地球電磁気地球惑星圏学会
2004年11月28日

木星シンクロトロン放射の2D イメージング観測計画

通信総研鹿島
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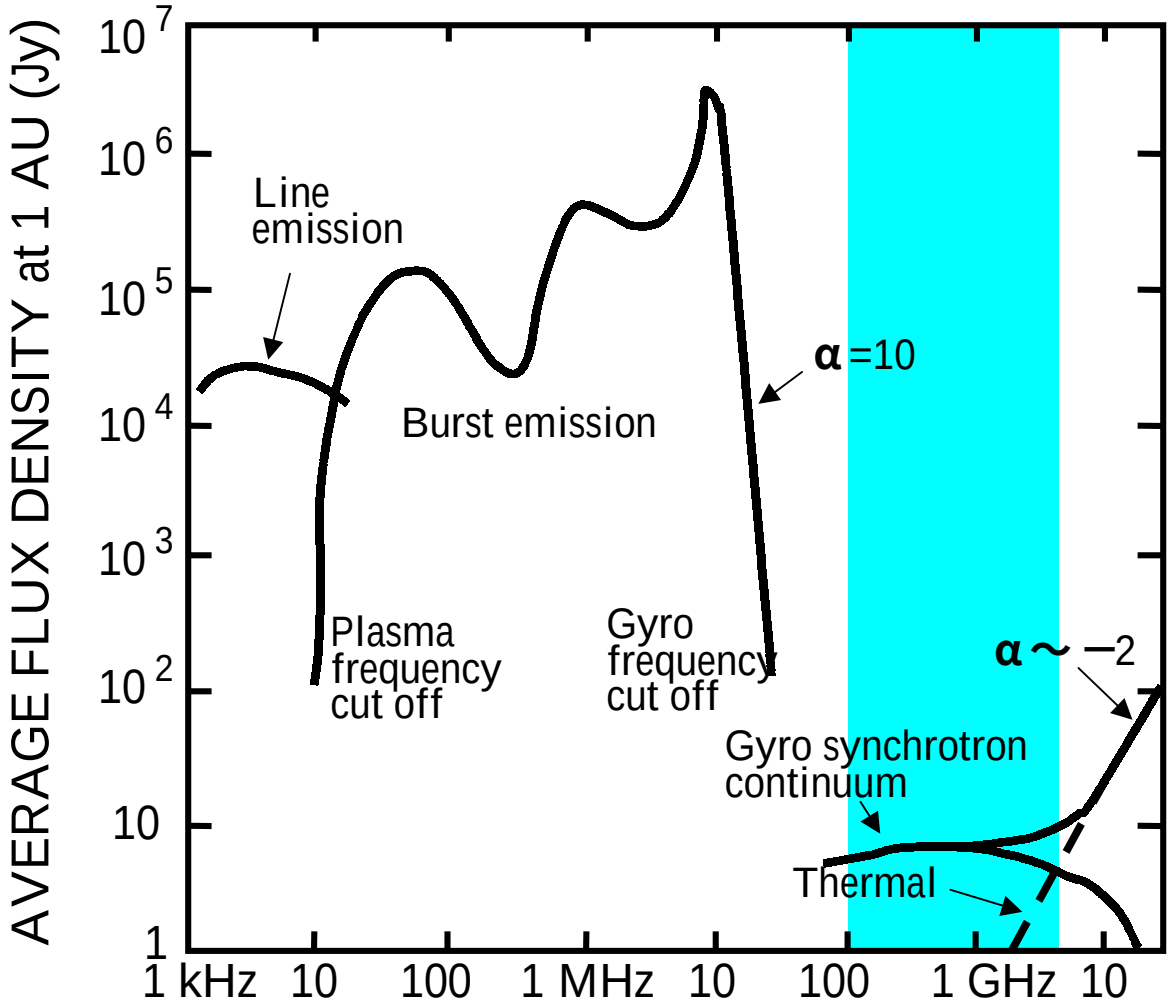
国土地理院
福崎順洋

