Highlight from IHEP ATLAS group

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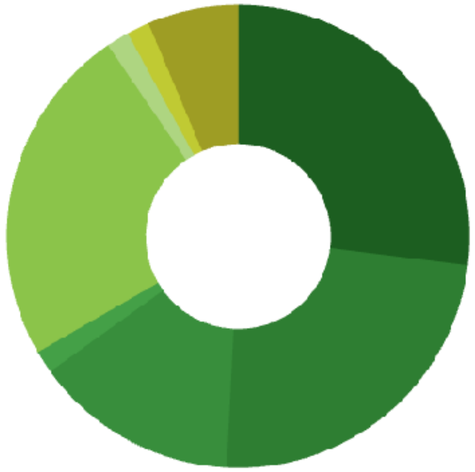
郑州大学，2026.4.25

Introduction to IHEP ATLAS group

高能所ATLAS团队 | ATLAS IHEP TEAM

高能所ATLAS团队由17名职工（12名海外引进人才）、30多名博士后和研究生组成

娄辛丑(千人A)、Joao Costa(外专千人)、庄胥爱(百人)、 方亚泉(青千)、黄燕萍(青千)、梁志均(百人)、史欣(青千)、李 一鸣(青千)、吕峰、单连友、徐达、徐子俊(百人)、赵梅、张杰 、Hideki Okawa (青千)、Bruce Mellado (百人A)、叶竞波 (百人A)、



- **17** Physicist
- **15** Physics PhD student
- **9** Physics masters/diploma student
- **1** Undergraduate/summer student
- **15** Engineer with PhD
- **1** Engineer without PhD
- **0** Engineering student
- **1** Technician or equivalent
- **4** Administrator/other

- **26** on Authorlist (A)
- **8** Signing-Only (a)
- **15** counted for M&O (M)
- **10** qualifying members (q)
- **30.75** for Operation Tasks (O, o)

OTP Status in 2025

OTP Type	Required	Fullfilled
Class 1&2 (online/offline shifts)	354	48.01
Class 3 (CP, MC, etc)	6.52 FTE	3.12 FTE
Class 4 (Computer service)		2.15 FTE
Upgrade	12.5 FTE	17.44 FTE

- Upgrade reaching at ~ 140% fullfillment
- Class 4 OTP from computer service
- Class 3 efforts on e/gamma /muon/tau software/reconstruction/performance, reaching ~47% fullfillment
- Class 1 &2 (online/offline shifts): fullfillment is a bit low, need to make more effort in future

Appointments in ATLAS (2025 - 2026)

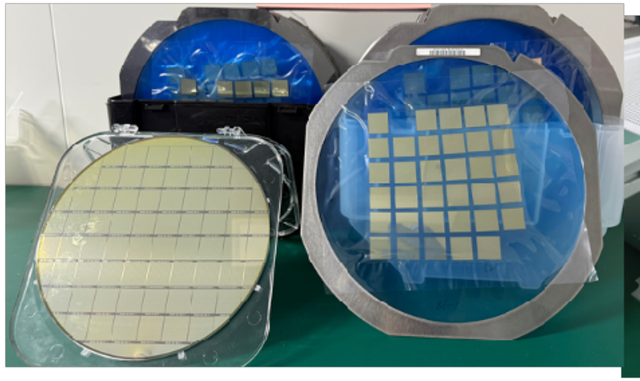
- **2 Level-1 leadership:**
  - **Zhijun Liang, deputy project leader for HGTD project (2025.3 - 2027.2)**
  - **Bruce Mellado, Tile System Deputy Project Leader (2024.6 - 2028.2)**
- **ATLAS Speaker committee member: Yanping Huang (2024.10 - 2027.9)**
- **8 Level-2 convenorship: Bruce Mellado, Da Xu, Jie Zhang, Mei Zhao, Zhijun, Lei Fan, Zhaoru**
- **3 Level-3 convenorship: Shuo Han, Yanping Huang, Yunyun Fan**

Appointment	Member	Start date	End date
HGTD System Deputy Project Leader // High Granularity Timing Detector (HGTD)	ZHIJUN, Liang	2025/3/1	2027/2/28
Tile System Deputy Project Leader	Bruce Mellado	2024/6/1	2025/2/28
Tile Calorimeter Phase-II Upgrade Resource Coordinator	Bruce Mellado	2023/5/1	2026/12/31
Tile Calorimeter Phase-II Upgrade Power Supplies Coordinator	Bruce Mellado	2018/3/1	2026/12/31
Speakers Committee member // Speakers Committee	YANPING, Huang	2024/10/1	2027/9/30
DP - Reprocessing Coordinator // Data Preparation	DA, Xu	2024/4/1	2025/3/31
LHC Higgs working group (ggF)	Yanping Huang	2025/7/1	2027/6/30
HGTD Electronics Coordinator // High Granularity Timing Detector (HGTD)	JIE, Zhang	2023/3/1	2027/2/28
HGTD Sensors Coordinator // High Granularity Timing Detector (HGTD)	MEI, Zhao	2023/3/1	2027/2/28
HGTD Module Assembly Coordinator // High Granularity Timing Detector (HGTD)	ZHIJUN, Liang	2023/3/1	2027/2/28
HGTD Schedule and Risk Manager // High Granularity Timing Detector (HGTD)	ZHAORU, Zhang	2023/3/1	2027/2/28
HGTD HV System Coordinator // High Granularity Timing Detector (HGTD)	LEI, Fan	2023/3/1	2027/2/28
HGTD support unit Coordinator // High Granularity Timing Detector (HGTD)	YunYun Fan	2025/3/1	2027/2/28
HGTD Peripheral Electronics Coordinator // High Granularity Timing Detector (HGTD)	JIE, Zhang	2023/3/1	2027/2/28
Convener of subgroup: Photons // Higgs and Di-Higgs Physics group	SHUO, Han	2024/10/1	2026/3/31
UK/China cluster production manager:	Xin Shi	2022/3/1	2027/2/28

ATLAS HGTD

- **IHEP played a leading role in HGTD project**
  - **Zhijun serving as the HGTD deputy project leader**
- **IHEP-IME won CERN contract on LGAD sensors**
  - have Produced 4k+ sensors, more than 20% of total
  - Will produce ~20k LGAD (90%) in 2026
  - 3 members awarded ATLAS outstanding achievements
- Finished pre-production for HV power supply (IHEP/SDU)
- Prototyping demonstrator, start module pre-production
- Completed the design of the 2nd PEB

