In This Issue

Special | Return of *Chang'e*-5

On December 17 we just witnessed the sophisticated re-entry of a *Chang'e*-5 capsule into the terrestrial atmosphere, together with about 2 kg lunar soils and rocks. Its milestone touchdown marks the first return of lunar samples in over 40 years – last time human beings saw such a return was in 1976.

The returner capsule of *Chang'e*-5 is illustrated detaching from the orbiter that has carried it back to the Earth. (Computer animation by CASC)

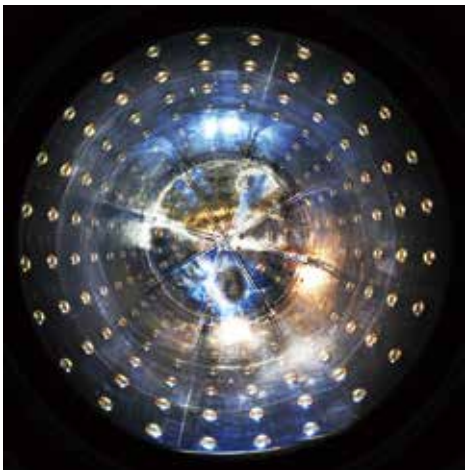
The successful return also marks the satisfactory completion of the *Chang'e*-5 space mission, the finale of the Phase I of China's Lunar Exploration Program (CLEP). The data as well as samples collected in CLEP missions will help scientists understand background characteristics of the landing site, the formation and evolution of lunar soils, the physical-chemical characteristics of lunar rocks and soils, and lunar geochemical evolution.

As an initiator of CLEP, the Chinese Academy of Sciences (CAS) has played an important role in defining and implementing the Program's scientific objectives. Now with the samples returned, a new stage featuring systematic, long-term lab analysis and research has begun, and new insights into the structure, physical properties, and chemical compositions of the lunar soils are expected to deepen our understanding of the origin and evolution of the Moon.

Turn to page 198 for the story.

InFocus | Farewell, Daya Bay; Hello, Multi-messenger Astronomy

On March 8, 2012, the Daya Bay Neutrino Experiment collaboration announced the discovery of a new type of neutrino "oscillation", the transformation between three known "flavors". This discovery, listed into *Science*'s picks for the annual 10 breakthroughs in the same year, earned the team the Breakthrough Prize for Fundamental Physics in 2016, and the team was also awarded a First Prize of the National S&T Awards for Natural Science of China.



Photomultipliers are installed on the inner wall of the neutrino detector of Daya Bay Neutrino Experiment to pick up the dim signals given off by the neutrinos. (Credit: IHEP)

On December 12, scientists saw the shutdown of the experiment site, located within a mile off the reactors of the Daya Bay nuclear power plant in Guangdong Province of southern China. Went into operation in 2011, it has now accomplished its mission and finished producing data. The experiment goes on, however. The scientific team, an international collaboration joining forces of 237 participants at 41 institutions in China, the U.S., the Czech Republic, Russia, and Chile, will continue to

analyze its complete dataset to improve upon the precision of their findings, based on the earlier measurements.

The prospective results could also benefit the exploration into the universe's matter-antimatter imbalance, an open question in fundamental physics. Physicists believe that neutrinos may have played a role in this imbalance through the breaking of a fundamental physics law known as charge-parity (CP) violation.

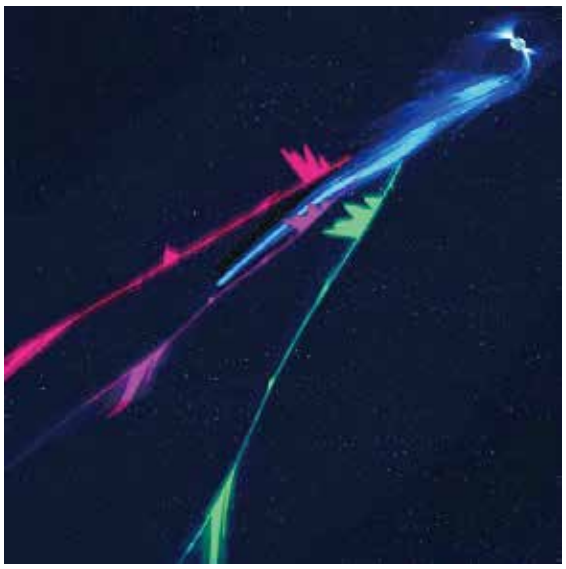
Turn to page 203 for detail.

A small pair of micro-satellites quietly embarked on a ground-breaking journey on December 10. Named "Huairou-1", the twin satellite is a mission set for a CAS-sponsored project called "the Gravitational wave high-energy Electromagnetic Counterpart All-sky Monitor (GECAM)". It marks the first ever space-based instrument of China for the search of electromagnetic (EM) counterparts of gravitational wave (GW) sources. By monitoring and detecting high-energy X-ray and gamma-ray signals, it will capture EM profiles of drastic astronomical events – like the merging of two black holes or neutron stars – that potentially stir up gravitational waves, hence help astronomers embrace the opportunities of the era of multi-messenger astronomy.

For more, please see page 206.

(Image by IHEP)

Highlights | FRBs Caught FAST's Eye



FAST team detected diverse polarization angle swings from a repeating fast radio burst source labelled as FRB 180301. (Credit: NAOC)

After nine years of construction, debugging and testing, the National Astronomical Observatories, CAS (NAOC) officially launched the Five-hundred-meter Aperture Spherical radio Telescope (FAST), the biggest and the most sensitive single-dish radio telescope of the world, in January 2020. With its first observational session, it has offered high-quality data that led to remarkable and inspiring discoveries. Among them are the results on the physical nature and origin of fast radio bursts (FRBs), the extremely strong radio waves with durations of only milliseconds.

From their careful analysis into the polarization signals of 11 radio bursts recorded by FAST on October 6 and 7, scientists got intriguing results. The polarization properties of seven of them showed not only interesting swings of polarization, but also diversity of swings. Such diverse polarization, never seen in any radio burst before, is believed to favor a model for FRB generation

suggesting that the bursts are produced in the magnetosphere of compact stars with extremely strong magnetic fields, such as neutron stars, and disfavors another model saying that the bursts are produced by jets of plasma. The results were published in *Nature* on October 28. See page 208 for a brief story.

Another team, based on data from an observational campaign occurring in April, gave strict constraints on the radio flux of the first FRB found within the Milky Way, a soft gamma-ray repeater labelled as SGR J1935+2154. Their analysis also concluded that there is a weak correlation between fast radio bursts (FRBs) and soft gamma-ray repeater J1935+2154. The work, published in *Nature* on November 4, was selected by both *Nature* and *Science* magazines into their lists of top scientific achievements of 2020. For more, please turn to page 210.

ThinkTank Reports | Suggestions on Enhancing Institutionalized Participation of S&T Community in Law Making

In this column we present a report released by a consultative group of CAS Academic Divisions. In the report, experts suggest enhancing institutionalized participation in law making by the Chinese S&T community, given that S&T factors are pervasive in everyday life of today's China. Drawing on legislation practice of developed countries on issues involved with science and technology, authors also give their thoughts on potential procedure applicable to China.

Please see page 212 for detail.