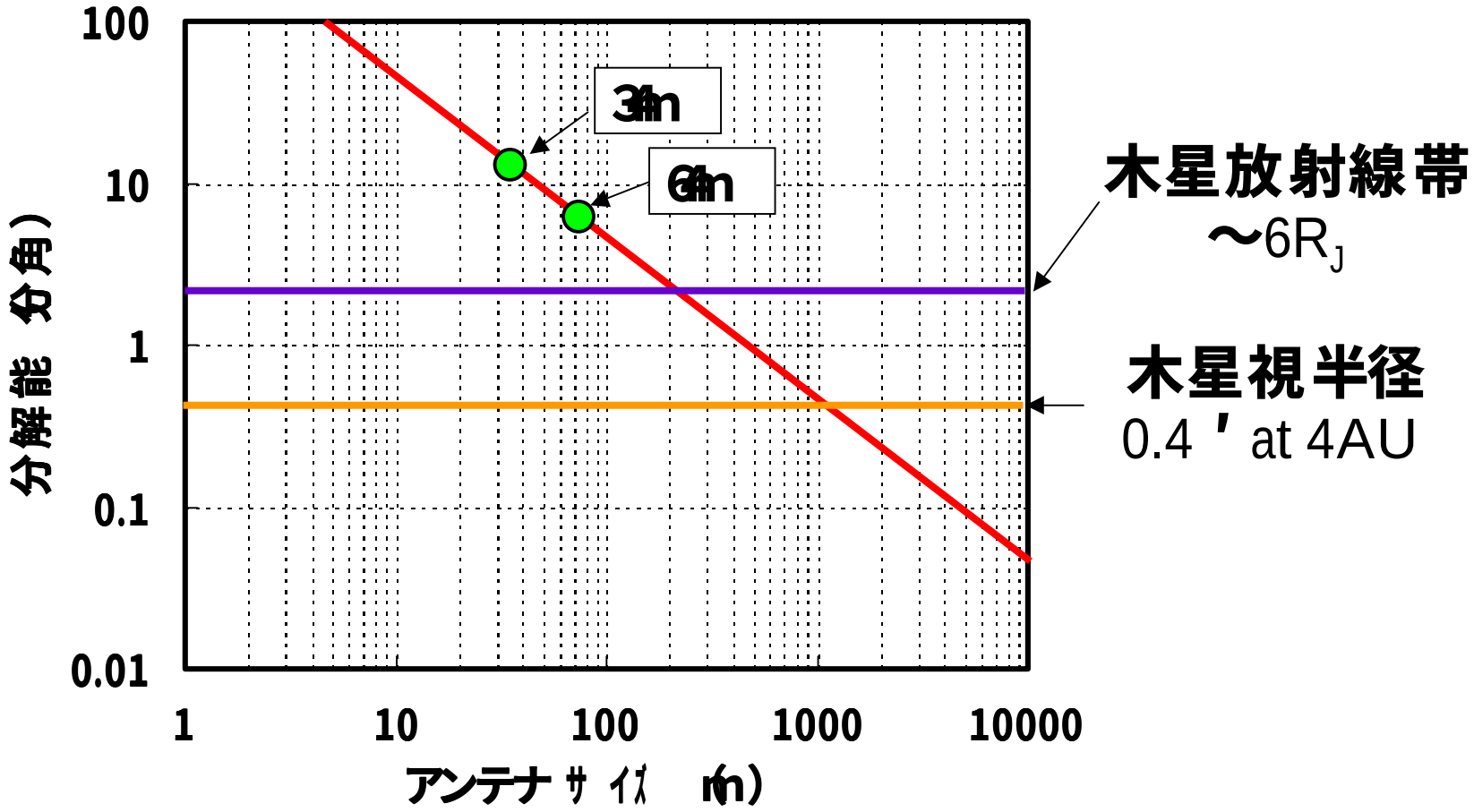
木星電波放射スペクトル



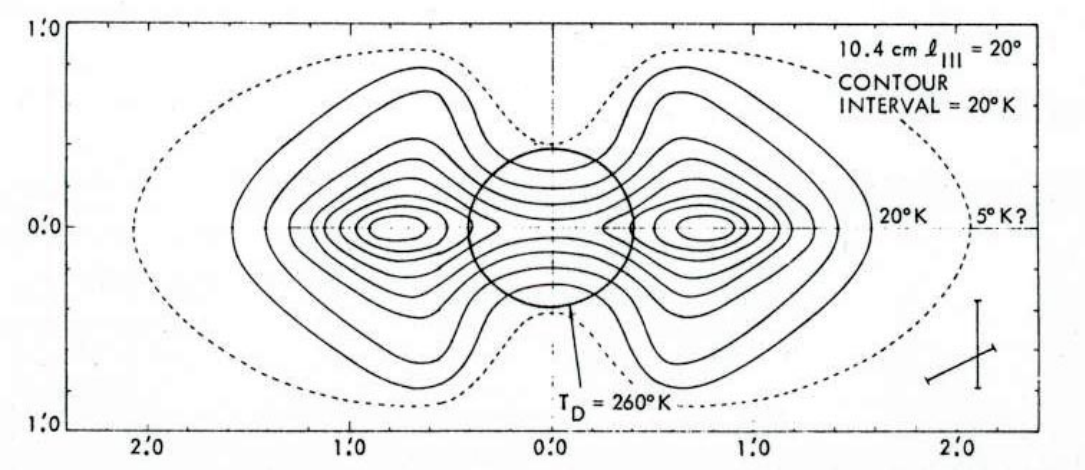
(Carr and Kraus, 1986)

アンテナサイズと分解能

(22GHz)

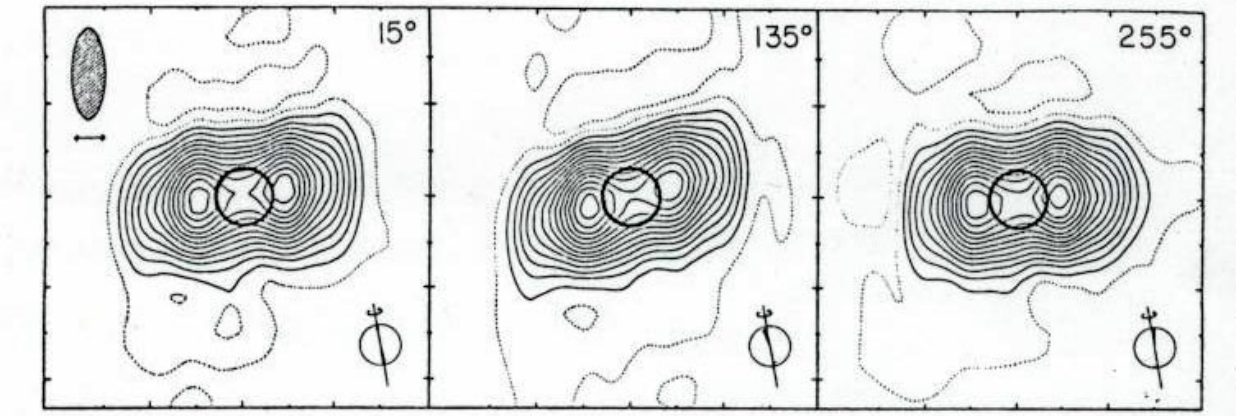


木星放射線帯2観測の 変遷



2.9 GHz
OVRO

(Berge 1966)



