

# Using Jupiter's Moon Io as a Plasma Probe:

## Appendix

Erik Hedenström and Anton Petré

### APPENDIX A CONSTANTS IN EQUATIONS

Equation 1

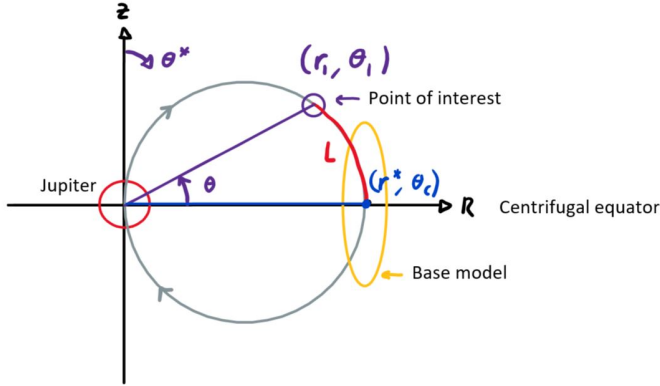
$$a = 1.66^\circ \mid b = 0.131 \mid c = 1.62 \mid d = 7.76^\circ \mid e = 249^\circ$$

Equation 2

$N \text{ (cm}^{-3}\text{)}$	$C \text{ (R}_j\text{)}$	$W \text{ (R}_j\text{)}$	$H \text{ (R}_j\text{)}$
$N_1 = 1710$	$C_1 = 5.23$	$W_1 = 0.20$	$H_1 = 0.1$
$N_2 = 2180$	$C_2 = 5.60$	$W_2 = 0.08$	$H_2 = 0.6$
$N_3 = 2160$	$C_3 = 5.89$	$W_3 = 0.32$	$H_3 = 1.0$
$N_4 = 1601$	$C_4 = 5.53$	$W_4 = 1.88$	$H_4 = 1.0$

### APPENDIX B

DERIVING THE DISTANCE ALONG MAGNETIC FIELD LINES



According to the dipole approximation,

$$r_I = r^* \cos^2(\theta_I - \theta_c), \quad (1)$$

which can be rewritten as

$$r^* = \frac{r_I}{\cos^2(\theta_I - \theta_c)}. \quad (2)$$

The distance along a field line from  $(r_I, \theta_I)$  to the plane of the centrifugal equator can be expressed as

$$L = \int_{\theta_I^*}^{\theta_c^*} \sqrt{\left(\frac{dr}{d\theta^*}\right)^2 + r^2} d\theta^*, \quad (3)$$

where

$$\theta^* = 90^\circ - \theta. \quad (4)$$

Computing the derivative gives

$$L = \int_{\theta_I^*}^{\theta_c^*} r_I \sqrt{(4 \cot^2(\theta^* + \theta_c) + 1) \csc^4(\theta^* + \theta_c)} d\theta^* \quad (5)$$

### APPENDIX C OBSERVATIONAL DATA

The aurora brightness data used in this paper is found in Table I. All coordinates are given in Jupiter System III.

