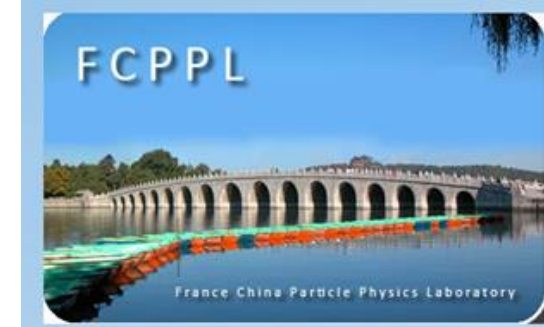




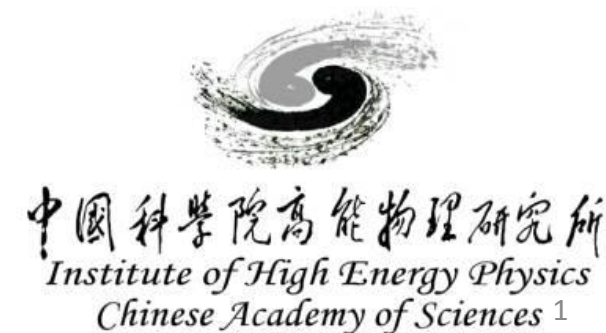
**11th France China Particle Physics Laboratory workshop
(FCPPL2018)
Marseille, France
May 22nd-25th, 2018**



Overview of CMS FCPPL collaborations

Junquan TAO¹ for all CMS FCPPL collaboration members
(Suzanne GASCON-SHOTKIN², Guoming CHEN¹, Nicolas CHANON², Qiang LI³, ...)

- 1 Institute of High Energy Physics (IHEP), CAS, Beijing
- 2 Institut de Physique Nucléaire de Lyon (IPNL), IN2P3-CNRS)/UCBL 1, Lyon
- 3 Peking University (PKU), Beijing





More than 10 years of exchanging **people** and **ideas**

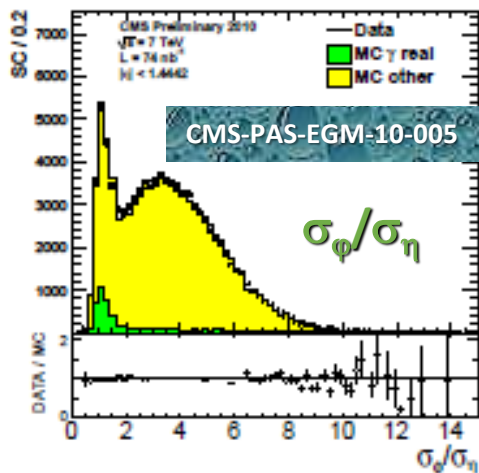
- **IHEP-IPNL:** Collaboration started in 2007
 - **6 IHEP doctoral students** have visited IPNL for stays of between 2-6 months: **TAO Junquan** (2007), ZHANG Zhen (2007-2008), XIAO Hong (2010,2011), FAN Jiawei (2011, 2012, 2014), SHEN Yuqiao (2013), ZHANG Sijing (2015, 2016, 2017)
 - **1 IHEP postdoc** ,**TAO Junquan**, has visited IPNL for 4 months (2009)
 - **4 IPNL doctoral students** have visited IHEP for stays of 2 months : **Nicolas CHANON** (2009), Hugues BRUN (2010), Olivier BONDU (2011), Louis SGANDURRA (2012)
 - **2 IPNL postdocs** have visited IHEP for stays of 1 month: Camillo CARRILLO (2014), Linda FINCO (2017)
 - **2 IHEP/UCAS doctoral students have been (are) co-PhD students** with IPNL/Universite Claude Bernard Lyon 1 under prestigious scholarships: Fan Jiawei (CAS, defended 2015) and Sijing ZHANG (Eiffel, defense forseen for May 2019)
- **PKU-IPNL:** Collaboration started in 2015 as **PKU-IPHC** (Institut Pluridisciplinaire Hubert CURIEN, Strasbourg), **1 PKU student** (Jing LI) visited IPHC for 2 stays of 3 months each (2016, 2017). Then **Nicolas CHANON** moved to IPNL, and **another PKU student** (Junho Lee) visited IPNL for 2 weeks (2017-2018).
- **IHEP, IPNL and IPHC** have hosted the FCPPL workshop and contribute members of the scientific committee on a regular basis



