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Major Research Interests

Collider Physics, top quark physics, higgs,
New physics beyond the Standard Model.

Education

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|------------------|---|
| 07/2011- Present | Postdoc Institute of Theoretical Physics, Chinese Academy of Sciences, Beijing, China.
Collaborate Supervisor: Prof. Tianjun Li. |
| 09/2007-06/2011 | Doctor of Science Theoretical Particle Physics, School of Physics, Peking University, Beijing, China.
Supervisor: Prof. Shou-Hua Zhu. |
| 08/2005-08/2007 | Joint educated Master of Science Theoretical Particle Physics, between Wuhan University and Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China.
Supervisors: Prof. Xiao-Hu Mo & Prof. Chang-Zheng Yuan |
| 09/2004-06/2007 | Master of Science Theoretical Particle Physics, School of Physics Science and Technology, Wuhan University, Wuhan, Hubei Province, China.
Supervisor: Prof. Jue-Ping Liu. |
| 09/2000-07/2004 | Bachelor of Science Physics, Department of Physics, Hua Zhong University of Science and Technology, Wuhan, Hubei Province, China. |

Research Experience

1. Higgs phenomenology.

We have made global analysis on the Yukawa couplings between higgs and the Fermions. By adopting the 5fb^{-1} results at 7 TeV, our investigation shows that, the global χ^2 fit can get its optimal value by introducing an universal suppression factor 1/2 on the SM Yukawa couplings. On July 4th 2012, both ATLAS and CMS collaborations at CERN have announced the discovery of a Standard Model(SM) higgs-like boson near the 125 GeV. The global fits by CMS has convinced our previous results.

After the discovery of the higgs-like particle, the urgent problem is to check whether it is a SM-like higgs or not, as well as to cross-check whether the new physics models can still survive. We studied the Next-to-Minimal-Supersymmetric Standard Model(NMSSM), improved the analysis method by taking a standard χ^2 global fit, instead of the 2-standard deviation cuts on the survive parameters space regions.

2. Forward backward Asymmetry A_{FB} phenomenology at hadron colliders.

Forward backward Asymmetry is defined as $A_{\text{FB}} = (N_{\text{F}} - N_{\text{B}})/(N_{\text{F}} + N_{\text{B}})$, where $N_{\text{F}}/N_{\text{B}}$ is the number of events in which some particular final-state particle is moving "forward/backward" with respect to some chosen direction. A_{FB} indicates the angular distribution information of the final-state particle which is determined by the nature of the coupling structure. It can be utilized to test the Standard Model and discover New Physics Beyond the SM. Some experimental and theoretical inconsistency has been observed in A_{FB} measurements, such as in channel of $e^+e^- \rightarrow b\bar{b}$ at LEP and $p\bar{p} \rightarrow t\bar{t} + X$ at Tevatron.

My research work includes:

- (a) **Calculated higher order correction of top quark A_{FB} in a Z' model.** A flavor changing t-channel Z' have been proposed in previous paper to explain the deviation from SM prediction in top A_{FB} measured at Tevatron. However, $d\sigma/dM_{t\bar{t}}$ distribution in this model based on Leading Order(LO) calculation can not fit well with the experimental observation. We calculated the higher order corrections and found the differential distribution $d\sigma/dM_{t\bar{t}}$ can be improved while the top asymmetry is still in agreement with the observed value.
- (b) **Proposed a new color octet axial-vector boson Z_C which locates near the top pair threshold region to explain the A_{FB} derivation observed at the Tevatron.** we pointed out that the deviation arises from the top quark pair production threshold region. Moreover we proposed a new color-octet vector boson Z_C with mass just above top quark pair threshold, rather than the O(1 TeV) heavy particle in other theoretical explanations. All experimental observables can be excellently reproduced in this scenario. The new boson is likely to be a $t\bar{t}$ bound state and the Large Hadron Collider(LHC) can make a discovery if it really exists. It is dramatic that after we finished this paper, the CDF collaboration at the Tevatron presented a new measurement recently showing that the inconsistency between the experimental and SM predicted A_{FB} is located in large $M_{t\bar{t}}$ region. Whether our proposed new boson scenario can still survive is currently under studying.
- (c) **Defined a new observable A_{OFB} to study the forward backward asymmetry at the LHC.** A_{FB} defined in the left right asymmetric colliders, e.g. e^+e^- collider LEP and $p\bar{p}$ collider Tevatron is invalid at the left right symmetric pp collider LHC since it does not have preferred direction. We defined a new experimental observable A_{OFB} to study the forward backward distribution at the LHC. We calculated the SM predictions for leptons, bottom and top quarks under this definition. At the LHC, experimental measurement of A_{OFB} can be used to crosscheck the previous A_{FB} measurements.

