ATLAS Experiment – Physics and Operations

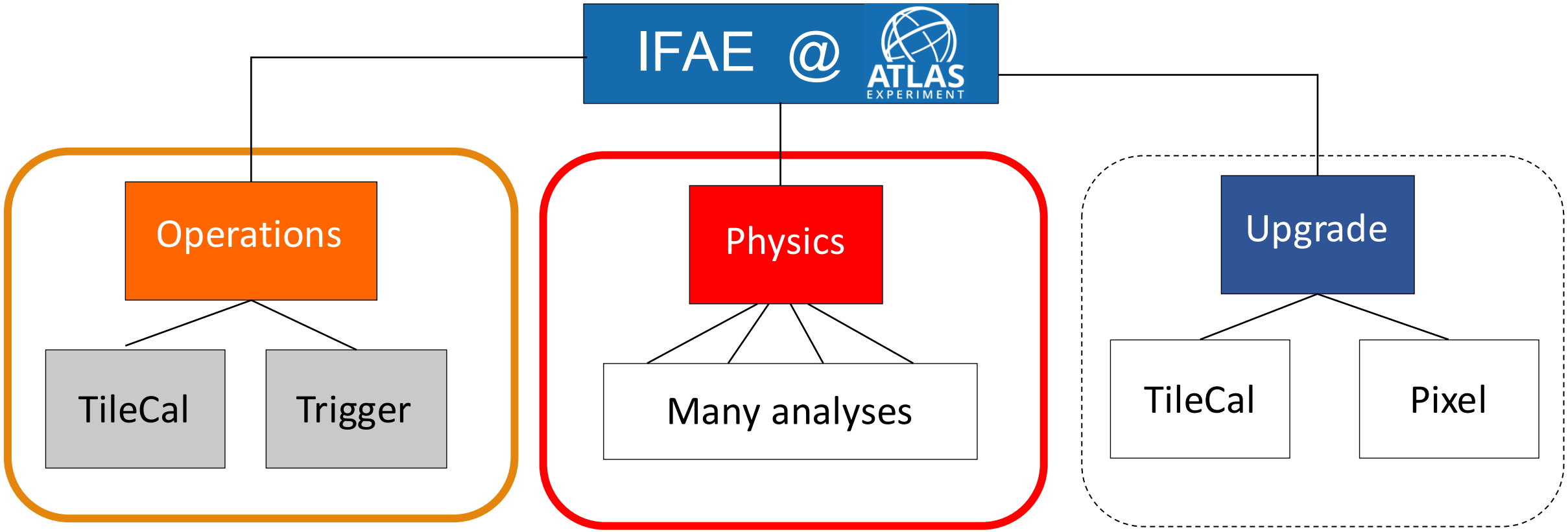
Imma Riu
on behalf of the IFAE-ATLAS group

18th May 2026

Meeting with Tsung-Dao Lee Institute

IFAE
Institut de Física d'Altes Energies
EXCELENCIA SEVERO OCHOA

Overview of IFAE activities in ATLAS



See talk by S. Grinstein

Operations: Tile Calorimeter and Trigger

Major contributions to TileCal

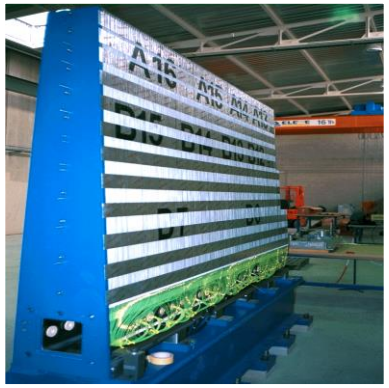
- Construction of one "**Extended Barrel**"
  - All 64 modules assembled and instrumented at IFAE

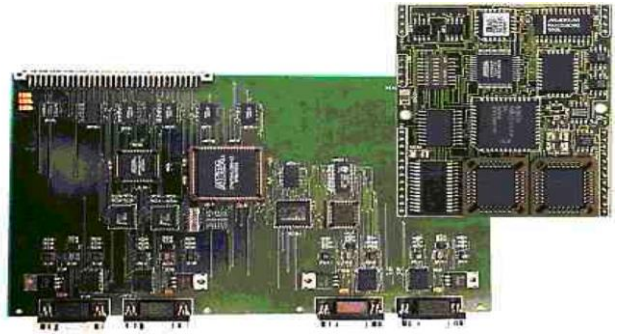
Current activities

- Contributing with shifts and Tilecal run coordination
- Studies of TileCal performance and detector aging
- Luminosity measurement with TileCal integrator