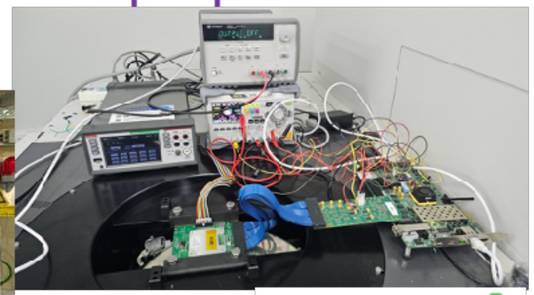
LGAD production

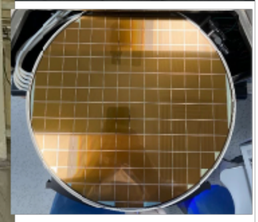


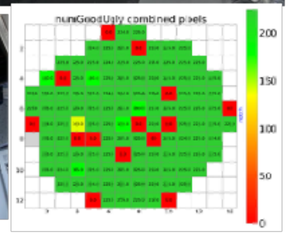
HV power supply pre-production

HGTD Demonstrator during CERN P2UG review

ASIC probing pre-production







3 IHEP members received ATLAS outstanding achievements

CERN Accelerating science

ABOUT NEWS

News › News › Topic: Experiments

Voir en français

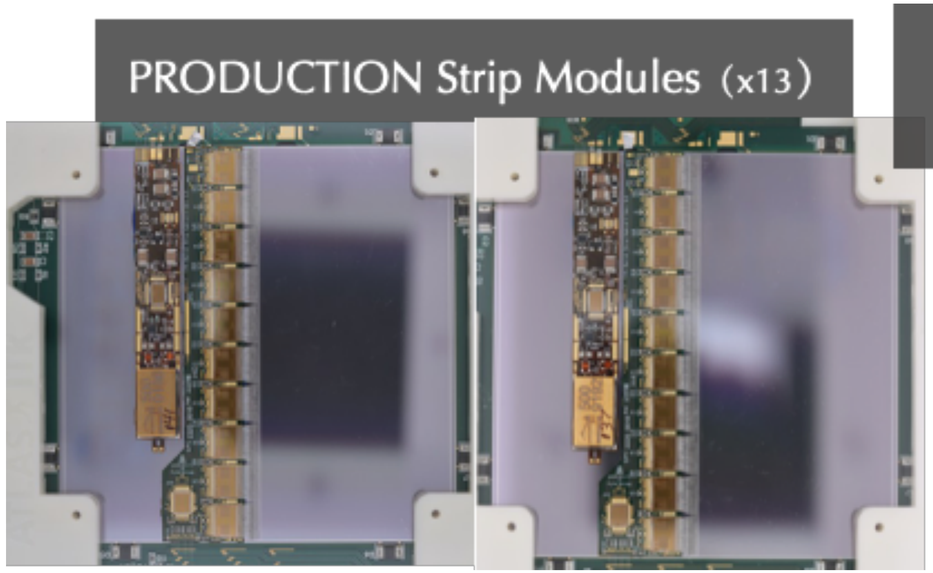
Celebrating the outstanding achievements of the ATLAS collaboration

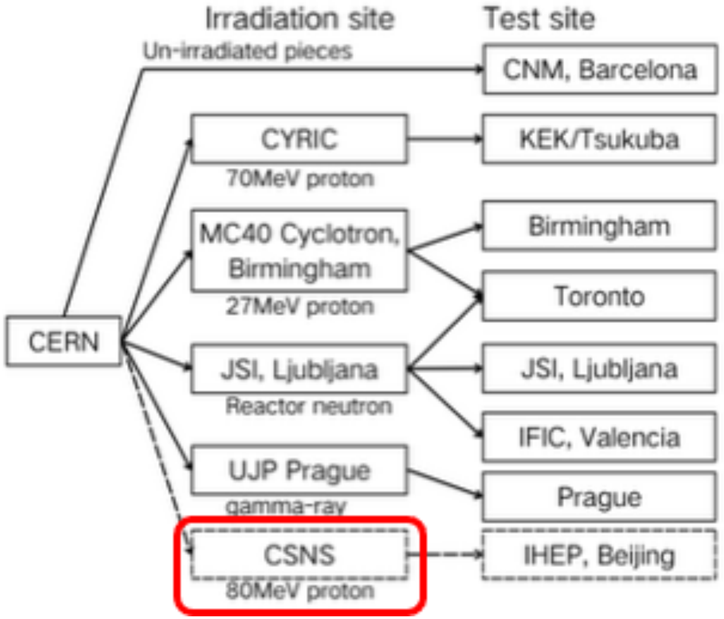
The ATLAS collaboration celebrated the dedication, ingenuity and collaborative spirit of its members at the 8th Outstanding Achievement Awards

8 JULY, 2025 | By ATLAS collaboration

ATLAS Inner Tracker (ITK)

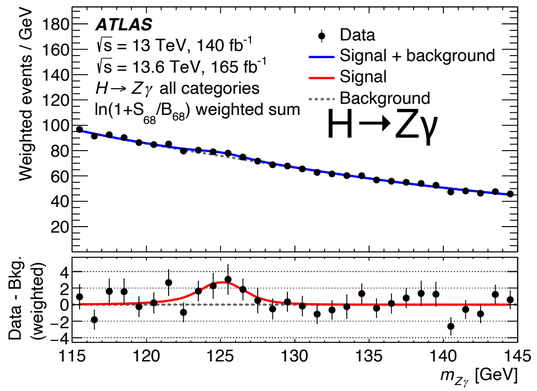
- IHEP lead China-ATLAS ITk barrel team responsible for 1000 strip modules (~**10m², 10%)**
  - Xin Shi as UK/China cluster manager, coordinating 50% of barrel production, passed production readiness review
  - Finished 13 PRODUCTION strip modules at IHEP
  - Passed Sensor Qualification Assurance（QA）site review (CSNS as irradiation site / IHEP as testing site)
  - Contributed to ~150 modules at RAL

