



Study of mutual occultation phenomena of the Galilean satellites at radio wavelengths

¹S.Pluchino, ^{1,2}G.Pupillo, ³E.Salerno,
⁴F.Schillirò, ¹M.Bartolini, ¹S.Montebugnoli

¹INAF-IRA Medicina Radiotelesopes

²INAF-OATo

³INAF-IRA Bologna

⁴INAF-IRA Noto VLBI Station



The Radio Occultation research program performed with INAF-IRA radiotelescopes



It is composed of two parts:

- Lunar Radio Occultation (LRO) program



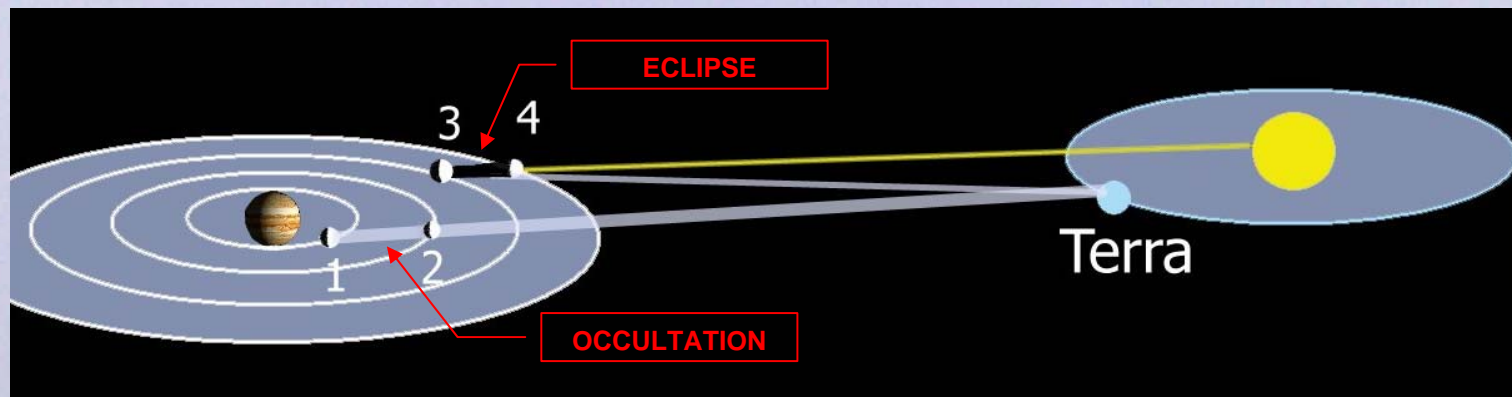
- Satellite by Satellite Occultation (SSO) program