HL-LHC upgrade activity

- Design and production of 40% of 1024 mini-drawers
- Plan to participate in the assembly and installation



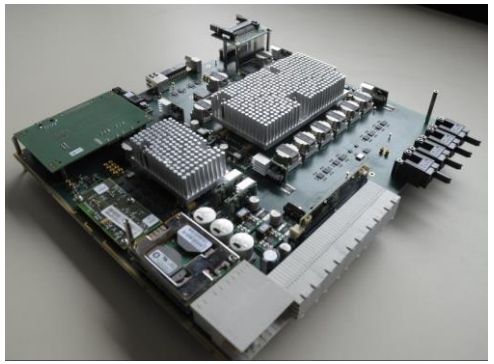


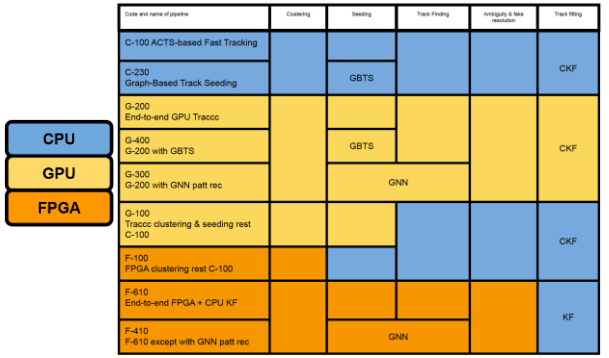
Major contributions to Trigger

- Commissioning and operation of the trigger since Run 1
- Held various coordination roles through the years
- Contributions to HLT infrastructure, tau trigger, jet trigger
- Responsibility of the simulation and commissioning of the L1 Topological trigger in Run 2 and currently in Run 3

HL-LHC upgrade activity

- Participation in the Event Filter Tracking activity
  - Performance evaluation and GPU code optimization
- Coordinating the Phase-II physics and performance group and participating in the trigger algorithms review panel





Current physics analyses in IFAE

Top physics

Top-quark measurements
- 4-top production
- ttH/tH

BSM physics

Extended Higgs sector
- Heavy Higgs bosons
- Light scalars

SUSY
- Electroweakinos

Other new particles
- Vector-like leptons
- Leptoquarks

Model-agnostic searches

Multi-Higgs physics

HH/HHH searches
- HH → 4b / 2b2τ
- HHH → 6b / 4b2τ

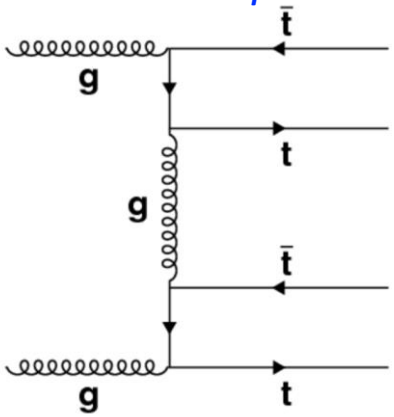
Generally motivated by excesses observed in previous analyses

Top and top/Higgs analyses

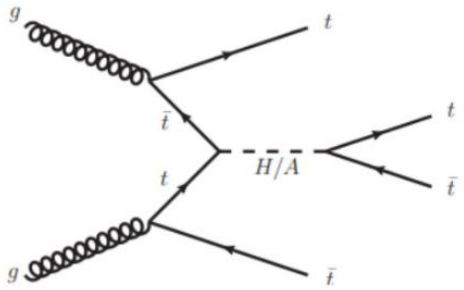
Analyses of four top quark events

- Both **SM production measurement** and **search for heavy Higgs decays to a pair of top-quarks**
- Involved in the 2lSS/≥3l final states
- Using full Run 2 and partial/full Run 3 data