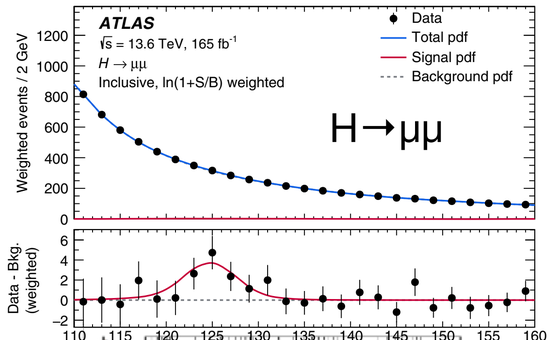


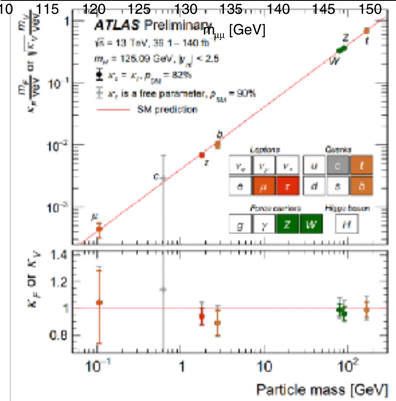


Physics Topic

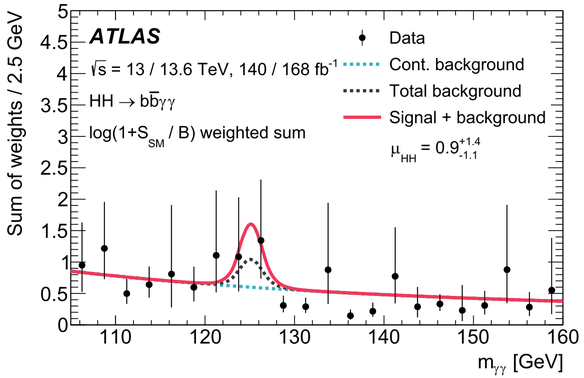
Higgs property measurement

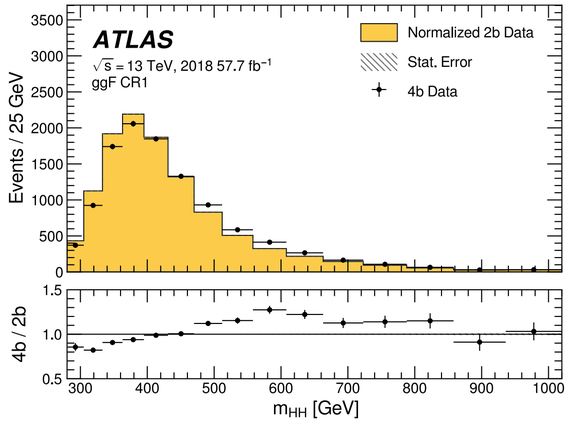


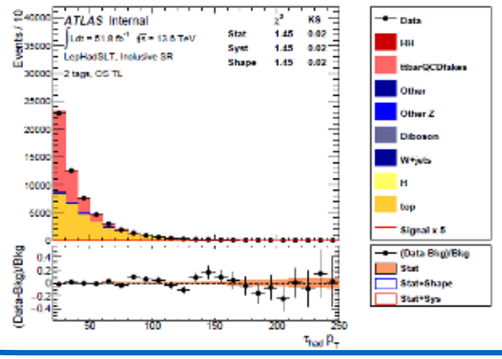




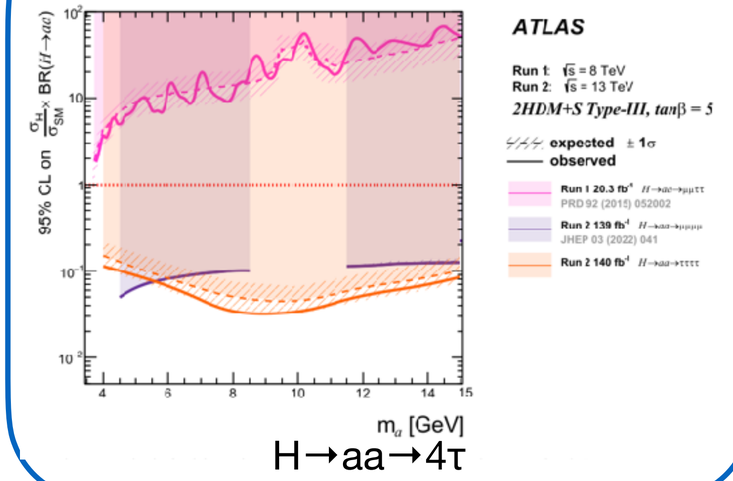
Higgs Self-coupling





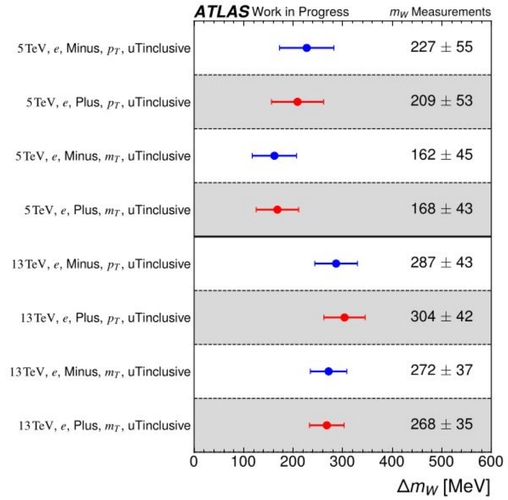


New Physics

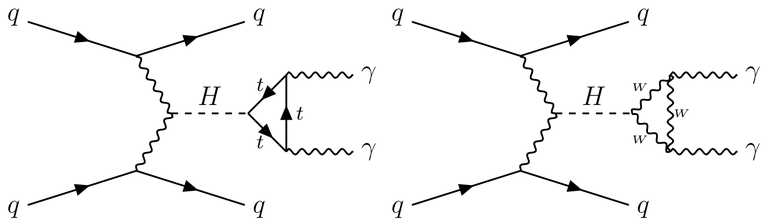


H→aa→4τ

SM precision measurement

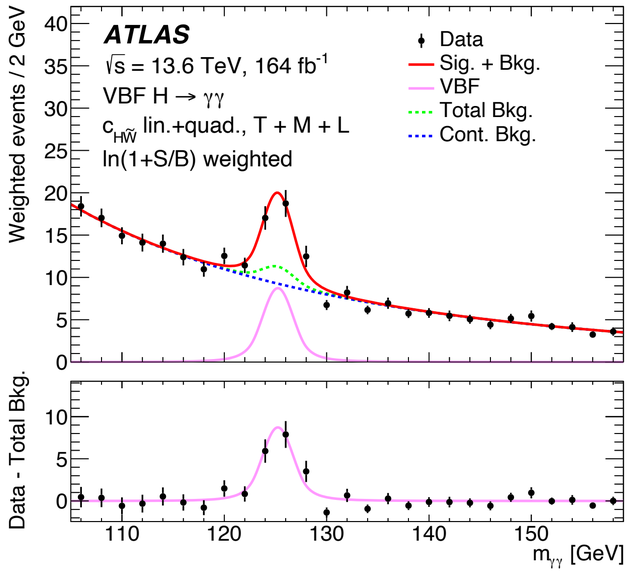


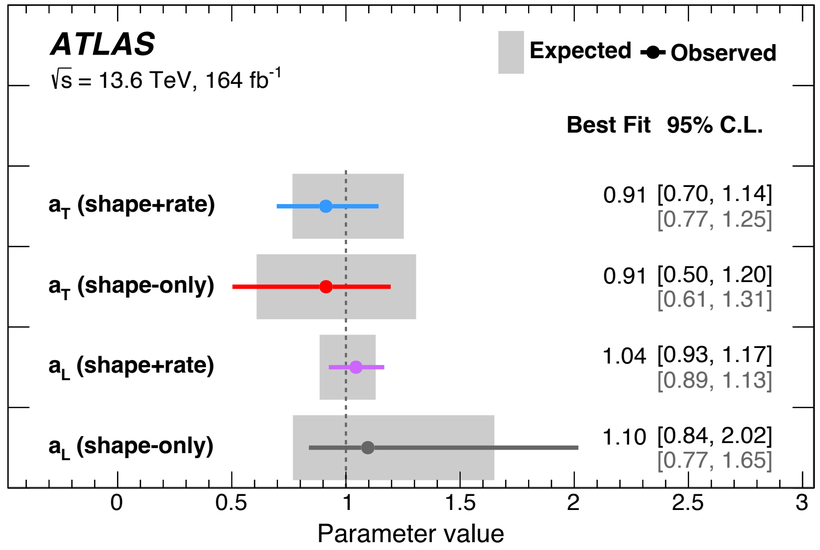
Higgs CP measurement



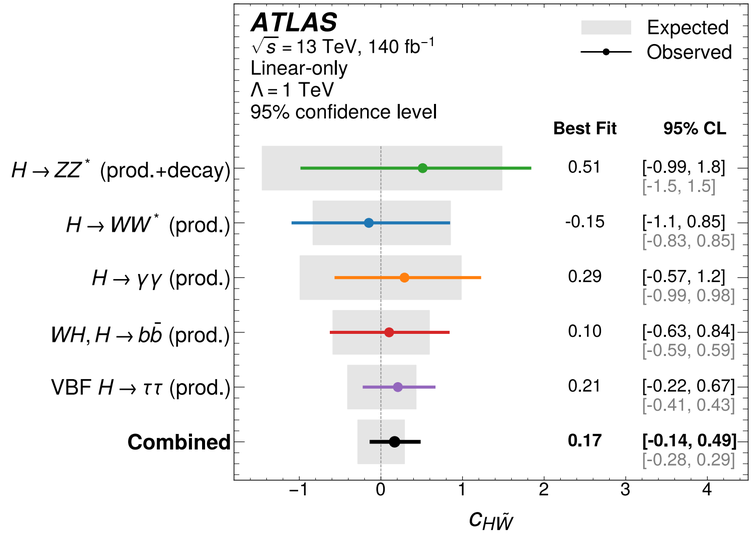
Constraint CP-odd coupling via OO sensitive to HVV vertex

Constraint polarization coupling via Δϕjj





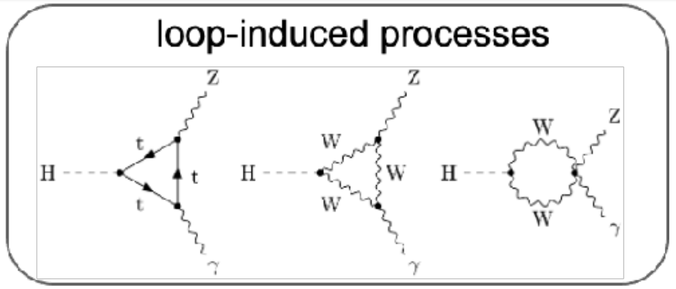
