



REINFORCE

REsearch INfrastructures FOR Citizens in Europe

WP5: Search for New Particles at the LHC

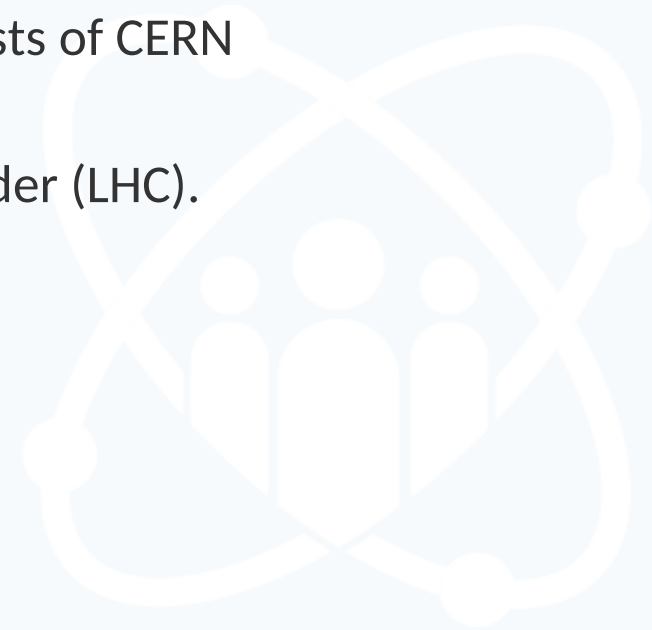
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Dimitris Fassouliotis,
Christine Kourkoumelis,
Stelios Vourakis

Project Advisory Board Meeting
Nov 20, 2020, 16:00 CET





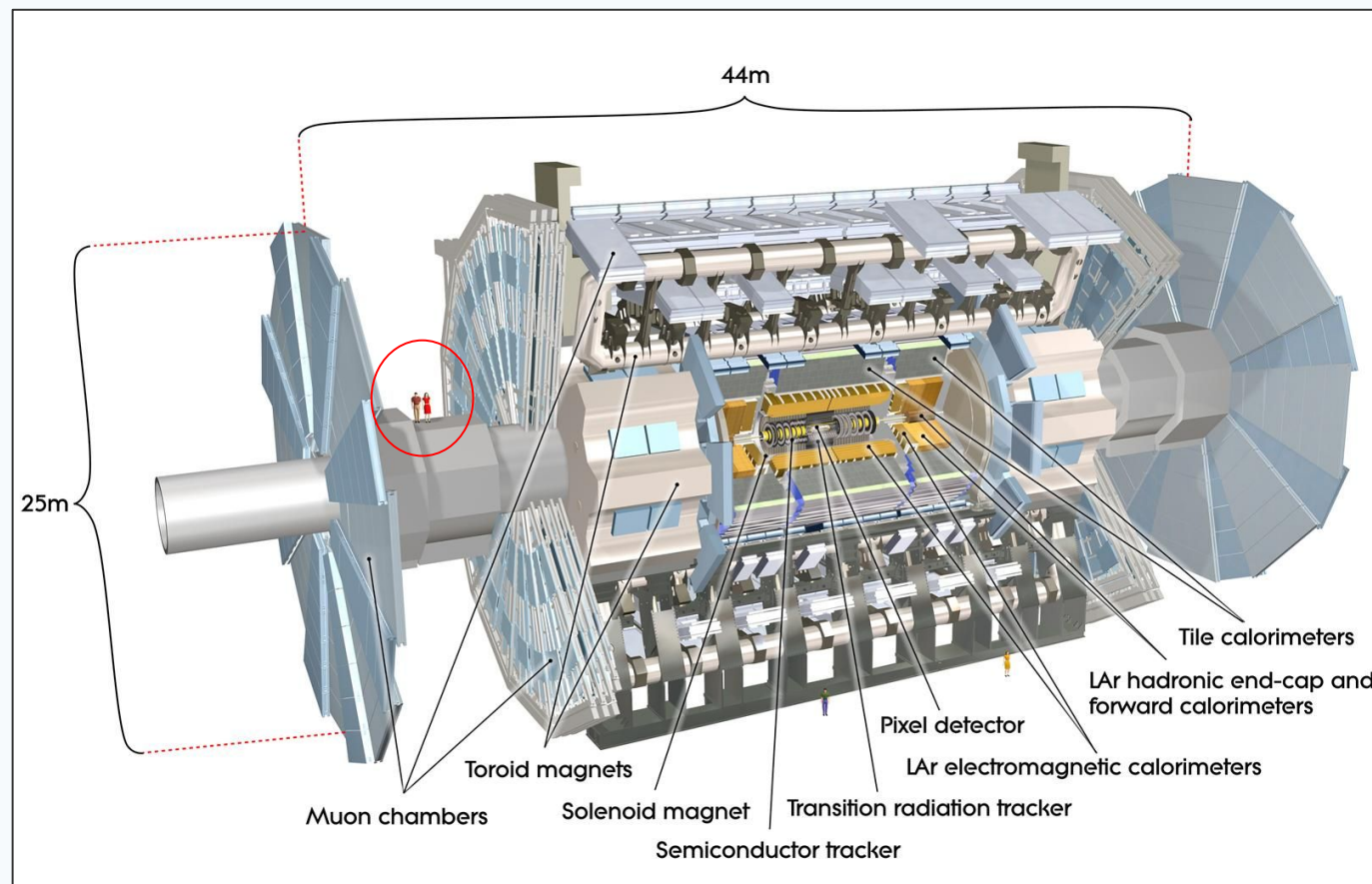
Citizens will become scientists of CERN
to discover New Physics
with the Large Hadron Collider (LHC).





