粒子物理前沿卓越创新中心
2020年度考评

李数

上海交通大学

2020年12月5日

个人简历

教育经历

2004-2008	中国科学技术大学少年班	学士
2008-2012	中国科学技术大学近代物理系 （导师：赵政国）	博士
	法国马赛粒子物理中心/艾克斯-马赛大学 （导师：Emmanuel Monnier）	博士

工作经历

2013-2017	美国杜克大学 (Duke Univ.) （合作导师：Ashutosh Kotwal）	博士后
2017至今	上海交通大学-李政道研究所	长聘教轨副教授

研究方向

2009至今	欧洲核子中心大型强子对撞机ATLAS实验
2018至今	未来高能正负电子对撞机实验预研 (CEPC R&D)

个人主要ATLAS物理研究方向简介

希格斯物理：
希格斯→玻色子
希格斯→费米子
…

其他标准模型物理：
电弱相互作用、强相互作用、B物理、顶夸克物理、…

主要研究方向：
基于W/Z/γ/H多玻色子过程的标准模型检验与新物理寻找

超越标准模型的新物理：
暗物质、超对称粒子、重质量共振态（双玻色子，双喷注，…），…

国际合作组任职情况

2018.10至今 — LHC电弱多玻色子工作组负责人 (ATLAS+CMS+理论)

2018.4 – 2019.9 — ATLAS产生子研发组负责人

2017.4 – 2018.3 — ATLAS标准模型电弱物理组负责人 → 成员：~15个国家50所研究机构（包括哈佛、伯克利、牛津等）

2015.12 – 2017.1 — ATLAS蒙特卡洛验证组负责人

2020年度工作概况：ATLAS与LHC物理

ATLAS物理分析主要成果概述

1) 矢量玻色子散射 (VBS) 重要进展
   - 同号WW散射**5σ+**测量的正式发表：
     - **Phys. Rev. Lett. 123 (2019) 161801** (2019CCEPP个人报告之后)
   - ZZ散射测量首次达到**5σ+**，通过合作组审核（Run2完整数据）：
     - arXiv:2008.05928 (**已投Nature Physics**)
   - Zγ散射测量达到**3σ+**：
     - **Phys. Lett. B 803 (2020) 135341**
2) H(bb)+γ共振态的寻找（Run2完整数据）
   - arXiv:2008.05928 **（PRL确认接收）**
3) VH(bb)测量（Run2完整数据）
   - arXiv:2007.02873（**EPJC确认接收**）
   - arXiv:2008.02508（**已投PLB**）
4) 担任Higgs物理组蒙特卡洛负责人（Higgs物理组**Coordination成员**）

LHC任职

2018至今，LHC (ATLAS+CMS+Theory) Electroweak Multi-Boson Convener

2019至今，CERN Yellow Report Contact Editor for Multi-Boson physics sector

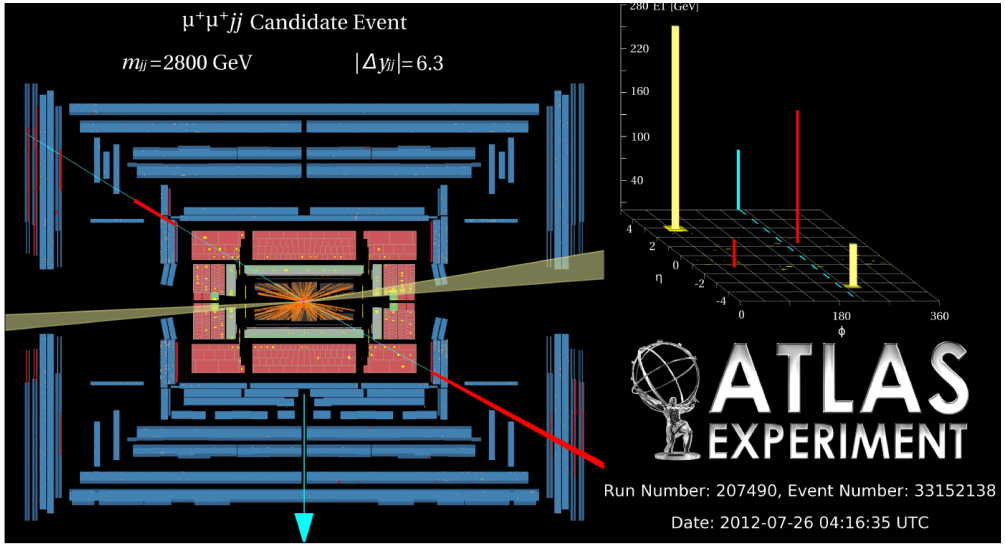
研究进展一：矢量玻色子散射背景综述

VBS过程典型动力学特征：
前后向电弱双喷注+桶部双玻色子

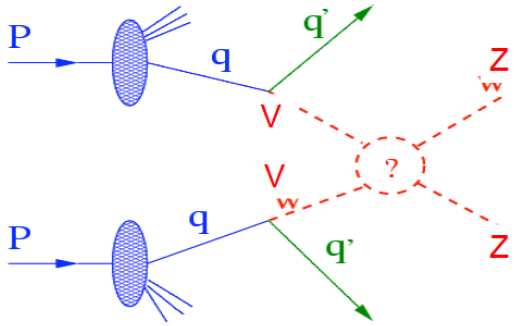
The large boson-boson collider 美国Symmetry杂志

大型玻色子玻色子对撞机

通过VV→VV矢量玻色子散射VBS过程检验希格斯幺正性，研究电弱对称性破坏机制、探索四规范反常耦合新物理与媒介新粒子态



$$\mathcal{M}(W_L^+W_L^- \to Z_LZ_L) \sim \frac{s}{M_W^2}$$

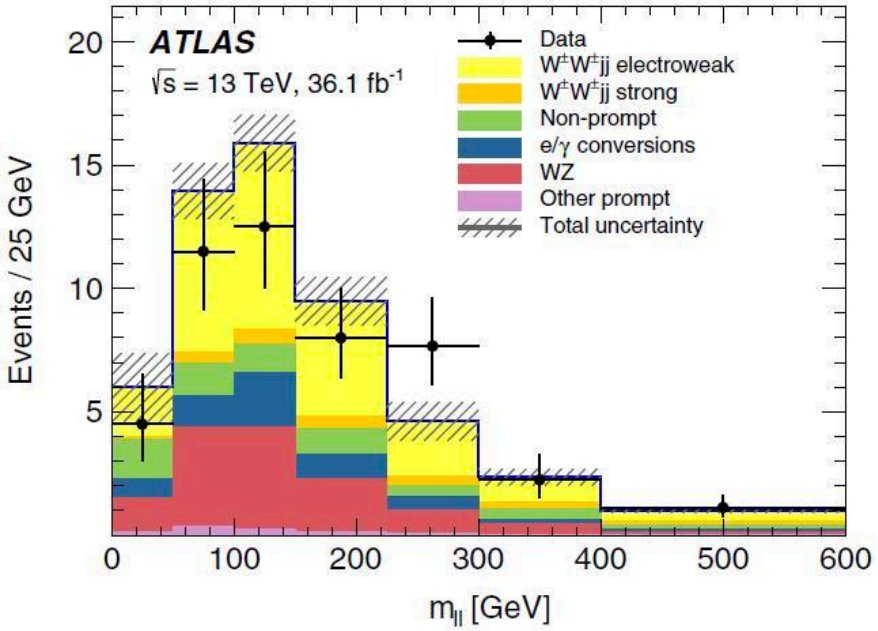


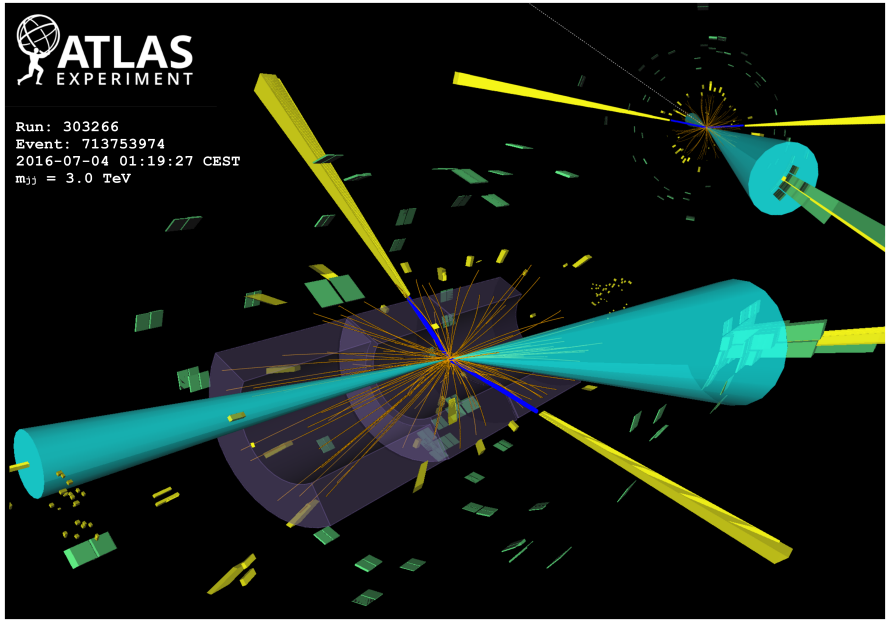
	$W^{\pm}W^{\pm}jj$	$WZjj$	$ZZjj$	$W\gamma jj$	$Z\gamma jj$
CMS 13TeV	5.5σ	6.8σ	4.0σ	5.3σ	3.9σ
ATLAS 13TeV	6.5σ	5.3σ	5.5σ		4.1σ

- 担任ATLAS Electroweak Convener与LHC Electroweak Multi-Boson Convener，全面负责和协调组内相关物理课题研究工作的开展、完成、审核与发表
- 主持基金委ATLAS矢量玻色子散射面上项目

VBS成果简介： 同号WW散射过程的发现

Phys. Rev. Lett. 123（2019）161801



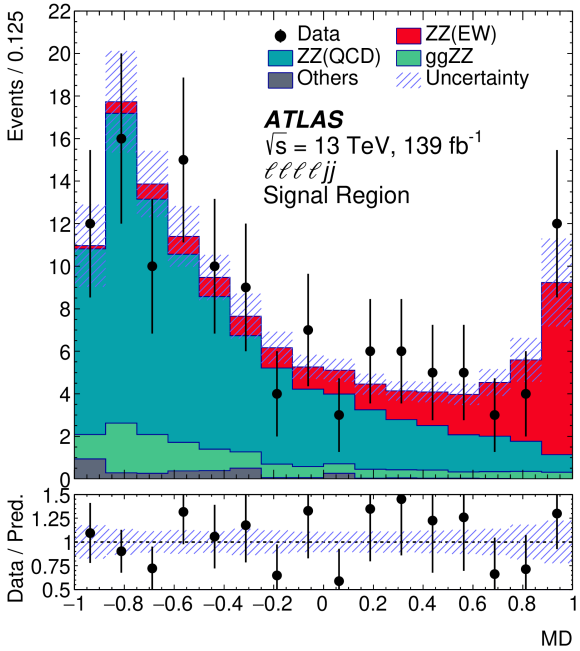


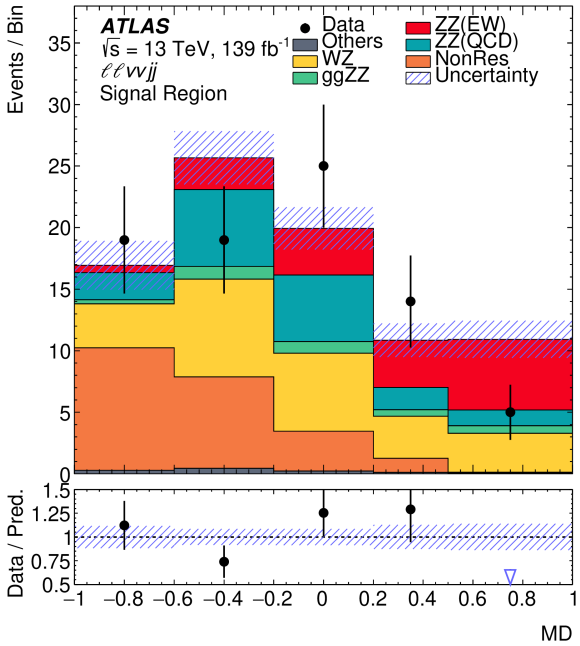
- 通过同号WW VBS过程有效限制强相互作用本底贡献：
  - 强相互作用双玻色子本底最少的VBS产生道
  - 主要本底为WZ轻子丢失、轻子误重建、电荷误甄别（不同于其他VBS过程）
- 主要工作：干涉效应理论计算及测量系统误差估计、控制区设计与本底优化
- 2019CCEPP个人报告之后正式发表