TABLE I  
OBSERVATIONAL BRIGHTNESS DATA

ID	Date	Time	Brightness (kR)	Sub-observer latitude on Io	Longitude of Io	Sub-observer longitude
o49d01010	97-10-14	02:14:20	0.6177	-0.25°	-353.61°	-241.31°
o49d01a10	97-10-14	02:33:08	0.5779	-0.32°	-2.32°	-243.96°
o49d01020	97-10-14	03:38:35	0.5466	-0.56°	-32.63°	-253.21°
o49d01a20	97-10-14	04:05:28	0.5515	-0.65°	-45.07°	-257.01°
o49d01030	97-10-14	05:15:23	0.7531	-0.88°	-77.43°	-266.89°
o49d01a30	97-10-14	05:42:15	0.8429	-0.97°	-89.87°	-270.69°
o4xm03010	98-08-21	18:27:43	0.4524	-1.4°	-175.84°	-259.97°
o4xm03020	98-08-21	18:46:23	0.3803	-1.36°	-184.5°	-262.61°
o4xm03030	98-08-21	20:01:34	0.4283	-1.16°	-219.4°	-273.24°
o4xm03040	98-08-21	20:28:50	0.4495	-1.07°	-232.06°	-277.09°
o4xm01030	98-08-23	17:12:37	0.5151	-0.59°	-35.37°	-296.54°
o4xm01040	98-08-23	17:37:45	0.5142	-0.49°	-47.03°	-300.09°
o4xm01050	98-08-23	18:51:33	0.7138	-0.19°	-81.25°	-310.52°
o4xm01060	98-08-23	19:15:02	0.8845	-0.1°	-92.12°	-313.84°
o4xm01070	98-08-23	20:27:54	1.21	0.2°	-125.89°	-324.13°
o4xm01080	98-08-23	20:50:32	1.1891	0.3°	-136.38°	-327.33°
o4xm02010	98-08-27	16:49:42	0.7746	1.58°	-172.77°	-27.65°
o4xm02020	98-08-27	17:55:00	0.6788	1.65°	-202.94°	-36.87°
o4xm02030	98-08-27	18:16:08	0.6761	1.66°	-212.71°	-39.86°
o4xm02040	98-08-27	19:34:52	0.7255	1.67°	-249.09°	-50.98°
o5h9a5010	99-10-08	11:42:33	0.8413	1.94°	-78.86°	-327.86°
o5h9a5020	99-10-08	12:02:41	0.9218	1.91°	-88.19°	-330.71°
o5h906010	99-10-11	04:24:13	0.7211	-1.83°	-76.07°	-156.7°
o5h906020	99-10-11	04:41:01	0.6938	-1.79°	-83.85°	-159.08°
o5h907010	99-10-11	10:51:09	0.7711	-0.36°	-255.43°	-211.45°
o5h907020	99-10-11	11:07:57	0.8107	-0.27°	-263.23°	-213.82°
o5h909010	00-02-20	09:13:05	0.6415	-1.24°	-60.06°	-58.71°
o5h909020	00-02-20	09:29:53	0.6345	-1.32°	-67.84°	-61.08°
o5h909030	00-02-20	10:33:55	0.7601	-1.58°	-97.5°	-70.12°
o5h909040	00-02-20	10:59:28	0.7161	-1.68°	-109.34°	-73.73°
o5h9a2010	00-02-25	11:33:08	0.3445	0.3°	-220.33°	-15.06°
o5h9a2020	00-02-25	11:46:36	0.4291	0.23°	-226.55°	-16.96°
o5h9b2010	00-02-25	12:54:18	0.6332	-0.14°	-257.86°	-26.51°
o5h9b2020	00-02-25	13:14:25	0.7399	-0.25°	-267.17°	-29.35°
o6jn03bnq	01-12-13	18:31:43	0.7485	2.6°	-184.48°	-135.2°
o6jn03bpq	01-12-13	18:50:41	0.6809	2.63°	-193.24°	-137.89°
o6jn04tmq	01-12-29	17:35:49	0.6338	2.67°	-31.18°	-145.19°
o6jn04toq	01-12-29	17:54:47	0.6542	2.68°	-39.95°	-147.88°
ocai01010	13-12-31	04:26:24	0.4329	1.34°	-26.56°	-247.69°
ocai01020	13-12-31	04:44:05	0.4335	1.41°	-34.76°	-250.19°
ocai01030	13-12-31	05:50:09	0.5152	1.67°	-65.41°	-259.53°
ocai01040	13-12-31	06:16:37	0.586	1.77°	-77.7°	-263.27°
ocai01050	13-12-31	07:25:47	0.9046	1.97°	-109.8°	-273.05°
ocai01060	13-12-31	07:52:15	0.9539	2.04°	-122.09°	-276.8°
ocai01070	13-12-31	09:01:24	0.7192	2.16°	-154.2°	-286.57°
ocai01080	13-12-31	09:27:52	0.6287	2.19°	-166.49°	-290.31°
ocai01090	13-12-31	10:37:02	0.5043	2.23°	-198.61°	-300.09°
ocai010a0	13-12-31	11:02:23	0.4993	2.23°	-210.38°	-303.67°
ocai02010	14-01-28	13:03:56	0.5266	1.72°	-223.81°	-262.15°
ocai02020	14-01-28	13:21:37	0.5572	1.78°	-232.02°	-264.65°
ocai02030	14-01-28	14:20:57	0.6228	1.95°	-259.57°	-273.04°
ocai02040	14-01-28	14:47:25	0.5674	2.02°	-271.86°	-276.78°
ocai02050	14-01-28	15:56:35	0.5219	2.15°	-303.98°	-286.56°
ocai02060	14-01-28	16:23:03	0.5061	2.18°	-316.27°	-290.3°
ocai02070	14-01-28	17:32:14	0.3975	2.22°	-348.39°	-300.07°
ocai02080	14-01-28	17:58:42	0.397	2.22°	-0.68°	-303.81°
ocai02090	14-01-28	19:07:51	0.3678	2.18°	-32.79°	-313.59°
ocai020a0	14-01-28	19:34:19	0.3847	2.14°	-45.07°	-317.33°
od8k96010	17-05-19	08:03:43	0.5128	-1.49°	-250.53°	-219.7°
od8k1k010	18-07-16	05:32:32	0.5623	0.11°	-101.65°	-204.64°
od8k1k020	18-07-16	06:55:54	0.5314	0.5°	-140.17°	-216.42°
od8k1l010	18-07-16	08:56:30	0.3884	1.02°	-195.9°	-233.47°
od8k1l020	18-07-16	10:12:35	0.3989	1.3°	-231.06°	-244.22°
od8k1y010	18-07-16	12:02:23	0.4251	1.63°	-281.81°	-259.74°
odxc51010	19-02-14	21:42:36	0.5905	-1.55°	-71.51°	-88.17°
odxc51020	19-02-14	23:08:02	0.4858	-1.21°	-111.06°	-100.23°