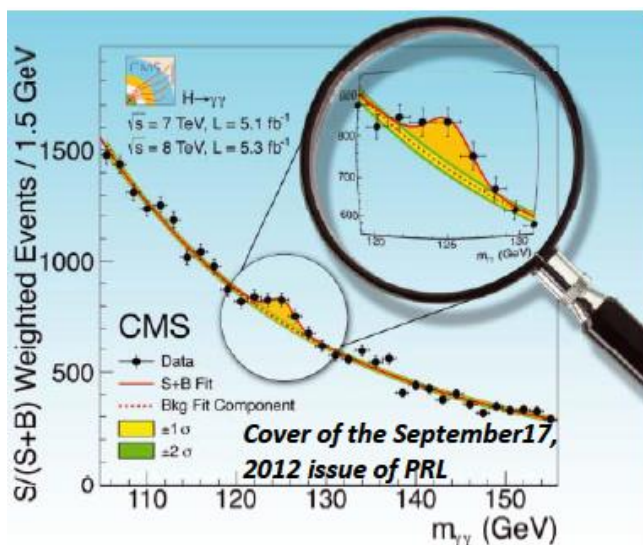
Some IPNL-IHEP collaborated physics results



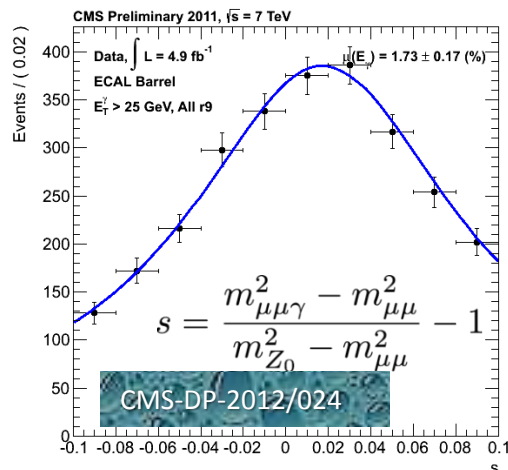
- Cluster/Photon commissioning, Runs 1&2 (2008-...)



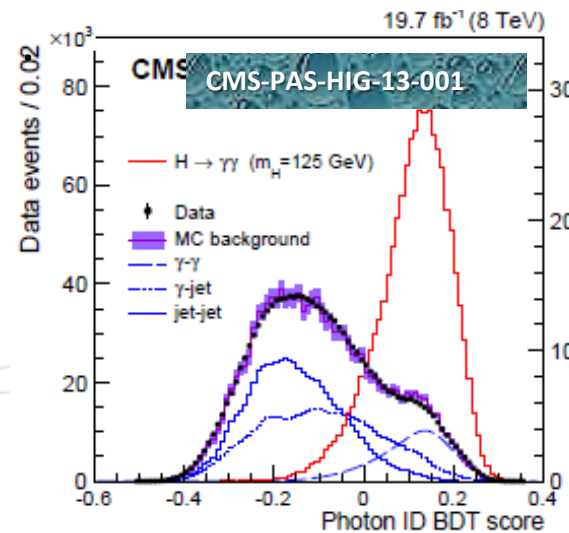
- Discovery and measurement of a Higgs boson (2012-...)
- Contribution to all $H \rightarrow \gamma\gamma$ public results with both Run1 and Run2 datasets



