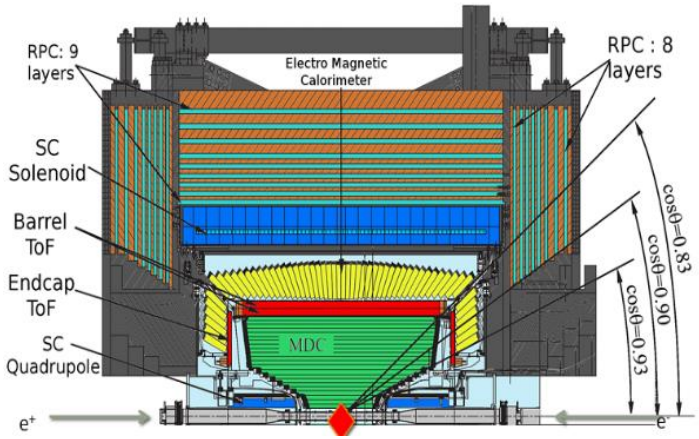
卓越中心“拔尖人才”答辩

周小蓉 副研究员
zxrong@ustc.edu.cn
中国科学技术大学，物理学院
2020年12月5日

个人基本情况

起止年月	在何单位学习或任职
2006.9-2010.6	中国科学技术大学-粒子物理与原子核物理专业，攻读学士
2010.9-2015.6	中国科学技术大学-粒子物理与原子核物理专业，攻读博士
2013.9-2013.12	意大利INFN研究所，交流
2015.6-2017.12	中国科学技术大学，博士后
2018.1-今	中国科学技术大学，副研究员

- **研究领域**：粒子物理实验——高亮度前沿
- **参与实验**： BESIII物理分析，担任tau-QCD组convener



研究背景

- 当前，标准模型在高能量前沿LHC实验上得到了充分的检验，但是在低能区下强相互作用的非微扰特性仍然没有解决。
- 量子色动力学（QCD）是描述自然界强相互作用的基本理论。高能下QCD检验获得成功并获2004年诺贝尔奖，然而，低能下QCD理论尚有待进一步发展和实验检验，尤其是有许多重大科学问题亟待实验和理论共同回答，例如

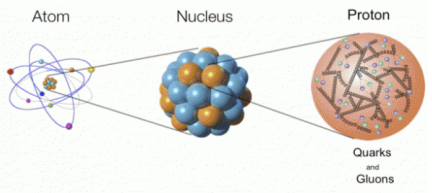
如何理解核子的内部结构（电/磁密度...）？

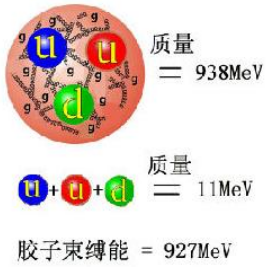
物质世界粒子-反粒子的不对称来源？

研究工作一：核子形状因子研究

Electromagnetic Structure of the Nucleon

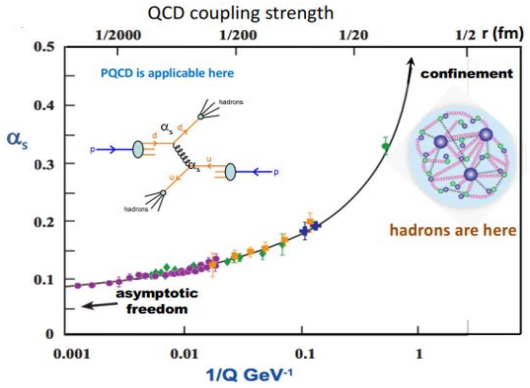
- **Nucleons are composite objects with inner structure**





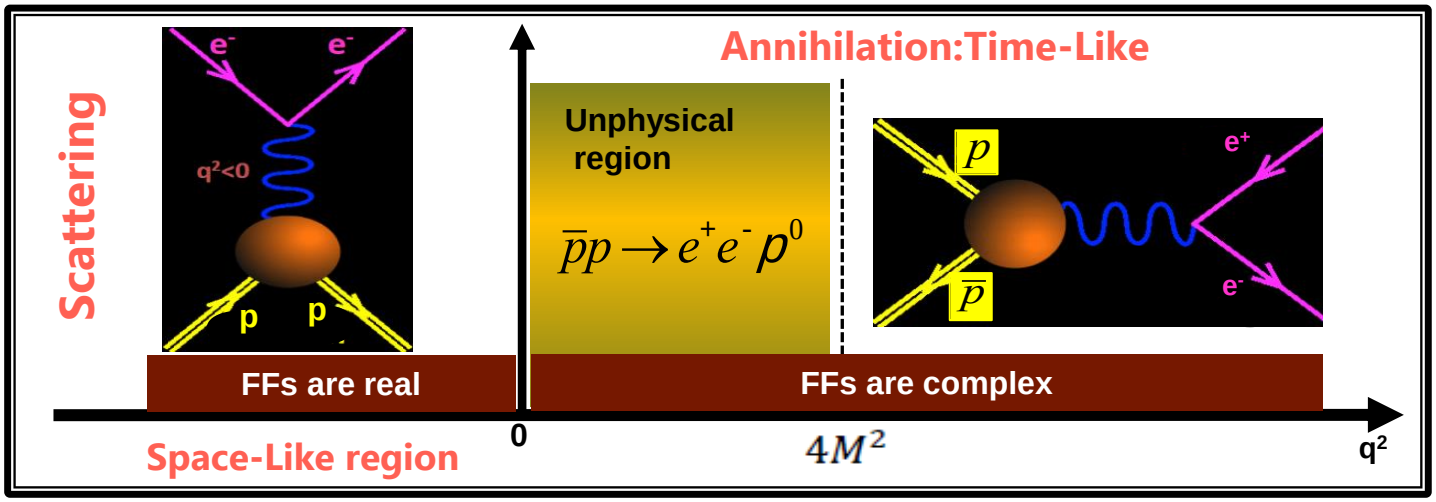
- **At low Q, perturbative QCD not possible (expansion of coupling constant α_s)**

⇒ Nucleon structure must be measured in experiments!



- **Most simple observables of nucleon structure**
  - ◇ **General Parton Distribution, Parton Distribution Functions, Electromagnetic Form Factors (EMFFs)**
  - ◇ **EMFFs are related to charge, magnetization distribution, provide crucial testing ground for models and improve our understanding of QCD**

Nucleon Electromagnetic Form Factors



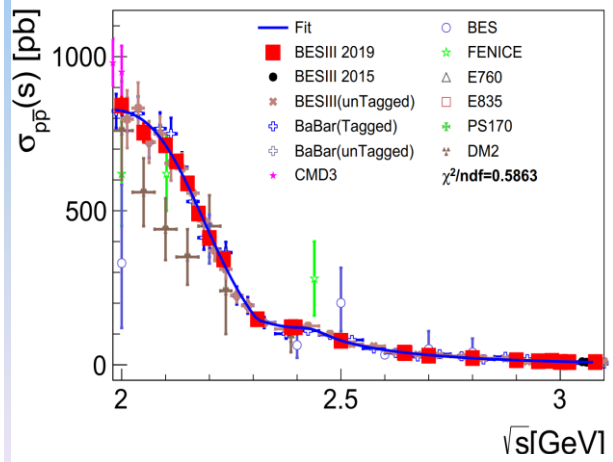
- The nucleon electromagnetic vertex Γ_μ describing the hadron current: $\Gamma_\mu(p',p) = \gamma_\mu F_1(q^2) + \frac{i\sigma_{\mu\nu}q^\nu}{2m_p}F_2(q^2)$
- Sachs FFs: $G_E(q^2) = F_1(q^2) + \tau\kappa_p F_2(q^2)$, $G_M(q^2) = F_1(q^2) + \kappa_p F_2(q^2)$
- NEFFs can be measured from space-like (eN) (precision 1%) or time-like process (precision 10%-30% before BESIII)

