环形正负电子对撞机简报

CIRCULAR ELECTRON POSITRON COLLIDER NEWSLETTER

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【本期导读】

湖南大学完成 CEPC 落户长沙论证报告

2021 年 9 月 4 日，《中国（长沙）环形正负电子对撞机暨国际科学新城项目论证报告》专家评审会在湖南长沙市举行。会议采用现场和线上相结合的形式。受长沙市科技局委托，湖南大学组织撰写了该论证报告并顺利召开了专家评审会。

长沙市科技局和湖南大学的有关领导出席了此次会议。来自北京大学、清华大学、上海交通大学，南开大学和湖南省当地高校及其它研究单位的物理，经济，建筑和政策研究等不同领域的专家组成了评审专家组。专家组高度肯定了湖南省、长沙市对推动建造 CEPC 大科学装置及科学新城项目的前瞻性和积极性，经过论证评议一致通过了《中国（长沙）环形正负电子对撞机暨国际科学新城项目论证报告》并提出了进一步的修改意见。

今年 6 月 15 日，长沙市人民政府办公厅发布了长沙市“十四五”科技创新发展规划（2021-2025 年）的通知。在争创重大科技基础设施方面，该规划明确提出：采取“省、市、校”共建模式，谋划建设环形正负电子对撞机 (CEPC)、新型同步辐射光源等大科学装置，力争在大科学装置建设领域实现零的突破。7 月初，湖南大学积极响应政府号召正式成立了 CEPC 项目工作小组，以物理与微电子科学学院为核心，联合了工商管理学院，经济贸易学院和建筑学院相关人员力量，先后访问调研了中科院高能物理研究所，怀柔国家综合性科学中心，中南勘探设计院，合肥国家综合性科学中心，合肥离子医学中心和中国科技大学等地，获取了大科学装置项目的相关资料和信息。项目工作小组经过近两个月的努力，撰写完成了 200 多页的近 10 万字的《中国（长沙）环形正负电子对撞机暨国际科学新城项目论证报告》。至此，湖南省长沙市成为中国 CEPC 项目候选建设地址中首个完成落户论证报告的城市。

湖南大学高能物理组成员戴凌云教授，俞洁晟助理教授，程山助理教授和张书磊助理教授作为工作小组的核心成员，撰写了论证报告的物理相关章节内容，并负责了整个工作小组的内部学习与沟通，对外联系等统筹工作，保证了该论证项目的顺利实施。目前，该论证报告已经正式提交给长沙市科技局，为 CEPC 落户长沙的后续工作打下了坚实基础。

《中国 (长沙) 环形正负电子对撞机暨国际科学新城项目论证报告》专家评审会
‘China (Changsha) Circular Electron Positron Collider and International Science New City Project Demonstration Report’ review meeting

Hunan University Completes the Demonstration Report of CEPC Settlement in Changsha

On September 4, 2021, an expert review meeting of the ‘China (Changsha) Circular Electron Positron Collider and International Science New City Project Demonstration Report’ was held in Changsha, Hunan. The meeting adopted the form of on-site and online. Entrusted by the Changsha Science and Technology Bureau, Hunan University organized and wrote the demonstration report and successfully held the meeting.

Relevant leaders from Changsha Science and Technology Bureau and Hunan University attended the meeting. Experts from the fields of physics, economics, architecture and policy research including Peking University, Tsinghua University, Shanghai Jiaotong University, Nankai University and local universities and other research units in Hunan formed an evaluation group. The group highly affirmed the forward-looking and enthusiasm of Hunan and Changsha in promoting the construction of the CEPC large scientific facility and the new science city project. After demonstration and evaluation, the group unanimously passed the 'Demonstration Report of China (Changsha) Circular Electron Positron Collider and International Science New City Project' and proposed further amendments.

On June 15 this year, the General Office of the People's Government of Changsha issued a notice on the "14th Five-Year Plan" for the Development of Science and Technology Innovation (2021-2025) in Changsha. In terms of striving for major scientific and technological infrastructure, the plan clearly proposes: adopting the “province, city, and school” co-construction model to plan the large scientific facilities such as the Circular Electron Positron Collider (CEPC) and the new synchrotron radiation light source to achieve zero breakthroughs in the construction of the large scientific facilities. In early July, Hunan University actively responded to the government to formally set up the CEPC project working group, with the School of Physics and Electronics as the core, combined with the Business School , the School of Economics and Trade, and the School of Architecture. They visited and investigated the Institute of High Energy Physics, Chinese Academy of Sciences, Huairou Comprehensive National Science Center, Central South Survey Design Institute, Hefei Comprehensive National Science Center, Hefei Ion Medical Center, and University of Science and Technology of China successively. They have obtained the relevant materials and information about the large scientific projects. After nearly two-month hard work, the project team has completed the "China (Changsha) Circular Electron Positron Collider and International Science New City Project Demonstration Report" with more than 200 pages of nearly 100,000 words. So far, Changsha ,Hunan has become the first city among the candidate construction sites in China of CEPC project to complete the settlement demonstration report.

Professor Dai Lingyun, Assistant Professor Yu Jiesheng, Assistant Professor Cheng Shan and Assistant Professor Zhang Shulei, members of the High Energy Physics Group of Hunan University, as the core members of the working group, wrote the physics-related chapters of the demonstration report, and were responsible for the internal learning and communication of the whole group, external relations and other overall work to ensure the smooth implementation of the demonstration project. At present, the demonstration report has been formally submitted to the Changsha Science and Technology Bureau, which lays a solid foundation for the follow-up work of CEPC settled in Changsha.

