**Major International (Regional) Joint Research Project APPLICATION FORM**

# Title of the Joint Research Project: Research on Networking Theory and Key Technologies of Ubiquitous Intelligence in B5G Vehicular Networks

1. **Key words (off by comma): B5G, Vehicular Networks, Ubiquitous Intelligence, Mobile Sensing, Distributed Data Cooperation, Space-Air-Ground Integrated Network Platform**
2. **Period of the Joint Research Project:From 2024-01-01 until 2028-12-31**
3. **Applicant Information:**
   1. **Chinese Side**
4. Name:
5. Degree:
6. Research area:
7. Academic Title:
8. Institution:
9. Address:
10. E-mail:
11. Tel.:
12. Fax:
13. Serial Number of on-going NSFC’s Project(s):
14. Title(s) of on-going NSFC’s Project(s):
15. Research Fields of on-going NSFC’s Project(s):
16. Main Scientific Publications (up to 10) in the last five years related to the application:

# Other Members in the Research Team:

1. Name:
2. Degree:
3. Specialty:
4. Academic Title :
5. Affiliation:
6. Address:
7. E-mail:
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9. Fax:

# Foreign Collaborator(s):

1. Name:
2. Degree:
3. Research area:
4. Academic Title:
5. Institution:
6. Address:
7. Email:
8. Tel.:
9. FAX:
10. Main Scientific Publications(up to 10) in the last five years related to the application:

# Project Abstract:

The construction of Beyond Five Generation (B5G) Internet of Vehicles (IoV) is of great significance to support the modern and future intelligent transportation system of ubiquitous intelligence. However, there are still some performance bottlenecks in the current B5G IoV technology in terms of networking theory, ubiquitous sensing technology, mobile real-time transmission scheme, distributed data collaborative computing and so on. This project focuses on the networking theory and key technologies of ubiquitous intelligent B5G IoV, and follows the technical route of "networking-mobile sensing-efficient transmission-collaborative computing-simulation system construction". Specifically, The following research will be conducted: 1) Research on the B5G IoV control architecture, and establish the theoretical methods of B5G network access management and network resource arrangement; 2) Research on the ubiquitous sensing technology under B5G, and explore the active, passive and collaborative sensing strategies for multiple vehicle nodes based on various sensing technologies; 3) Research on the real-time transmission technology for mobile scenario, and design various adaptation mechanisms for vehicle network resources; 4) Research on the client selection and incentive model for large-scale distributed data collaborative computing based on federated learning; 5) Finally, this project will build the B5G IoV integration simulation platform to realize the demonstration application of related results. This project will build a theory and technical system of B5G IoV for the pervasive intelligence, and provide key technical support for China to build a digital transportation power.

# Project Description:

* 1. description of the current research trend in the field
  2. detailed description of the joint research project including objectives, background, merits and importance of the project, scientific issues targeted, proposed methodologies applicable
  3. main research activities of key members
  4. description of the existing collaboration, the necessity of proposed collaboration, and collaborative arrangements defining general responsibilities and tasks assigned to each side in order to realize the project goals (i.e. what are the unique strengths and skills that the each side bring to the project and the added value)
  5. description of planned workshops or symposia Synopsis

On the basis of traditional IoV , B5G IoV technology is expected to provide: 1) Quality of service oriented reliable connection between vehicle users and base stations. In the context of B5G network, a variety of extensive coverage of macro stations and various types of micro-base stations constitute a multi-layer heterogeneous access network, which can provide low delay and high reliability on-board services for mobile IoV users; 2) Flexible resource scheduling for

diversified IoV services. Service requests of various IoV are uneven and dynamic in time and space. B5G technology can solve the service access management problems faced by base stations through adaptive network slices and elastic resource adaptation to ensure service quality; 3) Differentiated on-demand services for IoV business. In the IoV scenario, there are a large number of computation-intensive, communication-intensive and delay-sensitive business needs. B5G network technology can provide resource guarantee and service sharing for different business needs.

