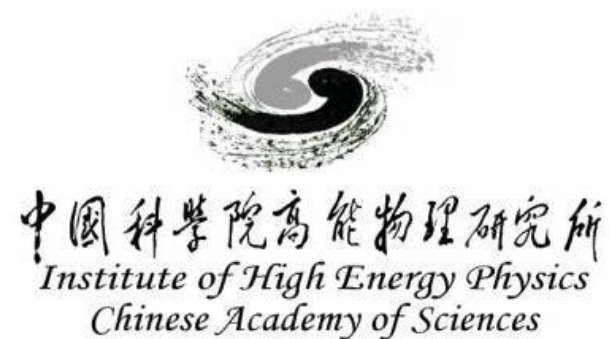


2024年度考核报告

高能物理前沿物理组（CMS小组） 陶军全

2024年11月



报告提纲

一、 岗位职责：CMS 物理分析岗位

二、 本年度工作汇报

1 CMS物理分析总结

- 1) 希格斯性质测量
- 2) 新粒子寻找
- 3) 物理性能研究

2 CMS HGCal 和 CEPC总结

3 学术论文、学术发展与交流

4 项目申请和经费

5 公共服务

三、 下年度工作计划

CMS物理分析总结

| 内容 | 数据 | 序号 | 物理分析 | PAS/AN号 | 完成状态 |
|------------|-----------------|-----------------|--|---|---|
| 希格斯粒子的性质测量 | Run2 | 1 | H $\rightarrow\gamma\gamma$ 质量和宽度测量 | HIG-24-007 | Unblinded, ARC Review 主导 |
| | 13TeV | 2 | cH, H $\rightarrow\gamma\gamma$ | HIG-23-010 | 2024年7月PAS-PUB公开 (ICHEP2024) 参与, 技术性贡献 |
| | | 3 | VH, VBF, ggH with H $\rightarrow\gamma\gamma$ 反常耦合 | HIG-24-006 | 分析中 参与, 技术性贡献 |
| | 2016-2018 | 4 | 非共振态HHH \rightarrow 4b2 γ | HIG-24-015 | 分析中 参与, 技术性贡献 |
| | | Run3 13.6TeV | 5 | 2022 13.6TeV H $\rightarrow\gamma\gamma$ 截面测量 | HIG-23-014 |
| 新粒子寻找 | Run2 | 6 | 共振态X \rightarrow HH/HY \rightarrow WW $\gamma\gamma$ | B2G-24-010 | 分析中 主导 |
| | | 7 | 共振态X \rightarrow HH/HY \rightarrow bb $\gamma\gamma$ | HIG-21-011 | 发表在JHEP05(2024)316 参与, 技术性贡献 |
| | 13 TeV | 8 | 共振态boosted X \rightarrow HH/HY \rightarrow bb $\gamma\gamma$ | B2G-24-019 | 分析中 参与, 技术性贡献 |
| | | 9 | 共振态和非共振态HH(/YH) \rightarrow $\tau\tau\gamma\gamma$ | HIG-22-012 | 2024年3月PAS-PUB公开 (Moriond2024) 参与, 技术性贡献 |
| | 2016-2018 | 10 | Run2 低质量H $\rightarrow\gamma\gamma$ 共振态 | HIG-20-002 | 2024年10月被PLB接收 主导 |
| | | 11 | Very low-mass H $\rightarrow\gamma\gamma$ | HIG-24-014 | Pre-approved 参与, 技术性贡献 |
| | Run3 13.6TeV | 12 | Run3低质量H $\rightarrow\gamma\gamma$ 共振态 | AN-24-116 | 分析中 主导 |

共12项

主导4项,
参与8项

5项已发表或者公开结果,
7项正在进行中

主导Run2 $H \rightarrow \gamma\gamma$ 质量和宽度测量

➤ 希格斯粒子的质量并未在标准模型的理论中精确预测，所以实验精确测量尤为关键

✓ 希格斯粒子的其他性质如截面、耦合、衰变分支比等均与质量有关

➤ 主导了Run2 $H \rightarrow \gamma\gamma$ 质量和宽度测量

✓ 高能所博士后F. lemme是分析负责人(~22年底由top物理分析转过来一起工作)

✓ 指导的博士生张镇轩做了预审核报告

➤ 该分析已经揭盲

✓ 目前CMS内部ARC Review

➤ 测量精度显著提升:

Target Moriond2025

与CMS实验2016年测量相比: 统计误差好了~50%; 系统误差好了~30%

• CMS 2016 $H \rightarrow \gamma\gamma$ [link](#):

- $m_H = 125.78 \pm 0.18(\text{stat.}) \pm 0.18(\text{syst.}) \text{ GeV}$

Measurements of the Higgs boson mass and width in the diphoton decay channel with full Run2 data

Zhenxuan Zhang

on behalf of the $H \rightarrow \gamma\gamma$ sub-group

Institute of High Energy Physics, Chinese Academy of Sciences

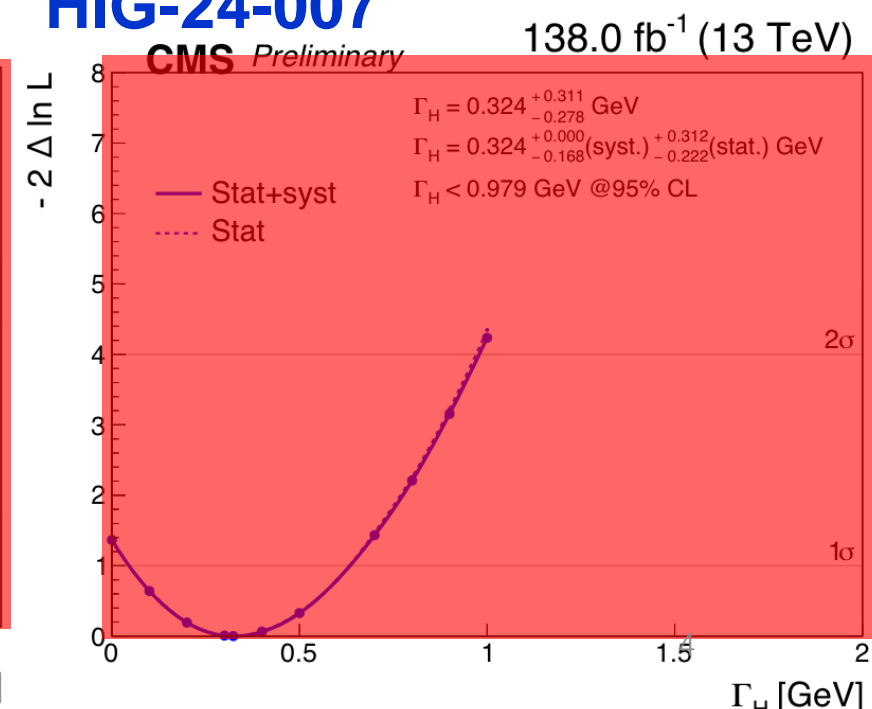
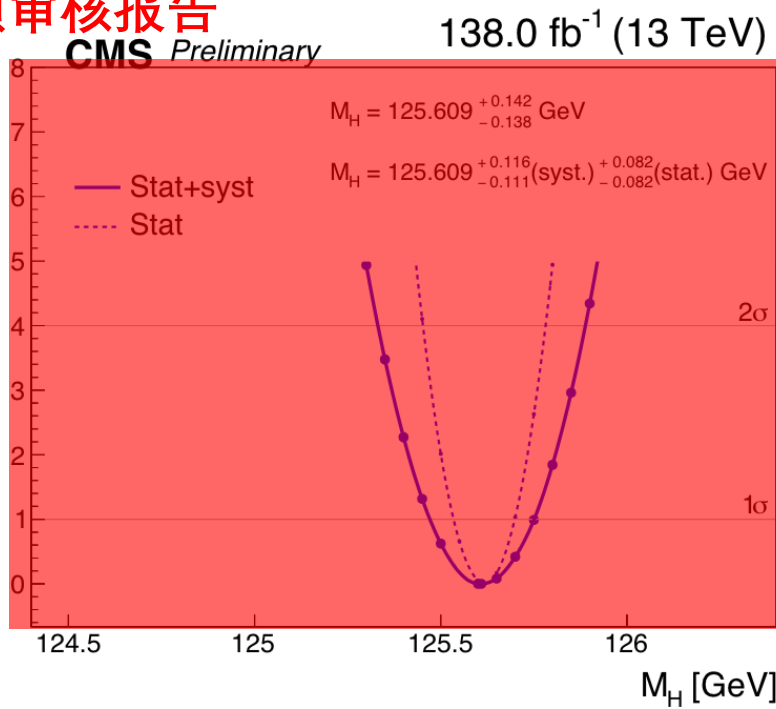
HIG-24-007 Pre-approval

28 June 2024



中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

HIG-24-007



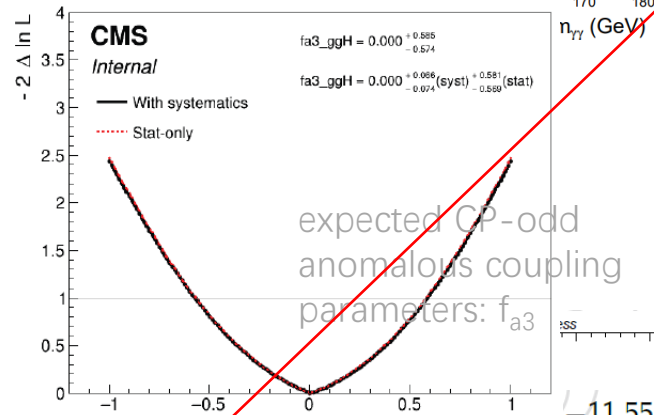
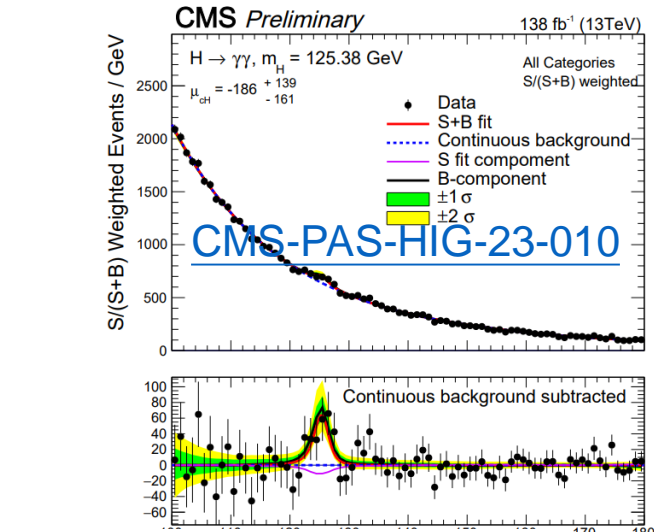
参与Run2其他H→γγ希格斯性质测量

