



Noise Diode-Based Calibrations for Accurate Flux Density Measurements

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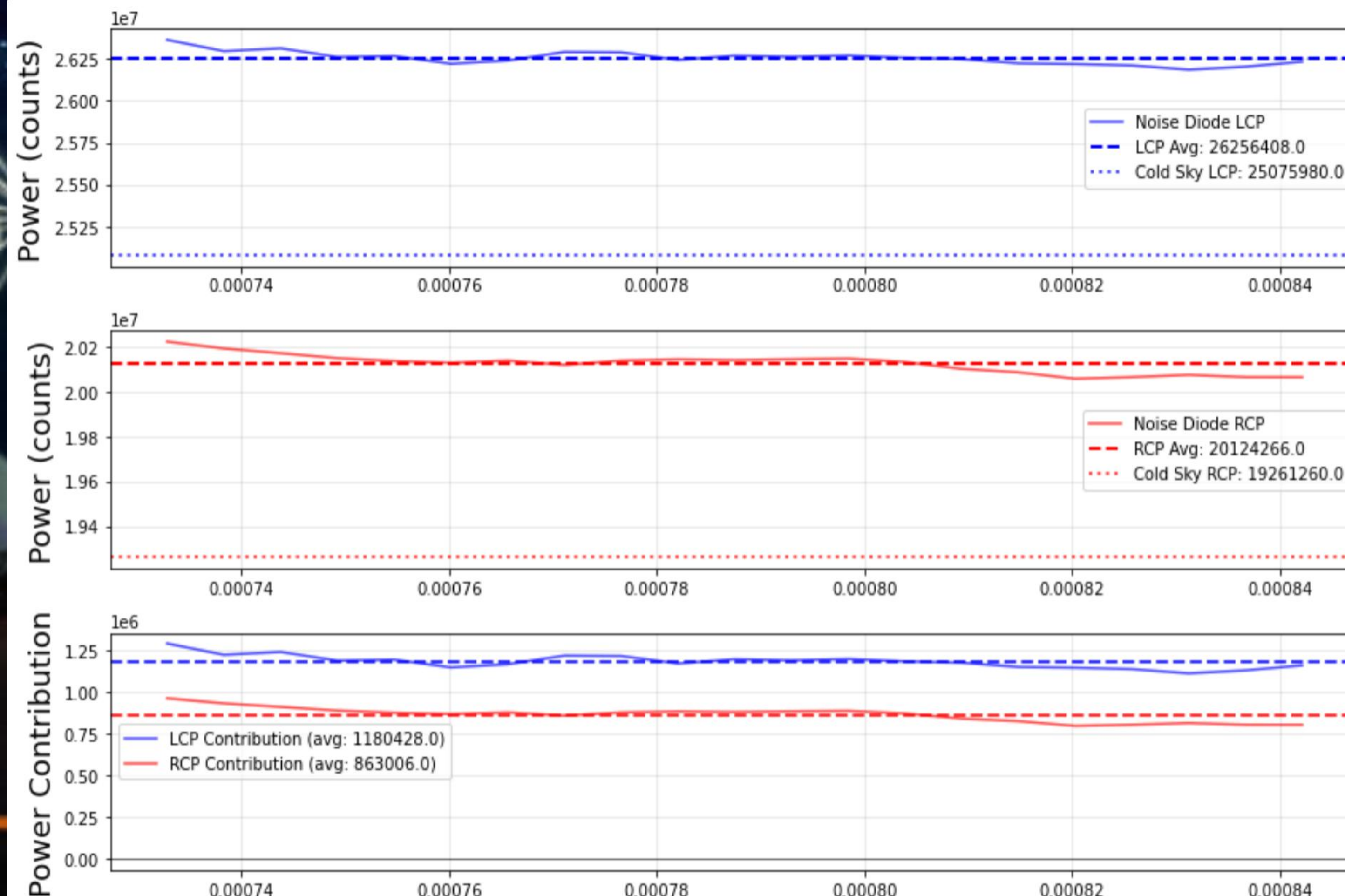
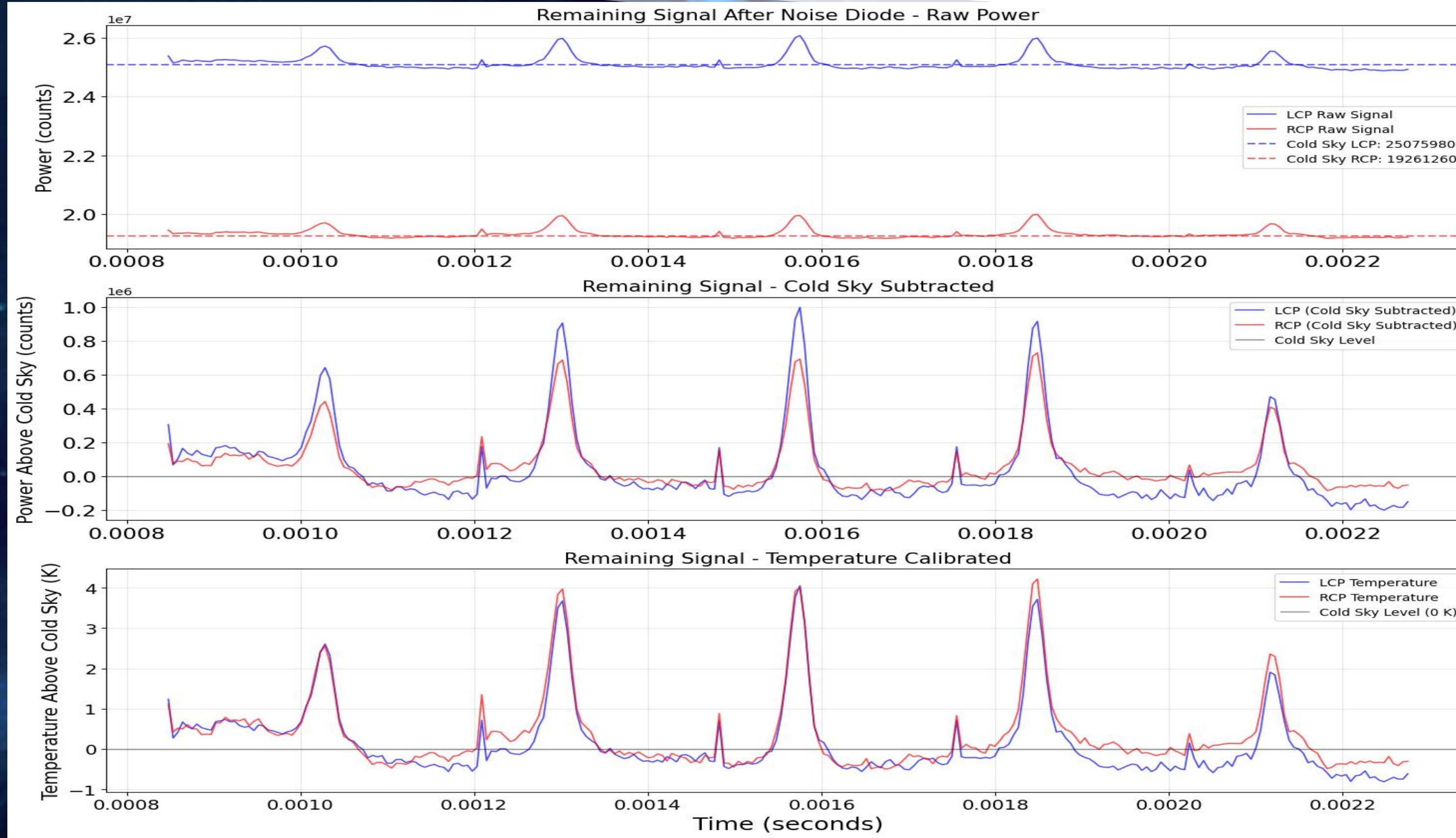
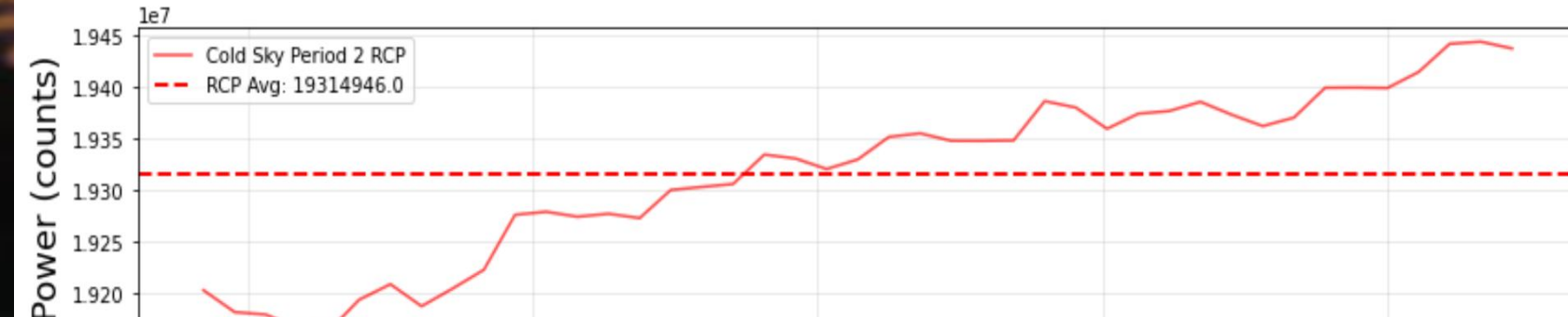
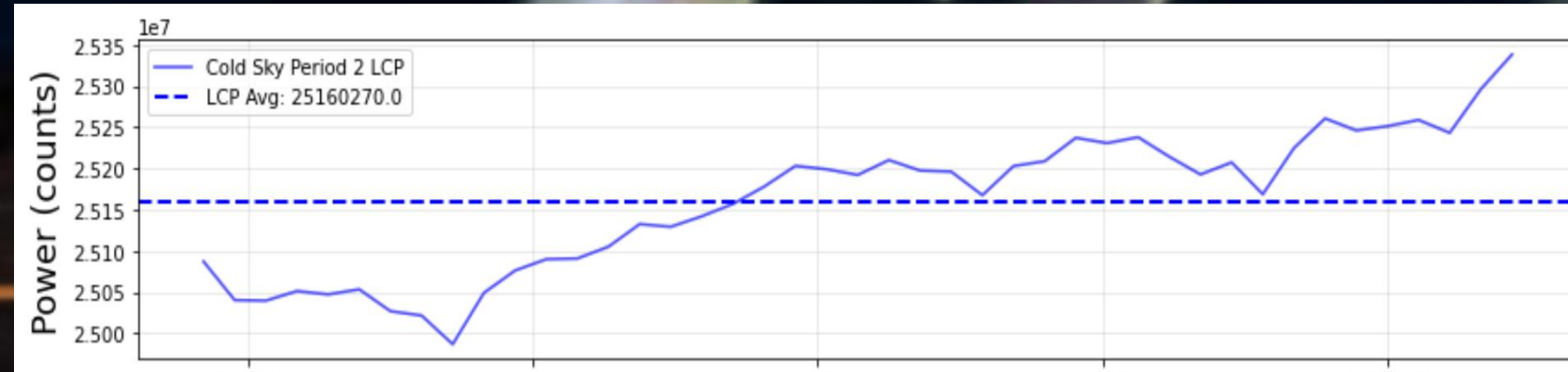
