KPLO Gamma Ray Spectrometer (KGRS) Data Management. S. Kim[1,2], K. Kim[1,2], [1]University of Science and Technology, Daejeon, Republic of Korea; [2]Korea Institute of Geoscience and Mineral Resources, Geology Division, Daejeon, Republic of Korea; yeon78@kigam.re.kr; kjkim@kigam.re.kr

Introduction: In 5 August 2022 (KST), Korea Pathfinder Lunar Orbiter (KPLO), the Korea's first lunar orbiter, was launched by Space-X's Falcon-9. KPLO Gamma-Ray Spectrometer (KGRS), one of the scientific instruments of the KPLO, will measure Gamma-Rays across the lunar surface to survey lunar resources and create element maps.

To save fuel, it used a Ballistic Lunar Transfer (BLT) trajectory. With this type of orbit, the journey of the spacecraft takes about four months and three weeks after launch [1, 2]. During this period, gamma rays from deep space will be observed by KGRS. The main purpose of this phase for KGRS is detecting gamma burst as well as obtain background spectrum of KGRS that is distinct from the lunar gammar rays. Gamma bursts are the most energetic and luminous electromagnetic events in the universe [3].

To check whether gamma burst signals are detected and whether there are any problems with the instrument, the KGRS team processes and stores each data in several steps, and carry out daily monitoring.

KGRS Data Formats: The data file first received from KARI is a .tm file containing approximately 1-3 days of data at a time. In order to check and manage this file more conveniently, it is converted to .csv file. At this time, it is divided into one file per single packet (10 seconds). KGRS collects a data every 10 seconds. In the first received tm file, each data's time is recorded in OBT format, and we converted it into UTC format, which is intuitively easy to recognize. In this way, the file in which UTC time is added to the original data is raw data.

The detailed process for creating raw files is as follows. First, convert the .tm file to .csv file using the 'KPLO Tool' program provided by Nucare. This program allows us to immediately check the .tm file information by packet and save it as a single .csv file.

Second step is time converting. There is one problem with OBT time of KGRS. OBT time with an incorrect value is recorded intermittently due to an system error. To solve this problem, when converting to a .csv file in KPLO Tool, the occurrence of such an error is indicated in the file, and based on this, the time error is corrected in the process of converting OBT Time to UTC Time.

All information in the original .tm file is included in Raw Data. It contains scientific data such as 'Gamma Burst' count value, 'LG Anti-coincidence spectrum 8192ch', 'LG Raw spectrum 8192ch', 'HG Anti-coincidence spec-trum 4096ch', 'HG Raw spectrum 4096ch', 'BLPS Anti-coincidence spectrum 1024ch', and 'BLPS Raw spectrum 1024ch', as well as technical data such as 'Packet No', 'Deadtime', and Temperature.

Partially Processed Data (PP Data) includes only a part of these data. Among the information of raw data file only 'LG Anti-coincidence spectrum 8192ch', 'HG Anti-coincidence spectrum 4096ch', and 'BLPS Anti-coincidece spectrum 1024ch' are remained, and instead Position and attitude information such as 'Lunar center – KPLO distance', 'Moon – KGRS boresight separation' are added.

Position and attitude information can be extracted using the Spacecraft Planet Instrument C-matrix Events (SPICE) system. SPICE is an observation geometry information system developed by NASA's Navigation and Ancillary Information Facility (NAIF). [4, 5].

The SPICE system can be accessed through various program languages. We used the python. To extract the location information of KPLO and KGRS, a SPICE kernel suitable for each satellite is required. The SPICE kernel is delivered in the same way as the KGRS science data, with time delay of a few days.

PP Data and Raw Data are saved as .csv files by date. The general folder organization of KGRS Data is shown in Fig. 1.

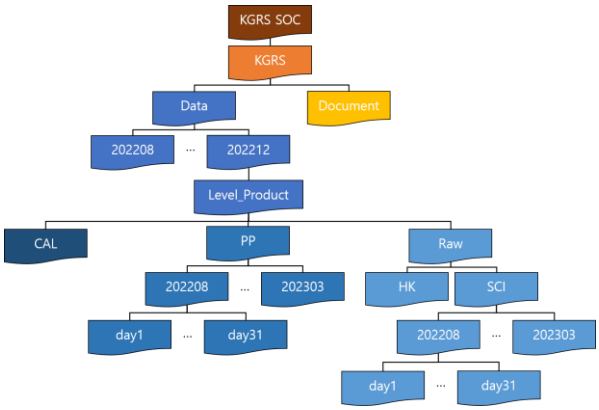

Fig. 1 KGRS Data folder organization

Daily Monitoring: A monitoring program was developed to easily visualize important information that needs to be checked every day. (fig. 2) In this program, we can collect the information of the data for the peri-

od that user want and make it into one summed data file.

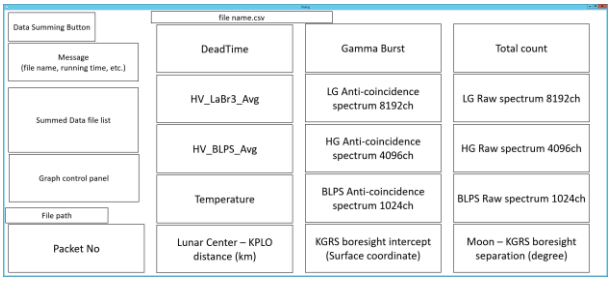

Fig. 2 Contents of KGRS Data Monitoring.

If we click the Data Summing Button after entering the date we want to sum, Summed Data according to the entered date is created. Items included in Summed Data are 'Packet No', 'DeadTime', 'Gam-ma Burst', 'Total count', 'HV_LaBr3_Avg', 'HV_BLPS_Avg', 'Temperature', 'LG Anti-coincidence spectrum 8192ch', 'LG Raw spec-trum 8192ch', 'HG Anti-coincidence spectrum 4096ch', 'HG Raw spectrum 4096ch', 'BLPS Anti-coincidence spectrum 1024ch', and 'BLPS Raw spectrum 1024ch', and 'Lunar Center – KPLO distance'. Of these, 6 spectrum items are created by summing up all the values during this period.

The list of created summed data is displayed in the 'Summed Data File List' on the left center of the screen, and when we select the file name, the data of that file is visualized and displayed as a graph on the right side of the screen.

With this program, we create summed data every day, check graphs of important information, and monitor whether there are any special signals or major error of KGRS instrument.

Conclusion: KGRS Data is classified, organized, and managed as above. Through daily monitoring, problematic data is identified and checked. Also, with this system, we can record gamma ray signals detected by KGRS. For example, a strong gamma burst occurred on October 9 was successfully identified.

Until now, only simple monitoring has been carried out, but if enough data are accumulated after arriving at the moon, the mapping process will be started by classifying data by position on the lunar surface with a data correction process.

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