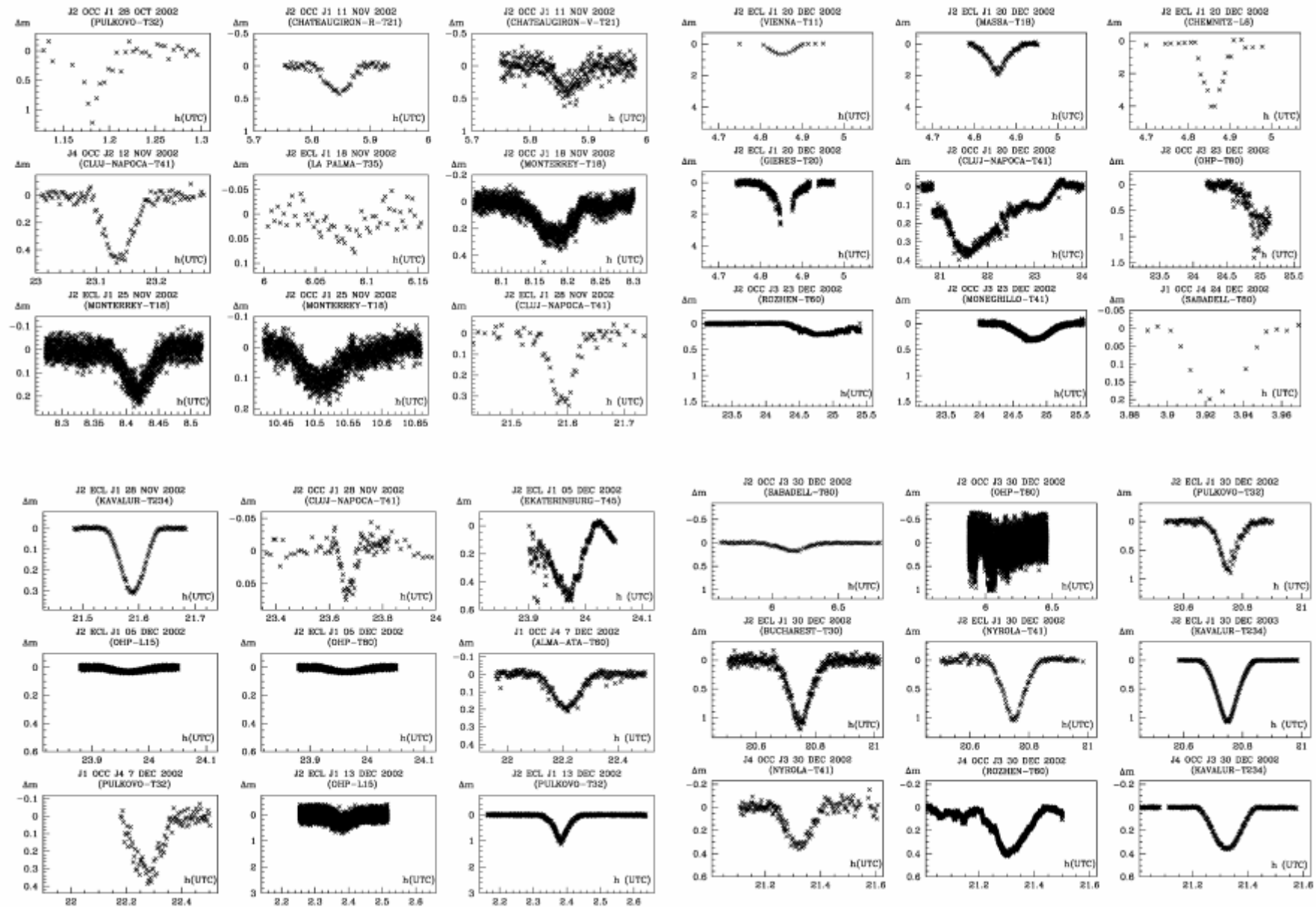
Satellite by Satellite Occultation program



It includes the observation of SSO events, as well as mutual occultations phenomena of Jupiter satellites (PHEMU).



These observations are aimed to measure the radio flux variation during the occultation and to derive surface spatial characteristics such as Io's hot spots.



Previous radio observations of Io satellite (VLA)



