Report on the new Effelsberg sub-reflector and timing of the PSR 1713+0747

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Recently, PSR 1713+0747, which is observed with the Effelsberg telescope from 1996, started showing a scattering in its timing residuals. This pulsar has a period of 4.57 ms, frequency of 218.8 Hz, low DM of 15 $cm^{-3}pc$ and is usually observed at 21cm, although there are occasionally 11 cm and 30 cm timing observations.

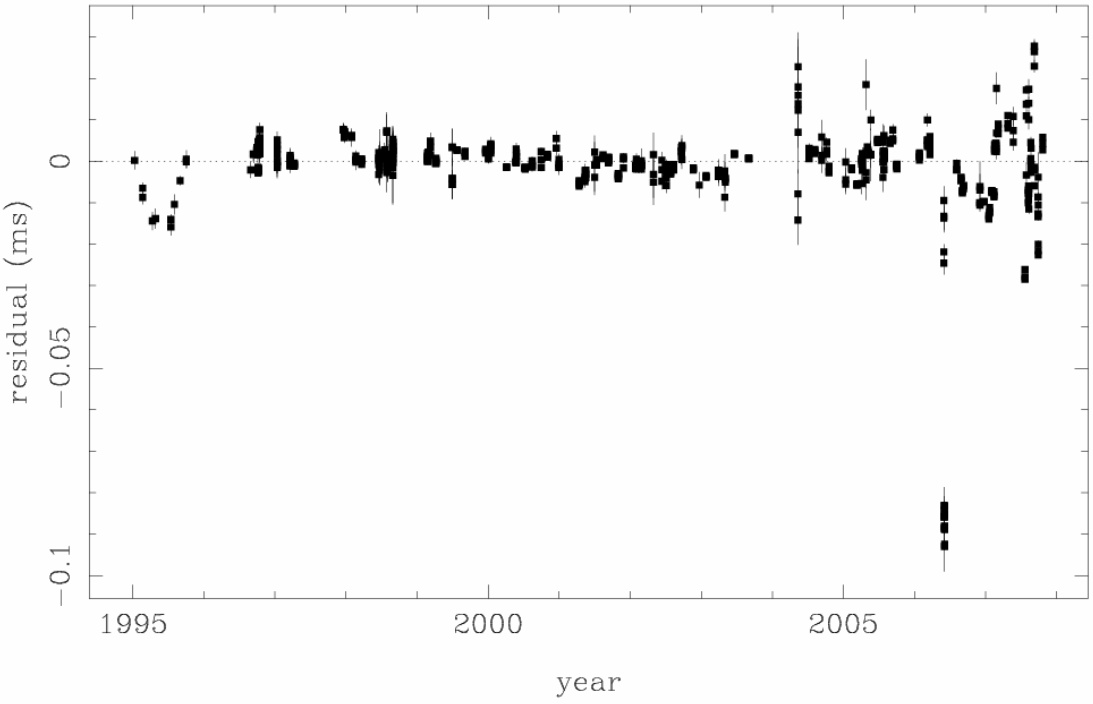

Figure 1: The timing solution for PSR 1713+0747 is very good in the beginning and getting worst after 2006.

Until May 2006 the residuals that don't align with the template are the ones that are either at different than 1.4 GHz frequencies (2.7 GHz or 865 MHz), either "not good" due to interstellar scintillation.

The typical calibration scan that is performed after every TOA observation is shown in Figure 2, where everything looks fine for all the 32 channels. This observation also happens to be the last timing observation of PSR 1713+0747 before the substitution of the Effelsberg sub-reflector.