ATLAS合作组物理亮点摘要: https://atlas.cern/updates/physics-briefing/weak-lightsabers

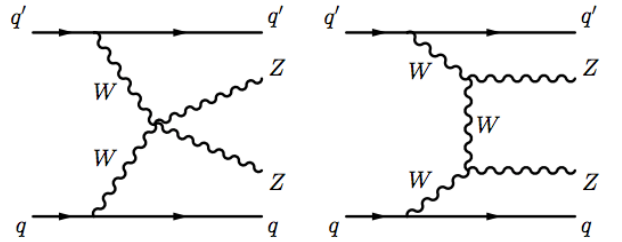
VBS成果简介： ZZ散射过程的发现

arXiv:2004.10612 (submitted to Nature Physics)

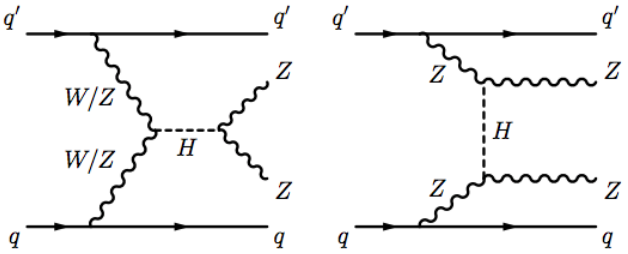




W/Z自耦合：



HVV耦合：



- 与中科大、密歇根大学等密切合作， 联合四轻子（低本底）与双轻子（高分支比）衰变道
- 采用BDT分析法进一步提高信噪比
- 获得5.5σ统计显著性，为LHC首次发现该过程，通过合作组审核并投稿
- 主要工作：系统误差估计、截面测量、双玻色子本底估计
- 指导研究生李京作了ATLAS Weekly Open presentation
- 代表合作组与分析团队作了2020国际会议相关成果专题报告

ATLAS合作组物理亮点摘要:

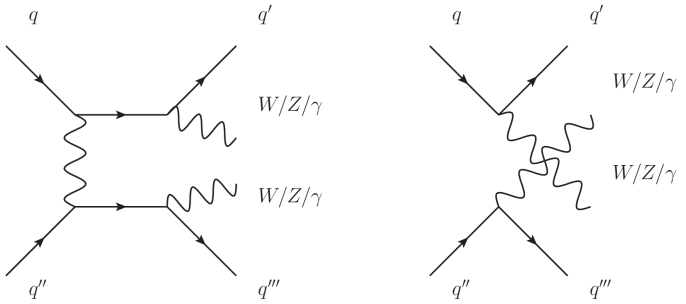
https://atlas.cern/updates/physics-briefing/milestone-electroweak-symmetry-breaking

VBS成果简介： Zγ散射过程的实验证据

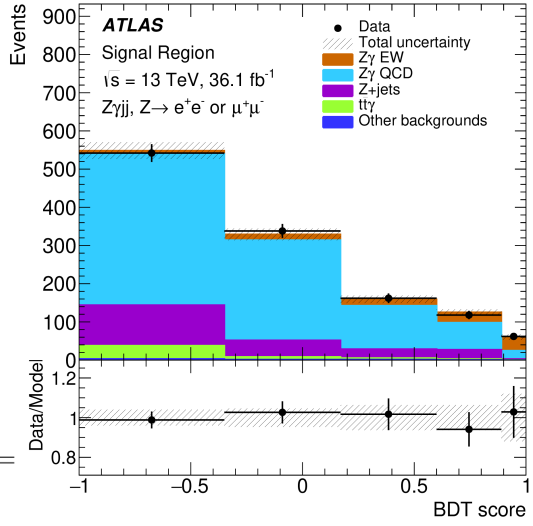
- 通过eeγ/$\mu\mu\gamma$末态测量Zγ散射过程
- 采用36fb^{-1}的Run2部分数据获得ATLAS首次3σ+统计显著性以上的实验证据(4.1σ)，承担干涉效应理论计算及测量系统误差估计、BDT多变量分析优化等
- 代表合作组与分析团队作了2020国际会议相关成果专题报告

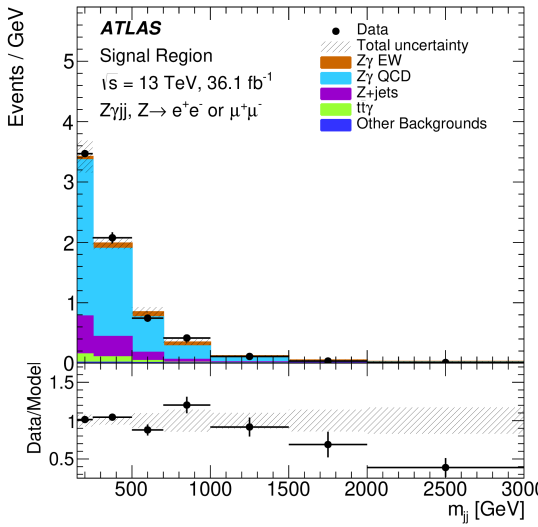
- Run2完整数据139fb^{-1}分析进行中，并首次拓展到Z$\nu\nu\gamma$衰变道

非VBS Zγ+2j电弱过程 VBS Zγ+2j电弱过程



Phys. Lett. B 803 (2020) 135341





VBS Zγ+2j电弱过程产生截面测量结果

$\sigma^{\text{fid.}}_{Z\gamma jj-\text{EW}}$	=	$7.8 \pm 1.5\,(\text{stat.}) \pm 1.0\,(\text{syst.})\,^{+1.0}_{-0.8}\,(\text{mod.})$ fb
$\sigma^{\text{fid., MadGraph}}_{Z\gamma jj-\text{EW}}$	=	$7.75 \pm 0.03\,(\text{stat.}) \pm 0.20\,(\text{PDF} + \alpha_S) \pm 0.40\,(\text{scale})$ fb
$\sigma^{\text{fid., Sherpa}}_{Z\gamma jj-\text{EW}}$	=	$8.94 \pm 0.08\,(\text{stat.}) \pm 0.20\,(\text{PDF} + \alpha_S) \pm 0.50\,(\text{scale})$ fb

担任欧洲核子中心物理黄皮书编辑

Multibosons Physics at the LHC

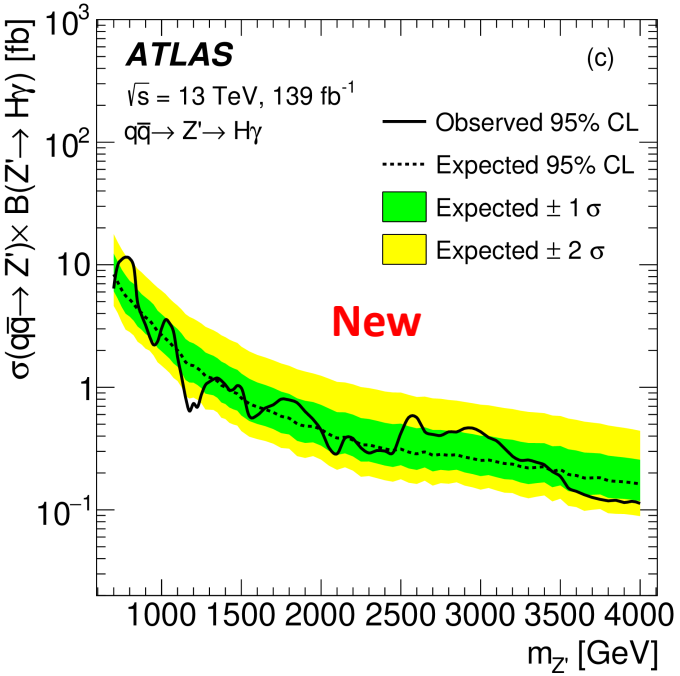
Report of the EW Working Group

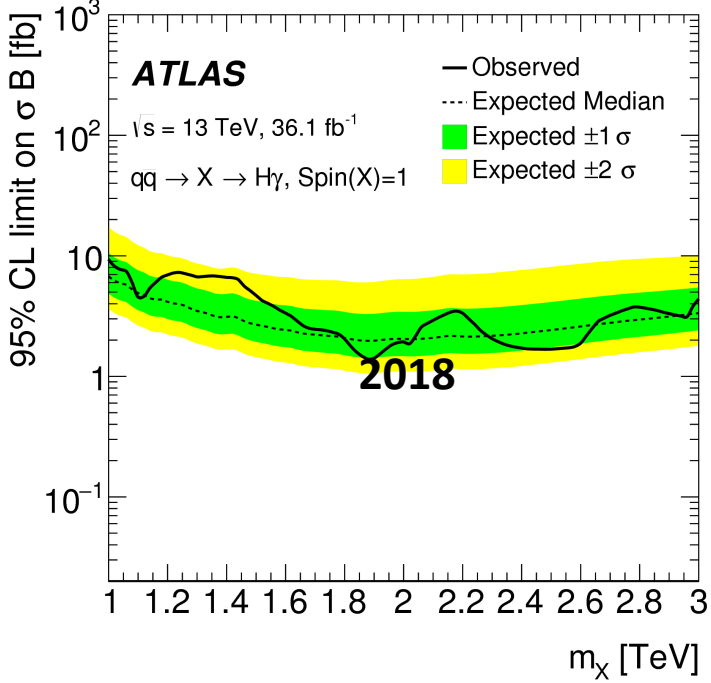
Editors: P. Azzuri
C. Degrande
L. Helary
S. Li
M. Liu
J.M. Lindert
K. Lohwasser
P. Vischia

研究进展二：H(bb)+γ共振态新物理寻找

arXiv:2008.05928 (accepted by PRL)

https://atlas.cern/updates/physics-briefing/searching-forces-beyond-standard-model



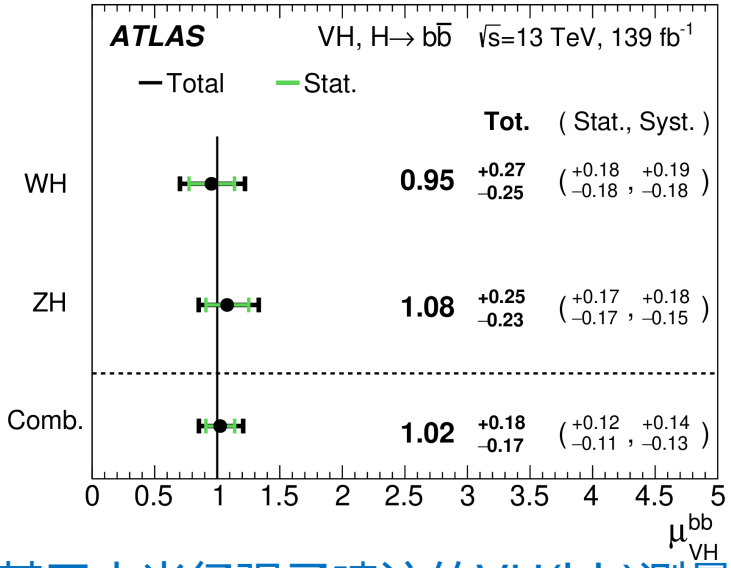


- 作为原创课题于2018年在LHC实验中提出并基于Run2部分数据完成首篇发表
- 本轮分析基于Run2完整数据，4倍积分亮度带来2倍左右的统计排除限基础性改善
- 与高能所、爱荷华州立大学等团队密切合作，应用了基于大半径强子喷注质心系来重新计算强子喷注组分动力学信息的新方法，对次级喷注在该质心系下重新做底夸克甄别，显著提高信噪比，获得H(bb)+γ共振态新物理在全质量区目前最好的统计限制。在2倍增量基础上进一步实现1.5~7.5倍的统计排除限改善。担任**合作组通讯编辑 (Contact Editor)**

