

Work process

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Supervisor : Mingshui Chen

CMS

2023.02-2023.04

- **Analysis**

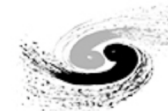
- Search for high mass Higgs(500-3000GeV) in HZZ2L2Q final state with Full RunII Data
- H+HH combination

- **Service Work**

- CSC Detector On Call Shifter
- CSC Longevity Studies



HZZ2L2Q Analysis



Institute of High Energy Physics
Chinese Academy of Sciences

CMS PAS HIG-23-001

DRAFT

CMS Physics Analysis Summary

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

2023/04/22
Archive Hash: e365d89-D
Archive Date: 2023/02/07

Search for high mass scalar bosons in ZZ semi-leptonic
decay mode at CMS

The CMS Collaboration

Abstract

This paper reports on the search for high-mass scalar bosons, a crucial aspect in the study of electroweak interactions. The discovery of a Higgs-like boson with a mass of approximately 125 GeV confirmed the existence of a scalar particle in the Standard Model, but the possibility of additional resonances still exists. The search was performed using the CMS detector, focusing on the semi-leptonic channel of an SM-like Higgs boson decaying to a pair of Z bosons, with a mass range of 500 GeV to 3 TeV using LHC Run-2 data with 139 fb^{-1} of integrated luminosity at a center-of-mass energy of 13 TeV. A new strategy called “particle net” was implemented to improve signal identification. Two model-independent signal interpretations were used with different width assumptions, the narrow width and varying width assumptions, with limits set on the product of cross section and branching fraction for the decay to ZZ for a range of masses and widths.

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

PDFAuthor: Jialin Guo, Yukasin Milosevic, Ram Krishna Sharma
PDFTitle: Search for high mass scalar bosons in ZZ semi-leptonic decay mode at CMS
PDFSubject: CMS
PDFKeywords: CMS, your topics

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

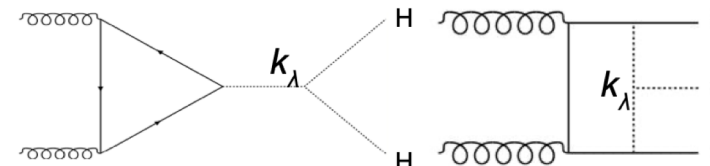
• Status

- Limit in new result improves comparing to previous 2016 analysis
- AN-Note-v3([AN-21-172](#))
- [CADI-HIG-23-001](#)
- Frist PAS is sent

• Plan

- Update result according to convener's suggestions
- Prepare pre-approval report
- Update PAS

Examples of λ -dependent diagrams in HH and ttH

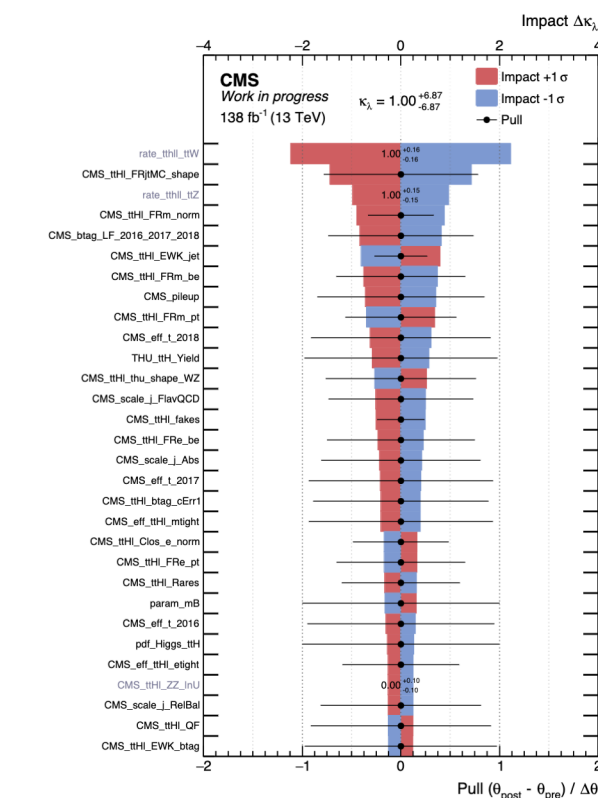
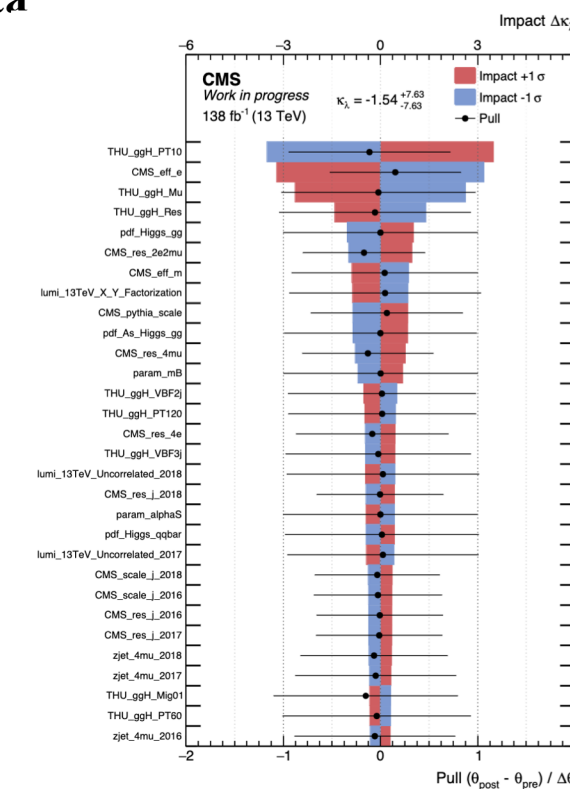