However, due to the unique characteristics of IoV -- lack of wireless spectrum resources,

high-speed movement of nodes, dynamic changes of network topology, etc., there are still many challenges to be solved in order to ensure mass application service quality under the ubiquitous intelligent scenario in the future. 1) Lack of spectrum resources of single dimension wireless network. With the surging demand for network resources for vehicle-mounted applications, both traffic safety and vehicle-mounted entertainment applications need high bandwidth resources. If only relying on ground wireline spectrum resources, when the network node density is high, there may be no resources available for a large number of vehicle-connected devices in local airspace, thus the service performance cannot be guaranteed; 2) Unstable high-speed mobile sensing environment. The high-speed movement of vehicle nodes causes unstable mobile sensing environment, in which the data communication is very short, accurate positioning perception and real-time tracking are difficult; 3) Multi-source dynamic heterogeneous scenarios affect reliable transmission. IoV nodes come from a wide range of sources and have strong mobility, and the network topology changes dynamically, which brings huge challenges to meet the real-time and reliability requirements of data transmission to meet complex business requirements; 4) Difficulties in ubiquitous collaboration in complex business scenarios. Complex ubiquitous intelligent iot scenarios are characterized by huge network scale, massive heterogeneous perception data, and large differences in vehicle node capabilities, which put forward extremely high requirements for real-time application, perception accuracy, and information accuracy, and collaborative computing between nodes also faces severe challenges.

In view of the above challenges, this project aims at the four key scientific issues of networking, awareness, transmission and collaborative computing existing in the ubiquitous intelligent B5G IoV system, and intends to comprehensively explore the networking theory and key technologies of B5G IoV in the ubiquitous intelligent field from five dimensions, and carry out the following research contents:

1. Networking theory and architecture for B5G IoV. This section aims to study the data-driven B5G vehicle network control architecture for urban intelligent transportation system. Based on this architecture, an efficient B5G network access management mechanism is designed to meet various service quality and network requirements. Explore the technology of arranging network resources of B5G IoV, so as to ensure that heterogeneous network resources can better serve the scene of B5G IoV.
2. Key technologies of ubiquitous perception under the B5G vehicular networks. This section aims to design a variety of high-effect and stable sensing technologies in the scenario of B5G IoV, so as to adapt to the unstable sensing environment of vehicle nodes moving at high speed. Based on millimeter-wave radar and visual perception technology, active perception strategy is

studied. Based on acoustic imaging and terahertz imaging, passive perception strategies are studied. The collaborative perception strategy of multi-vehicle nodes is studied to obtain more comprehensive environmental data, so as to better provide data support for various applications in B5G IoV scenarios.

1. Real-time transmission technology for mobile scenes. Aiming at efficient transmission of dynamic real-time perception scenes based on the characteristics of edge environment perception scenes, a variety of adaptation mechanisms were studied, including: 1) Distributed sampling and bandwidth resource adaptation mechanism for heterogeneous sensing services, so as to adapt to the time-varying status update frequency; 2) The time-varying energy-saving sampling and transmission power adaptation mechanism of sensing device functions to maximize the average utilization efficiency of energy and improve the real-time perception of status information of monitoring equipment; 3) Feedback sampling and communication delay adaptation mechanism of complex network topology, so that the sensing device can automatically adjust the sampling frequency based on the change of target state and communication delay.
2. Distributed data collaborative computing technology. Aiming at the large-scale distributed data collaborative computing scenario, the problem of insufficient ability of single edge data is investigated, the edge distributed data is integrated into the calculation, and the intelligent high-quality client selection strategy for federated learning system is studied, so as to solve the challenges of difficult quantification of client learning quality, high time complexity of client selection algorithm, and dynamic change of client number. The federated learning system of quality perception and its incentive mechanism are studied to maximize the total quality of the federated learning model.
3. B5G vehicular network integrated simulation system. By integrating the above key technologies, a B5G vehicle-mounted network integration simulation platform integrating

multi-layer network entities, different network protocols, node mobility and control algorithms is constructed to verify core technologies such as network-perception-transport-computing in complex vehicle-connected environment.

This project follows the system-level main line of "networking - perception - transmission - collaborative computing", breaks through four key technologies, develops a network integrated simulation system for ubiquitous intelligent B5G IoV, carries out large-scale verification and service deployment, and finally forms a "safety-intelligence-efficient" new architecture system and new technology for B5G IoV.

Detailed Proposal

This project focuses on the four core issues of network networking, ubiquitous perception enhancement, resource transmission scheduling and intelligent collaborative computing under the ubiquitous intelligent B5G IoV scenario, and comprehensively considers the characteristics of heterogeneous and diverse network resources, dynamic changes of ubiquitous perception, complex and limited real-time transmission, insufficient edge data capability and other scenarios. Taking "Network architecture - perception technology - transmission mechanism - collaborative computing" as the main line of research, this paper conducts in-depth research on the four key technologies of B5G vehicle-connected network networking theory and architecture, ubiquitous

perception key technology under the background of B5G, real-time transmission technology for mobile scenes, and distributed data collaborative computing technology. Based on this, a B5G vehicle-mounted network architecture supported by four key technologies is constructed, a network integration simulation system for ubiquitous intelligent B5G IoV is developed, and large-scale verification and service deployment are carried out.

