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Erratum: Filament Hunting: Integrated H I 21cm Emission From Filaments Inferred by Galaxy Surveys

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Key words: errata, addenda – cosmology: theory – diffuse radiation – intergalactic medium – large scale structure of universe.

This is an erratum to the paper' Filament Hunting: Integrated H I 21cm Emission From Filaments Inferred by Galaxy Surveys' that was published in MNRAS, 468, 857. Due to the use of an incorrect equation to calculate the thermal noise of an observation, the noise was underestimated in the paper, affecting some of our conclusions.

The baseline correction factor in Equation 16 was not applied correctly for the interferometers. The correct expression for the thermal noise of a single dish telescope is given by (Furlanetto, Oh & Briggs 2006; Thompson, Moran & Swenson 2017)

$$\delta T_{\rm N} = \frac{c^2(1+z)^2}{\nu_0^2 \Delta\theta^2 \epsilon_{\rm ap} A_{\rm dish}} \frac{T_{\rm sys}}{\sqrt{2\Delta\nu t_{\rm obs}}}, \tag{15}$$

where $A_{\rm dish}$ is the area of the dish and the factor $1/\sqrt{2}$ follows by considering two polarizations. Since interferometers measure multiple baselines at the same time, they receive an extra correction factor:

$$\delta T_{\rm N} = \frac{c^2(1+z)^2}{\nu_0^2 \Delta\theta^2 \epsilon_{\rm ap} A_{\rm dish}} \frac{T_{\rm sys}}{\sqrt{2\Delta\nu t_{\rm obs}}} \times \frac{1}{\sqrt{N_{\rm dish}(N_{\rm dish}-1)/2}}.$$

In Takeuchi, Zaroubi & Sugiyama (2014) and subsequently in this paper, $A_{\rm dish}$ was replaced by the total area of the entire array $A_{\rm tot}$. Note that, for large arrays, $\sqrt{N_{\rm dish}(N_{\rm dish}-1)/2} \approx N_{\rm dish}/\sqrt{2}$ and $A_{\rm tot} = N_{\rm dish} \times A_{\rm dish}$. Therefore, in the paper, the factor accounting for the dependence of the noise on the number of baselines for interferometers was already included in Equation 15 and so it was not necessary to apply it again in Equation 16. As a result, the noise values for the interferometers are too low by a factor of $\sim N_{\rm dish}$.

We further note that this calculation assumes that the filaments contain structure on all the scales for which the interferometers have baselines and therefore do not suffer from spatial filtering. This will be discussed in more detail in Kooistra et al. in prep.

This results in the need to update Figs 8 and 10 and it also affects the matters discussed in Section 6, the conclusions and the abstract. The updated figures are included at the end of this erratum.

As can be seen in Fig. 8, the SKA will be able to detect the signal in all cases. Furthermore, the single dish telescopes are the best alternatives, where FAST can detect the signal in all but the worst case scenario. Both ASKAP and Apertif are not sensitive enough to make a detection within 100 hours, however. The signal is also still detectable for most instruments in the most optimistic case, whereas for the lower signals from Filaments 1 and 3, the signal would still be within reach of FAST and the SKA. The conclusion in the paper that SKA will be able to fully map the filaments was also based on the previous noise estimates. Instead the SKA will have to rely on the integrated signal as well in order to make a detection.

In Section 6 of the paper, the Apertif and ASKAP instruments were highlighted for their large fields-of-view (FoV). Despite the recalculated S/N being too low to make a detection for these instruments (see Fig. 10), the concepts that were introduced in this paper still apply to the other telescopes as well. It matters little if the filament is aligned along the line of sight, or perpendicular to it. In both cases the recovered S/N is about the same. If large H I surveys become available for the more sensitive telescopes (i.e. FAST and SKA), they could get a significant detection, even if it requires multiple pointings to cover a full filament on the sky due to their smaller FoVs.