1.4 GHz
one mile
radio telescope

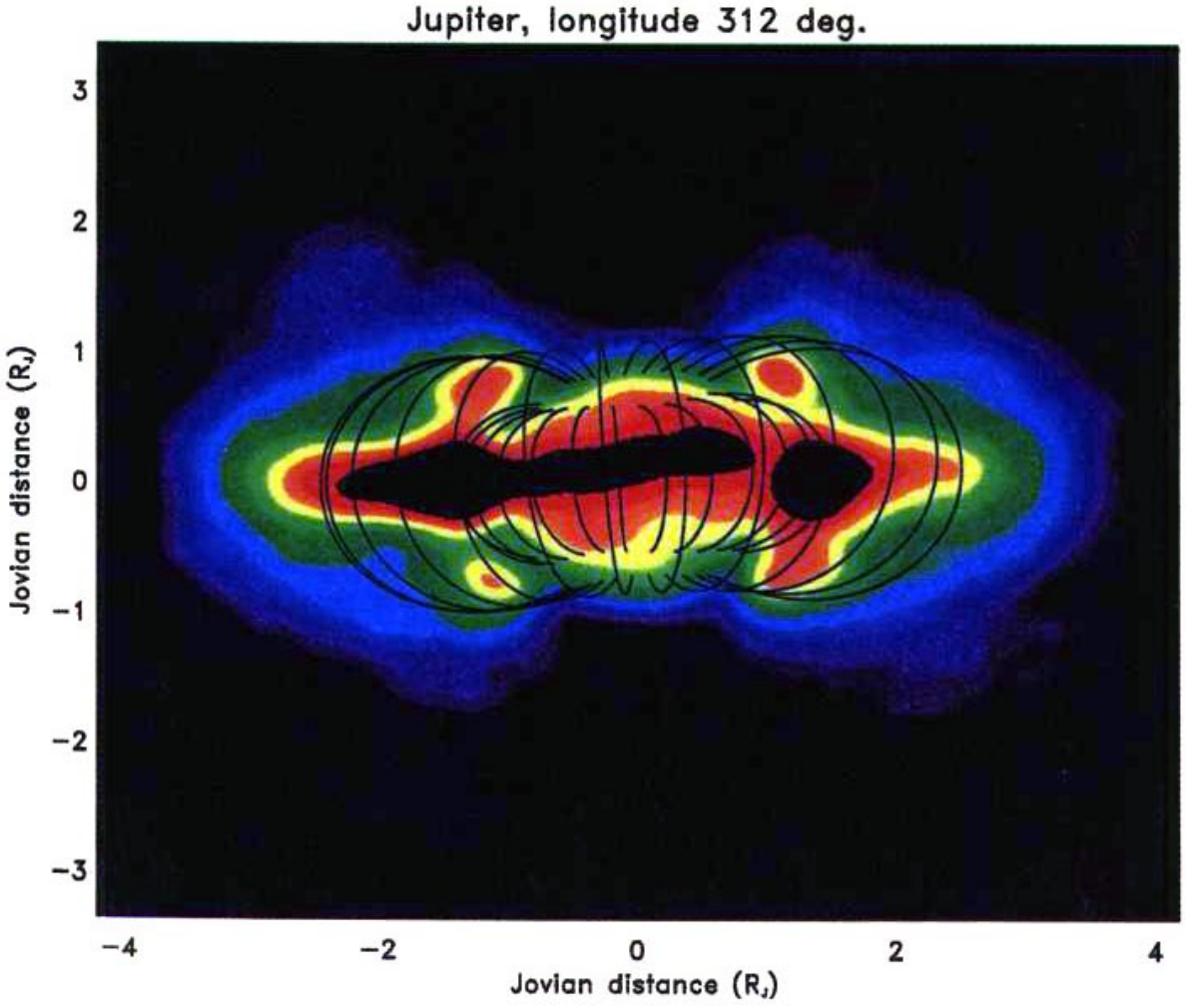
(Branson 1968)

Very Large Array (VLA)

Socorro, USA

25mアンテナ × 27基　　受信周波数(GHz): 0.32, 1.5, 4.75, 8.4, 15, 23, 45

http://www.aoc.nrao.edu/intro/vlapix/vlaoverall.html



1465 MHz

VLA

(de Pater et al., 1997)

Australia Telescope Compact Array (ATCA)
Narrabri, Australia

22mアンテナ × 6基　　受信周波数(GHz) : 1.5, 2.4, 5.8, 8.5

ATCA

1.4 GHz

2.3 GHz

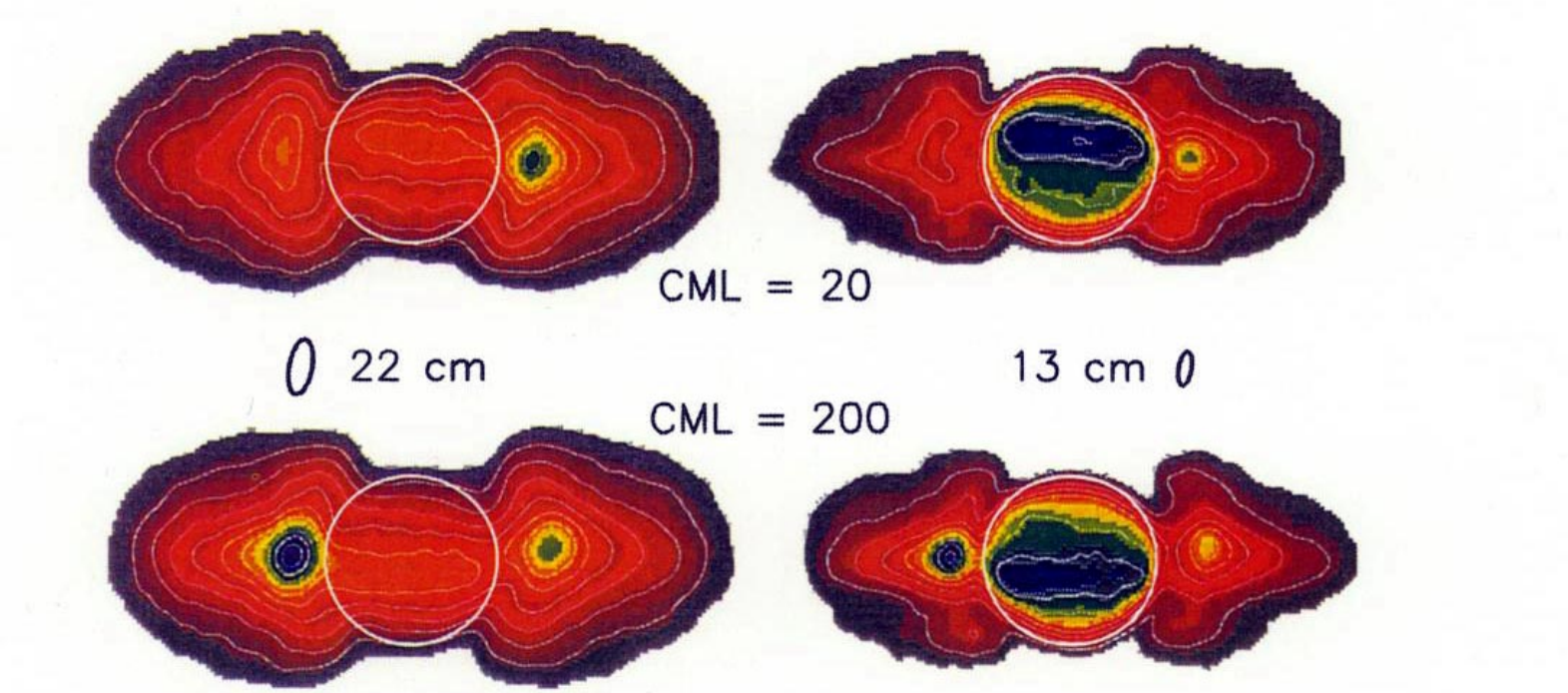


Fig. 3. Two-dimensional images of Jupiter at 22 and 13 cm for two longitudes. The resolution at 13 cm is 8.5″ × 3.2″ and at 22 cm it is 14″ × 5′ The color table was chosen to cover the full brightness range of 100 K to 1320 K at 22 cm and 50 K to 530 K at 13 cm. The circle shows th size of Jupiter's disk and the ellipses show the half power beams.