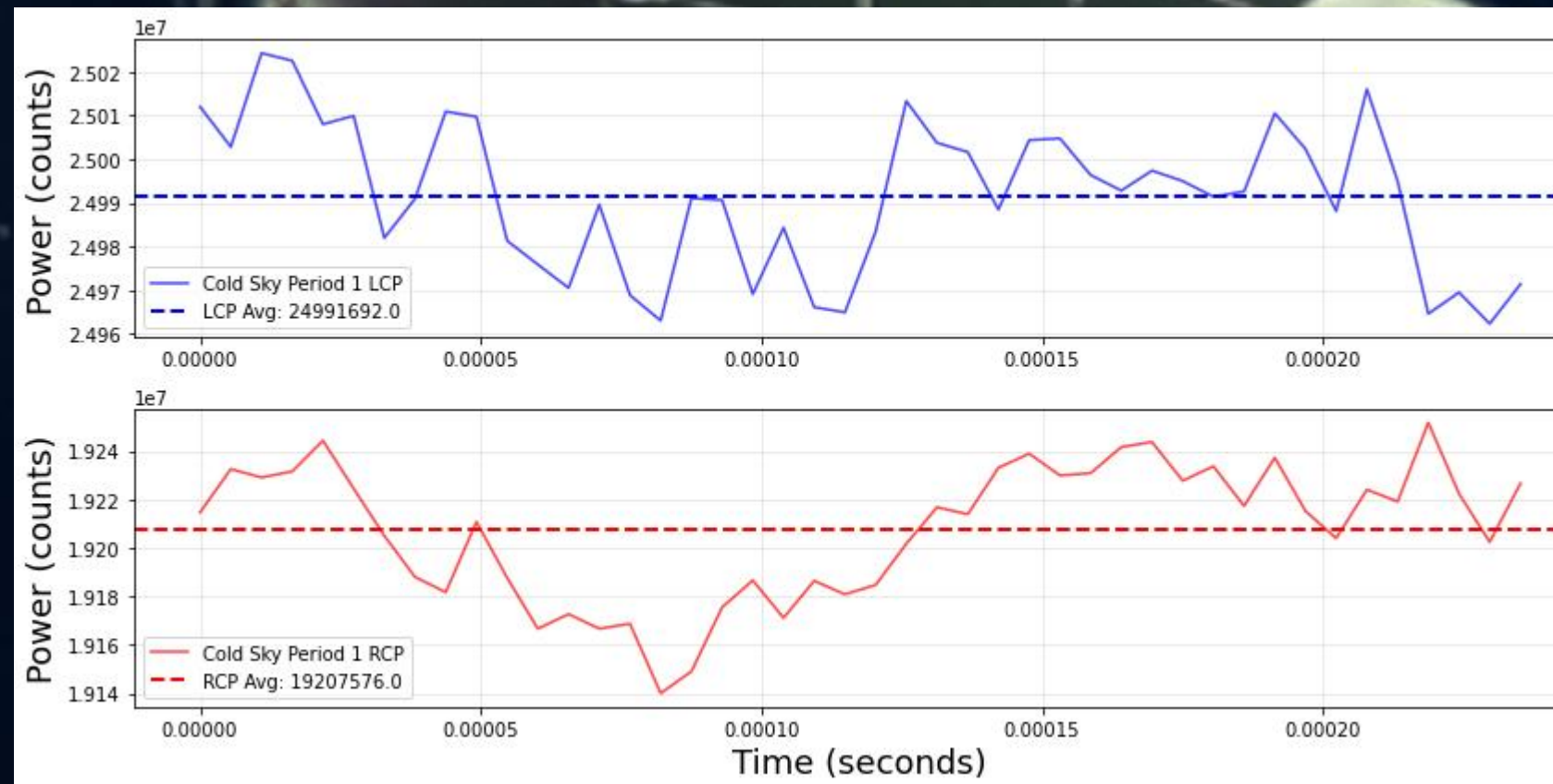
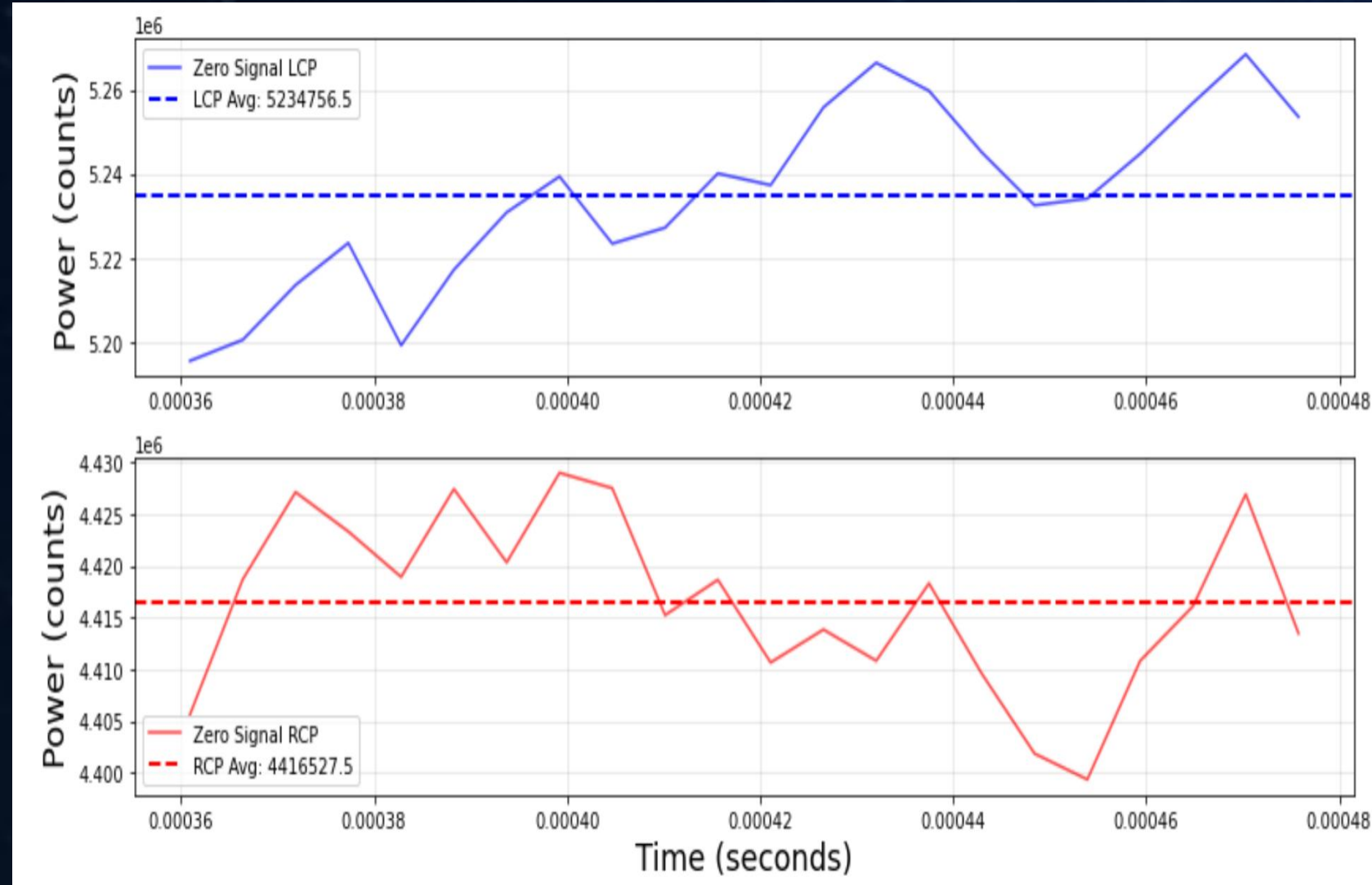
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Introduction: Accurate flux density calibration is essential in radio astronomy for reliable measurement of astrophysical sources