- 参与了LHC上首次寻找cH, H→γγ的分析
 - ✓ 结果HIG-23-010在ICHEP2024国际会议上公开
 - ✓ 截面上限 $243 (355) \times \sigma_{SM}$ obs. (exp.) at 95% CL
 - ✓ 限制H-c耦合参数 $|\kappa_c| < 38.1$ ($|\kappa_c| < 72.5$) obs. (exp.) at 95% CL

- 参与了H→γγ反常耦合的测量
 - ✓ 初步预期结果 (HIG-24-006)
 - ✓ 正寻求合作组的pre-approval

- 参与了HHH → 4b2γ的分析
 - ✓ 可以对自耦合参数 λ_3 和 λ_4 限制, 得到初步预期结果 (HIG-24-015)
 - ✓ 正寻求合作组的pre-approval

- 本人做出重要的技术性贡献: 在光子模拟的修正、光子能量刻度和鉴别、电子的排除等做出直接重要贡献, 是H→γγ双光子基础分析CMS内部文章(AN-2021/025)的主编辑



CMS AN-2021/025 -- Common tools for analyses of Higgs boson in the diphoton decay channel with Run2 ultra-legacy data
 Most Recent File: AN2021_025_v3.pdf

CMS AN-2021/025

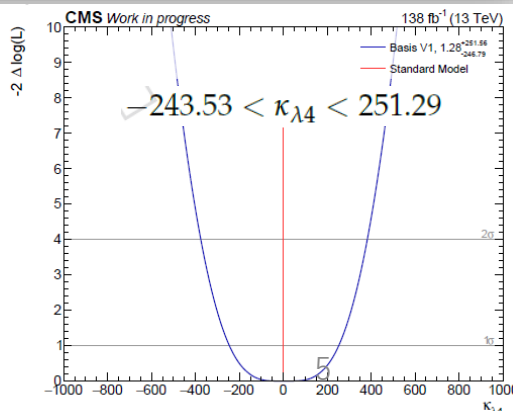
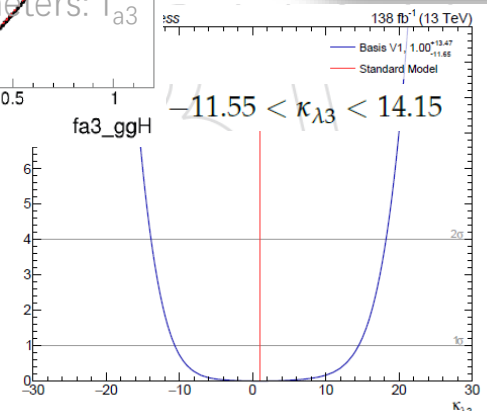
Common tools for analyses of Higgs boson in the diphoton decay channel with Run2 ultra-legacy data

URL: AN2021_025_v2.pdf
 AN2021_025_v1.pdf
 AN2021_025_v3.pdf

Submitter: Junquan Tao
Authors: Working Group
Working Group: HGGS
Abstract: The common studies and inputs used by the multiple \Htgg analyses are described. These studies are performed using the dataset recorded in 2016-2018 by the CMS experiment at the LHC from pp collisions at centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 137.6 fb⁻¹ and reconstructed with the ultra-legacy conditions.

Related to:
Registered on: 2021/02/01 02:24:46
Last updated on: 2024/05/15 05:25:54

2024年5月更新



参与Run3 H→γγ截面测量

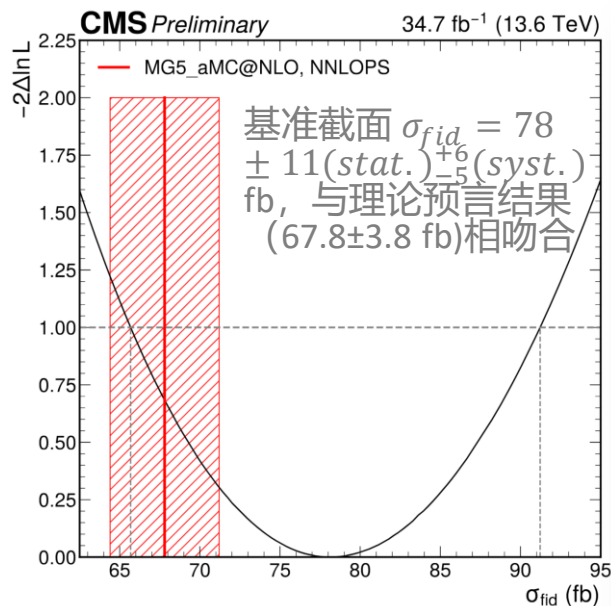
➤ 使用2022年数据参与了CMS第一个Run3

H→γγ 物理分析：

- ✓ 基准截面和微分基准截面 (Higgs PT、y, Njet)
- ✓ 测量结果与理论预言相吻合

➤ 测量结果在ICHEP2024国际会议上公开(PAS)

➤ 本人做出重要的技术性贡献：在光子模拟的修正、光子能量刻度和鉴别、电子的排除等做出直接重要贡献，是CMS内部文章 (AN-23-124) 的编辑之一



CMS-PAS-HIG-23-014

CMS Draft Analysis Note

The content of this note is intended for CMS internal use and distribution only

AN-23-124

2024/06/28
Archive Hash: c548f70-D
Archive Date: 2024/06/28

H → γγ inclusive and differential fiducial cross sections with 2022 data

Anirban Bala¹⁶, Tiziano Bevilacqua¹³, Elizabeth Castaneda¹⁸, Rajdeep Mohan Chatterjee¹⁶, Fabrice Couderc⁷, Suman Das Gupta¹⁵, Caio Cesar Daumann¹⁴, Emanuele Di Marco⁵, Mauro Donega¹, Johannes Erdmann¹⁴, Linda Finco⁶, Paul Gaigne², Massimiliano Galli¹, Ruben Gargiulo⁹, Susan Gascon⁸, Lindsey Gray², Nico Harringer¹, Elise Anne Marie Jourdain⁸, Charlotte Knight³, Paul Felix Kruper³, Jonathon Mark Langford³, You-Ying Li¹¹, Badder Marzocchi⁹, Florian Mausolf¹⁴, Hualin Mei¹⁷, Soumya Mukherjee¹⁶, Chengyang Pang¹², Simone Pigazzini¹, Arnab Purohit⁸, Prasant Kumar Rout¹⁰, Neil Raymond Schroeder⁹, Shaowei Song⁴, Jan Lukas Spah¹⁴, Junquan Tao⁴, Alessandro Tarabini¹, Nicholas Warburton⁹, Peter Wissmann¹⁴, Jie Xiao⁸, Anwar Zada⁴, Xuanhao Zhang¹², Zhenxuan Zhang⁴, and Chen Zhou¹²

¹ETH Zurich - Institute for Particle Physics and Astrophysics (IPA), Zurich, Switzerland
²Fermi National Accelerator Laboratory, Batavia, Illinois, USA
³Imperial College London, United Kingdom
⁴Institute of High Energy Physics, Chinese Academy of Sciences, China
⁵INFN Sezione di Roma, Roma, Italy
⁶INFN Sezione di Torino, Torino, Italy
⁷IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France
⁸Institut de Physique des 2 Infinis de Lyon (IP2I), Villeurbanne, France
⁹University of Minnesota, Minneapolis, Minnesota, USA
¹⁰National Central University, Chung-Li, Taiwan
¹¹National Taiwan University (NTU), Taipei, Taiwan
¹²State Key Laboratory of Nuclear Physics and Technology, Beijing University, Beijing, China

July 19



Jan Lukas Spah 4:23 PM

Hi Junquan!

The physics briefing for HIG-23-014 and the PAS have been made public:

- <https://cms.cern/news/counting-higgs-bosons-136-tev>
- <https://cds.cern.ch/record/2904882/files/HIG-23-014-pas.pdf>

Thanks again for your contribution to this important measurement! It would not have been possible without it 😊



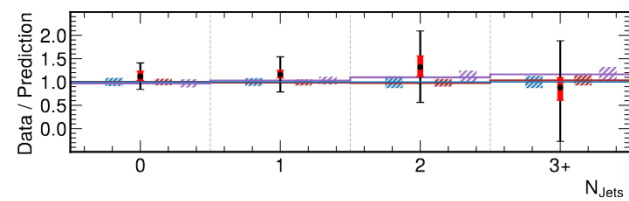
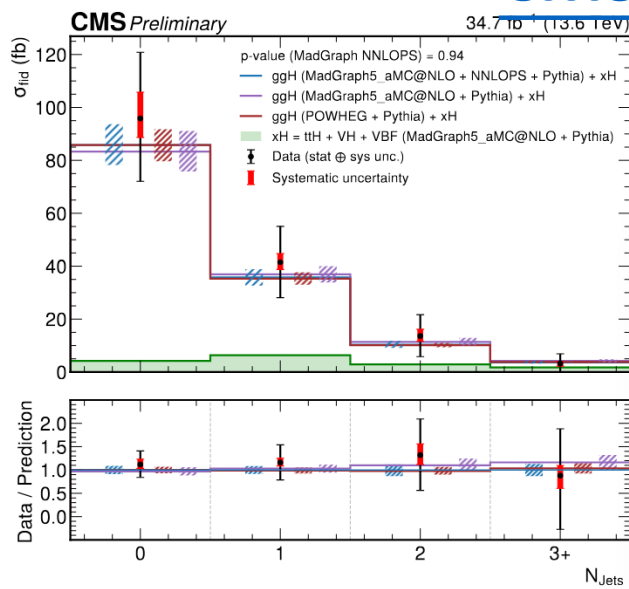
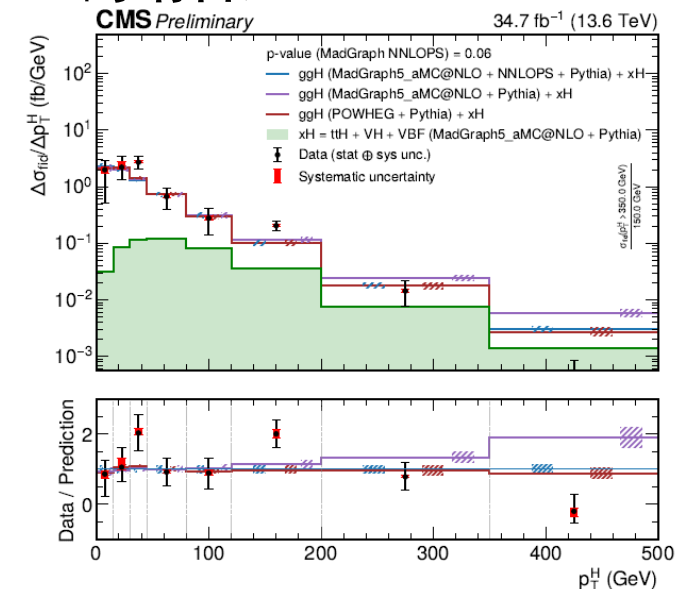
Junquan Tao Update your status 10:13 PM

Thank you! Congratulations!