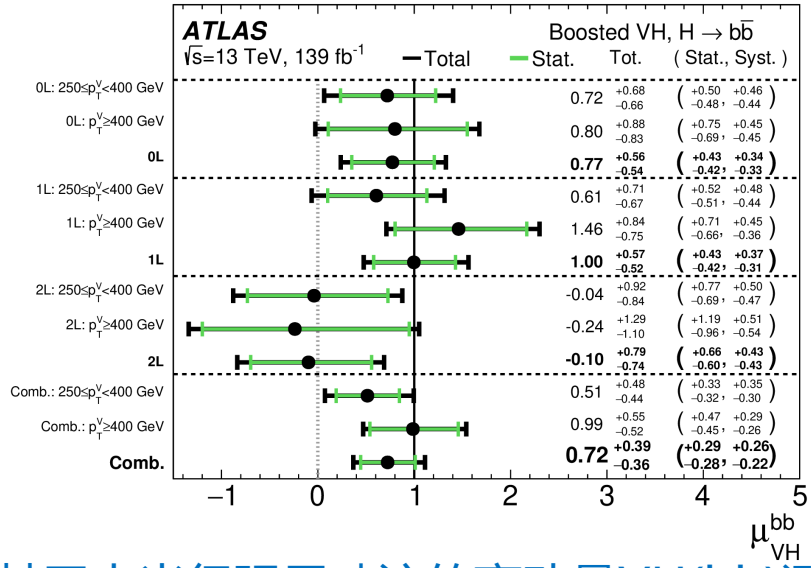
研究进展三：VH(bb)过程的测量

arXiv:2007.02873 (accepted by EPJC)　arXiv:2008.02508 (submitted to PLB)

https://atlas.cern/updates/physics-briefing/measuring-beauty-higgs-boson

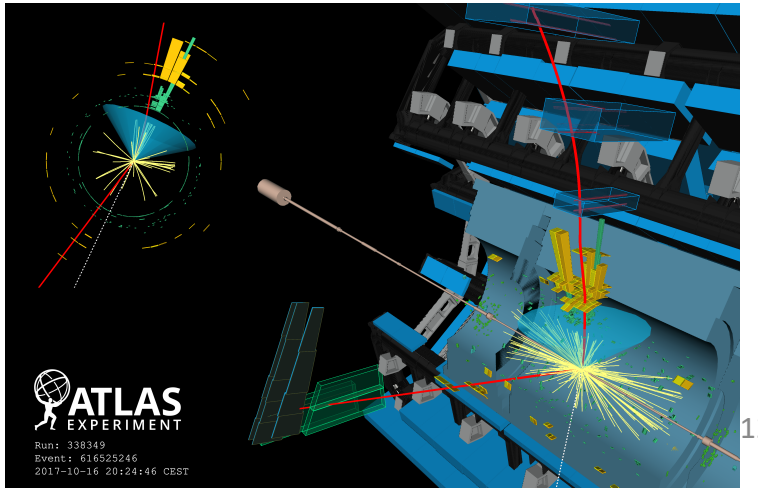


基于小半径强子喷注的VH(bb)测量



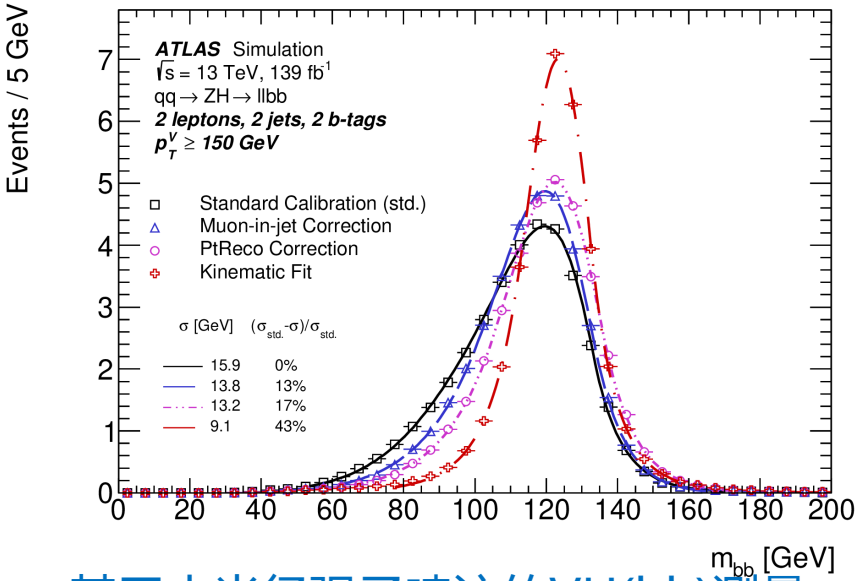
基于大半径强子喷注的高动量VH(bb)测量

- 采用Run2完整数据量(139fb^{-1})在后H(bb)发现时代开展更精确的测量：大半径强子喷注与小半径强子喷注相结合，使得高动量区分析得以开展
- 获得WH与ZH衰变道的单独测量结果，分别达到4.0σ和5.3σ的统计显著度



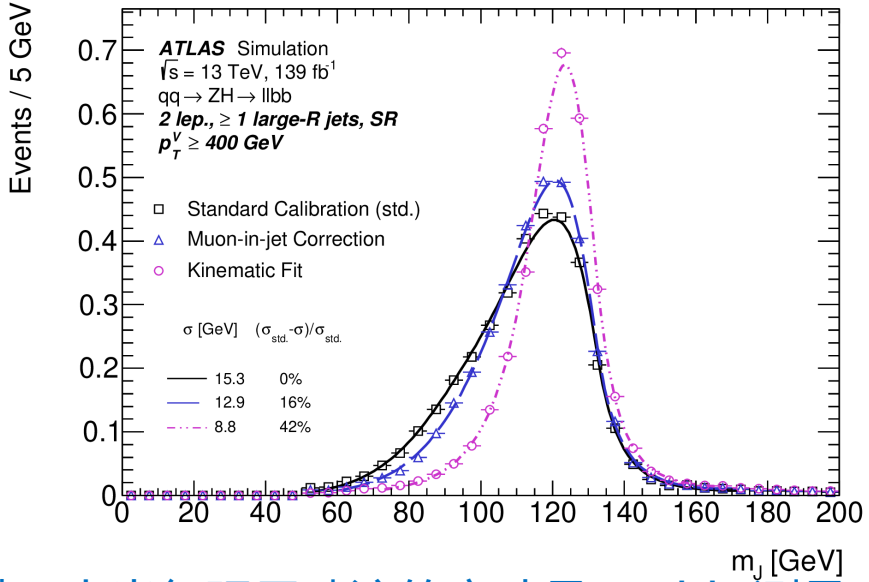
研究进展三：VH(bb)过程的测量

arXiv:2007.02873 (accepted by EPJC)



基于小半径强子喷注的VH(bb)测量

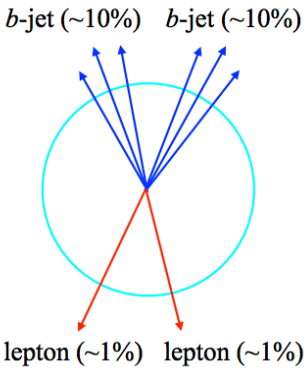
arXiv:2008.02508 (submitted to PLB)



基于大半径强子喷注的高动量VH(bb)测量

主要工作：

- 与博士后Chikuma Kato及研究生合作，采用双轻子道动力学平衡限制拟合获得更精确的底夸克喷注能量修正的新方法，实现最高40%的希格斯质量分辨率提升。
- Chikuma担任**Hbb组分析软件框架负责人**与**希格斯物理组物理验证项目协调人。**



$$-2\ln L = \quad \leftarrow \text{Maximize likelihood}$$

$$\Sigma_i \frac{(p_T - p_T^{fit})}{\sigma^2} \quad \leftarrow \text{Leptons, 3rd jet, MET soft term: Gaussian}$$

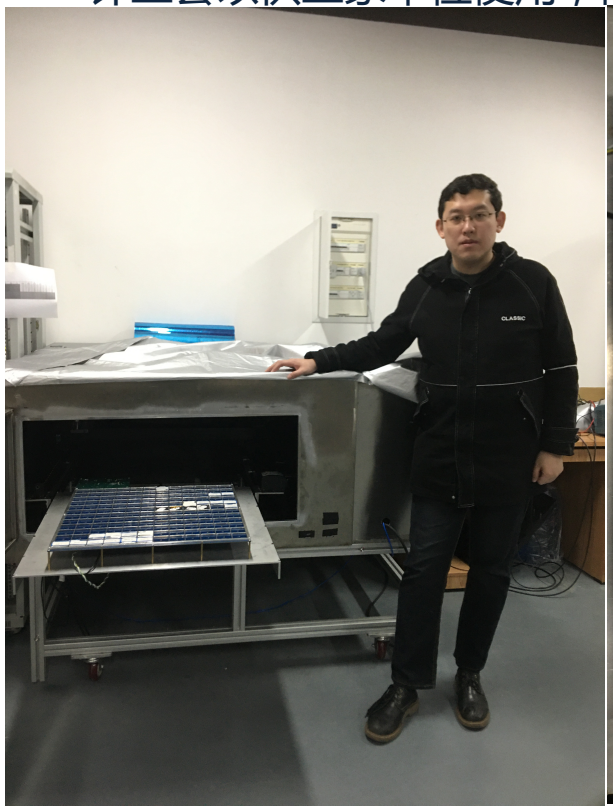
$$-\Sigma_j 2\ln L(p_T, p_T^{fit}) \quad \leftarrow b\text{-jets: Trasnfer Functions}$$

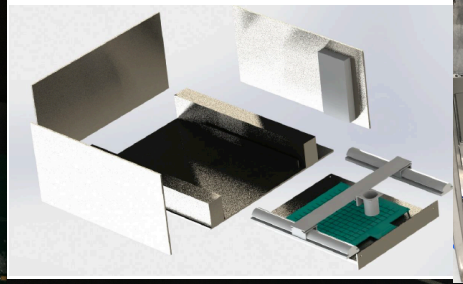
$$+\frac{(\Sigma_{i,j} p_x)^2}{\sigma_{bal}^2} + \frac{(\Sigma_{i,j} p_y)^2}{\sigma_{bal}^2} \quad \leftarrow \text{Balance constraint: Gaussian}$$

$$+2\ln\{(m_{ll}^2 - m_Z^2)^2 + m_Z^2\Gamma_Z^2\} \quad \leftarrow Z \text{ mass constraint: Breit-Wigner}$$

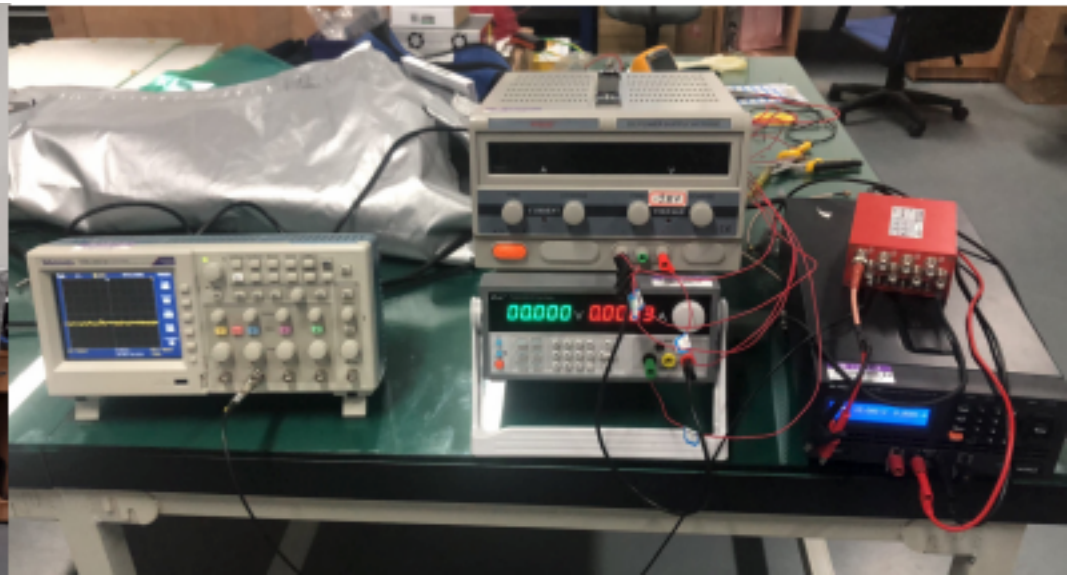
CEPC成像型强子量能器预研

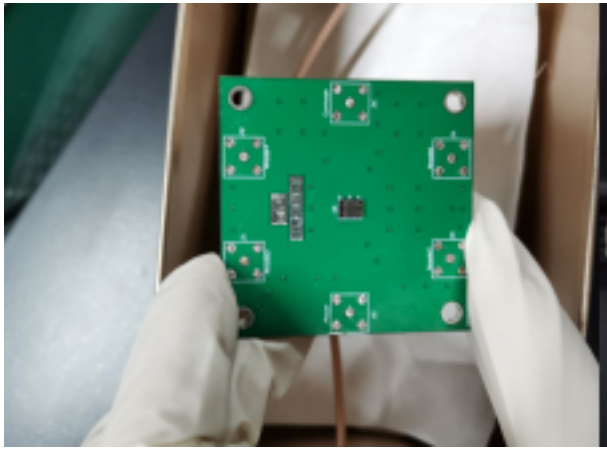
- 依托科技部重点研发计划支持：
  - 高能环形正负电子对撞机关键技术研发和验证：成像型强子量能器技术验证（课题3），课题骨干，2018.05~2023.04
- 与高能所、中科大密切合作，开展成像型强子量能器预研、样机设计及测试工作。
- 基于塑闪+硅光电倍增管的设计方案，参与样机设计。
- 承担探测器塑闪单元基于Sr^{90}放射源、暗箱与二维步进电机的批量测试系统设计工作。共设计三套以供三家单位使用，两套基本交付到位并即将开展测试任务。