Thrust 1 - Networking Theory and Architecture of B5G IoV

Centering on the above research objectives, this project plans to set three research contents: 1) Design of B5G vehicle network control architecture; 2) B5G vehicular network access management; 3) Scheduling of B5G vehicular network resources.

1-1. Design of B5G vehicle network control architecture

Considering that the management of space and earth network resources in B5G IoV requires global real-time information, this topic explores the design of centralized control architecture to solve the contradiction between real-time information collection and communication overhead. Through network virtualization, the data packet behavior of the bottom layer can be decoupled from the control of the top layer, and the unified hardware of the bottom layer can be used to support the dynamically customized control strategy. At the same time, at the application level, application requirements can be determined in advance and transmitted to the control level.

According to real-time network status information, including available air and earth network resources in the system, vehicle density, performance requirements, vehicle movement statistics, etc., the control layer can carry out network access control and network resource orchestration for different applications. However, it is very difficult to manage all the resources in an air-heaven network at the same time, because these networks have different interference ranges, and the coverage of each controller is limited due to communication overhead. On the one hand, in order to support fast optimal decision output, the system needs a large number of multi-dimensional and accurate network state information. On the other hand, the acquisition of heterogeneous network real-time full state information requires a large number of controllers, and high frequency information acquisition and update will cause a lot of communication overhead.

Therefore, it is an urgent problem to design an efficient centralized control architecture that can collect the information of air and earth network resource status in real time within the scope of communication overhead.

1-2. B5G vehicular network access management

Network access management is one of the key problems in the design of B5G IoV. However, designing efficient network access management policies is a very challenging task. Vehicle users can access through different networks. Specifically, each access mode has its own limitations, and different access modes have different special points, such as the delay, throughput, jitter and cost of ground base station, air base station and satellite communication are different, and different vehicle users have different business needs. In this case, it is necessary to select the access mode effectively to improve the overall performance of vehicle network service. This project intends to study the vehicle network access management strategy based on large-scale complex network communication system, study the intelligent access learning mechanism based on polymorphic network and vehicle user requirements, and design intelligent network access

management strategy under the condition that vehicle user needs are heterogeneous and updated in real time. Ensure that vehicle users with different requirements for delay, throughput and channel can be reasonably connected to the optimal network combined with current network resources, so as to ensure the efficient operation of B5G IoV.

1-3. Scheduling of B5G vehicular network resources

To explore the work and control flow of B5G vehicle-mounted network resource dynamic slicing technology, and to conduct problem modeling and optimization. This topic first studies the dynamic slicing technology of spectrum resources, and then extends to computing resources and storage resources. Network dynamic slicing technology needs to slice each network resource in each time slot, allocate appropriate resources for various services of each vehicle to ensure its service quality, and dynamically adjust the resource allocation strategy with the change of vehicle mobile network topology and the random change of task arrival. Therefore, this topic needs to explore the work flow of dynamic slicing, map the slicing process to specific problem decision-making, and solve the problem through complete problem modeling and optimization technology to achieve dynamic slicing.

Thrust 2 - Key Technologies of Ubiquitous Perception under the B5G networks 2-1. Research on active sensing technology in B5G IoV scenario

Due to the high business diversity and complexity in the high-mobility scenario of the Internet of Vehicles, more data needs to be quickly acquired to more accurately and efficiently identify dynamic targets and recognize complex environments, so as to provide more precise, intelligent and efficient services for vehicles. However, in the face of increasingly complex driving environment, a single sensor can no longer meet the needs of on-board terminal by relying on optimization algorithm and improving hardware performance. Meanwhile, the information capability obtained by a single sensor is limited, and its shortcomings cannot be overcome only by using the same sensor. This requires us to explore the combination of different sensors to enrich the information of IoV environment. Therefore, this project intends to study the millimeter wave radar technology and visual perception technology, which complement each other by utilizing their respective advantages of target detection, and provide an important foundation for the ubiquitous information network of the Internet of vehicles.