arxiv:2603.20087 (JHEP)



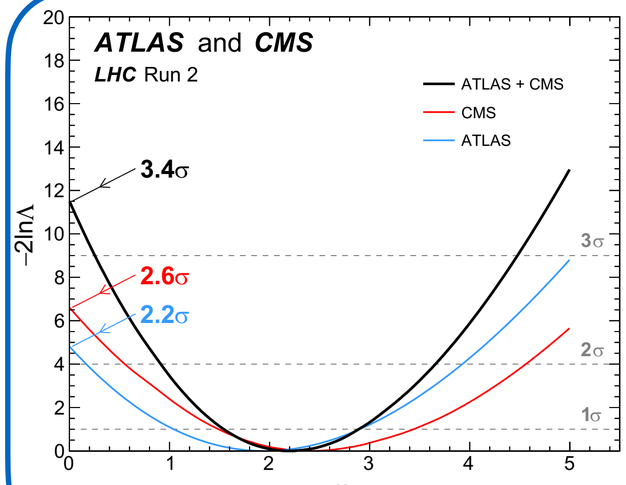
arxiv:2603.20117

- **Run2+ Partial Run3:** Yaquan, Fangyi (Contact), Peng (Editor), Shudong (Approval talk)
  - Run3 constraints on CHW shows a 38% improvement with 29% arising from refined techniques
  - Constraint on polarization coupling reduced by a factor of ~3 w.r.t. H->WW
- **First CP combination on CHW etc:** 40% improvement w.r.t. individual limits

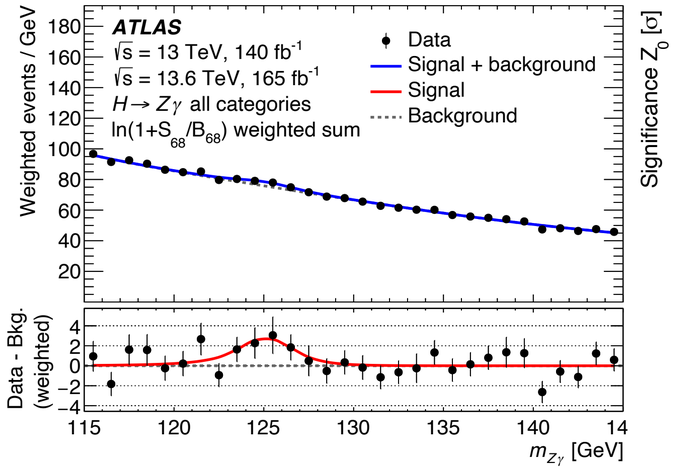
H→Zγ Rare decay Search



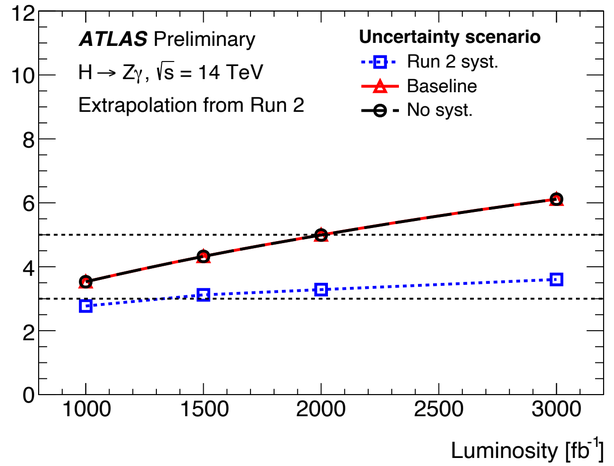
- **Probe the higgs loop interaction**
- **Unique missing part for the suite of Higgs decays into electroweak boson pairs**
- **Challenge: only ~1 H→Zγ event with leptonic decay in 10^{13} pp events**



