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# Combination of Course Teaching and Scientific Research for Particle Physics at Guizhou Minzu University

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**Abstract:** Particle physics as an important branch of modern physics, its important research object is the microcosmic elementary particles and their interactions. The fundamentals of the particle physics course provide students with the necessary tools to explore particle physics research in depth. By studying particle physics courses, students can better understand the nature of particle physics theory and the design and results of related experiments, and communicate with the international physics community more smoothly. Today's particle science research is devoted to the exploration of higher energy particles and deeper physical phenomena. Combining particle physics courses with particle physics science research can help students gain an in-depth understanding of the current frontiers of physics research and cultivate their innovative ability in this field. At the same time, it helps students to deeply understand and participate in the forefront of particle physics research. Through such learning, students can not only master basic physics knowledge and experimental skills but also develop the ability of thinking, innovation, and teamwork. The deep integration of the two can enhance students' innovative consciousness and teamwork ability. Through course design and practical activities, students will be exposed to the latest scientific developments and cutting-edge technologies, and cultivate their scientific research interests and innovative thinking. Based on this, this paper systematically sorts out the objectives, key difficulties, and theoretical framework of particle physics courses, and introduces the basic situation of the research team of particle physics at Guizhou Minzu University and some recent research progress of myself. Combining the course of particle physics with some current scientific research, this paper puts forward some suggestions for improving course teaching for readers' reference.

**Keywords:** Particle Physics Course, Frontier of Particle Physics, Curriculum Improvement

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## 1. Introduction

Particle physics is the study of the most fundamental components of matter and their properties, interactions, and the universe and its origin. With the development of science and technology and the progress of experimental technology, the research of particle physics is getting deeper and deeper, so that people have a deeper understanding of the nature of matter and the mystery of the universe. At the same time, the research of particle physics has also continuously promoted the development and progress of modern science and technology. As an important course in the postgraduate stage, the combination of particle physics teaching and current particle physics research can provide students with a

richer learning experience and a deeper combination of theory and practice, and help students better grasp and apply the knowledge of particle physics.

As a basic subject, particle physics is of great significance to physics learners. The main significance of particle physics teaching is reflected in the following aspects: Broadening academic vision: Particle physics research involves the most basic components of the material world. By studying particle physics, students can expand their academic vision and understand the microstructure of matter and its basic interaction rules. Develop scientific thinking: Particle physics courses require students to learn and master rigorous theoretical knowledge and experimental techniques, as well as scientific thinking methods to solve practical problems. Training students'

scientific thinking is of great significance for their future scientific research work and for solving practical problems [1]. Improve scientific research ability: Particle physics research is of high difficulty and complexity, which requires students to have a solid theoretical foundation and practical skills. The study of particle physics courses can provide a good foundation for students' scientific research ability. Promoting scientific and technological innovation: The technology and methods of particle physics research have played an important role in promoting development and innovation in the field of science and technology. The study of particle physics courses can help students understand and master relevant experimental techniques and methods, and provide support for their future scientific and technological work [2-10].

The development of particle physics research is closely related to the progress of experimental technology. At the same time, particle physics teaching also needs to be integrated with the latest advances in particle physics research today to provide students with more dynamic and hands-on experiences. Specifically, the combination of particle physics teaching and today's particle physics research is present in the following aspects:

1. Updating textbooks and teaching content: With the continuous development of particle physics research, new theoretical models, experimental results, and technical methods continue to emerge. Particle physics teaching needs to constantly update the teaching content and textbooks, and timely incorporate the latest research results and progress into the curriculum.
2. Increase experimental operation and calculation practice: the practice and experimental technology of particle physics research are of great significance to students' mastering and training. By increasing the experimental operation and calculation practice, students can better understand and master the experimental technology and methods, and improve the practical application ability of particle physics research.
3. Invite industry experts to give lectures and exchanges: Invite scientists, engineers, experimenters, and other industry experts engaged in particle physics research to give lectures and exchanges, introduce the latest research results and technical progress to students, and interact and discuss with students to provide students with more practical cases and experience sharing.
4. Organize visits and internship activities: Organize students to visit research laboratories and scientific research institutions, so that students can personally experience the real environment and practice the process of particle physics research, and communicate with researchers to improve students' actual knowledge and understanding of particle physics research.