3. τ mass measurement using threshold scan method at BES

BEijing Spectrometer(BES) has unique advantage in τ mass measurement by studying the production of $e^+e^- \rightarrow \tau^+\tau^-$ in the immediate vicinity of the threshold. τ mass measured by BES collaboration is one of the most accurate values in the world. Based on Monte Carlo simulation, I researched the tau mass measurement experiment for the new generation high luminosity detector BESIII before its upgrade.

- (a) **Refitted the existing data by adopting new high accurate $e^+e^- \rightarrow \tau^+\tau^-$ theoretical cross section.** The refitted τ mass agrees with previous results, which shows theoretical uncertainty is not the dominant error resource.
- (b) **Simulated the data taking strategy and obtained the optimal scheme for BESIII τ mass measurement.** I studied all possible error resources and estimated the precision of m_τ that BESIII can achieve. Our research shows that beam energy calibration is the dominant error. This induced the sequential project of installing Compton backscattering equipments to calibrate the beam energy precisely. Now the BESIII has already obtained the preliminary results on τ mass. More data will be taken in the coming year.

Computer Proficiency

Languages: FORTRAN, C.

Software: Mathematica, ROOT, PYTHIA, FEYARTS, FORMCALC, FEYNALC, LOOPTOOLS, Madgraph etc.

Conferences and Workshops

20th International Conference on Supersymmetry and Unification of Fundamental Interactions, August 2012. Peking University, Beijing, China

School on Strongly Coupled Physics Beyond the Standard Model, January, 2012, The Abdus Salam International Center for Theoretical Physics, Trieste, ITALY

International Conference and Summer school on LHC Physics, August, 2010, Tsinghua University, Beijing, China

Weihai Summer Forum On Frontiers of High Energy Physics–QCD and Hadron Physics, August 2010, Weihai, China

4th TeV Work Group Conference. August, 2009, Tianjin, China

Weihai Summer Forum On Frontiers of High Energy Physics–LHC Physics, July 2008, Weihai, China

BCSPIN Summer School In Particle Physics And Cosmology, June 2007, Beijing, China

Frontiers of Particle Physics 2006: Beyond the Standard Model, August 7 - 11, 2006, Beijing, China

Topical Seminar on Frontier of Particle Physics 2005: Heavy Flavor Physics, August 13- 17, 2005, Beijing, China

Foundation

Postdoctoral Science Foundation of China under grant number Y2Y2231B11. 50000RMB.

Publications

According to the convention in High Energy Physics, the author's names are arranged by the Alphabetical order after April, 2011. Citations are come from the database inspirehep.

First author or corresponding author:

1. Toward the Natural and Realistic NMSSM with and without R -Parity. Taoli Cheng, Jinmian Li, Tianjun Li, Xia Wan, You-kai Wang, Shou-hua Zhu. e-Print: arXiv:1207.6392(Submitted to PRD). citations: 13. Corresponding author.
2. *New color-octet axial vector boson revisited again.* Hao Wang, You-kai Wang, Bo Xiao, Shou-hua Zhu. Phys.Rev. D **84**, 094019, 2011. arXiv:1107.5769. citations: 12. Corresponding author.
3. *One-side forward-backward asymmetry at the LHC.* You-kai Wang, Bo Xiao, Shou-hua Zhu. Phys.Rev.D **83**, 015002 (2011), arXiv:1011.1428. citations: 22. Essential Science Indicators.
4. *One-side Forward-backward Asymmetry in Top Quark Pair Production at CERN Large Hadron Collider.* You-kai Wang, Bo Xiao, Shou-hua Zhu. Phys.Rev.D **82**, 094011 (2010), arXiv:1008.2685. citations: 31.

5. *Study of the data taking strategy for a high precision τ mass measurement*, WANG You-Kai, ZHANG Jian-Yong, MO Xiao-Hu, YUAN Chang-Zheng. Chinese Physics C **33** (**07**): 501 (2009). citations: 2.
6. *Optimization of the data taking strategy for a high precision tau mass measurement*. Y.K. Wang, X.H. Mo, C.Z. Yuan, J.P. Liu. Nucl.Instrum.Meth.A**583**, 479 (2007). citations: 4.
7. *Refit of tau mass based on Improved Theoretical Calculations*. Y. K. Wang, X. H. Mo, C. Z. Yuan, J. P. Liu, High Energy Physics and Nuclear Physics, **31**, 325 (2007).