2-2. Research on passive sensing technology in B5G IoV scenario

Different from the way in which special sensors are responsible for sensing in active sensing technology, the passive sensing method uses existing ubiquitous signals (sound, light, radio frequency signals, etc.) in the environment to complete its own tasks (lighting, communication, etc.) and at the same time, it is used to perceive the environment, so as to significantly reduce the operating cost of the sensor system and possibly detect more information. This requires us to explore the propagation characteristics of environmental signals and clarify the coupling relationship between environmental changes and signals. Sound is everywhere. Sound waves are affected by both time and level differences. As far as sound sounds are concerned, we can visualize sound using acoustic imaging. Since the frequency of sound that humans can hear is limited, we can visualize sound using frequencies beyond the audible range. Based on the characteristics of larger absolute bandwidth and shorter wavelength of high-frequency signals,

thus smaller antennas, a sensing device of the same size can accommodate more antennas, increase the density of equipment and increase the sensing accuracy. In addition, due to the limitations of communication technology before 5G, high frequency signals such as terahertz frequency have not been fully developed for information transmission. Therefore, under the background of B5G, This project intends to study acoustic imaging technology and terahertz imaging technology in the scenario of Internet of vehicles.

2-3. Research on collaborative sensing technology in B5G IoV scenario

The collaborative perception method can effectively perceive the traffic elements and environment from different positions and angles, and use the corresponding data fusion method to combine, correlate and synthesize the perception information of individual vehicles, from which comprehensive and reliable perception information of complex traffic elements and environment can be extracted. However, in the process of vehicle collaborative perception, human factors or equipment failures may lead to incomplete data, which leads to data loss, error, noise and other problems in the real database. Therefore, data preprocessing is a key step to improve data quality. This project intends to study the preprocessing of cooperative perception data.

Thrust 3 - Research on Real-Time Transmission Technology for Mobile Scene

3-1. Research on distributed sampling and bandwidth resource adaptation mechanism for heterogeneous sensing services

There are different types of sensing services and corresponding sensing devices in actual sensing application scenarios. In multi-business scenario, different businesses have different and

time-varying requirements for perceived real-time performance. Due to limited network resources and deployment costs, the status information collected by different sensing devices for their own business objectives is usually summarized to the same monitoring center for human or intelligent system analysis and processing. Therefore, a distributed dynamic sampling mechanism is designed for the multi-source heterogeneous service scenario to adapt to the time-varying status update frequency and rationally allocate limited bandwidth resources among different services.

3-2. Research on energy saving sampling and transmission power adaptation mechanism for time-varying energy supply of sensing equipment

As the actual sensing environment is complex, the deployment range of sensing devices is far and wide, and the traditional battery-powered mode has security risks and high battery replacement and maintenance costs, more and more sensing devices use the energy collection technology for self-power supply. However, the new feeding mode is easily affected by environmental changes, resulting in unstable energy supply of sensing equipment. In the case of uncertain energy supply of sensing equipment, an effective cooperation mechanism of collection and transmission is intended to be designed, so that the sampling frequency and transmission power can be

self-adaptive adjusted according to changes in energy supply rate, so as to maximize the average utilization efficiency of energy and improve the real-time sensing of state information of monitoring equipment.

3-3. Research on feedback sampling and communication delay adaptation mechanism in complex network topology

In the actual perception application scenario, the transmission network between the sensing device (edge) and the monitoring device (center) presents the characteristics of complex topology and time-varying channel. The proposed research will be carried out from wired network and wireless network to analyze the influence of channel time-varying, topology complexity and other factors on perceptual real-time performance. In view of the random time-varying characteristics of communication delay in the transmission network, an effective collection and transmission cooperation mechanism is designed, so that the sensing device can autonomously adjust the sampling frequency based on the changes of the target state and communication delay, and improve the real-time information perception.

Thrust 4 - Research on Distributed Data Collaborative Computing Technology

This section intends to set up two research contents: 1) Research on intelligent high-quality client selection strategy for federated learning system; 2) The Federal Learning system of quality perception and its incentive mechanism.