CEPC 650 MHz 超导腔模组样机完成系统集成和低温实验

为了验证 CEPC 超导高频系统的关键技术，在先进光源技术研发与测试平台项目（PAPS）的支持下，CEPC 超导高频研究团队从 2017 年开始了 CEPC 650 MHz 超导加速腔模组样机的研制，该样机包括了 2 只 650 MHz 2-cell 超导腔及附属设备。

这台样机是世界上首个 650 MHz 超导腔模组，采用了多项先进技术：高 Q、高梯度的 650 MHz 2-cell 超导腔，在国内首次采用了大功率宽带高阶模耦合器，采用先进复合材料的宽带大功率高阶模吸收器等等。2021 年 3 月，模组样机开始了系统集成；5 月运往怀柔 PAPS 实验室，并装到了加速器的束线上；6 月完成了 2K 下的低温实验，各项性能指标（频率、真空度、耦合度）均满足要求。

650 MHz 超导加速腔模组样机的研制成功为 CEPC 超导高频系统 TDR 阶段的预研奠定了坚实的基础，对于其它类似加速器超导高频系统的研制也具有重要意义。

650 MHz 超导腔腔串
String of 650 MHz superconducting cavities

650 MHz 超导腔模组样机（包含 2 个 650 MHz 2-cell 超导腔及附属设备）
Prototype of 650 MHz cryomodule, which consist of two 650 MHz 2-cell Superconducting cavities and accessories.

CEPC 650 MHz Superconducting Cavity Module Prototype Completes the System Integration and Low Temperature Experiments

Funding by Platform of Advanced Photon Source Technology R&D (PAPS), CEPC SRF group began to develop the prototype of CEPC 650 MHz cryomodule in 2017, aiming to verify key technologies of CEPC SRF system. The prototype consists of two 650 MHz 2-cell cavities and accessories.

This prototype is the first cryomodule of 650 MHz in the world. Many advanced technologies are adopted: 650 MHz 2-cell cavity with high Q & gradient, high-power and broadband HOM coupler, high-power and broadband HOM absorbers made of advanced composite, etc. In March 2021, the prototype began the integration. Then, it was shipped to PAPS lab and installed in the beamline in May. The cryogenic performance of the prototype was qualified at 2.0 K in June, and the specs were all reached.

Development of this prototype is successful, which lay the foundation of research during CEPC SRF TDR. It can be referred to SRF system of other similar accelerators, too.

CEPC 650 MHz 大晶粒超导腔入选国家“十三五”科技创新成就展

国家“十三五”科技创新成就展（以下简称“成就展”）于 10 月 21 日至 27 日在北京展览馆开展，CEPC 650MHz 大晶粒超导腔入选成就展。此外，中国科学院高能物理研究所主导和参与的多项成果也成功入选，包括中国散裂中子源、高海拔宇宙线观测站、高能同步辐射光源、天宫二号“天极”望远镜、“慧眼”卫星、“怀柔一号”卫星、西藏羊八井 ASgamma 实验等。

本次成就展以“创新驱动发展 迈向科技强国”为主题，体现“创新是引领发展的第一动力”，全面展示“十三五”以来，贯彻落实党中央和国务院关于科技工作的重大决策部署，深入实施创新驱动发展战略、建设创新型国家所取得的重大成就，彰显科技创新在我国经济社会发展中的重要支撑引领作用。

在“十三五”科技创新成就展现场的 CEPC 650MHz 大晶粒超导腔
CEPC 650MHz large-grain superconducting cavity in the National "Thirteenth Five-Year"
Science and Technology Innovation Achievement Exhibition

CEPC 650 MHz Large-grain Superconducting Cavity Selected for the National "Thirteenth Five-Year" Science and Technology Innovation Achievement Exhibition

The National "Thirteenth Five-Year" Science and Technology Innovation Achievement Exhibition (hereinafter referred to as the "Achievement Exhibition") was held at the Beijing Exhibition Hall from October 21 to 27. The CEPC 650MHz large-grain superconducting cavity was selected for the Achievement Exhibition. In addition, a number of results achieved by or with the participation of the Institute of High Energy Physics, Chinese Academy of Sciences have also been successfully selected, including CSNS, LHAASO, HEPS, POLAR TG-2, HXMT, GECAM, Tibet Yangbajing ASgamma experiment, etc.

The theme of this achievement exhibition is "Innovation-driven development towards a powerful country in science and technology", which reflects "Innovation is the first driving force for development". Since the "13th Five-Year Plan", it comprehensively demonstrates the implementation of the important policies and deployments of science and technology by the government, and shows the major achievements in building an innovative country. It also demonstrates the important supporting and leading role of scientific and technological innovation in country’s economic and social development.

