PAON-4 data Map making

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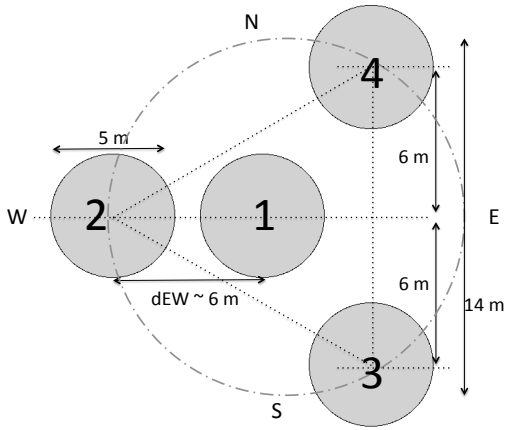
Quick map making



- Based on Phased Array technic.
- Robust with respect to non stationary noise and time dependent RFI.
- Simply combining the antenna signals in amplitude with some coefficients in front.
- Starting from clean/calibrated and ordered data according to Right Ascension.
- Showing the Quick Map Making formulas for PAON-4 dish array with angular resolution ~ 0.25deg.

First case

- For map rows corresponding to the scan declinations, we use only the visibility data from the corresponding scan. Now, c_i=1, same weight and no phase shift.

$$S = S_1 + S_2 + e^{i\frac{2\pi}{\lambda}(-6)\sin(\theta_0)} S_3 + e^{i\frac{2\pi}{\lambda}6\sin(\theta_0)} S_4$$

W-term

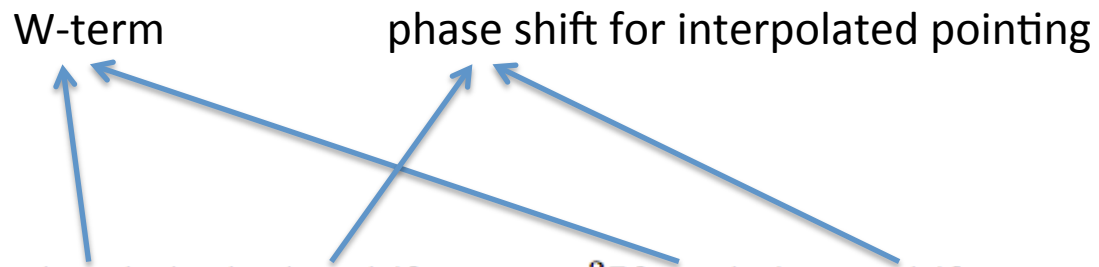
$$\varphi = \frac{2\pi}{\lambda} 6 \sin(\theta_0)$$

$$\begin{aligned} I &= S^* S \\ &= I_1 + I_2 + I_3 + I_4 + V_{12} + V_{21} + e^{i\varphi} V_{13} + e^{-i\varphi} V_{31} + e^{-i\varphi} V_{14} + e^{i\varphi} V_{41} \\ &\quad + e^{i\varphi} V_{23} + e^{-i\varphi} V_{32} + e^{-i\varphi} V_{24} + e^{i\varphi} V_{42} + e^{-2i\varphi} V_{34} + e^{2i\varphi} V_{43} \end{aligned}$$

We expect the four auto-correlation to be the same.

Second case

- For interpolated map rows between two sky scans, we combine the visibilities from the two θ_0 - scans.



$$S_1^\star = S_1 + S_2 + e^{i\frac{2\pi}{\lambda}[(-6)\sin(\theta_0)+(-6)\sin(\theta)]} S_3 + e^{i\frac{2\pi}{\lambda}[6\sin(\theta_0)+6\sin(\theta)]} S_4$$

$$S_2^\star = S_1' + S_2' + e^{i\frac{2\pi}{\lambda}[(-6)\sin(\theta_0')+(-6)\sin(\theta')]} S_3' + e^{i\frac{2\pi}{\lambda}[6\sin(\theta_0')+6\sin(\theta')]} S_4'$$

$$\theta' = \theta - 1^o$$

$$\varphi_1 = \frac{2\pi}{\lambda}[6\sin(\theta_0) + 6\sin(\theta)] \qquad \varphi_2 = \frac{2\pi}{\lambda}[6\sin(\theta_0') + 6\sin(\theta')]$$