398

DE PATER, JAFFE, BROWN, AND BERGE

Vol. 261

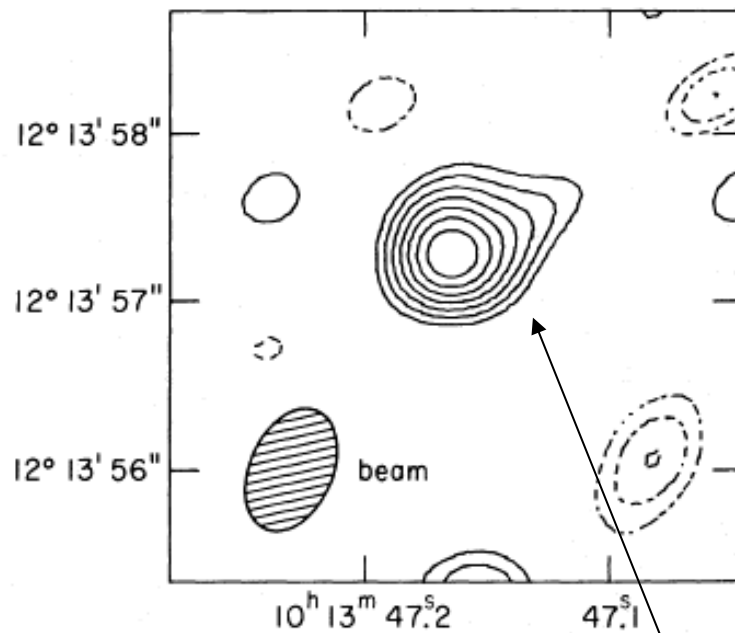


FIG. 1a

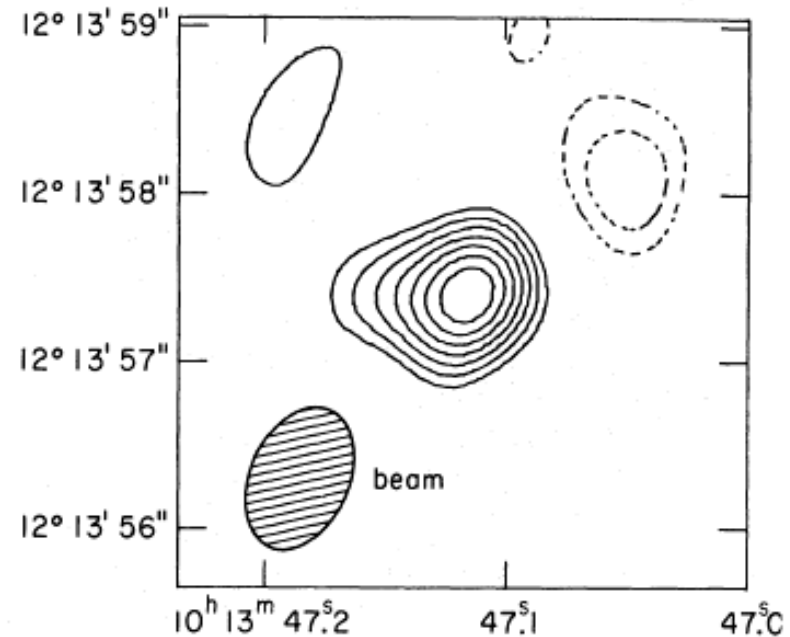


FIG. 1b

FIG. 1.—Maps of Io at (a) 2 cm and (b) 6 cm. The contour intervals are 30%–90% in steps of 10% of the peak intensity, which is 6.7 mJy/beam