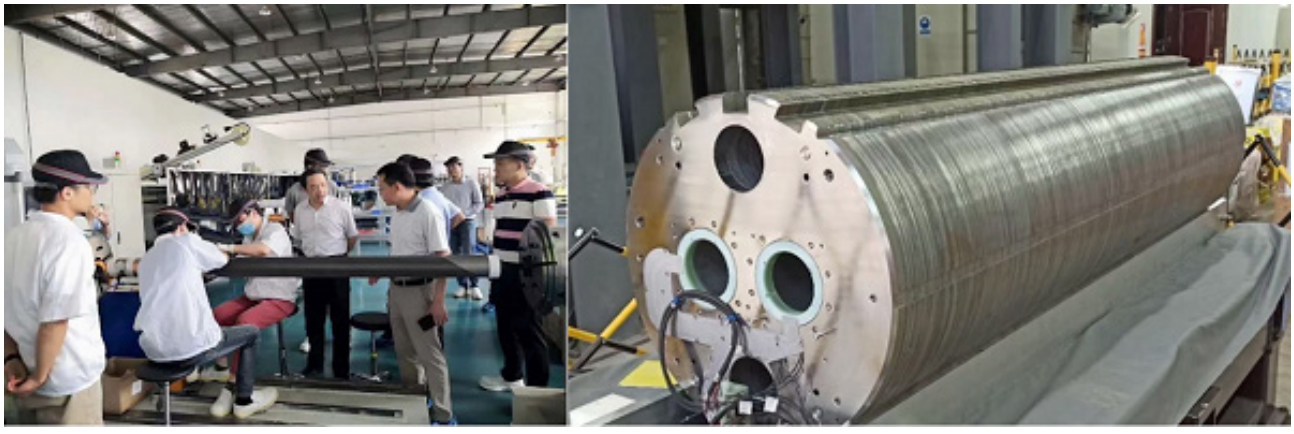
首套 HL-LHC CCT 超导磁体发往欧洲

中国团队为欧洲核子研究中心 (CERN，Conseil Européenn pour la Recherche Nucléaire) 大型强子对撞机亮度升级项目（HL-LHC，High-Luminosity Large Hadron Collider）研制的首套正式斜螺线管型 (CCT, Canted-Cosine-Theta) 双孔径超导磁体，在通过 4K 环境下磁场强度、磁场质量，以及多次 4 小时运行稳定性测试后，10 月 18 日启程发往欧洲；该磁体将首先运送至瑞典乌普萨拉大学 (Uppsala University) 进行 1.9K 性能复测，然后发往 CERN 等待后续组装工作。

2020 年中国团队完成 CCT 磁体全尺寸样机的研制及国内 4K 性能测试；样机于 2020 年 9 月发往 CERN 进行 1.9K 性能复测，12 月份 CERN 完成各项测试，确认达到设计指标，验证了国内 CCT 磁体技术及工艺路线的可靠性。正式磁体的研制于 2020 年年中开始，为改善磁体样机性能测试时过多的失超锻炼次数，首套 CCT 磁体研制尝试采用了新的超导线圈制作工艺；与原工艺相比，将每个孔径到达设计电流前的失超锻炼次数缩减至一半左右，大幅度降低了磁体初次性能测试的时间及经济成本，同时场质量误差达到了 0.05% 以内。后续磁体的制作将基于该新工艺，同时进行更严格的质量管控，以进一步提升磁体锻炼特性。

HL-LHC CCT 超导磁体项目由中科院高能物理所牵头，联合中科院近代物理所及西部超导、八匹马超导、高能锐新、合肥科烨等国内相关企业，完成 1 台全尺寸样机加 12 台正式磁体的研制任务；交付 CERN 后，与 HL-LHC 项目中其它性能升级的装备一起，将 LHC 加速器对撞亮度提高 5 倍；磁体在两个孔径内分别产生一个水平方向及一个垂直方向的偏转磁场，孔径 105mm，孔中心间距 188mm，运行电流为 394A，每个孔径可提供 5Tm 的积分场，用于控制束流轨道的交叉角和轨道偏差。HL-LHC CCT 磁体将是新型 CCT 结构的超导磁体首次应用于在运行的粒子加速器中。

CCT 型超导磁体相较于传统的加速器磁体，具有结构及制作工艺简单、制作成本低等特点，有望在未来建设的对撞机等大科学装置或医用重离子 / 质子治癌项目上得到更广泛的应用。



图一：首套 HL-LHC CCT 磁体研制完成并通过 4K 性能测试
Figure 1：Development of the 1st set HL-LHC CCT magnet, l)coil fabrication; r)magnet after assembly

The first set HL-LHC CCT magnet delivered to Europe

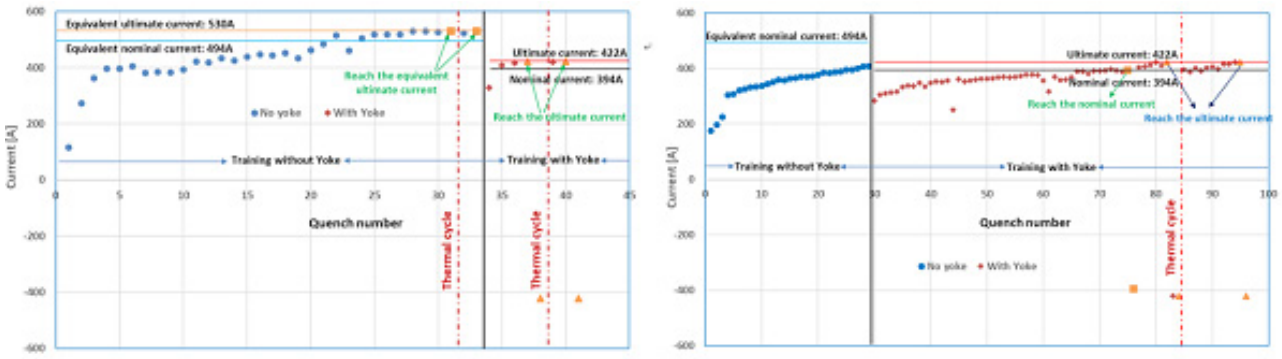
The first set of the dual-aperture Canted Cosine-Theta type (CCT) superconducting magnet, developed in China for the luminosity upgrade project of the Large Hadron Collider (HL-LHC) at CERN, was delivered to Europe on October 18 2021, after passing the 4K performance test including magnetic field strength, magnetic field quality, and multiple 4-hour operational stability demonstration. The magnet will be shipped first to Uppsala University in Sweden to conduct a performance retest at 1.9K, and then to CERN to wait for subsequent assembly work.