Motivation

- Ultimate precision on $k_\lambda = k/k_{SM}$ with the Run2 data

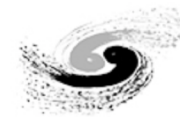
Ongoing

- Systematics unc. Studies
 - Impact plot
- Documenting on AN and PAS
- Including VHH(4b)+WW $\gamma\gamma$





CSC DOC Shift

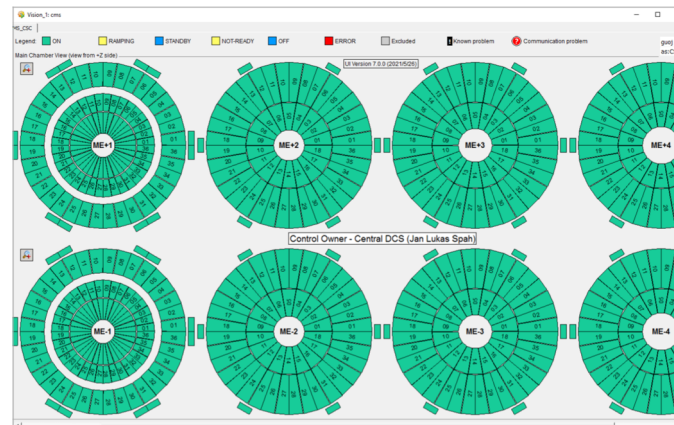
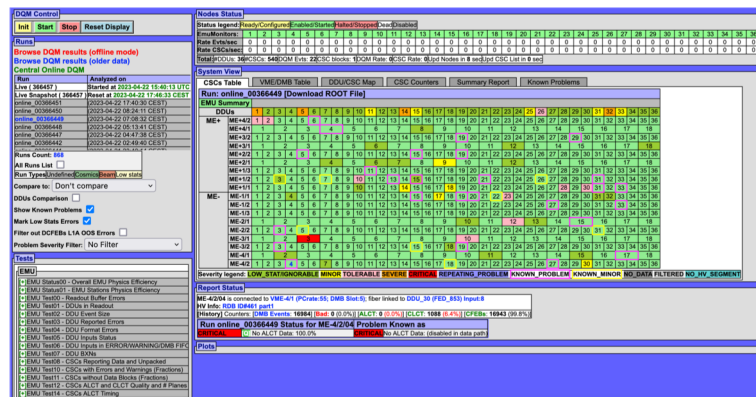


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- To be as CSC DOC Shift Apr19-Apr26

- Duty
 - Monitor running state of CSC
 - Daily health check for system
 - Check and Report issues

CSC control room



CSC DOC daily checklist

(time stamp: 2023-04-22 15:14:21, Email: Li Core:15.06.01, App:15.06.01)

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Attention: It is strongly recommended to re-start the application before doing Step 1).

STEP 1) Check System Firmware

-> DO NOT CHECK FIRMWARE DURING A GLOBAL RUN <-
-> STOP XMAS MONITORING BEFORE FIRMWARE CHECK <-
Check firmware in DIMs, CFEs and ALCs

