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TIFR Near Infrared Spectrometer and Imager (TIRSPEC)

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Abstract. TIFR Near Infrared Spectrometer and Imager (TIRSPEC) which is based on 1024 x 1024 HgCdTe focal plane array (Rockwell HAWAII-1 PACE detector with imaging capabilities in 1 - 2.5 μm waveband range) at the focal plane of the 2 m Himalayan *Chandra* Telescope (HCT) will be a major workhorse for a variety of challenging astrophysical problems. This will be extremely sensitive to low temperature stellar photospheres (T $\leq$ 2500 K) and objects surrounded by warm dust envelopes or embedded in dust/molecular clouds. It is therefore particularly suited to the search for low and very low mass stellar populations (M/L dwarfs, brown dwarfs), strong mass-losing stars on the asymptotic giant branch, young stellar objects still in their protostellar envelopes and active galactic nuclei. TIRSPEC is being developed by Mauna Kea Infrared, LLC, Hawaii, USA (MKIR) in collaboration with the infrared astronomy group of TIFR.

Keywords : instrumentation: detectors – instrumentation: spectrographs

1. TIRSPEC specifications

TIRSPEC will be used at the f/9.2 focus of the 2 m HCT. It will use a HAWAII-1 1024 x 1024 focal plane array and the image scale will be 0″.3 per pixel (18.5 μm), covering a 307″ x 307″ field of view. Filter wheels capable of mounting 16 filters will be implemented. TIRSPEC will include a grism mode designed to work in the *J*, *H*, and *K* passbands with a minimum resolving power of 1000 and a goal of 2500 matched to a slit width of 0″.9, and a minimum slit length of 60″. TIRSPEC will

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have a built-in calibration unit to feed light from calibration lamps onto the slit. The main specifications of the TIRSPEC are the following:

Grism Mode:

TIRSPEC will initially be equipped with 2 grisms. One will be the $YJHK$ grism that will allow single order imaging in the J, H and K windows. The second will be the HK cross dispersing grism that will allow simultaneous H and K imaging in the cross dispersed mode.

Filters:

TIRSPEC will be equipped with a number of broad and narrow-band filters. The wide-band filter set includes J, H and K_s standard filters. The narrow-band filter set includes H_2 1-0 S(1), Br Gamma, CO 2-0, [Fe II] and CH_4 filters, plus the associated K and H narrow-band filters to sample the near-by continuum.

Slit Sizes:

TIRSPEC will use a slit width of $0''.9$ that is matched to the highest resolving power (R = 1500), a slit width of $1''.35$ (R = 1000) for increased efficiency when the seeing is marginal, and a slit width of $3''.0$ (R = 450) for absolute spectro-photometry. The maximum slit length of $120''$ is set by the size of the calibration system.

2. TIRSPEC sensitivity

For the purpose of estimating the spectral sensitivity of TIRSPEC, it is assumed that the sky above HCT (4500m) is the same as the sky above Mauna Kea (4200m). Thermal emission from the sky was calculated by assuming a sky emissivity and a sky temperature of 273 K. Thermal background from the telescope and cryostat window were calculated assuming a temperature of 273 K and an emissivity of 0.1. TIRSPEC one-hour 10σ point source continuum sensitivity (dark current = 1.0 e^-/s, read noise = 20 e^- rms, seeing = $1''.0$, R = 1500, throughput = 0.12, pixel scale = $0''.3$/pix, slit width = $0''.9$) is estimated to be 15.6, 14.9 and 14.7 mag in J, H and K, respectively.

3. Current status

The preliminary and critical design reviews of the TIRSPEC were completed during 2009 - 2010. The construction of the camera has already begun at MKIR, which will be completed by June 2012. It is expected that the TIRSPEC will be at a stage where first astrophysical observations can be made after June 2012 and some of the interesting objectives of the proposal could be met and the results presented. We expect that regular science observations with TIRSPEC will start after October 2012.