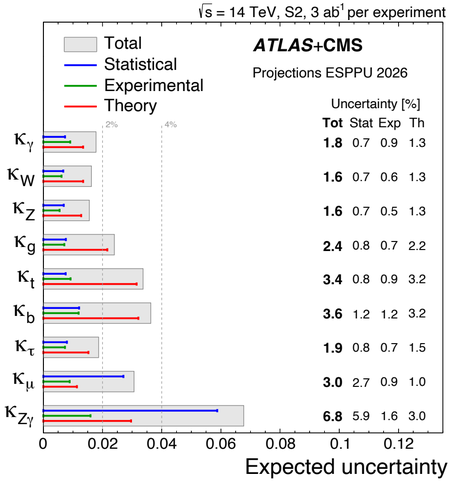
PRL 132 (2024) 021803



arxiv:2507.12598



ATL-PHYS-PUB-2025-014

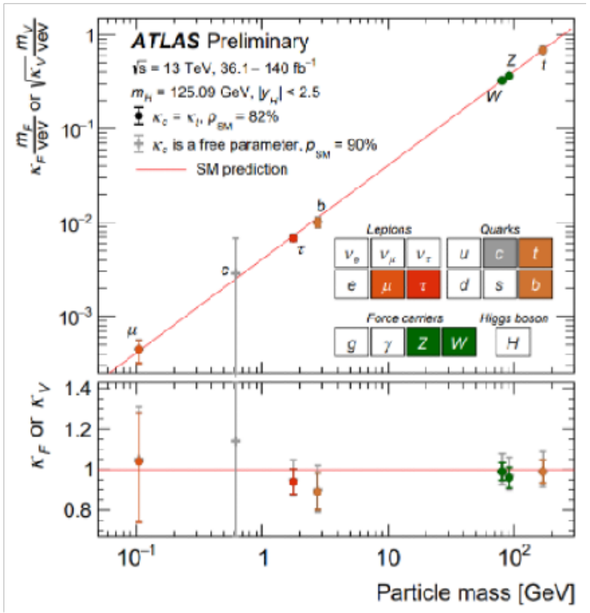


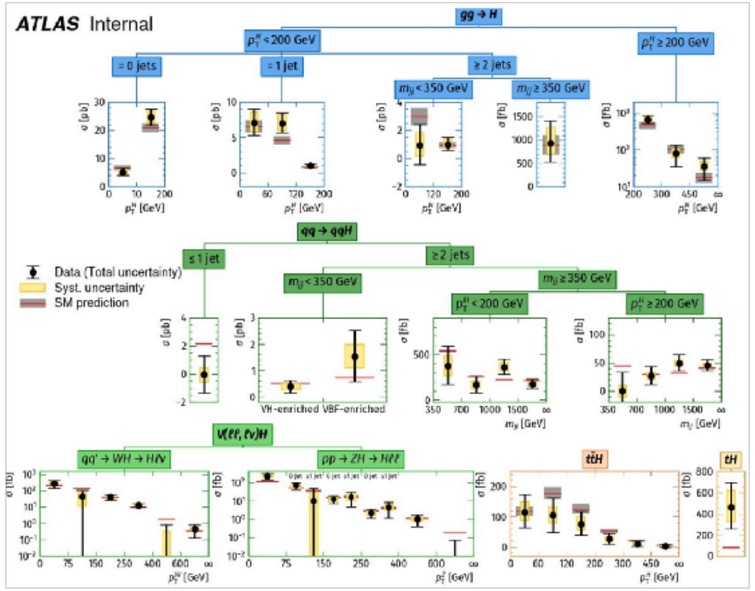
ATL-PHYS-PUB-2025-018

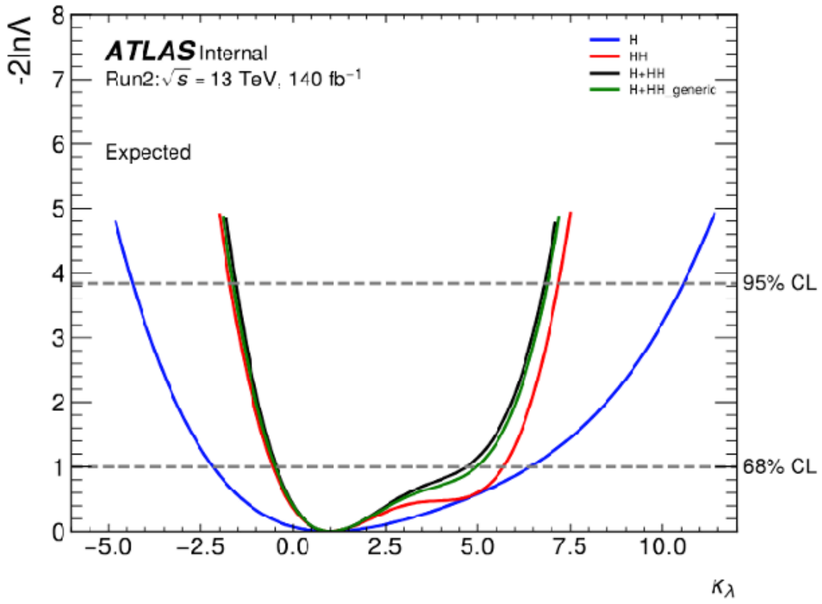
- ❖ **ATLAS-CMS combination: 3.4σ (Obs.) / 1.6σ (Exp.)**
- ❖ **ATLAS Run2 + Partial Run3: 2.5σ (Obs.) / 1.9σ (Exp.)**
  - 19% better expected significance than Run2 ATLAS-CMS combination

- ❖ **Prospect in HL-LHC based Run2 results:**
  - ATLAS-only: 5σ could be achieved already with 2ab^{-1}
  - ATLAS-CMS combination: precision of ~14% with 3ab^{-1}

Run2 legacy Higgs Coupling Global Measurement



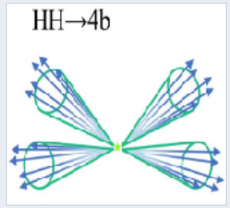




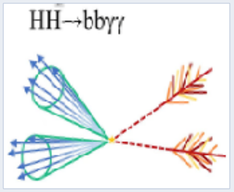
ATLAS-CONF-2025-006

- **Update w.r.t. Nature paper: reanalysis/more data for H→WW/ττ/bb/cc**
  - **Global signal strength precision ~6%**
  - **Improvement: ~28% (ggF), 44%(VBF), 39% (VH), 45%(ttH), 22% (tH)**
- **STXS measurement with refined binning**
- **H+HH combination: 7% improvement on the κλ w.r.t. HH-only, 15% improvement w.r.t. previous round analysis**