SM 4-tops

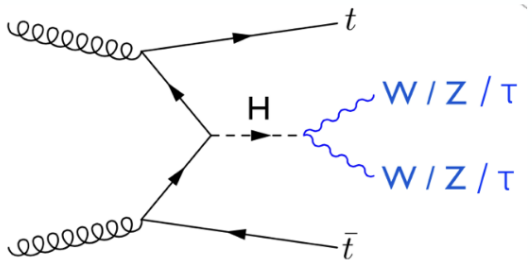


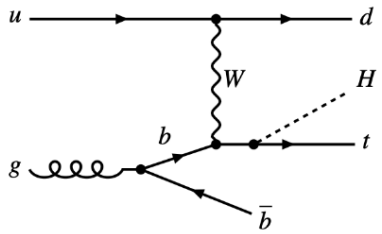
BSM 4-tops

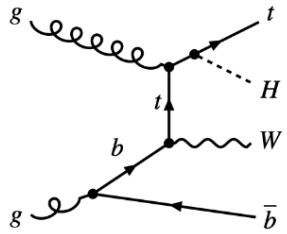


Simultaneous search for ttH/tH production

- Focus on the 2lSS/≥3l channels, most sensitive
- Plan to measure inclusive and differential STXS cross-section
- Using full Run 2 and full Run 3 data

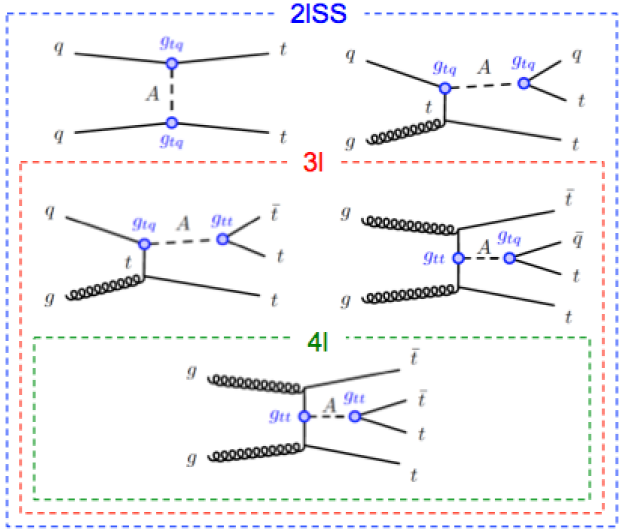






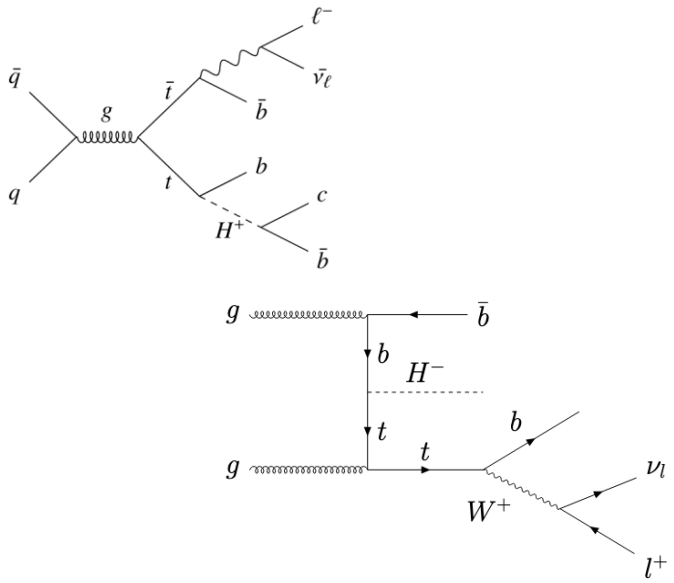
BSM – new scalars and anomaly detection

- **Search for flavour-violating neutral scalars as predicted by a General 2HDM** with a sophisticated search of multiple channels including taus



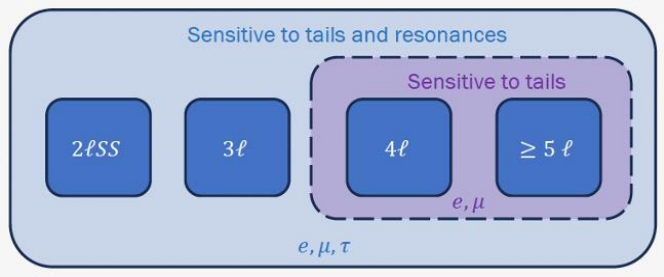
- Previous analysis found a local excess of 2.8σ at m_A=900 GeV and large flavour-violating g_{tu} coupling