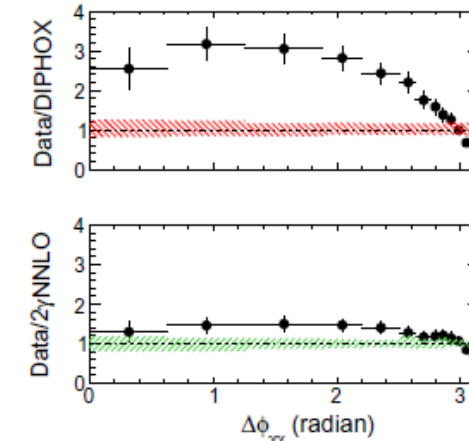
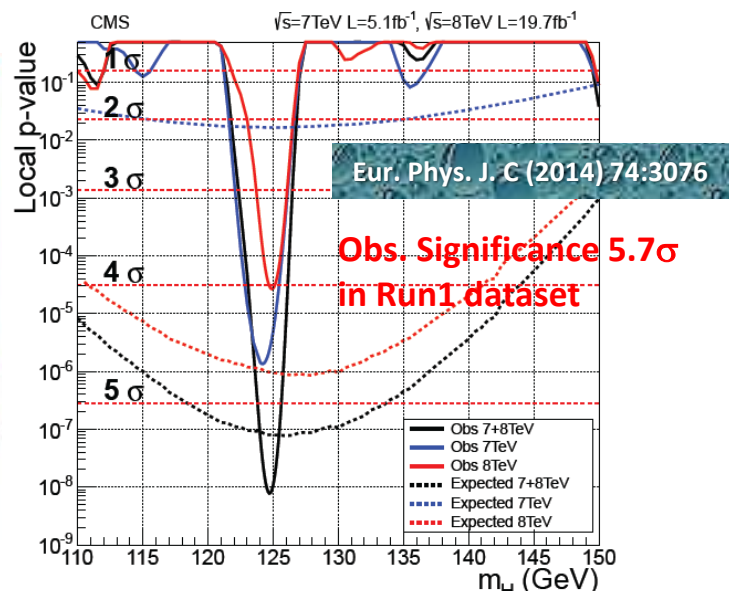
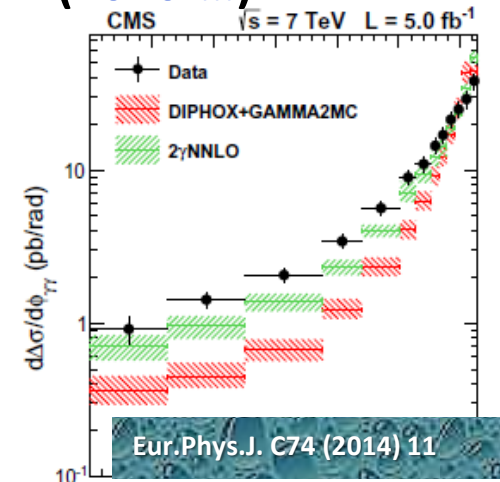
- Photon energy scale extraction with $Z \rightarrow \mu\mu\gamma$ (2007-...)



- γ/π^0 discrimination for photon ID (2008-...)



- $\gamma\gamma + X$ differential cross section measurement (2010-...)