In 2020, the Chinese team completed the development of a full-scale prototype CCT magnet and 4K performance test; the prototype was sent to CERN in September 2020. In December 2020, CERN completed various tests at 1.9K, confirming that it reached the design

objective. The development of series CCT magnets began in mid-2020. In order to improve the training performance of the magnet, the first set of CCT magnets was developed using a new manufacturing process. The number of quench of the new aperture to reach the design current is reduced to about half, greatly reduces the time and economic cost of the initial performance test of the magnet, and the field quality error is within 0.05%. The subsequent production of magnets will be based on this new process, and more strict quality control will be carried out to further improve the performance of the magnets.

The HL-LHC CCT superconducting magnet project is led by the Institute of High Energy Physics of the Chinese Academy of Sciences (IHEP), in collaboration with the Institute of Modern Physics of the Chinese Academy of Sciences (IMP), Western Superconducting Technologies Co. Ltd, Bama Superconducting Technology Co. Ltd, HE-Rising Co. Ltd, Hefei Keye Co. Ltd and other related companies. The project team will develop 1 prototype and 12 sets of series magnets for HL-LHC. Together with other upgraded equipment in the HL-LHC project, the luminosity of the LHC accelerator is expected to be increased by 5 times than before. The magnet produces 5 Tm integrated dipole field in horizontal direction and vertical direction in the two apertures respectively, to control the beam orbit crossing angle and orbit deviation. The aperture diameter is 105mm, with a distance of 188mm between two apertures.

The HL-LHC CCT magnets will be the first time a CCT-type superconducting magnet being used in a particle accelerator. Compared with traditional accelerator magnets, CCT-type superconducting magnets have the characteristics of simple structure and manufacturing process, and low manufacturing cost. They are expected to be more widely used in large-scale scientific facilities or medical heavy ion/ proton cancer treatment facilities in the future.



图二：采用新工艺 (左) 与样机原工艺 (右) 的线圈失超锻炼过程曲线对比

Figure 2: Comparison of the coil quench training process curve using the new process (left) and the original process of the prototype (right)

图三：磁体打包发往欧洲

Figure 3: The magnet is packaged and sent to Europe

CEPC 漂移室模拟取得重要进展

为了在 CEPC 实验上精确测量 Higgs 玻色子的属性，需要实现高精度的带电粒子径迹重建和粒子鉴别。为此，CEPC 实验提出了漂移室结合硅探测器的探测器设计方案。该方案采用漂移室原初电离计数（Cluster Counting） 方法，可以在保证径迹重建性能前提下，实现高精度的粒子鉴别。为了验证方案的可行性，研发漂移室单元内的探测器响应模拟软件至关重要。

目前正在开发的 CEPC 实验软件（CEPCSW） 采用 Gaudi 作为软件框架，研究团队已经实现了主要的软件功能，可以支持探测器模拟、事例重建和物理分析。并且，CEPCSW 和未来实验公共软件 Key4HEP 也有深度的融合，这保证了它的未来发展将继续与高能物理最先进软件技术接轨。为了研究原初电离计数方案，软件研究团队在 Gaudi 框架中完成了 Garfield++ 软件和 Geant4 探测器模拟的整合，使得 CEPCSW 可以使用 Garfield++ 对漂移室单元内电子漂移和雪崩等过程进行模拟。由于运行 Garfield++ 模拟非常耗时，很难将它用于产生大规模的模拟数据。为了克服这一障碍，研究团队利用深度学习技术进一步发展了快速模拟方法。该方法利用 Garfield++ 产生的模拟数据来训练人工神经网络，训练得到的模型可以反映电离电子的信息与信号丝响应之间的关系。测试表明：运用机器学习方法可以在保证模拟精度的前提下，实现近 200 倍的模拟加速。

下一步的计划是：研究 Gaudi Hive 的多线程技术；采用数据驱动的机制，实现模拟算法的并行运行；并进一步提升运行速度。特别是，将着重研究和 Gaud Functional 相关的编程，通过使用 Gaudi Functional，有望实现模拟算法在事例内和事例间两个层次上的高效并行运行。

Significant Progress in Simulation of Drift Chamber at CEPC

It is a necessity to achieve high-precision tracking and particle identification so as to perform the precise measurement on the Higgs boson at the CEPC experiment. Due to this requirement, the detector design, combining silicon tracker and drift chamber, was proposed by the experiment. One of the motivations of the design is to provide high performance tracking as well as good particle separation by using cluster counting method in the drift chamber. To validate the feasibility, it is critically important to develop precise simulation of detector response inside the cell of the drift chamber.

At present, the CEPC software (CEPCSW) is being developed in the Gaudi framework and its basic functionality for detector simulation, event reconstruction and physics analysis has already been implemented. Furthermore, the CEPCSW is also integrated with the common software stack, Key4HEP, being developed for the future experiments. This assures the most advanced software technology in high energy physics will continuously be adopted by the CEPCSW's future development. In order to facilitate the study on cluster counting in the drift chamber, the software team managed to integrate Garfield++ with the Geant4-based detector simulation, which enables the simulation of drifting and avalanche processes of ionized electrons in the drift chamber. But the simulation with Garfield++ is too time-consuming to be used by large scale Monte Carlo production. To overcome the barrier, the software team further developed a fast simulation tool based on deep learning techniques. The training data is from Garfield++ simulation and the obtained artificial neural network model can reflect the relationship between position of ionized electron and response on the signal wire. Performance testing shows consistent physics performance as well as ~200 times speed up can be achieved by the fast simulation,

The next plan is to study Gaudi Hive's multi-threading technology, to develop concurrent simulation based on data-driven mechanism, and to further improve simulation's execution speed. In particular, the programming with Gaudi Functional will be the focus. By using Gaudi Functional, it is expected to be able to develop the simulation application which supports concurrent computing at both inter-event and intra-event levels.

