# A new Fabry-Perot Imager developed for thermospheric wind and temperature measurements at Syowa Station

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A new Fabry-Perot imager (FPI) has been developed as the last optical instrument among the suite of remote sensing apparatuses introduced into Syowa Station. The FPI is equipped with a fish-eye lens with a 150 degree field-of-view, a Fabry-Perot etalon with a 150 mm clear aperture, and a cooled CCD camera with 1k x 1k pixels. The large throughput of the etalon enables us to obtain a map of wind and temperature fields in the lower or upper thermosphere for 1 minute exposure time. A special air-conditioned chamber surrounding the etalon stabilizes the etalon temperature at a preset temperature within a +/- 0.05C variation to avoid etalon-gap drifting which causes artifacts in derivation of wind speed.

The particular virtues of Fabry-Perot imager (FPI) observations have been widely applied to studies on 1) thermospheric response to the auroral energy input during auroral substorms and 2) variability of the global pattern of the thermospheric circulation with the solar cycle. Although the spatial resolution of thermospheric neutral wind and temperature fields derived from wide-angle FPI observations is rather low, the FPI is capable of observing different altitudes in the thermosphere by selecting OI 557.7nm and OI 630.0 nm emission lines.

Having ancestry of the Fabry-Perot Imagers (FPIs) developed and operated at Syowa Station, Antarctica by Tohoku University, a new FPI has been developed as the last optical instrument among the suite of remote sensing apparatuses introduced into Syowa Station. Though the past FPI observations at Syowa Station were intermittently performed for several seasons, the FPI presented here is designed under a philosophy that it will be continuously operated for successive seasons over one solar cycle at least. The FPI is equipped with a fish-eye lens with a 150 degree field-of-view, a Fabry-Perot etalon with a 150 mm clear aperture, and a cooled CCD camera with 1k x 1k pixels. The large throughput of the etalon enables us to obtain a map of wind and temperature fields in the lower or upper thermosphere for 1 minute exposure time. A special air-conditioned chamber surrounding the etalon stabilizes the etalon temperature at a preset temperature within a +/- 0.05C variation to avoid etalon-gap drifting which causes artifacts in derivation of wind speed.

Light emitted from a frequency-stabilized He-Ne laser is used for reference of the etalon-gap and also for obtaining an etalon transmission function. A temperature-stabilized chamber contains the He-Ne laser and an etalon controller. Inhomogeneity of auroral appearance may be an error source in wind speed retrieval. Contemporaneous observations of an all-sky monochromatic auroral imager will provide data for the inhomogeneity correction.

Dual computers control the FPI. One collects etalon-gap monitoring data and HK data and, if necessary, feeds a operation command back to the etalon controller. The other controls a shutter, a translation mirror which selects signal and reference lights, a filter turret and the CCD camera, and acquires images of auroral and laser fringe pattern.

We also paid meticulous attention to thermal design of a building that contains the FPI at Syowa Station so that the etalon temperature can be stabilized within the tolerance. The building will be built next to the information processing building at Syowa Station. It has more room for optical remote measurements of general purposes. HF radars, an MF radar, a VHF radar, an all-sky imager, and a Na lidar have been already operated at Syowa Station to study the dynamics of the polar mesosphere and thermosphere. The FPI will be installed there during the next austral summer season and receive the first light from aurora australis in the next century.