4-1. Research on intelligent high-quality client selection strategy for federated learning systems Different from cloud servers with unlimited resources and sufficient data, distributed devices involved in federated learning are limited in terms of hardware conditions and data resources, and have heterogeneity, which will greatly affect the performance of federated learning. For example, due to the defects of sensors and the complexity of the surrounding environment information, sensors often collect some mislabeled data and low-quality data, resulting in a large difference in the quality of the model trained by terminal equipment using local data, which has a great impact on the performance of federated learning, especially the low-quality model update will seriously reduce the quality of the model. Therefore, client selection, that is, selecting suitable terminal devices from candidate clients to participate in federated learning, becomes the key to

high-quality federated learning. This project will comprehensively consider the impact of terminal device data quantity, data quality, computing power and other factors on federated learning performance, and use modern machine learning methods to design an intelligent

high-quality client selection strategy to solve the challenges of difficult quantification of client learning quality, high time complexity of client selection algorithm, dynamic change of client number and so on.

4-2. The federated learning system of quality perception and its incentive mechanism

The success of federated learning is highly dependent on the participation of compute nodes such as intelligent terminal devices. However, the training of the model and the transmission process of model update will consume a large amount of computing and communication resources of the device. Therefore, if there is no satisfactory return, the computing node will not be willing to participate in federated learning. Moreover, affected by the size and quality of training data and the computing capacity of nodes, the model updating quality contributed by nodes varies greatly. High quality model updating is beneficial to the improvement of global model quality, but low quality model updating will worsen the quality of global model and cause the problem of model convergence. Therefore, this project will design a quality-aware federated learning system, and

design an incentive mechanism for it to attract high-quality computing nodes to participate in the training of the federated learning model. This project will study the quantification and evaluation scheme of the learning quality of computing nodes, and embed the learning quality of nodes into the incentive mechanism and model aggregation algorithm to determine the allocation scheme of federated learning tasks and the reward scheme of nodes, so as to maximize the total quality of the federated learning model.

Thrust 5 - B5G Vehicular Network Integrated Simulation System

We plan to design a comprehensive B5G vehicle-mounted network integration simulation platform. Considering the complex network architecture, high mobility and dynamic network conditions and requirements of B5G, developing the simulation platform is a challenging task. The simulation platform designed should have the following different characteristics.

Integration: In the B5G scenario, the simulation platform needs to provide a model of the complex network structure and communication environment. Therefore, the platform needs to integrate different simulation software to simultaneously support different network protocols and communication capabilities.

Controllability: The platform needs to control the heterogeneous network. Different from the implementation of existing network controllers, heterogeneous network controllers in B5G are deployed on edge nodes and cloud servers and mainly focus on wireless access to the network, handling network information collection and monitoring, mobility management, wireless resource coordination, and other types of network control.

Flexibility: The platform should not only support existing network protocols and flexibly customize network control functions, but also retain the extension of the application of new communication protocols and algorithms. Therefore, the simulation platform needs to implement various interfaces to support different functions.

Cooperative Activities

We plan to carry out cooperative activities into the following ways:

1. Annual Workshop: A joint annual workshop will be held once every year in the order of China and Canada. The purpose is to discuss research results and find mutual common research interests;
2. Group-level Mutual Visit, Joint Seminar and Further Research Collaboration: A group

of several research lab members in each country can visit other country and hold joint seminars and discuss their results and pursue further research collaboration.

1. Individual-level Mutual Visit, Joint Seminar, and Further Research Collaboration: Each professor’s research lab members can visit some counterpart research labs and hold joint seminars and discuss their research results.
2. Student/Professor Exchange Program: We encourage graduate students and/or

professors (research fellows) to have a short-term visit to carry out a collaborative research. We can support this program through this Foresight budget.

1. Further Collaboration Work: We encourage members to jointly write papers through their collaborative research work. In addition, we encourage members to propose some joint

projects through their collaborative research work. Moreover, we encourage members to submit some contributions to international standard bodies through the collaborative research work.

# Annual Work Plan:

**Milestone Starting date ~ Completion date**

**1-1. Design of B5G vehicle network control architecture 2024.01.01 ~2024.06.30 2-1. Research on active sensing technology in B5G IoV scenario**

**3-1. Research on distributed sampling and bandwidth resource adaptation mechanism for heterogeneous sensing services**

**4-1. Research on intelligent high-quality client selection strategy for federated learning systems**

**1-1. Design of B5G vehicle network control architecture 2024.07.01 ~2024.12.31 2-1. Research on active sensing technology in B5G IoV scenario**

**3-1. Research on distributed sampling and bandwidth resource adaptation mechanism for heterogeneous sensing services**

**4-1. Research on intelligent high-quality client selection strategy for federated learning systems**

**1-1. Design of B5G vehicular network control architecture 2025.01.01 ~2025.06.30 2-1. Research on active sensing technology in B5G IoV scenario**