- **Search for charged Higgs $H^+ \rightarrow cb$** with full Run 2 and partial Run 3 in a wide mass range and using c-tagging



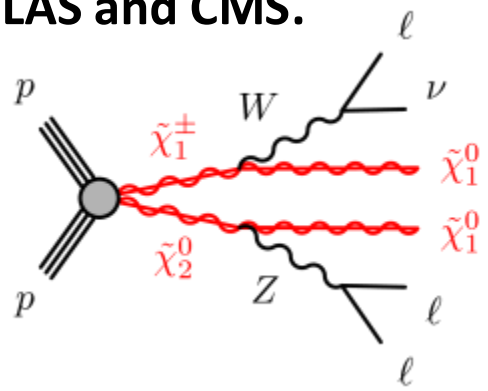
- Previous analysis found a local excess of 3σ at m_{H+}~130 GeV, consistent with mass resolution

- **Anomaly detection search with multi-lepton events**
- Novel **model-agnostic search** using an anomaly score to detect non-SM-like events
- Extends the previous analysis with more multi-lepton channels

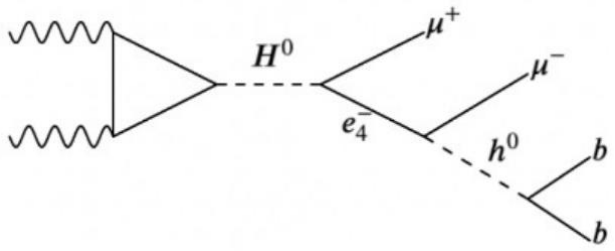


BSM – SUSY/VLL/LQ

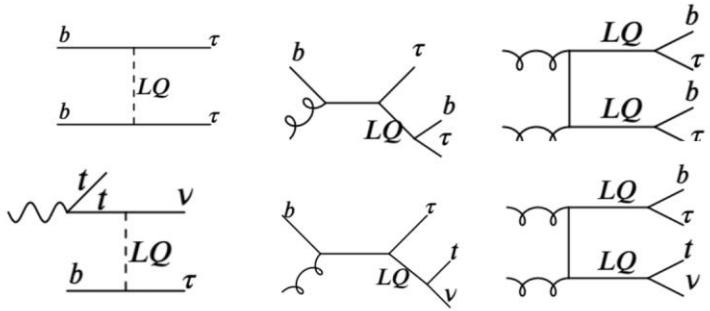
- **Search for chargino/neutralino** in 2l/3l+Etmiss
- New analysis targeting a previously unexplored signature using Run 2 + Run 3 data.
- **Following previous excess by ATLAS and CMS.**



- **Search for Vector-like Leptons** in 2l+bjets in a VLL+2HDM model
- New analysis targeting yet an unexcluded region
- Decay to VLL singlet for VLL mass > 320-400 GeV and heavy Higgs mass > 350-400 GeV



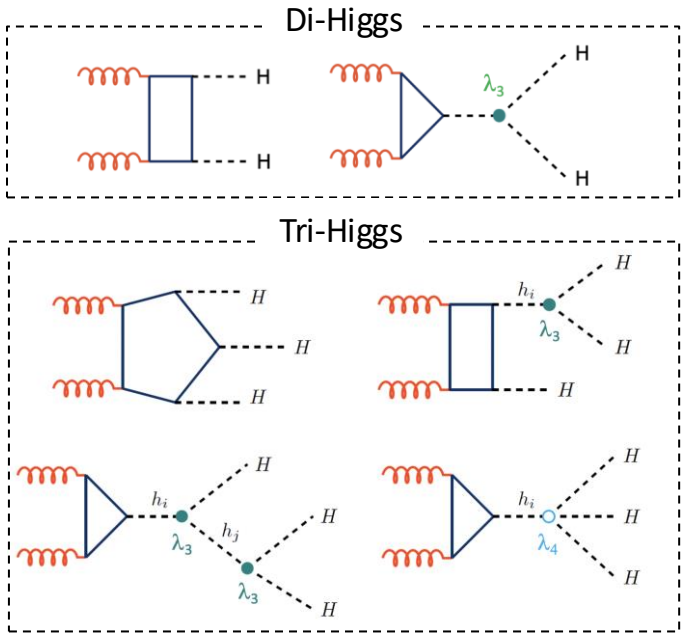
- **Search for 3rd generation Leptoquarks in tau final states**
- Probing in a **single search all relevant production and decay modes**
- Covering non-resonant and single/double resonant
- To interpret in the coupling-mass plane. Sensitive to space consistent with R(D), R(D*) anomalies



