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Low-noise superheterodyne receiver array for ECEI and MIR
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JAMIN TOBIAS, PPPL, NEVILLE LUHMANN, UC Davis — Superheterodyne re-
ceiver array has been widely used in ECEI and MIR to extract the temperature and
plasma density fluctuation, respectively. The system downconverts RF signals to a
much lower IF for easy filtering and processing. The current system employs Schot-
tky diode as the mixing element, which is mounted directly on the antenna. The LO
and RF signals illuminate the antenna simultaneously to produce desired IF signals.
One big drawback is that the system generates large amount of noise due to the
lack of low-noise amplifier (LNA) before the mixer. It also requires complicated lens
system in order to facilitate simultaneous RF and LO illumination. Additionally,
it's difficult to shield the circuits from stray heating power and interfering signals.
New receivers are developed for improving the signal quality as well as the ease of
measurement. The new circuit consists of compact GaAs MMICs integrated on low-
loss liquid crystal polymer substrate. Low noise and high gain GaAs LNAs, mixers
and even complete receivers are available as off-the-shelf chips for V and W band
applications. Employing MMICs in plasma diagnostics not only dramatically im-
proves signal integrity, the on-board LO signal supply also eliminates the lenses for
simultaneous RF and LO illumination. Additionally, the new receiver employs horn
antennas, which produces directive radiation and strong interference attenuation.

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