Development of readout electronics for Hamamatsu Fully Depleted CCD

Ching-Huang Wu and 2m telescope team
Graduate Institute of Astronomy, National Central University
No. 300, Jung-Da Rd., Jung-Li City, Tao-Yuan, Taiwan 32001

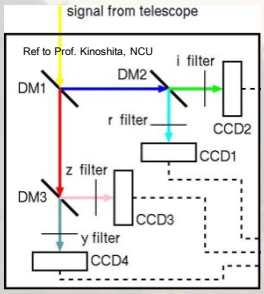
Abstract

In September 2002, the Lulin One-meter Telescope (LOT) was installed, after the completion of the basic infrastructure. We are looking into the next step to install a new two-meter telescope. This new telescope will enable us to do immediate follow-up observations for new discoveries by Pan-STARRS and will also servers as a platform for the instrumentation and education programs.

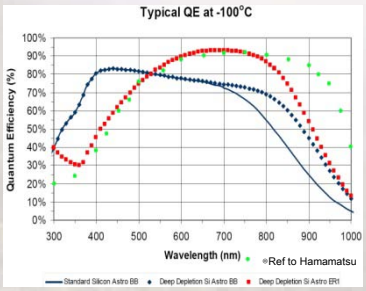
A two-meter telescope, although will be the largest in Taiwan and among the largest telescopes in East-Asia, is only a medium-size telescope among the astronomy community in the world. In order to fully utilize the two-meter telescope for research activities, we thus develop optical simultaneous multi-color cameras to maximize the strategic use of the two-meter telescope and in accordance to the Pan-STARRS discoveries.

Our optical simultaneous multi-color camera is consist of dichroic beam splitters and higher QE detectors. The dichroic mirrors split the light into 4 bands as: 552-689nm(r), 691-815nm(i), 815-915nm(z) and 967-1024nm(y). For detectors, 3 back illuminated deep depletion CCDs and 1 fully depleted CCD for higher quantum efficiency, particular in longer wavelengths are used. For science goal and capability of development, we purchase 3 cameras with E2V deep depletion CCDs from Spectral Instruments Inc. USA, and develop 1 camera with Hamamatsu fully depleted CCD by us. Here, we report the development of readout electronics and dewar with Hamamatsu fully depleted CCD.

1. About the fully depleted CCD

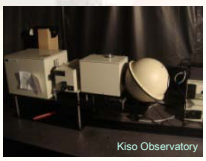


1. Made by solid state division of Hamamatsu photonics K.K., Japan.
2. This CCD will be use for our y-band camera as left picture.
3. QE as right picture in green dot line(> 40% from 400-1000nm).
4. Fully depleted thick(200μm) back illuminated detector.
5. Pixel size=15μm x 15μm, number=2048 x 4096, 4-side buttable.
6. N-type high-resistivity(> 10kΩ-cm) silicon with back bias voltage.
7. CTE > 0.999995, CCE=5μV/e-, Dark < 5e-/pixel/hour@-100 ℃.
8. Full well > 150ke-, Readout noise < 5e-@130kHz.
9. 3 phases for vertical clock, 2/4 phases for horizontal clock.



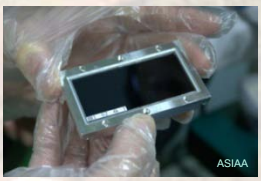
2. Cooperation with Kiso & Nagoya

1. Kiso Observatory of Tokyo University has a team for readout electronics and dewar development.
2. Physics and Astrophysics Lab of Nagoya University has experience on Leach controller and dewar.



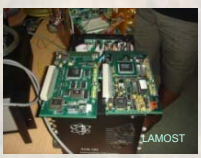
3. Cooperation with ASIAA

1. Institute of Astronomy and Astrophysics of Academia Sinica, Taiwan. They has a team for Leach controller and dewar development.
2. They got this fully depleted CCD and developing the controller system now.



4. Cooperation with NAOC

1. National Astronomical Observatories of Chinese Academy of Sciences, China. They use more than 30 AET ACS-164 CCD controllers for LAMOST project.
2. This controller has been developed by UCO/Lick Observatory. They have experience on LBNL CCD and dewar.



5. Discussion

1. Compatibility of each CCD controller(Spectral Instruments, Leach, AET…) with fully depleted CCD(high voltage bias and phase different).
2. Specifications of CCD controller such as noise, speed, setup, security, interface, maintenance, operation, dimension, weight, source code and OS support.
3. Development resources of preamp, dewar, vacuum and cooler(with gauge and feedback controller).
4. Reliability, budget, time, and manpower for our project.