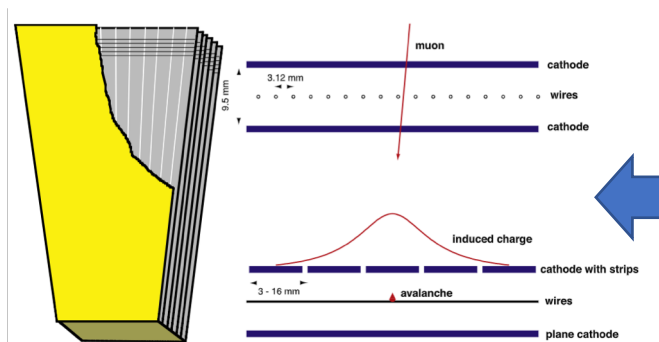
STEP 2) Fix Firmware

The following FPGAs showed problems:
Crate Chamber Slot Component Reason

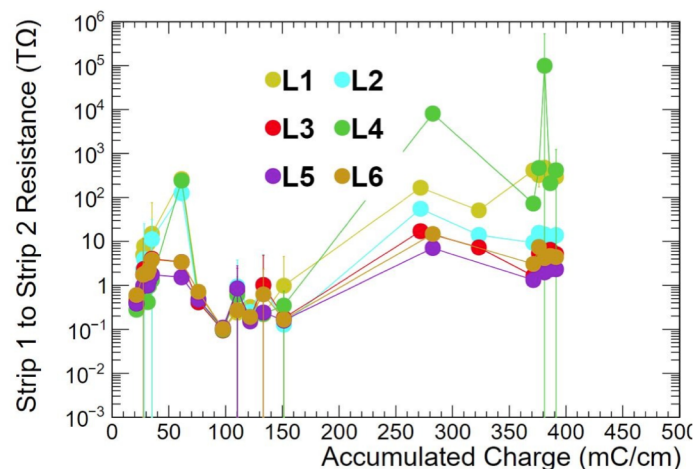
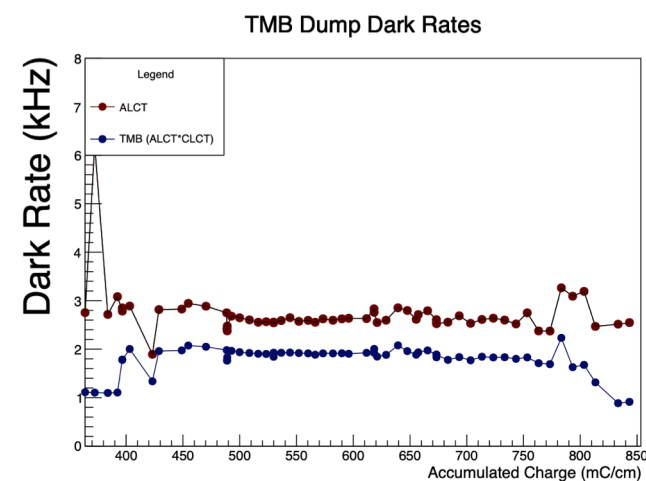
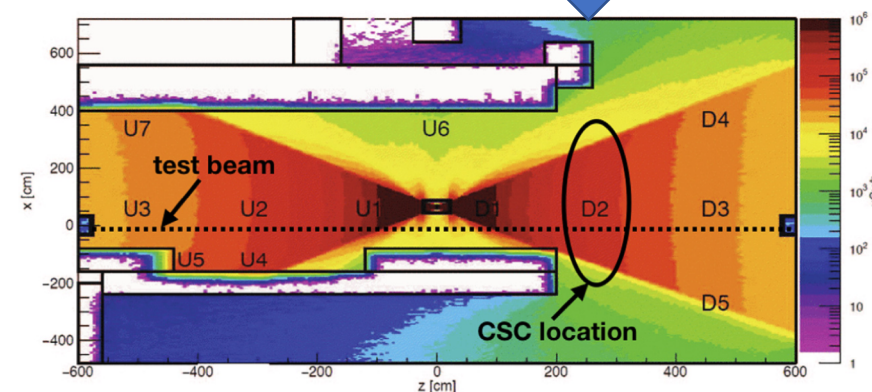
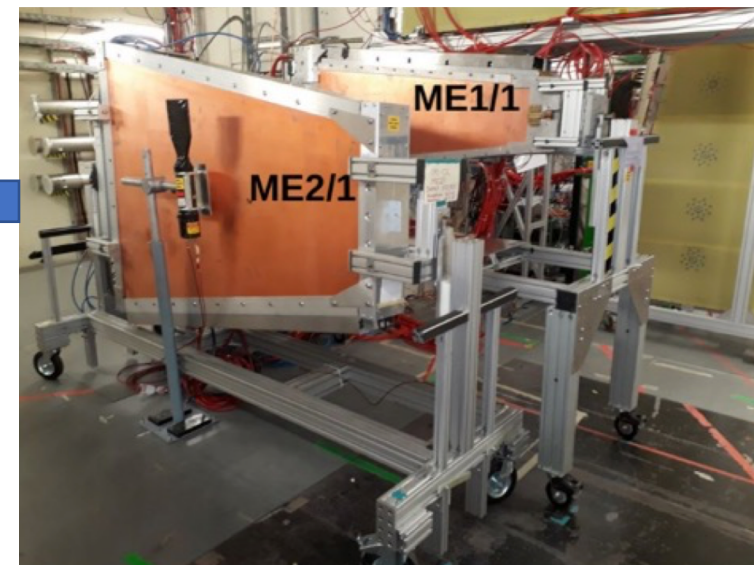
STEP 3) Check Crate Configuration