$$
\begin{aligned}
I_1^\star &= I_1 + I_2 + I_3 + I_4 + V_{12} + V_{12}^* + e^{i\varphi_1} V_{13} + [e^{i\varphi_1} V_{13}]^* + e^{-i\varphi_1} V_{14} + [e^{-i\varphi_1} V_{14}]^* \\
&\quad + e^{i\varphi_1} V_{23} + [e^{i\varphi_1} V_{23}]^* + e^{-i\varphi_1} V_{24} + [e^{-i\varphi_1} V_{24}]^* + e^{-2i\varphi_1} V_{34} + [e^{-2i\varphi_1} V_{34}]^* \\
I_2^\star &= I_1' + I_2' + I_3' + I_4' + V_{12}' + V_{12}'^* + e^{i\varphi_2} V_{13}' + [e^{i\varphi_2} V_{13}']^* + e^{-i\varphi_2} V_{14}' + [e^{-i\varphi_2} V_{14}']^* \\
&\quad + e^{i\varphi_2} V_{23}' + [e^{i\varphi_2} V_{23}']^* + e^{-i\varphi_2} V_{24}' + [e^{-i\varphi_2} V_{24}']^* + e^{-2i\varphi_2} V_{34}' + [e^{-2i\varphi_2} V_{34}']^*
\end{aligned}
$$

$$
I = c_1^2 I_1^\star + c_2^2 I_2^\star
$$

- For $\theta = 0.5$deg, and $\theta' = -0.5$deg, $c_1 = c_2 = 0.7$;
- For $\theta = 0.25$deg, and $\theta' = -0.75$deg, $c_1 = 0.94$; $c_2 = 0.33$;
- For $\theta = 0.75$deg, and $\theta' = -0.25$deg, $c_1 = 0.33$; $c_2 = 0.87$;

Third case

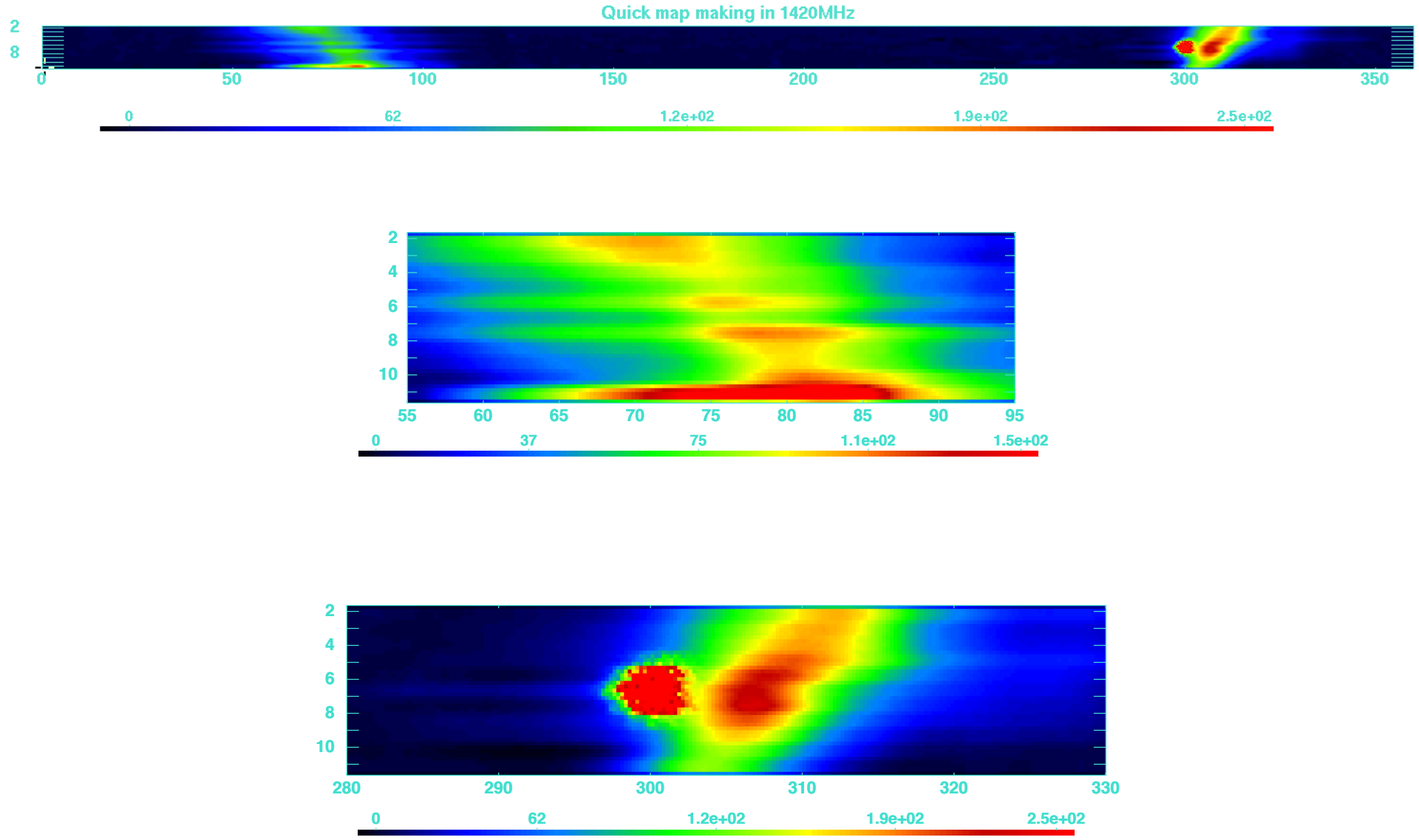
- For the map rows beyond the edge scan, we use only the corresponding edge scan, applying the phase term compensating the shift in NS between the sky direction and antennae pointing directions.