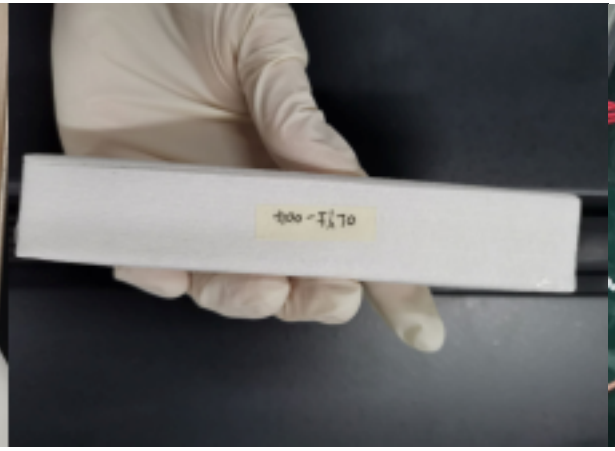


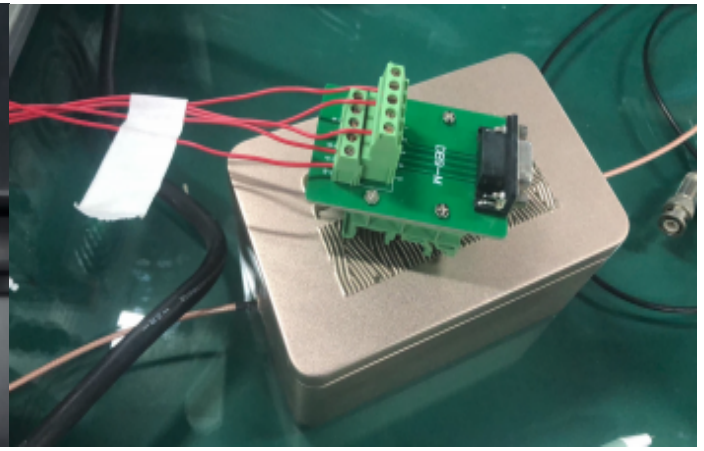


基于CAEN Module搭建闪烁体基础测试系统



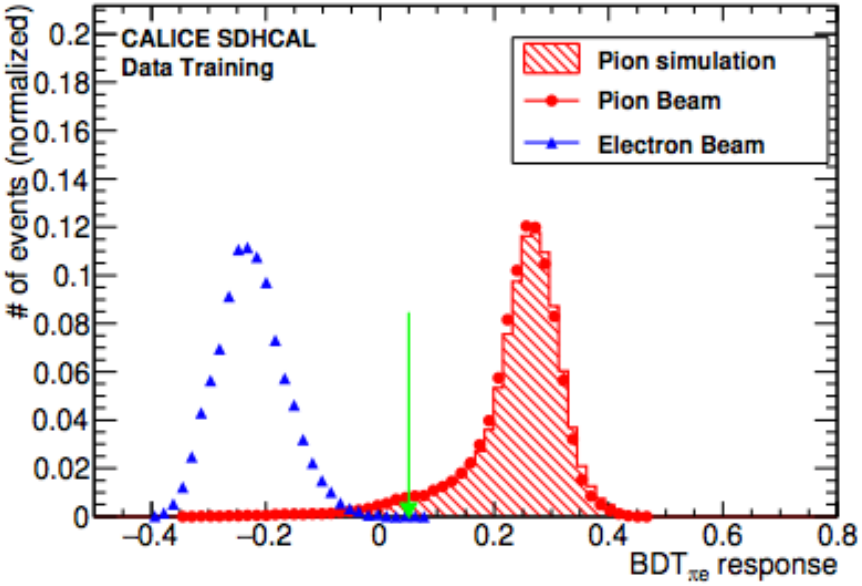


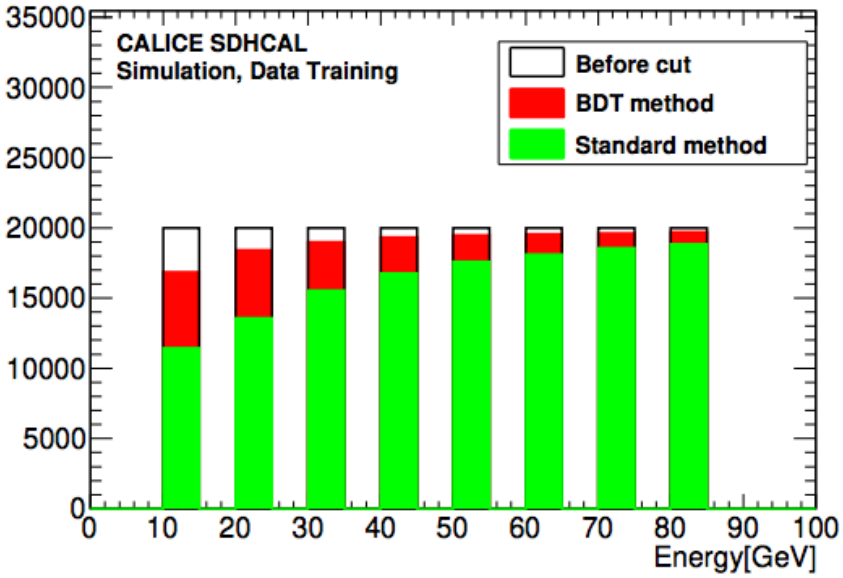




轻子对撞机上基于提升决策树的粒子鉴别算法研究

JINST 15 (2020) P10009





- 基于玻璃阻性板室的强子量能器设计方案是CALICE合作组针对未来轻子对撞机上高颗粒度量能器设计需求而提出的几个主要设计方案之一
- 2012-2018多次通过CERN PS和SPS的完成强子与轻子束流测试
- 设计BDT算法用于甄别Pion与轻子，并应用于束流测试数据
- 综合应用了多个与事例拓扑性状相关的实验观测量，提高粒子分辨能力

SnowMass CEPC未来物理预期工作的开展

https://www.snowmass21.org/docs/files/summaries/EF/SNOWMASS21-EF8_EF2-100.pdf

Study of Electroweak Phase Transition in Exotic Higgs Decays with CEPC Detector Simulation

Michael Ramsey-Musolf[a,b,c], Shu Li[a,d]

(a) Tsung-Dao Lee Institute and School of Physics and Astronomy, Shanghai Jiao Tong University, 800 Dongchuan Road, Shanghai, China

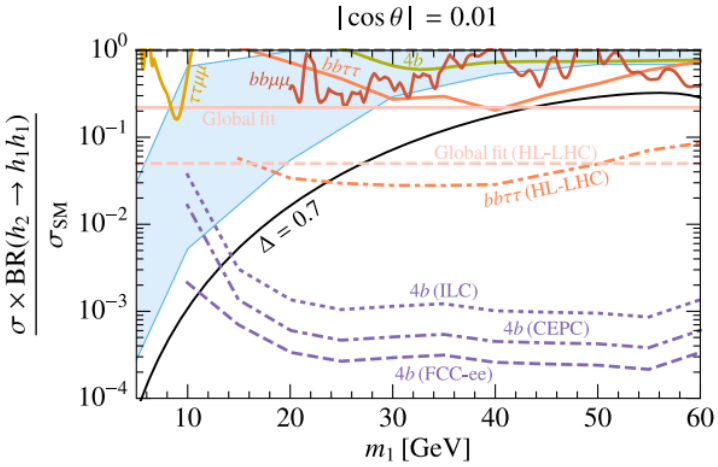
(b) Amherst Center for Fundamental Interactions, Department of Physics, University of Massachusetts, Amherst, MA 01003, USA

(c) Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, CA 91125 USA

(d) Center for High Energy Physics, Peking University

mjrm@sjtu.edu.cn, shuli@sjtu.edu.cn

We propose a light scalar search topic in exotic Higgs decay final states to be carried out using CEPC detector simulation so as to examine the first-order electroweak phase transition phenomenon search sensitivity in such future lepton collider experiment. The work will not only strengthen the R&D physics program but also provide advice on detector design optimization so as to improve the search sensitivity.



Keywords: Electroweak Phase Transition; Exotic Higgs Decay; Light Scalar; Beyond Standard Model Physics; Future Colliders; CEPC

与理论家合作提出通过希格斯玻色子奇异衰变过程研究电弱相变的未来物理预研课题
已提交SnowMass2021 Letter of Intent (LoI)，唯象学模拟与分析工作已逐步开展

年度成果总结：文章发表

ATLAS合作组文章**发表或确认接收4篇，投稿3篇**

- ✓ 矢量玻色子散射研究
  - 同号WW VBS 5σ+测量（Phys. Rev. Lett. 发表）
  - ZZ VBS 5σ+测量（投稿Nature Physics）
  - Zγ VBS 3σ+测量（Phys. Lett. B发表）
- ✓ H(bb)+γ共振态新物理寻找（Phys. Rev. Lett.确认接收）
- ✓ VH(bb)测量
  - 小半径喷注测量（EPJC确认接收）
  - 大半径喷注测量（投稿Phys. Lett. B）
- ✓ Z(bb)+γ测量（投稿Phys. Lett. B）

CALICE SDHCAL研究文章1篇：

- ✓ 粒子鉴别与探测器性能研究（JINST发表）

年度成果总结：主要会议报告

- Latest VBS measurements in ATLAS (30’ +10’)
  - 大会报告：VBSCan@Helskin, Finland, 2020.02
  - 亮点报告内容：ZZ VBS 5σ+与Zγ VBS 3σ+测量最新结果
- Aspects of Experimental Particle Physics (3小时)
  - 讲座报告：北大高能中心暑期学校, 2020.07
- Status of CEPC Hadronic Calorimeter (20’ +10’)
  - 月会报告：CEPC DAY, 高能所, 2020.09
- From the Great Colliders to the Great Futures (20’ +5’)
  - 分会报告：CUSPEA-40周年纪念报告会, 西安, 2019.11 (2019年卓越中心个人报告之后)

- Calibration of Quark/Gluon Jet BDT Tagger (1小时)
  - ATLAS Hadronic Calibration Workshop 2020 (HCW2020), 2020.09
  - 博士研究生苏琬云担任session chair和报告人

年度成果总结：在研项目及荣誉获得情况

在研项目：

- 在ATLAS实验上测量矢量玻色子散射过程以及对相关新物理的寻找，**基金委面上项目，主持**，2019.01~2022.12
- 高能环形正负电子对撞机关键技术研发和验证：成像型强子量能器技术验证，**国家重点研发计划，子课题骨干**，2018.05~2023.04
- ATLAS实验Run-2数据物理分析：标准模型测量和其他超出标准模型的新物理寻找，**国家重点研发计划，子课题骨干**，2018.05~2023.04