基于 CEPC 的超对称粒子前瞻性研究取得重大进展

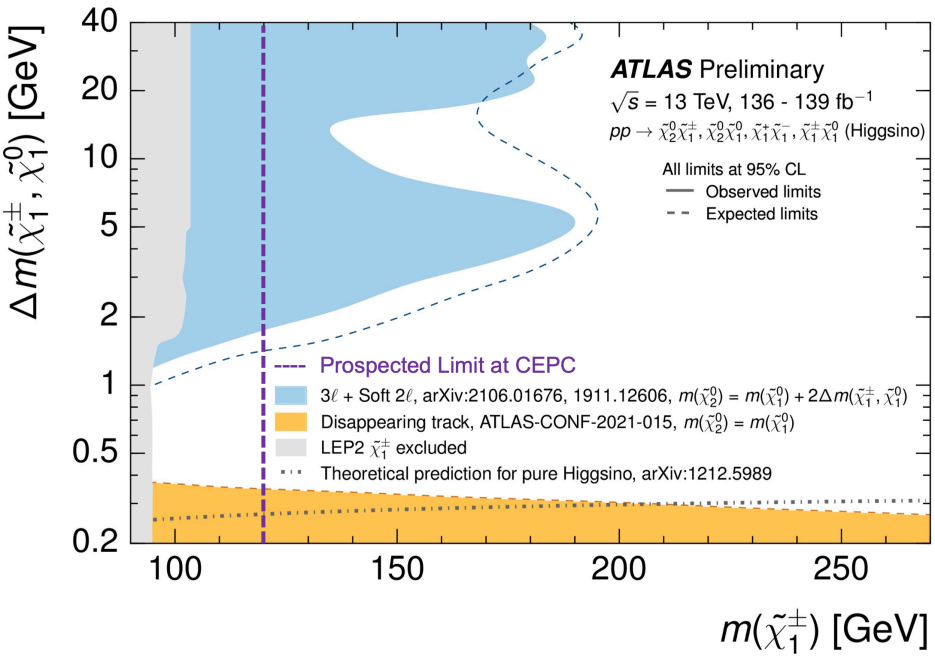
轻子对撞机不仅是一台精确的粒子测量机器，还具备粒子探索发现的能力，该优势尤其体现在一些强子对撞机难以企及的挑战性相空间。最近的两项超对称粒子的前瞻性研究更加揭示了这一点。这两项研究均基于 CEPC 探测器设计概念和软件环境。最新结果已在第三届 CEPC 物理模拟和软件研讨会以及 SUSY2021 会议上展示。

Higgsino 粒子为自然性机制所偏爱，他们往往具备较小的质量劈裂，由于其衰变末态质量非常软，因而很难在 LHC 实验中被捕捉。基于 CEPC 探测器的研究显示了我们有望探寻到超压缩空间 -- 质量差为 1.75 GeV 的 Higgsino 粒子，这要归功于 CEPC 更为干净的对撞环境和更好的低能粒子重建能力。对低于该质量差的空间，也预计会有一定的信号敏感度。该研究利用了 CEPC 实验中优秀的 μ 子识别效率，重建了 1GeV 以下的低能 μ 子。此外，反冲质量在去除标准模型本底方面起着重要作用。

最新的 muon g-2 超出和暗物质密度测量结果再次激发了人们寻找 smuon 和 stau 粒子的热情。我们基于 CEPC 探测器对其进行了研究。根据不同的 sparticle 粒子，设计了三个信号区域分别对高、中、低质量的粒子进行探寻。对于 smuon 粒子的直接产生过程，基于 5% 的系统不确定度，其发现灵敏度可达 117 GeV（smuon 质量）。对于左 / 右手组合（仅左 / 右手）stau 粒子的直接产生过程，基于 5% 的系统不确定度，其发现灵敏度可达 116 GeV（113 GeV）。该研究结果大大填补了 LHC 实验的空白。

上述 Higgsino 和 slepton 前瞻性研究的发现灵敏度涵盖了大片人们所感兴趣的相空间，达到了该探测器所能覆盖的能量极限$\sqrt{}$ s/2。研究表明，CEPC 实验在研究超出标准模型物理方面有其独特的能力——探索新物理！

同时，该研究结果对模型重建和探测器构造的依赖性较小。尤其是考虑到设施、探测器、质心能量和设计亮度等性质，该结果也可作为其他拟议的电子 - 正电子对撞机（如未来环形对撞机 ee（FCC ee）或国际线性对撞机（ILC））类似研究的参考。



（a）ATLAS 实验上基于 Higgsino LSP 的 Chargino 产生过程的 SUSY 简化模型的观察和预期排除限。灰色区域显示了通过 LEP 获得的观察限值。紫色虚线标记了 CEPC 的预期限值，用于粗略比较。

（a）Observed and expected exclusion limits on SUSY simplified models for chargino-pair production with Higgsino-like LSP obtained by ATLAS. The observed limits obtained by LEP are also shown. The prospected limits at CEPC are also shown in the dotted purple line for rough comparison.