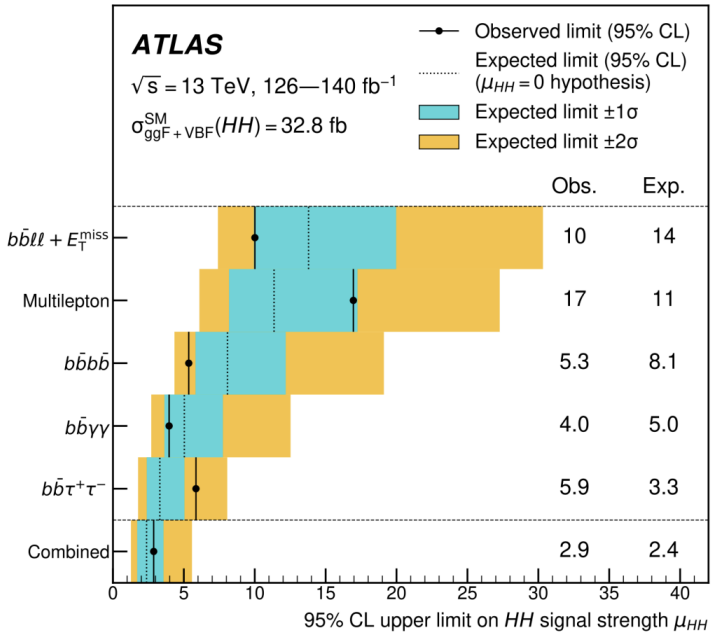
Multi-Higgs searches

- **Important analyses to probe the shape of the Higgs potential by measuring the Higgs self coupling** (trilinear and quartic)
- Involved in some of the highest profile **di-Higgs** and **tri-Higgs** physics analyses channels:

- **Di-Higgs:**
  - HH → bbττ
  - HH → 4b
- **Tri-Higgs:**
  - HHH → 4bττ
  - HHH → 6b



ATLAS Run 2



About the IFAE ATLAS physics group (1)

Name	Seniors (7)
M. Bosman	IFAE Research Prof. Emeritus
A. Juste	ICREA Research Prof.
I. Korolkov	IFAE Researcher
Ll. Mir	IFAE Researcher
I. Riu	IFAE Researcher
A. Pacheco	Senior Applied Physicist (Computing)
T. Vázquez	ATRAE Tenure

Name	Postdocs (3)	Fellowship / project
D. Bogavac	Postdoc (TileCal/analysis)	BdP (Jan 2028)
M. Aparo	Postdoc (Trigger/analysis)	JdC (Aug 2028)
N. M. Tamir	Postdoc (Trigger/analysis)	ATRAE Project

Name	PhD Students (9)	Fellowship / project
A. Berrocal	TileCal/analysis	FI AGAUR
G. Correa	Trigger/analysis	FI AGAUR
H. Moyano	Trigger/analysis	FPI MICINN
A. Odella	Egamma/analysis	FPI MICINN
P. Tricarico	Tilecal/analysis	National physics project
P. Mitra	Trigger/analysis	FI AGAUR
S. Rai	Tilecal/analysis	National physics project
C. Prat	Phase-II/analysis	ATRAE project
S. Rijal	Phase-II/analysis	ATRAE project

Since Dec 2010:

- 28 PhD theses defended
  ~2 PhD theses per year
- **More than 60% of the students stay in research after PhD.**

