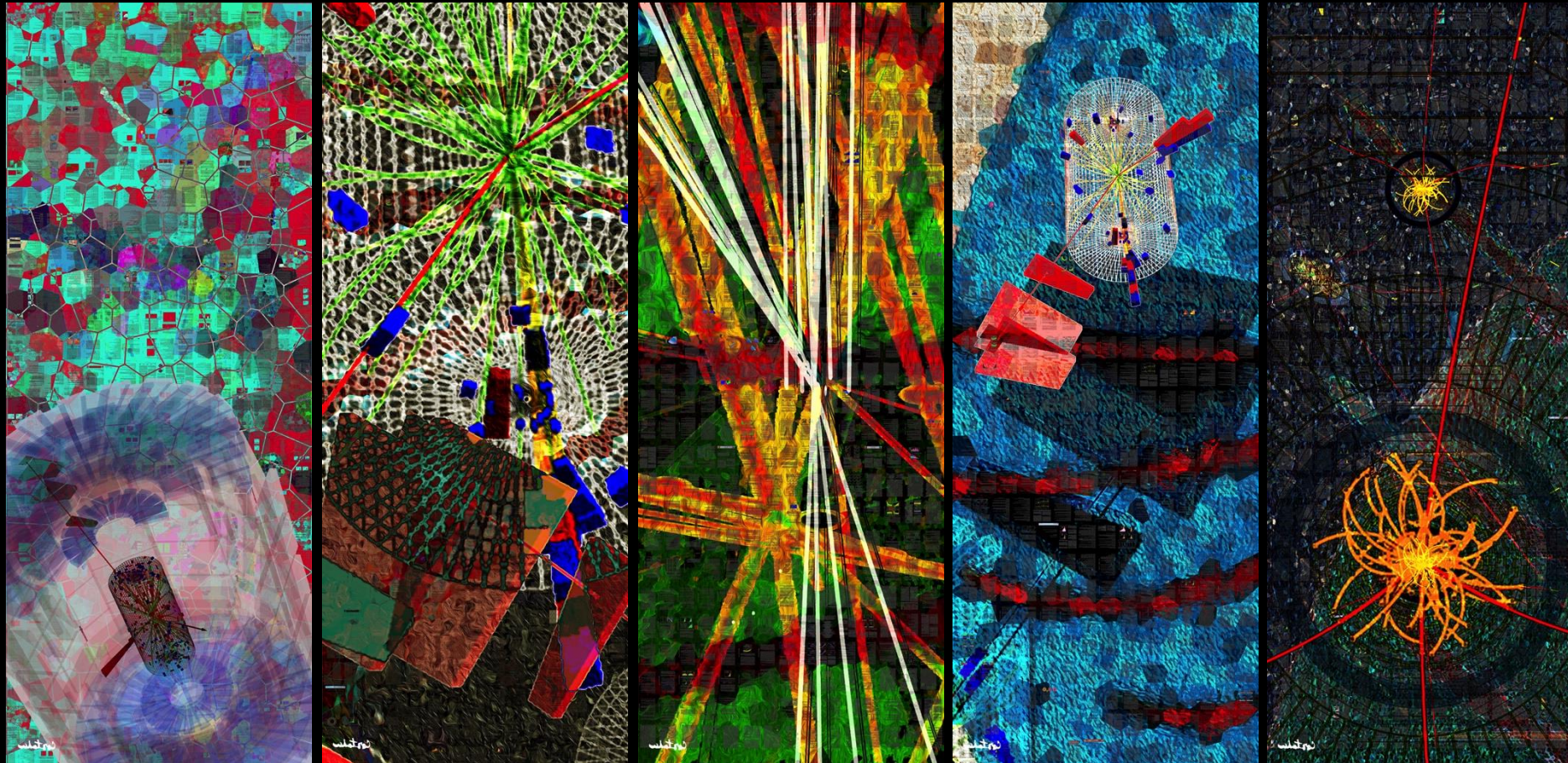
- Fractal
- O-ring
- Window Rose
- Catherine Wheel

Students have an open and creative mind



In Search of the Higgs Boson

Xavier Cortada (with the participation of physicist Pete Markowitz), digital art, 2013



$H \rightarrow WW$

$H \rightarrow \gamma\gamma$

$H \rightarrow b\bar{b}$

$H \rightarrow \tau\tau$

$H \rightarrow ZZ$

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ЦЕНТР
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НАУКЕ