at 2 cm and 0.95 mJy per beam at 6 cm. Dashed contours indicate negative values. The half-power beam area is shown in each map.

Unresolved surface details

Io Hot Spots in 1991 (optical and infrared)

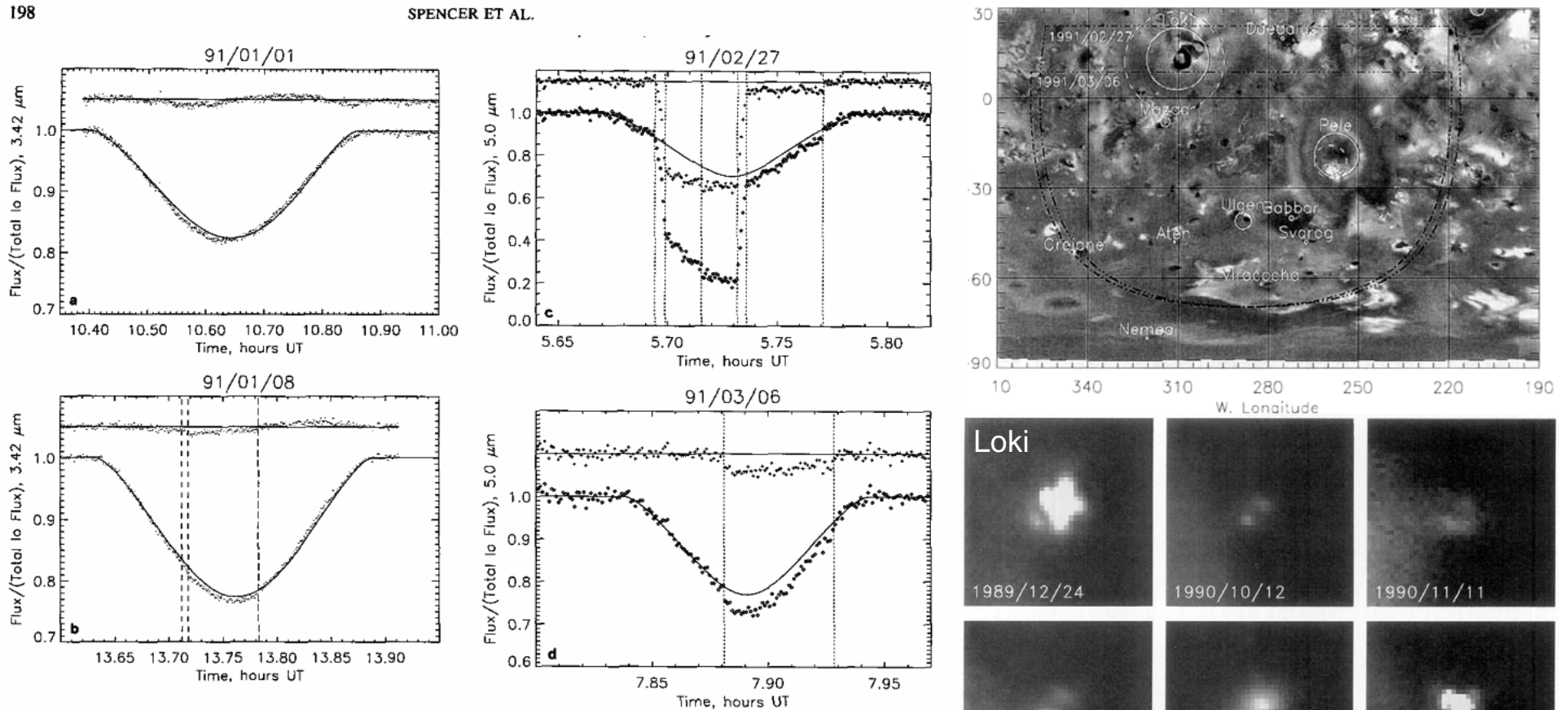
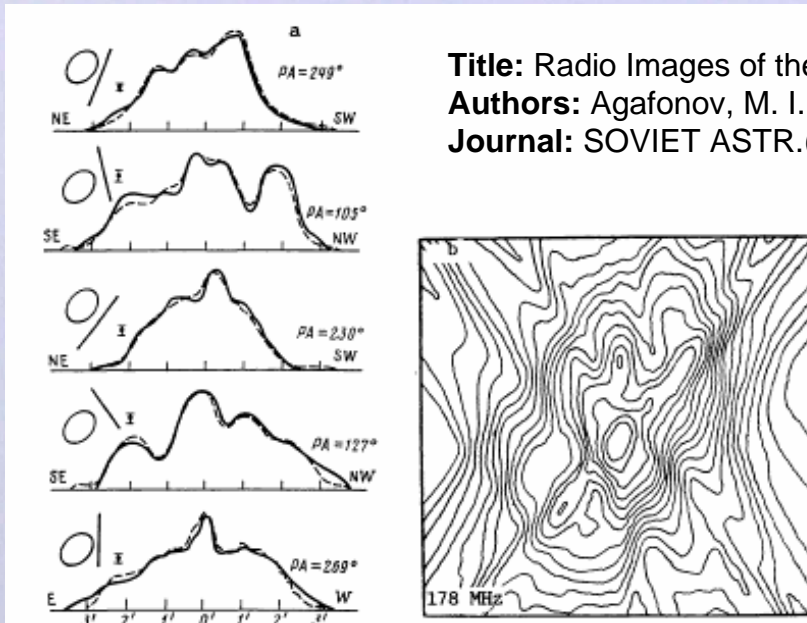