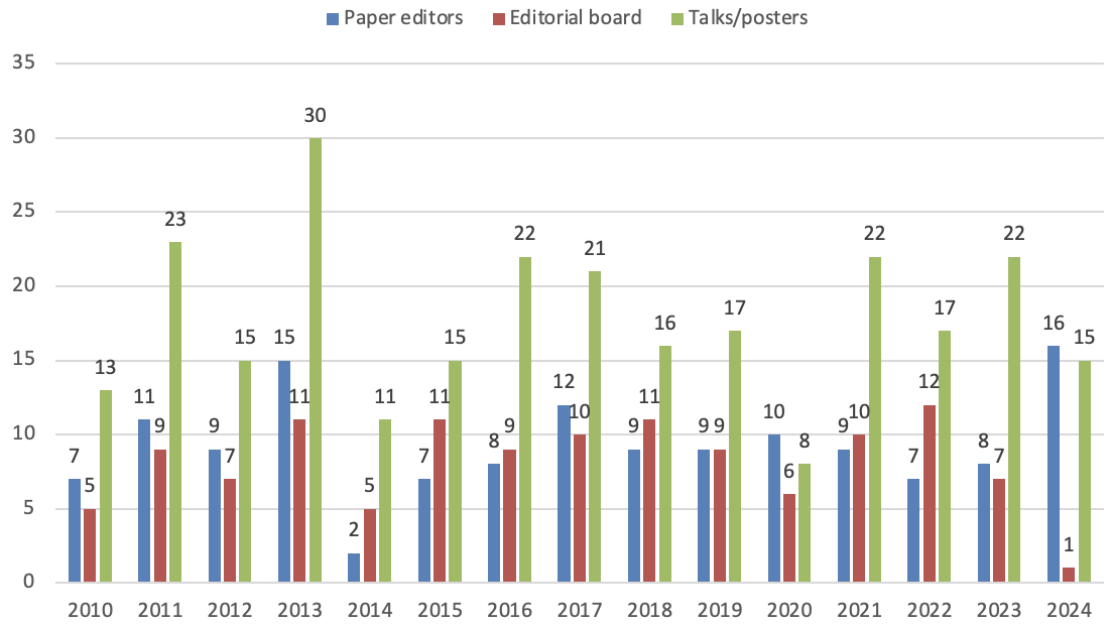
Large and dynamic group of 7+3+9 = 19

About the IFAE ATLAS physics group (2)

Current membership
New since Jun 2023

Since 2010 (non-exhaustive)

IFAE-ATLAS paper/EdBoard/talks+posters



IFAE plays a leading role in ATLAS papers.

ATLAS Management

- Collaboration Board chair (M. Cavalli-Sforza(1997-2000), M. Bosman)
- Collaboration Board Chair Advisory Board (I. Riu)
- Publication Committee (M. Martínez, Ll. Mir, A. Juste(chair))
- Speakers Committee (C. Padilla, A. Juste (chair), I. Riu)
- Speakers Committee Advisory Board (I. Riu(chair), C. Padilla)
- National Contact Physicist (M. Bosman)

Physics Coordination

- Exotics Leptons, Z', W' and LFV subgroup (N. Agaras)
- Higgs Beyond the SM subgroup (N. Orlando, I. Riu)
- Top Properties and Mass (J. Jiménez)
- Exotics analysis group (A. Juste, T. Vázquez)
- SUSY analysis group (J. Montejo)
- LHC BSM group convenor (T. Vázquez)
- **Physics coordination (A. Juste, Oct 2025)**

Detector/Trigger Operations

- Tile Management Board, Tile Test beam coordinator (I. Korolkov)
- Tile Run/Operations Coordinator (J. Glätzer, R. Rosten, D. Bogavac)
- Tile Trigger Coordinator (D. Bogavac)
- L1Topo Commissioning Coordinator (D. Gerbaudo, I. Riu, N. Orlando, J. Jiménez)
- Tau trigger signature Coordinator (I. Riu)
- Trigger menu and signatures Coordinator (I. Riu)
- TDAQ EF tracking performance Coordinator (M. Aparo)
- Phase-II: Performance, Physics, Event Selection Coordinator (T. Vázquez)
- TDAQ Institute Board chair (I. Riu)

Data Preparation/Computing/Software

- Distributed Production and Analysis Coordinator (A. Pacheco)
- Workflow Management Coordinator (A. Pacheco)
- ATLAS Distributed Computing Coordinator (A. Pacheco)

Outlook

- Shown our **interesting and diverse physics program in ATLAS**
- Would be **happy to identify common topic(s) of interest** to collaborate with you
- Could **investigate the posibilities that you offered us**:
  - Sharing of PhD students
  - Sharing of Postdoctoral fellows
  - Other possibilities

Looking forward to collaborating with you in the near future