Advanced space astronomical facilities

- The Hard X-ray Modulation Telescope (HXMT) will be a collimated hard X-ray (20-200 keV) telescope that, once built, will have the highest sensitivity and spatial resolution power in the world. The mission began in March of 2011, and it will be developed and sent into space within the nation’s twelfth Five-Year Plan. It will perform an all-sky hard X-ray survey, in which about 1,000 new hard X-ray sources, including possible point-like sources of important cosmic X-ray sources, such as black holes and neutron stars, will be discovered.

Main scientific objectives:

1. HXMT will conduct an all-sky hard X-ray survey to discover new hard X-ray sources, including possible new types of objects, and observe important high-energy celestial bodies.

2. HXMT will observe the temporal variability of high-energy sources, the formation and evolution of accretion disks, jets and black holes, and perform further tests of general relativity.

3. HXMT will observe the hard X-ray spectra of the X-ray binaries and pulsars, measure the rotation of black holes, and study the magnetic fields and inner structures of neutron stars.

- The LHAASO is one of the major science facilities in the nation’s twelfth five-year plan, which is intended to explore the origins of high-energy cosmic rays, study the evolution of the universe and high-energy celestial bodies, and push forward the frontiers of new physics.

Features of LHAASO

- The commissioning site of HXMT payload high energy gamma-ray telescope

- LHAASO will accurately measure the energy spectra of all cosmic ray species above 0.1 PeV.

- It will also be the most sensitive detector for gamma rays above 10 TeV in the world. This will enable high precision measurements of the high-energy end of the spectra for the most gamma-ray sources, which will lead to the identification of source families of galactic high-energy cosmic rays.

Alpha Magnetic Spectrometer Experiment

- The Alpha Magnetic Spectrometer (AMS) is a large international collaborative program under the leadership of Nobel Laureate Samuel Ting, a famous physicist and a Nobel Prize laureate in physics. The experiment will use the unique environment of space to study the universe and its origin by searching for antimatter and dark matter while performing precision measurements of the composition of cosmic rays and the flux of cosmic rays from about 60 research institutions in 16 countries, including the United States, China, Russia, Poland, Kennedy, Italy, Romania, and Switzerland.

- In the AMS-02 program, scientific researchers from the Institute of High Energy Physics (IHEP), the University of Pisa in Italy, and the Laboratoire d'Annecy-le-Vieux de Physique des Particules in France developed an electromagnetic calorimeter weighing 700 kg. The AMS-02 was successfully installed on the International Space Station (ISS) in 2011 and released its first results on the search for dark matter particles in April 2016.

- As part of the AMS-01 program, scientific researchers from the Institute of Electrical Engineering (IEE), IHEP, the Center for Space Science and Applied Research (CSSAR), and the Chinese Academy of Launch Vehicle Technology (CALVT) joined in the design and manufacture of the permanent magnet. Loaded on board the American space shuttle ST91 of “Discoverer” on June 2, 1998, the permanent magnet of AMS-01 was the first large magnetic spectrometer ever sent into space.

- In the AMS-02 program, scientists and engineers from IHEP, the University of Rome in Italy, and the Laboratoire d’Annecy-le-Vieux de Physique des Particules in France developed an electromagnetic calorimeter weighing 700 kg. The AMS-02 was successfully installed on the International Space Station (ISS) in 2011 and released its first results on the search for dark matter particles in April 2016.

- In 1988 and 2011, the permanent magnet of Alpha Magnetic Spectrometer was sent into the International Space Station. The permanent magnet was partly developed by IHEP, the Institute of Electrical Engineering and the China Academy of Launch Vehicle Technology, and was the first large permanent magnet sent into space by humankind.

Particle Astrophysics
Disciplinary orientation

Particle astrophysics, also known as astroparticle physics, is a branch of particle physics focusing on observations of astronomical objects at both microscopic and macroscopic levels, and the study of elementary particles and their interactions in the universe. Its research encompasses the exploration of the fundamental interactions of matter, the origin and evolution of the universe, and the study of dark matter and dark energy. This field is at the intersection of high-energy physics, astrophysics, and cosmology, and is continually expanding to address the most pressing questions in modern physics.