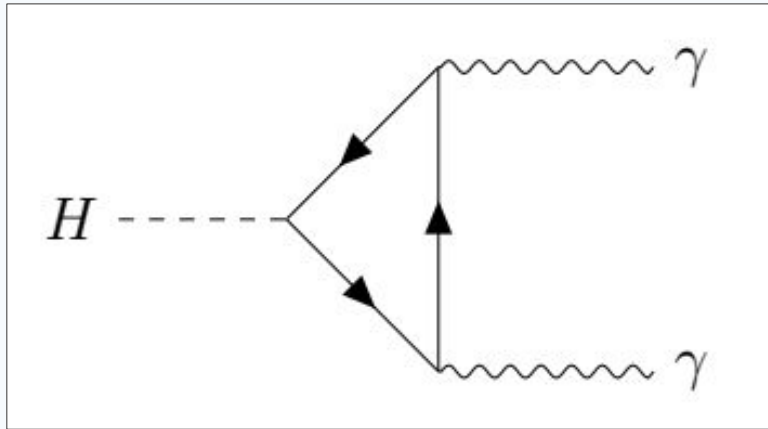
Citizen-scientists can contribute to searches for New Physics.

We designed a project for the analysis of collision events recorded with the **ATLAS detector**.

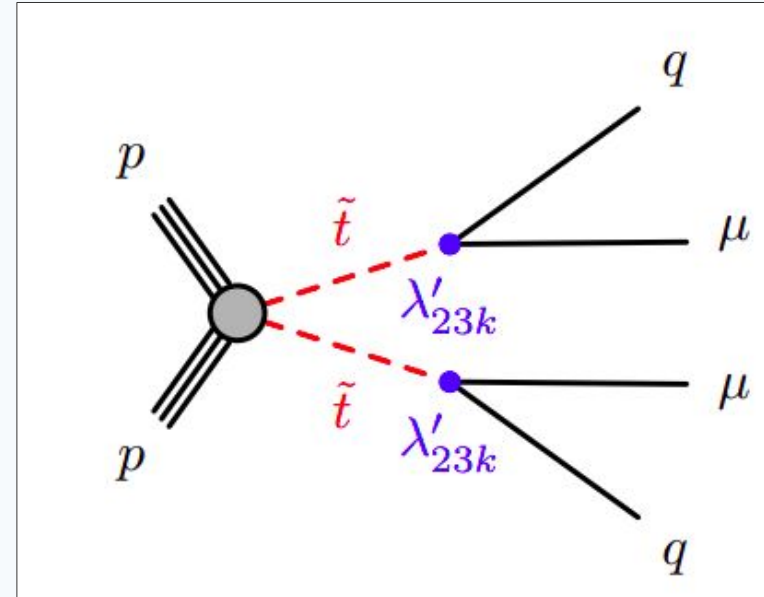




Current research topics in ATLAS:



SM $H \rightarrow \gamma\gamma$ studies
with converted photon(s)



SUSY scenarios
with long-lived particles.