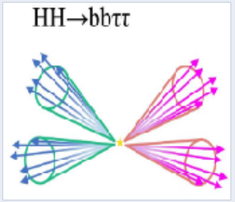
Higgs Self-Coupling measurement



- ✓ 高分支比
- ✓ 但高QCD本底

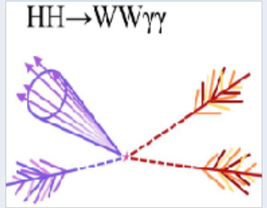


- ✓ 低分支比，背景干净
- ✓ 可重建γγ 质量峰



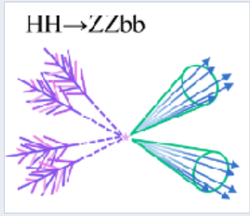
- ✓ 中等分支比
- ✓ 末态干净

	bb	WW	ττ	ZZ	γγ
bb	34%				
WW	25%	4.6%			
ττ	7.3%	2.7%	0.39%		
ZZ	3.1%	1.1%	0.33%	0.069%	
γγ	0.26%	0.10%	0.028%	0.012%	0.0005%



- ✓ 低分支比
- ✓ 低背景
- ✓ γγ 质量峰

- ✓ 分为2LSS, 3L, 4L类
- ✓ 不同策略，压低QCD



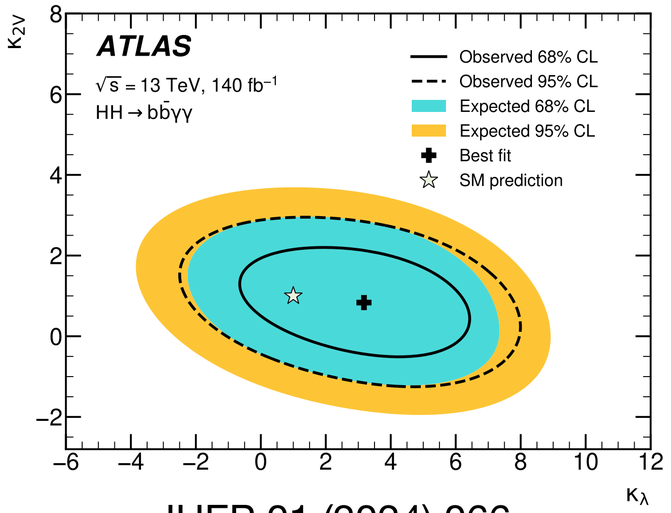
- ✓ ZZ质量峰；
- ✓ 末态干净

IHEP group has been conducting a comprehensive research on Higgs self-coupling measurement

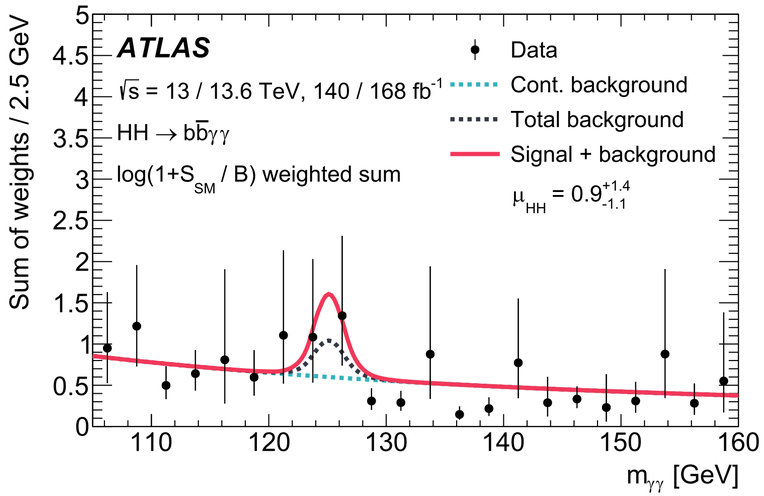
- **HH→bbbb , HH→bbγγ, HH→bbττ**
- **HH→bb+ll**
- **HH→multi-lepton**
- **HH combination**

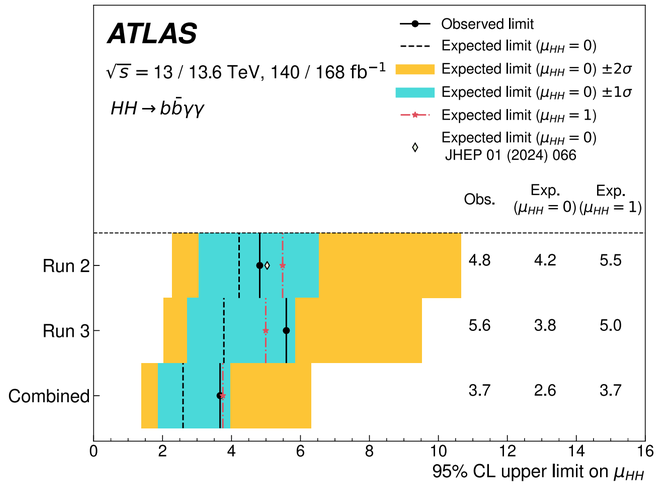
Search for $HH \rightarrow bb\gamma\gamma$

Advantage: high photon efficiency and well resolution for $H \rightarrow \gamma\gamma$ signal extraction



JHEP 01 (2024) 066





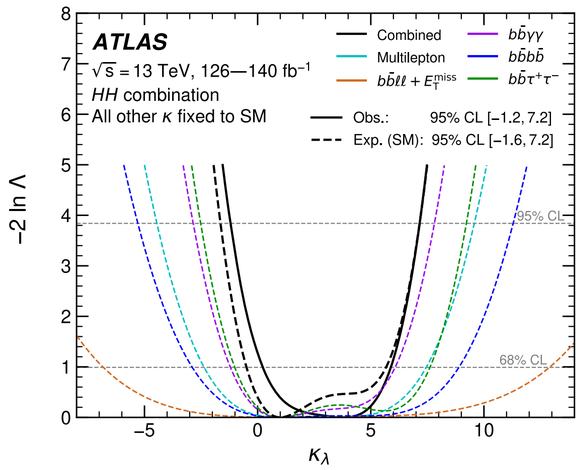
PLB 876 (2026) 140280

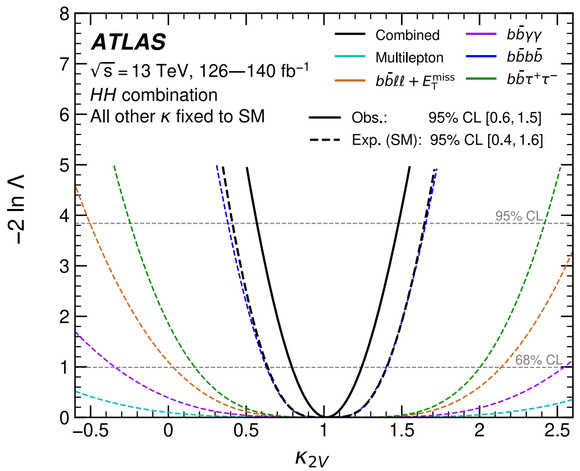
- **Full-Run2 legacy: 4× SM (5× SM)**
- **Run2+partial Run3:**
  - **First HH results to reach 1σ expected significance**
  - **Obs.(Exp.) HH XS: 3.8× SM (2.6× SM)**
  - **Limits set on Higgs self-coupling κ_λ: [-1.7, 6.6], competitive with the Run2 legacy HH combination [-1.2,7.2]**
- **Run2 + Full Run3 is ongoing**