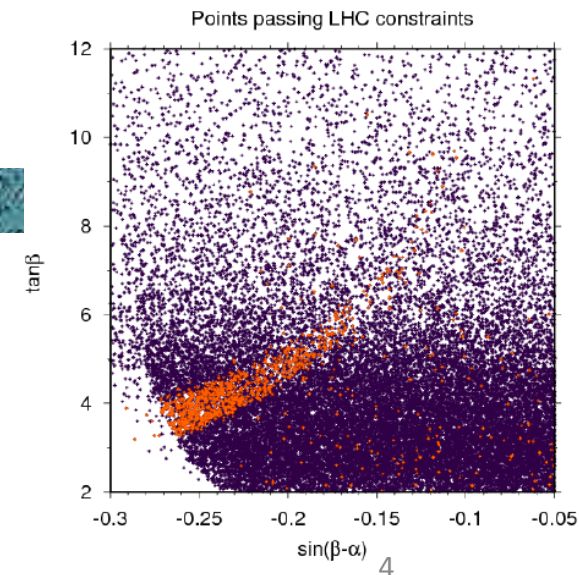
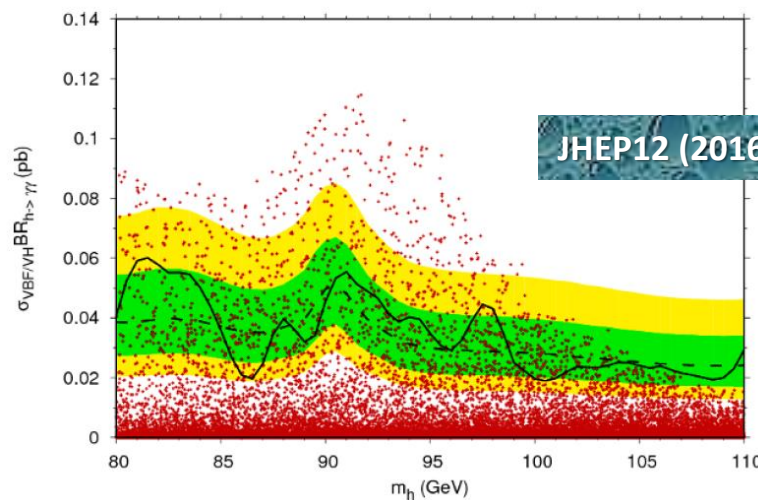
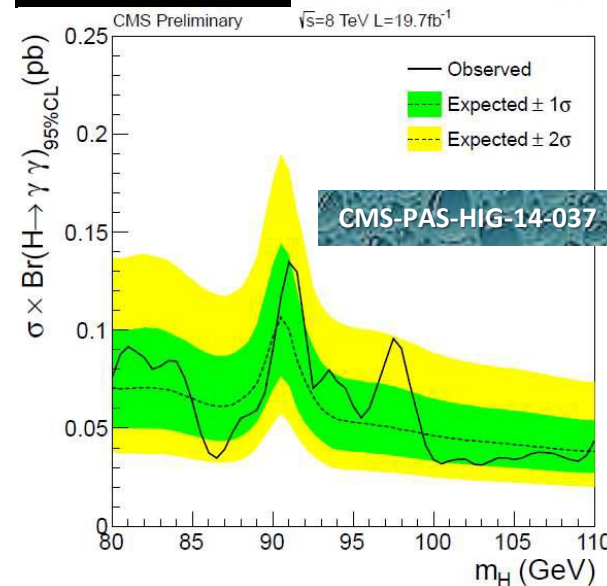
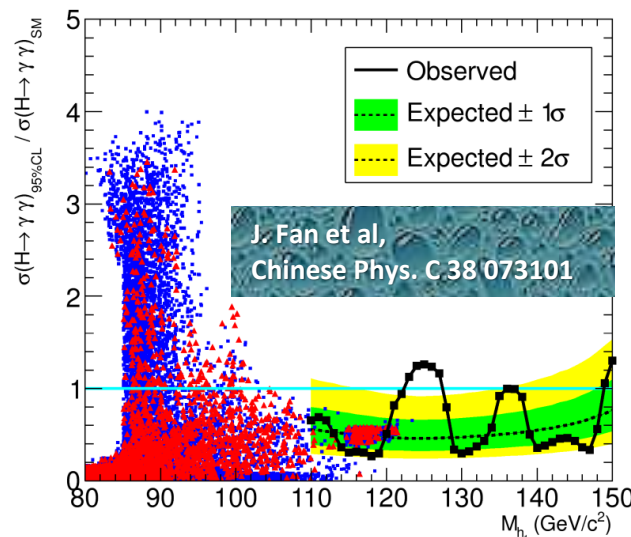
Some IPNL-IHEP collaborated physics results (cont)



➤ Feasibility study for a 2nd lighter Higgs boson with NMSSM (2013-...)

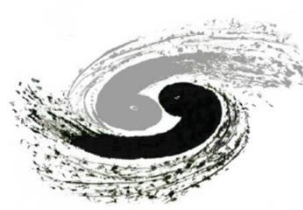
➤ Search for a 2nd lighter Higgs boson in 8 TeV data (2013-...)