HELLENIC REPUBLIC
National and Kapodistrian
University of Athens



UNIVERSITY OF
BIRMINGHAM



UNIVERSITY OF MALTA
L-Università ta' Malta



HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI



ELLINOGERMANIKI AGOGI

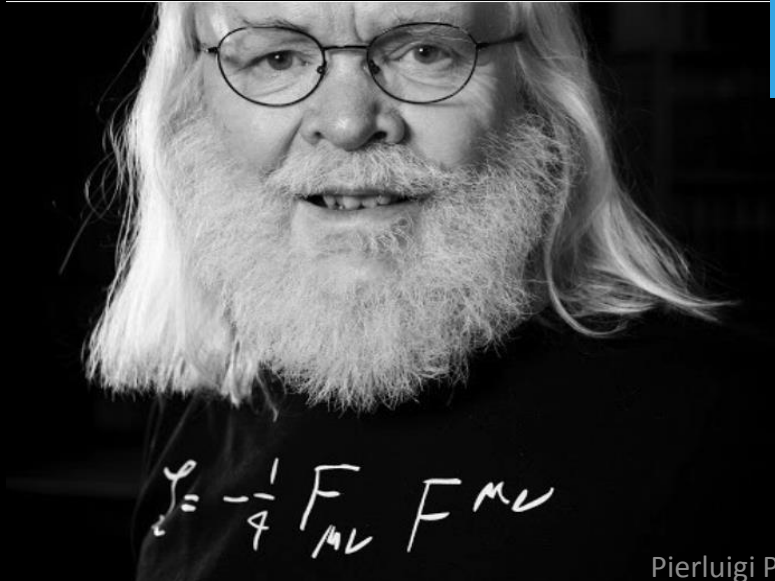


Athens Science Festival 2016



ATHENS
SCIENCE
FESTIVAL

#asf



Pierluigi Paolucci (INFN of Napoli) - IJHCP 2016



“Art & Science across Italy” project

in Milano, Firenze, Venezia/Padova and Napoli

- **Goal:** attract young and general people to Particle Physics
- **Addressed to:** students and teachers of Italian Lyceums and art schools.
- **Steps:**
 1. Seminar at school and INFN about Particle Physics and INFN/CERN research.
 2. Students create artworks with the help of teachers and scientists.
 3. Report (book) about how and why artwork was realized (description, pictures and explanations).
- Best artworks will be awarded and exposed at the “**I colori del bosone di Higgs**” exhibition.
 - Students will **act as guide** during the exhibitions.
- Winners will be invited to visit CERN

Pilot Run in Napoli

teaching

Il Dono della Massa (INFN)

Corriere della Sera, L'Espresso,
Il Mattino, RAI.....

RAI 1

vodafone IT 3G 12:57 91%

< Alessandro Catocci

Alessandro Catocci presso
Castello Giusso.
venerdì alle 23:07 · 🌐

TG1 ore 20 - vedere un servizio
che inizia con una mia foto del
bosone di... Continua a leggere



1,3 mila visualizzazioni

📅 👤 💬 🌐 ☰

- 2014 Nobel Prize **Stefan Hell** at the exhibition in Vico Equense (2016): **1500 visitors + 12 schools** (in 5 days).
- **2500 visitors in 4 days in Napoli 2015**



STEAM @ ATLAS

- STEAM in ATLAS is based on projects, proposed by a member and founded by her/his institute.
- The project is presented to the ATLAS outreach group and eventually approved.
- If approved the project will use the ATLAS logo and will be helped by the outreach group for publicity, news, web site....


Projecting pARTicles

Luis Flores Castillo, Chinese University of Hong Kong
Steve Goldfarb, University of Melbourne, Australia

- Agnes Chavez is a media artist in US.
- Informal partnership with some ATLAS physicists will be developed through a series of workshop (Virtual visit, Master Class and presence of physicists)
- The goal is to use new media art to explore, teach and communicate particle physics concepts.
- The project is based on a long term collaboration between artists, students and scientists.

Projecting pARTicles Activities

- **2014**: the second pilot workshop includes an [ATLAS Virtual Visit](#)
- **2015**: research stay of two weeks at CERN, Agnes meets a number of ATLAS physicists.
- **June 2015**: workshop in Cuba, in collaboration with ATLAS physicist Luis Flores
- **March 2016**: integration of a Master Class in Day 1 of [workshop at the Harwood Museum](#) (Taos, New Mexico)
- **May 2016**: second research stay at CERN, one week long, to present and discuss future evolution

A blue curved arrow pointing from the text "workshop at the Harwood Museum" in the list above to the start of the text block below.

After a two days immersion with experts in particle physics, students began the exploration of projection art as a medium of expression and communication. The three-day workshop March 22-24 was led by three teenagers that participated in the workshop in December 2015. **They lead a group of new students to explore a projection art iPad tool called Tagtool.** Together they will storyboard, design and document a live projection on to a building inspired by the physics concepts.