人才类项目荣誉：

- 国家青年千人计划，2019~2022
- 北京大学高能物理研究中心李政道青年学者，2020~

参与学术会议举办与组织工作

教学工作

2020年春季学期：
大学物理I（力学、热学），64学时，本科

2020年秋季学期：
大学物理II（电磁学、光学、量子力学基础），64学时，本科

其他教学经历：
2019年春，实验粒子物理前沿，48学时，研究生专业课

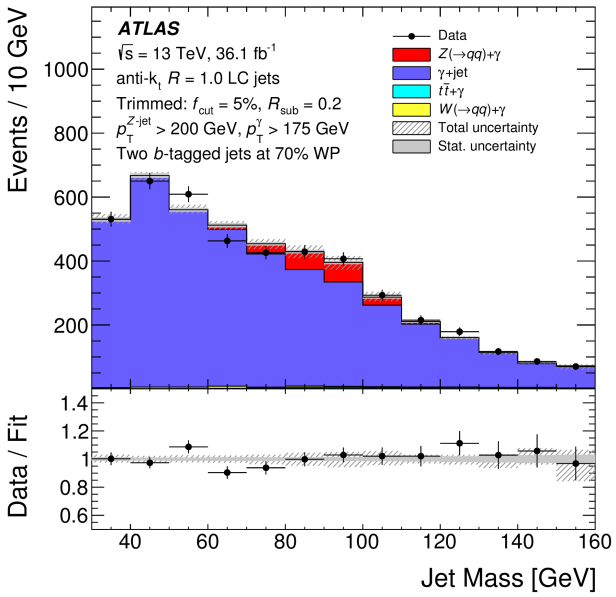
致谢

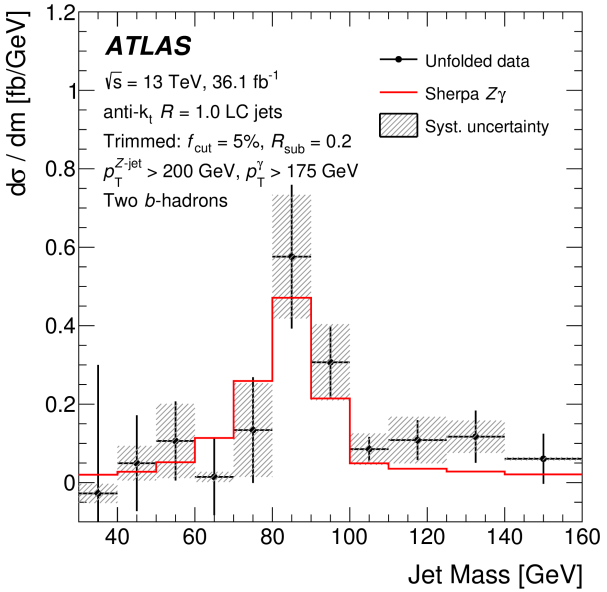
谢谢各位评委老师
敬请批评指正！

备份页

其他研究进展：Z(bb)+γ过程的测量

arXiv:1907.07093 (submitted to PLB)





- 通过标准模型Z(→bb)+γ过程检验大张角高动量双b强子喷注(DeltaR=1.0)的性状，基于Z(→bb)喷注质量的微分截面测量
- 检验大半径高动量喷注重建算法在标准模型典型过程中的性状
- 主要工作：Z(→bb)+γ信号过程模拟，ttbar+γ本底过程模拟及计算

LHC任职证明

TWiki > LHCPhysics Web > LHCEW > EWWG3 (2020-09-14, RobertoCovarelli)

LHC Electroweak Multiboson Subgroup

- LHC Electroweak Multiboson Subgroup
  - Organization of the Group
  - Meetings and Mailing Lists
  - ATLAS+CMS Summary Plots
  - ATLAS+CMS Combination of Anomalous Coupling Limits

This public page documents relevant discussions and results in the Multiboson subgroup of the LHC electroweak group.

Organization of the Group

The activities of the group are organised by subgroup conveners:

- **ATLAS:** Joany Manjarres Ramos, Kristin Lohwasser, Shu Li
- **CMS:** Philip Chang, Roberto Covarelli, Pietro Vischia
- **Theory**: Jonas Lindert and Celine Degrande
- Send mail to conveners

https://twiki.cern.ch/twiki/bin/view/LHCPhysics/EWWG3

可供公开查阅

ATLAS任职证明

In case of any information inconsistency, please contact Atlas Secretariat.

Shu Li

shu.li@cern.ch

Physicist

TDLI

Tsung-Dao Lee Institute

Institute Representative (TDLI)

Shu has 3 assigned appointment records:

Convener of subgroup: Generator Infrastructure and Tools

2018-04-01 — 2019-09-30

100%

Convener of subgroup: Electroweak Physics

2017-04-01 — 2018-03-31

100%

Convener of subgroup: MC Validation (discontinued Oct 2017)

2015-12-01 — 2017-01-31

100%

In case of any inconsistencies, please contact Martine Desnyder-Ivesdal.

ATLAS任职证明

Organisation and responsibilities

Higgs WG Subgroups

Sub-Group	Conveners	Main Topics
HP	Marianna Testa	Higgs Prospects and Upgrade
	Stephane Jezequel	
HGam	Anthony Morley	Diphoton and Zgamma
	Chen Zhou	
HZZ	Christos Anastopoulos	ZZ, ZH(invisible), and dimuons
	Will Leight	
HWW	Yun-Ju Lu	WW
	Kristin Lohwasser	
HLep	Duc Bao Ta	Ditaus
	Kathrin Becker	
Hbb	Hannah Arnold	VH(bb), VBF(bb), and bH(bb)
	Andy Chisholm	
HTop	Judith Katzy	Higgs production in association with top
	Tamara Vazquez Schroeder	
HComb	Nicolas Morange	Higgs Properties and combinations
	Sarah Heim	
CDM	Priscilla Pani (on leave)	Common Dark Matter (shared with HDBS, Exotics and SUSY)
	James Frost	
	Valerio Ippolito	

Other Working Groups

- Higgs WG Trigger
- Higgs ASG
- LHC Higgs Cross Sections

ATLAS conveners of the LHC Higgs XS WG

(Sub-) Group	Conveners	Main Topics
LHC Higgs XS WG Steering committee	Kerstin Tackmann	Overall coordination and Higgs group theory contacts
	Giacinto Piacquadio	
WG1	Giovanni Marchiori	SM Higgs XS and BR
WG2	Nicolas Berger	Higgs properties
WG3	Anna Goussiou	BSM Higgs

Higgs Task Coordinators and Group Contacts

Task	Coordinator / Contact
MC production	Shu Li, Daniela Rebuzzi
Grid group space	Heather Gray
Statistics forum	Aaron Armbruster
Trigger	Ki Lie, Rhys Owen
Photons	Elisabeth Petit
Electrons	Sarah Heim
Jets	Tae Hyoun Park
MET	Tae Hyoun Park
Muons	Weitao Wang
Taus	Antonio De Maria
b-Tagging	Jelena Jovicevic
PMG	Ana Rosario Cueto Gomez, Liza Mijovic (+ MC Production contacts)
Hepdata	Dag Gillberg
ASG	Arturo Sanchez Pineda

There is also a central table on the PhysicsGroupLiaisons twiki page.

ATLAS任职证明

Inner Tracking Combined Performance Group

Conveners: Valentina Cairo, Maximilian Goblirsch

(atlas-perf-idtracking-conveners@cern.ch)

Please sign up to eGroup: hn-atlas-id-tracking-performance@cern.ch

All important messages will be circulated via this list.

What is going on

- Plenary **Thursday @ 5:30pm in 42-3-002**
  - on Zoom mostly in 2020!!!
- Summary list of recent plenary meetings
- Mailing List
- High Priority Task
- Tracking CP recommendations
  - Calibration, sysematics and instructions of tools
  - InDetTrackingEfficiency, InDetTrackingFake, InDetTrackingIPResolution
- Large Radius Tracking in Release 22
- Ongoing Papers and Notes

Newcomers: Start here!

- Introduction from 2019! (**latest!!!**)
  - Example how to run tracking!
    - Intro Slides
    - Git repo with examples
  - Basics to Truth Definitions for Tracking
    - Truth for Tracks
  - Event Data Model (EDM) summary
    - Tracking EDM
- TrackingCPBasics
- Inner Detector software tutorials
  - Vertexing tutorial (2013)
  - Vertexing tutorial (2015)
  - Vertexing tutorial (2018 - **Start Here**)
- Definition of ATLAS perigee parameters
- Tracking CP MC samples

Sub-groups and Task Forces

Group	Convener(s)	Meeting	tWiki
Alignment	Paolo Sabatini, Javier Jimenez Pena	Tue, 5:30 pm	twiki
Clustering and Tracking In Dense Environments	Marco Battaglia, Gabriel Facini	Wed 5:00 pm	twiki
Vertexing	Vadim Kostyukhin, Ke Li	Thurs , 4:30 pm	twiki
Upgrade Tracking	Thomas Strebler, Noemi Calace	Wed, 3:30 pm	twiki

Contact People and Responsibles

Role	Person
Contact People	
Pixel Software	Soshi Tsuno, Marco Battaglia
SCT Software	Susumu Oda, Pat Ward
TRT Software	Philippe Calfayan, Christian Grefe
ITK Software	Nick Styles
Heavy Ion	Petr Balek
Responsibles	
ID Software	Goetz Gaycken, Shaun Roe
new ART twiki old RTT twiki	Ke Li
InDetTrackingValidation	Maria Moreno Llacer, Susana Cabrera Urban, Shih-Chieh Hsu
InDetPhysValMonitoring	Shaun Roe, Goetz Gaycken, Tim Ayde
ID Online and Data Quality Coordinators	Per Johansson
MC Production Manager	Shu Li

ATLAS任职证明

TWiki > AtlasProtected Web > AtlasPhysics > HiggsWorkingGroup > Higgsbb (2020-09-30, HannahArnold)

Physics Analysis R22 Validation

Introduction

This page lists the analyses involved in the Release 22 Physics Validation effort.

Physics Analysis Contacts

PA Group	Contact(s)
SM	Evgeny Soldatov
Top	Tomas Dado (initially Marco Vanadia)
Higgs	Chikuma Kato
HDBS	Bill Balunas
Exotics	James Frost
SUSY	Alvaro Lopez Solis

ATLAS H->bb SubGroup

Convenors: Andrew Chisholm, Hannah Arnold

Contact People

- **Hbb Derivation**: Giuseppe Callea, Antonio Giannini (from DBL)
- **CxAOD production**: Paul Thompson
- **CxAOD Analysis Framework**: Jonathan Hays, Chikuma Kato
  - **General (AB, common part)** : Chikuma Kato
  - **Egamma**: Ava Lee(electron), Bo Liu (photon)
  - **Muons**: Weitao Wang, Masahiro Yamatani(from DBL) (outgoing)
  - **Tau** : Christopher Deutsch (from HBSM)
  - **Jets**: Matt Klein
  - **Fat Jets**: Brian Moser
  - **Track Jets**: Maria Giovanna Foti
  - **MET**: Giulia Di Gregorio
  - **b-tagging**: Marko Stamenkovic, Jonathan Shlomi
- **Trigger:** Bo Liu
- **MC:** Main.Stephen Jiggins
- **Higgs Comb/ATLAS-CMS Combination**: Thomas Calvet (outgoing), Brian Moser
- **Hbb EFT contact**: Thomas Calvet (outgoing), Brian Moser
- **Stat Framework**: Nicolas Morange, Thomas Calvet, Yanhui Ma
- **HL/HE-LHC Yellow Report**: Changqiao Li