Proton: Born Cross Section and EMFF ratio

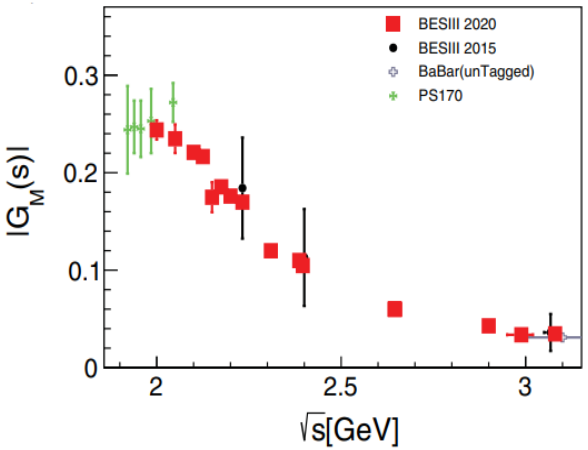
PRL 124, 042001(2020)

- Via direct scan, 688 pb^{-1} data @ 2.0-3.08 GeV, Born cross section measured with most precise results, (Near)-threshold platform observed at low q^2
- Significant improvement of the precision for model independent $|G_M|$ and $|R_{em}|=|G_E/G_M|$

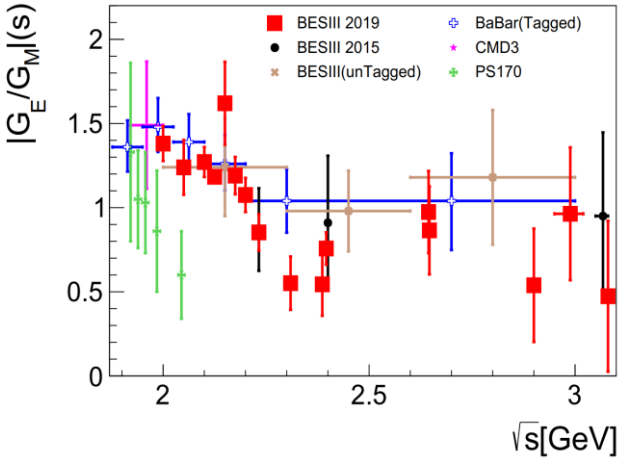
$$\frac{d\sigma_B}{d\cos\theta} = \frac{\pi\alpha^2\beta}{2q^2}|G_M|^2\left[(1+\cos^2\theta)+\frac{1}{\tau}|R_{em}|^2\sin^2\theta\right]$$



Best precision: 3.0%



Best precision: 1.6%



Best precision: 0.04

Several citations of the paper

Measurement of proton electromagnetic form factors in $e^+e^- \to p\bar{p}$ in the energy region 2.00 - 3.08 GeV

#1

BESIII Collaboration • Medina Ablikim (Beijing, Inst. High Energy Phys.) et al. (May 22, 2019)

Published in: *Phys.Rev.Lett.* 124 (2020) 4, 042001 • e-Print: 1905.09001 [hep-ex]

pdf   links   DOI   cite   15 citations

15 citations

...n axial and pseudoscalar form factors from lattice QCD at the physical point

C. Alexandrou[1,2], S. Bacchio[2], M. Constantinou[3], P. Dimopoulos[4] J. Finkenrath[2]
K. Hadjiyiannakou[1,2], K. Jansen[5], G. Koutsou[2], B. Kostrzewa[6], T. Leontiou[7], C. Urbach[8]
[1]*Department of Physics, University of Cyprus, P.O. Box 20537, 1678 Nicosia, Cyprus*
[2]*Computation-based Science and Technology Research Center, The Cyprus Institute, 20 Kavafi Str., Nicosia 2121, Cyprus*
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[5]*NIC, DESY, Platanenallee 6, D-15738 Zeuthen, Germany*
[6] *High Performance Computing and Analytics Lab, University of Bonn, Endenicher Allee 19A, 53115 Bonn, Germany*
[7]*Department of Mechanical Engineering, Frederick University, 1036 Nicosia, Cyprus*
[8]*Helmholtz-Institut für Strahlen- und Kernphysik, University of Bonn, 53115 Bonn, Germany and Bethe Center for Theoretical Physics, University of Bonn, 53115 Bonn, Germany*

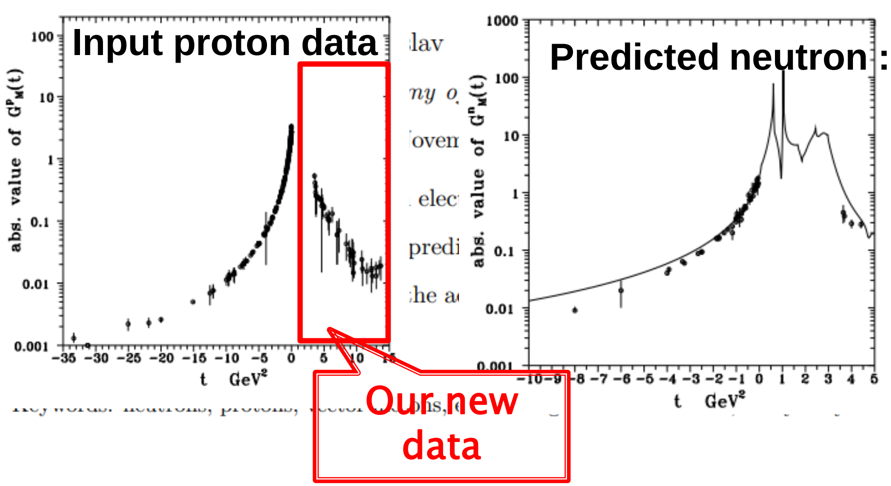
Extended Twisted Mass Collaboration

We compute the nucleon axial and induced pseudoscalar form factors using three ensembles of gauge configurations, generated with dynamical light quarks with mass tuned to approximately their ...

Prediction of neutron electromagnetic form factors behaviors just by the proton electromagnetic form factors data

利用质子电磁形状因子数据预测中子电磁形状因子行为

Anna Z. Dubničková
Department of Theoretical Physics, Comenius University, Bratislava, Slovak Republic

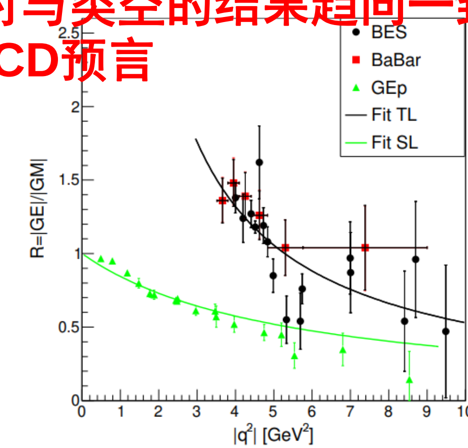


Diquark Correlations in Hadron Physics: Origin, Impact and Evidence

与各种理论模型比较

高能区类时与类空的结果趋向一致，验证了pQCD预言

Yu. ... D. Cates,[4] C. Chen,[5] Y. Chen,[6,7]
E. ... R. W. Gothe,[14]
. Horn, ... S. Liuti, C. Mezi...
P. ... G. Sa...
M. Takizawa,[26,27,28] E. Toma...
[1]*Joint Institute ...*
[2]*Mesoam...*
Universidad Autónoma ...
[3]*Departamento de Física, Un...*
[4]*University of ...*
...nstitut für Theoretische Physik, ...
[6]*Institute of High Energy Phy...*
[7]*School of Physics, Universit...*



Impact will going on…

- **BESIII提供了最高精度的质子类时空间形状因子结果，将对各种理论模型或重要参数给出更严格的约束**

The fourth dimension of the nucleon structure: spacetime analysis of the timelike electromagnetic proton form factors

Andrea Bianconi
Egle Tomasi-Gustafsson
IRFU, CEA, Université Paris-Saclay, 91191 Gif-sur-Yvette Cedex, France
(Dated: August 8, 2018)

As well known, spacelike proton form factors expressed in the Breit frame may be interpreted as the Fourier transform of static space distributions of electric charge and current. In particular, the electric form factor is simply the Fourier transform of the charge distribution $F(q) = \int e^{i\vec{q}\cdot\vec{r}}\rho(r)d^3r$. We don't have an intuitive interpretation of the same level of simplicity for the proton timelike form factor appearing in the reactions $e^+e^- \leftrightarrow \bar{p}p$. However, one may suggest that in the center of mass (CM) frame, where $q_\mu x^\mu = qt$, a timelike electric form factor is the Fourier transform $F(q) = \int e^{iqt}R(t)dt$ of a function $R(t)$ expressing how the electric properties of the forming (or annihilating) proton-antiproton pair evolve in time. Here we analyze in depth this idea, show that the functions $\rho(r)$ and $R(t)$ can be formally written as the time and space integrals of a unique

