Session IX. Possible Future Measurements and Models

Jim Condon
NRAO, Charlottesville
Session VIII. Possible future measurements and models

ARCADE2 non-CMB monopole $T_b = 54 \text{ mK}$ at 3.3 GHz

ARCADE2 plus old “all sky” maps are consistent with $T_b \propto \nu^{-2.6}$,

a typical synchrotron spectrum (our Galaxy, extragalactic sources, SNRs, …)

JVLA monopole from counts of discrete extragalactic sources stronger than $\sim 1 \mu\text{Jy/beam}$ (in an 8” beam) at 3.02 GHz is only $T_b \sim 13 \text{ mK}$ (versus 68 mK ARCADE2)

No *observational* disagreement is possible because the JVLA monopole is only a lower limit to the actual monopole. Tension arises from *modeling* the temperature difference as being primarily extragalactic, in which case a bright and smooth “new population” of sources seems to be required.
Revisit $T_b$ at frequencies $\ll 3.3$ GHz?

<table>
<thead>
<tr>
<th>$v$ (GHz)</th>
<th>$T_b$ (K)</th>
<th>“Sources” $\propto v^{-2.7}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>0.054</td>
<td></td>
</tr>
<tr>
<td>3.02</td>
<td>0.068</td>
<td>0.013</td>
</tr>
<tr>
<td>1.4</td>
<td>0.50</td>
<td>0.10</td>
</tr>
<tr>
<td>0.408</td>
<td>12.6</td>
<td>2.9</td>
</tr>
<tr>
<td>0.3</td>
<td>28</td>
<td>6.6</td>
</tr>
<tr>
<td>0.12</td>
<td>300</td>
<td>79</td>
</tr>
</tbody>
</table>

Compare with CMB = 2.7 K, ambient = 300 K, $T_{sys}/(BT)^{1/2} < 0.1$
GBT
GBT prime focus boom and feed
GBT atmosphere and spillover

Green Bank
zenith opacity
1.0 cm pwv
55% cloud cover

\[ \tau_z \]

\[ \nu \text{ (GHz)} \]

- total
- hydrosols
- oxygen
- dry air
- water vapor

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Source counts and sky brightness

\[ S = \frac{2k_B T_b \Omega}{\chi^2} \]

\[ dT_b = \frac{\lambda^2}{2k_B} S^2 n(S) d\ln(S) \]

\[ S n(S) dS = \frac{2k_B dT_b}{\chi^2} \]

\[ \left[ \frac{dT_b}{d \log(S)} \right] = \left[ \frac{\ln(10)c^2}{2k_B \nu^2} \right] S^2 n(S) \]

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Observed confusion from non-overlapping sources

$\sigma_T \sim 30$ mK on GBT, could be reduced to $\sim 3$ mK by NVSS point-source subtraction to infer large sources making 500 mK background unless more than about $(500/3)^2 > 10^4$ sources overlap
$T_b$ limits on star-forming galaxies

$T_b < 10^5$ K at 1.4 GHz
IC scattering off CMB at high $z$

\[ \frac{P_{IC}}{P_{syn}} = \frac{U_{rad}}{U_B}. \]

$U_{CMB} \propto (1+z)^4$

$U_B = B^2 / (8 \pi)$

$U_{CMB} = U_B$ when $B = 3(1+z)^2$ $\mu$G

e.g., 3000 $\mu$G for a Pop III SNR at $z = 30$