ATLAS物理摘要：ZZ散射过程的发现

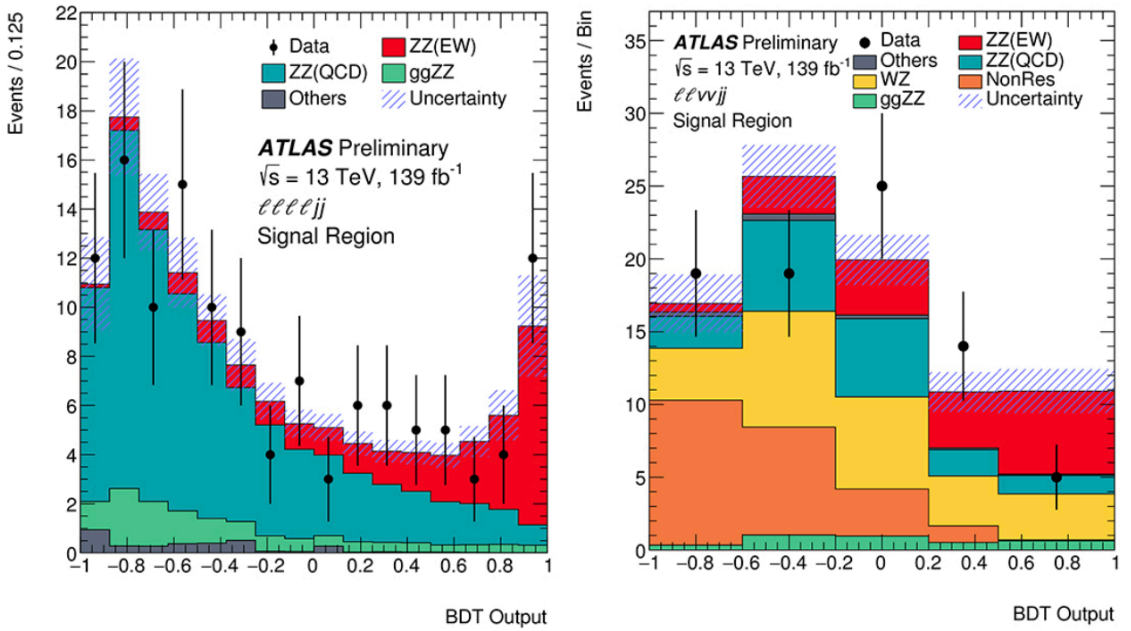
Physics Briefing

Tags: EPS, EPS 2019, Physics Results

New milestone reached in the study of electroweak symmetry breaking

ATLAS observes the electroweak production of two jets in association with a Z-boson pair

By ATLAS Collaboration, 15th July 2019



https://atlas.cern/updates/physics-briefing/milestone-electroweak-symmetry-breaking

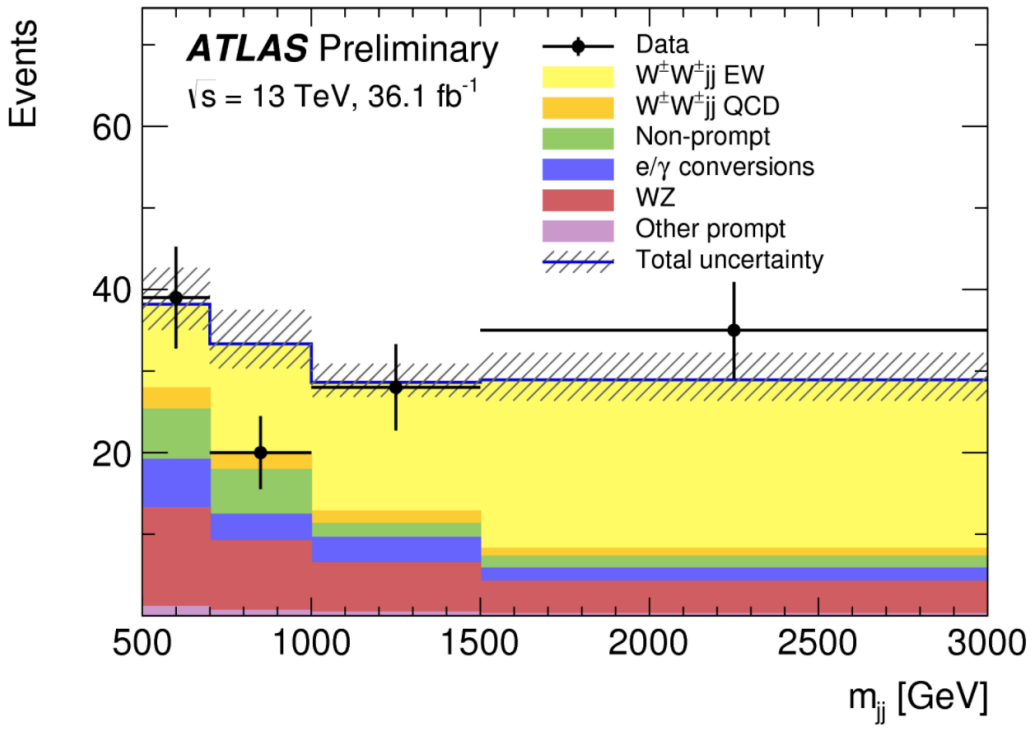
ATLAS物理摘要：同号WW与WZ散射过程的发现

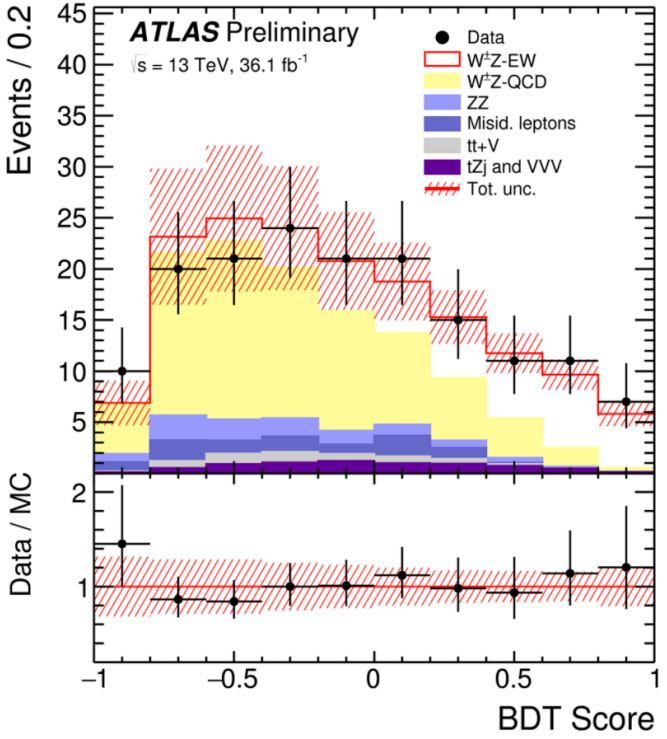
Physics Briefing

Tags: Physics Results, ICHEP2018, STDM group

Quarks observed to interact via minuscule “weak lightsabers”

By ATLAS Collaboration, 5th July 2018





https://atlas.cern/updates/physics-briefing/weak-lightsabers

ATLAS物理摘要：H(bb)+γ共振态新物理寻找

Physics Briefing

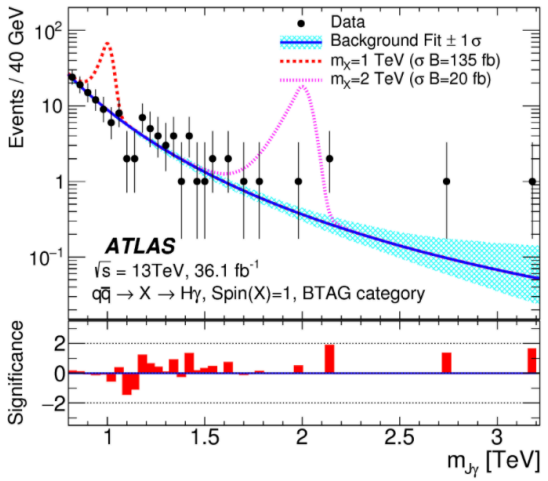
Tags: EXOT group, Physics Results, new physics

Searching for forces beyond the Standard Model

By ATLAS Collaboration, 8th May 2018

The ATLAS collaboration is continuing to scour the wealth of data provided by the LHC for any signs of physics beyond the particles and interactions described by the Standard Model. One approach is to search for new forces in addition to the Standard Model's electroweak and strong interactions. Such forces could be propagated by new massive bosons playing the role the W and Z bosons have in mediating the electroweak force.

A recent ATLAS measurement extends searches for new bosons up to masses about 70 times the mass of the Z boson. The search examines events where the postulated boson (X) would decay into an energetic photon plus a W or Z boson. ATLAS is well suited for detecting such events, initially selecting an energetic photon and subsequently identifying highly-boosted W/Z bosons from their decays to quark-antiquark pairs. The mass of the X boson can be obtained directly from the decay products and evidence for the X boson would appear as an excess of events above background. Alas, no such excess is observed, allowing improved limits to be set on the production of an X boson in the mass range from 1.0 to 6.7 TeV.



Invariant mass spectrum of a jet J, selected as the candidate for an H→bb decay, and a high-energy photon. The black points show the data with the solid blue curve a parameterized smoothly falling mass spectrum. The dotted red peaks illustrate what would be expected for X→H+g signals of mass 1.0 or 2.0 TeV. The bottom panel shows that there are no significant deviations of the data from a smoothly falling mass spectrum. (Image: ATLAS Collaboration/CERN)

Since all-things-Higgs are of particular interest these days at the LHC, the ATLAS measurement also carries out the first search for a massive new boson decaying to a Higgs boson plus a photon. This signal is identified using decays of Higgs bosons with the largest branching ratio, namely a pair of b quarks. As shown in the figure, the observed invariant mass distribution of the events selected as a Higgs boson plus photon is a smoothly falling spectrum, showing no evidence for a new boson. The plot shows a computer simulation of what would be expected for X signals with masses of 1.0 and 2.0 TeV. This is the first search carried out at the LHC for a massive boson X decaying to a Higgs boson plus a photon, and is sensitive to these bosons with masses up to about 25 times the mass of the Higgs boson.

https://atlas.cern/updates/physics-briefing/searching-forces-beyond-standard-model

