

Announcements

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On behalf of Program Committee

CLHCP, NNU, Nov.23-27, 2022

CLHCP2022 Best Poster Award (最佳墙报奖)

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Thanks to the poster committee:
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Awarded Posters

Measuring CP properties of Higgs boson interactions with τ leptons in ATLAS detector

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Introduction

The measurement of the charge conjugation and parity (CP) properties in the Higgs boson interaction with τ leptons. [1] The Yukawa interaction is formulated with a single mixing angle parameter ϕ_τ to describe the CP -odd interactions between the Higgs boson and τ leptons. The study is based on a measurement of CP -sensitive angular observables defined by the visible decay products of τ lepton decays, performed using a data sample corresponding to 359 fb^{-1} of proton-proton collisions recorded at a center-of-mass energy of $\sqrt{s}=13\text{ TeV}$ with the ATLAS detector at the Large Hadron Collider. Without assuming Standard Model hypothesis for the $H \rightarrow \tau\tau$ signal strength, the mixing angle ϕ_τ is measured to be $9 \pm 10^\circ$, with an expected value of $0 \pm 20^\circ$ at the 95% confidence level. The pure CP -odd hypothesis is disfavored at 3.4 standard deviations. The results are compatible with the predictions for the Higgs boson in the Standard Model as well as CP -violating scenarios.

Analysis Strategy

1 Motivation

CP properties of the fundamental particle is a very important symmetry related to the formation and the evolution of the universe. Currently we observe more matter than anti-matter in our universe known as the Baryon Asymmetry, which might be explained by the CP violation in the Baryogenesis. In SM the CP violation is explained by Kobayashi-Maskawa (KM) mechanism by introducing a non-zero phase δ_{CKM} in CKM matrix, while it still does not correspond to the experiment observation.

2 Theory Predictions

In SM the Higgs boson is predicted as the CP -even (scalar) particle, the presence of a CP -odd (pseudoscalar) admixture has not yet been excluded. The CP properties of the Higgs boson can be measured via the interaction with τ leptons parameterized by the CP -mixing angle ϕ_τ of the general effective Yukawa coupling is:

$$C_{H\tau\tau} = \frac{m_\tau}{v} [\cos\phi_\tau + i \sin\phi_\tau \gamma_5]$$

The CP -mixing angle could be encoded in the correlations between the transverse spin components of the τ leptons then reflected in the directions of the τ lepton decay products:

$$\vec{d}_{1,2} \cdot \vec{d}_{3,4} \propto 1 - M(\vec{e}_1) M(\vec{e}_2) \cos(\phi_\tau^2 - 2\phi_\tau)$$

3 Observable

The observable defined as the acoplanarity angle between d_1 - d_2 decay planes named as ϕ_{CP} , it would be reconstructed in visible d_1 - d_2 non-momentum frames by different method according to the τ decay mode:

- \bullet μ method, for τ decay to only one charged particle and one neutral visible particle, the leptonic decay and one charged and one neutral hadronic decay, define plane spanned by charged track and neutral track.
- \bullet μ method, for τ decay to both charged and neutral visible particles, define plane spanned by charged track and neutral track.

After the decay plane reconstruction, we can get the observable ϕ_{CP} by calculate the angle between two normal vectors of the d_1 - d_2 decay planes with the direction.

Results

The observed and expected negative log-likelihood ($-\ln L$) scans in ϕ_τ showed that the observed (expected) value ϕ_τ is $9 \pm 10^\circ$ ($0 \pm 20^\circ$) at the 95% confidence level (CL), and 3.4σ (3.4σ) at the 95% CL. The data disfavors the pure CP -odd hypothesis at 3.4σ , while the expected exclusion limit is at 2.1σ . The results are compatible with the SM expectation within the measured uncertainties.

A 2D scan of $-\ln L$ on the signal strength $\mu_{\tau\tau}$ versus ϕ_τ showed that the 1σ and 2σ 2D confidence levels for $-\ln L$ correspond to 1.15 and 1.03, respectively. No strong correlation is observed between $\mu_{\tau\tau}$ and ϕ_τ . The 3D prediction ($\mu_{\tau\tau} = 1, \phi_\tau = 0$) of $\mu_{\tau\tau}$ is compatible with the measurement within the 1σ -confidence region.

Reference

[1] Measuring CP properties of Higgs boson interactions with τ leptons with the ATLAS detector. Technical report, CERN, Geneva, 2022.

Observation of new structures in the $J/\psi/\psi$ mass spectrum in pp collisions at $\sqrt{s}=13\text{ TeV}$ in CMS

Shiyi HUANG* [Nanjing Normal University] on behalf of the CMS Collaboration
The 8th China LHC Physics Workshop, 24 Nov 2022, Nanjing

Introduction

For the first time, charm baryons were performed in 13 TeV, while in 2012, the first observation reported [1].