FIG. 2. The four Europa occultation lightcurves, along with model lightcurves derived from the Goguen empirical ephemeris, with residuals from the model plotted at the top of each panel, displaced vertically for clarity. Dashed vertical lines show the times of possible or definite hot spot occultations: pairs of lines show the duration of the hot spot occultation if this is resolved. (c and d) Diamonds represent the original data and crosses represent the residuals.

Radio occultation technique



Title: Radio Images of the Crab Nebula Based on Lunar Occultation Data
Authors: Agafonov, M. I., Ivanov, V. P., & Podvoiskaya, O. A.
Journal: SOVIET ASTR.(TR: A. ZHURN.) V.34, NO. 3/MAY, P.275, 1990

FIG. 3. Profiles of the strip distributions (a) used to construct an image of the Crab Nebula at 178 MHz (the control profiles are dashed; the position of the lunar limb relative to the radio source is shown on the left) and an uncorrected map of the nebula at 178 MHz (b).

Two-dimensional images of the Crab Nebula at 750 and 178 MHz with angular resolution of 20×35 and 45×65 arcsec, respectively, have been restored on the basis of occultation profiles for 1982-1983.

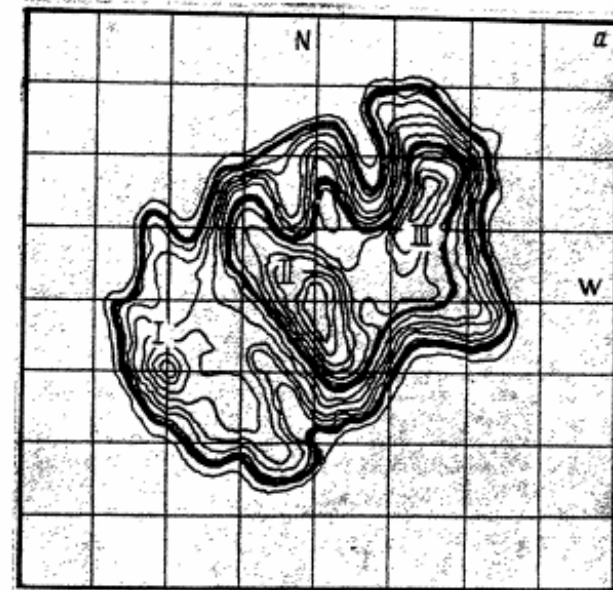
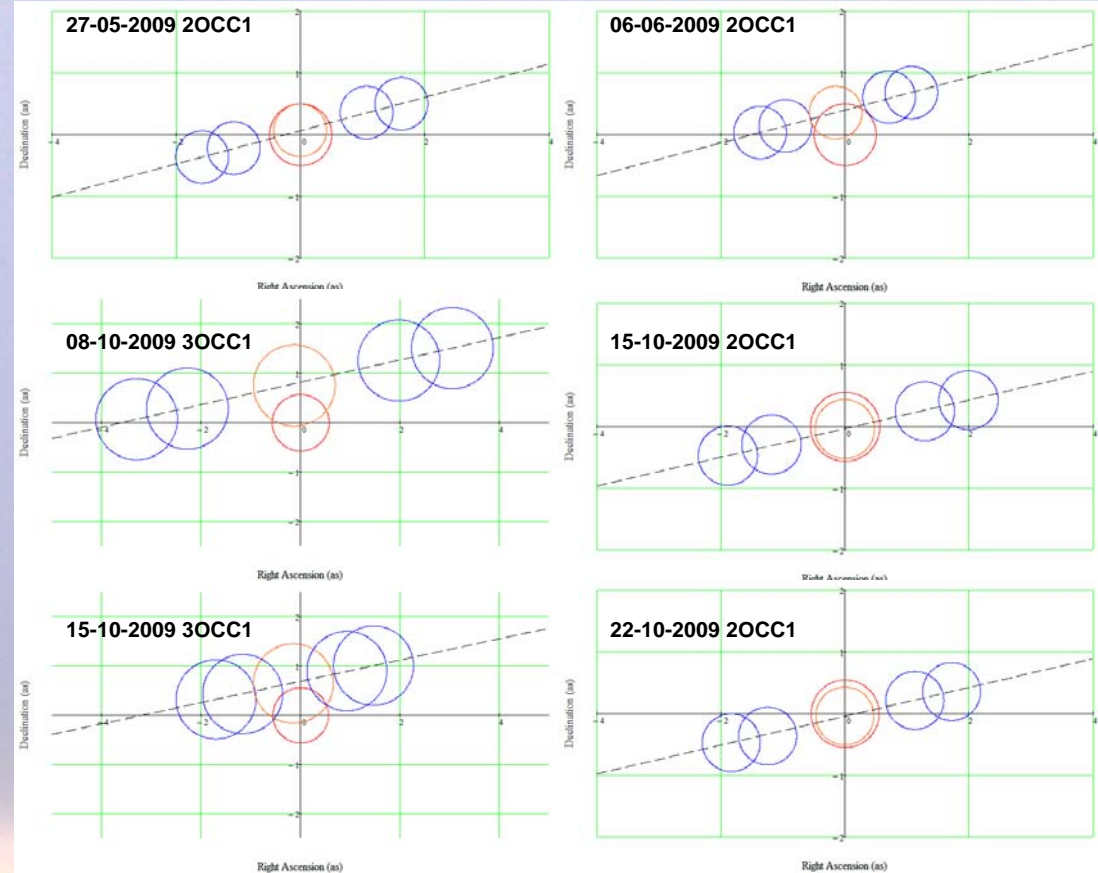
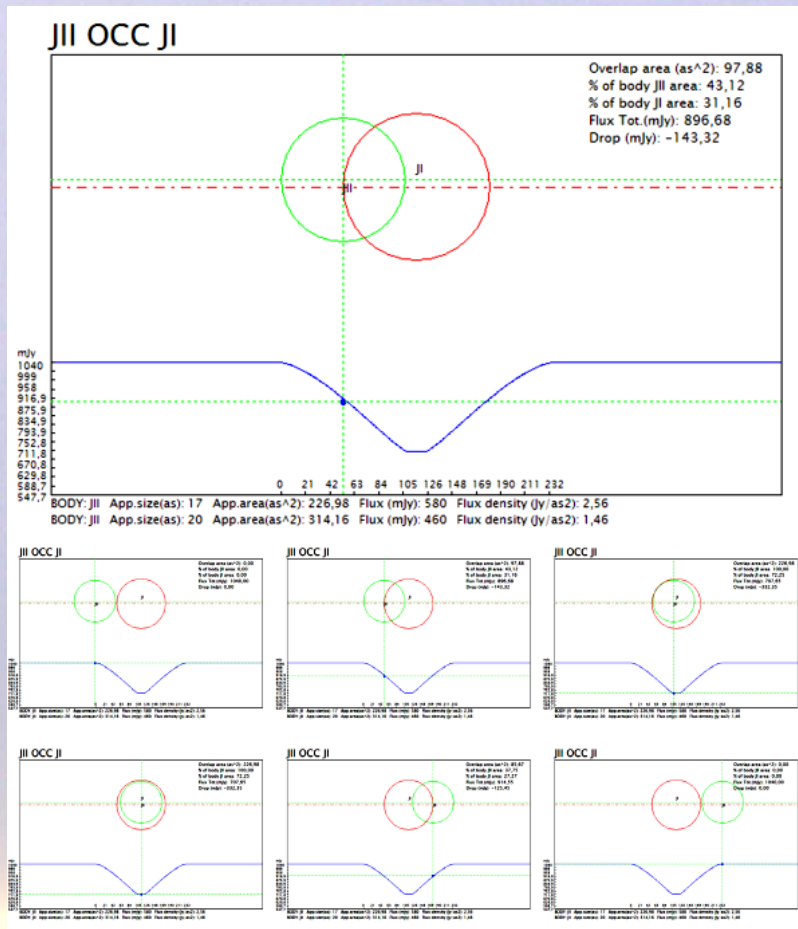