Main improvements over Run2 legacy

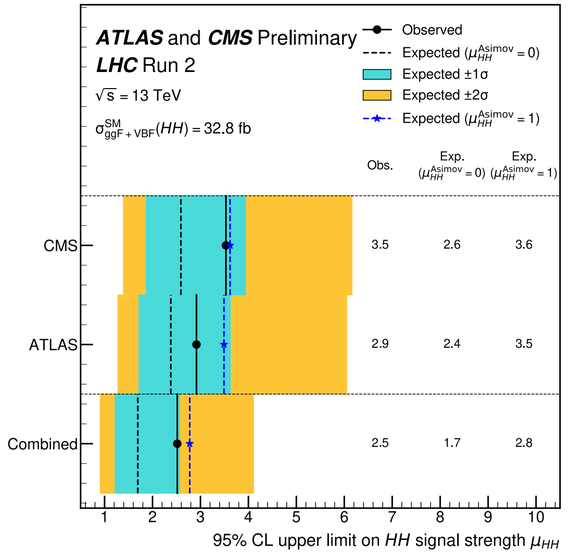
- **More data! 140 fb-1 → 308fb-1 (50%)**
- **New GNN-based tagger GN2 (20%)**
- **Correlation between Run2 and Run3 events in BDT and category optimization (10%)**
- **Kinematic Fit for m_{bb} resolution improvement (5%)**

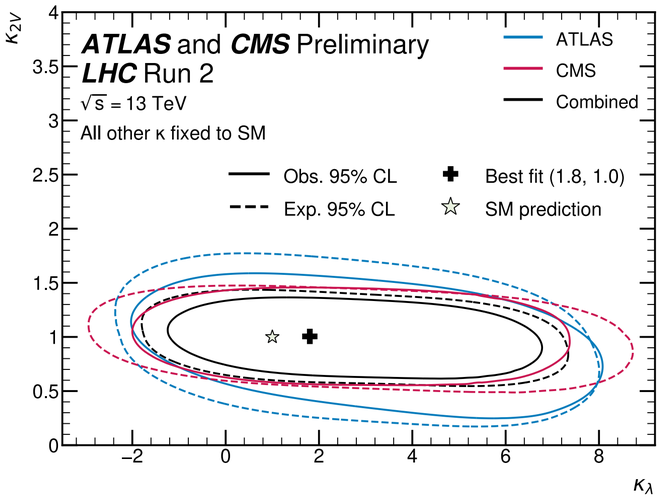
HH combination





PRL 133 (2024) 101801



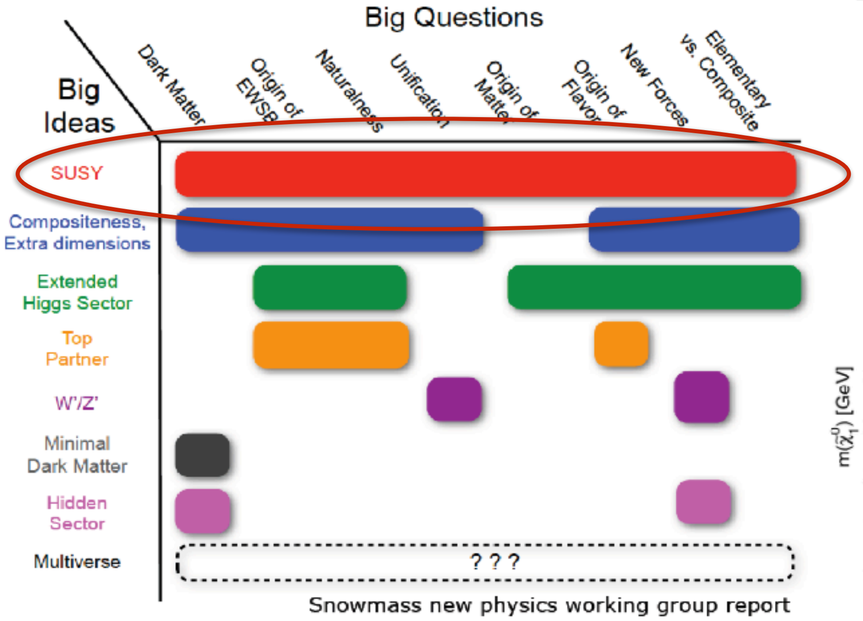


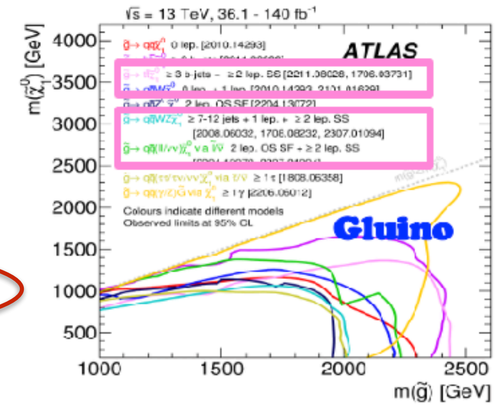
arxiv: 2602.2399

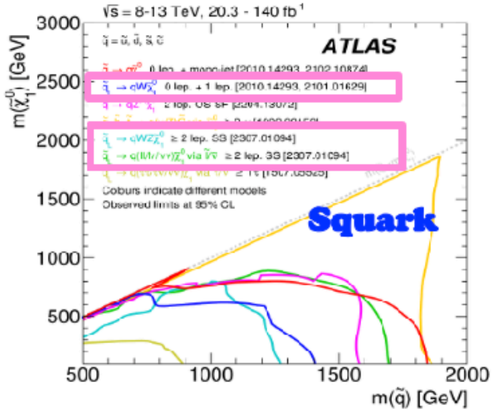
- **Run2 ATLAS HH combination:**
  - **Obs. (Exp.) HH: 2.9× SM (2.4× SM)**
  - **κ_λ limit dominated by $HH \to bb\gamma\gamma$ and $HH \to bb\tau\tau$**
  - **κ_{2V} limit dominated by 4b boosted signature, $\kappa_{2V} = 0$ excluded at $> 4\sigma$**