$$S = S_1 + S_2 + e^{i\frac{2\pi}{\lambda}[(-6)\sin(\theta_0)+(-6)\sin(\theta)]} S_3 + e^{i\frac{2\pi}{\lambda}[6\sin(\theta_0)+6\sin(\theta)]} S_4$$

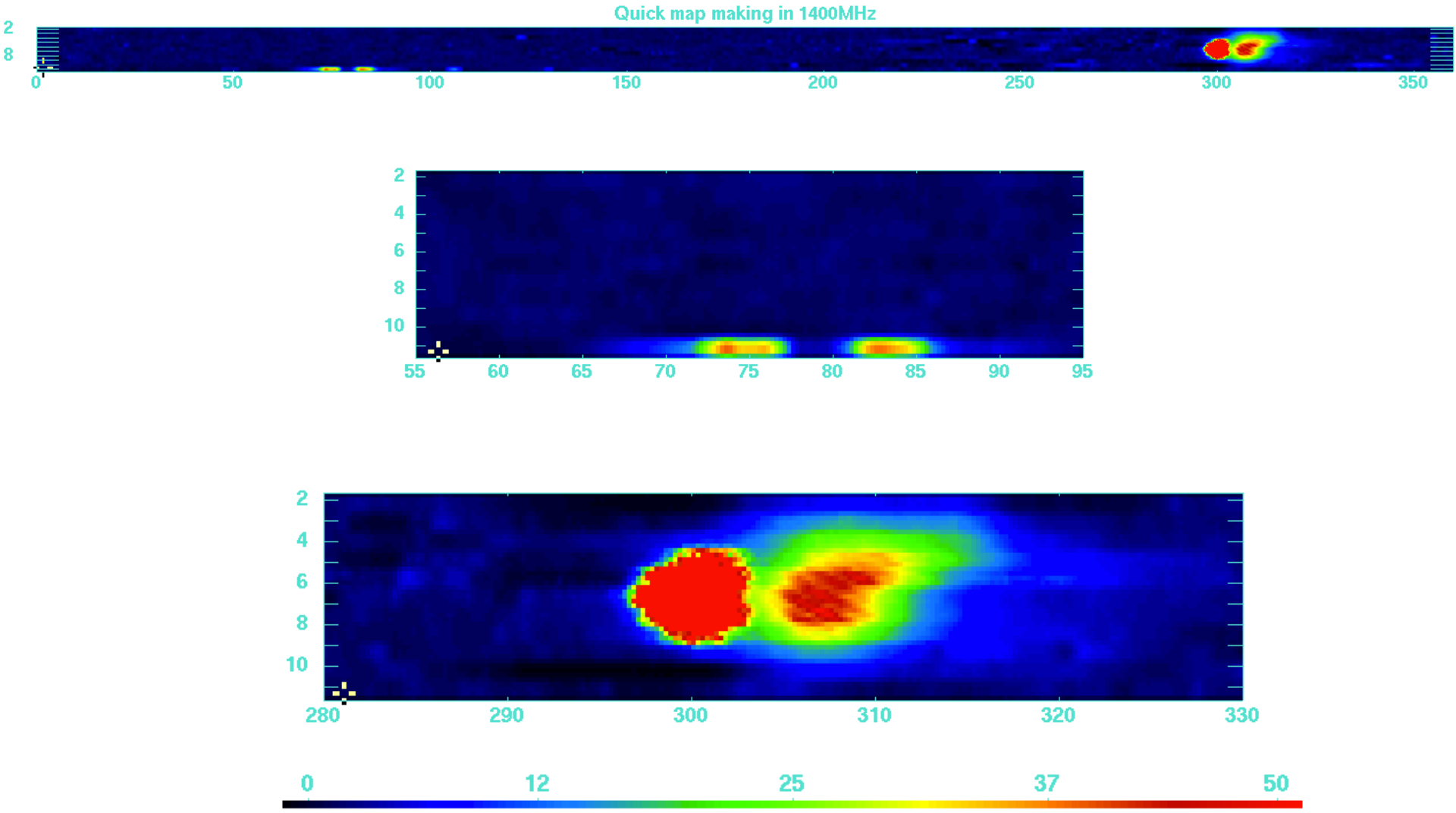
$$\begin{aligned} I &= c^2 S^* S \\ &= c^2 \left\{ I_1 + I_2 + I_3 + I_4 + V_{12} + V_{12}^* + e^{i\varphi} V_{13} + [e^{i\varphi} V_{13}]^* + e^{-i\varphi} V_{14} + [e^{-i\varphi} V_{14}]^* \right. \\ &\quad \left. + e^{i\varphi} V_{23} + [e^{i\varphi} V_{23}]^* + e^{-i\varphi} V_{24} + [e^{-i\varphi} V_{24}]^* + e^{-2i\varphi} V_{34} + [e^{-2i\varphi} V_{34}]^* \right\} \end{aligned}$$