By combining with today's particle physics research, students can better understand and grasp the latest research trends and development trends, and improve the understanding and application ability of particle physics. At the same time, it can also enhance students' innovative

thinking and scientific research ability, laying a solid foundation for students' future scientific research and career development. Finally, the combination of particle physics teaching and current particle physics research is of great significance. By combining with current particle physics research, it can broaden students' academic vision, cultivate scientific thinking, improve scientific research ability, and promote scientific and technological innovation. At the same time, the combination of teaching and research also needs to update the teaching content and textbooks in a timely manner, increase the experimental operation and calculation practice, invite industry experts to give lectures and exchanges, and organize visits and internship activities. Through the implementation of these measures, students can be provided with a richer learning experience and a deeper combination of theory and practice to help students better grasp and apply the knowledge of particle physics.

## 2. Particle Physics Course Teaching

Particle physics is an important discipline in the study of the microscopic world, involving the structure, properties, and interactions of elementary particles. As an advanced academic course, the particle physics course aims to cultivate students' theoretical and experimental abilities and enable them to participate in particle physics research. To develop students' comprehensive knowledge and in-depth understanding of particle physics; Through the study of theoretical knowledge, experimental technology, and cutting-edge problems, improve students' scientific research and academic communication ability. In teaching, it is necessary to focus on the study and understanding of theoretical knowledge, experimental technology, frontier problems, breakthrough teaching difficulties, encourage students to participate in scientific research and academic exchanges on the basis of innovative teaching methods and optimization of teaching resources and improve students' academic level and ability with the support of personalized tutoring and guidance. It will lay a solid foundation for future related scientific research and other work.

### 2.1. Teaching Objectives of the Particle Physics Course

1. Familiar with the basic concepts and theories of particle physics, including the composition, interaction, and properties of particles.
2. Understand and master particle physics' experimental methods and technologies, including the principle and design of particle colliders, detectors, etc.
3. Understand the main research content and cutting-edge issues in particle physics, including the Standard Model, dark matter, string theory, etc.
4. Cultivate the ability of scientific research and problem analysis, such as scientific thinking, experimental data analysis, and model construction.
5. Improve students' scientific research and academic communication abilities, including literature reading, academic reports, and research paper writing.

## 2.2. Teaching Focus of the Particle Physics Course

1. Mastery of theoretical knowledge: Students need to master the basic concepts and theories of particle physics, including the classification of elementary particles and the standard model that can describe the interaction of particles.
2. Understanding of experimental methods and technologies: Students need to understand the main experimental methods and technologies in particle physics, including the principle of particle collider, detector design, and working principle.
3. Understanding of cutting-edge issues: Students need to understand some cutting-edge issues in particle physics, such as dark matter, string theory, and other hot issues, and master relevant research methods and technologies.
4. Training in data analysis and model-building ability: Students need to cultivate scientific research and problem-solving ability through the analysis of experimental data and the construction of theoretical models.
5. Improvement of academic communication ability: Students need to improve their academic communication and expression ability through literature reading, academic reports, and research paper writing.

## 2.3. Teaching Difficulties of the Particle Physics Course

1. Theoretical complexity: Particle physics is a complex subject, involving a large number of abstract theories, which requires students to have a high theoretical basis and mathematical ability.
2. Complexity of experimental technology: Experimental techniques and methods of particle physics usually involve high-energy physics and high-precision measurement, and students need to have certain experimental design and data analysis capabilities.
3. Difficulty of cutting-edge problems: the cutting-edge research problems of particle physics are usually complex and abstract, which are challenging to students' scientific thinking and innovation ability.
4. Cultivation of scientific research ability: Postgraduate particle physics courses need to cultivate students' scientific research ability, including literature reading, experiment design, and data analysis, which is a new challenge for students.