Significant Progress in the Prospective Research of Supersymmetric Particles Based on CEPC

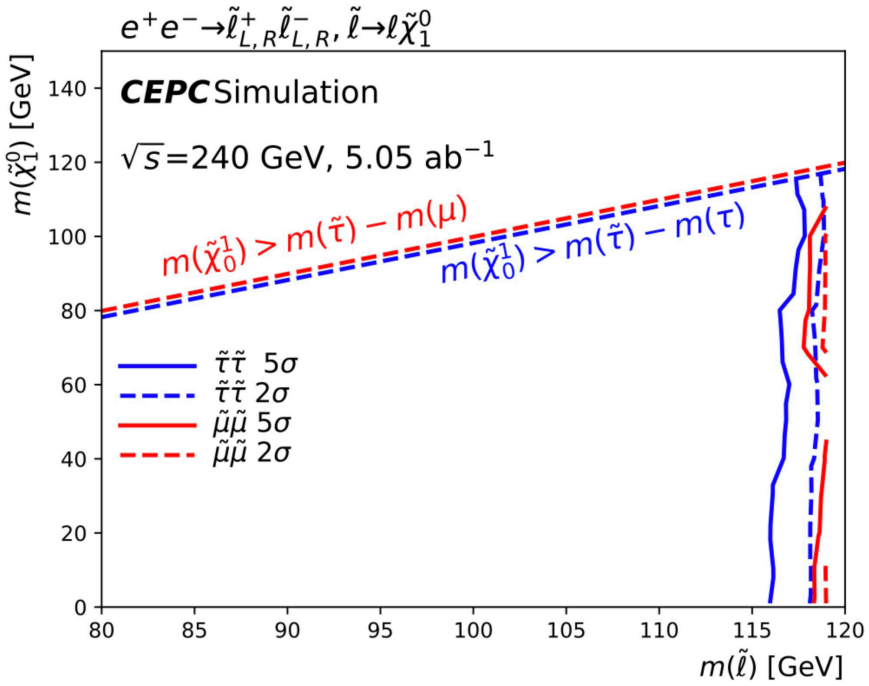
A lepton collider is not only just a precision-measurement machine, but also has the discovery advantage in many challenge scenarios which can be very difficult at hadron colliders. This is demonstrated in the latest two prospective studies of supersymmetric search. Both studies are performed with the CEPC detector concepts and software environment. The latest results have been presented in the 3rd CEPC Physics Simulation and Software Workshop, as well as in the SUSY2021 conference.

The Higgsino particles, well-motivated by naturalness, are tend to have small mass splitting and are quite challenge to catch in the LHC experiments due to very soft decay products. With the cleaner collision environment and the better low energy particle reconstruction, the study performed with the CEPC detector has shown the capability of probing very compressed region with mass difference of 1.75 GeV. Sensitivity is also expected at lower mass splittings not explored here. The study takes the advantage of the excellent muon identification efficiency in CEPC to reconstruct very low energy muon down 1 GeV. Additionally, the recoil mass plays an important role to remove the standard model background.

The search for smuon and stau particles is favored by the latest muon g-2 excess and dark matter relic density measurement. They have also been explored with CEPC detector. For each sparticle case, three dedicated search regions have been designed for the high, medium and low mass regions. For direct smuon production, assuming a flat 5% systematic uncertainty, the discovery sensitivity can reach up to 117 GeV in smuon mass. For direct stau production with left-/right-combined (only) stau, assuming a flat 5% systematic uncertainty, the discovery sensitivity can reach up to 116 GeV (113 GeV) in stau mass. The above results greatly fill in the LHC gap.

For both Higgsino and slepton searches, the discovery potential has reached a large coverage of the interested scenario, up to the kinematic limit of the detector √s/2. It is shown that CEPC has its own special power in probing the physics beyond the standard model – the searches!

The results have a minor dependence on the reconstruction model and detector geometry. These results can also be considered as a reference and benchmark for similar searches at other proposed electron-positron colliders, such as the Future Circular Collider ee (FCC-ee) or the International Linear Collider (ILC), particularly given the similar nature of the facilities, detectors, center-of-mass energies, and target luminosities.



（b） 基于 5% 的系统误差，直接 stau 和直接 smuon 产生过程的预期 5σ 发现（实线）和 2σ 排除（虚线）线。

（b） The expected 5σ discovery (solid line) and 2 σ exclusion (dashed line) contours of direct τ production and direct μ production with 5% flat systematic uncertainty.

2021 年 CEPC 探测器与 MDI 机械设计研讨会在莞召开

10 月 22 至 23 日，环形正负电子对撞机（CEPC）探测器与 MDI 机械设计研讨会在广东省东莞市中国散裂中子源召开。参会代表由来自中科院高能所以及上海交通大学、复旦大学、浙江大学和南华大学的专家组成，会议通过现场和线上形式举行。

CEPC 项目经理娄辛丑致辞，他建议进一步加强北京、东莞两地的合作，资源共享，不断推动 CEPC 的 MDI 设计进展和关键技术攻关。CEPC 项目副经理杨海军、CEPC 加速器负责人李煜辉分别介绍了 CEPC 物理和探测器总体概况和加速器设计研究进展。本次会议围绕 CEPC 探测器与 MDI 中的关键机械设计进行报告及讨论，CEPC 各子探测器以及 MDI 机械设计、MDI 超导磁铁、探测器初步安装方案等相关系统汇报了主要设计目标和研究进展，提出了亟待解决的机械相关的设计需求和技术难点，商讨可行的解决方案。

此次会议促进了 CEPC 不同方向研究者之间的交流，沟通了 MDI 交叉区域涉及到的参数及要求，规划了下一步更好地收敛指标方案，有利于稳步推进 CEPC 探测器和 MDI 设计验证。

CEPC detector and MDI mechanical design workshop held in Donggu

On 22nd and 23rd October, the CEPC detector and Machine-Detector Interface (MDI) mechanical design workshop was held at the China Spallation Neutron Source campus in Dongguan, Guangdong Province. Experts from the Institute of High Energy Physics, Shanghai Jiaotong University, Fudan University, Zhejiang University and University of South China participated the workshop. The workshop was held in hybrid mode combining in-person and online participants.