(Leblanc et al., 1997)

ATCA 1.4 GHz

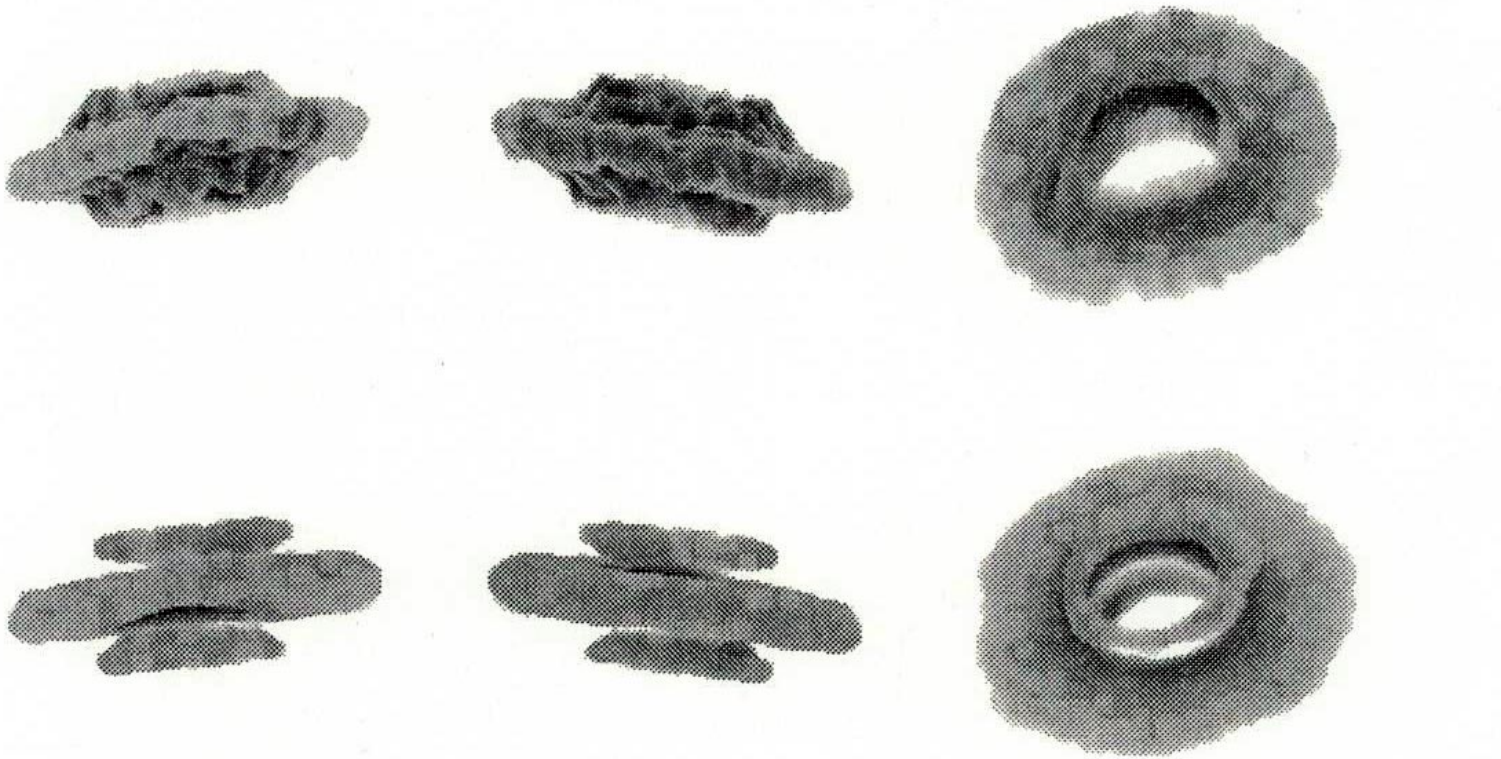


Fig. 4. Three-dimensional images of Jupiter's radiation belts at 22 cm. At the top are images in total intensity and on the bottom in linear polarization. The values of CML for the left and middle images are 90° and 270°. The right-hand image is at CML = 90° and viewing angle declination 55°. The warping of the magnetic surface is most evident in the images at CML = 90°.

(Leblanc et al., 1997)