ATLAS物理摘要：VH(bb)的测量

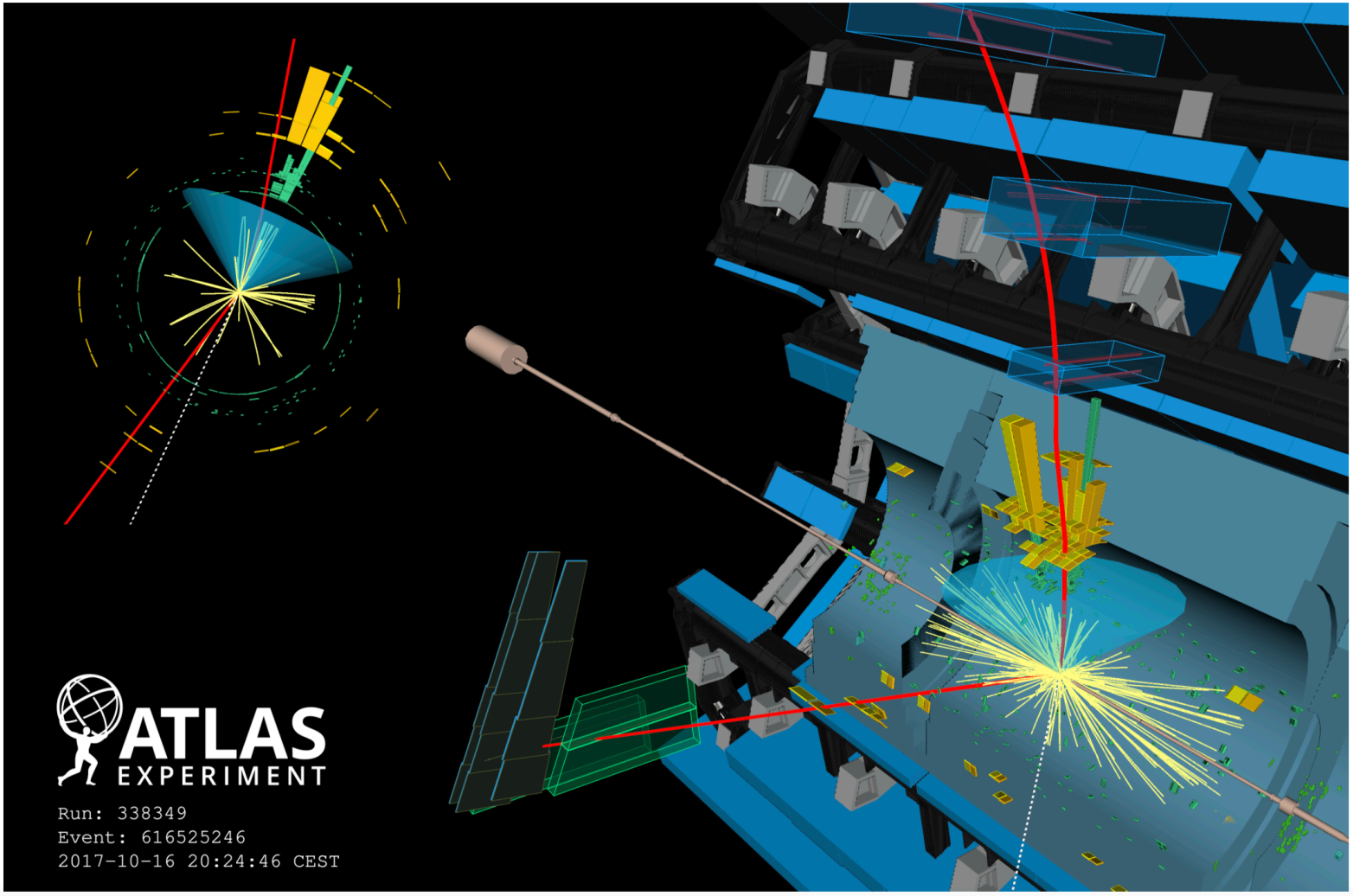
Physics Briefing

Measuring the beauty of the Higgs boson

Tags: Higgs boson, Physics Results, Run 2, Higgs Seminar 2020

By ATLAS Collaboration, 7th April 2020

https://atlas.cern/updates/physics-briefing/measuring-beauty-higgs-boson



同号WW散射成果证明

Internal Note

Report number	ATL-COM-PHYS-2018-745
Title	**Observation of electroweak production of a same-sign W boson pair in association with two jets in pp collisions at $\sqrt{s}=13$ TeV with the ATLAS detector**
Author(s)	Bittrich, Carsten (Institut fuer Kern- und Teilchenphysik, Technische Universitaet Dresden) ; Di Clemente, William Kennedy (Department of Physics and Astronomy, University of Pennsylvania) ; Duffield, Emily Marie (Lawrence Berkeley National Laboratory and University of California, Berkeley) ; Geng, Cong (University of Michigan, Department of Physics) ; Gonella, Giulia (Albert-Ludwigs-Universitaet Freiburg) ; Guo, Jun (Shanghai Jiao Tong University) ; Heinemann, Beate (DESY, Hamburg and Zeuthen) ; Herrmann, Tim (Institut fuer Kern- und Teilchenphysik, Technische Universitaet Dresden) ; Iltzsche Speiser, Franziska (Institut fuer Kern- und Teilchenphysik, Technische Universitaet Dresden) ; Kobel, Michael (Institut fuer Kern- und Teilchenphysik, Technische Universitaet Dresden) ; Koeneke, Karsten (Albert Ludwigs-Universitaet Freiburg (DE)) ; Kroll, Joe (Department of Physics and Astronomy, University of Pennsylvania) ; Lee, Claire Alexandra (Brookhaven National Laboratory (BNL)) ; Li, Shu (Tsung-Dao Lee Institute) ; Liu, Jianbei (University of Science and Technology of China) ; Liu, Yanlin (University of Science and Technology of China) ; Manjarres Ramos, Joany Andreina (Institut fuer Kern- und Teilchenphysik, Technische Universitaet Dresden) ; Mittal, Monika (Shanghai Jiao Tong University) ; Mwewa, Chilufya (University of Cape Town) ; Ospanov, Rustem (University of Science and Technology of China) ; Pagan Griso, Simone (Lawrence Berkeley National Laboratory and University of California, Berkeley) ; Pleier, Marc-Andre (Brookhaven National Laboratory (BNL)) ; Potamianos, Karolos Jozef (DESY, Hamburg and Zeuthen) ; Shapiro, Marjorie (Lawrence Berkeley National Laboratory and University of California, Berkeley) ; Sommer, Philip (University of Sheffield) ; Todt, Stefanie (Institut fuer Kern- und Teilchenphysik, Technische Universitaet Dresden) ; Wu, Yusheng (University of Science and Technology of China) ; Xu, Wenhao (University of Michigan, Department of Physics) ; Yacoob, Sahal (University of Cape Town) ; Yang, Haijun (Shanghai Jiao Tong University) ; Zhang, Liqing (University of Science and Technology of China) ; Zhao, Zhengguo (University of Science and Technology of China) ; Zhou, Bing (University of Michigan, Department of Physics) ; Zhu, Junjie (University of Michigan, Department of Physics) *Hide*
Imprint	04 Jun 2018. - mult. p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	same-sign WW ; vector boson scattering ; electroweak symmetry breaking ; EWEAK
Abstract	This Letter presents the observation and measurement of electroweak production of a same-sign W boson pair in association with two jets using 36.1 fb^{-1} of proton--proton collision data recorded at a center-of-mass energy of $\sqrt{s}=13$ \TeV\ by the ATLAS detector at the Large Hadron Collider. The analysis is performed in the detector fiducial phase-space region, defined by the presence of two same-sign leptons, electron or muon, and at least two jets with a large invariant mass and rapidity difference. A total of 122 candidate events are observed for a background expectation of 69 ± 7 events, corresponding to an observed signal significance of 6.5 standard deviations. The measured fiducial signal cross section is $\sigma^{\textrm{fid.}}=2.89^{+0.51}_{-0.48} \textrm{(stat.)}\ ^{+0.29}_{-0.28} \textrm{(syst.)}\textrm{ fb}$.

ZZ散射成果证明

Internal Note	
Report number	ATL-COM-PHYS-2018-1338
Title	**Measurements of cross sections and search for the electroweak production of ZZ in association with two jets in four-lepton and two-lepton plus two-neutrino channel**
Author(s)	Chen, Jing (University of Science and Technology of China) (+) ; Geng, Cong (University of Michigan, Department of Physics) (+) ; Guo, Jun (Shanghai Jiao Tong University) (+) ; Kotwal, Ashutosh (Duke University, Department of Physics) (+) ; Li, Bing (University of Michigan, Department of Physics) (+) ; Li, Shu (Tsung-Dao Lee Institute) (+) ; Liu, Jianbei (University of Science and Technology of China) (+) ; Liu, Mingyi (University of Science and Technology of China) (+) ; Liu, Yanlin (University of Science and Technology of China) (+) ; Mittal, Monika (Shanghai Jiao Tong University) (+) *Show all 26 authors*
Imprint	12 Sep 2018. - mult. p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	VBS ; ZZ ; EWEAK
Abstract	Measurements of cross sections and search for the electroweak production of ZZ in association with two jets and constraints on anomalous quartic couplings in four-lepton and two-lepton plus two-neutrino channel, using 80/fb data at 13 TeV, from year 2015 to 2017.

Zγ散射成果证明

Internal Note

Report number	ATL-COM-PHYS-2019-295
Title	**Evidence for the electroweak Zgammajj cross section in pp collisions at sqrt(s)=13 TeV with the ATLAS Detector - Paper Draft**
Author(s)	Helary, Louis (Physikalisches Institut) (+) ; Lorenzo Martinez, Narei (LAPP, Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS/IN2P3, Annecy) (+) ; Dartsi, Olympia (LAPP, Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS/IN2P3, Annecy) (+) ; Di Ciaccio, Lucia (LAPP, Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS/IN2P3, Annecy) (+) ; Sauvan, Emmanuel (LAPP, Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS/IN2P3, Annecy) (+) ; Koletsou, Iro (LAPP, Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS/IN2P3, Annecy) (+) ; Yap, Yee Chinn (DESY, Hamburg and Zeuthen) (+) ; Smart, Ben (Rutherford Appleton Laboratory) (+) ; Lenzi, Bruno (European Laboratory for Particle Physics, CERN) (+) ; Li, Shu (Tsung-Dao Lee Institute) (+)
Imprint	05 Apr 2019. - 10 p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	Vector boson scattering ; Standard Model ; EWEAK
Abstract	The measurement of the electroweak Zgamma production in association with two jets in proton−proton collisions is presented. The data collected by the ATLAS detector at the Large Hadron Collider in 2015 and 2016 at a centre-of-mass energy of sqrt(s) = 13 TeV are used, corresponding to an integrated luminosity of 36.1 fb−1. Events containing two identified leptons, either electrons or muons, one photon, and two jets are selected. The electroweak production of Zgamma bosons in association with two jets is measured with an observed and expected significance of 4.1 standard deviations. The fiducial cross-section for electroweak production including interference effects is measured.

H(bb)+γ共振态新物理寻找成果证明

Internal Note

Report number	ATL-COM-PHYS-2019-466
Title	**Search for $H\gamma$ resonances in boosted large-R jet plus photon final states with 140 fb^{-1} pp collision data at $\sqrt{s}$=13 TeV collected by the ATLAS detector**
Author(s)	Chen, Boping (Iowa State University) (+) ; Liu, Bo (Iowa State University) (+) ; Chen, Chunhui (Iowa State University) (+) ; Yu, Jie (Iowa State University) (+) ; Li, Shu (Tsung-Dao Lee Institute) (+) ; Liang, Zhijun (Institute of High Energy Physics, Chinese Academy of Sciences) (+) ; Goshaw, Alfred (Duke University, Department of Physics) (+) ; Feng, Minyu (Duke University, Department of Physics) (+) ; Cui, Han (Institute of High Energy Physics, Chinese Academy of Sciences) (+) ; Shi, Liaoshan (Academia Sinica, Taipei) (+) *Show all 19 authors*
Imprint	03 May 2019. - mult. p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	EXOTICS
Abstract	A search for a narrow heavy boson resonance in a decay mode of a Higgs boson and a photon, $H\gamma$, is performed using proton-proton (pp) collision data at a center-of-mass energy of 13 TeV. The pp data set is collected by ATLAS during the whole LHC run-II data taking period, corresponding to an integrated luminosity of 140 fb^{-1}. The events are selected using a trigger on high E_T photons followed by the identification of the boosted Higgs boson decaying to a pair of b-hadrons. To improve the search sensitivity, a novel $H \to b\bar{b}$ tagging method, center-of-mass (CoM) tagging method, is implemented to enhance the signal tagging efficiency. The measurements are compared to model predictions of the production of neutral resonances X^0 with spin 1. Upper limits on the heavy resonance mass in the range of 700—5000 GeV are set through searches on the mass of the large-R jet and the photon. The most stringent constraints are set to date.