## 2.4. Structure of the Particle Physics Course

The teaching content of particle physics courses for graduate students should include the classification of elementary particles, the standard model, quantum field theory, and other basic knowledge, combined with practical cases and the latest research results to explain. The teaching content should be organized in a progressive manner, from basic concepts to in-depth details, to help students gradually build up an overall understanding of particle physics. The Introduction to particle physics course mainly includes the following five chapters, including the classification of

elementary particles, the basic knowledge of particle physics and field theory, and particle physics experiments.

### 2.4.1. Classification of Elementary Particles

At the beginning of the Introduction to Particle Physics course, students will learn and understand the classification of elementary particles. Elementary particles can be divided into two categories according to their properties: fermions and bosons. Fermions are particles with half-integer spin, such as electrons, neutrinos, etc. Bosons are particles with integer spin, such as photons, hadrons, etc. Students will learn about the properties and interactions of different particles and how to classify elementary particles by these properties.

### 2.4.2. Basic Knowledge of Particle Physics

Particle physics is the fundamental theory for studying the microscopic world. In the Introduction to Particle Physics course, students will learn the fundamental principles and mathematical tools of particle physics. This includes the Schrodinger equation, wave function, measurement, and uncertainty principle. Students will gain an in-depth understanding of the concepts and applications of particle physics to build a solid foundation for their subsequent studies.

### 2.4.3. Basic Knowledge of Field Theory

Field theory is a theoretical framework for describing particle interactions. In this part of the Introductory Particle Physics course, students will learn the basic concepts and mathematical tools of field theory. This includes the traditional Lagrange and Hamiltonian forms, as well as complex scalar fields, vector fields, and gravitational fields. Students will also learn about quantization methods for fields, such as regular quantization and path integral quantization.

### 2.4.4. Standard Model

The Standard Model is the most accurate description of elementary particles. In this part of the Introductory Particle Physics course, students will study in depth the construction of the Standard Model and the basic theoretical framework. Students will learn about the unified theory of strong, weak, and electromagnetic interactions, as well as the properties of elementary particles such as quarks, leptons, and hadrons. In addition, students will learn important concepts such as symmetry breaking and the Higgs mechanism in the standard model.

### 2.4.5. Particle Physics Experiment

Particle physics experiments play a crucial role in verifying theoretical predictions and discovering new particles. In the final stage of the Introductory Particle Physics course, students will learn the principles and techniques of particle physics experiments. Students will learn about different types of particle detectors and experimental devices, and how to obtain information about particles' mass, spin, and interactions through experiments. Students will also learn methods for analyzing and interpreting experimental data, as well as methods for

studying new particles and physical phenomena.