DESY 18-033

Proton and neutron electromagnetic form factors from lattice QCD

C. Alexandrou[1,2], S. Bacchio[1], M. Constantinou[3], J. Finkenrath[2]
K. Hadjiyiannakou[2], K. Jansen[4], G. Koutsou[2], and A. Vaquero Aviles-Casco[5]
[1]Department of Physics, University of Cyprus, P.O. Box 20537, 1678 Nicosia, Cyprus
[2]Computation-based Science and Technology Research Center,
The Cyprus Institute, 20 Kavafi Str., Nicosia 2121, Cyprus
[3]Department of Physics, Temple University, 1925 N. 12th Street, Philadelphia, PA 19122-1801, USA
[4]NIC, DESY, Platanenallee 6, D-15738 Zeuthen, Germany
[5]Department of Physics, Astronomy and Mathematics, University of Hertfordshire, Hatfield, AL10 9AB, UK

The electromagnetic form factors of the proton and the neutron are computed within lattice QCD using gauge ensembles with pion masses fixed to their physical value. Both connected and disconnected contributions are included. We analyze two ensembles with $N_f = 2$ and $N_f = 2+1+1$ twisted mass clover-improved fermions and determine the proton and neutron form factors, the electric and magnetic radii, and the magnetic moments. We use several values of the sink-source time separation in the range of 1.0 fm to 1.6 fm to ensure ground state identification. Disconnected contributions are calculated to an unprecedented accuracy at the physical point. Although they constitute a small correction, they are non-negligible and contribute up to 15% for the case of the neutron electric charge radius.

PACS numbers: 11.15.Ha, 12.38.Gc, 24.85.+p, 12.38.Aw, 12.38.-t
Keywords: Nucleon structure, Nucleon electromagnetic form factors, Disconnected, Lattice QCD

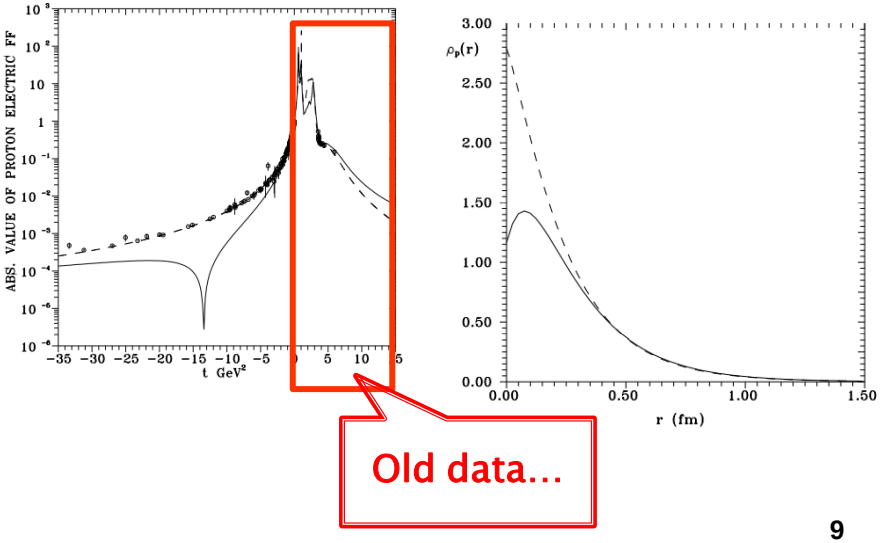
类时FF作为电磁顶点的时间分布振幅，是类空FF的时间对应，即经典电荷分布的傅里叶变换。

利用电磁形状因子的参数计算格点QCD是近年理论的一个主要成就

Unitary and analytic model of nucleon EM structure, the puzzle with JLab proton polarization data and new insight into proton charge distribution

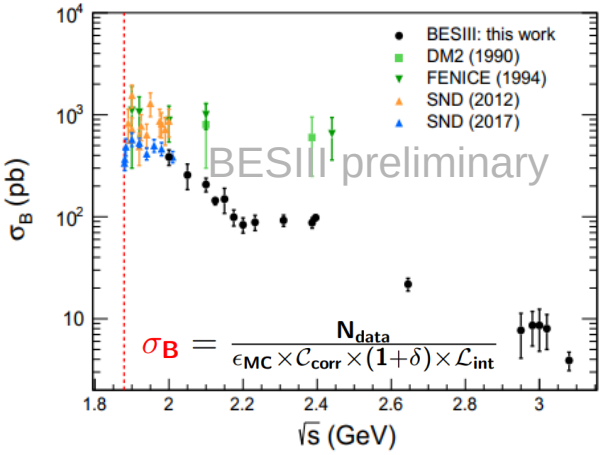
C.Adamuščín[1], S.Dubnička[1], A.Z.Dubničková[2], P.Weisenpacher[3]
[1]Institute of Physics, Slovak Academy of Sciences, Bratislava, Slovak Republic
[2]Department of Theoretical Physics, Comenius University, Bratislava, Slovak Republic
[3]Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovak Republic
June 25, 2018

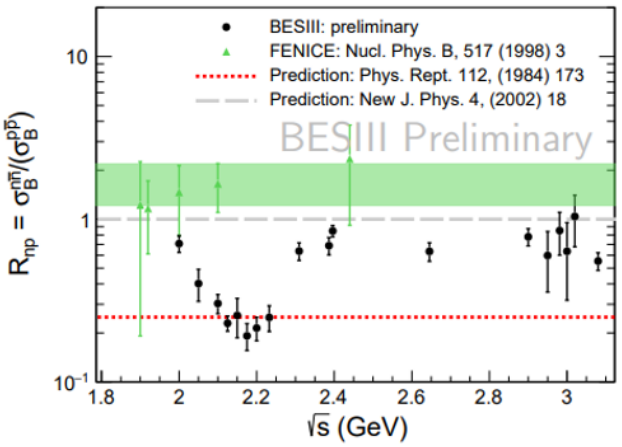
通过Unitary and analytic model联立类时和类空的结果，给出质子半径测量的新结果！

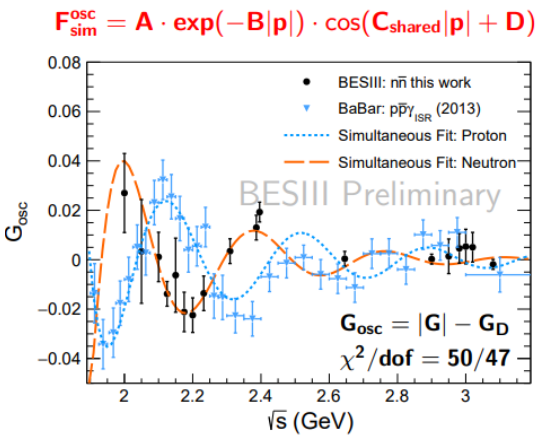


Neutron: Born Cross Section and EMFF ratio

Submitted to Nature Physics







- **Born cross section measured over wide $\sqrt{s}$ with unprecedented precision**
- **Solved the long standing puzzle for between $\gamma - p$ and $\gamma - n$ coupling, essential for pQCD and quark model prediction.**
- **Oscillation of |G| observed in neutron data**

Review reports from NP

Reviewer #1 (Remarks to the Author):

A. Article has new results of outstanding statistical accuracy for the process e+e− to n \bar n.
B. Results are based on novel data and solid analysis method. Article has very useful information for the nucleon form factor physics.
C. [illegible]nt, high quality. However, a bit more could be added to the supplement e.g. the event distribution vs. PHI angle.
Sup[illegible] line [illegible]
brow[illegible]
D. All [illegible]ds. However,
an [illegible]proton and
neutron in energy range below 1 GeV needs to be reviewed (see line 263 of the article).

Reviewer #1:
文章有新的高统计精度的结果。对核子形状因子物理是非常有用的信息。

Reviewer #2 (Remarks to the Author):

In the manuscript, the authors have measured the effective
electromagnetic (EM) form factor of the neutron in the time-
based on the EM process e^+e^− to N \bar{N} in the range bet
sqrt{s} < 3.2 GeV. While there are similar measurements prev
BESIII provides the new results with precise measurements, c
previous other experiments.