鹿島宇宙通信センター

Kashima Space Research Center

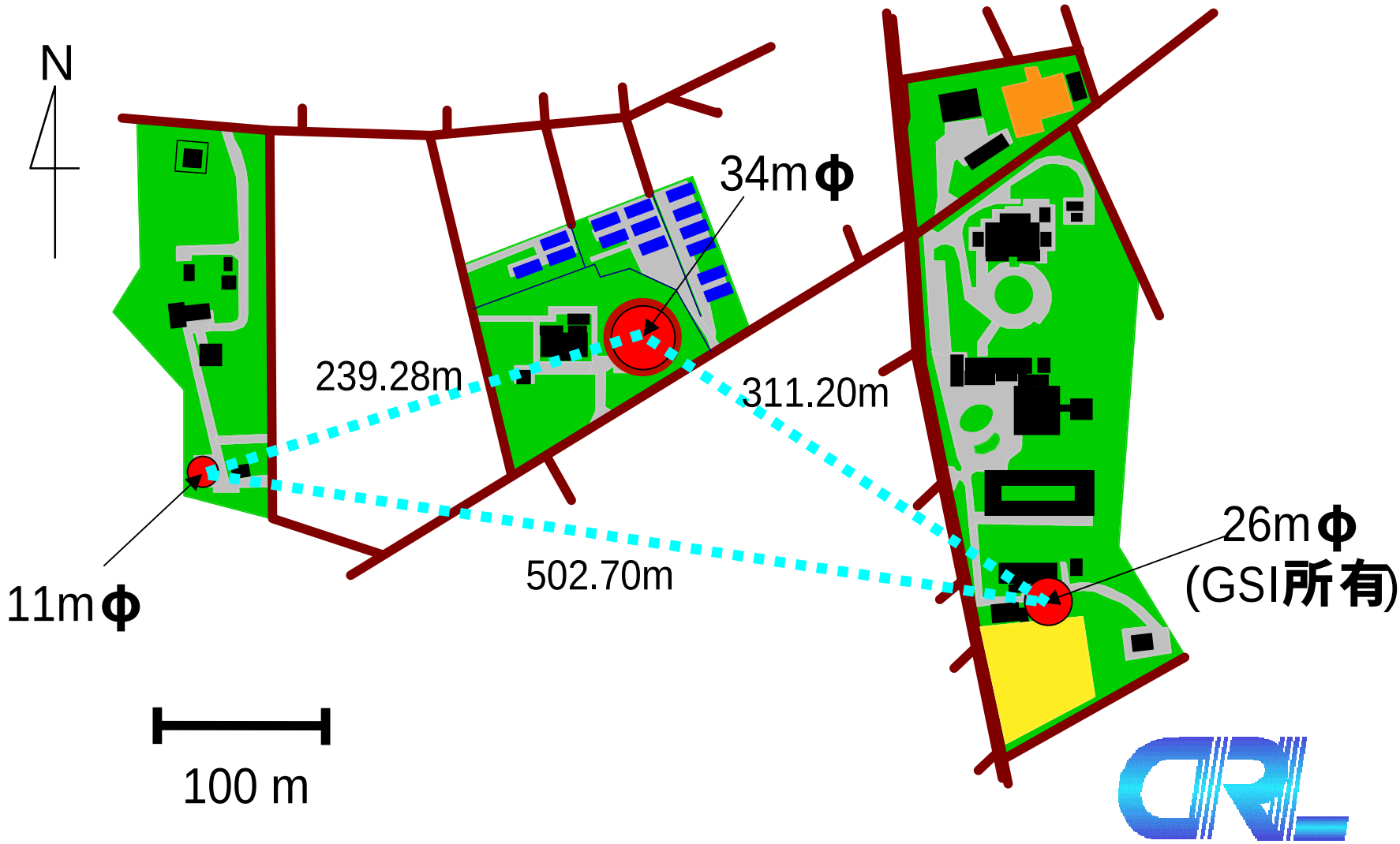
郵政省通信総合研究所

Communications Research Laboratory
Ministry of Posts and Telecommunications

鹿島の
アンテナ

鹿島宇宙通信センター

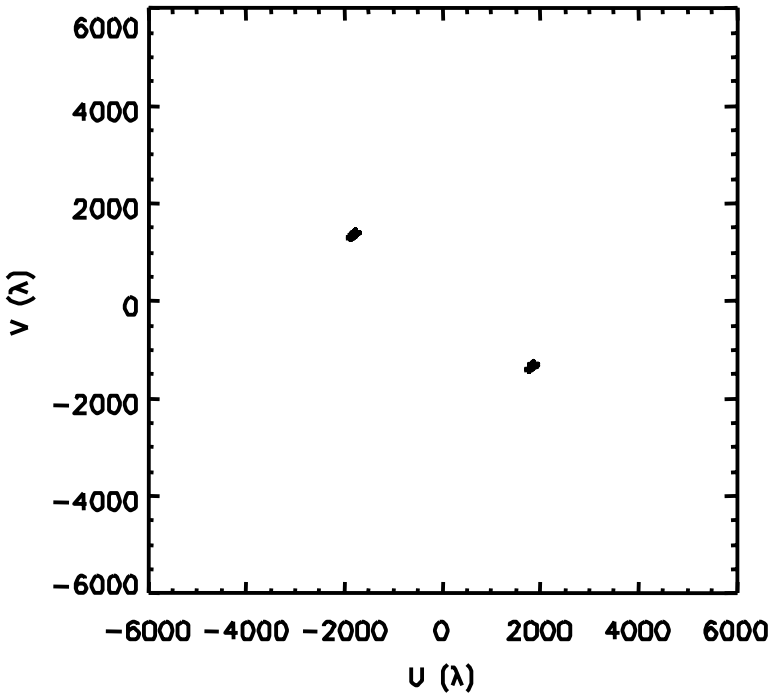
26GHz帯が 受信可能なアンテナ配置



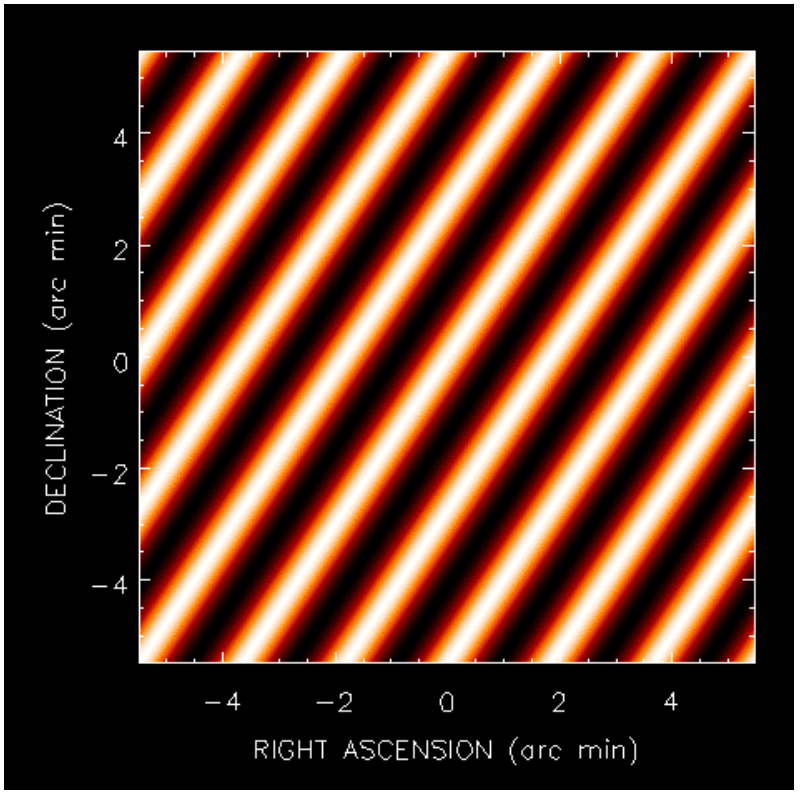
34mアンテナと26mアンテナの場合

δ=20°, H=0～10°　　f = 2.2 GHz

U－V



ビームパターン

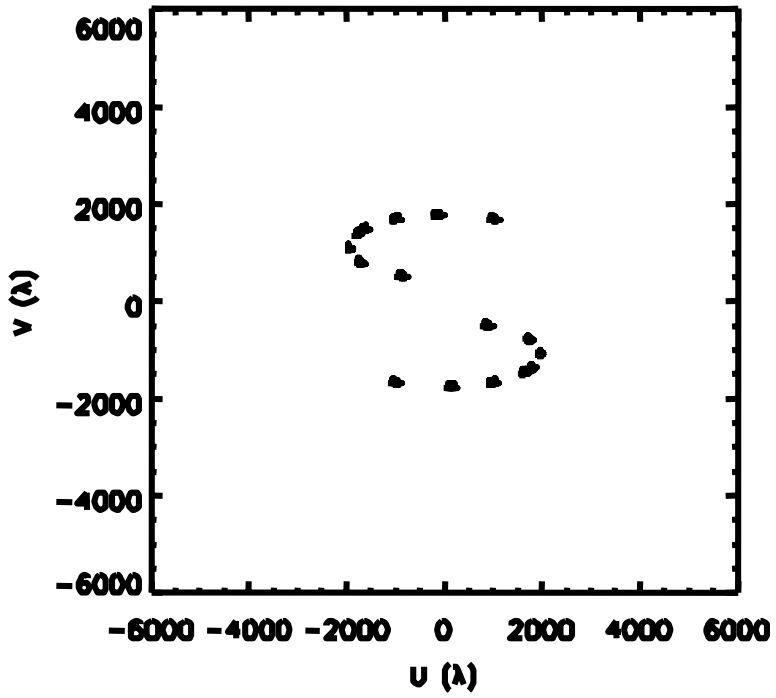


○ 4AUでの木星の大きさ
(視直径0.8')