FIG. 5. Result of reconstruction by the TC-CLEAN method at 178 MHz (the uniform step of isophotes on the map is $\sim 7\%$ of the peak intensity).

Satellite by Satellite Occultation program



Simulation of occultation events are performed by “ad hoc” softwares based on NASA JPL ephemerides data.



Satellite by Satellite Occultation program



- Further measurements are already planned to confirm previous results and explain observed phenomena.
- Simultaneous measurements performed at optical and/or IR wavelengths could help to explain observed phenomena (collaborations are welcome!).
- Next Io's occultation events:

DATE	(TE)		DEBUT	DEBUT	DEBUT	MAXIMUM	FIN	FIN	FIN		DIST.A	DIST.	ELEV.				
DU	MAXIMUM	PHENOMENE	PENOMBRE	OMBRE/OCC	TOTALITE		TOTALITE	OMBRE/OCC	PENOMBRE	MAGNITUDE	DUREE	SAT.	IMPACT	MED	NOTO		
AN	MS	JR	H	M	S	H	M	S	H	M	S	S	(RS)	(")	deg	deg	
2009	10	8	3	49	34.	17	51	6.	17	52	38.	0.030	184	3.3	1.189	+25	+33
2009	10	15	2	19	53.	17	21	44.	17	23	35.	0.426	221	1.5	0.036	+24	+33
2009	10	15	3	28	26.	20	30	33.	20	32	40.	0.071	254	3.9	1.008	+25	+30
2009	10	22	2	28	28.	19	30	19.	19	32	10.	0.426	223	1.7	0.079	+27	+33
2009	11	16	2	12	32.	15	14	29.	15	16	26.	0.426	234	2.6	0.015	+25	+33
2009	11	23	2	28	55.	17	30	54.	17	32	53.	0.426	238	2.8	0.055	+28	+34
2009	11	28	3	44	35.	13	46	42.	13	48	49.	0.025	254	5.4	1.036	+20	+28
2009	11	30	2	46	53.	19	48	53.	19	50	53.	0.388	240	3.1	0.142	+12	+14
2009	12	11	2	16	40.	11	18	38.	11	20	37.	0.281	237	3.5	0.298	+07	+13
2009	12	18	2	38	22.	13	40	16.	13	42	9.	0.201	227	3.7	0.413	+27	+35
2009	12	25	2	1	31.	16	3	14.	16	4	58.	0.123	206	4.0	0.533	+28	+35
2010	1	1	2	26	10.	18	27	34.	18	28	58.	0.054	169	4.2	0.655	+10	+11
2010	3	21	2	53	8.	10	8	35.	10	24	30.	0.397	1882	1.4	0.112	+38	+46
2010	3	28	2	44	24.	9	1	15.	9	17	24.	0.400	1980	1.3	0.109	+32	+31



Thank you

Vicenza, 17 Ott 2009

XVII° Convegno Nazionale del GAD