### 3. Research in Particle Physics Science

#### 3.1. High-Energy Physics

High-energy physics is the study of the interactions between microscopic particles, the exploration of the nature of the universe, and the understanding of the origin of the universe. Ever since the discovery of protons, neutrons, and electrons, the field of high-energy physics has been breaking new frontiers. Firstly, quantum chromodynamics (QCD) is an important research field in high-energy physics. In recent years, scientists have made important advances in the precise calculation of QCD theory. QCD theory is a theory describing the interaction between quarks and gluons. Studying it can help us better understand the nature and interaction law of elemental particles. For example, by simulating the behavior of quark-gluon plasmas, scientists have successfully predicted important observations in many high-energy collision experiments. Secondly, dark matter is one of the most important research topics in high-energy physics. Dark matter, the most important component of matter in the universe, affects gravity but does not interact with electromagnetism, so it cannot be directly observed. In order to decipher the nature of dark matter, scientists carry out research through the direct and indirect detection experiments of dark matter, as well as the search for new particle signals generated by dark matter in high-energy collision experiments. In recent years, important achievements have been made in the study of dark matter, and the properties of the mass and interaction of dark matter particles have been more deeply understood. Third, the discovery of new particles is one of the important goals of high-energy physics experiments. In the costly LHC experiments, scientists seek to confirm the predictions of existing theoretical models and seek to discover new elementary particles. For example, in 2012, the Large Hadron Collider (LHC) experiment collaboration successfully discovered the Higgs boson, a major discovery that is considered an important breakthrough in particle physics. At the same time, many new theoretical models have been proposed, including the extended Standard model, the dark extended model, etc., providing more clues and challenges for the discovery of new particles. Finally, gravitational waves have become a new hotspot in the field of high-energy physics in recent years. Gravitational waves, a key prediction of Einstein's theory of general relativity, are the curvature of space-time caused by the distribution of mass and energy that propagate as waves through space. Scientists have successfully detected many gravitational wave signals by building large gravitational wave detectors, such as LIGO and VIRGO. The detection of gravitational waves provides a new means for us to further understand the extreme gravitational field in the universe, black hole collision, and other phenomena. In summary, cutting-edge advances in high-energy physics involve many important topics, including quantum chromodynamics, dark matter, the discovery of new

particles, and the detection of gravitational waves. With the continuous progress of science and technology, we have reason to believe that in the near future, new breakthroughs will continue to be made in the field of high-energy physics, helping us to understand the universe more deeply and understand the most basic composition of matter.

#### 3.2. Particle Physics Research

Particle physics is an important branch of high-energy physics, which studies the basic composition of matter and its interaction, and is an important field of modern physics. First, particle physics courses provide us with key knowledge about the microscopic world of the universe. By studying particle physics, we can understand that matter is made up of elementary particles, such as electrons, protons, neutrons, and so on. A deeper understanding of the properties of these particles, their interactions, and how they form atoms can help us gain a deeper understanding of the nature of the physical world. Secondly, particle physics research and experiments have also played an important role in promoting the development of science and technology. Many particle physics experiments require the use of advanced instruments and techniques, which has led to the development and advancement of scientific instruments. For example, particle accelerators are an important tool for studying the microscopic world, and they provide not only a platform for particle physicists to study but also a means for scientists and engineers in other fields to simulate and test technologies. In addition, the study of particle physics has a broad impact on human society. By studying and discovering new elementary particles, particle physics scientists provide possibilities for the development of new technologies and applications. For example, particle physics research has played an important role in the development of applications in medical imaging, materials science, and other fields. At the same time, because the research of particle physics requires international cooperation and large-scale scientific experiments, it also promotes international scientific cooperation and exchange and helps to promote the improvement of global scientific level and common scientific progress. Finally, the study of particle physics courses also cultivates our scientific thinking and problem-solving ability. The research of particle physics is not smooth sailing, and it faces many complex experimental and theoretical problems. By participating in particle physics experiments and theoretical research, we need to develop a solid foundation of mathematical and physical knowledge, rigorous thinking, and problem-solving skills. These abilities will play an important role in our future study and work.

#### 3.3. Research Progress of Particle Physics Team at Guizhou Minzu University

The particle physics team of Guizhou Minzu University was established in 2015. Its main research directions are the theoretical research and application of the QCD sum rule method, non-relativistic QCD theory, and its application in the

field of heavy quarks, renormalization scale setting. Specifically, my main research directions are as follows: 1. Precise research on QCD sum rule approach for heavy hadron-related decay processes at high energy colliders LHCb, BESIII, Belle-II. 2. Research on background field theory of heavy and light meson distribution amplitude. 3. Search for CP violation and new physical effects in the decay process.