- For $\theta = \pm 0.5$deg, c = 0.7;
- For $\theta = \pm 0.25$deg, c = 0.94;

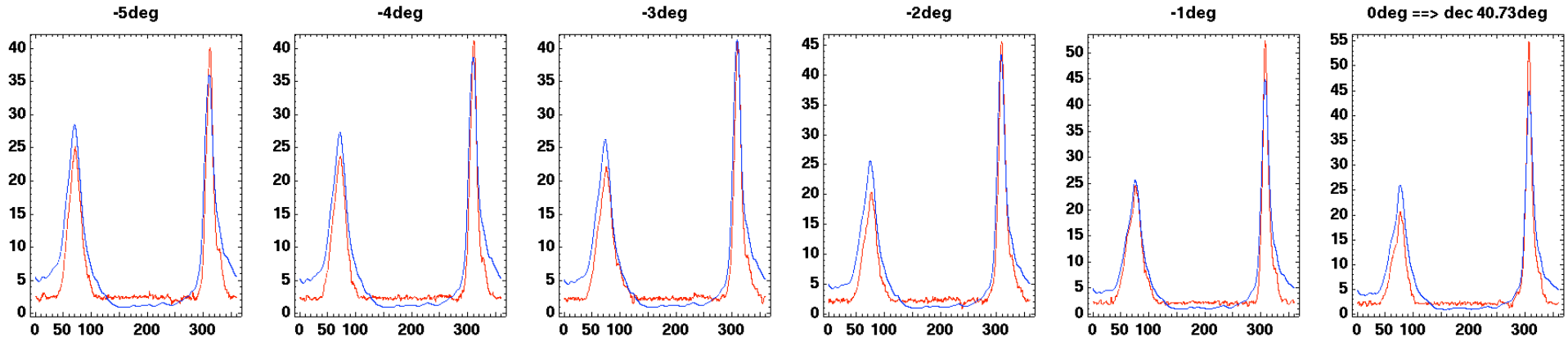
Quick map making in 1420MHz



Quick map making in 1400MHz

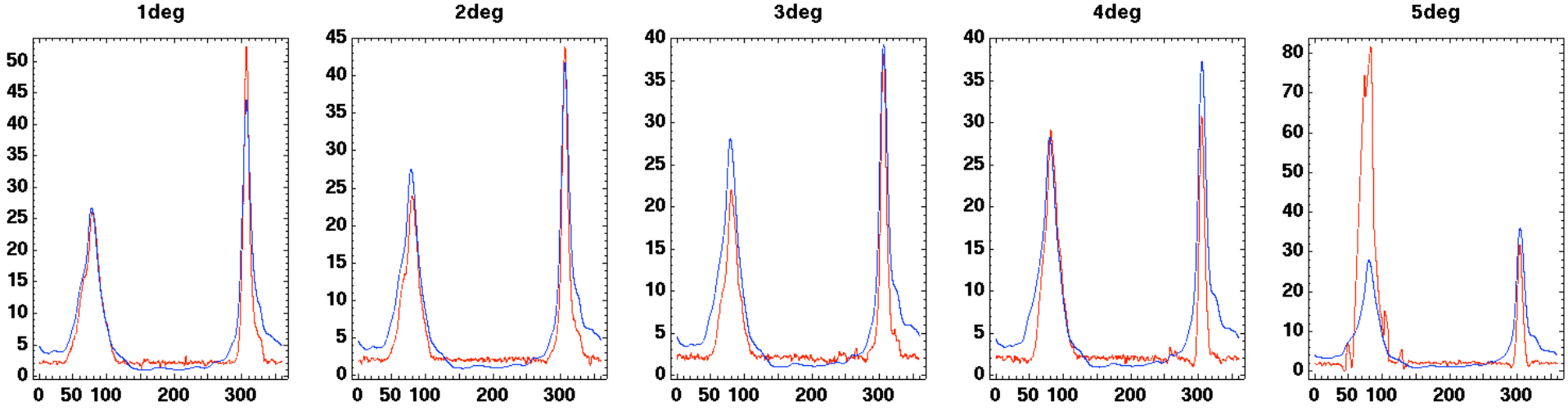


Auto-correlation at 1420MHz

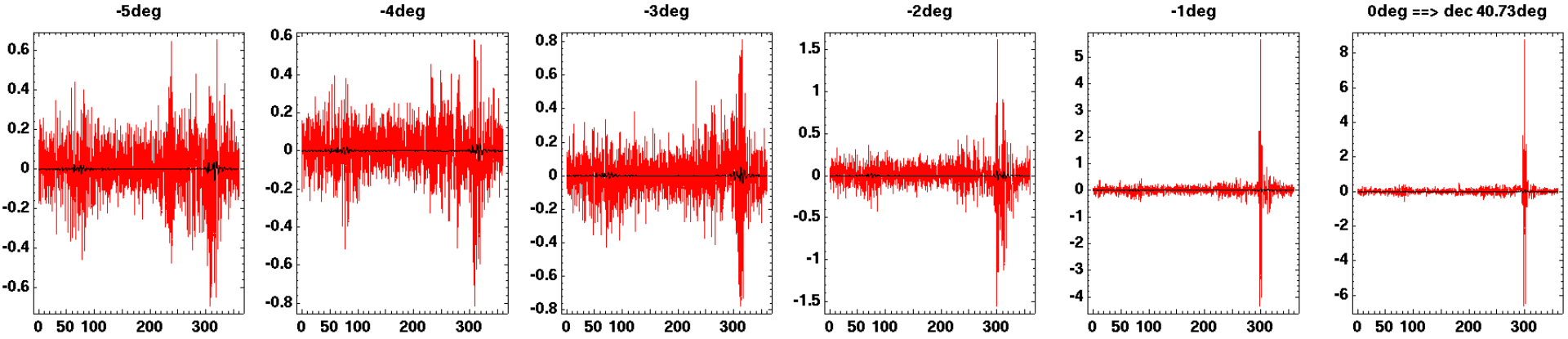


Blue : simulated from LAB;

Red : Nov data;

