1 Introduction

The antenna temperature spectrum for a sky temperature $T_{\text{sky}}$ measured with an achromatic antenna beam $B(\Omega, \nu_0)$ is given by

$$T(\nu) = \int T_{\text{sky}}(\Omega, \nu) B(\Omega, \nu_0) d\Omega.$$  \hspace{1cm} (1)

In general, however, the beam is chromatic and the measured spectrum is given by

$$T_m(\nu) = \int T_{\text{sky}}(\Omega, \nu) B(\Omega, \nu) d\Omega.$$  \hspace{1cm} (2)

A spectrum corrected for beam chromaticity can be obtained from the measured spectrum by dividing the measured spectrum by the chromaticity correction factor $C$,

$$C(\nu) = \frac{T^*_m(\nu)}{T^*_s(\nu)},$$  \hspace{1cm} (3)

where

$$T^*_s(\nu) = \int T^*_{\text{sky}}(\Omega, \nu) B^*(\Omega, \nu_0) d\Omega$$  \hspace{1cm} (4)

and

$$T^*_m(\nu) = \int T^*_{\text{sky}}(\Omega, \nu) B^*(\Omega, \nu) d\Omega$$  \hspace{1cm} (5)

are simulated spectra for an achromatic and chromatic beam, respectively. They are computed using the models $T^*_{\text{sky}}$ and $B^*$ for the sky temperature and antenna beam, respectively.
2 Beam Correction Alternatives

Two possible beam corrections approaches are presented for consideration when integrating measurements across time (LST or GHA). Here, \( t_1, t_2, t_3, \ldots \) represent the time stamps of the raw spectra and \( N_t \) is the total number of raw spectra.

2.1 Alternative 1: Time-averaging the corrected spectra

\[
\langle \frac{T_m}{C} \rangle_t = \frac{1}{N_t} \left[ \frac{T_m(t_1)}{C(t_1)} + \frac{T_m(t_2)}{C(t_2)} + \frac{T_m(t_3)}{C(t_3)} \ldots \right]
\]  

(6)

2.2 Alternative 2: Correcting the time-average of uncorrected spectra

\[
\frac{\langle T_m \rangle_t}{\langle T^* \rangle_t} = \frac{\frac{1}{N_t} [T_m(t_1) + T_m(t_2) + T_m(t_3) \ldots]}{\frac{1}{N_t} [T^*(t_1) + T^*(t_2) + T^*(t_3) \ldots]}
\]

(7)

Both alternatives approach the following average

\[
\frac{1}{N_t} [T(t_1) + T(t_2) + T(t_3) \ldots]
\]

(8)
as the models for the sky temperature and beam approach the true values.