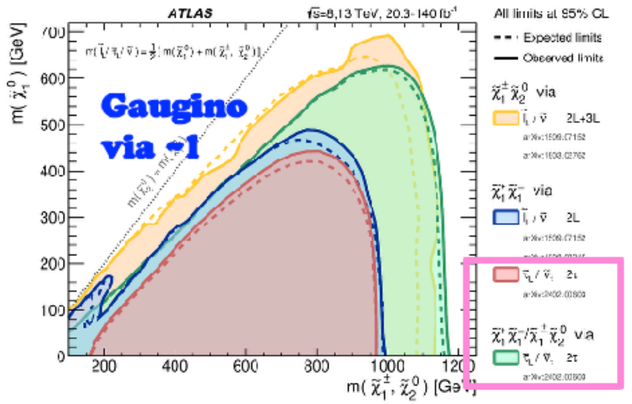
- **Run2 ATLAS-CMS HH combination:**
  - **Obs. (Exp.) HH: 2.5× SM (1.7× SM w.o SM HH/ 2.8× SM w SM HH)**
  - **Obs. (exp) significance: 1.1σ (1.3σ)**
  - **Obs. (exp) κ_λ: [-0.71, 6.1] ([-1.3, 6.7]) with improvement of 10%**
    κ_{2V}: [0.73, 1.3] ([0.66, 1.4]) with improvement of 8%

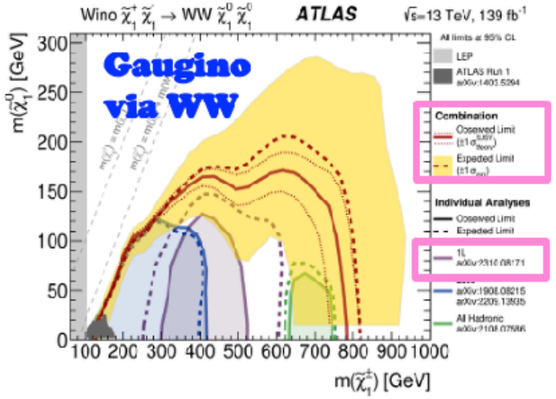
The quest to discover supersysmmetry

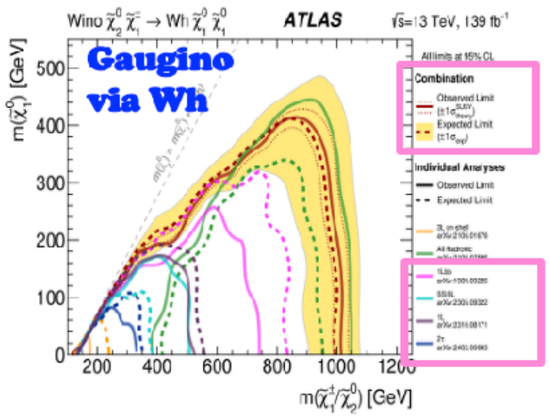


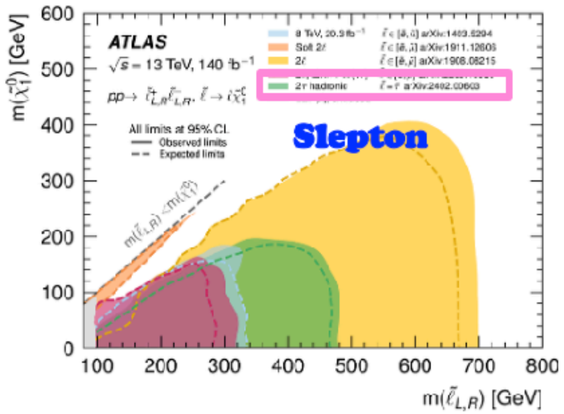












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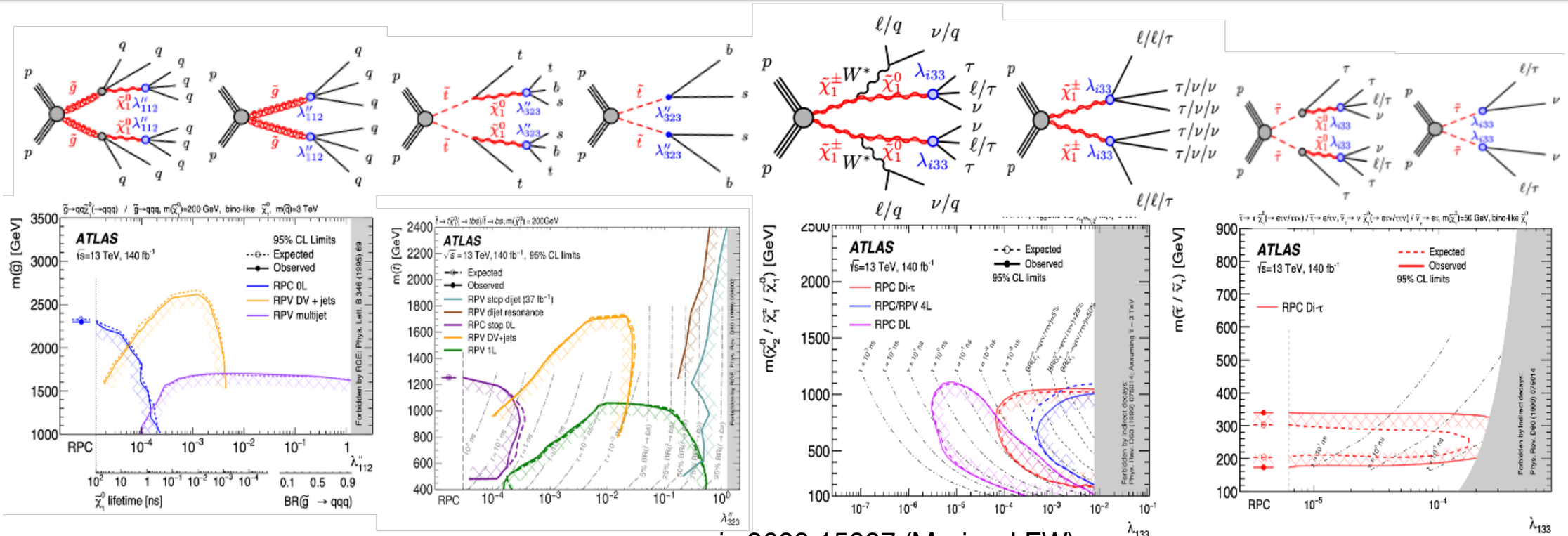
- **Summary paper (Run2): gluinos, squarks, and electroweakinos for scenarios with and without R-parity conservation, models with long-lived particles**
- **IHEP group made leading contributions for most of involved analyses**

Summary paper: PRC-TO-RPV



arxiv:2603.15007 (Moriond EW)

13 results optimized with RPC/RPV SUSY

Reinterpretation

A broad class of RPV framework with variable RPV coupling

- **Achieve significantly improved sensitivity to a diverse range of long-lived particle signatures**
- **Leading contribution: Take as paper editor (Xuai), analysis contact (Yuchen) and give HMBS approval talk (Jiarong)**

Summary

- Achieved important results based on Run2 and Partial-Run3
- Significant room for further sensitivity improvement: more data, better reconstruction/identification/trigger, novel deep learning techniques
- It is important for the cooperation among different institutes/ universities on hardware/software/physics