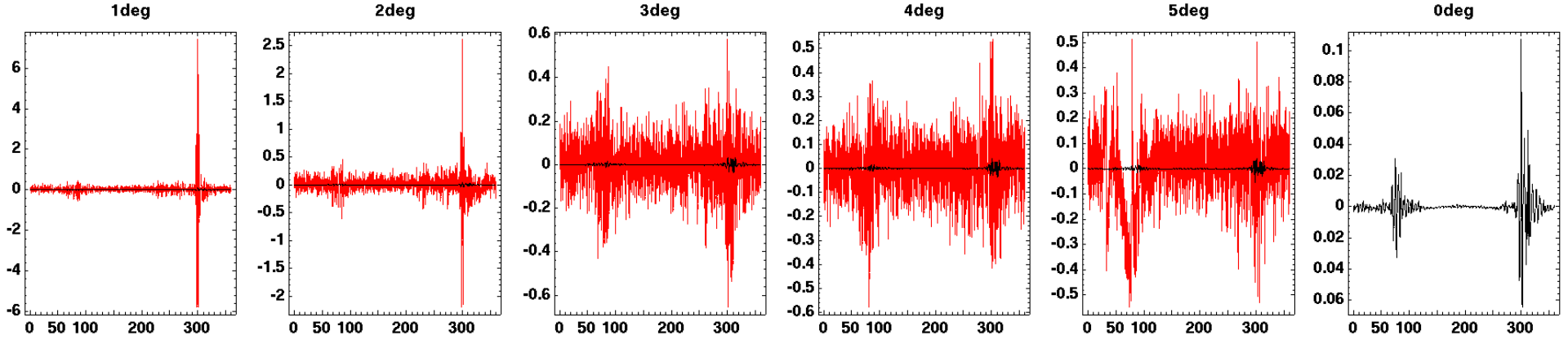


Cross-correlation (~6m,0) at 1420MHz

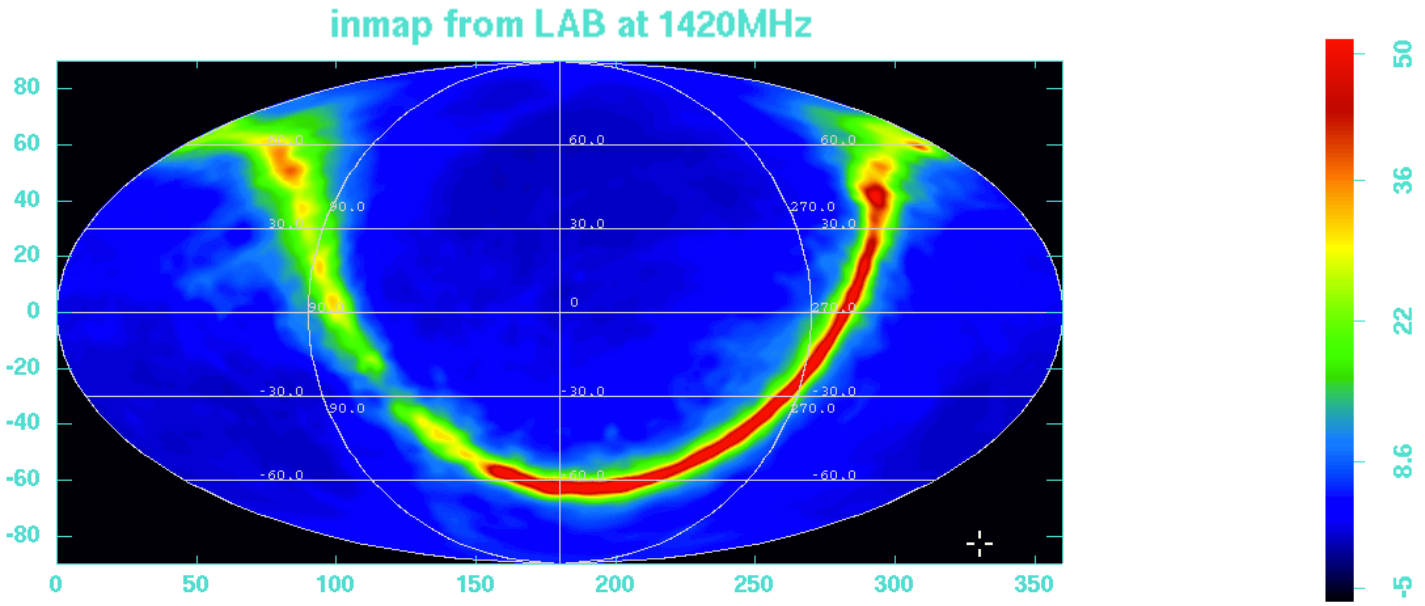