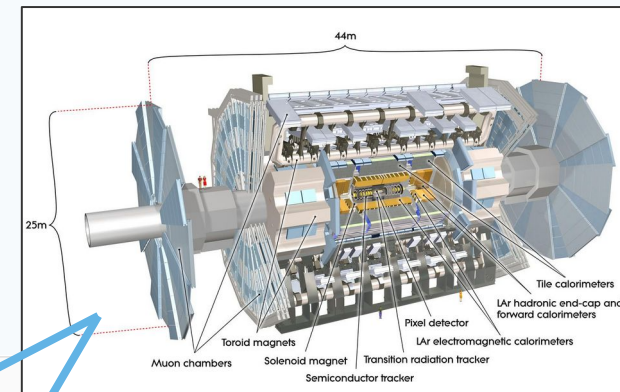
Exploit ATLAS real and simulated data to provide:

- an exciting and educating experience to citizen-scientists,
- quantitative assessments on their performance.

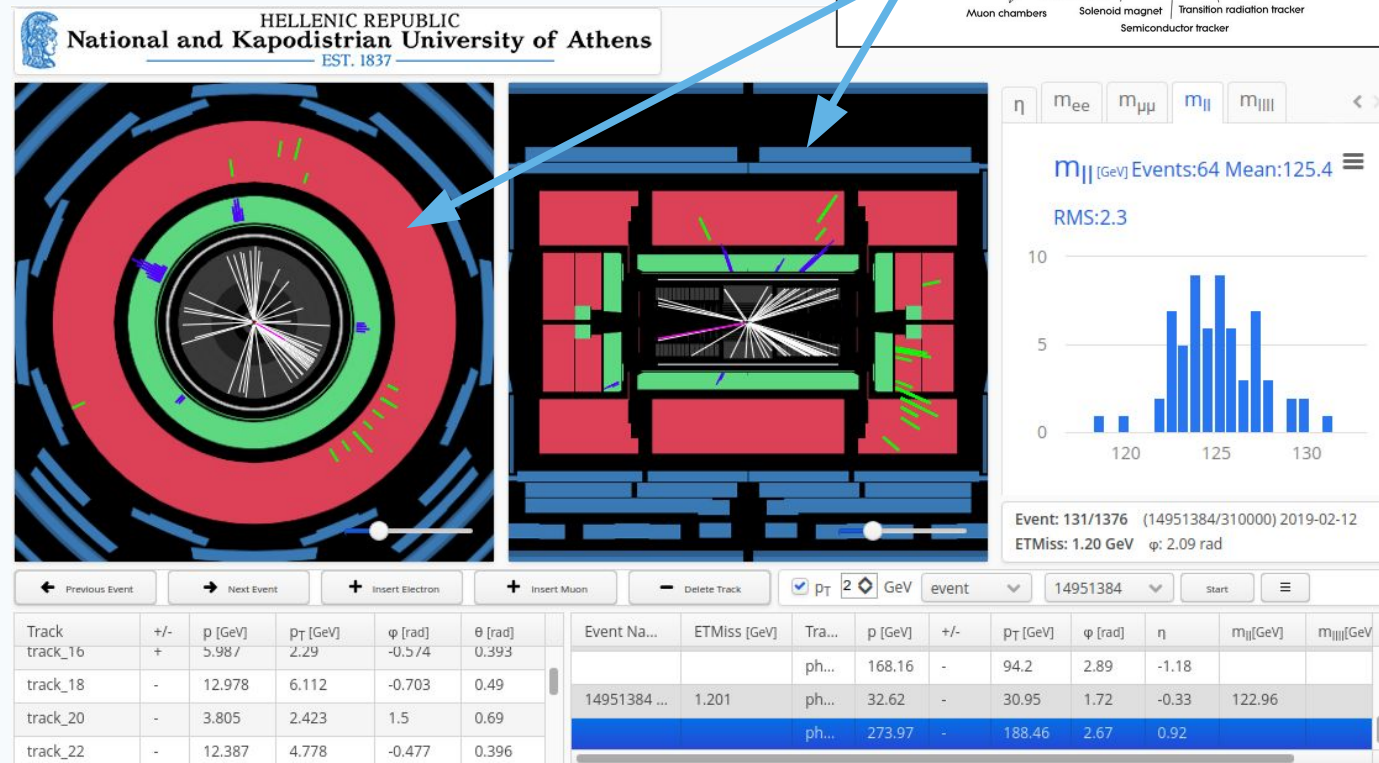
The project is based on visual (and if possible audio) representation of LHC collisions.

