

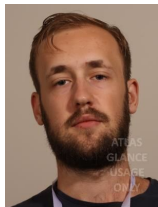
FJPPN HEP_18

2026 Mini-workshop

@ LAPP

FJPPN HEP_18 Project

“Beyond the SM physics probed with Higgs boson pair production in the ATLAS experiment”



France

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Hind TAIBI

Nicolas BERGER

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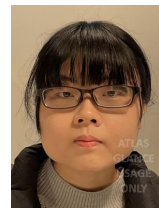
Kosuke ITABASHI

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Rina KUGO

Yu NAKAHAMA

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HEP_18 project: Focus points

This project aims to strengthen the France–Japan collaboration toward **the first observation of Higgs boson pair (HH) production** and the **measurement of the Higgs self-coupling** using the **full Run 2 and Run 3 datasets**. We focus on the search for HH production in the **HH→bb $\gamma\gamma$** and **4b** channels. Since no single HH channel provides sufficient sensitivity on its own, **statistical combinations** of multiple channels will also be performed. In the **HH→4b channel**, a **search for resonances** decaying to HH pairs will also be performed.

A particular focus of the project is **high-momentum (“boosted”) Higgs boson decays**, which are expected to be particularly sensitive to BSM physics. These configurations are relevant to the study of **HH→4b**, and will also be explored in high-momentum **H→ $\tau\tau$** decays, which provide similar challenges.

The project also emphasizes the development of **object identification** and **jet flavor tagging** algorithms, along with their calibration, as these are key technologies for improving H and HH analyses, in particular in the H→bb and H→ $\tau\tau$ channels

HEP_18 project: Timeline & Activities

- **2026:** Establish **calibration of boosted $H \rightarrow b\bar{b}$ and $H \rightarrow \tau\tau$ taggers** and perform the **first search for non-resonant and resonant signal** using this technique with **Run 2 and partial Run 3 data**. Huge improvement in search sensitivity is expected thanks to the new Higgs tagger.
- **2027:** Advance object identification and core analysis development for $HH \rightarrow b\bar{b}\gamma\gamma$, $HH \rightarrow 4b$ toward the full Run 3 analysis
- **2028:** **Complete the $HH \rightarrow 4b$ and $b\bar{b}\gamma\gamma$ analyses using the full Run 3 dataset**
- **2029:** **Combine HH results** with other HH channels within ATLAS; produce final Run 3 HH results combining **ATLAS and CMS data**, aiming for the **first observation of Higgs pair production**. Interpret results in the context of **Effective Field Theories (EFT)**, which provide a general framework to describe deviations from the SM.

Work with/on Omni
boosted $H \rightarrow \tau\tau$ tagger

Work with/on GN3X
boosted $H \rightarrow b\bar{b}$ tagger

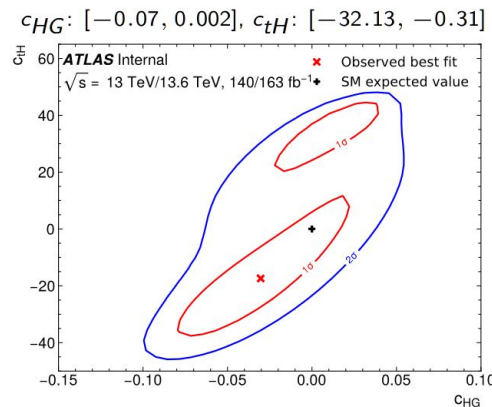
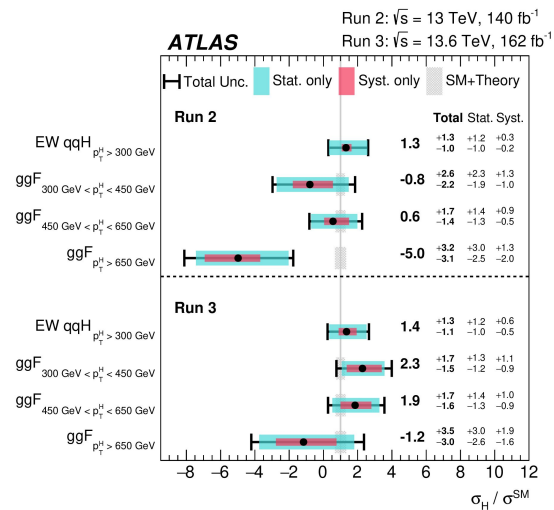
Contributions to partial-Run 3
and full-Run 3 ($X \rightarrow$)HH analyses

