Research Report
ICRR Inter-University Research Program 2020

Research Subject: Engineering runs of the first Large Size Telescope of CTA and construction of LST2-4 in La Palma Canary Islands, Spain

Principal Investigator:
Mazin, Daniel

Participating Researchers:
Daniel Mazin, Masahiro Teshima, Daniela Hadasch, Koji Noda, Juan Cortina, Carlos Diaz, Thomas Schweizer, Holger Wetteskind, Carlos Delgado, Riccardo Rando, Takayuki Saito, Armand Fiasson

Summary of Research Result：

Figure 1: Completed LST1 in La Palma in October 2018.

The purpose of the project is to commission the first Large Size Telescope (LST, see Figure 1) of the CTA project in La Palma, Canary Islands, Spain. In FY2020 the goal was to automatize data taking procedure. Triggered by COVID-19, the goal has shifted to be "automatize the operation and allow a safe remote operation" of the telescope. The commissioning of the LST1 began in November 2018, which is intensive collaborative work of engineers and physicists of the entire LST project under my supervision.

Status of the commissioning: Several commissioning goals have been achieved in FY2020. In particular, the telescope can be operated by shifters without any experts on-site. Remote support from experts is provided whenever needed via designated communication channels, typically on the day after the problems or questions occurred. The status of the central control software, dubbed Telescope Control Unit (TCU, see Figure 2),

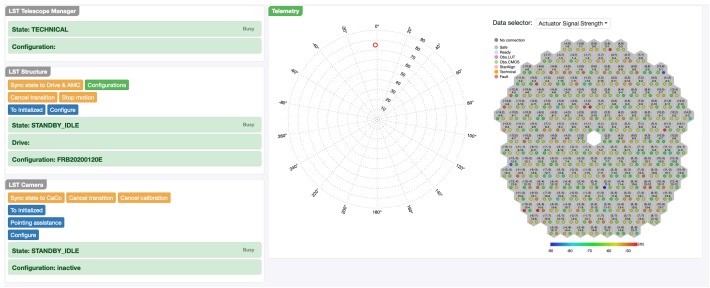

Figure 2: GUI of the Central Control software of LST1

progressed very well and it is now routinely used to operate the telescope. This replaces the need to operate the telescope through individual engineering semi-expert interfaces. The telescope has been routinely operated every dark night in FY2020, with exception of the first wave in COVID-19, which imposed a break between March and June 2020.

COVID-19. Triggered by the pandemic we developed a safety and operation concept allowing us to operate the telescope from remote. The IT infrastructure has been improved and working conditions onsite have been adapted to Spanish COVID19 regulations. The onsite team has been reduced to the absolute minimum to ensure the telescope safety in case of technical emergencies. Several remote operation rooms (ICRR, see Figure 3, Kyoto, France, Croatia) have been prepared and successfully operators trained.

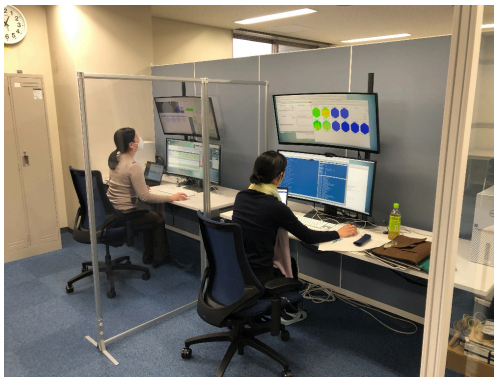

Figure 3: Remote LST operation room at ICRR, 3rd floor.

Camera shutter. The shutter of the LST1 camera, which was damaged during storm in February 2020, was repaired in Sep 2020 and is working fine since then.

Results from technical runs First scientific results look very promising. Already now LST1 detected a clear gamma-ray signal from several AGNs (Mrk421, Mrk501, 1ES1959+650, PG1553+113 and 1ES 0647+25). The Crab nebula and pulsar (see Figure 4) are also clearly detected. LST1 is taking regular data together with the two MAGIC telescopes and stereoscopic analysis, which is led by ICRR, has been developed and first stereoscopic detection of a gamma-ray source using a CTA telescope has been achieved.

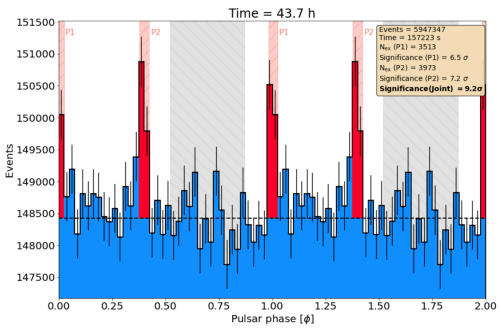

Figure 4: Crab pulsar as seen with LST1 in FY2020

Critical Design Review. The LST team is working hard to close the Critical Design Review (CDR) of CTA. In FY2020 the focus has been given to verification of Requirements and Specifications.

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