The manuscript was clearly written and will be influential i
physics. The two most valuable points of the present manuscr
given as follows: The experimental results they have obtaine
presented in Fig. 2, are remarkable ones in comparison with
experimental data. The data also render several important ph
points. For example, the results for R_{np} contradict the p
measurements by the FENICE Collaboration. This indicates tha
data will surely trigger many theoretical and experimental w
recommend this manuscript to be published in Nature Physics.

Nevertheless, I want to ask a question: The authors wrote th
a[illegible] "This result agrees with the predictio
and [illegible] photon-nucleon interaction puzzle that ha
f[illegible] The BESIII meas
i[illegible] contradicts the former FEN
R_{np}=1.69 +- 0.49>1). However, as noted in Fig. 3(a), Ref.
s[illegible]}<1 [illegible] [10] predicts rat
the BESIII data. The authors should clarify this point.

Once this point is clarified, the manuscript will be suitable for publication in Nature Physics.

Reviewer #2:
文章对强子物理学将产生影响…适合在《自然物理学》上发表

Reviewer #3 (Remarks to the Author):

The article presents the most accurate measurement of the cross section for the production of neutron-antineutron pairs in electron-positron annihilation near the threshold. The scientific novelty of the results obtained is obvious. For the first time in direct measurements, it was possible to obtain the most accurate values of the cross-section e+ e- → n n-bar in the wide energy range from the threshold to 3.08 GeV. Statistical precision was improved by a factor of 60 over the previous measurements.

The [illegible] results are of great interest as they allow to extract energy dependence of the neutron form-factors, revealing the neutron structure. The understanding of the nature of the neutron - one of the building blocks of matter, which still remains not entirely understood theoretically - is certainly a significant and important task.

For the described measurements, a sophisticated method is used to register events of the neutron-antineutron pair production, as neutrons are difficult to detect and to trigger in the modern detectors. However, in spite of complexity the method looks solid thanks to numerous cross-checks that was performed using the BESIII data. In particular, the detector efficiency was extracted not solely from the simulation but also from the data using the reference channel J/psi -> p n-bar pi-, while the trigger efficiency was estimated from the e+e- -> p p-bar events where the trigger was activated by the neutral components. While I have no doubts that both reconstruction and trigger efficiencies are reliably estimated I should comment that the corresponding paragraphs in the "Methods" section is not detailed enough. It is not clear for me, how the difference in passage through the detector material for protons from e+ e- -> p p-bar (deflected by magnetic field and loosing significantly
their energy in the tracker, and thus having much lower "neutral" response) was taken into account for the proper correction of e+ e- -> n n-bar trigger efficiency.

The paper is written quite popularly for non-specialists in the field of Particle Physics to understand. It contains theory introduction, brief description of the BESIII detector, measurement techniques, physical analysis, including systematic errors and discussion of the results.

The obtained results are quite unexpected and surprising: the observed effective form-factors for neutrons differ significantly from those for protons. Thus, the originality and significance of the presented analysis is beyond doubt. The formulated conclusions are based on a unprecedented (for this energy range) amount of processed data of integrated luminosity of 647.91/pb from electron-positron annihilation collected at the BESIII experiment and do not raise doubts about [illegible]

State[illegible] obtained is a thorou[illegible] results is confirmed by a good agreement of the obtained values with the measurements of the previous experiments but with much higher precision.

The manuscript contains 44 bibliographic items including references to all related previous studies of BESIII and other experiments, such as DM2, FENICE, SND and BaBar. The paper is written in good language and is easy to read. It is reasonably structured, contains rich illustrative material, a detailed description of the proposed methods and measurements performed, demonstrates the authors deep knowledge of the methods and techniques of modern experiments, as well as confident knowledge of data analysis methods.

In summary I'd like to recommend the manuscript for publication in Nature Physics. However, I also recommend to ask authors to extend slightly the "Method" section to describe in more details the reconstruction and trigger efficiency corrections. In particular it might be helpful for readers to understand how the difference in kinematics for the studied (e+e- -> n n-bar) and reference (J/psi -> p n-bar pi-) processes was taken into account, as well as how the electromagnetic impact of the detector (dE/dx losses and electromagnetic field) on e+e- -> p p-bar events biases the "neutral" trigger response with respect to e+e- -> n n-bar.

Reviewer #3:
文章所得结果的科学新颖性是显而易见的…
推荐在《自然物理学》上发表

Received on 2020.11.23

研究工作二：重子对阈值截面测量

Hyperon FFs near threshold

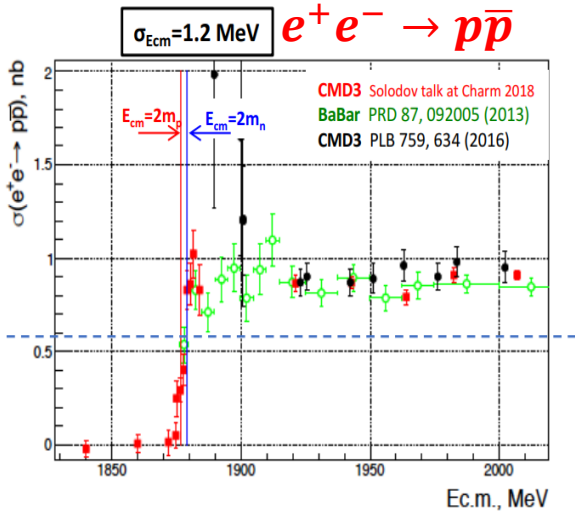
- The Born cross section for $e^+e^- \to \gamma^* \to B\bar{B}$:

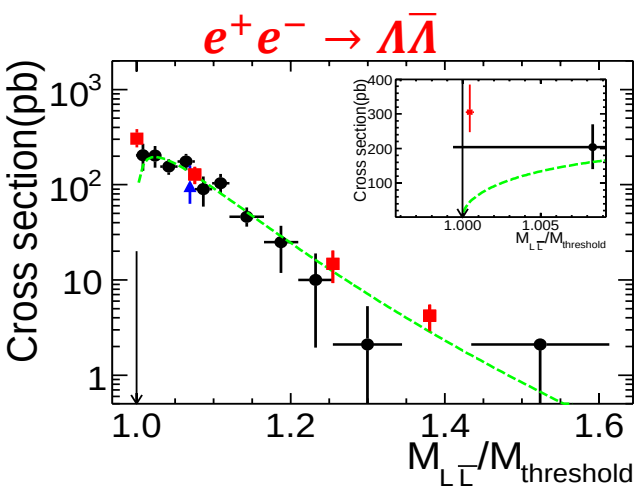
$$\sigma_{B\bar{B}}(q) = \frac{4\pi\alpha^2 C\beta}{3q^2}\left[|G_M(q)|^2 + \frac{1}{2\tau}|G_E(q)|^2\right]$$

- Coulomb factor (under point-like hypothesis):

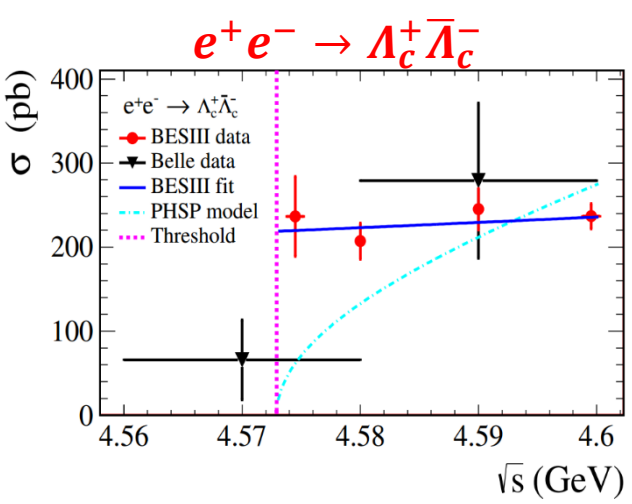
Charged $B\bar{B}$: $C=\frac{\pi\alpha}{\beta}\frac{1}{1-exp\,(-\frac{\pi\alpha}{\beta})}$; Neutral $B\bar{B}$: C=1

- Near threshold, abnormal threshold effects are observed for proton, Λ, Λ_c^+ pair.