Thank you! 1

👍 1

分析负责人发来的致意



主导Run2 $X \rightarrow HH/HY \rightarrow WW\gamma\gamma$ 的分析

➤ 许多新物理模型，比如WED和NMSSM，预测了新共振态粒子

- ✓ CMS和ATLAS实验上都有一些新共振态超出的报道

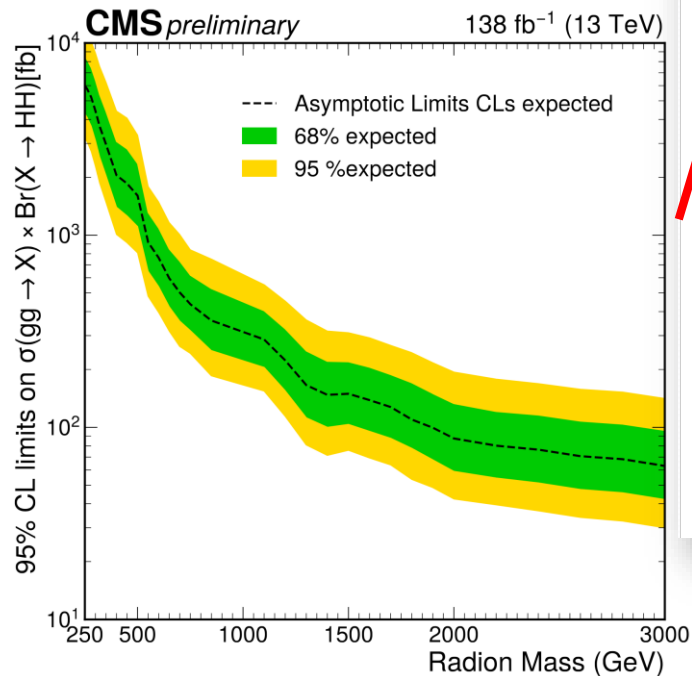
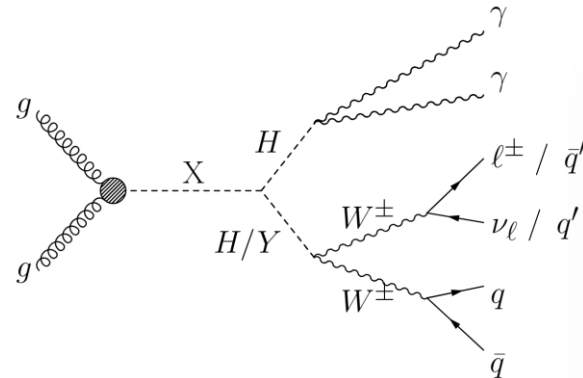
➤ 主导了CMS实验上第一次利用 $WW\gamma\gamma$ 衰变道来寻找双希格斯粒子的共振态

- ✓ 可以探测新粒子与希格斯粒子的直接耦合
- ✓ $H \rightarrow WW$ 有第二大分支比， $H \rightarrow \gamma\gamma$ 有非常清晰的末态和优异的双光子不变质量分辨率

➤ 指导的博士生张镇轩是分析负责人

- ✓ 本人负责发展了新的光子鉴别ID MVA，研究ID MVA cut的data/MC修正SF，对高质量X即boosted $H \rightarrow \gamma\gamma$ 的信号事例效率提升~50%
- ✓ 本人是内部文章(AN-23-071)的主编辑

➤ 得到初步预期结果(B2G-24-010)，正在寻求CMS内部的预审核：Target Moriond2025



相对于ATLAS 500GeV (寻找最高质量)结果 scale到相同积分亮度: 提升了~40%

CMS AN-2023/071 -- Search for a new resonance decaying to a pair of Higgs bosons in the $WW\gamma\gamma$ final state in proton-proton collisions at $\sqrt{s} = 13$ TeV
Most Recent File: AN2023_071_v4.pdf

CMS AN-2023/071

Search for a new resonance decaying to a pair of Higgs bosons in the $WW\gamma\gamma$ final state in proton-proton collisions at $\sqrt{s} = 13$ TeV

URL: AN2023_071_v3.pdf
AN2023_071_v4.pdf
AN2023_071_v2.pdf
AN2023_071_v1.pdf

Submitter: Junquan Tao

Authors: Mingshui Chen, John Dervan, Fabio Iemmi, Fabio Monti, Toyoko Orimoto, Ram Krishna Sharma, Shaowei Song, Junquan Tao, Chu Wang, Jin Wang, Jie Zhang, Zhenxuan Zhang

Working Group: B2G

Abstract: A search for a new resonance in $WW\gamma\gamma$ channel is presented, using CERN LHC proton-proton collision data collected during Run2 by the CMS detector at $\sqrt{s} = 13$ TeV, and corresponding to an integrated luminosity of 138 fb^{-1} . A model-independent analysis is performed with a narrow-width approximation for new resonance in the mass range 250 GeV - 3 TeV. The upper limits at 95% confidence level on the product of the production cross section of spin-0 resonance and its decay branching fraction to HH are expected (observed) to be within XX-XX fb (65-6000 fb), depending on the considered new resonance mass.

Related to:

Registered on: 2023/05/25 03:23:56

Last updated 2024/09/19 15:38:11

参与共振态 $X \rightarrow HH/HY \rightarrow b\bar{b}\gamma\gamma$ 的分析

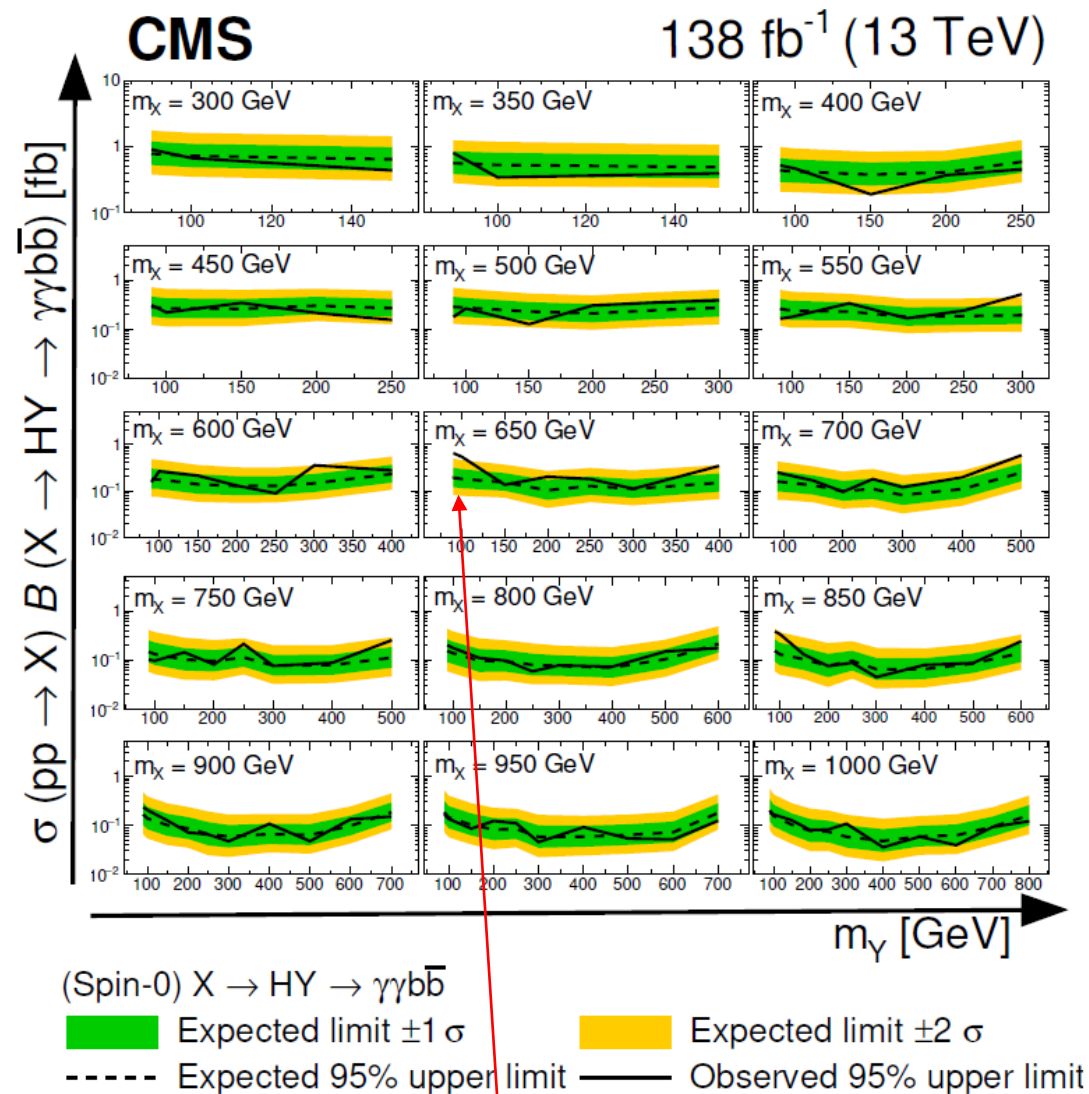
➤ 参与了共振态 $X \rightarrow HH/HY \rightarrow b\bar{b}\gamma\gamma$ 的寻找：文章2024年发表在 [JHEP05\(2024\)316](#)

- ✓ $H \rightarrow b\bar{b}$ 有大分支比， $H \rightarrow \gamma\gamma$ 有非常清晰的末态和优异的双光子不变质量分辨率
- ✓ $m_X = 260\text{--}1000\text{ GeV}$ for $X \rightarrow HH$ and $m_X = 300\text{--}1000\text{ GeV}$, for $X \rightarrow HY$

➤ 本人做出重要的技术性贡献：在光子模拟的修正、光子能量刻度和鉴别、电子的排除等做出直接重要贡献，是 $H \rightarrow \gamma\gamma$ 双光子基础分析CMS内部文章([AN-2019/149](#))编辑之一