Lou Xinchou, manager of CEPC project, gave a speech and suggested further strengthening cooperation between Beijing and Dongguan by sharing resources as well as continuously promoting MDI design progress and key technology researches of CEPC. Yang Haijun, deputy manager of CEPC project, and Li Yuhui, leader of CEPC accelerator project, presented the general situation of CEPC detectors, and the progress of the design studies of the accelerator respectively. This workshop focuses on the key mechanical design of CEPC detector and MDI. CEPC sub-detector groups and MDI mechanical design group, MDI superconducting magnet group, and other related system study groups reported their primary design goals and research progress, raised the mechanical-related design requirements and technical difficulties that need to be solved, and discussed feasible solutions.

This workshop promoted cooperation between researchers from different aspects of CEPC project, exchanged requirements involved in the intersection area of MDI, and made plans for a convergence scheme for the next step, which is conducive to the steady advancement of CEPC detector and MDI design verification.

2021 年度 CEPC 加速器国际评审会议举行

根据 2020 年环形正负电子对撞机（CEPC）国际顾问委员会的要求，CEPC 加速器国际评审委员会（International Accelerator Review Committee，IARC）于 2021 年 5 月 11 日至 14 日以及 10 月 11 日至 20 日分别举行了两次线上 CEPC 加速器国际评审会议。由于受到疫情的影响，两次评审会都采取线上会议的形式。会议由来自意大利 INFN 的 IARC 主席 Maria Enrica Biagini 主持。评审专家由来自英国牛津大学的 Brian Foster，瑞士 CERN 的 Steinar Stapnes 和 Katsunobu Oide，俄罗斯 JINR 的 Anatoly Sidorin，日本 KEK 的 Makoto Tobiyama 和 Norihito Ohuchi，法国 IJCLab 的 Philip Bambade，俄罗斯 BINP 的 Eugene Levichev，上海高等研究院的赵振堂院士，意大利 Milano-INFN 的 Carlo Pagani 组成。

IARC 评审会议审议了 CEPC 加速器总体及各系统一年以来的进展报告，并根据评审会讨论的内容形成并提交了正式报告。IARC 对一年以来 CEPC 加速器团队在物理优化设计与技术预研方面所取得的成绩表示祝贺，肯定了 CEPC 加速器系统技术概念设计报告（TDR）阶段的计划，即开展高亮度物理优化设计和一系列关键部件样机研制，并在 2022 年底完成 CEPC 加速器系统 TDR。IARC 也对 CEPC 加速器 TDR 现阶段研究过程中的不足和下一阶段的工作给出了相应的建议。

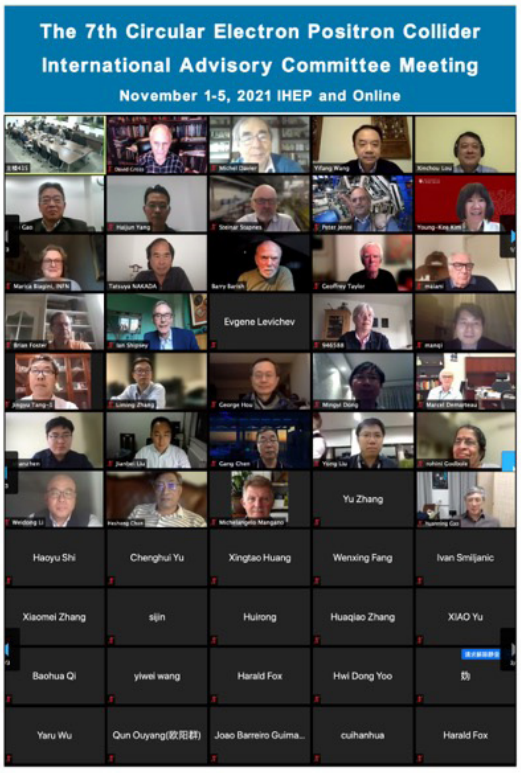
2021 CEPC accelerator international review meeting was held online

As requested by the Electron-Positron Circular Collider (CEPC) International Advisory Committee (IAC) in 2020, two international CEPC accelerator review meetings organized by CEPC International Accelerator Review Committee (IARC) were held online from 11-14 May and 11-20 October, respectively. The meetings were chaired by Maria Enrica Biagini from INFN, Italy, who is also chairperson of IARC. The review experts include Brian Foster from Oxford University, UK, Steinar Stapnes and Katsunobu Oide from CERN, Switzerland, Anatoly Sidorin from JINR, Russia, Makoto Tobiyama and Norihito Ohuchi from KEK, Japan, Philip Bambade from IJCLab, France, Eugene Levichev from BINP, Russia, Zhao Zhentang from Shanghai Advanced Research institute, and Carlo Pagani from Milano-INFN, Italy.

IARC reviewed the general statutes of the CEPC accelerator and the progress of each system over the past year, and formed a formal report based on the content discussed at the review meeting. IARC congratulates the CEPC accelerator team for their achievements in optimizing design and progresses on technical R&D over the past year, and supports the plan for the CEPC accelerator technical design report (TDR) phase, which is to optimize the design for high-luminosity accelerator, accomplish a series of prototype development of key components, and complete the CEPC accelerator system TDR by the end of 2022. IARC also pointed out the weakness in the current stage of the CEPC accelerator TDR progresses and made corresponding suggestions for the next stage.