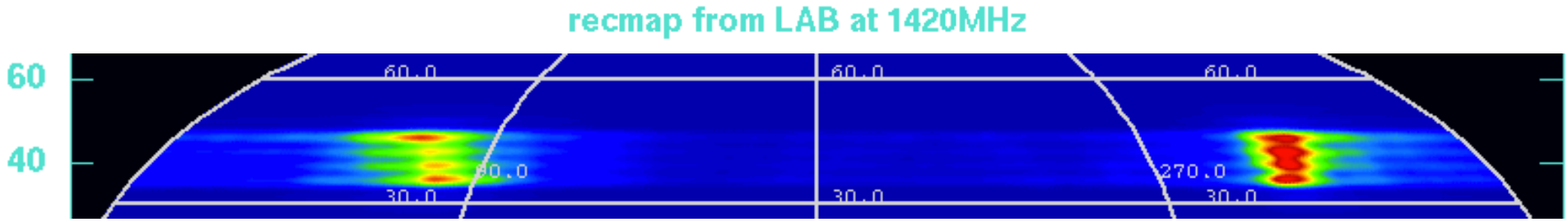
Black: simulated from LAB;

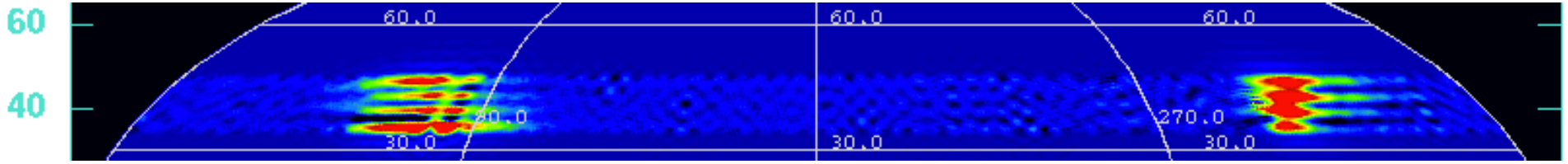
Red : Nov data;



