



## A demonstration of cryogenic trans-impedance amplifier using fully-depleted silicon-on-insulator CMOS operational amplifier for far-infrared image sensor

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We are developing low power cryogenic readout integrated circuit (ROIC) for large format far-infrared image sensor using fully-depleted silicon-on-insulator (FD-SOI) CMOS technology.

It is difficult to design ROIC operated below 30 K because N-channel MOSFETs fabricated by conventional bulk-CMOS technology usually suffer from anomalous behavior such as kink and hysteresis caused by impact ionization and carrier freeze out. However, MOSFETs fabricated by FD-SOI CMOS technology show very stable static characteristics at 4.2 K. In consequence, the operational amplifier (OPAMP) fabricated by FD-SOI CMOS technology has excellent performances such as power consumption of 1 micro-W and good stability at 4.2 K.

In this presentation, we report the trans-impedance amplifier (TIA) circuit using FD-SOI CMOS OPAMP at cryogenic temperatures. In order to evaluate a performance in measuring current for the TIA circuit, we combined the TIA circuit with the germanium blocked impurity band (Ge-BIB) detector as very small and calibrated current source. The Ge-BIB detector has calibrated by silicon junction FET (Si-JFET) TIA. We compared the dark current measured by using Si-JFET and FD-SOI CMOS. FD-SOI CMOS OPAMP can operate at low power consumption and achieve low background environment because can operate below 4.2 K. On the other hand, It is difficult for Si-JFET to achieve low power consumption and low background environment because Si-JFET must be heated more than 80 K.

We plan the development of image sensor using the trans-impedance amplifier on balloon telescope for astronomical observations.