PRD 97, 032013(2018)

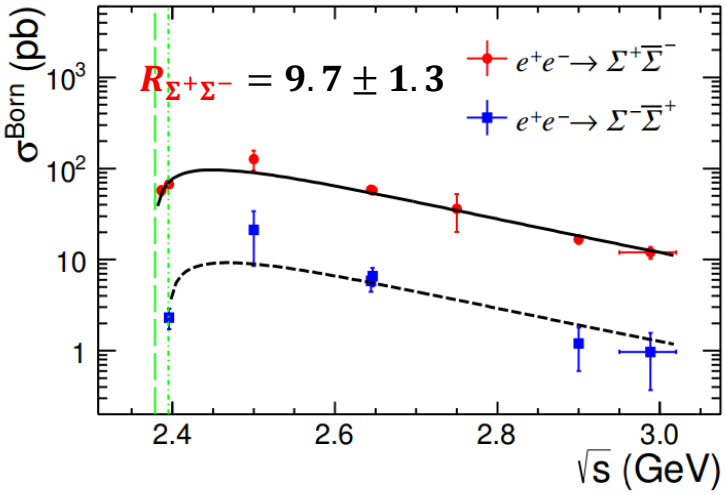


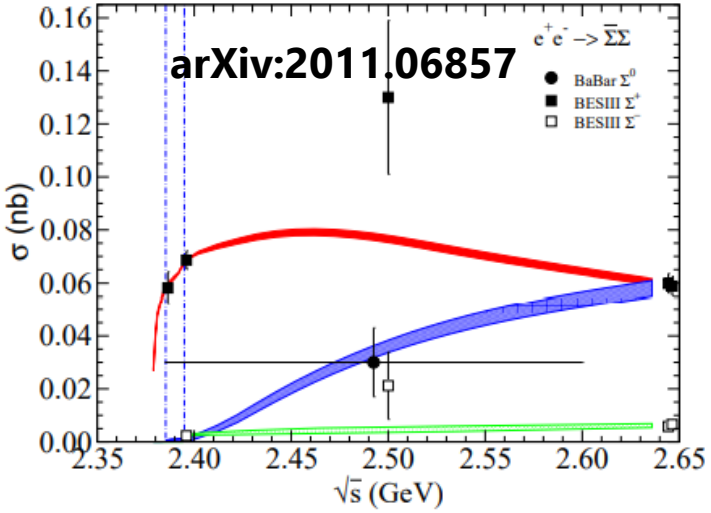
PRL 120, 132001(2018)

Born Cross sections: $\Sigma^+\bar{\Sigma}^-$ and $\Sigma^-\bar{\Sigma}^+$

arXiv:2009.01404

- The cross sections can be well described by pQCD-motivated functions
  - Why no threshold effect observed for Σ ?
  - Why pQCD described so well near threshold? Non point-like under the Compton wavelength ~0.1 fm
- The results draw attention from theory discussion

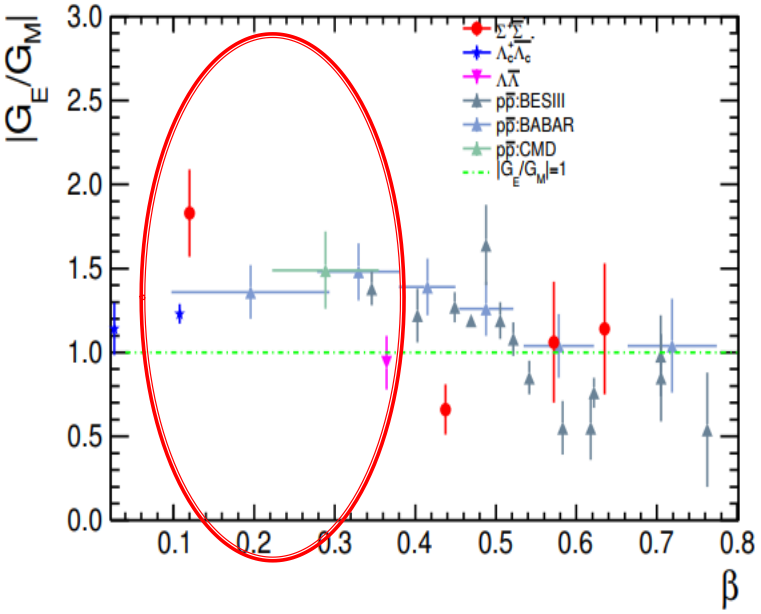


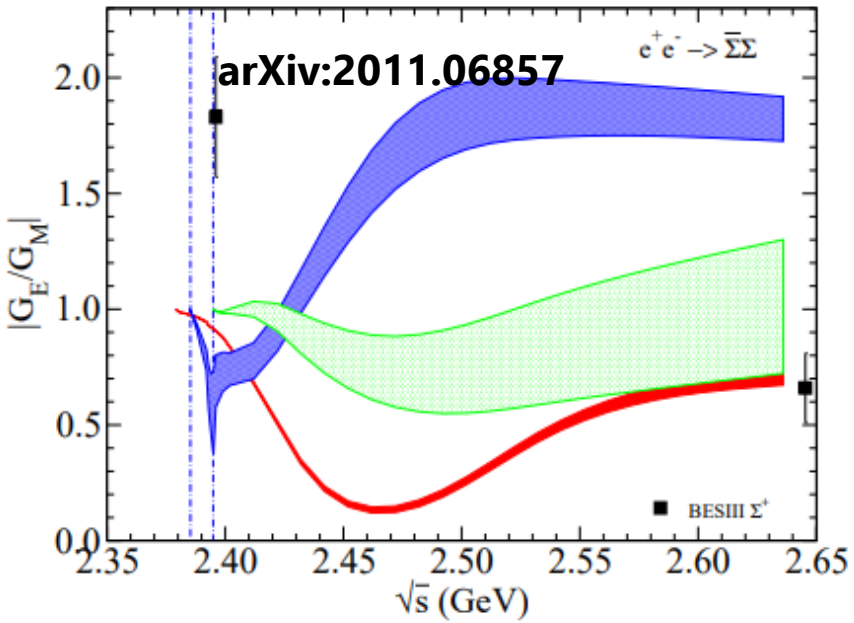


EMFF ratio of Σ^+

arXiv:2009.01404

- The $|G_E/G_M|$ shows similar distributions among current available baryon data $(p, \Lambda, \Sigma^+, \Lambda_c^+)$ in TL region
- Exotic contributions like near-threshold D-wave resonances might provide such drastic effects
- Disagreement with theoretical prediction

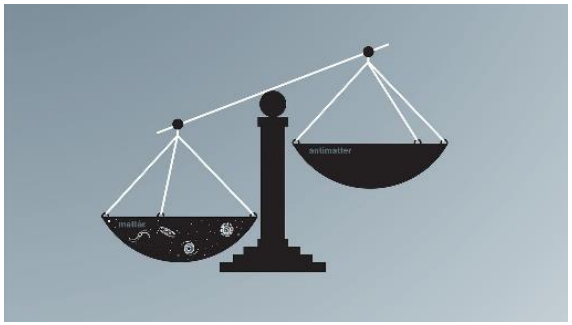




研究工作三：超子CP破坏和稀有衰变寻找

CPV of hyperon with 10Billion J/ψ

Matter asymmetry of universe



- The CPV discovered in meson sector. Consistent with CKM theory in SM.
- CPV in baryon system?
  - ◇ SM predict CPV in hyperon decay $10^{-4} \sim 10^{-5}$
  - ◇ With 1.3 Billion J/ψ collected at BESIII, the CPV of Λ is studied with spin correlation via $J/\psi \to \Lambda\bar{\Lambda}$, to be 10^{-2}
  - ◇ BESIII has accumulated 10 Billion J/ψ Events!
- CPV via $J/\psi \to \Xi^-\bar{\Xi}^+$ (ongoing analysis)
  - ◇ Two channels are reconstructed