Second author:

1. *New color-octet vector boson revisited*. Xiao-Ping Wang, You-Kai Wang, Bo Xiao, Jia Xu, Shou-hua Zhu. Phys.Rev.D **83**, 115010,2011. arXiv:1104.1917. citations: 47. Essential Science Indicators.
2. *$\mathcal{O}(100\text{GeV})$ Deci-weak W'/Z' at Tevatron and LHC*. Xiao-Ping Wang, You-Kai Wang, Bo Xiao, Jia Xu, Shou-hua Zhu. Phys.Rev.D **83**, 117701,(2011). arXiv:1104.1161. citations: 31.
3. *Edge Charge Asymmetry in Top Pair Production at the LHC*. Bo Xiao, You-Kai Wang, Zhong-Qiu Zhou, Shou-hua Zhu. Phys.Rev.D **83**, 057503,(2011), arXiv:1101.2507. citations: 28.
4. *New Color-Octet Vector Boson?* Bo Xiao, You-kai Wang, Shou-hua Zhu. arXiv:1011.0152 [hep-ph] (2010). citations: 26.
5. *Forward-backward Asymmetry and Differential Cross Section of Top Quark in Flavor Violating Z' model at $\mathcal{O}(\alpha_s^2\alpha_X)$* . Bo Xiao, You-kai Wang, Shou-hua Zhu. Phys.Rev.D **82**, 034026 (2010), arXiv:1006.2510. citations: 64. Essential Science Indicators.
6. *Tau mass near threshold*. Xiao-Hu Mo, Y.K. Wang, C.Z. Yuan, C.D. Fu. Int.J.Mod.Phys.A**24**S1:739 (2009). *Physics at BES-III*, Part VI τ Physics, Chapter 30 τ mass near threshold. By BES Collaboration (D.M. Asner et al.) IHEP-PHYSICS-REPORT-BES-III-2008-001, (2008). arXiv:0809.1869 [hep-ex]. citations: 127.

Third author:

1. *Constraints on the Universal Varying Yukawa Couplings: from SM-like to Fermiophobic*. Tianjun Li, Xia Wan, You-kai Wang, Shou-hua Zhu. JHEP 1209 (2012) 086. arXiv:1203.5083. citations: 17.
2. *Discriminating Different Z' s via Asymmetries at the LHC*. Zhong-qiu Zhou, Bo Xiao, You-kai Wang, Shou-hua Zhu. Phys.Rev.D **83**, 094022,(2011), arXiv:1102.1044. citations: 8.

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研究方向

对撞机物理, 顶夸克, 黑格斯粒子, 超出标准模型的新物理。

教育经历

- 07/2011至今 **博士后** 中国科学院理论物理研究所, 北京。
合作导师: 李田军 研究员。
- 09/2007-06/2011 **理学博士** 理论物理, 北京大学物理学院。
导师: 朱守华 教授。
- 08/2005-08/2007 **联合培养理学硕士** 理论物理, 武汉大学与中国科学院高能物理研究所。
导师: 莫晓虎 研究员, 苑长征 研究员。
- 09/2004-06/2007 **理学硕士** 理论物理, 武汉大学物理科学与技术学院。
导师: 刘觉平 教授。
- 09/2000-07/2004 **理学学士** 华中科技大学物理系, 湖北武汉。

研究经历

1. 黑格斯粒子唯象学。

利用LHC上先前质心能量在7TeV处积分亮度为 5fb^{-1} 的数据结果, 我们对黑格斯粒子与费米子之间的Yukawa耦合进行了整体的分析。分析表明, 当取Yukawa耦合压低因子为1/2时, 可以使整体的 χ^2 拟合达到最优。在2012年7月4日, 欧洲核子中心的ATLAS和CMS合作组同时宣布发现了一个类似标准模型黑格斯粒子的新的波色子, CMS合作组拟合得到的结果和我们之前的结果完全一致。

在发现类黑格斯粒子之后, 关键的问题就是判断这个新发现的粒子是否就是标准模型所预言的黑格斯粒子, 进一步的研究还要判断各种所谓的新物理模型是否能够依然存活。我们研究了一种叫做次最小超对称模型的理论, 利用整体的 χ^2 拟合, 替换了之前常用的2倍标准偏差截断的方法, 给出了在此模型下存活的参数区间。

