Feasible Spectral Indices Measurement by Broad-band VLBI in VGOS Era

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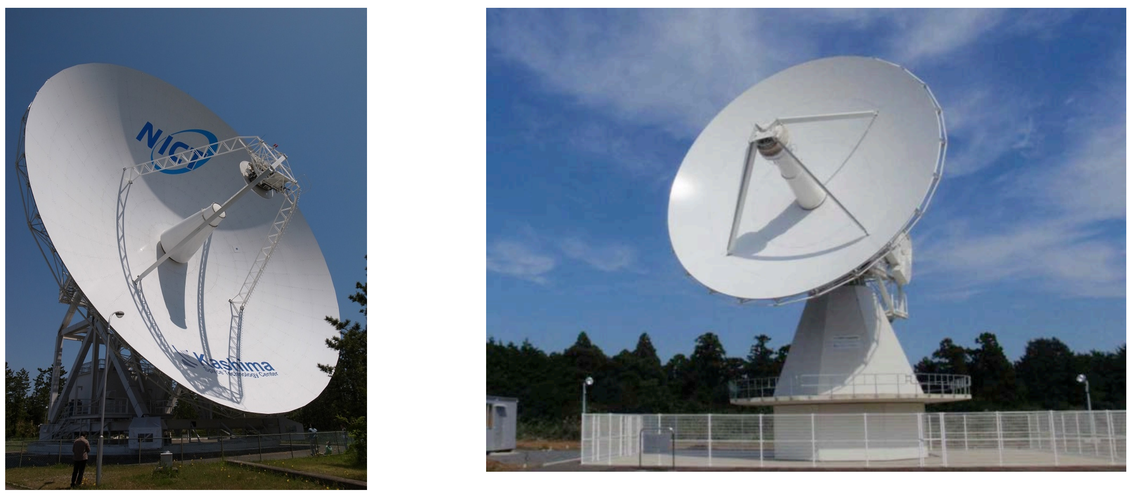
Introduction

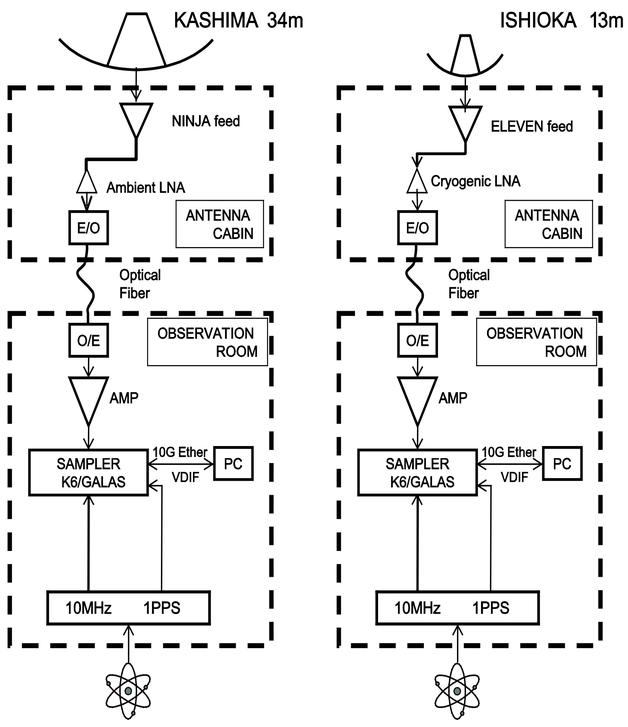
To establish next generation geodetic VLBI, called VGOS (VLBI Global Observing System) which is based on the so-called broadband delay which uses four or more frequency bands in the range from 2.5 GHz to 14 GHz(1), we have been developing a broad-band system for Kashima 34 meter radio telescope which is the third largest radio telescope with cassegrain optics in Japan. Currently we have installed two type of broadband feed (IGUANA-H and NINJA). Firstly for 6.5 GHz to 15 GHz since December 2013 and secondary 3.2 GHz to 14.4 GHz since July 2015.



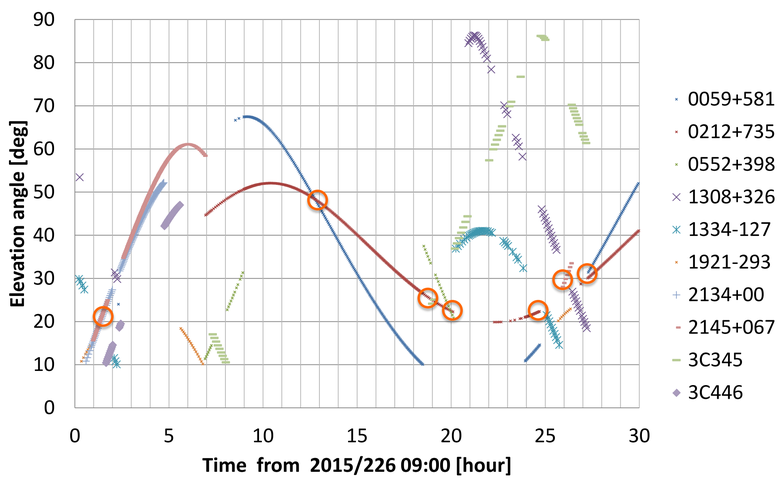
Broad band VLBI experiment on NICT/Kashima (left) and GSI/Ishioka (right) baseline