Projecting pARTicles Activities





ATLAS Quantizer

Ewan Hill, University of Victoria & Triumf, Canada

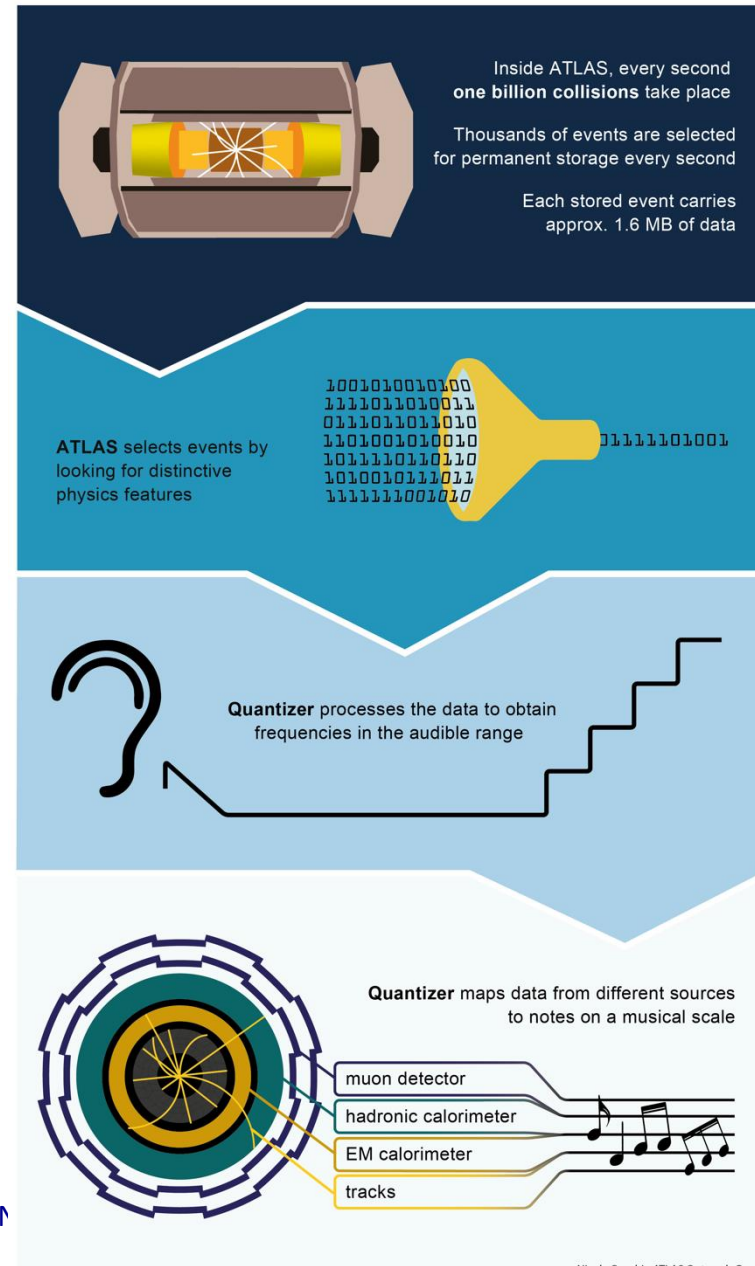
Steve Goldfarb, University of Melbourne, Australia

- A new interface for musical expression
- The goal is to transform ATLAS data into sound and explore how this could be a source of inspiration for musicians and general public.
- The ATLAS collaboration permits access to the data streams which feed the [live event display](#) which are not public.
- Event kinematics and the detector information contained in these events is transformed into musical sequences by a set of tools developed by the [Responsive Environments Group](#) (link is [external](#)) at the MIT Media Lab.

ATLAS Data Quantizer

- **2015**: early prototype demonstration in June 2015 at the [Montreux Jazz festival \(link is external\)](#)
- **July 2015**, Gratz. 2016 : presentation of the project architecture at the Computer Human Interface conference
- Project web site [was opened to the public on May 20th, 2016.](#)

The Physics of Music and the Music of Physics | CERN at the Montreux Jazz Festival | 9 July



Conclusions



- **STEAM** provides a framework for integrating art in science teaching and learning.
- The STEAM movement is gaining more momentum and attention.
- Education and Outreach (E&O) in particle physics have started to respond positively to STEAM efforts.
- **ATLAS and CMS** are developing many interesting E&O projects:
 - involving more and more students and teachers.
 - attracting a larger and more diverse public to science through art.
- Current and future **EU Horizon 2020** projects can foster STEAM activities in the coming years.