$$\Lambda(\to p\pi^-)\pi^-\bar{\Lambda}(\to \bar{n}\pi^0)\pi^+$$

$$\Lambda(\to n\pi^0)\pi^-\bar{\Lambda}(\to \bar{p}\pi^+)\pi^+$$

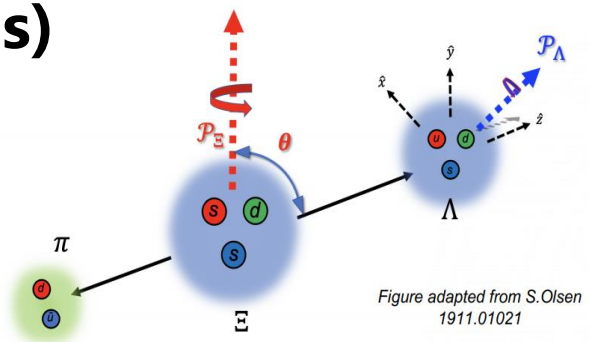
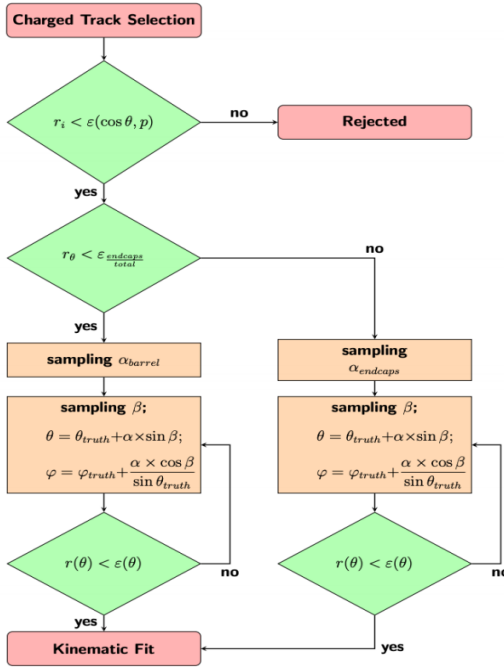


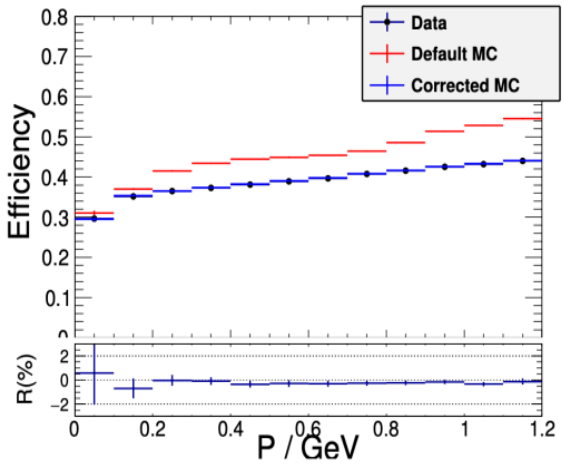
Figure adapted from S.Olsen 1911.01021

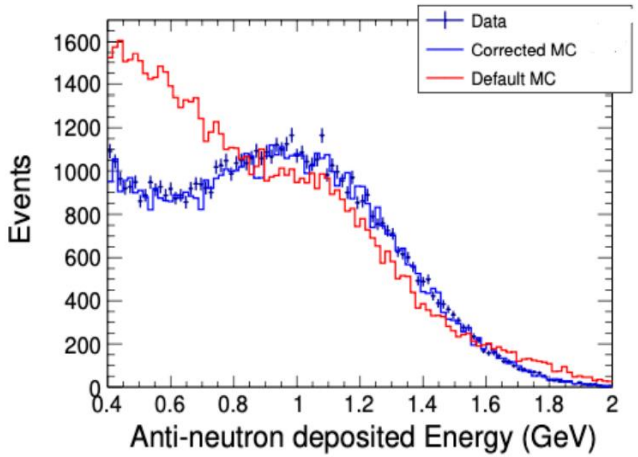
  - ◇ Four independent CPV can be tested with higher sensitivity!

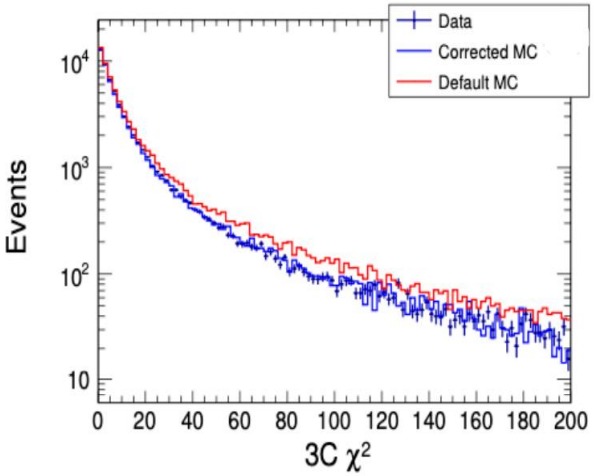
Correction of $\bar{n}$ in MC Simulation

- In the hyperon physics, $\bar{n}$ is an important final state
- The MC simulation is not satisfying
- An algorithm with data-driven method is developed to correct MC simulation
- The difference between corrected MC and data is ~1% now



