Protecting the outer space environment contributes to sustainable space activities

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Introduction

- Outer space environment is important and fragile
- Environmental worsen is threat to human activities
- The need for enhancing space governance to address the challenge is rising
- Protection the space environment is indispensable for space activities
1. **Space debris**
   - Human activities in space are the main source of space debris
   - Debris have been produced at least hundreds of millions
   - Space debris is growing rapidly
   - LEO debris will reach amount of a critical value within a few decades
1. **Space debris (continue)**

- The Debris impact on spacecraft is no longer a small probability event, but often occurs
- ERS-1, the Mir space station, etc. often conduct orbital maneuvers to avoid debris collisions
- If space debris grows at this rate, the near earth space will be difficult to be used continuously
2. **large constellation deployment**

- Space is going to get more congested, intensifying the concern of use in satellite frequency and orbit resources.
- Driven by low cost, the satellite anomalies induced by the space radiation environment will become more significant.
- The operation of a large fleet of satellites poses risks to the background electromagnetic environment in outer space.
3. Space weather

- High-energy Protons, electrons, electromagnetic radiation etc. in space induce anomalies of on-orbit system
- The sudden increase of atmospheric density will lead to the satellite orbit decay, even tracking of debris is lost
- Ionospheric storm can cause interrupt in communication and navigation systems
4. Artificial radiation

- Nuclear explosion can produce radioactive dust and particles
- The artificial radiation belt formed is stronger than natural level
- Space-based high-power radar can also improve electromagnetic background radiation level
- Radiation environment seriously affects the safety of satellite, etc.
Space is full of energies, particles, debris, and objects, in order to ensure sustainable space activities, we need to take the following measures.

- Environmental awareness
- Pollution control
- Impact mitigation
- …
1. **Strengthening environmental awareness**

   Detecting the distribution and evolution of the outer space and know the hazards to outer space activities:
   - Approaching celestial objects trajectories
   - Electromagnetic spectrum interference
   - Space debris distribution
   - Solar storms and impacts …
1. Strengthening environmental awareness (continue)

- Implementation of construction projects of the Asia-Pacific Space Science Observatory and the International Meridian Science
- Launched advanced environmental exploration test test satellites
- Environmental exploration on the moon and Mars
- Forming debris and space weather monitor system
2. Less environmental pollution

- Follow the international outer space security regulations and strengthen the supervision of compliance
  - Implement space debris mitigation
  - Passivation of the last stage of rockets
  - De-orbit satellites at their end of life
  - Charged particle cleaning
  - Orbital electromagnetic noise control
  - Orbital removal of space objects
2. Less environmental pollution (continue)

- Follow the international outer space security regulations and strengthen the supervision of compliance
- Participate in the activities of IADC, COPUOS and other organizations to formulate relevant laws and policies, to further international cooperation
- Strictly control the flight license for our launch activities
- Regulate our space launch activities
- De-orbiting of the upper part of the rocket
2. Less environmental pollution (continue)

- Carry out space debris mitigation and removal technology experiments, such as launched the "Aalong No.1" aircraft, etc.
- Promote the verification of debris removal technology
- Participate in the test of actively cleaning charged particles in space
- Fulfilling environmental protection in the construction of space facilities
3. Reduce environmental impact

- Strengthen international cooperation in global early warning of severe space weather and joint disposal of space debris risks

- Detect solar activity, space object trajectories, electromagnetic spectrum information, etc.
- Develop accurate solar storm early warning
- Debris trajectory prediction
- Space traffic safety management
3. Reduce environmental impact (continue)

- BITTT (China) and the United States counterpart have established safety cooperation mechanism of space collision in 2014
- Undertake relevant tasks of international environmental organizations
- Established environmental impact correction system to improve the robustness of the on-orbit system
Thanks