34mアンテナと26mアンテナの場合

δ=20°, 5日間同じCML (0-10°)のみ観測　f = 2.2 GHz

U-V



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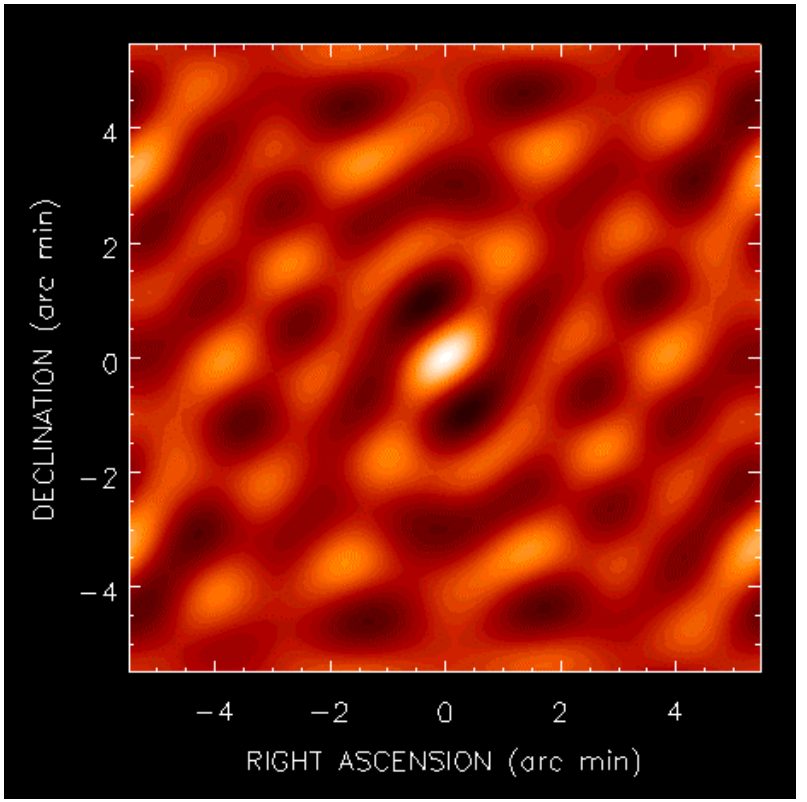

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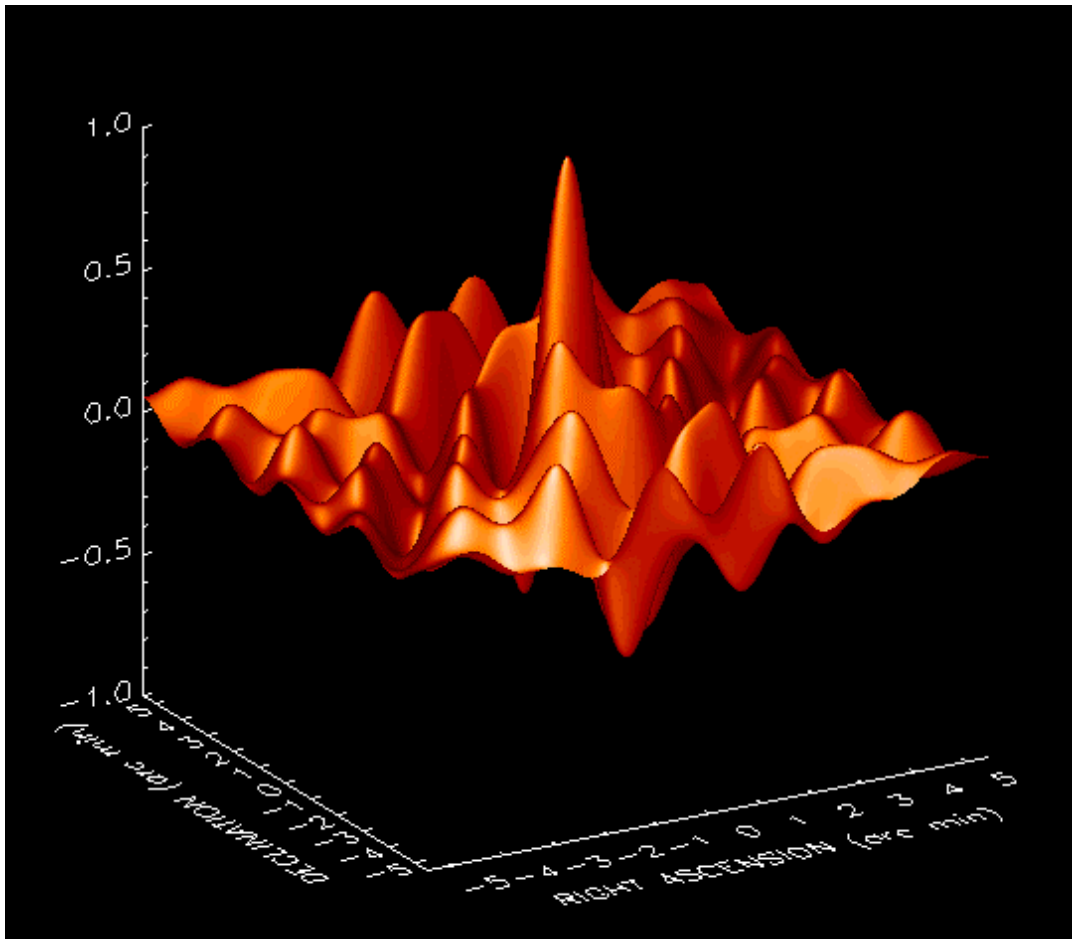
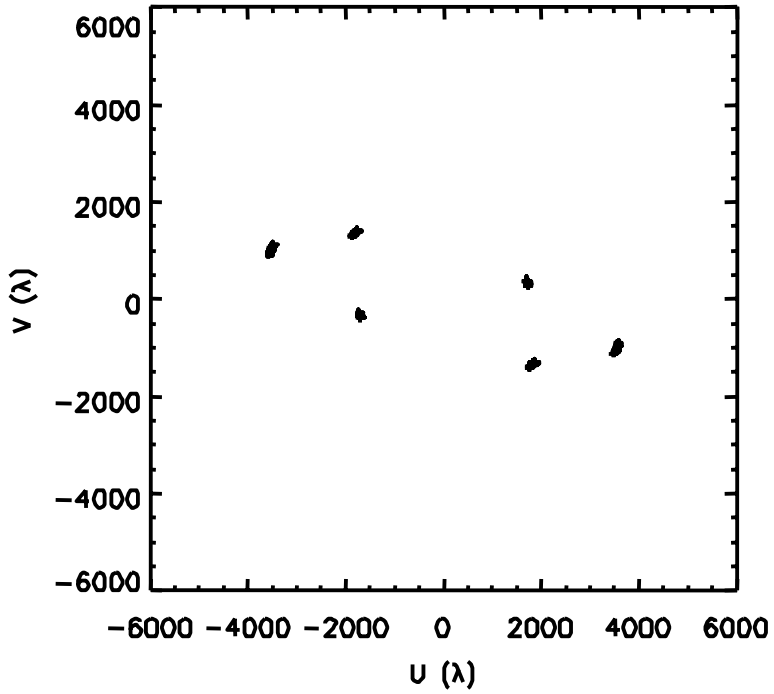