➤ Interpretation of Run 1 public result (HIG-14-037) within 2HDM in paper with IPNL theorists A. Deandrea, G. Cacciapaglia, S. Le Corre (JHEP12 (2016) 068)





IHEP-IPNL 2017-2018: Run2 $H \rightarrow \gamma\gamma$ measurements



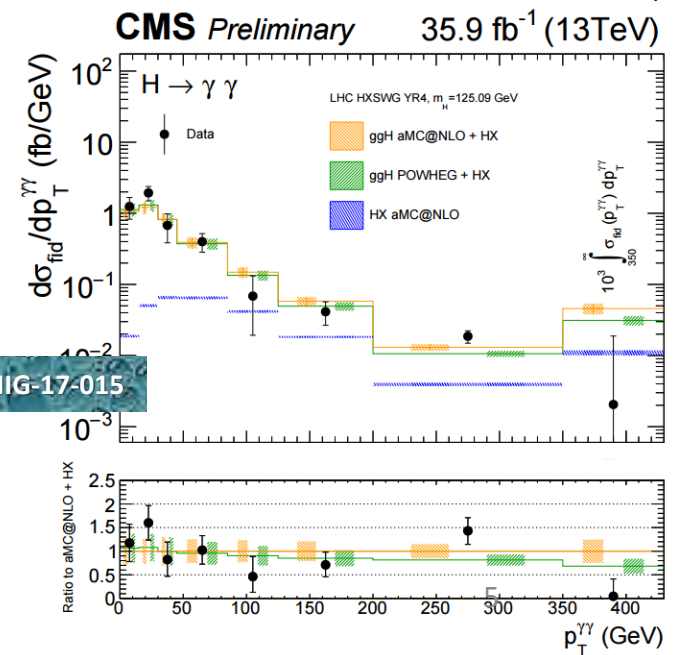