The main research contents are: The application of semi-leptonic decay of  $D(s)$  mesons to pseudoscalar, scalar, vector, and axial-vector mesons are studied by the QCD sum rule approach. The background field theory is used to study the amplitudes of twist-2 distribution of different types of mesons, and on this basis, experimental observations, asymmetry, polarization, breaking effect, and some abnormal effects are studied. The effects of new physical effects on the Wilson coefficient and experimental measurements are researched.

### **3.3.1. Study the Experimental Observables of the Semileptonic/Radiative/FCNC Decay Process of $D(s)$ Mesons to Light Mesons**

For the QCD light cone sum rule, the contribution of the LO/NLO correction of the twist-2 transverse/longitudinal distribution amplitudes of this decay-type transition form factor can be derived from the complete Feynman diagram. At the same time, we can also start from the LCSR theory itself and consider the influence of the chiral flow and helicity LCSR approach on the results. In the case of the difference between the experimental results and the theoretical results, the anomalous effects are studied and new physics is sought. For the semi-leptonic decay process with s-quark mesons in the final state, the CP breaking effect of non-zero weak phase Angle in CKM matrix is usually accompanied by experimental observations such as isospin asymmetry, longitudinal polarization asymmetry, front and back asymmetry, ratio to  $e/\mu$  channel, and mixing effect of resonance states. At the same time, we have carried out some work in the early stage, and this project will continue to learn and expand the research direction. For the typical semi-leptonic, radiation, FCNC decay process, especially the process containing the final state of the s-quark meson, the new physical model is studied, the influence of the model on the physical observation is deeply explored, the rationality of its existence is found and the reasonable parameter space is determined [11, 12].

### **3.3.2. Study the Amplitude of Twist-2 Distribution of Pseudoscalar/Scalar/Vector/Axial-Vector Mesons**

The SVZ sum rule approach is applied to pseudoscalar mesons, scalar mesons, vector mesons, and axial-vector mesons using the 6-dimensional propagators and vertex terms under the complete background field framework to give the sum rule analytic expression of the complete twist-2 (transverse and longitudinal) distribution amplitude moments up to 6-dimension accuracy. We give the sum rule results of the amplitudes of vector mesons twist-2 distribution. Then the decay properties of these mesons in charm mesons are considered. Attempts will also be made to study the

amplitudes of the twist-2 distribution of tensor mesons with antisymmetry [4, 5].

After the development in recent years, I have made some scientific research achievements. I have accumulated some experience in the research of the semi-leptonic decay process, QCD light cone sum rule, light cone distribution amplitude, SVZ sum rule, and other aspects. Up to now, I have finished 38 papers that were published in JHEP, Eur. Phys. J. C, Phys. Lett. B, Phys. Rev. D, Nucl. Phys. B and Eur. Phys. J. A, among which 10 were first-author papers and 8 were corresponding authors. It has been cited more than 200 times (high energy physics database INSPIRE-HEP data). The current research work has been recognized by domestic and foreign experimental and theoretical teams. Scientific research projects: 4 projects hosted by the National Natural Science Foundation of China, 2 projects by the Department of Science and Technology of Guizhou Province, and 1 top-notch talent project by the Department of Education of Guizhou Province, and won the third prize of Guizhou Natural Science in 2022 (ranked first). Six graduate students have been supervised, two of whom have graduated and are pursuing doctoral studies.

## **4. Combination of Course Teaching and Scientific Research**

### **4.1. Challenges, Limitations, and Solutions**

The combination of particle physics course teaching and particle physics science research is an important teaching model, which helps to improve students' learning interest and innovation ability. However, this teaching mode faces some challenges and limitations in the concrete implementation process, including limited resources, complex teaching content, expensive experimental equipment, and so on. These challenges and constraints are explored in detail below and solutions are proposed.