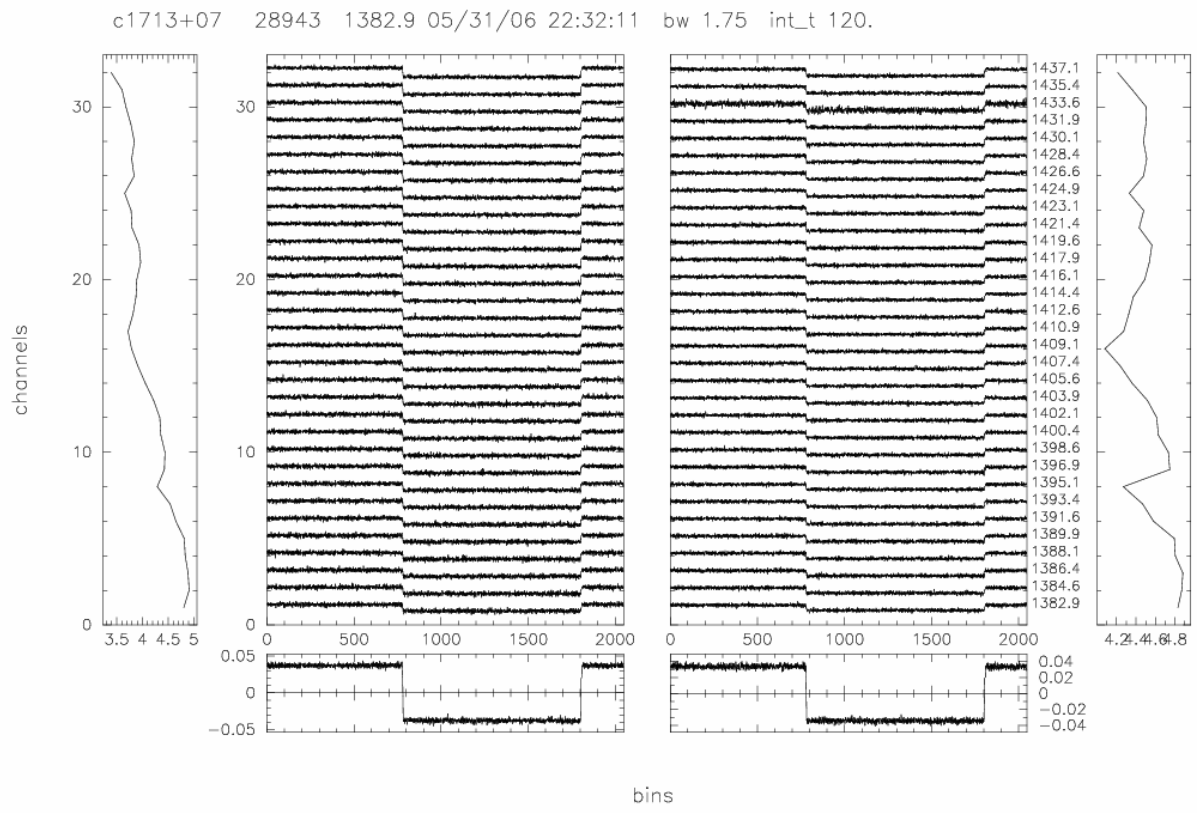

Figure 2: Last calibration scan observation at 21cm with the old sub-reflector in May 2006. Everything looks good and normal.

After that day there was a gap in the Effelsberg timing observations and they started again in December 2006 with a sequence of 2.7 GHz observations. In figure 3, the first timing observations at 21 cm with the new sub-reflector are shown, where for the first time peaks that look like interference are appearing. This continues to all of the observations ever after, with extreme peaks at 21 cm and not so strong at 11 cm. This interference, as suggested by Axel Jessner, **might be caused by the new sub-reflector** itself that has electronics emitting at 41.3 GHz, a frequency 5 times less than the pulsars frequency (218 Hz). This behaviour, to have interference when the pulsar frequency is multiple to 41.3 GHz, seems to create problems in the timing observations.

