A 4.7-THz gas laser local oscillator for GREAT on SOFIA

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Abstract

A particularly important transition for astronomy is the OI fine structure line at 4.7 THz. It is an important cooling line of the interstellar medium and allows studying the chemical composition, the evolution, and the dynamical behavior of astronomical objects. Consequently, this transition is a main target to be observed with GREAT, the German Receiver for Astronomy at Terahertz Frequencies, which will be operated on board of SOFIA.

A major challenge for a heterodyne receiver operating at such a high frequency is the local oscillator (LO). Despite significant progress in the development of a quantum-cascade laser based LO [1] the baseline design for GREAT is an optically pumped gas laser operated at 4.7 THz. In this report we will present the design and performance of the 4.7-THz gas laser LO for SOFIA. The LO is based on a radio frequency excited CO_2 laser which has a sealed-off gas volume and which is frequency tunable by a grating. The CO_2 laser is operated on the 9P12 transition of the CO_2 molecule. The output emission is focused into the THz laser resonator. The THz laser is transversely excited. It operates on the 4.75 THz line of $^{13}CH_3OH$. For frequency stabilization of the CO_2 laser a small part of its output radiation is guided into a Fabry-Pérot interferometer (FPI) which serves as a length or frequency reference. In order to compensate for temperature or pressure induced drifts of the FPI length the emission of a frequency stabilized a helium-neon (HeNe) laser is coupled into the FPI as well. The FPI is locked to the emission of the HeNe laser. We will present the design and the performance of the LO with respect to output power, short and long term power stability, and beam profile. The system is ready and awaits implementation in GREAT and operation on board of SOFIA.

REFERENCES

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