#### **4.1.1. Limited Resources**

Particle physics is a frontier science, which requires a large number of experimental equipment and experimental conditions to carry out research. However, most schools and educational institutions have limited resources in this area, and it is difficult to provide the experimental equipment and practical operating environment that students need. One of the ways to solve this problem is to make reasonable use of existing resources and provide students with the opportunity to experiment through virtual laboratories and simulation software. At the same time, schools and educational institutions can cooperate with relevant scientific research institutions and borrow their experimental equipment and experimental conditions to provide students with a better practice environment.

#### **4.1.2. Complexity of the Teaching**

Particle physics is a deep and complex subject, and the concepts and theories involved are often beyond students' comprehension. In order to overcome this challenge, teachers

should pay attention to the explanation and connection of concepts, so that students can understand the basic principles and research methods of particle physics. At the same time, teachers should also guide students to conduct independent learning and exploration and improve students' theoretical application ability and innovation ability by solving practical problems and carrying out small research projects.

#### **4.1.3. Experimental Equipment Is Expensive**

Equipment for particle physics experiments is often expensive and not available in most schools and educational institutions. One way to address this challenge is to strengthen cooperation between schools and educational institutions to share experimental equipment. In addition, an open experimental platform can be developed to provide students with opportunities for experimental operation. At the same time, low-cost experimental devices can be introduced so that students can carry out some basic experimental operations and observations. In addition to the above challenges and limitations, there are other issues to consider, such as the lack of teachers and students low interest in learning. In order to overcome these problems, schools and educational institutions can strengthen the training and introduction of teachers, and improve teachers' teaching ability and scientific research level; By reforming the curriculum and teaching methods, students' interest and motivation in learning will be enhanced.

### **4.2. Some Suggestions for Teaching Improvement**

Particle physics, as a frontier field of modern physics, is of great significance for cultivating students' innovative consciousness and scientific literacy. However, there are some problems in the traditional teaching of particle physics, such as the teaching content being too theoretical, the lack of practice, and the single-learning mode.

#### **4.2.1. The Application of Multimedia Teaching and Online Learning Platform**

Traditional particle physics teaching is too theoretical, it is difficult for students to intuitively understand abstract concepts and physical principles. Therefore, teachers can concretize abstract concepts by introducing multimedia teaching means, such as animation, simulation experiments, experimental videos, etc., so that students can understand and accept them more easily. At the same time, it is suggested that schools establish an online learning platform to digitize course teaching resources and learning materials so that students can learn independently according to their own learning pace and time, and improve the learning effect.

#### **4.2.2. Strengthening Practical Teaching and Laboratory Construction**

Particle physics is an experiment-oriented discipline, and practical links are very important for students to develop their understanding and application ability. Therefore, practical teaching should be added to the teaching of particle physics courses, such as experimental operation (simulation), data processing, and analysis, so that students can participate in the experiment and carry out practical operations. In addition,

schools should also strengthen the updating and maintenance of laboratory equipment, provide advanced experimental equipment and conditions, and provide better experimental platforms for students.

#### **4.2.3. Group Cooperative Learning and Project-Driven Teaching Mode**

Traditional teaching mode often leads to passive acceptance of students and poor learning effects. Therefore, it is suggested to introduce a group cooperative learning mode to encourage cooperation and communication among students. Through group work, students can discuss and think about each other, improve their problem-solving skills and teamwork skills. At the same time, a project-driven teaching mode can be introduced to combine theoretical knowledge with practical projects, so that students can apply what they have learned in practical projects and improve the practicability and interest of learning.

#### **4.2.4. Strengthen the Provision of Academic Exchange Opportunities**

Particle physics is a frontier subject, and academic exchange is of great significance to students' learning and development. It is suggested that the university strengthen academic exchanges and cooperation with domestic and foreign universities and research institutions, and organize students to participate in academic conferences, lectures, and seminars. At the same time, internship opportunities are provided for students to practice and research in scientific research teams to cultivate students' scientific research ability and innovation awareness. It provides a broader academic exchange platform for students and promotes the development of particle physics teaching and research at Guizhou Minzu University.