**3-1. Research on distributed sampling and bandwidth resource adaptation mechanism for heterogeneous sensing services**

**4-1. Research on intelligent high-quality client selection strategy for federated learning systems**

**1-2. B5G vehicular network access management 2025.07.01 ~2025.12.31 2-2. Research on passive sensing technology in B5G IoV scenario**

**3-2. Research on energy saving sampling and transmission power adaptation mechanism for time-varying energy supply of sensing equipment 4-2. The federated learning system of quality perception**

**and its incentive mechanism**

**1-2. B5G vehicular network access management 2026.01.01 ~2026.06.30 2-2. Research on passive sensing technology in B5G IoV scenario**

**3-2. Research on energy saving sampling and transmission power adaptation mechanism for time-varying energy supply of sensing equipment 4-2. The federated learning system of quality perception**

**and its incentive mechanism**

**1-2. B5G vehicular network access management 2026.07.01 ~2026.12.31 2-2. Research on passive sensing technology in B5G IoV scenario**

**3-2. Research on energy saving sampling and transmission power**

**adaptation mechanism for time-varying energy supply of sensing equipment 4-2. The federated learning system of quality perception**

**and its incentive mechanism**

**1-3. Scheduling of B5G vehicular network resources 2027.01.01 ~2027.06.30 2-3. Research on collaborative sensing technology in**

**B5G IoV scenario**

**3-3. Research on feedback sampling and communication delay adaptation mechanism in complex network topology**

**1-3. Scheduling of B5G vehicular network resources 2027.07.01 ~2027.12.31 2-3. Research on collaborative sensing technology in**

**B5G IoV scenario**

**3-3. Research on feedback sampling and communication delay adaptation mechanism in complex network topology**

**1-3. Scheduling of B5G vehicular network resources 2028.01.01 ~2028.06.30 2-3. Research on collaborative sensing technology in**

**B5G IoV scenario**

**3-3. Research on feedback sampling and communication delay adaptation mechanism in complex network topology**

**5. B5G Vehicular Network Integrated Simulation System**

**5. B5G Vehicular Network Integrated Simulation System 2028.07.01 ~2028.09.30 Summary and Reports 2028.10.01 ~2028.12.31**

1. **Budget Estimation:**
2. **Chinese Side:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Year 2024 | Year  2025 | Year  2026 | Year  2027 | Year  2028 | **Total** |
| Research Cost | 200K | 300K | 300K | 300K | 300K | 1400K |
| Equipment/Instruments | 150K | 200K | 100K | 100K | 50K | 600K |
| Seminar/Workshop Costs | 70K | 60K | 60K | 60K | 50K | 300K |
| Cooperation and  Exchanges | 90K | 80K | 80K | 80K | 70K | 400K |
| Others\* | 60K | 60K | 60K | 60K | 60K | 300K |
| **Total** | 570K | 700K | 600K | 600K | 530K | 3000K |

* Please specify:Administration (5%), lab re-construction and other unpredicable costs

# Total Amount Applied for from NSFC:3000K yuan RMB Total Amount from Other Sources:0

1. **Cooperative Side:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Year  2024 | Year  2025 | Year  2026 | Year 2027 | Year  2028 | **Total** |
| Research Cost | 15K | 20K | 20K | 20K | 25K | 100K |
| Equipment/Instruments | 3K | 4K | 4K | 4K | 5K | 20K |
| Seminar/Workshop Costs | 4K | 6K | 7K | 7K | 6K | 30K |
| Cooperation and Exchanges | 4K | 7K | 7K | 6K | 6K | 30K |
| Others\* | 4K | 4K | 4K | 4K | 4K | 20K |
| **Total** | 30K | 41K | 42K | 41K | 46K | 200K |

* Please specify:Consumables and energy

# Total Amount Provided by the collaborator:0

**Total Amount from Other Sources:200K US dollars**

1. **Signatures:**

Signatures of persons in charge, dates and places (“I assure that the information I have presented in this application and its appendices is correct and that all the factors essential for the processing of the application have been included. I undertake the responsibility that, in the event that NSFC grants funding, the funds will be used for the purpose for which they have been granted, the project will be conducted as planned and the reports required by NSFC will be submitted.”)

Date and place: Date and place:

Signature: Signature:

Chinese Applicant Cooperative Side

(may be replaced by letter of confirmation)

# Attachment: Cooperative Agreement (including the sharing of intellectual property rights) and other Necessary Documents