➤ 参与Run3数据($X \rightarrow$) $HH(/HY) \rightarrow b\bar{b}\gamma\gamma$ 的分析

- ✓ 法国里昂博士生Elise2024年7月来访高能所一个月，开展Run3数据分析的合作研究

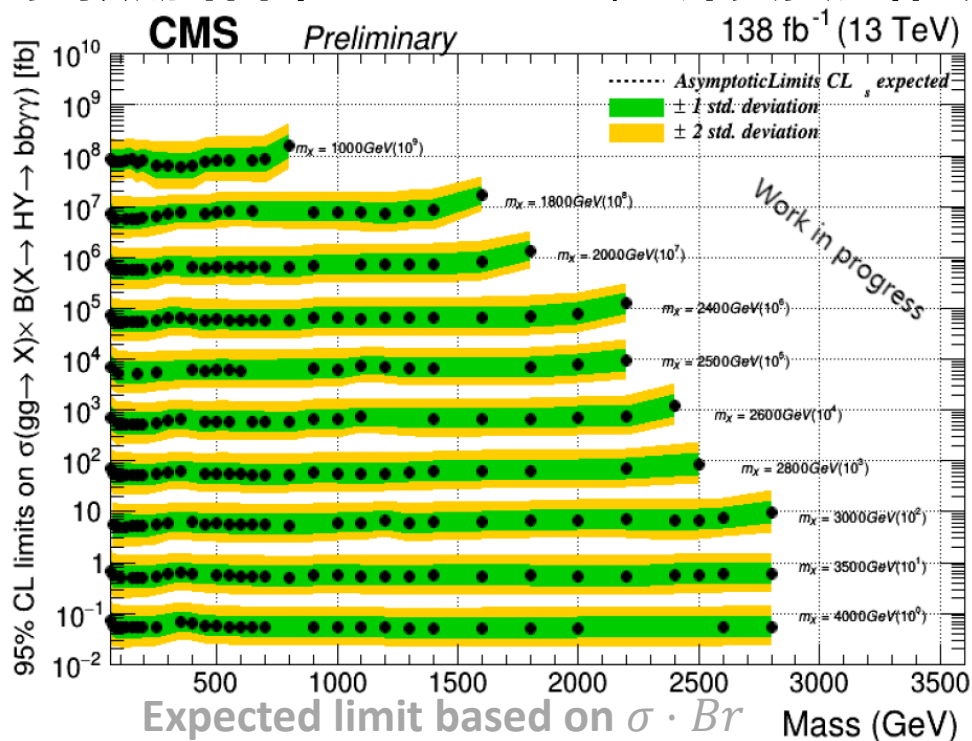


$m_X = 650\text{ GeV}$ 、 $m_\gamma = 90\text{ GeV}$ 处
观察到 3.8σ 的超出

参与高质量 $X \rightarrow HH/HY \rightarrow b\bar{b}\gamma\gamma$ 的分析

参与了Run2数据高质量 (1-4 TeV) $X \rightarrow HH/HY \rightarrow b\bar{b}\gamma\gamma$ 的物理分析

- ✓ 本人负责发展新的光子鉴别ID MVA以及ID Cut data/MC的修正SF, 对高质量X的信号事例效率提升~50%
- ✓ 对分析和内部文章(AN-23-162)的审查
- ✓ 得到初步预期结果(B2G-24-019,王锦负责人), 分析完善中



Available on the CMS information server

CMS AN-23-162



The Compact Muon Solenoid Experiment

CMS Draft Note

Mailing address: CMS CERN, CH-1211 GENEVA 23, Switzerland



2024/10/12
Archive Hash: 463ed60-D
Archive Date: 2024/10/09

Search for a new resonance decaying into two scalars in the final state with two bottom quarks and two photons

M.Chen¹, J.Tao¹, C.Wang¹, J.Wang¹, J.Zhang¹, T.Cao¹, S.Song¹, Z.Zhang¹, F.Lemmi¹, Ram¹, and F.Monti²

¹ IHEP
² CERN

tao 10月15日

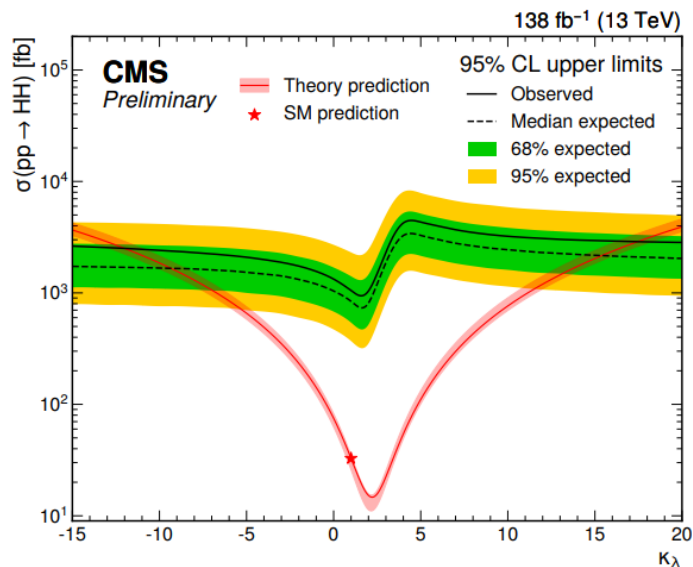
Search for a heavy (或者 massive) resonance decaying into a Higgs boson in association with an additional scalar boson in the $\gamma\gamma b\bar{b}$ final state in proton-proton collisions at $\sqrt{s} = 13$ TeV

添加回复

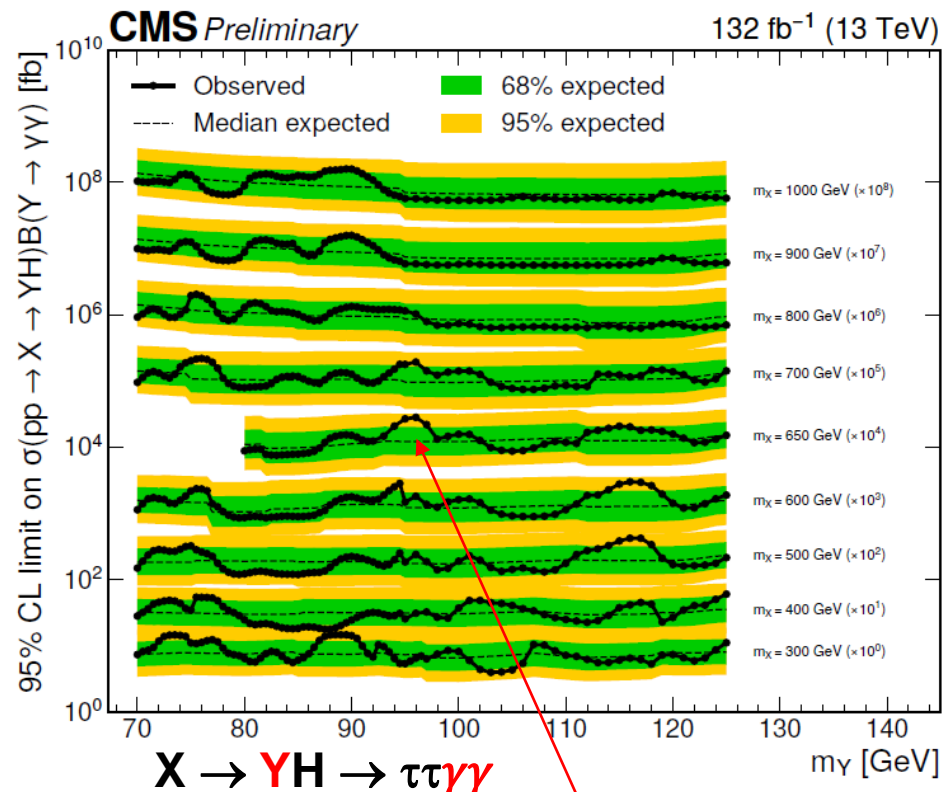
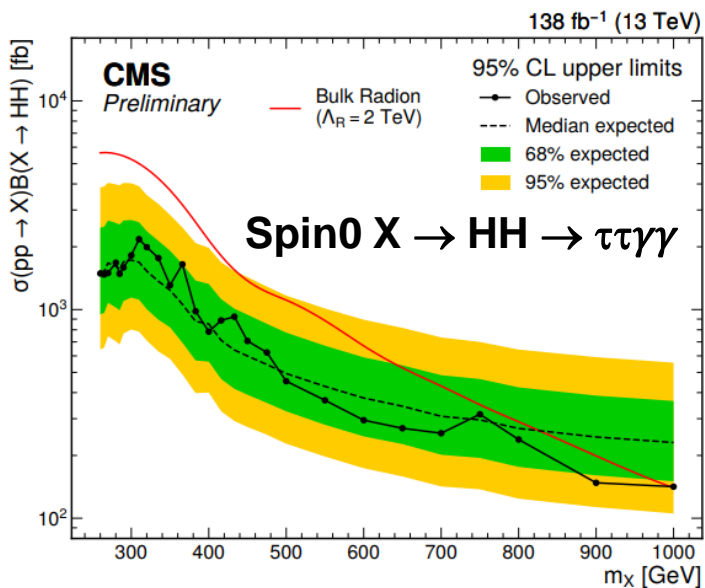
参与非共振态和共振态 $HH(\text{YH}) \rightarrow \tau\tau\gamma\gamma$ 的研究

➤ 参与了非共振态和共振态 $HH(\text{YH}) \rightarrow \tau\tau\gamma\gamma$ 的分析：结果以PAS (CMS-PAS-HIG-22-012) 在今年Moriond2024会议公开

➤ 本人做出重要的技术性贡献：在光子模拟的修正、光子能量刻度和鉴别、电子的排除等做出直接重要贡献，是 $H \rightarrow \gamma\gamma$ 双光子基础分析CMS内部文章(AN-2021/025)的主编辑



非共振态 $HH \rightarrow \tau\tau\gamma\gamma$ 对自耦合的限制
 $-13 (-11) < \kappa_\lambda < 18 (16)$ obs. (exp.)