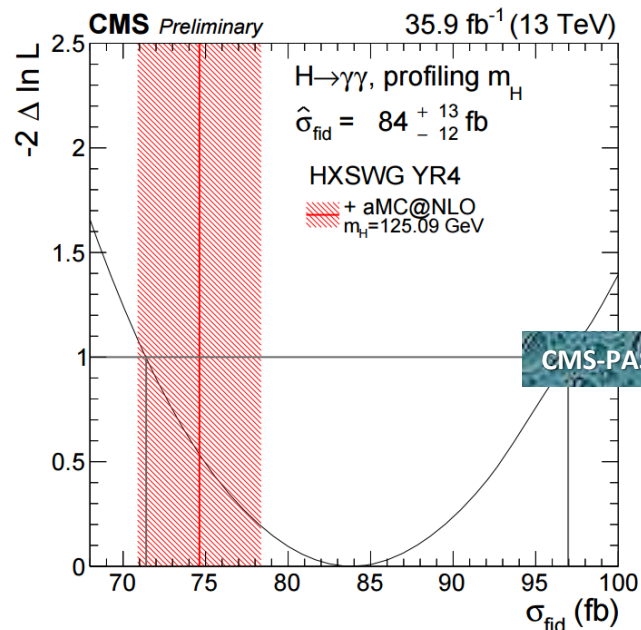
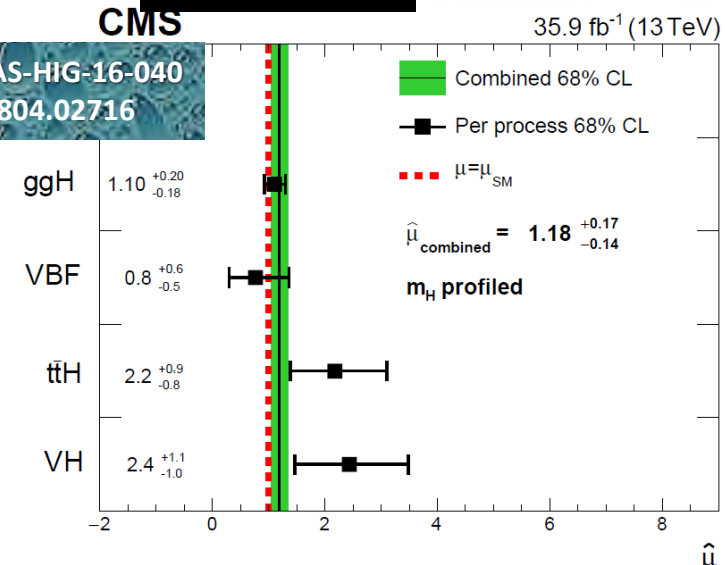
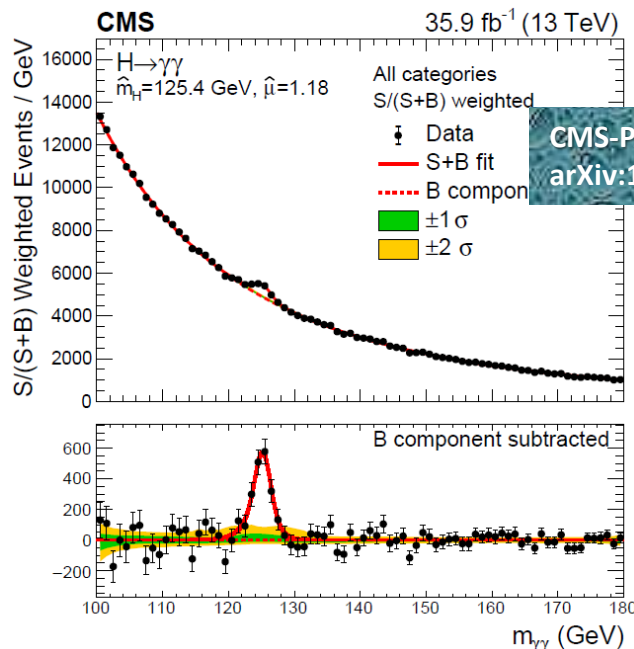
➤ **IPN Lyon** : Benoit COURBON, Linda FINCO, Suzanne GASCON-SHOTKIN, Morgan LETHUILLIER, Camille CAMEN, Antoine Lesauvage