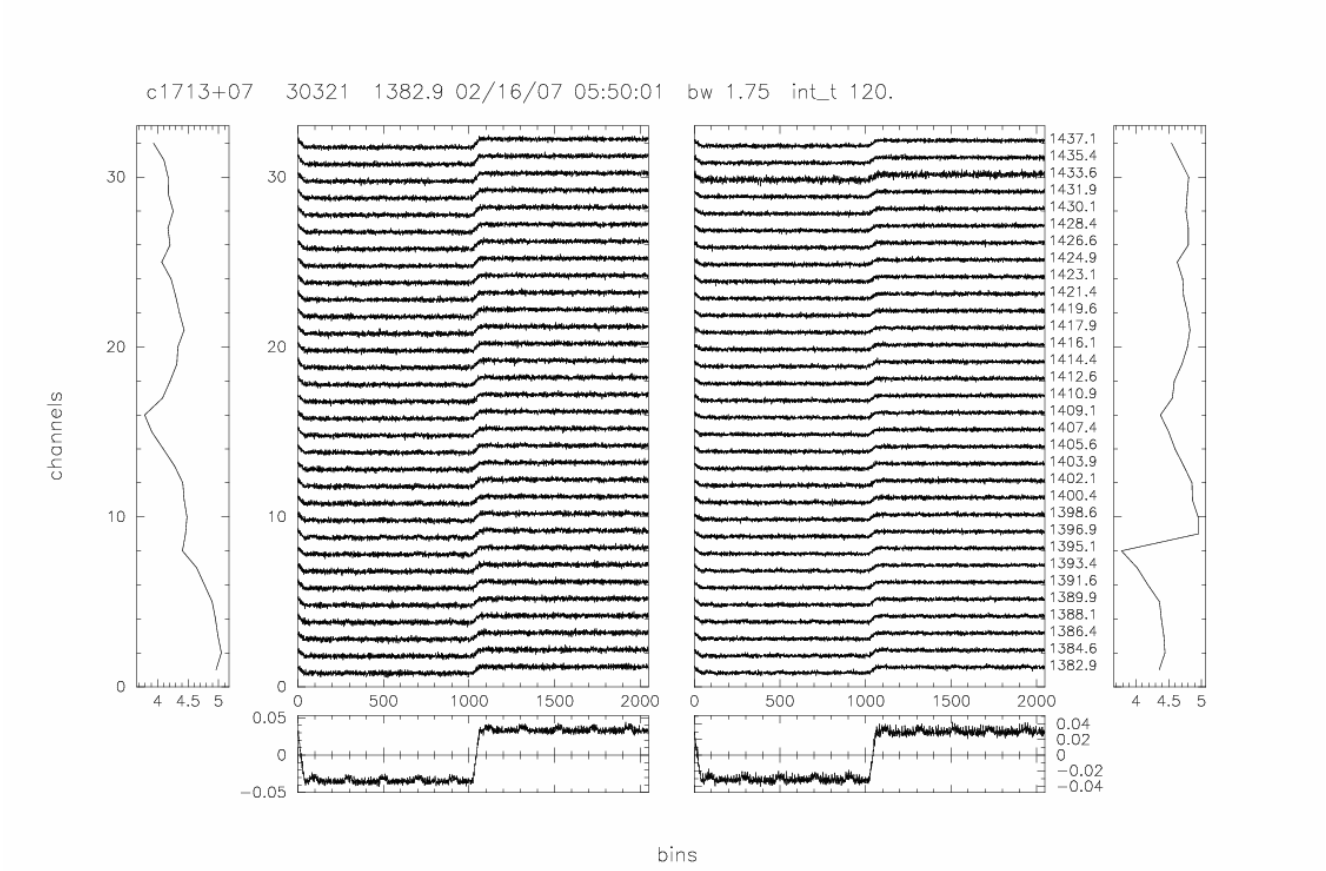

Figure 3: First observation at 21cm with the new sub-reflector in February 2007. The interference peaks are obvious.