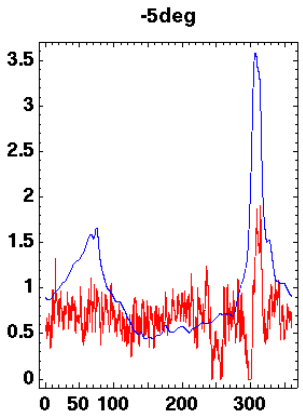
Reconstructed map at 1420MHz

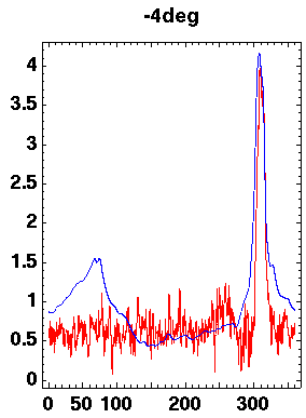


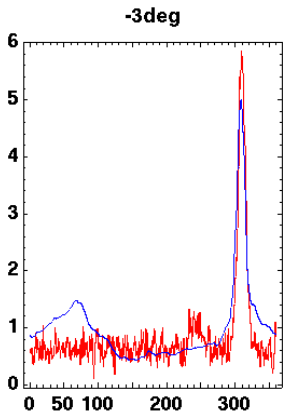


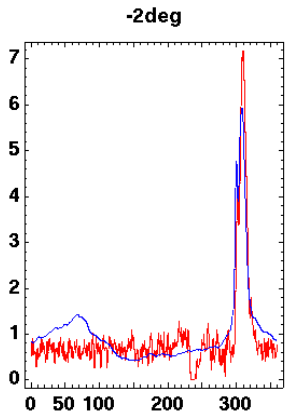


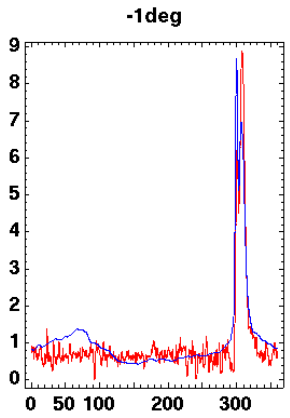
Auto-correlation at 1420MHz

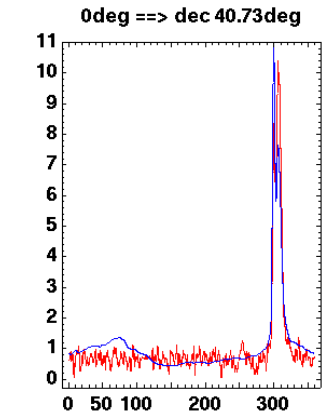












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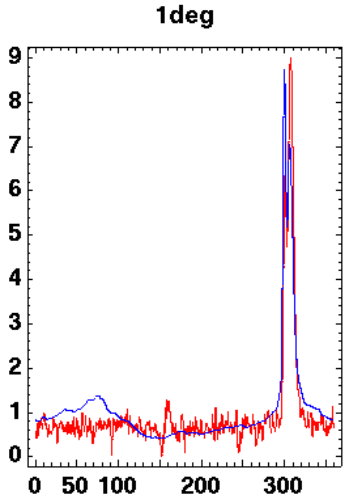