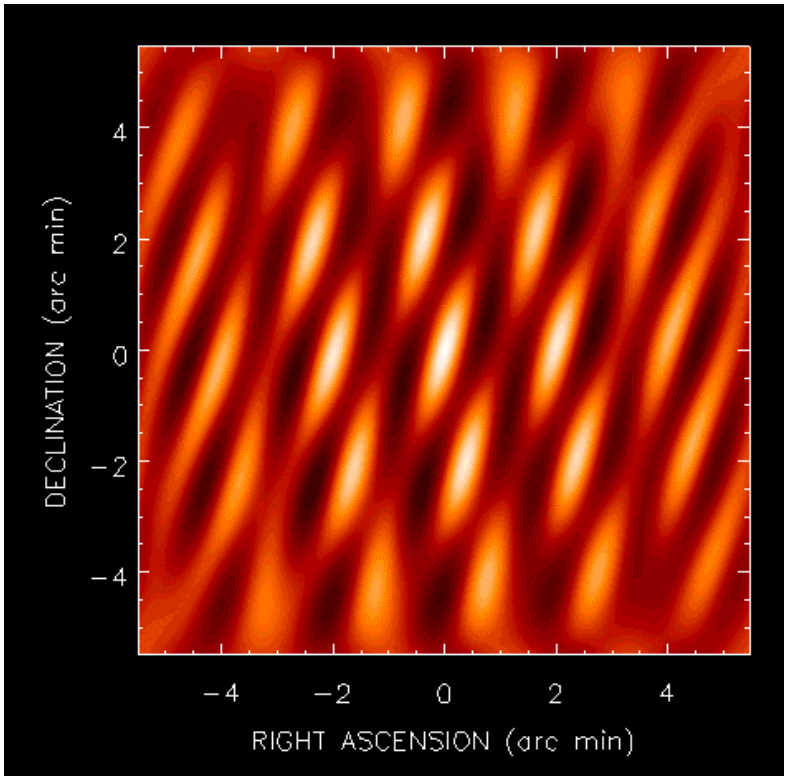
34m＋ 26m＋ 10mアンテナの 場合

δ=20°, H=0～10°　　f = 2.2 GHz

U－V



ビームパターン

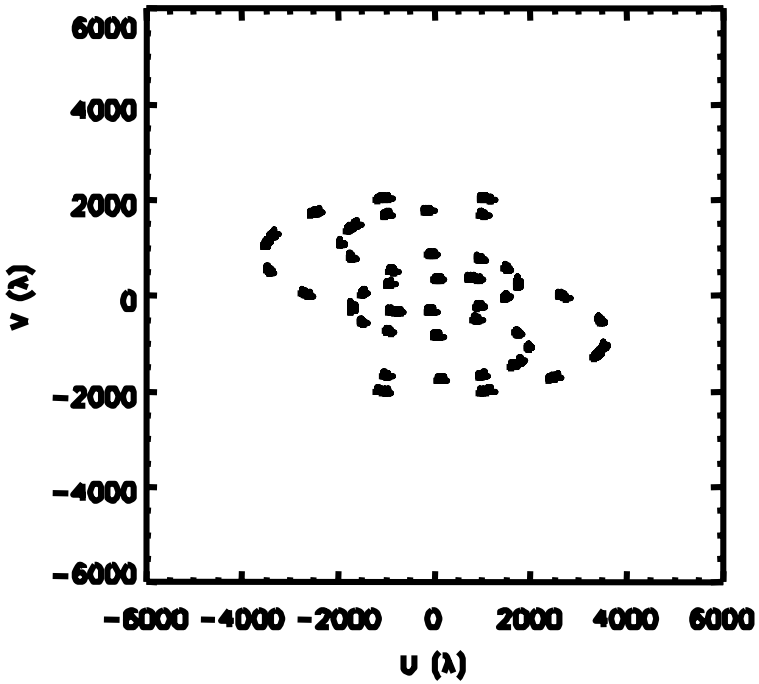


○ 4AUでの 木星の 大きさ
(視直径0.8')