Great proof of what mentioned before is the last timing observation of PSR 1713+0747, after the correction of the sub-reflector problem, in October 2007. It is clear, as shown in figure 4 that **the peaks disappeared!** Thus, the interference seemed to come from the sub-reflector and it was strong enough to harm timing data taken from the 1.4 GHz receiver that is in the primary focus of the telescope.

Great attention is needed when using this period's data because the interference is not easily noted all the times and can cause problems in the timing model.

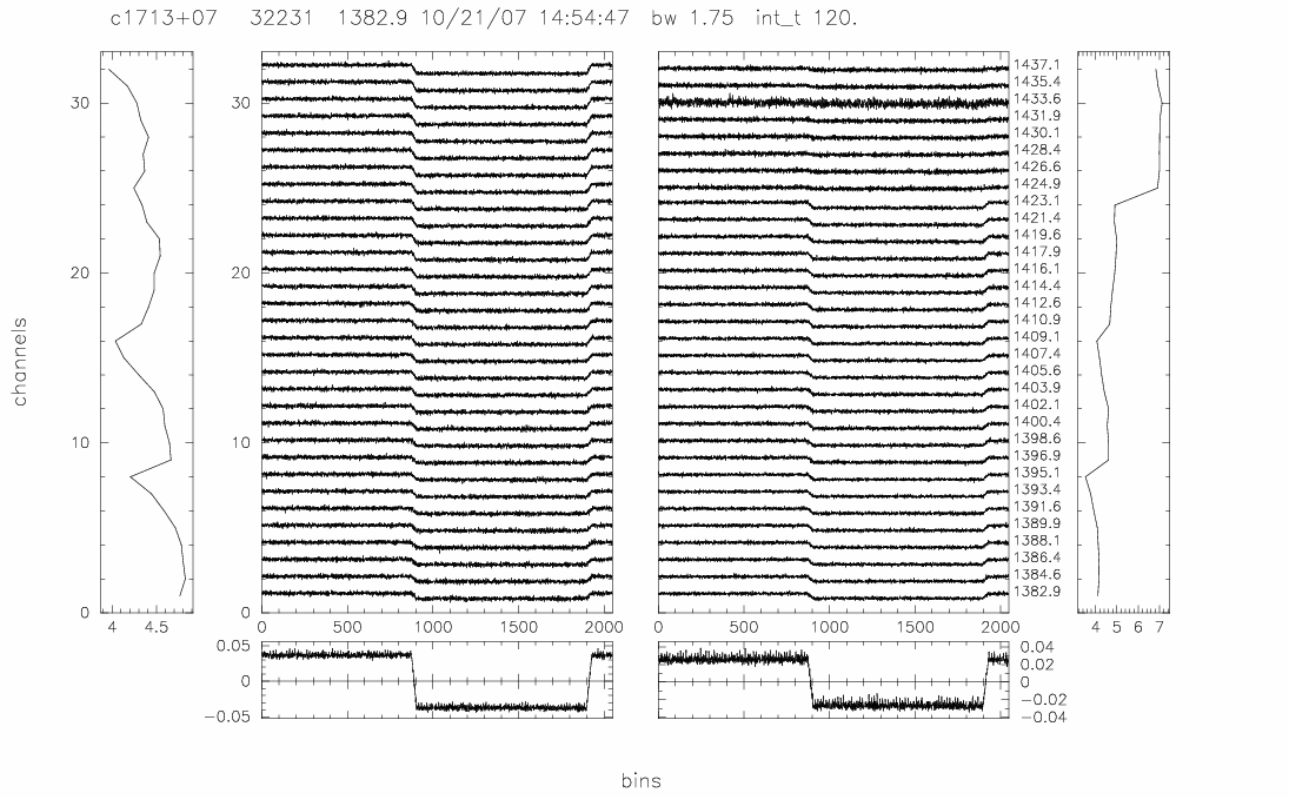

Figure 4: Observation at 21cm in October 2007. The interference disappeared.