Noise diode calibration provides a stable, repeatable reference independent of sky conditions.

A three-level calibration: zero-input termination, cold-sky measurement and noise diode injection were applied to convert backend counts into physical units.



Calibration Parameters

Parameter	LCP	RCP	Average
Zero sky level (counts)	5.23×10^6	4.42×10^6	4.83×10^6
Cold sky level period 1 (counts)	2.49×10^7	1.92×10^7	2.21×10^7
Cold sky level period 2 (counts)	2.51×10^7	1.93×10^7	2.21×10^7
Noise diode level (counts)	2.62×10^7	2.01×10^7	2.31×10^7
Noise diode contribution (counts)	1.12×10^6	8.60×10^5	9.90×10^5
Noise diode temperature (K)	4.79	4.99	4.89
Conversion factor (K/count)	4.0×10^{-5}	6.0×10^{-5}	5.0×10^{-5}
System temperature Tsys (K)	80.55	85.88	83.22
Antenna temperature TA (K)	12.30	11.90	12.10

The internal noise diode was activated during calibration intervals to provide a reference signal of known equivalent temperature. The calibration constant used to convert raw counts into physical temperature units is the ratio of the known temperature of the calibration diode to the difference in measured power between the diode-on and cold-sky signals.

The system temperatures for the LCP and RCP were obtained as 80.55 K LCP and 85.88 K respectively. Using the effective antenna collecting area of 619.3 m² and efficiency of 0.77, the flux density was obtained as 26.60 Jy LCP and 27.50 Jy RCP giving a total flux density of 54.10 Jy at the 6.75 GHz.

The calibration results were cross-validated with standard calibrator models confirming the accuracy of the noise diode-based method for flux density determination for single-dish radio observations

References

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