2. 强子对撞机上的前后不对称性。

前后不对称性可定义为: $A_{\text{FB}} = (N_{\text{F}} - N_{\text{B}})/(N_{\text{F}} + N_{\text{B}})$, 其中 $N_{\text{F}}/N_{\text{B}}$ 是指对撞机上相对于取定方向朝前/朝后飞行的末态粒子的数目。 A_{FB} 表征了由耦合结构所决定的末态粒子的角分布信息。它可以用来检验标准模型过程, 以及探索新物理现象。现有测量 A_{FB} 的实验, 例如在LEP上的 $e^+e^- \rightarrow b\bar{b}$ 过程, 以及Tevatron上的 $p\bar{p} \rightarrow t\bar{t} + X$ 过程, 都已经观测到了与标准模型理论预言值之间的偏离。这种偏离有可能是由于未知的新物理理论产生的。

我的研究工作包括:

- (a) 计算了在一种 Z' 模型下, 顶夸克的高阶过程对 A_{FB} 的修正。为了解释Tevatron实验上发现的顶夸克 A_{FB} 相对于标准模型预言值的超出, 有人提出了一种所谓t道味改变的 Z' 模型。但是, 这种

理论在领头阶所预言的 $d\sigma/dM_{t\bar{t}}$ 分布并不能和实验观测很好地符合。我们计算了高阶修正带来的影响，发现考虑了高阶修正之后， $d\sigma/dM_{t\bar{t}}$ 的微分分布可以有所改善。相关文章被引用59次。

- (b) **我们提出了一个质量接近顶夸克对产生阈的色八重态轴矢耦合的波色子 Z_C 。**我们首先指出这种偏离来自于近顶夸克产生阈附近，而不是像其它理论那样引入一个质量在TeV量级的重粒子。通过引入一个质量恰好在顶夸克质量阈附近的色八重态轴矢粒子 Z_C ，所有的实验观测量都可以完美地加以解释。实际上，其它的种种解释都或多或少地存在各种问题，而我们的解释被称做“last man standing”。

- (c) **我们定义了在大强子对撞机LHC上用来研究前后不对称性的新的可观测量 A_{OFB} 。**

通常情况下， A_{FB} 可以定义在左右束流不对称的对撞机上，例如 e^+e^- 对撞机LEP和 $p\bar{p}$ 对撞机Tevatron，但这并不适用于左右对称的 pp 对撞机LHC，因为它没有唯一的初始纵向方向。我们定义的新的可观测量 A_{OFB} 就能够解决这个问题，这引发了一系列他人的后续研究，包括LHC上ATLAS实验组最近撰写的一篇note也讨论了我们的工作。

3. 在北京谱仪上通过阈值扫描的办法测量 τ 轻子质量。

通过精确扫描 $e^+e^- \rightarrow \tau^+\tau^-$ 的产生能量阈，北京谱仪 BES可以精确地测量 τ 轻子的质量。基于蒙特卡罗模拟，在新一代谱仪BESIII运行之前，我对 τ 质量测量进行了研究。BES合作组有望得到世界上精度最高的 τ 质量测量值。

- (a) **基于高精度 $e^+e^- \rightarrow \tau^+\tau^-$ 理论截面的 τ 质量再拟合。**重新拟合得到的 τ 质量精度和之前的精度相当，这意味着理论的不确定性并不是实验误差的主要来源。
- (b) **我模拟了实验的取数过程，得到了BESIII τ 质量测量的最佳取点方案。**我研究了各种误差可能的来源，估计了BESIII可能达到的精度。实验束流能量刻度是误差的主要来源。为了降低此项误差，BESIII安装了康普顿背散射装置来刻度束流能量。现在，BES合作组已经得到了最新的 τ 质量测量值，结果将于近期发表。

计算机能力

计算机语言: FORTRAN, C.

计算机软件: Mathematica, ROOT, PYTHIA, FEYNARTS, FORMCALC, FEYNCALC, LOOPTOOLS, Madgraph 等。