第七届环形正负电子对撞机国际顾问委员会年会召开

11 月 1 日至 5 日，第七届环形正负电子对撞机（CEPC）国际顾问委员会（IAC）年会在中国科学院高能物理研究所召开，高能所所长王贻芳、项目总体及相关系统负责人、执委会成员及部分参研人员参加了会议。本次会议通过线上线下同步召开。



CEPC 国际顾问委员会主席、费米国家实验室前副所长、美国物理协会副理事长、美国芝加哥大学教授 Young-Kee Kim 主持会议。CEPC 项目副经理、上海交通大学杨海军教授首先介绍了项目总体进展情况和对上一年度建议的回复；高能所研究员高杰、Joao Guimaraes da Costa 等分别介绍了 CEPC 加速器技术设计与预研情况、CEPC 探测器设计、国际合作与未来规划等。IAC 委员们分别和项目管理层、加速器、物理与探测器各分总体相应的 CEPC 负责人和骨干进行了深入的调研和交流。

IAC 委员们一致肯定了 CEPC 过去一年取得的包括加速器关键技术研发、与 CERN 合作的高场超导磁体重要进展、第四个探测器概念设计重要技术预研、软件国际化发展、选址论证等新成果，IAC 委员们对技术设计阶段技术研发方面的国际合作、经济效益分析等方向给出了建议，并对项目研发过程中的重要技术给予了建设性的指导。

来自美国、俄罗斯、瑞士、意大利、英国、法国、澳大利亚、印度、中国等国家和中国台湾地区的 19 位国际知名科学家、技术专家和具有大科学工程经验的管理专家应邀参加了会议。

The 7th Annual Meeting of the CEPC International Advisory Committee was held

From 1st to 5th November, the 7th Annual Meeting of the Circular Electron Positron Collider (CEPC) International Advisory Committee (IAC) was held at the Institute of High Energy Physics, Chinese Academy of Sciences. Director of the Institute of High Energy, sub-system project leaders, and members of the CEPC executive committee participated in the meeting. This meeting was held in hybrid mode combining in-person and online participants.

Young-Kee Kim, chairperson of CEPC International Advisory Committee, former deputy director of Fermi National Laboratory, Vice President-elect of American Physical Society, and professor of the University of Chicago, U.S., chaired the meeting. The deputy manager of the CEPC project, professor Yang Haijun from Shanghai Jiaotong University introduced the overall progress of the project and responses to recommendations from previous year. Professor Gao Jie and professor Joao Guimaraes da Costa from the Institute of High Energy introduced the CEPC accelerator technical design and R&D status, the status of CEPC detector designs, international cooperation status, and future plans, etc. IAC committee members had an in-depth exchange of view with the core team members of CEPC study group on the project management, accelerator, physics and detectors studies.

IAC committee members unanimously affirmed the achievements that the CEPC study group made in the past year, including the development of key accelerator technologies, progress in high-field superconducting magnets in cooperation with CERN, R&D on the 4th conceptual detector design, development on internationalized software, and efforts on site selection.

IAC members also made suggestions on international corporation, economic benefit analyses during the technical design stage, and on the roadmap of key technologies development.

19 internationally renowned scientists, technical experts and management experts with great scientific and engineering experience from the United States, Russia, Switzerland, Italy, the United Kingdom, France, Australia, India and China were invited to participate in the conference.

2021 环形正负电子对撞机国际研讨会成功召开

11 月 8 至 12 日，2021 年度环形正负电子对撞机（CEPC）国际研讨会成功举行。考虑到疫情影响，本次国际研讨会采用线上会议模式。会议共计 347 人参加，其中大约三分之一是国际单位或组织的科学家远程参会。会议由南京大学主办，中国科学院高能物理研究所和粒子物理前沿卓越中心共同协办。

南京大学金山教授代表主办方致辞并主持开幕大会。研讨会总报告数 209 个，国内和国外参会者的报告数分别为 137 和 72 个。

本次研讨会参会代表们对未来的高能正负电子对撞机的物理研究机遇、加速器、探测器和软件等多方面的关键技术及验证作了报告和研讨，对新形势下国内、国际预研合作的如何推动进行了广泛的讨论，也对未来对撞机的研究重点和计划进行了展望。会议进一步明确了 CEPC 路线图，项目将进一步加强与国际同类希格斯工厂项目的合作关系，争取在关键技术研究和验证装置试验上进行深入的合作，高质量地开展高能粒子物理研究。

2021 Annular Electron Positron Collider International workshop was successfully held

From 8th to 12th November, the 2021 CEPC International workshop was successfully held. Due to the ongoing pandemic, the CEPC workshop this year was held fully online. 347 participants registered for the workshop, and about one-third of participants are from foreign institutes. The workshop was hosted by Nanjing University and co-organized by the Institute of High Energy Physics, Chinese Academy of Sciences and the CAS Center for Excellence in Particle Physics.

Professor Jin Shan from Nanjing University delivered a speech on behalf of the organizers and presided over the opening session. There were 209 reports in the workshop, of which 72 were made by participants from foreign institutes.

Participants in this workshop reported and discussed on different aspects of the key technologies and verifications of the future high-energy electron-positron collider, including physical research opportunities, accelerators, detectors, and software. Extensive discussions took place on how to promote the R&D cooperation, future research priorities and plans. The workshop further clarified the CEPC roadmap, and the development of the CEPC project will further strengthen the cooperation with similar international Higgs factory projects, strive to establish deep cooperation in key technology studies and system testing, and carry out high-energy particle physics research with high quality.

CONTENTS

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