VH(bb)小半径喷注测量成果证明

Internal Note

Report number	ATL-COM-PHYS-2019-1276
Title	**Measurement of $VH, H \to b\bar{b}$ with the ATLAS detector**
Author(s)	Al Khoury, Konie (Universite Paris-Saclay, CNRS/IN2P3, IJCLab, 91405, Orsay) (+) ; Calvet, Thomas Philippe (Centre de Physique des Particules de Marseille (CPPM), IN2P3-CNRS) (+) ; Ma, Yanhui (Department of Physics and Astronomy, University College London) (+) ; Schopf, Elisabeth (University of Oxford, Particle Physics) (+) ; Abidi, Syed Haider (Department of Physics, University of Toronto) (+) ; Ahmadov, Faig (Joint Institute for Nuclear Research) (+) ; Ambroz, Luca (University of Oxford, Particle Physics) (+) ; Argyropoulos, Spyridon (Albert-Ludwigs-Universitaet Freiburg) (+) ; Arnold, Hannah (FOM - Institute SAF Nikhef and University of Amsterdam/Nikhef) (+) ; Atkin, Ryan Justin (University of Cape Town) (+) ; Bernardi, Gregorio (Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Sorbonne Universite, Universite de Paris, CNRS/IN2P3) (+) ; Bortoletto, Daniela (University of Oxford, Particle Physics) (+) ; Buzatu, Adrian (Academia Sinica, Taipei) (+) ; Cabras, Grazia (Universita e INFN, Bologna) (+) ; Calderini, Giovanni (Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Sorbonne Universite, Universite de Paris, CNRS/IN2P3) (+) ; Charman, Thomas Paul (Queen Mary University of London) (+) ; Ciungu, Bianca Monica (Department of Physics, University of Toronto) (+) ; D'eramo, Louis (Northern Illinois University) (+) ; Da Cunha Sargedas De Sousa, Mario Jose (Shandong University) (+) ; Dao, Valerio (European Laboratory for Particle Physics, CERN) (+) ; Didenko, Mariya (Tomsk State University) (+) ; Foti, Maria Giovanna (University of Oxford, Particle Physics) (+) ; Gargiulo, Simona (Albert-Ludwigs-Universitaet Freiburg) (+) ; Grivaz, Jean-Francois (Universite Paris-Saclay, CNRS/IN2P3, IJCLab, 91405, Orsay) (+) ; Hays, Jonathan Michael (Queen Mary University of London) (+) ; Jiggins, Stephen (Albert-Ludwigs-Universitaet Freiburg) (+) ; Kato, Chikuma (Tsung-Dao Lee Institute) (+) ; Ke, Yan (Stony Brook University) (+) ; Klein, Matthew Henry (University of Michigan, Department of Physics) (+) ; Lee, Ava Chloe Audrey (Department of Physics and Astronomy, University College London) (+) ; Li, Shu (Tsung-Dao Lee Institute) (+) ; Liu, Kun (Tsung-Dao Lee Institute) (+) ; Liu, Qibin (Tsung-Dao Lee Institute) (+) ; Luise, Ilaria (Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Sorbonne Universite, Universite de Paris, CNRS/IN2P3) (+) ; Mallik, Usha (University of Iowa) (+) ; Marchiori, Giovanni (Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Sorbonne Universite, Universite de Paris, CNRS/IN2P3) (+) ; Masubuchi, Tatsuya (International Center for Elementary Particle Physics and Department of Physics, The University of Tokyo) (+) ; Morange, Nicolas (Universite Paris-Saclay, CNRS/IN2P3, IJCLab, 91405, Orsay) (+) ; Moser, Brian (FOM - Institute SAF Nikhef and University of Amsterdam/Nikhef) (+) ; Noguchi, Yohei (Kyoto University, Department of Physics) (+) ; Parida, Bibhuti (Tomsk State University) (+) ; Piacquadio, Giacinto (Stony Brook University) (+) ; Rettie, Sebastien (Department of Physics and Astronomy, University College London) (+) ; Robson, Aidan (University of Glasgow, SUPA - School of Physics and Astronomy) (+) ; Scanlon, Timothy Paul (Department of Physics and Astronomy, University College London) (+) ; Sekula, Stephen Jacob (Southern Methodist University, Department of Physics) (+) ; Spiteri, Dwayne Patrick (University of Glasgow, SUPA - School of Physics and Astronomy) (+) ; Stamenkovic, Marko (FOM - Institute SAF Nikhef and University of Amsterdam/Nikhef) (+) ; Sumida, Toshi (Kyoto University, Department of Physics) (+) ; Thompson, Paul (University of Birmingham) (+) ; Tsybychev, Dmitri (Stony Brook University) (+) ; Tosciri, Cecilia (University of Oxford, Particle Physics) (+) ; Vittori, Camilla (Universita e INFN, Bologna) (+) ; Wang, Peilong (Southern Methodist University, Department of Physics) (+) ; Wang, Song-Ming (Academia Sinica, Taipei) (+) ; Wang, Wei (Nanjing University) (+) ; Wang, Weitao (University of Science and Technology of China) (+) ; Weiser, Christian (Albert-Ludwigs-Universitaet Freiburg) (+) ; Windischhofer, Philipp Jonas (University of Oxford, Particle Physics) (+) ; Zhang, Lei (Nanjing University) (+) *Hide*
Imprint	03 Oct 2019. - mult. p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	Higgs ; Hbb ; VH ; VHbb ; HIGGS ; HIGGS
Abstract	This supporting note describes the measurement of the SM Higgs boson produced in association with a vector boson, and decaying to a pair of b-quarks. This measurement uses pp collision data collected with the ATLAS detectors during the LHC Run-2 period at $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of 139 \ifb. It includes the descriptions of object and event selections as well as signal and background modelling. The systematic uncertainties, statistical treatment used to extract the measurement and results are discussed. This measurement uses a multi-variate analysis to enhance the sensitivity to the signal and exctract the observed signal strength, significance and STXS measurements. A measurement of the SM diboson (VZ) signal and signal strength extraction of the $V, H \to b\bar{b}$ process from the m_{bb} shape are also performed as cross checks of the main analysis.

VH(bb)大半径喷注测量成果证明

Internal Note

Report number	ATL-COM-PHYS-2019-1125
Title	**Search for the Standard Model Higgs boson produced in association with a vector boson and decaying to a pair of b-quarks using large-R jets**
Author(s)	Dao, Valerio (European Laboratory for Particle Physics, CERN) (+) ; Arnold, Hannah (FOM - Institute SAF Nikhef and University of Amsterdam/Nikhef) (+) ; Bortoletto, Daniela (University of Oxford, Particle Physics) (+) ; Buckley, Andrew (University of Glasgow, SUPA - School of Physics and Astronomy) (+) ; Callea, Giuseppe (University of Glasgow, SUPA - School of Physics and Astronomy) (+) ; Calvetti, Milene (INFN Pisa and Universita' di Pisa, Dipartimento di Fisica) (+) ; Camacho Toro, Reina (Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Sorbonne Universite, Universite de Paris, CNRS/IN2P3) (+) ; Chen, Cheng (University of Science and Technology of China) (+) ; Coelho Barrue, Ricardo Filipe (Laboratorio de Instrumenta\c{c}\~ao e Fisica Experimental de Particulas - LIP, Lisbon) (+) ; Conde Muino, Patricia (Laboratorio de Instrumenta\c{c}\~ao e Fisica Experimental de Particulas - LIP, Lisbon) (+) ; Costa Batalha Pedro, Rute (Laboratorio de Instrumenta\c{c}\~ao e Fisica Experimental de Particulas - LIP, Lisbon) (+) ; Da Cunha Sargedas De Sousa, Mario Jose (Shandong University) (+) ; Di Gregorio, Giulia (INFN Pisa and Universita' di Pisa, Dipartimento di Fisica) (+) ; Du Pree, Tristan Arnoldus (FOM - Institute SAF Nikhef and University of Amsterdam/Nikhef) (+) ; Foti, Maria Giovanna (University of Oxford, Particle Physics) (+) ; Francavilla, Paolo (INFN Pisa and Universita' di Pisa, Dipartimento di Fisica) (+) ; Grivaz, Jean-Francois (LAL, Univ. Paris-Sud, IN2P3/CNRS, Universite Paris-Saclay) (+) ; Han, Jingyi (Shandong University) (+) ; Huang, Yicong (University of Science and Technology of China) (+) ; Jiggins, Stephen (Albert-Ludwigs-Universitaet Freiburg) (+) ; Kato, Chikuma (Tsung-Dao Lee Institute) (+) ; Liu, Yanwen (University of Science and Technology of China) (+) ; Mallik, Usha (University of Iowa) (+) ; Masubuchi, Tatsuya (International Center for Elementary Particle Physics and Department of Physics, The University of Tokyo) (+) ; Moser, Brian (FOM - Institute SAF Nikhef and University of Amsterdam/Nikhef) (+) ; Prell, Soeren (Iowa State University) (+) ; Rizzi, Chiara (European Laboratory for Particle Physics, CERN) (+) ; Robson, Aidan (University of Glasgow, SUPA - School of Physics and Astronomy) (+) ; Roda, Chiara (INFN Pisa and Universita' di Pisa, Dipartimento di Fisica) (+) ; Scanlon, Timothy Paul (Department of Physics and Astronomy, University College London) (+) ; Schopf, Elisabeth (University of Oxford, Particle Physics) (+) ; Vergel Infante, Carlos Miguel (Iowa State University) (+) ; Wang, Weitao (University of Science and Technology of China) (+) ; Weiser, Christian (Albert-Ludwigs-Universitaet Freiburg) (+) ; Yu, Jie (Iowa State University) (+) ; Ma, Yanhui (Shandong University) (+) ; Di Bello, Francesco Armando (INFN Roma and Sapienza Universita' di Roma, Dipartimento di Fisica) (+) ; Kado, Marumi (INFN Roma and Sapienza Universita' di Roma, Dipartimento di Fisica) (+) ; Calvet, Thomas Philippe (Stony Brook University) (+) ; Chen, Chunhui (Iowa State University) (+) ; Scuri, Fabrizio (INFN Pisa and Universita' di Pisa, Dipartimento di Fisica) (+) ; Spiteri, Dwayne Patrick (University of Glasgow, SUPA - School of Physics and Astronomy) (+) ; Van Stroud, Samuel (Department of Physics and Astronomy, University College London) (+) ; Li, Changqiao (University of Science and Technology of China) (+) ; Li, Shu (Tsung-Dao Lee Institute) (+) ; Ma, LianLiang (Shandong University) (+) ; Windischhofer, Philipp Jonas (University of Oxford, Particle Physics) (+) *Hide*
Imprint	02 Sep 2019. - mult. p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	Higgs ; bottom quark ; W/Z boson ; boosted ; largeR ; HIGGS
Abstract	This supporting note describes a search for the Standard Model Higgs boson produced in association with a vector boson and decaying to a pair of b-quarks using large-R jets. The analysed pp-collision data collected by the ATLAS detector in the years 2015-2018 at a centre-of-mass energy of \sqrt{s} = 13 TeV corresponds to an integrated luminosity of 139 fb^{-1}.

Z(bb)+γ测量成果证明

Internal Note

Report number	ATL-COM-PHYS-2018-1672
Title	**Measurement of high transverse momentum $Z(\rightarrow b\bar{b})\gamma$ production at $\sqrt{s} = 13$ TeV using the ATLAS detector**
Author(s)	Wu, Miles (University of Chicago, Enrico Fermi Institute) (+) ; Delitzsch, Chris Malena (University of Arizona) (+) ; Camacho Toro, Reina (Laboratoire de Physique Nucleaire et de Hautes Energies (LPNHE), Sorbonne Universite, Paris-Diderot Sorbonne Paris Cite, CNRS/IN2P3) (+) ; Miller, David (University of Chicago, Enrico Fermi Institute) (+) ; Li, Shu (Tsung-Dao Lee Institute) (+)
Imprint	04 Dec 2018. - mult. p.
Subject category	Particle Physics - Experiment
Accelerator/Facility, Experiment	CERN LHC ; ATLAS
Free keywords	EWEAK
Abstract	This paper presents the fiducial cross-section results for high transverse momentum $Z\gamma$ production in the $Z \rightarrow b\bar{b}$ decay channel as well as the $Z \rightarrow b\bar{b}$ mass distribution in proton-proton collisions at 13 TeV. The data analysed were collected between 2015 and 2016 with the ATLAS detector at the Large Hadron Collider. The $Z \rightarrow b\bar{b}$ decay is reconstructed from jets with pT>200 GeV found with the anti-k_t $R = 1.0$ jet algorithm which are groomed to remove contributions from underlying events and additional proton-proton collisions. To tag Z bosons b-tagged $R = 0.2$ track jets matched to the large-R calorimeter are used as proxy for the b-quarks. Two grooming techniques with different performance, trimming and soft-drop, are used in the analysis. The signal yield is extracted from a fit to the jet mass distribution.

ZZ/Zγ散射国际会议报告证明

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In case of any information inconsistency, please contact **Atlas Secretariat**.

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A Active Author
M Counted for M&O
O Operation Tasks

Shu has given **13** talks:

VBSCanHel2020 VBSCan@Helsinki: Second In-person Meeting in the Third Grant Period

Recent VBS Measurements in ATLAS

Type Talk at limited scope conference
Institute TDLI
Indico -
CDS http://cds.cern.ch/record/2709982
CINCO -

ω = 0 Speaker confirmed

SUSY2019 XXVIIth International Conference on Supersymmetry and Unification of Fundamental Interactions

LHC Higgs/BSM Higgs

Type Long plenary talks via the Speakers Committee
Institute TDLI
Indico https://indico.cern.ch/event/822087/
CDS https://cds.cern.ch/record/2674157
CINCO https://cms-mgt-conferences.web.cern.ch/cms-mgt-conferences/conferences/pres_display.aspx?cid=2578&pid=20117

ω = 1.2 Speaker confirmed

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ATLAS合作组论文贡献认定形式

项目成果的呈现形式

- 本项目的成果主要是在ATLAS实验分析中所获得的物理成果，主要呈现形式为国际学术期刊发表和国际学术会议报告发布两种形式。
- 【特别说明】对国际学术会议上发布的成果，ATLAS实验以ATLAS-CONF-NOTE系列文集形式发表并在网上公布可供查阅引用
  - ATLAS合作组对国际会议发布的成果审查和国际期刊发表文章的成果审查采用了一样的多级内部评审程序
- 明确要求项目组成员应该在含考核指标的物理成果中做出主导或主要贡献
  - 主导贡献：在该物理分析中担任分析联系人（Analysis Contact）或在ATLAS内部撰写期刊文章或会议文集ATLAS-CONT-NOTE时担任联系编辑（Contact Editor）
  - 主要贡献：做合作组内各层级的批准报告（approval talks）或担任文章、会议文集的内部编辑（Editors）或代表合作组在国际会议报告与该分析相关的研究成果