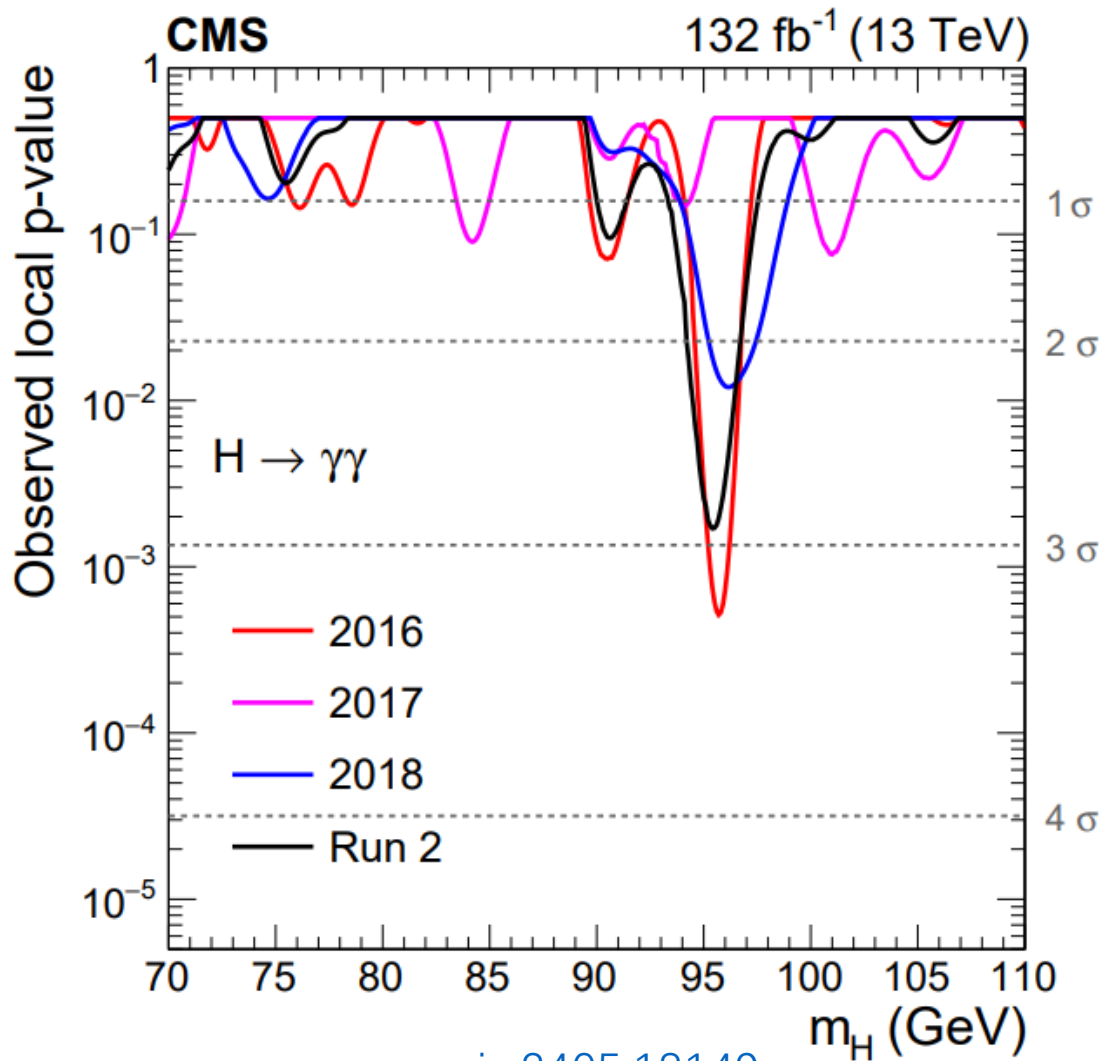
$m_X = 650 \text{ GeV}, m_\gamma = 95 \text{ GeV}$
 处观察到 2.3σ 的超出

[CMS-PAS-HIG-22-012](#)

“CWR-ended”

主导Run2 低质量 $H \rightarrow \gamma\gamma$ 共振态寻找

- 许多超标准模型（比如2HDM, NMSSM等）预测了多个希格斯玻色子，可能存在质量小于125GeV的、额外的希格斯玻色子
- 寻找额外的希格斯玻色子，是寻找BSM的直接有效途径之一
- 主导了Run2双光子末态低质量共振态的寻找（HIG-20-002）
 - ✓ 本人是该分析负责人
 - ✓ 95.4 GeV处 2.9σ 超出：引起关注
- 文章 ([arxiv:2405.18149](https://arxiv.org/abs/2405.18149)) 2024年5月投稿、10月份被Phys. Lett. B接收



[arxiv:2405.18149](https://arxiv.org/abs/2405.18149)

参与Run2 非常低质量 $H \rightarrow \gamma\gamma$ 的分析

- 参与Run2 2018数据非常低质量 (10-70 GeV) $H \rightarrow \gamma\gamma$ 的物理分析 (HIG-24-014)
 - ✓ 分析技术和方法继承于LM $H \rightarrow \gamma\gamma$ (HIG-20-002)
 - ✓ 本人提供技术支持和部分分析指导
- 通过CMS预审核“pre-approved”，已经揭盲

Available on CMS information server

CMS AN -2023/202



The Compact Muon Solenoid Experiment

Analysis Note

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19 December 2023 (v13, 18 October 2024)

CMS 内部文章

Search for a very low mass diphoton resonance using 2018 data



Anna Tsatsos, Elisa Fontanesi, David Sperka, Susan Gascon-Shotkin, Junquan Tao, Prasant Kumar Rout, Jie Xiao, Linda Finco, Rajdeep Mohan Chatterjee, Suman Das Gupta, Satyaki Bhattacharya, Shaowei Song, Zhenxuan Zhang, Benjamin MassotEAU, Debabrata Bhowmik, Chia-Ming Kuo, Saba Taj



CMS 内部预审核报告

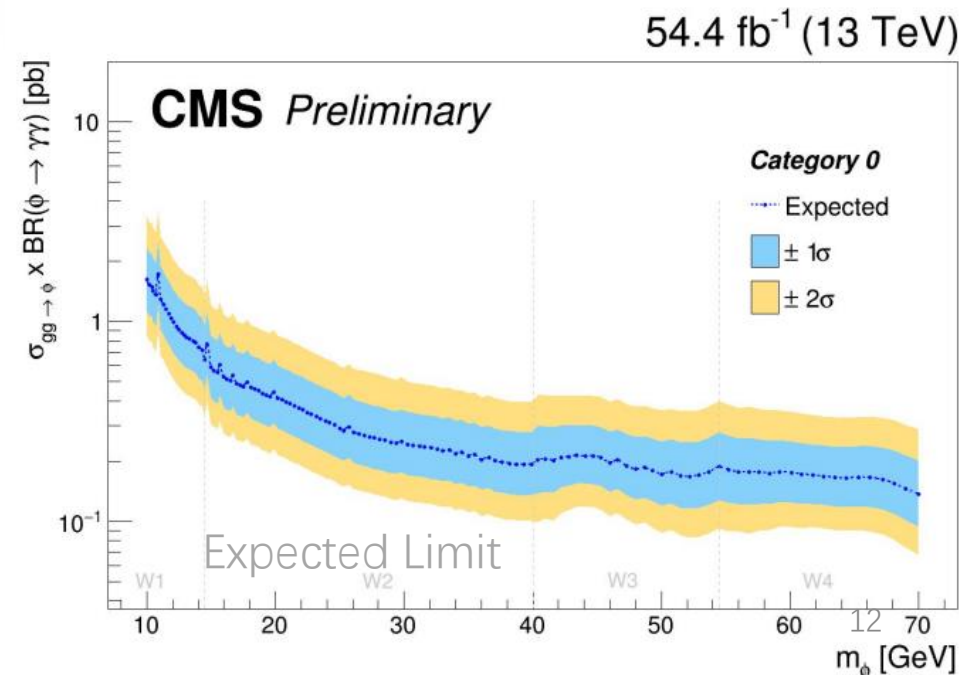


HIG 24-014: Search for a very low mass diphoton resonance using 2018 data

Preapproval at HIG PAG meeting
October 1st, 2024

Anna Tsatsos¹, Elisa Fontanesi¹, David Sperka¹, Shaowei Song², Junquan Tao², Zhenxuan Zhang², Susan Gascon-Shotkin³, Benjamin MassotEAU³, Jie Xiao³, Debabrata Bhowmik⁴, Chia-Ming Kuo⁴, Prasant Kumar Rout⁴, Saba Taj⁴, Satyaki Bhattacharya⁵, Suman Das Gupta⁵, Linda Finco⁶, Rajdeep M. Chatterjee⁷

¹ Boston University
² IHEP, CAS, Beijing
³ IP2I, Lyon
⁴ National Central University
⁵ Saha Institute of Nuclear Physics
⁶ INFN Torino
⁷ Tata Institute of Fundamental Physics



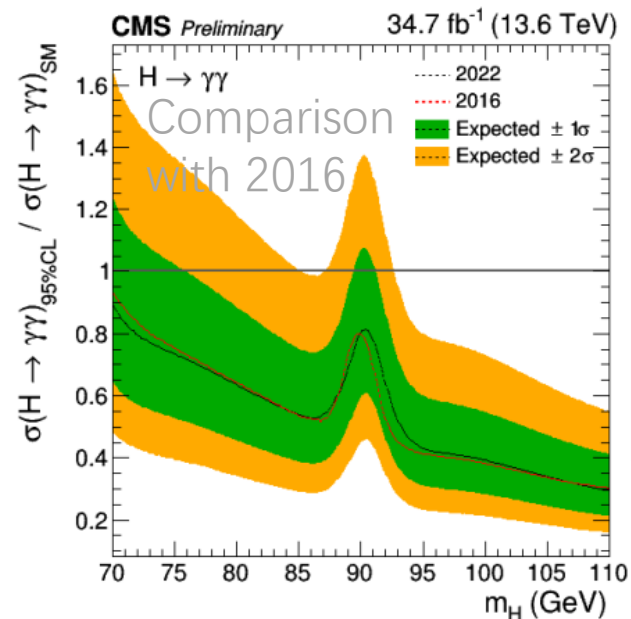
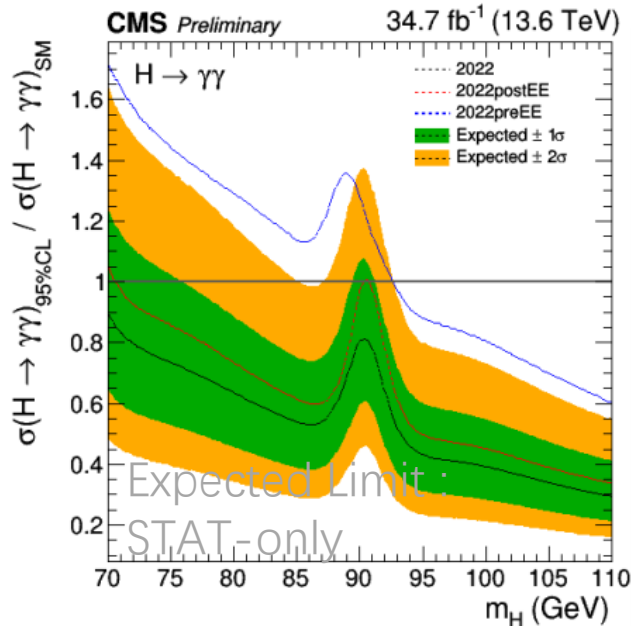
正在开展Run3 低质量H $\rightarrow\gamma\gamma$ 共振态寻找