IHEP-Beijing : Guoming CHEN, Mingshui CHEN, Junquan TAO, Yuqiao Shen, Sijing ZHANG, M Aamir SHAHZAD

➤ Contributed to $H \rightarrow \gamma\gamma$ public results with 2016 13TeV dataset (35.9 fb⁻¹): HIG-17-015 (Moriond17), HIG-16-040 (LHCP17)

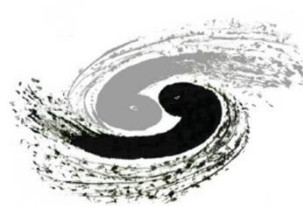
➤ **Major contributions**: HLT Trigger, photon ID MVA development, photon energy corrections, electron veto efficiency, $Z \rightarrow \mu\mu\gamma$ validations (see dedicated talk by Linda FINCO)

➤ Now working together with 2017 data set

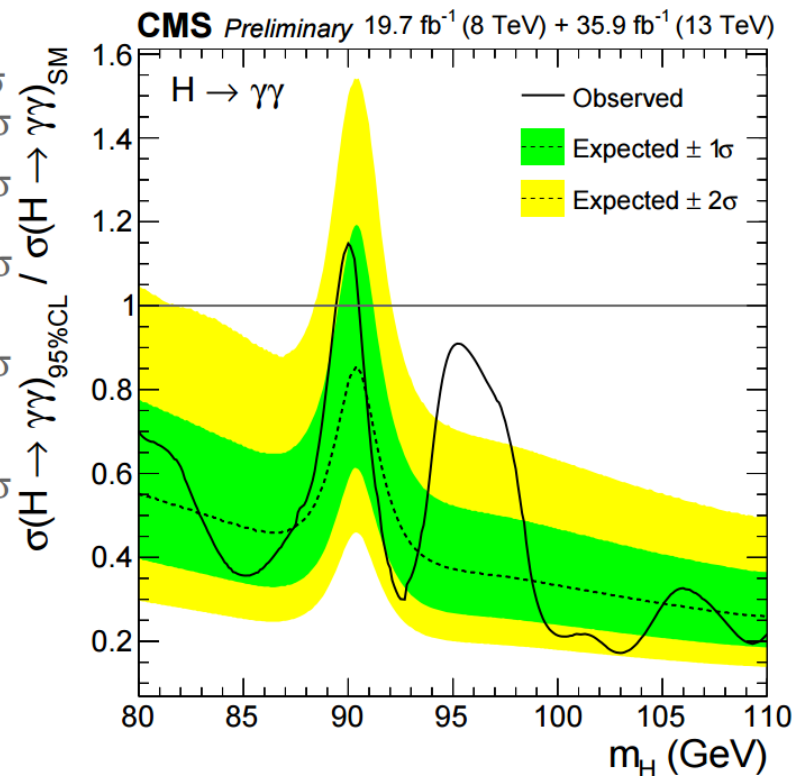
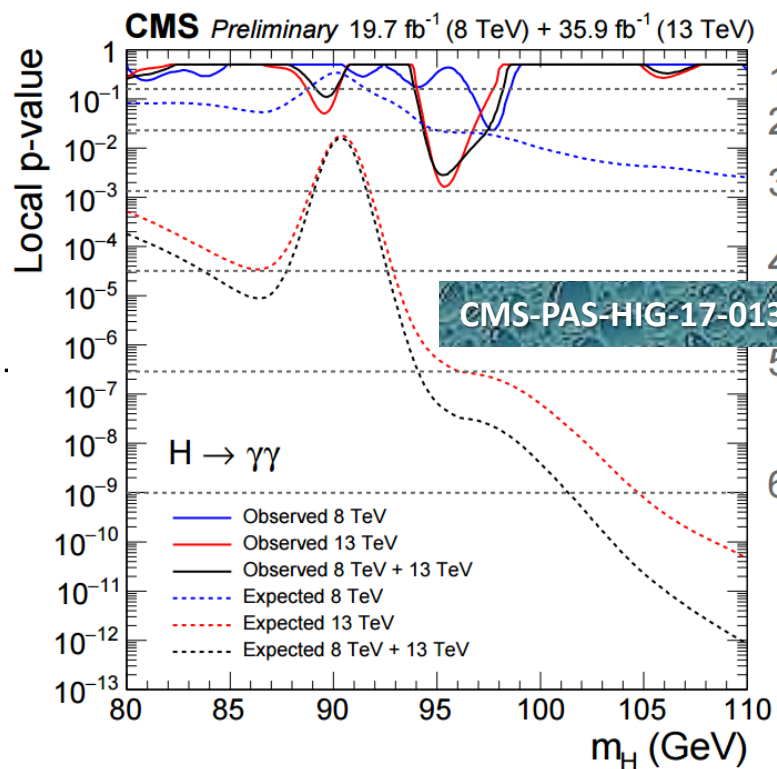




IHEP-IPNL 2017-2018: Run 2 low-mass $H \rightarrow \gamma\gamma$ search



- Hold responsibility for the low-mass $H \rightarrow \gamma\gamma$ search at CMS
- Performed the low-mass $H \rightarrow \gamma\gamma$ search with **Run2 2016 dataset and 8TeV+13TeV combination** (CMS-PAS-HIG-17-013): public, max. 2.8σ observed at 95.3 GeV (see dedicated talk by [Sijing ZHANG](#))
- Work in progress for the 2017 data set analysis
- Request financing for
 - 3-month stay of IHEP PhD student [Aamir SHAHZAD](#) at IPNL in autumn 2018
 - 1-month stay of IPNL PhD student [Camille CAMEN](#) at IHEP at the end of 2018 to learn and contribute to the analysis of the 2018 data set