Using:

- the capabilities of ZOOINVERSE,
- the interactive data-analysis tool HYPATIA.



HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

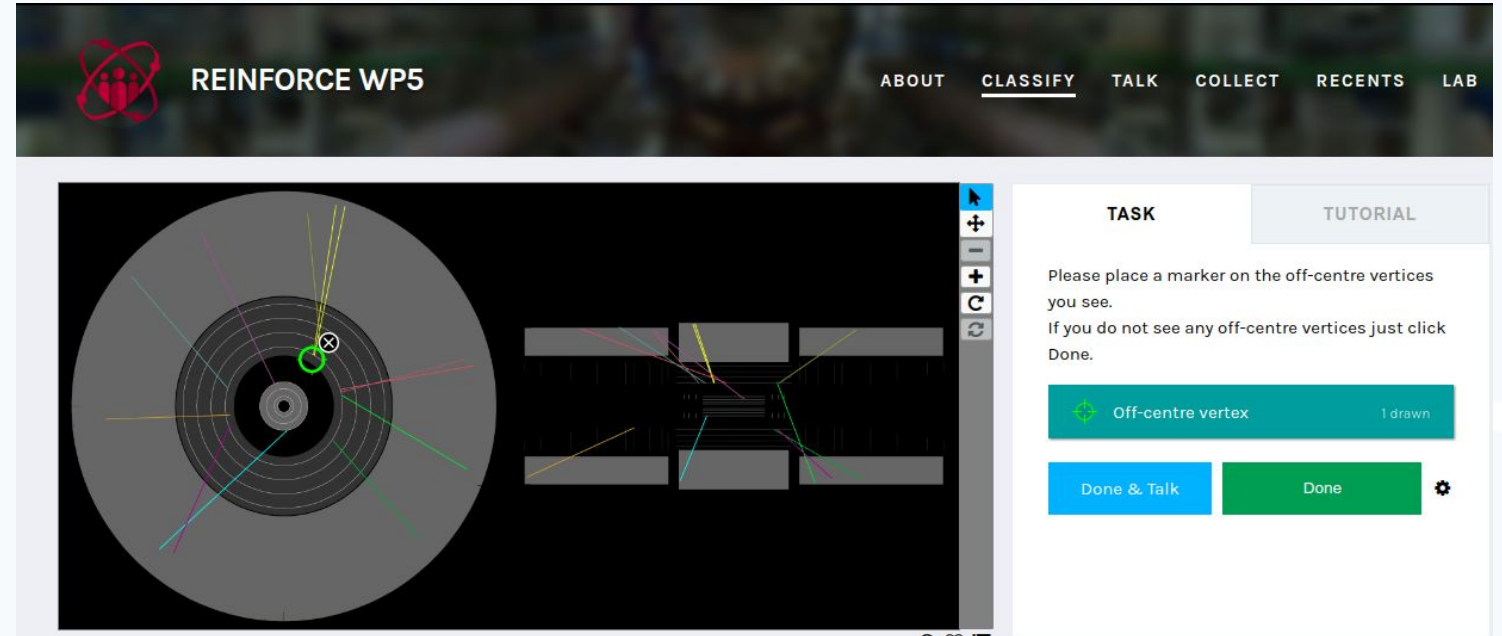


Track	+/-	p [GeV]	p _T [GeV]	φ [rad]	θ [rad]
track_16	+	5.987	2.29	-0.574	0.393
track_18	-	12.978	6.112	-0.703	0.49
track_20	-	3.805	2.423	1.5	0.69
track_22	-	12.387	4.778	-0.477	0.396

