Upgrading 30cm Sub-millimeter Telescope to Map the Milky Way in CO and CI Lines

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We have developed a transportable 30cm sub-millimeter telescope to map the Milky Way in CO (J=4-3) and CI ($^3P_1$-$^3P_1$) lines at high plateau area in Antarctica. The CO and CI lines are good probes for interstellar matter (ISM), however these lines could be observable only on high altitude and dry site because of strong absorption by water vapor and oxygen. We showed atmospheric opacity at 220 GHz is very low and stable at Dome Fuji on Antarctic plateaus (Ishii et. al.,2010). The 30cm telescope has a 9' beam at 500 GHz that is similar to that of the Columbia-CfA 1.2 m telescope. Physical conditions such as density of ISM could be derived from a direct intensity comparison of CO (J=4-3) and CI with CO (J=1-0) taken by the Columbia-CfA survey. It is equipped with sideband separating (2SB) type superconducting (SIS) mixers, that require operational temperature of 4 K. The maximum weight of each component is designed to be less than 60 kg and total weight is about 700 kg. The total power consumption is less than 2.5 kW including 4K refrigerator. We could assemble the 30cm telescope easily on site and operate with a small electric power generator. We operated the telescope at a high altitude site in northern Chile. It worked in low pressure environment of 600 hPa. We succeeded in demonstrating its capability as an astronomical instrument by mapping Orion molecular cloud (Ishii et. al., 2016). We operated the telescope in a low temperature room of National Institute of Polar Research for confirming it works in low temperature environment of -50 ℃.

We are now upgrading the 30 cm telescope. First, we are upgrading a small optical telescope for pointing. We use it for establishing pointing of the 30 cm sub-millimeter telescope. It is not sensitive enough to observe stars in day time. We plan to operate the 30 cm telescope in Antarctic plateau in summer. We cannot get dark night during summer in antarctica. We are optimizing size of the CCD sensor and diameter of optical lens. Second, we are upgrading intermediate frequency (IF) system of the receiver. The present system cannot observe the CO and CI lines simultaneously due to the limited IF frequency band. By expanding the IF frequency band from 8 GHz to 16 GHz, we could observe these two lines simultaneously.

Figure 1. 30 cm telescope in Chile

References

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