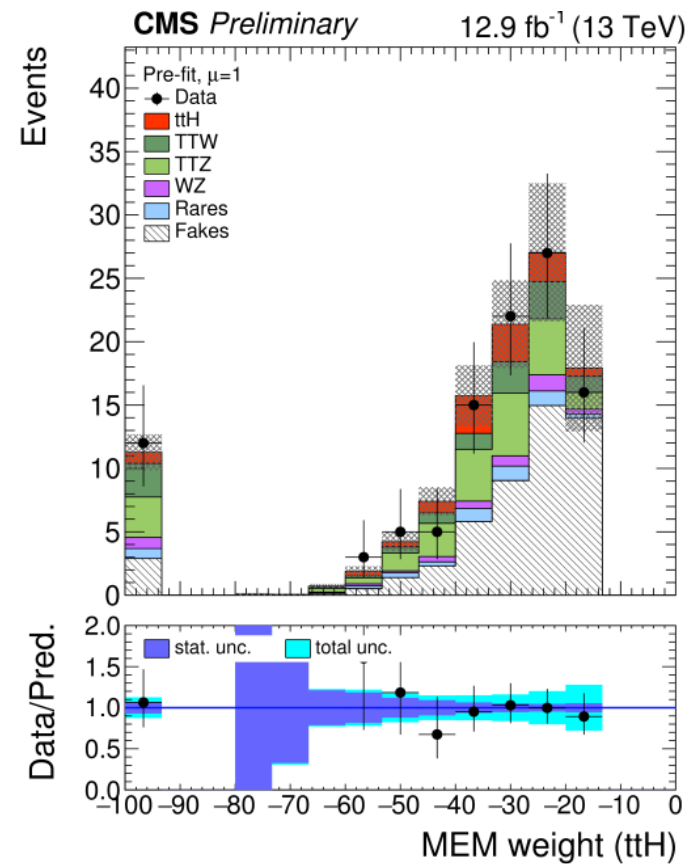
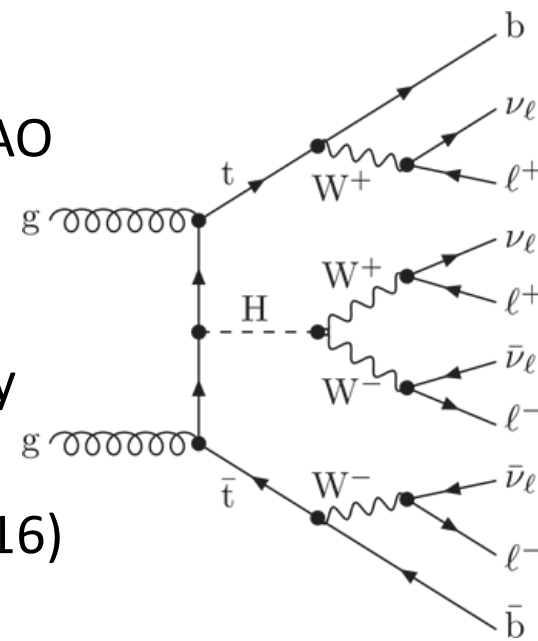


PKU-IPNL/IPHC 2016-2018: $t\bar{t}b\bar{b}H \rightarrow$ multilepton



CMS PAS HIG-17-004

- IPNL Lyon: Nicolas CHANON
- IPHC: Jérémy Andrea, Nicolas Tonon
- PKU-Beijing: Junho Lee, Jing LI, Qiang LI, Yajun MAO
- $t\bar{t}b\bar{b}H$ multilepton channel can provide the first direct measurement of the top-Higgs coupling
- **Matrix Element Method (MEM)** is complementary to usual multivariate methods
- **Contribution to public results:** HIG-16-022 (ICHEP16) and HIG-17-004 (Moriond2017). Papers: arxiv:1803.05485 (submitted to JHEP), arxiv:1804.02610 (accepted by Phys. Rev. Lett.) (see dedicated talk by Nicolas CHANON)
- Plans: **Extension to more involved multivariate methods** for improved signal/background discrimination: MEM with Neural Networks, Deep learning



- Requesting financing for a 3-month stay at IPNL in Autumn 2018 for Junho Lee who is a key contributor to these topics

FCPPL

Acknowledgements

- THANKS to the FCPPL
- We are looking forward to your continued support!
- Many thanks to the organizers!



Merci

谢谢

France China Particle Physics Laboratory