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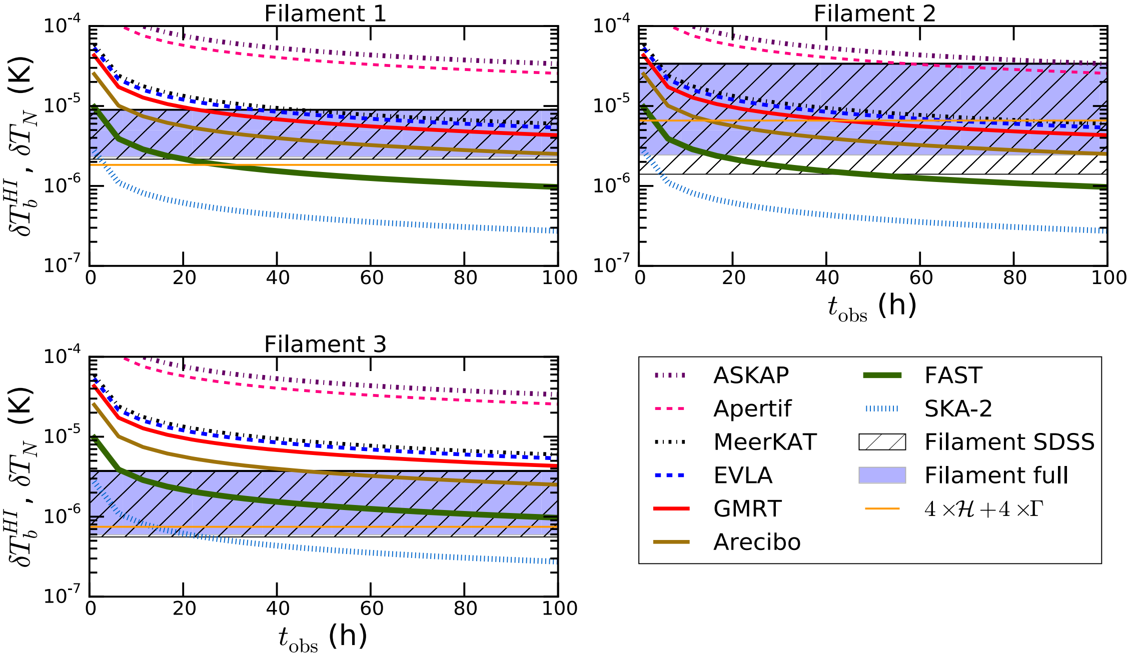

Figure 8. The expected signal of the three filaments in this study (see Fig. 7) together with the noise temperatures for the different instruments being considered. The shaded blue area shows the signal for the full filament, where the top and bottom denote the minimum and maximum signal when rotating the observational skewer −5 to +5 degrees. The white striated shaded area shows the same, but for the case where the filament is only as long as expected from SDSS data. The colored lines denote the noise level of the instruments described in Table 2 for $\Delta\theta = 10$ arcmin, $\Delta\nu = 15$ MHz. The orange solid line shows the maximum signal of the filament after increasing the heating and the photoionization by a factor of 4.

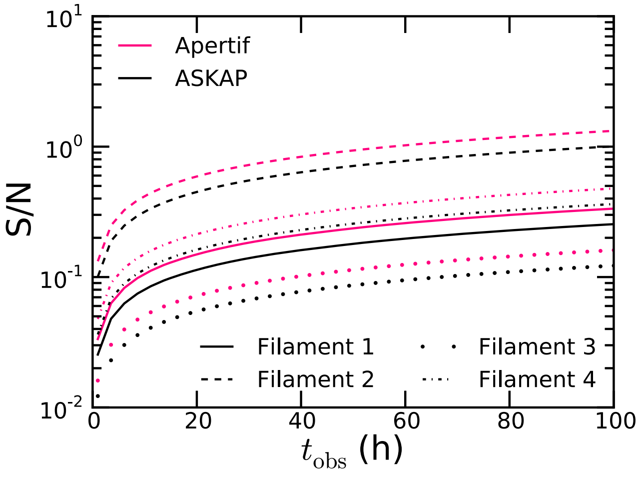

Figure 10. Expected signal to noise of the simulated filaments with the H I survey instruments Apertif and ASKAP. We assume an angular resolution of 10 arcmin and a frequency bandwith of 0.6 MHz. The color of the lines denotes the instrument and the linestyle shows for which filament it is.

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