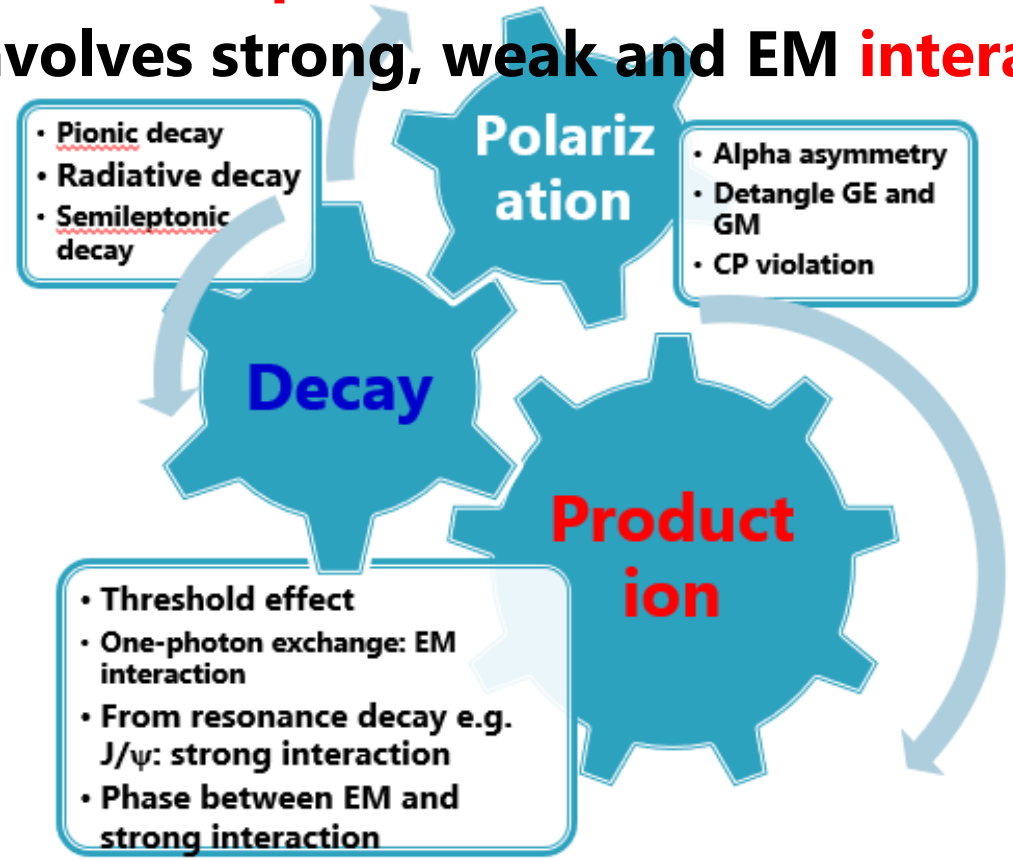






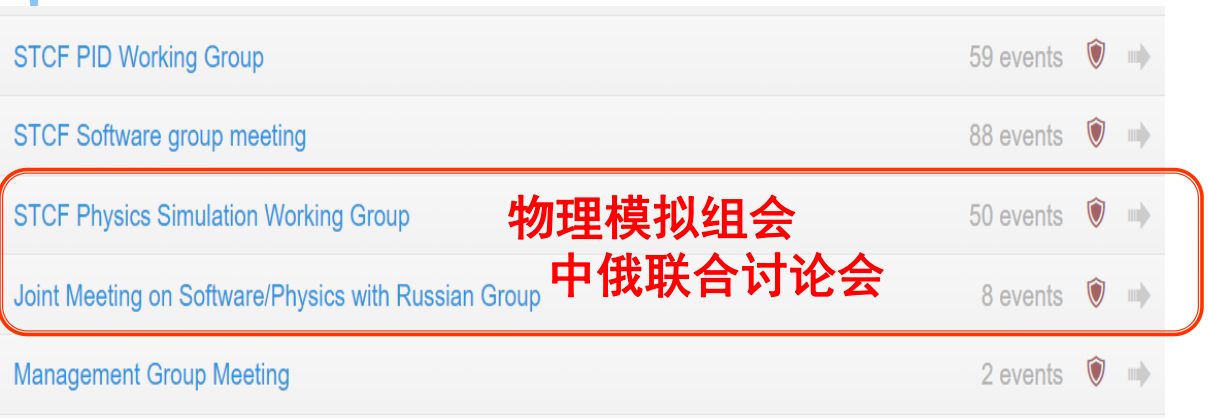
Experimental Searches of Baryon at BESIII

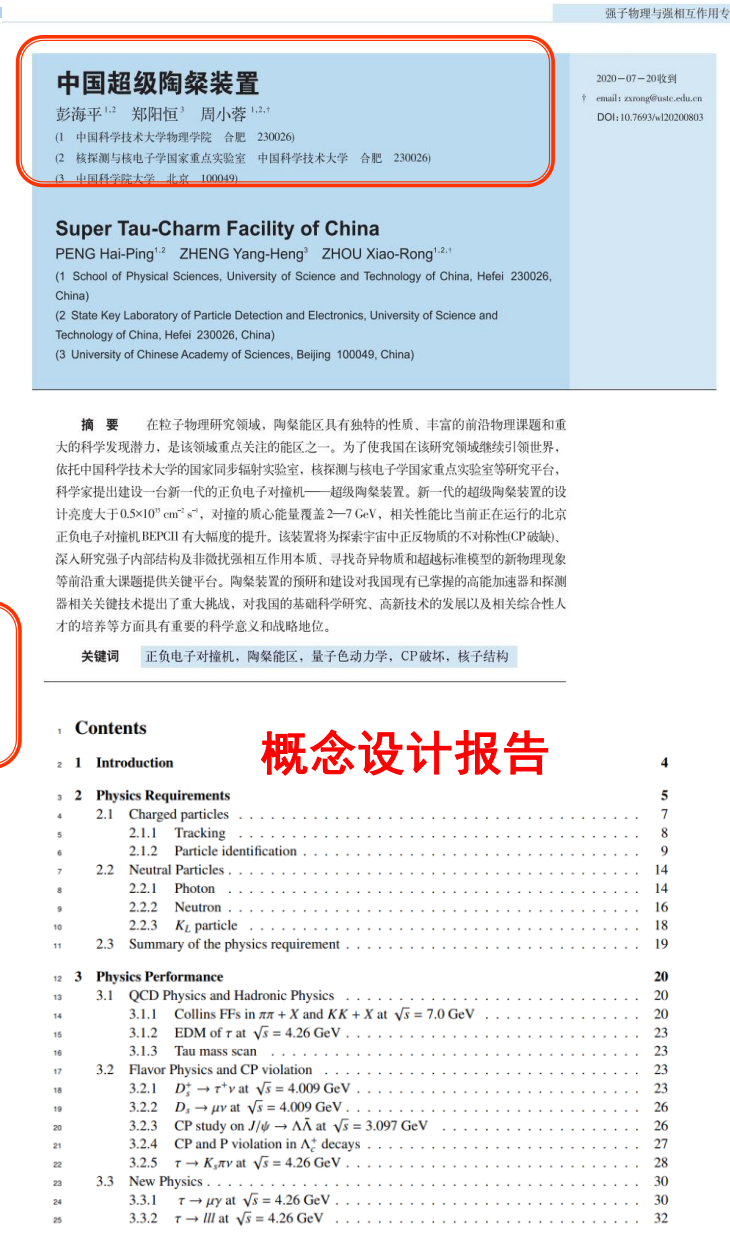
- **Threshold** produce for baryon pairs
- Large **statistics** at resonance decay
- **Spin-correlation**, **polarization**
- **Decay** involves strong, weak and EM **interaction**



担任STCF物理模拟组负责人

- 组织组会、中俄联合讨论会
- 撰写《物理》强子物理与强相互作用专题
- 探测器概念设计报告，负责撰写物理需求和物理展望部分
- 组织国内/国际各种研讨会




强子物理与强相互作用专题

中国超级陶粲装置

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Super Tau-Charm Facility of China

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(3 University of Chinese Academy of Sciences, Beijing 100049, China)

摘 要 在粒子物理研究领域，陶粲能区具有独特的性质、丰富的前沿物理课题和重大的科学发现潜力，是该领域重点关注的能区之一。为了使我国在该研究领域继续引领世界，依托中国科学技术大学的国家同步辐射实验室，核探测与核电子学国家重点实验室等研究平台，科学家提出建设一台新一代的正负电子对撞机——超级陶粲装置。新一代的超级陶粲装置的设计亮度大于0.5×10^{35} cm^{-2} s^{-1}，对撞的质心能量覆盖2—7 GeV，相关性能比当前正在运行的北京正负电子对撞机BEPCII有大幅度的提升。该装置将为探索宇宙中正反物质的不对称性(CP破缺)、深入研究强子内部结构及非微扰强相互作用本质、寻找奇异物质和超越标准模型的新物理现象等前沿重大课题提供关键平台。陶粲装置的预研和建设对我国现有已掌握的高能加速器和探测器相关关键技术提出了重大挑战，对我国的基础科学研究、高新技术的发展以及相关综合性人才的培养等方面具有重要的科学意义和战略地位。

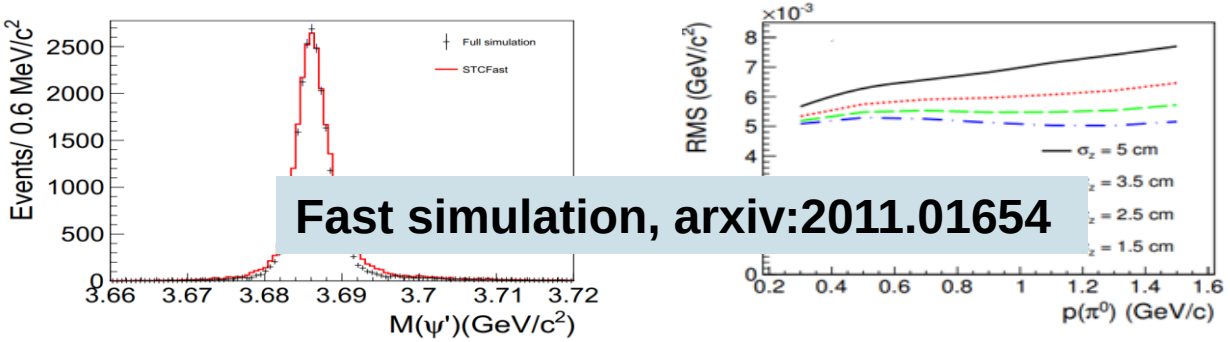
关键词 正负电子对撞机，陶粲能区，量子色动力学，CP破坏，核子结构

概念设计报告

Contents

Physics Prospect at STCF

- 开发快模拟算法，并开展各项物理过程模拟



- **Prospect with 1 year data taking**

Physics	Process	Stat. Sensitivity	Detector optimization
Collins effect	$e^+e^- \to \pi\pi + X$, $e^+e^- \to KK + X$	(2~7)× 10^{-4} (7~20)× 10^{-4}	K/π mis-id 1% at 2 GeV/c
|Vcs|, fDs, LU	$D_s^+ \to l^+ \upsilon_l$ $(l = \mu, \tau)$	(0.29~0.4)%	Efficiency of low-momentum ↑
Strong phase	$D_0 \to K_{s/L}\pi^+\pi^-$	-	K_L identification
CPV in tau	$\tau^- \to K_s\pi^-\upsilon_\tau$	9.7× 10^{-4}	π/μ mis-id 3%
CPV in hyperon	$J/\psi \to \Lambda\bar{\Lambda}$	3× 10^{-4}	$\bar{n}$ identification
cLFV in tau	$\tau \to \gamma\mu, \tau \to 3\text{leptons}$	(1.4~17)× 10^{-9}	π/μ mis-id 3% Position res. at EMC 4mm
γ polarization	$D \to K_1 l^+ \nu$	-	