利用Run3 2022数据开展低质量H $\rightarrow\gamma\gamma$ 的物理分析

- ✓ 2022 ECAL EE+ leakage issue: **preEE**、**postEE**分别分析
- ✓ **数据驱动** data-driven QCD (pf+ff)应用在 diphoton BDT训练中区分信号和本底
- ✓ **主导了分析**, **得到初步研究结果**(目前仅包含统计误差)

该分析还没有CADI, **分析和内部文章(AN-24-116)完善中**

- ✓ 2022+ Run2 PAS : Moriond 2025
- ✓ OR 2022+2023 +Run2 paper: Summer2025
- ✓ **内部AN主编辑**



Available on the CMS information server

CMS AN-24-116

CMS Draft Analysis Note

The content of this note is intended for CMS internal use and distribution only

2024/11/04
Archive Hash: 682205b
Archive Date: 2024/10/22

Search for low mass resonances in the diphoton final state in pp collisions at $\sqrt{s}=13.6$ TeV with the 2022 dataset

Satiyaki Bhattacharya³, Tianyu Cao¹, Guoming Chen¹, Susan Gascon-Shotkin², Prasant Kumar Rout³, Shaowei Song¹, Junquan Tao¹, Jie Xiao², and Zhenxuan Zhang¹

¹ Institute of High Energy Physics, Beijing, China
² Institut de Physique des 2 Infinis de Lyon, Lyon, France
³ Saha Institute of Nuclear Physics, Kolkata, India

Abstract

We present the results of a search for a new resonance decaying into two photons selected from a sample of proton-proton collisions at a center-of-mass energy $\sqrt{s}=13.6$ TeV collected by the CMS detector at the LHC in 2022, corresponding to an integrated luminosity of 34.7 fb^{-1} . The expected 95% confidence level upper limits on the product of the cross section times branching ratio into two photons and the expected local p-value are presented. Finally the expected and observed results of the upper limit and local p-value from the statistical combinations of the 2022 data set and 2016-2018 data set, are also presented.

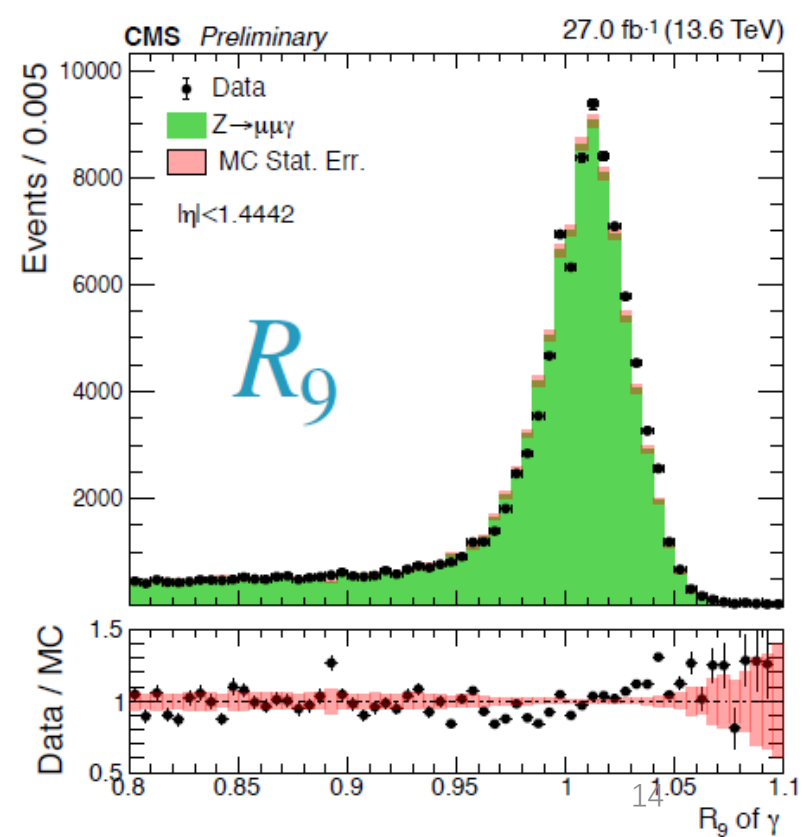
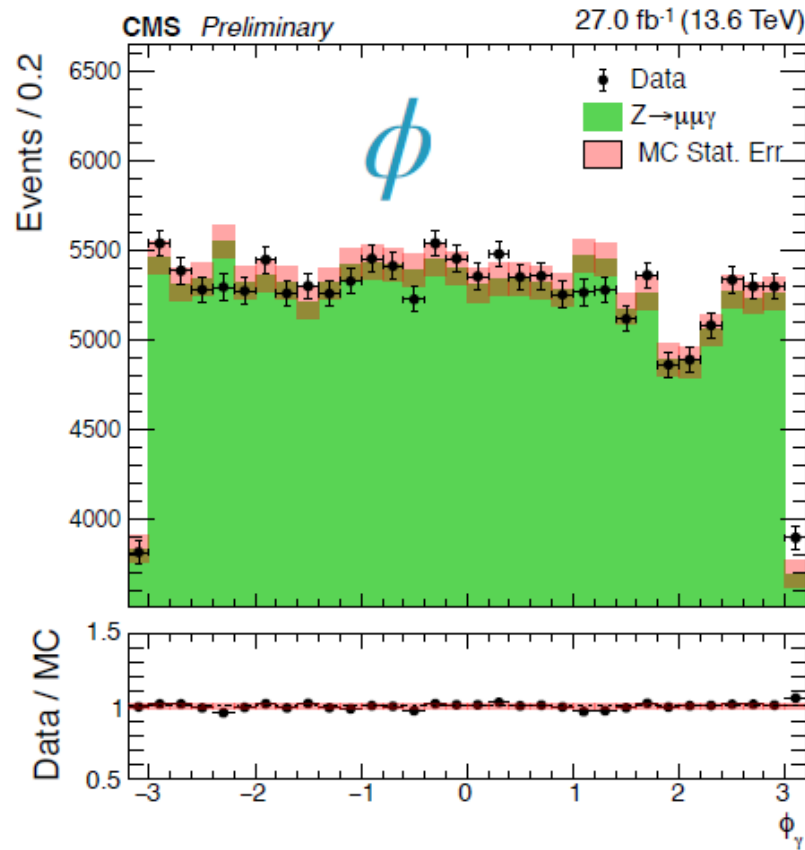
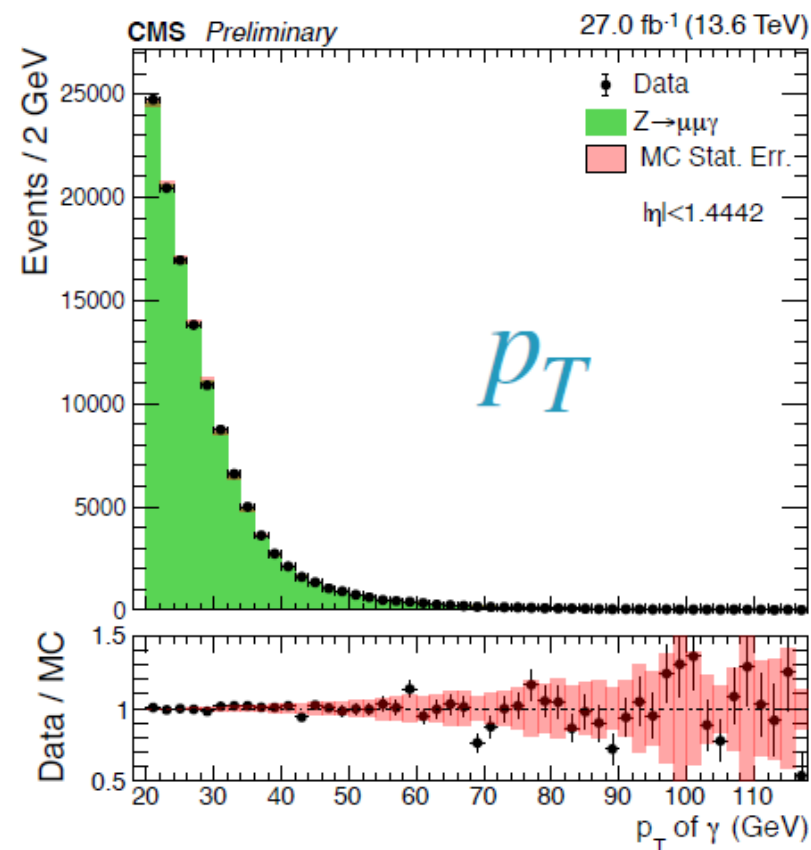
参与Run3 电子和光子的性能研究

本人贡献于Run3电子和光子重建和鉴别等性能研究

- ✓ 利用来自 $Z \rightarrow \mu\mu\gamma$ 的真实光子验证光子的重建和鉴别以及经典变量MC模拟和真实数据的对比、光子刻度和鉴别的验证等

性能Note(DP2024_052)在ICHEP2024公开

[DP2024_052](#)



