**Introduction**

SCORPIO is an eight arm imaging spectrograph, based on the use of high-efficiency dichroic splitters to split the light (Figure 1). Each of the arms has a classical imaging spectrograph design, with a collimator, an exit pupil, and a camera that refracts the light onto the detector. To economize weight and space, some of the optics are shared between different arms. All wavelengths share a common optical path up to the telescope focal plane, where the focal plane unit (FPU) positions slits for the spectroscopic mode and field stops for the imaging mode. In spectroscopic mode SCORPIO uses a long slit common to all eight arms, paired with VPH gratings optimized for each arm.

**Timings and Synchronization**

The instrument offers a nominal 50ms temporal resolution for observations of high time resolution events and transients. In order to minimize noise and maximize the scientific throughput of the instrument, all 8 channels will be synchronized together with a synchronization precision of 10ms. Furthermore, the individual frames will be time stamped to an accuracy of 5ms.

**Detectors and Readout Modes**

SCORPIO uses 8 focal plane arrays: 4 e2v CCD231-84 and 4 Teledyne Imaging Sensors CMOS H2RGs. The selected VIS CCDs are e2v devices.

The CCDs have 15μm pixels with A/R coatings and detector architecture optimized for each individual band. These are frame transfer devices, reading from 4 channels, with the top/bottom 4096(H) x 1556(V) areas blocked permanently via a mask. This allows for high-speed readout for observational sequences that require high-time resolution data and results in a CCD with a 4096(H) x 1048(V) illuminated pixel area.

The near-infrared detectors are Teledyne H2RG focal plane arrays in the ground-based astronomy package. These are 2048 x 2048 pixel (2040 x 2040 sensitive) HgCdTe devices with 18μm pixels. The detectors are sensitive to 2.5μm with nearly flat Quantum Efficiency across the IR bands.

**Instrument Design**

The mechanical layout (Figure 2) of the instrument is based on two main modules: the near infrared (NIR) module, that is kept cold (100K bench and 77K detectors), and the visible (VIS) module that operates at room temperature (283K bench and 173K detectors). The f/16 beam arriving from the telescope enters the NIR module after passing through an external atmospheric dispersion corrector (ADC) and the main vacuum window. The telescope focal plane lies immediately after the vacuum window. At that point, a Focal Plane Unit (FPU), which is kept cold to reduce the thermal background in the NIR, is located to host a selection of long slits and field stop. After the FPU, the light is divided by a VIS/NIR dichroic. The NIR light, transmitted through the dichroic, remains inside the cryogenic volume while the VIS light is reflected and exits the cryostat passing through a second vacuum window. The beam is then captured by a folding mirror and diverted to the VIS arms. From there on, both light beams follow similar paths, where the light is collimated and split by two additional dichroics. The collimated beam of each arm passes through either a filter or a prism, depending on the observing mode (imaging or spectroscopy, respectively), a shutter on the VIS side, and is refocused by a camera onto the detector. The optical design is on-axis, which reduces the optical aberrations and mitigates the effects of mechanical flexures in a Cassegrain-mounted instrument.

**Instrument Operational Modes**

SCORPIO can be configured as either an imager or a spectrograph. SCORPIO can be configured for full field of view observations or windowed observations. The windowed observations require the insertion of a window mask at the telescope focal plane. This mask is located inside the instrument cryogenic volume in order to minimize the thermal noise in the K-band.

The detectors have multiple readout speeds to optimize the performance based on the observing mode and configuration of the instrument. The fastest readout speeds provide increased temporal performance for high time resolution observations while the slower readout speeds provide a decreased temporal performance but better noise performance for observations where the desire is to minimize the instrument noise.

Nod-and-shift spectroscopic observations are used to compensate for sky background variations in the near-infrared. Nod-and-shift is a strategy designed to take advantage of the nearly lossless ability of transferring charge around a CCD without imparting the additional read noise associated with readout.

**Conclusion**

SCORPIO is the new workhorse instrument in development for the GEMINI observatories. Nominally, SCORPIO will be deployed at GEMINI south, but is designed to function at both sites. SCORPIO is primarily designed to follow-up LSST transients. Critical Design ends mid-2019. Commissioning is scheduled for Dec. 2021 with science operations starting in early 2022.