Contributions to ATLAS
full-Run 2 H+HH combination

Contribution to EFT interpretation
of H and HH analyses

LAPP activities: boosted $H \rightarrow \tau\tau$

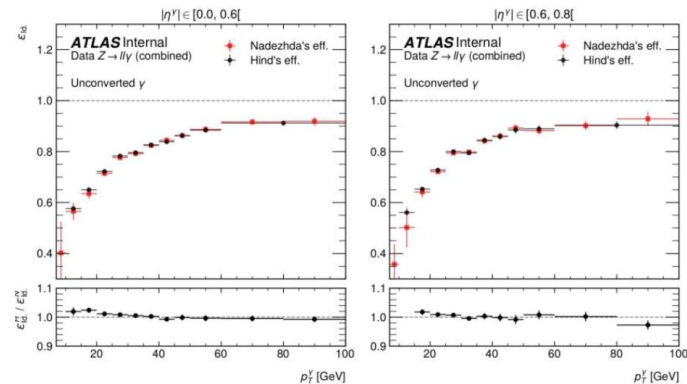
- Boosted $H \rightarrow \tau\tau$ in Run 2 + partial Run 3
 - ✓ Differential measurement for $p_T^H > 300$ GeV
 - ✓ STXS measurements in ggF and EW qqH production
 - ✓ Work on STXS measurement framework, statistical implementation, TES modeling, ...
 - ✓ [Paper](#) published this summer
- Ongoing work on EFT interpretation + HL-LHC extrapolation.
 - ✓ PUB note planned for the end of the year



LAPP activities: $HH \rightarrow bb\gamma\gamma$

- Photon ID

- Implement setup to calibrate Photon ID using $Z \rightarrow l\bar{l}\gamma$ events in Run 3
- Applied to calibrating existing *Tight* photon ID
- Next step: move to BDT-based photon ID, which should gain 5-10% in signal yield and HH significance.

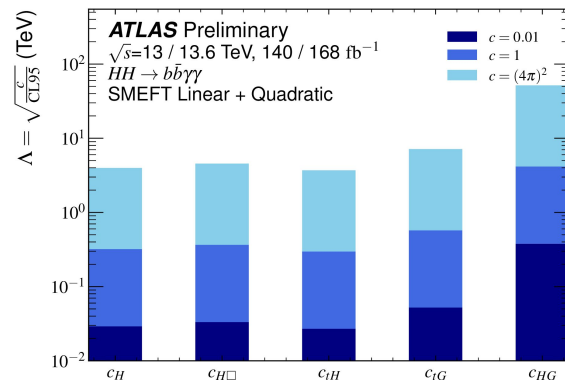


- Analysis strategy

- Studies on improving categorization scheme
- Investigate fitting schemes: “1D” ($m_{\gamma\gamma}$ fit) vs. “2D” ($m_{\gamma\gamma}$ & m_{bb} fit); also check fitting MVA output ?

- Work on EFT interpretation

- 2025 [PUB note](#) for partial-Run 3 analysis



Agenda and Goals

Goals

- Learn a bit more about what everyone is doing
- Investigate possible topics of common work
- Plan future activities in the scope of the project

Today's agenda

- Introductory session + discussion (now)
- Lunch
- Presentation on ongoing work + plans in each activity
- Discussion of future activities (Run 3, HL-LHC, other projects ?)

11:00 → 12:00		Introduction	
11:00	Jepn	Orateur: Tatsuya Masubuchi (Osaka University)	20m
11:20	France	Orateur: Nicolas Berger (LAPP)	20m
12:00 → 13:30		Lunch	1h 30m
13:30 → 15:30		Current activities	
13:30	Boosted H→ττ	Orateur: Gianna LOESCHKE CENTENO	20m
13:50	HH→bbττ	Orateur: Issei Horikoshi (Tsukuba University)	20m
14:10	Photon ID for HH→bbγγ	Orateur: Hind Taibi	20m
14:30	HH→bbγγ	Orateur: Kazuki Kojima (KEK Tsukuba)	20m
14:50	HH→bbγγ	Orateur: Oleksii KURDYSH (LAPP)	20m
15:10	Boosted X→HH→bbbb	Orateur: Rina Kugo (Osaka University)	20m
15:30 → 16:30		Future plans	
15:30	Plan for next few years i.e. what to write for next-year's proposal		20m
15:50	Future directions: HL-LHC		20m
16:10	Future directions (if enough time): future colliders		20m

Practicalities

Morning and afternoon talks will be in “Salle Palmier”

Lunch + coffee will be served in the patio downstairs during the break after this talk.

Dinner in a local restaurant (Rita, [here](#)) is reserved for 19:00 tonight.

11:00 → 12:00 Introduction

- 11:00 Japan**
Orateur: Tatsuya Masubuchi (Osaka University)
- 11:20 France**
Orateur: Nicolas Berger (LAPP)

12:00 → 13:30 Lunch

13:30 → 15:30 Current activities

- 13:30 Boosted H → $\tau\tau$**
Orateur: Gianna LOESCHKE (CENTENIO)
- 13:50 HH → b $\bar{b}\tau\tau$**
Orateur: Issai Horikoshi (Tsukuba University)
- 14:10 Photon ID for HH → b $\bar{b}\gamma\gamma$**
Orateur: Hind Taibi
- 14:30 HH → b $\bar{b}\gamma\gamma$**
Orateur: Kazuki Kojima (KIX Tsukuba)
- 14:50 HH → b $\bar{b}\gamma\gamma$**
Orateur: Oleksii KURDYSH (LAPP)
- 15:10 Boosted X → HH → b $\bar{b}\bar{b}\bar{b}$**
Orateur: Rina Kugo (Osaka University)

15:30 → 16:30 Future plans

- 15:30 Plan for next few years i.e. what to write for next-year's proposal**
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