参加会议经历

第20届国际超对称大会，2012年8月，北京大学。

第11届全国粒子物理学术会议，2012年4月，云南昆明。

超出标准模型的强相互作用物理，2012年1月，国际理论物理中心，意大利，的里亚斯特。

国际LHC 物理大会，2010年8月，清华大学，北京。

QCD和强子物理讨论会，2010年8月，山东威海。

第4届TeV工作组会议，2009年8月，天津。

LHC物理-高能物理前沿讨论会，2008年7月，山东威海。

粒子物理与宇宙学暑期学校，2007年6月，北京。

超出标准模型-粒子物理前沿会议，2006年8月，北京。

重味物理-粒子物理前沿会议，2005年8月，北京。

基金申请

第51批博士后科学基金，人民币5万元。

发表文章目录

2011年4月之后的文章,根据高能物理领域内的惯例,全部按照作者名字拼音排序. 被引次数来自inspirehep数据库。

第一作者或通讯作者文章：

1. Toward the Natural and Realistic NMSSM with and without R -Parity. Taoli Cheng, Jinmian Li, Tianjun Li, Xia Wan, You kai Wang, Shou-hua Zhu. e-Print: arXiv:1207.6392 (已投稿至PRD). 被引次数: 13. 通讯作者.
2. *New color-octet axial vector boson revisited again.* Hao Wang, You-kai Wang, Bo Xiao, Shou-hua Zhu. Phys.Rev. D **84**, 094019, 2011. arXiv:1107.5769. 被引次数: 12. 通讯作者.
3. *One-side forward-backward asymmetry at the LHC.* You-kai Wang, Bo Xiao, Shou-hua Zhu. Phys.Rev.D **83**, 015002 (2011), arXiv:1011.1428. 被引次数: 22. Essential Science Indicators, 基本科学指标收录.
4. *One-side Forward-backward Asymmetry in Top Quark Pair Production at CERN Large Hadron Collider.* You-kai Wang, Bo Xiao, Shou-hua Zhu. Phys.Rev.D **82**, 094011 (2010), arXiv:1008.2685. 被引次数: 31.
5. *Study of the data taking strategy for a high precision τ mass measurement,* WANG You-Kai, ZHANG Jian-Yong, MO Xiao-Hu, YUAN Chang-Zheng. Chinese Physics C **33** (07): 501 (2009). 被引次数: 2.
6. *Optimization of the data taking strategy for a high precision tau mass measurement.* Y.K. Wang, X.H. Mo, C.Z. Yuan, J.P. Liu. Nucl.Instrum.Meth.A**583**, 479 (2007). 被引次数: 4.
7. *Refit of tau mass based on Improved Theoretical Calculations.* Y. K. Wang, X. H. Mo, C. Z. Yuan, J. P. Liu, High Energy Physics and Nuclear Physics, **31**, 325 (2007).

第二作者文章：

1. *New color-octet vector boson revisited.* Xiao-Ping Wang, You-Kai Wang, Bo Xiao, Jia Xu, Shou-hua Zhu. Phys.Rev.D **83**, 115010,2011. arXiv:1104.1917. 被引次数: 47. Essential Science Indicators, 基本科学指标收录.
2. *$\mathcal{O}(100\text{GeV})$ Deci-weak W'/Z' at Tevatron and LHC.* Xiao-Ping Wang, You-Kai Wang, Bo Xiao, Jia Xu, Shou-hua Zhu. Phys.Rev.D **83**, 117701,(2011). arXiv:1104.1161. 被引次数: 31.
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4. *New Color-Octet Vector Boson?* Bo Xiao, You-kai Wang, Shou-hua Zhu. arXiv:1011.0152 [hep-ph] (2010). 被引次数: 26.
5. *Forward-backward Asymmetry and Differential Cross Section of Top Quark in Flavor Violating Z' model at $\mathcal{O}(\alpha_s^2\alpha_X)$.* Bo Xiao, You-kai Wang, Shou-hua Zhu. Phys.Rev.D **82**, 034026 (2010), arXiv:1006.2510. 被引次数: 64. Essential Science Indicators, 基本科学指标收录.

6. *Tau mass near threshold*. Xiao-Hu Mo, Y.K. Wang, C.Z. Yuan, C.D. Fu. Int.J.Mod.Phys.A24S1:739 (2009). *Physics at BES-III*, Part VI τ Physics, Chapter 30 τ mass near threshold. By BES Collaboration (D.M. Asner et al.) IHEP-PHYSICS-REPORT-BES-III-2008-001, (2008). arXiv:0809.1869 [hep-ex]. 被引次数: 127.

第三作者文章：

1. *Constraints on the Universal Varying Yukawa Couplings: from SM-like to Fermiophobic*. Tianjun Li, Xia Wan, You-kai Wang, Shou-hua Zhu. JHEP 1209 (2012) 086. arXiv:1203.5083. 被引次数: 17.
2. *Discriminating Different Z 's via Asymmetries at the LHC*. Zhong-qiu Zhou, Bo Xiao, You-kai Wang, Shou-hua Zhu. Phys.Rev.D **83**, 094022,(2011), arXiv:1102.1044. 被引次数: 8.