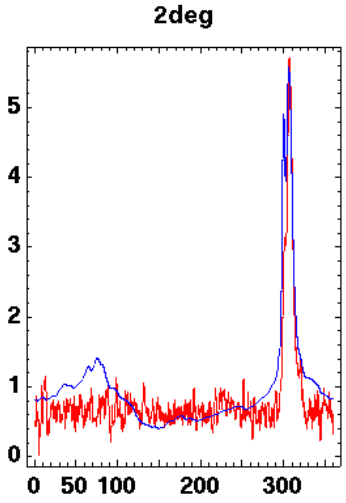

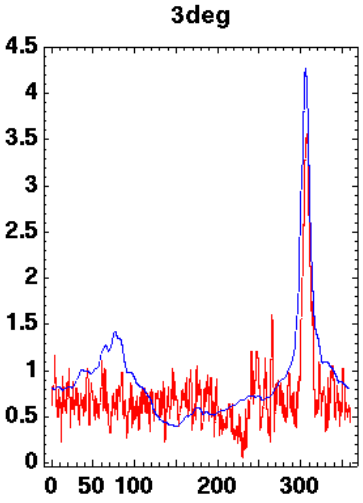

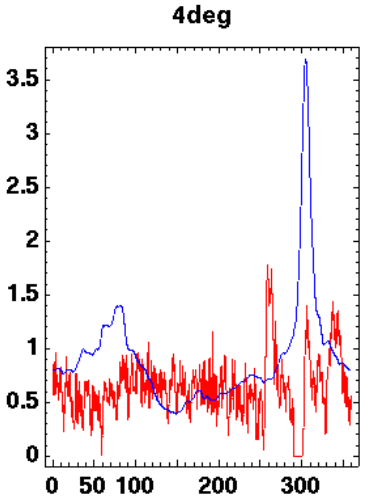

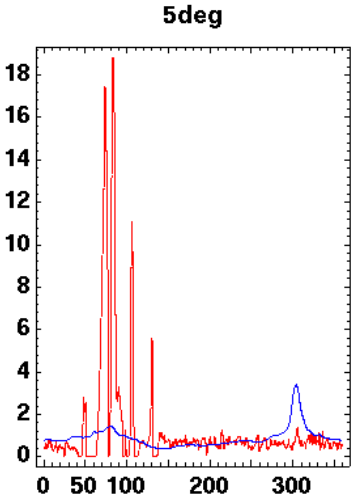

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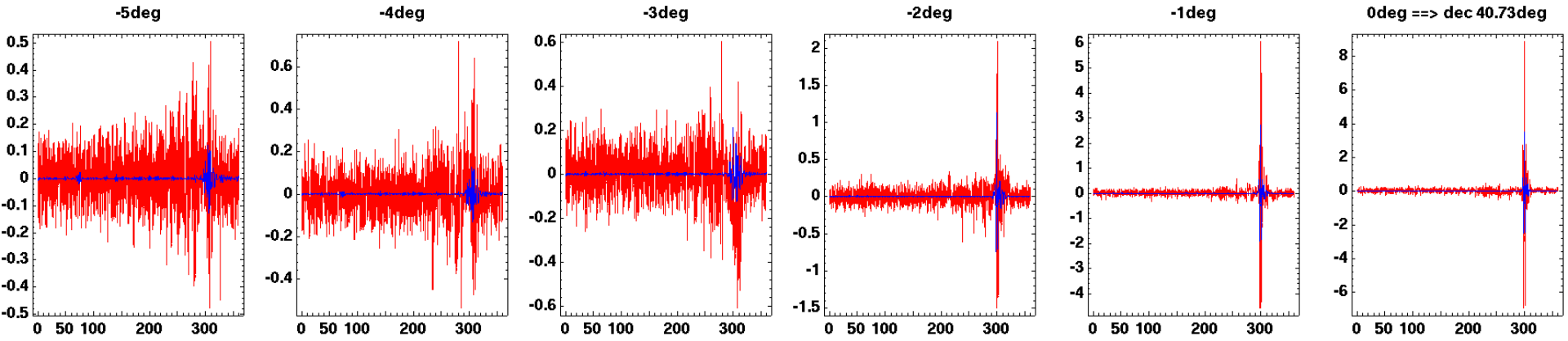

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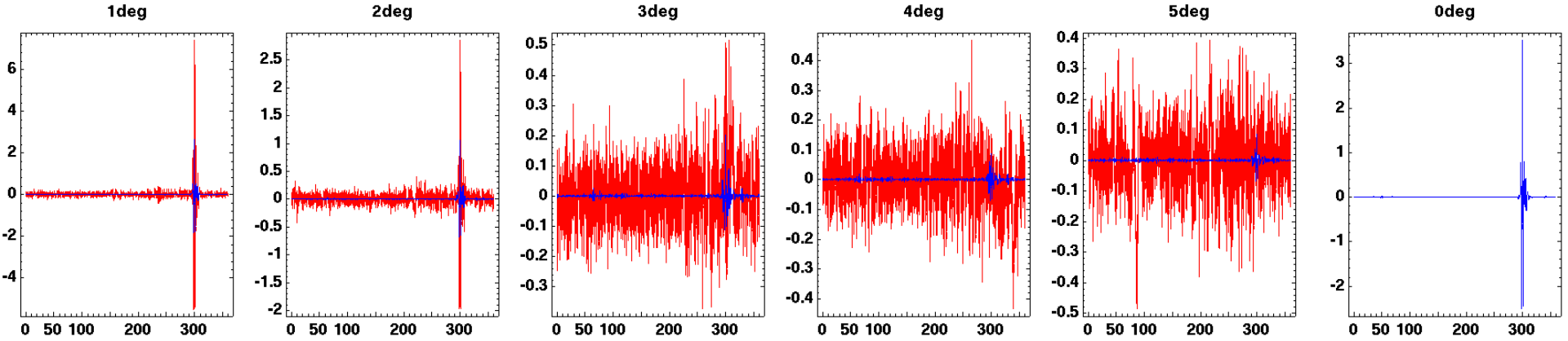

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