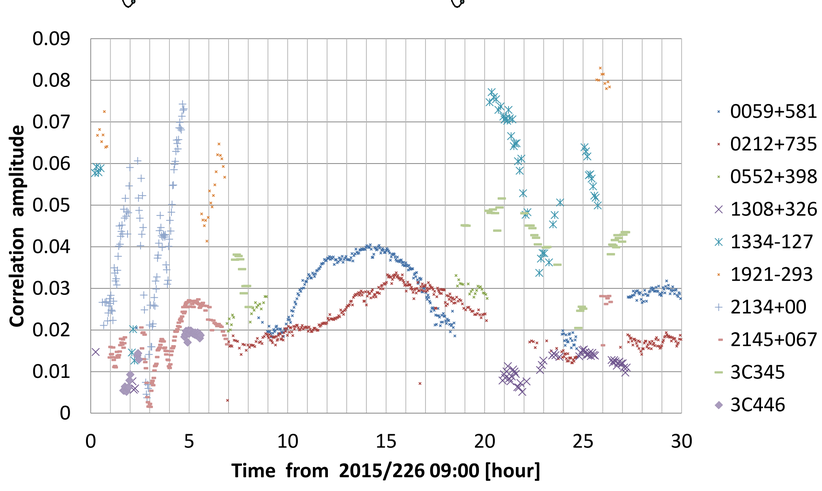
VLBI between Kashima and Ishioka

The feasible broad-band VLBI sessions with Kashima 34 m and new VGOS-type Ishioka 13 m were carried out on January and July 2015. We carried out intensive sessions for 6 to 14GHz (6-bands, 2048Msps, 1bit) in January and 3.2, 4.6, 8.8, and 11.6GHz (2048Msps, 1bit) in July. we try to measure the spectral indices on broad-band correlation by comparing with radio sources in geodetic VLBI sessions. A result of session are shown lower plots. There include an EL angle dependent and unknown fluctuations. Since it is hard to compare the correlation amplitude, correlation amplitude were compared with considering ΔEL angle and ΔTime.



Left panel shows a signal flow of both antennas. It was quite simple. We only installed a direct sampler K6/GALAS and 8Gbps PC based recorder.

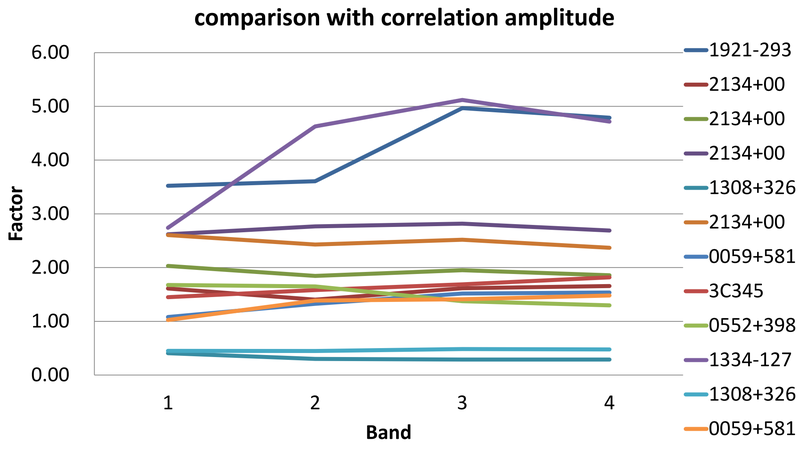




↑Elevation angle and time plot in GV15226 geodetic VLBI scheduled radio sources(left). VLBI result on Kashima and Ishioka baseline in 11.6GHz (band #4, Right). The correlation amplitude seems to be maximum around 45 degree of elevation angle compared with elevation angle and time plot for especially 0059+581. Unknown variations are found (caused RFI?) in the right plot. The open circles indicate cross points of two radio sources, where are used for ΔEL angle and ΔTime calibration.

↓ΔEL angle and Δtime calibration result. The right figure shows the comparison result. The most sources have flat indices, however indices of 1921-293 and 1308+326 are increasing at higher frequency. The LSQ method with weight of 1/cos(ΔEL) and 1/Δtime has a possibility for more precise determination.

Source	calibrator	Time	Δtime[s]	EL[deg]	ΔEL[deg]	Factor 3.2GHz	Factor 4.6GHz	Factor 8.8GHz	Factor 11.6GHz
1921-293	2145+067	2015/226 9:49:40	180	14.4	1.2	3.52	3.61	4.97	4.79
2134+00	2145+067	2015/226 09:51:40	60	14.029	-0.371	1.61	1.40	1.61	1.66
2134+00	2145+067	2015/226 9:59:40	60	15.628	-1.222	2.03	1.85	1.95	1.86
2134+00	2145+067	2015/226 10:41:00	140	23.759	-1.149	2.62	2.77	2.82	2.69
1308+326	2145+067	2015/226 11:15:30	800	34.722	4.95	0.41	0.30	0.29	0.29
2134+00	2145+067	2015/226 11:27:50	60	32.573	-2.199	2.61	2.43	2.52	2.37
0059+581	0212+735	2015/226 21:43:10	90	48.717	0.331	1.08	1.33	1.52	1.54
3C345	0212+735	2015/227 3:59:30	160	24.117	-0.739	1.45	1.58	1.69	1.82
0552+398	0212+735	2015/227 4:51:50	120	23.516	-0.701	1.68	1.65	1.37	1.30
1334-127	0212+735	2015/227 9:41:40	1370	21.481	-0.855	2.74	4.63	5.12	4.72
1308+326	2145+067	2015/227 11:26:50	510	26.929	-6.576	0.45	0.45	0.48	0.48
0059+581	0212+735	2015/227 12:15:50	80	31.38	1.339	1.03	1.39	1.41	1.48



Acknowledgements

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