Fit strategy

The signal mass spectrum with the fit extracted information:

$$N(\text{signal}) = \sum_i N_i \cdot \text{Gaussian}(m_i) \cdot \text{Gaussian}(m_i)$$

Signal region

Backgrounds: J/ψ (background), ψ (background), $\psi(2S)$ (background), $\psi(3S)$ (background), $\psi(4S)$ (background), $\psi(5S)$ (background), $\psi(6S)$ (background), $\psi(7S)$ (background), $\psi(8S)$ (background), $\psi(9S)$ (background), $\psi(10S)$ (background), $\psi(11S)$ (background), $\psi(12S)$ (background), $\psi(13S)$ (background), $\psi(14S)$ (background), $\psi(15S)$ (background), $\psi(16S)$ (background), $\psi(17S)$ (background), $\psi(18S)$ (background), $\psi(19S)$ (background), $\psi(20S)$ (background), $\psi(21S)$ (background), $\psi(22S)$ (background), $\psi(23S)$ (background), $\psi(24S)$ (background), $\psi(25S)$ (background), $\psi(26S)$ (background), $\psi(27S)$ (background), $\psi(28S)$ (background), $\psi(29S)$ (background), $\psi(30S)$ (background), $\psi(31S)$ (background), $\psi(32S)$ (background), $\psi(33S)$ (background), $\psi(34S)$ (background), $\psi(35S)$ (background), $\psi(36S)$ (background), $\psi(37S)$ (background), $\psi(38S)$ (background), 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<https://indico.ihep.ac.cn/e/CLHCP2022>

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Nov. 23-27, 2022, Nanjing Tangshan Yishang Hotel

腾讯会议: 766-4242-9169

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CLHCP2022 议程委员会 (PC)

Chair:
吴雨生 (USTC) 张昊 (IHEP)

Theory:
刘佳 (PKU) 宋慧超 (PKU) 王健 (SDU)
王玉明 (NKU) 张昊 (IHEP)

ALICE:
唐泽波 (USTC) 张晓明 (CCNU)

ATLAS:
李海峰 (SDU) 李数 (SJTU)
吴雨生 (USTC) 徐达 (IHEP) 张雷 (NJU)

CMS:
廖红波 (IHEP) 孙小虎 (PKU) 肖臻 (ZJU)

LHCb:
李一鸥 (IHEP) 孙亮 (WHU) 张黎明 (THU)

Upgrade:
孙勇杰 (USTC) 王大勇 (PKU)

CEPC:
阮曼奇 (IHEP)

南师-物理科学与技术学院 南师-理论所彭桓武科教合作中心



Great Thanks to
all speakers,
all session chairs,
all on-site & on-line
participants!

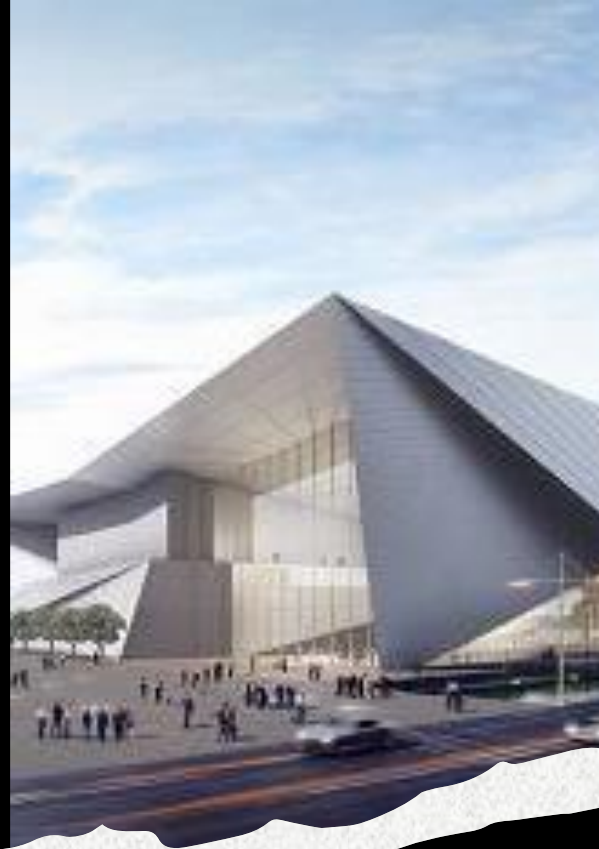
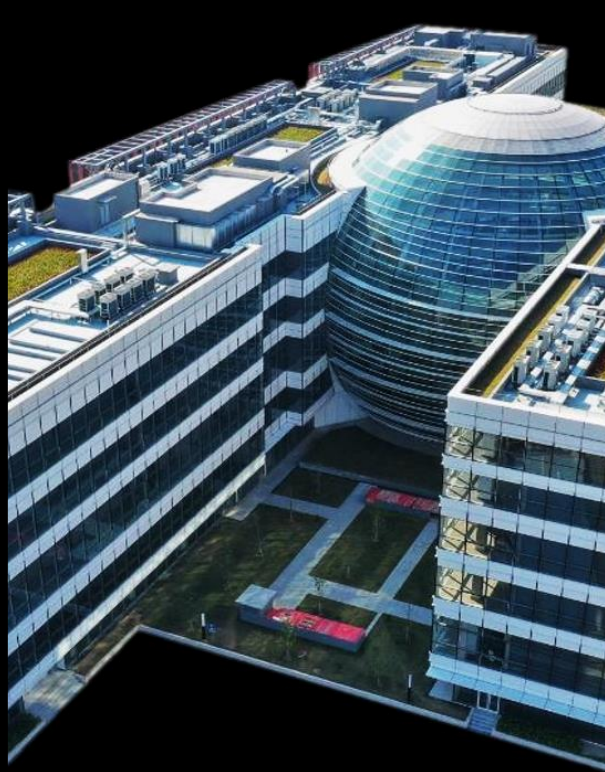


This edition of
workshop sets yet
another example for
holding hybrid
conferences in
difficult time

Looking forward to CLHCP2023

After receiving expressions of interests, the CLHCP program committee voted and decided that CLHCP2023 will be hosted by

Shanghai Jiao Tong University /
T. D. Lee Institute



See you in 2023 @ Shanghai!