Event Na...	ETMiss [GeV]	Tra...	p [GeV]	+/-	p _T [GeV]	φ [rad]	η	m _{II} [GeV]	m _{III} [GeV]
14951384 ...	1.201	ph...	32.62	-	30.95	1.72	-0.33	122.96	
		ph...	273.97	-	188.46	2.67	0.92		

STAGE 1

Learn to identify displaced vertices.





STAGE 1

Learn to identify displaced vertices.

STAGE 2

Learn to identify particles (electrons, muons, photons, converted photons).

The screenshot shows the REINFORCE WP5 interface. At the top, there is a navigation bar with 'ABOUT', 'CLASSIFY', 'TALK', 'COLLECT', 'RECENTS', and 'LAB'. Below this is the logo of the Hellenic Republic National and Kapodistrian University of Athens, established in 1837. The main area is split into two panels: a top-down view of a detector with concentric rings and tracks, and a side-view of the detector with tracks. A control bar at the bottom allows adding particles (Electron, Muon, Photon, Conv. P...) and deleting them. A table below the control bar lists tracks with their properties.

Particle	+/-	p [GeV]	p _T [GeV]
track_0	+	22.895	4.393
track_3	-	344.52	140.063
track_6	+	5.96	4.422
track_10	+	11.795	4.848
track_12	-	0.889	0.338

On the right side of the interface, there is a 'TASK' panel with a 'TUTORIAL' tab. The task instructions are: 'Please place a marker on the off-centre vertices you see. If you do not see any off-centre vertices just click Done.' Below the instructions are buttons for 'Off-centre vertex' (with a '1 drawn' indicator), 'Done & Talk', and 'Done'.



STAGE 1

Learn to identify displaced vertices.

STAGE 2

Learn to identify particles (electrons, muons, photons, converted photons).

STAGE 3

Scan a large sample of real data to discover new-physics signatures.

The screenshot displays the REINFORCE WP5 web interface. At the top, there is a navigation bar with the REINFORCE logo and the text "REINFORCE WP5". To the right of the navigation bar are links for "ABOUT", "CLASSIFY", "TALK", "COLLECT", "RECENTS", and "LAB". Below the navigation bar is a header for the "National and Kapodistrian University of Athens" with the text "HELLENIC REPUBLIC" and "EST. 1837".

The main content area is divided into several sections. On the left, there is a sidebar with a "+ Electron" button and a list of tracks: track_0, track_3, track_6, track_10, track_12. The central part of the interface shows a 3D visualization of particle tracks in a detector, with tracks colored in red, green, and blue. To the right of the 3D visualization is a histogram showing the distribution of m_{ll} [GeV] for 64 events, with a mean of 125.4 and an RMS of 2.3. The histogram has a y-axis from 0 to 10 and an x-axis from 120 to 130. Below the histogram, there is a text box with the event information: "Event: 131/1376 (14951384/310000) 2019-02-12" and "ETMiss: 1.20 GeV ϕ : 2.09 rad".

At the bottom of the interface, there is a table with columns for "Particle", "Track", "+/-", "p [GeV]", "p_T [GeV]", " ϕ [rad]", " θ [rad]", "Event Na...", "ETMiss [GeV]", "Tra...", "p [GeV]", "+/-", "p_T [GeV]", " ϕ [rad]", " η ", "m_{ll}[GeV]", and "m_{llll}[GeV]". The table contains several rows of data, with the last row highlighted in blue.

- Real and simulated data samples have been chosen for all stages.
Presently in the process of getting approval from the ATLAS collaboration to make them public.
- **STAGE 1:** fully implemented on Zooniverse, presently refining the event selection.
- **STAGE 2:** HYPATIA and data samples are ready; implementation on Zooniverse will follow.
- **STAGE 3:** HYPATIA and data samples are ready; implementation on Zooniverse will follow.