CMS HGICAL和CEPC总结

➤ 参加**CMS HGICAL升级**模块生产工作：负责**绑定**

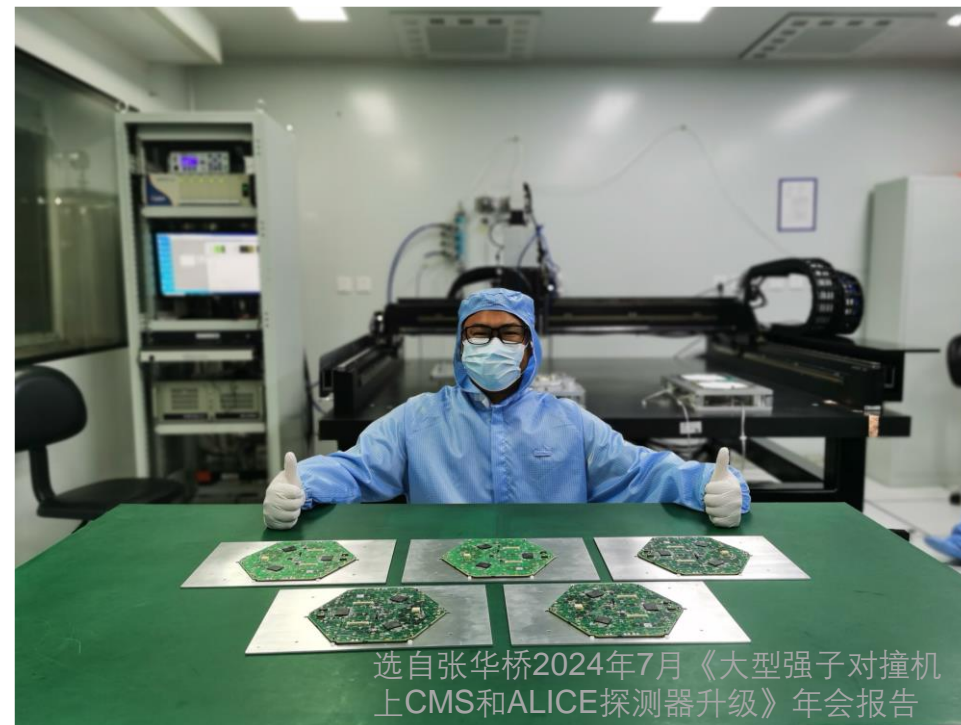
- ✓ 高能所是CMS高粒度量能器6个模块集成组装中心之一
- ✓ 负责模块生产中的**绑定、程序测试和工装等准备工作、以及绑定操作的简要记录**
- ✓ 2023年12-2024年1月完成**10块**pre-series模块生产
- ✓ 2024年3-4月完成**9块**模块生产（HGCROC3B改装测试）
- ✓ 2024年6-7月**7块**pre-production模块生产
- ✓ 2024年9月完成**9块**pre-series模块生产

过去一年共完成**35块**模块的打线任务，
发表**1篇**技术性贡献文章

CMS HGICAL collaboration ; Timing Performance of the CMS High Granularity Calorimeter Prototype, *JINST* **19** (2024) 04, P04015

➤ 开始涉及**CEPC**分析：**学习阶段**

- ✓ 参加**两次培训** ([软件和探测器17-18/09](#), [物理28/10](#)), 学习软件的运行和物理目标以及物理分析的处理
- ✓ 参加每周CEPC RefTDR 物理性能组例会, 学习和讨论
- ✓ 参加CEPC2024 **workshop** (杭州)
- ✓ 希望深入开展研究工作 (缺人力!)



高能所MAC模块**A级品率**和已生产**数量**均处于领先

学术论文、学术发展与交流 (1)

➤ **研究团队:** +1名博士后 Fabio lemme (合作导师 陈明水, JMAR convener, 合同至2026年5月)+1名博士生张镇轩 (本人副导师, 导师陈明水, 预期2025年6月毕业)

➤ **发表CMS文章 (3篇) 以及PAS (3篇) : 6篇**

- 1) CMS collaboration, Search for a standard model-like Higgs boson in the mass range between 70 and 110 GeV GeV in the diphoton final state in proton-proton collisions at $\sqrt{s}=13$ TeV, [CMS-PAS-HIG-20-002](#), [arxiv:2405.18149](#) **PLB已接收**, 本人担任分析负责人、内部文章编辑, 博士生 Aamir做预审核reprise、揭盲和审核报告
- 2) CMS collaboration, Search for a new resonance decaying into two spin-0 bosons in a final state with two photons and two bottom quarks in proton-proton collisions at $\sqrt{s}=13$ TeV, [JHEP05\(2024\)316](#), 本人重要技术性贡献
- 3) CMS HGCAL collaboration, Timing Performance of the CMS High Granularity Calorimeter Prototype, [JINST 19 \(2024\) 04 P04015](#), 本人技术性贡献
- 4) CMS collaboration, Measurements of inclusive and differential Higgs boson production cross sections at 13.6 TeV13.6 TeV in the $H\rightarrow\gamma\gamma$ decay channel, [CMS-PAS-HIG-23-014](#), 本人重要技术性贡献
- 5) CMS collaboration, Search for Higgs boson production in association with a charm quark in the diphoton decay channel, [CMS-PAS-HIG-23-010](#), 本人重要技术性贡献
- 6) CMS collaboration, Search for the nonresonant and resonant production of a Higgs boson in association with an additional scalar boson in the $\gamma\gamma\tau\tau$ final state, [CMS-PAS-HIG-22-012](#), 本人重要技术性贡献

➤ **发表CMS 探测器性能研究公开文档 (DP Note) 5篇 (1)**

- 1) Electron and photon reconstruction and identification performance at CMS in 2022 and 2023, [CMS-DP-2024-052](#), 本人重要技术性贡献
- 2) Hadronic top quark tagging with variable-sized jets for the CMS experiment, [CMS-DP-2024-038](#), 博士后重要技术性贡献
- 3) A novel approach for discriminating hadronically decaying W^+ , W^- , and Z boson in the CMS experiment, [CMS-DP-2024-044](#), 博士后重要技术性贡献
- 4) Determination of jet identification criteria with proton-proton collision at 13.6 TeV data collected with the CMS detector at the CERN LHC, [CMS-DP-2024-028](#), 博士后重要技术性贡献
- 5) Optimizing the pileup per particle identification algorithm in the context of τ_h lepton identification in Run3, [CMS-DP-2024-043](#), 博士后重要技术贡献

学术论文、学术发展与交流 (2)

➤ 单独署名文章或会议文集2篇 (1)

- 1) F. Lemmi et al., Distilling particle knowledge for fast reconstruction at high-energy physics experiments, *Mach. Learn. Sci. Tech.* 5 (2024) 025033
- 2) **J. Tao**, Extra Higgs boson searches at the LHC, [arXiv:2404.03571](https://arxiv.org/abs/2404.03571) CKM2023 proceeding, 2024年4月发表

➤ 国际会议报告6个 (2)

- 1) Fabio Lemmi, Mass, width and CP measurements at CMSHH2024: Higgs Hunting 2024, 23-25 Sep 2024, IJCLab Orsay, Paris (France)
- 2) Fabio Lemmi, Boosted top/W/Z tagging in CMS, FTAG2024: 2024 ATLAS-CMS Flavour Tagging Workshop, 9-13 Sep 2024, Genova (Italy)
- 3) **Junquan Tao**, Search for low-mass resonance with $H \rightarrow \gamma\gamma$ at CMS, FCPPL2023, 2023.11.6-11 Zhuhai, China
- 4) **Junquan Tao**, CMS collaboration within FCPPL, FCPPL2024, 2024.6.10-14 Bordeaux, France
- 5) Fabio Lemmi, Measurement of Higgs boson mass using bosonic decay channels with the CMS detector, Higgs2023, 27 Nov-1 Dec 2023, Beijing, China
- 6) Muhammad Aamir Shahzad, Search for a standard model-like Higgs boson in the mass range between 70 and 110 GeV in the diphoton final state in proton-proton collisions at $\sqrt{s}=13$ TeV, Higgs2023, 27 Nov-1 Dec 2023, Beijing, China

➤ 国内会议报告4个 (2)

- 1) **Junquan Tao**, Measurements of Higgs boson properties and search for new resonances in gamma gamma final state at CMS, 第10届中国LHC物理会议, 2024.11.13-17, 中国青岛
- 2) Zhenxuan Zhang, Search for double Higgs resonances with $\gamma\gamma$ in the final state at CMS, 第10届中国LHC物理会议, 2024.11.13-17, 中国青岛
- 3) **Junquan Tao**, Search for additional scalars at CMS, 中国物理学会高能物理分会第十四届全国粒子物理学术会议, 2014.8.14-18, 中国青岛
- 4) Jie Xiao (visitor), Run2 and Run3 low mass $H\gamma\gamma$, 2024 CMS China Workshop, 2024.7.11-13, 中国潜山

➤ 国际合作研究

- ✓ 在中法粒子物理实验室FCPPL框架下与法国里昂两无限物理研究所 (IP2I, 原里昂核物理研究所INPL) 开展长期合作研究: 每周例会
- ✓ 与美国东北大学、波斯顿大学、明尼苏达大学、印度Tata基础研究所TIFR等的合作研究: 1-2周每次例会

公共服务

➤ CMS合作组的服务性工作:

- 1) 包括承担每人每年4个月的服务工作 (EPR) : **2023年完成5个月, 2024年 pledged 4个月**
- 2) CMS内部文章的评议: B2G-23-002

➤ 中国CMS组服务性工作: 会议委员会成员, 会议组织、报告的沟通和协调; 第二届中国CMS冬令营 (Jan 20 – 24, 2024, 中山大学) 授课等

➤ 高能所CMS课题组的服务性工作: 包括协助完成项目组大课题的各种总结和考核、课题申请, 协助课题组外籍博士生和博士后招聘等。

Member Pledges in 2023

2023年完成了5个月的CMS service work

| Project | Activity | Level-3 | Task Name | Needed Work | Fraction Done | % of work at CERN | Type of task | Comment | User | Institute for Pledge | Work Pledged | Work Accepted | Work Done | Done/ Pledged | Status |
|--------------------------------|----------------|------------------------|---|-------------|---------------|-------------------|-----------------|---------|-----------------------------|----------------------|--------------|---------------|-----------|---------------|--------|
| HGCAL (CE) | Detector | SI Sensors and Modules | Mac setup (task) | 34.5 | 1.00 | 0 | Perennial | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 1.00 | 1.00 | 1.00 | 1.00 | done |
| Offline Software And Computing | Reconstruction | Reconstruction | EGamma POG reco maintenance (task) | 20 | 0.90 | 5 | Perennial(CORE) | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 1.00 | 1.00 | 1.00 | 1.00 | done |
| HGCAL (CE) | Detector | SI Sensors and Modules | Module production (task) | 60 | 1.00 | 0 | Perennial | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 1.00 | 1.00 | 1.00 | 1.00 | done |
| ECAL | DPG | Calibration/alignment | Calibration: Zmumugamma analysis and development (task) | 4 | 1.00 | 50 | Perennial | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 2.00 | 2.00 | 2.00 | 1.00 | done |
| Sum this page | | | | | | | | | | | 5.00 | 5.00 | 5.00 | 0.042 | |
| Sum all pages | | | | | | | | | | | 5.00 | 5.00 | 5.00 | 0.042 | |