项目、发表文章、国际会议及其他

承担科研项目情况

起止年月	项目名称	项目来源	总经费	主持/参与
19.01-21.12	Σ超子的电磁形状因子和相位角测量	国家自然科学基金-联合基金面上项目	54万	主持
19.01-21.12	奇异重子的研究	国家自然科学基金-国际合作与交流项目	39.7万	主持
21.01-25.12	北京谱仪BESIII上强子产生截面测量和强子结构研究	国家自然科学基金-重点项目	330万	骨干

已发表的论文 (作为主要贡献者)

1. M. Ablikim et al.,(BESIII Collaboration) “Measurement of proton electromagnetic form factors in $e^+e^- \to p\bar{p}$ in the energy region 2.00 – 3.08 GeV”, Phys. Rev. Lett. 124, 042001 (2020).

本人贡献：是本人博士论文课题的延续，基本实验方法的确定，合作并指导研究生完成整个分析工作，文章撰写及修改，回答合作组和杂志评审人的问题

2. M. Ablikim et al.,(BESIII Collaboration) “First measurements of $\chi_{cJ} \to \Sigma^-\bar{\Sigma}^+$ decays”, Phys. Rev. D 101, 092002 (2020).

本人贡献：选题，整个实验方法的确定，合作并指导研究生完成整个分析工作，文章撰写及修改，回答合作组和杂志评审人的问题

项目、发表文章、国际会议及其他

已投稿的论文

1. M. Ablikim et al.,(BESIII Collaboration) “New features in the electromagnetic structure of the neutron”, submitted to Nature Physics **(three referee response positive)**.

本人贡献：是本人博士论文课题的延续，担任课题召集人，独立完成第二种方法的所有实验分析（共三种），文章撰写及修改，回答合作组评审人问题

2. M. Ablikim et al.,(BESIII Collaboration) “Measurements of $\Sigma^+$and Σ^- time-like electromagnetic form factors for center-of-mass energies from 2.3864 to 3.0200 GeV”, submitted to Phys. Lett. B.

本人贡献：选题，独立完成所有实验分析，文章撰写及修改，回答合作组评审人问题

3. “A fast simulation package for STCF detector”, submitted to JINST.

合作组审核工作

- Precise cross section measurement of $e^+e^- \to \pi^+\pi^-\psi(3686)$ with XYZ data, BAM-00397
- Cross section measurement of $e^+e^- \to \Sigma^0\bar{\Sigma}^0$ from threshold to 3.02 GeV, BAM-00441
- Precision cross section measurement of $e^+e^- \to \Lambda_c^+\bar{\Lambda}_c^-$ near threshold, BAM-00453
- First measurement of $J/\psi \to \Sigma^-\bar{\Sigma}^+$, BAM-00476

项目、发表文章、国际会议及其他

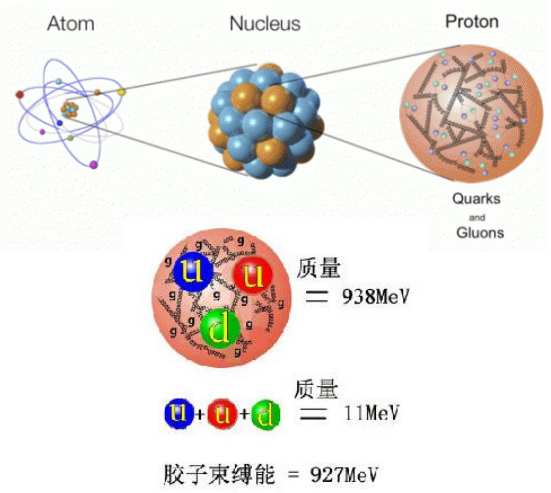
- **国际会议大会报告**

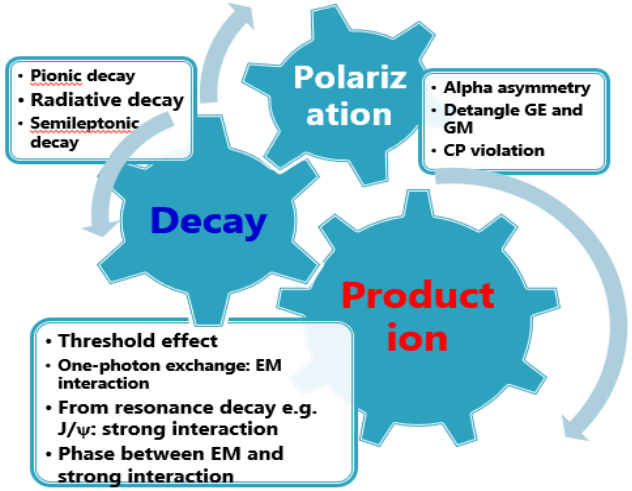
1. 2020.10.2, “BESIII physics and future tau-charm factories”, Snowmass 2020: Rere Processes and Precision Frontier Townhall Meeting, **Invited plenary talk**, online
2. 2020.7.23， “Tau LFV decay: Super Tau Charm Facility”, Snowmass 2020 CLFV workshop, online
3. 2020.11.16-18, “Progress of physics simulation at STCF”, Joint International Workshop for Super-Charm Tau Facility, 2020, online
4. 2019.12.16-2019.12.19, “Status of the STCF project in China”, BINP-IHEP seminar “Tau and QCD physics at present and future e^+e^- colliders”, Novosibirsk, Russia

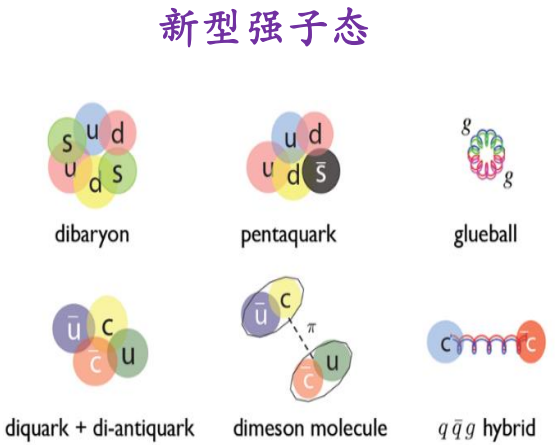
- 协助指导学生：Muzaffar Irshad, 2020.6博士毕业，博士论文《Measurement of B($\chi_{cJ} \to \Sigma^-\bar{\Sigma}^+$) and Study of $e^+e^- \to \Sigma^0\bar{\Sigma}^0$ at BESIII》

未来工作计划

- 进一步精确研究形状因子，并开展夸克碎裂函数测量理解核子内部结构
- 精确测量涉及重子产生、衰变和极化的一系列物理课题，并与理论相结合，从而加强对粒子相互作用的理解！
- 研究类粲偶素和奇异偶素能谱，寻找奇特态粒子，检验和理解QCD
- 加强实验与理论的沟通与合作！！！







总结

- 过去的一年内，发表两篇文章（PRL，PRD)，投稿三篇（Nature Physics, PLB, JINST）
  - 类时空间最精确的质子电磁形状因子，对理解核子内部结果提供重要实验结果，对理论模型给出严格的约束
  - 类时空间最精确的中子电磁形状因子，解决长期以来光子-核子耦合的困惑
  - Σ重子近阈截面的测量，截面谱与pQCD符合。但EMFF ratio在阈值附近显著大于1，与理论预期不符
- 主持两项科研项目，参与一项，四次国际会议上做报告
- 担任BESIII合作组tau-QCD组负责人，积极推动组内各项工作
- 负责STCF的物理模拟，组织国内及国际研讨会

感谢各位老师！
请各位老师批评指正