#### **4.2.5. Encourage Participation in Scientific Research**

The course is set in the second semester of the first year of graduate school, and students have basically had a certain scientific foundation. At this time, students can be encouraged to actively participate in the scientific research projects and scientific research of the supervisor's research group, carry out in-depth exchanges with the supervisor and fellow seniors, and carry out basic theoretical derivation, programming calculation, and other work. In this way, students can learn the content related to particle physics more deeply, so as to master the particle physics course better and improve their scientific research level and ability.

### **4.3. Examples and Efficiency**

In the training of theoretical physics-particle physics graduate students at Guizhou Minzu University, the model of combining particle physics teaching and scientific research has been preliminarily applied. By learning particle physics theory and experimental methods, students get in-depth academic training and practical exercise, which lays a solid foundation for their scientific research work.

First, through the teaching of particle physics courses, students gain solid theoretical knowledge. For example, in the

course Elementary Particle Physics and the Standard Model, students learn about the classification of elementary particles, their interaction mechanisms, and the Standard Model of elementary particle physics. Through the study of this course, students have a deeper understanding of the basic concepts and theories of particle physics, and can accurately understand the basic properties of particles when conducting scientific research.

Second, in the first year, master's students participate in particle physics research projects through cooperation with teachers and scientific research teams. For example, Long Zeng, Dan-Dan Hu, and Zai-Hui Wu, graduate students of 2018, 2019, and 2020 classes, participated in the project "Precise research on sum rule approach for the charm mesons semi-leptonic Decay Processes" (NSFC:11765007). In this project, by deeply studying the amplitude of twist-2 distribution of light meson  $\eta$ ,  $\eta'$ ,  $a_1$  (1260), the students used the SVZ sum rule approach to accurately calculate its first six moments, and then calculated the corresponding semi-leptonic decay processes, improving the calculation accuracy, which was recognized by the theory and the experimental group [13-17]. Through participation in research projects, students not only consolidate the theoretical knowledge of particle physics, but also comprehensively master practical research skills, and cultivate an awareness of innovation and comprehensive ability.

In addition, students can participate in academic conferences organized in China, have in-depth discussions with domestic experts, and cooperate and exchange with top domestic research teams. For example, in a cooperative project with the Institute of Particle Physics of Chongqing University, master's students participated in the discussion of cutting-edge ideas in high-energy physics particles, formed a system, and completed the corresponding thesis. By cooperating with domestic research teams, students not only expand their horizons but also learn some cutting-edge international research methods and techniques.

Through the model of combining particle physics teaching with scientific research, a series of positive learning results and research experiences have been achieved among the theoretical physics master students at Guizhou Minzu University. The students have been comprehensively cultivated in the theoretical knowledge, experimental methods, and scientific research ability of particle physics. This not only lays a solid foundation for their academic development but also provides important support for their future scientific research and teaching work. In short, the combination of particle physics teaching and particle physics research has had a positive impact on the learning results and research experience of theoretical physics master students at Guizhou Minzu University. By learning theoretical knowledge and practical experience in particle physics, students get comprehensive academic training, laying a solid foundation for their future academic development. At the same time, this combination model also provides students with the opportunity to participate in research projects, collaborate with international research teams, and develop their awareness

of innovation and international vision.

## 5. Conclusion

The study of postgraduate particle physics courses is an essential part of the postgraduate stage. For postgraduate students, it is the key to understanding the problems, sorting out the ideas and study methods, and effectively expanding and improving the current research status. This paper introduces the significance, objectives, key points, difficulties, and theoretical structure of particle physics teaching, and analyzes the importance of particle physics teaching in detail. The present situation of particle physics, including high energy physics and particle physics, is introduced. This paper introduces the basic situation and research progress of the particle physics team at Guizhou Minzu University. Based on the current situation of graduate students at Guizhou Minzu University, this paper puts forward 5 suggestions for improving particle physics teaching for your reference.

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