Member Pledges in 2024

2024年pledged了4个月EPR

| Project | Activity | Level-3 | Task Name | Needed Work | Fraction Done | % of work at CERN | Type of task | Comment | User | Institute for Pledge | Work Pledged | Work Accepted | Work Done | Done/ Pledged | Status |
|--------------------------------|------------|------------------------|---|-------------|---------------|-------------------|-----------------|---------|-----------------------------|----------------------|--------------|---------------|-----------|---------------|--------|
| ECAL | DPG | Calibration/alignment | Calibration: Zmumugamma analysis and development (task) | 4 | 0.00 | 50 | InstResp | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 1.00 | 0.00 | 0.00 | 0.00 | new |
| HGCAL (CE) | Detector | SI Sensors and Modules | Mac setup (task) | 34.5 | 0.00 | 0 | Perennial | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 0.50 | 0.00 | 0.00 | 0.00 | new |
| HGCAL (CE) | Detector | SI Sensors and Modules | Module production (task) | 60 | 0.00 | 0 | Perennial | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 1.00 | 0.00 | 0.00 | 0.00 | new |
| Offline Software And Computing | Generators | Maintenance | CMSFW interface and "external" maintenance (task) | 25 | 0.00 | 5 | Perennial(CORE) | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 1.00 | 0.00 | 0.00 | 0.00 | new |
| Offline Software And Computing | XPOG | Unknown | NanoAOD (task) | 19 | 0.00 | 0 | Perennial | | Tao, Junquan (BEIJING-IHEP) | BEIJING-IHEP | 0.50 | 0.00 | 0.00 | 0.00 | new |
| Sum this page | | | | | | | | | | | 4.00 | 0.00 | 0.00 | 0.000 | |
| Sum all pages | | | | | | | | | | | 4.00 | 0.00 | 0.00 | 0.000 | |


科研项目和经费

➤ 科研项目：在研4项

1. 高能所科技创新项目，“CMS实验上寻找额外的低质量希格斯粒子”，19.5 万元，2024.1-2024.12（主持）
2. 科技部国家重点研发计划“政府间国际科技创新合作”，“中法粒子物理联合实验室”(2022YFE0116900)，400万元，2023.01-2025.12（参与，在研）
3. 国家基金委国际(地区)合作与交流项目，“CMS实验希格斯粒子性质研究及新物理寻找”(12061141003)，900万元，2021.01-2025.12（参与，在研）
4. 科技部国家重点研发计划大科学装置专项，“CMS上的Higgs物理和新物理寻找”(2023YFA1605801)，1900万元，2023.12-2028.11（参与，在研）

➤ 项目申请

- ✓ 申请1项基金委面上项目，未获批准

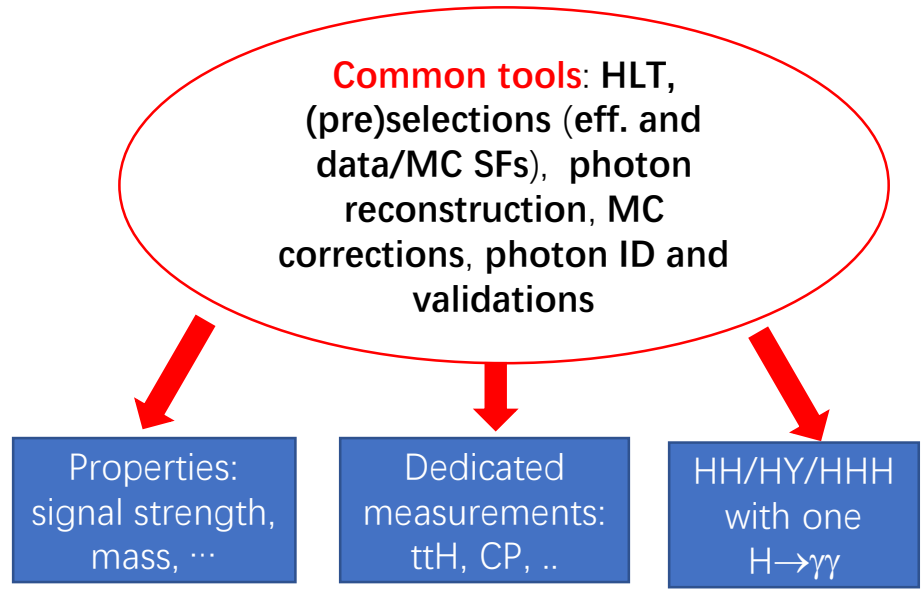
| 项目名称/依托单位/资助类别/起止时间/申请经费 (万元) | 申报年度 | 状态/提交时间 | 操作/截止时间 |
|--|------|--------------------------------|----------------------|
|  CMS实验上通过双光子事例寻找新粒子 中国科学院高能物理研究所 / 实验物理中心 面上项目，2025-01-01至2028-12-31，72.4 | 2024 | NSFC已审核 2024-03-01 17:19:49 | 查看附件 |

下一年度工作计划

- **聚焦于进行中的CMS物理分析：希格斯性质测量和新粒子寻找，多发文章和PAS（主导或贡献）**
- **继续参加CMS HGICAL模块的组装：2025年批量生产，任务繁重**
- **希望更深入的参与CEPC项目的研究工作（缺学生）**
- **积极开展经费申请，努力拓张合作研究和课题方向**
- **同时争取完成4个月CMS服务性工作，以及领导安排的其他任务，等服务性工作**

Backup

➤ UL数据双光子分析基础内部文章的主编辑: **Common tools**是所有 $H \rightarrow \gamma\gamma$ 分析的基础



- As many analyses are now using ultra-legacy datasets, we have created an equivalent note for the same purpose but with UL
 - note number is AN-21-025, available on gitlab [here](#)
 - the editor is Junquan Tao** ~10 sub-editors
 - everyone on the cms-hgg-working list should have access

| Code | Name | Status | PAS | PAPER | ARC |
|---------------------------------------|---|----------------------------|--|-------|------------------------------------|
| HIG-22-012 | Search for HH->gamma gamma tau tau (non-resonant, X-&g ... | CWR-ended | P | P | Christophe Ochando (POLYTECHNIQUE) |
| For example | | | | | |
| Name | Search for HH->gamma gamma tau tau (non-resonant, X->HH, X->YH) | Description | Search for non-resonant HH, X->HH, and X->YH in gamma gamma tau tau final states | | |
| Status | CWR-ended | Contact Person | Leonardo Giannini (UCSD) | | |
| Twiki | HIG-22-012 | Forum | PubTalk HIG-22-012 | | |
| Data, Samples | DataSet: Run2 Samples: not set | Conference | | | |
| Target Date PreApp | 29/11/2022 | Target Date PhysApp | 11/03/2024 | | |
| Talks | Pre-Approval Talk Approval Talk | Actions | Not in Edit Mode | | |
| Related Analyses | none | Related CMS Notes | AN-2022/073 AN-2022/074 AN-2021/025 | | |
| Physics Analysis Summary (PAS) | | | | | |
| ARC Chair | Christophe Ochando (POLYTECHNIQUE) | ARC | Accepted show 5 members | | |
| PAS Actions | P | PAS CDS id | 2893031 [CDS Marc] | | |

➤ 曾主持过1青年 + 1面上

| 项目批准号 / 项目名称 / 依托单位 / 资助类别 / 起止时间 / 项目经费 (万元) | 报告年度 | 状态 / 最后提交时间 | 操作 / 截止日期 |
|---|------|--|----------------|
|  11875275, CMS实验中利用双光子事例寻找额外的小质量希格斯粒子 中国科学院高能物理研究所 / 粒子天体物理研究中心 面上项目, 2019-01-01至2022-12-31, 66 | 2018 | 基金委已审核  批准通知书 2018-08-18 22:05:28 | 查看计划书 下载申请书 |
|  11505208, CMS上通过双光子未态寻找非标准模型希格斯粒子的研究 中国科学院高能物理研究所 青年科学基金项目, 2016-01-01至2018-12-31, 25 | 2015 | 基金委已审核  批准通知书 2015-08-26 14:08:22 | 查看计划书 下载申请书 |

- 是CMS内部文章(AN/PAS)的编辑/主编辑和作者之一

Available on the CMS information server CMS AN-18-105

CMS Draft Analysis Note

The content of this note is intended for CMS internal use and distribution only

2017 dataset

2018/06/29
 Head Id: 466719
 Archive Id: 466816M
 Archive Date: 2018/06/29
 Archive Tag: trunk

Common tools to all measurements for the diphoton decay channel of the SM Higgs boson

Rajdeep Mohan Chatterjee, Linda Finco, Peter Hansen, Gouranga Kole, Kuntal Mondal, Arnab Purohit, Thomas Reitenspiess, Junquan Tao and $H \rightarrow \gamma\gamma$ Working Group

Abstract

The common studies and inputs used by the multiple $H \rightarrow \gamma\gamma$ analyses are described. These studies are performed using the dataset recorded in 2017 by the CMS experiment at the LHC from pp collisions at centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 41.5 fb⁻¹.

Available on the CMS information server CMS AN-19-149

CMS Draft Analysis Note

The content of this note is intended for CMS internal use and distribution only

Full Run2 ReReco dataset

2019/11/24
 Archive Hash: 73da2111-D
 Archive Date: 2019/11/24

Common tools for analyses of Higgs boson decay in the diphoton final state

Rajdeep Mohan Chatterjee, Linda Finco, Neil Schroeder, Peter Hansen, Gouranga Kole, Kuntal Mondal, Arnab Purohit, Thomas Reitenspiess, Junquan Tao, Simone Pigazzini for $H \rightarrow \gamma\gamma$ Working Group

Abstract

The common studies and inputs used by the multiple $H \rightarrow \gamma\gamma$ analyses are described. These studies are performed using the dataset recorded in 2016-2018 by the CMS experiment at the LHC from pp collisions at centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 137.4 fb⁻¹.

Available on the CMS information server CMS AN-21-025

CMS Draft Analysis Note

The content of this note is intended for CMS internal use and distribution only

2024/05/15
 Archive Hash: 26c5493
 Archive Date: 2024/05/15

Common tools for analyses of Higgs boson in the diphoton decay channel with Run2 ultra-legacy data

$H \rightarrow \gamma\gamma$ Working Group

Abstract

The common studies and inputs used by the multiple $H \rightarrow \gamma\gamma$ analyses are described. These studies are performed using the dataset recorded in 2016-2018 by the CMS experiment at the LHC from pp collisions at centre-of-mass energy of 13 TeV corresponding to an integrated luminosity of 137.6 fb⁻¹ and reconstructed with the ultra-legacy conditions.

Full Run2 Ultra-legacy dataset

This box is only visible in draft mode. Please make sure the values below make sense.

PDFAuthor: Junquan Tao
 PDFTitle: Common tools for analyses of Higgs boson in the diphoton decay channel with Run2 ultra-legacy data
 PDFSubject: CMS
 PDFKeywords: CMS, Higgs, diphoton decay, common tools

Please also verify that the abstract does not use any user defined symbols 23