High Energy Physics Research

Institute of High Energy Physics

The Institute of High Energy Physics (IHEP) is a research institute with a focus on high-energy physics research. It was founded in 1958 and is located in Beijing, China. The institute conducts research on particle physics, astrophysics, detector physics, and relativity. It is known for its contributions to the understanding of cosmic rays, neutrinos, and dark matter.

High-energy physics research at IHEP.

A team of researchers at IHEP finds that the neutrino mass (the mass of a neutrino) is not zero, which is a significant discovery in the field of particle physics.

Disciplinary development

In 1954, the Luoxue Mountain Cosmic Rays Research Center was established at 3,200 meters above sea level in Dongchuan, China. This center was later moved to Longling, Yunnan Province. This move allowed for the development of high-energy physics research on cosmic rays. In 1972, a heavy particle with mass possibly exceeding 1 GeV was discovered at the Luoxue Mountain Cosmic Ray Research Center. This discovery marked the beginning of high-energy physics research in China.

The ASγ Experiment (Sino-Japanese Cooperation)

A joint international research team discovered that some black holes, which reach saturated luminosities above a certain accretion rate, can become electromagnetic h الدين (ICR). This discovery is significant as it provides new insights into the behavior of black holes and the nature of gravitational waves.

The detectors of the ARGO-YBJ Project were installed and put into operation in June 2006. The ARGO-YBJ project observed a large number of high-energy particles and X-rays, and then analyzes the chemical element composition of the sample. The alpha-induced X-ray spectrometer is one of the payloads of Chang'e-3 lunar exploration project.

The Large Area Water Cherenkov Array (LAWCA) is a new type of water Cherenkov detector. It will use water Cherenkov techniques aimed mainly at a multi-wavelength analysis of Mrk 121 from February to May 2010. On February 16, 2010, the EAS array began observing TeV flares every 4-5 seconds.

LAWCA Experiment

The Alpha-Induced X-ray spectrometer is one of the payloads of Chang'e-1 lunar exploration project. The alpha-induction of X-ray spectrometer is an effective way to observe the composition of the solar wind. The detection of the ARGO-YBJ Project was installed and put into operation in June 2008. The ARGO-YBJ project observed a large number of high-energy particles and X-rays, and then analyzes the chemical element composition of the sample. The alpha-induced X-ray spectrometer is one of the payloads of Chang'e-3 lunar exploration project.

The Large Area Water Cherenkov Array (LAWCA), a new type of water Cherenkov detector, is being planned to be constructed on Mount Yangbajing, which is a rich geothermal power source, make it among the best sites in the world for high-altitude cosmic ray observations. The ARGO-YBJ experiment hall will use water Cherenkov techniques aimed mainly at a multi-wavelength analysis of Mrk 121 from February to May 2010. On February 16, 2010, the EAS array began observing TeV flares every 4-5 seconds.

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High-energy physics research

A joint international research team discovered that some black holes, whose accretion luminosity exceeds a certain threshold, can become electromagnetic h الدين (ICR). This discovery is significant as it provides new insights into the behavior of black holes and the nature of gravitational waves.

ARGO-YBJ experiment hall (Sino-Italian Cooperation).

The X-ray spectrometer developed at IHEP is important payload for China's lunar exploration project, the Chang'e-1 satellite and the Chang'e-2 satellite. Launched on October 1, 2010, the X-ray spectrometer aboard the Chang'e-1 satellite observed 180 gamma-ray bursts is currently a hot topic, and it is also an important disciplinary orientation at IHEP.

The Chang'e-2 satellite payload X-ray spectrometer was successful launched on October 1, 2010. While orbiting the moon for 100 days in one year, it has obtained 100 days of X-ray data. The world first X-ray line on a lunar surface was observed. The first map of Al element based on X-ray spectra on lunar surface was generated. The X-ray spectrometer is an effective way to observe the composition of the solar wind.

The ASγ Experiment (Sino-Japanese Cooperation)

The world first Cr characteristic fluorescent X-ray spectrum line on lunar surface.

The change in the X-ray spectrum line.

As an international team, researchers at IHEP and IASU found that some black holes, which reach saturated luminosities above a certain accretion rate, can become electromagnetic h الدين (ICR). This discovery is significant as it provides new insights into the behavior of black holes and the nature of gravitational waves.

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