Results of the One-Year Operation of the Wide-Angle Polarimetic Camera Onboard Danuri. Young-Jun Choi[1, 2], Minsup Jeong[1], Sungsoo S. Kim[3], Kilho Baek[3], Eunjin Cho[5], Minbae Kim[1], Bongkon Moon[1], Chae Kyung Sim[1,2], Dukhang Lee[1], Kyung-In Kang[4], BonJu-Gu[4], [1]Korea Astronomy and Space Science Institute, [2]University of Science and Technology, Korea, [3]Kyung Hee University, Korea, [4]Korea Advanced Institute of Science and Technology, Korea, [5]Chungnam National University, Korea (yjchoi@kasi.re.kr).

Introduction: The Danuri lunar orbiter, successfully launched on August 5th, 2022, incorporates the Wide-Angle Polarimetric Camera (PolCam) as a scientific instrument. The primary objective of the camera is to obtain polarization data across the lunar surface at two distinct wavelengths (430 nm and 750 nm) and cover a broad range of phase angles from 0° to 135° while operating at a spatial resolution of approximately 40 meters. PolCam also takes an image of 320 nm photometry data to obtain reflectance ratio at 320 nm and 430 nm for the lunar surface, maintaining a similar spatial resolution.

The PolCam data can unveil about the Moon's regolith. By employing polarimetry, we can obtain lunar regolith properties such as grain size, maturity, and porosity. These data are able to contribute to our understanding of the lunar surface composition and its geological evolution [1, 2].

Furthermore, the calculated reflectance ratio at 320 nm to 430 nm serves as a crucial metric for estimating the distribution of TiO2 across the lunar surface.

Operation mode: The initial observation plan for PolCam was designed to capture the region within a latitude range of ±70 degrees for 45 minutes in each orbit, maintaining a spatial resolution of 81 meters. However, with the extension of Danuri's mission duration from 1 year to 3 years, there was a consequential augmentation in the total allowable data for observations. This led to a strategic decision to enhance mission resolution, reducing it from the original 81 m to 40 m.

In the early stages of operation, PolCam faced limitations in the size of its PDHU partition, necessitating the division of the observation latitude range of -70 to +70 into three segments. However, as of December 2023, a refined operational approach has been implemented, with observations now conducted by partitioning the latitude range into two segments. This adjustment demonstrates the adaptability and optimization efforts undertaken to maximize the scientific yield from PolCam throughout the extended mission period.

Data Reduction: The current data processing for PolCam is facilitated by software applications developed in both IDL and Python. In the processing workflow, IDL and Python leverage the telemetry and SPICE kernel provided by Danuri for meticulous geometry correction. It's noteworthy that an ongoing development effort is dedicated to creating software utilizing ISIS3, and we intend to make it publicly available once the development reaches completion. The data reduction flow chart is shown in Figure 1.

As illustrated in Figure 2 below, the lunar map is a product of PolCam's observation data processed with the IDL software. While some areas have yet to be observed, it is anticipated that these data gaps will be addressed and filled in soon, contributing to a more comprehensive understanding of the lunar surface.

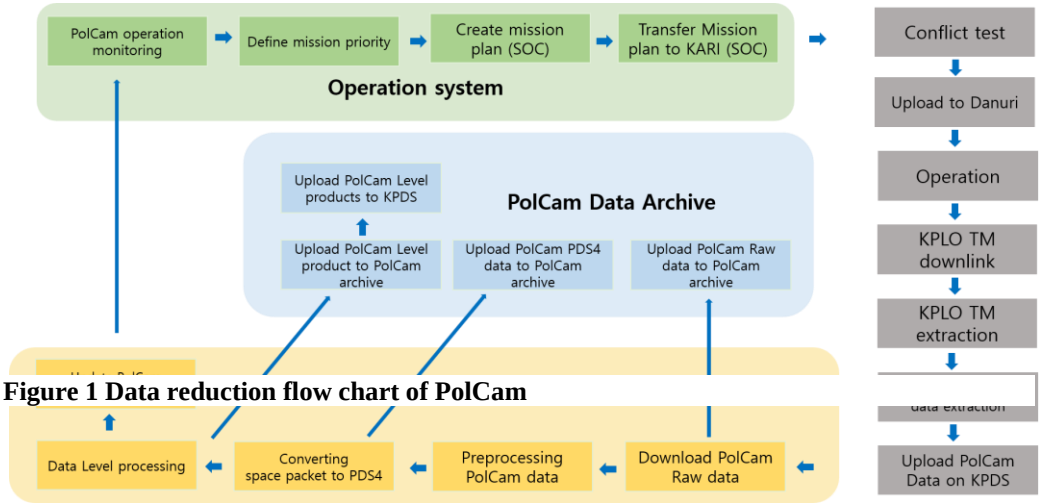

Figure 1 Data reduction flow chart of PolCam

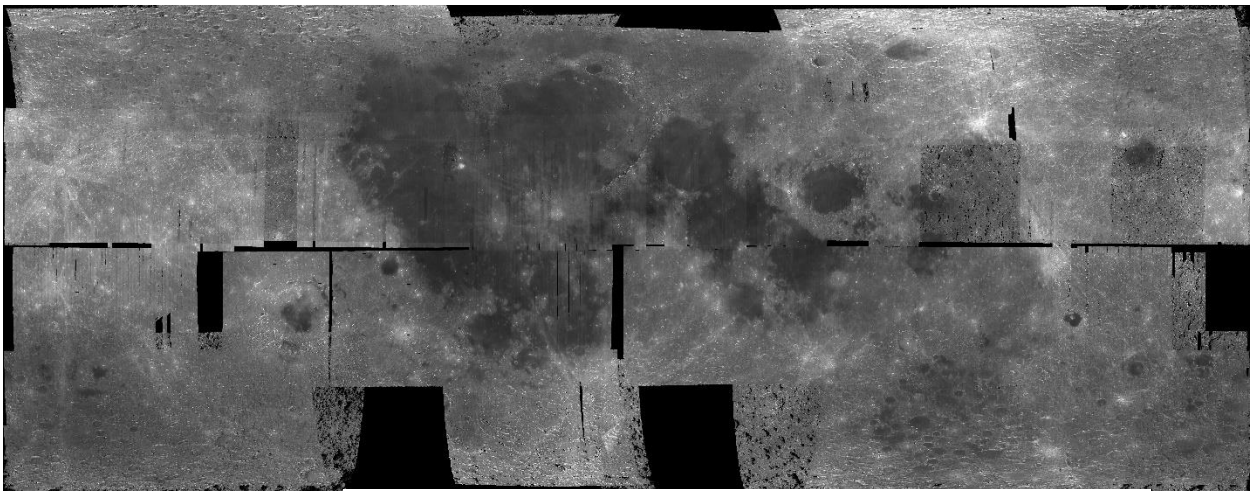

Figure 2 Map from 430 nm channel of PolCam

Conclusion: We plan to introduce the operational policies of PolCam over the operation of one year, including data coverage, the phase angle range of observation data, the outcomes of data processing software development, and preliminary results derived from PolCam data.

References: [1] Jeong et al. (2015) ApJS, 221:16. [2] Shkuratov et al. 2007, ICAR., 187, 406-416