Check full configuration of crates
VMEin1_5, ME-1/117 TMB config fail, ...
VMEin1_7, ME-1/120, ... expected DMB config fail, DCFEB 5 and 7 bad
VMEin1_7, ME-1/215, ... did not see expected DMB config failure, CFEB 1 and 5 current low
VMEin1_8, ME-1/120 TMB config fail, ...
VMEin1_8, ME-1/222 TMB config fail, ...
VMEin2_5, ME-3/116, ... DMB config fail,
VMEin3_6, ME-3/117, ... DMB config fail,
VMEin4_1, ME-4/24, expected ALCCT config fail, ... ALCCT off
VMEin4_5, ME-4/227, ... did not see expected DMB config failure, CFEB3 6V reads 3.27 V
VMEin4_5, ME-4/230, did not see expected ALCCT config failure, ... ALCCT slow control bad
VMEin4_5, ME-4/232, ... expected DMB config fail, CFEB3 comparator threshold high
VMEin4_5, ME-4/1117, ... expected DMB config fail, DCFEB 4 bad

- From February 2023
- Motivation
 - HL-HLC may lead to chamber damage.
- Duty
 - Dark rate measurements
 - Strip to Strip Resistance measurements
 - [Weekly Report](#)



<https://doi.org/10.1016/j.nima.2019.06.020>



Thanks

Systematic uncertainties: module has been integral in combine tool

➤ The theoretical uncertainties:

https://twiki.cern.ch/twiki/bin/viewauth/CMS/CitationsForGenerators#Scale_choice_and_related_uncerta

➤ QCD scale:

➤ ggH: 3.9% VZ: 3.2% qqH: 0.4%

➤ PDF uncertainty

➤ gg 3.2%

➤ acceptance uncertainty and di-Z boson decay branch ratio: 2%

Summary of relative systematic uncertainties			
Common experimental uncertainties			
	2016	2017	2018
Luminosity uncorrelated	1 %	2 %	1.5 %
Luminosity corr 16 17 18	0.6 %	0.9 %	2 %
Luminosity corr 17 18	-	0.6 %	0.2 %
Lepton id/reco efficiencies	0.7–10 %	0.6–8.5 %	0.6–9.5 %
Background related uncertainties			
Reducible background (Z+X)	25–43 %	23–36 %	24–36 %
Signal related uncertainties			
Lepton energy scale	0.01%(μ) - 0.06%(e)	0.01%(μ) - 0.06%(e)	0.01%(μ) - 0.06%(e)
Lepton energy resolution	3%(μ) - 10%(e)	3%(μ) - 10%(e)	3%(μ) - 10%(e)

➤ The experimental uncertainties:

➤ **Luminosity uncertainty:** <http://cms-results.web.cern.ch/cms-results/public-results/publications/LUM-17-003/index.html> <http://cms-results.web.cern.ch/cms-results/public-results/preliminary-results/LUM-17-004/index.html> <http://cms-results.web.cern.ch/cms-results/public-results/preliminary-results/LUM-18-002/index.html>

➤ **Lepton reconstruction and identification** https://gitlab.cern.ch/cms-hcg/cadi/hig-21-019/-/blob/master/MassMeasurement/Higgs/cards_Full_RunII/withBkg_2D_VXBS_Refitted_9bins_hzz4l_2e2muS_13TeV_FULL.txtLepton/.

➤ **jet energy scale and resolution:** calculated by changing the jet energies by +/- 1 sigma

➤ <https://twiki.cern.ch/twiki/bin/view/CMS/JECDataMC>

➤ https://twiki.cern.ch/twiki/bin/view/CMS/JetResolution#Run2_JER_uncertainty_correlation

➤ B-tagging

➤ https://twiki.cern.ch/twiki/bin/view/CMS/BTagShapeCalibration#Systematic_uncertaintie

➤ <https://twiki.cern.ch/twiki/bin/view/CMS/BtagRecommendation106XUL16postVFP#Genera>

➤ **Z+jet Alpha Method uncertainty:** statistical + JEC