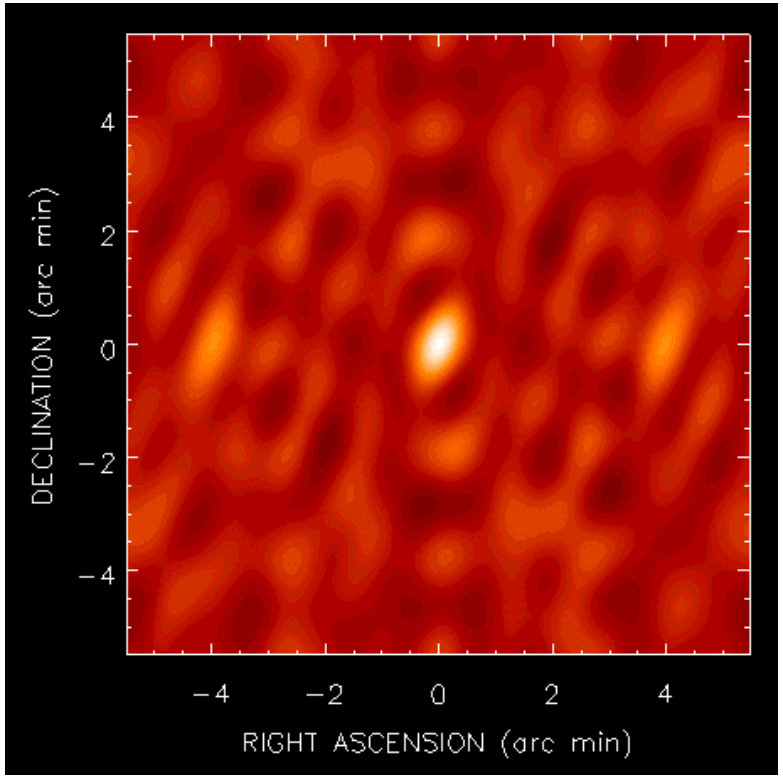
34m＋ 26m＋ 11mアンテナの 場合

δ=20°, **5日間同じCM L (0-10°)の み観測** f = 2.2 GHz

U—V



ビームパターン

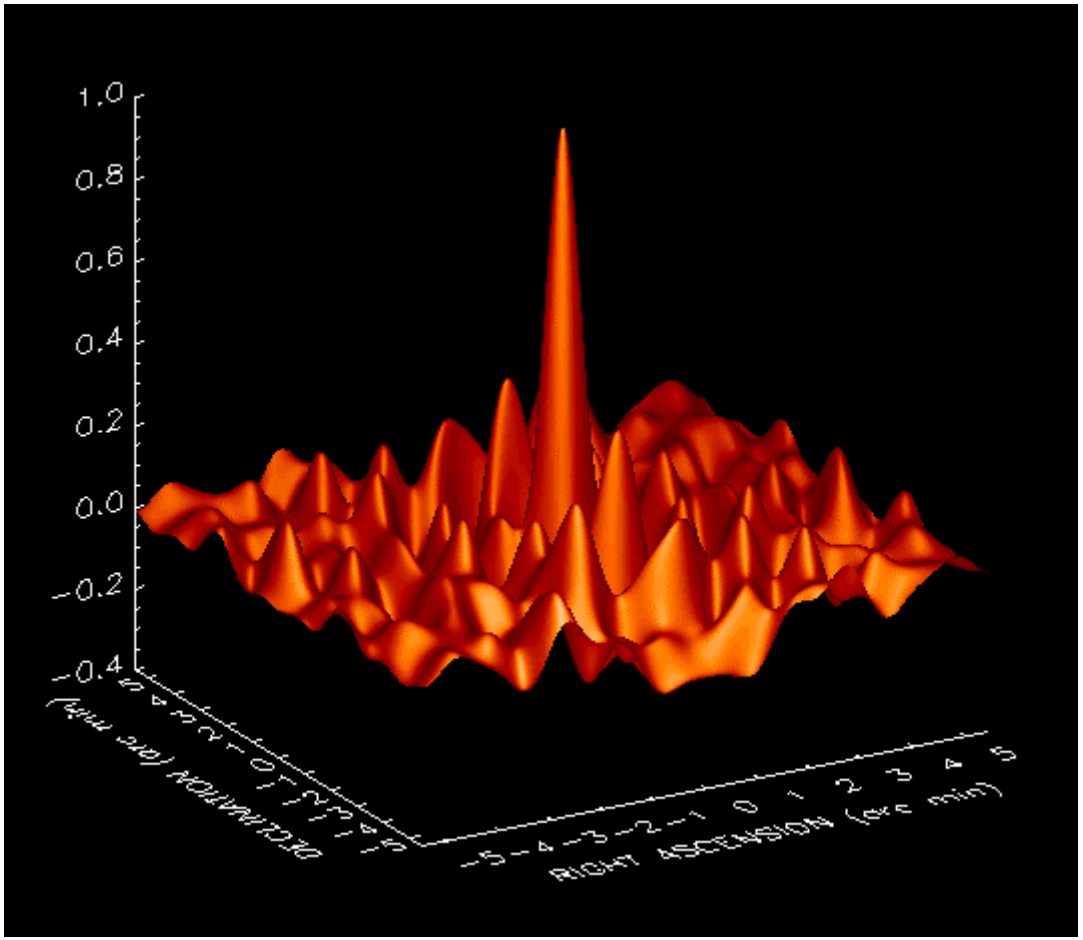


○ 4AUでの 木星の 大きさ
(視直径0.8')

34m＋ 26m＋ 11mアンテナの 場合

δ=20°, El>0°　　f = 2.2 GHz

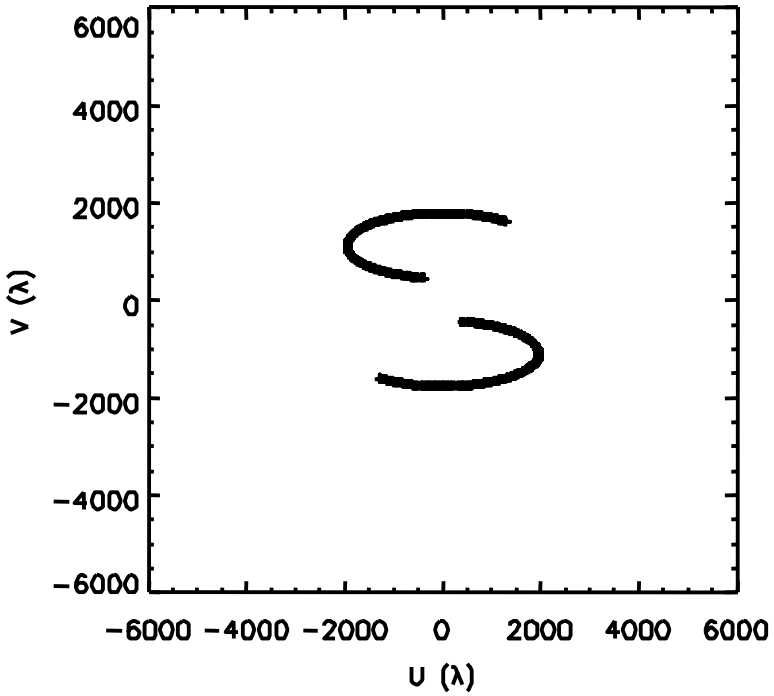
ビームパターン



34mアンテナと26mアンテナの場合

δ=20°, El>0°　　f = 2.2 GHz

U-V



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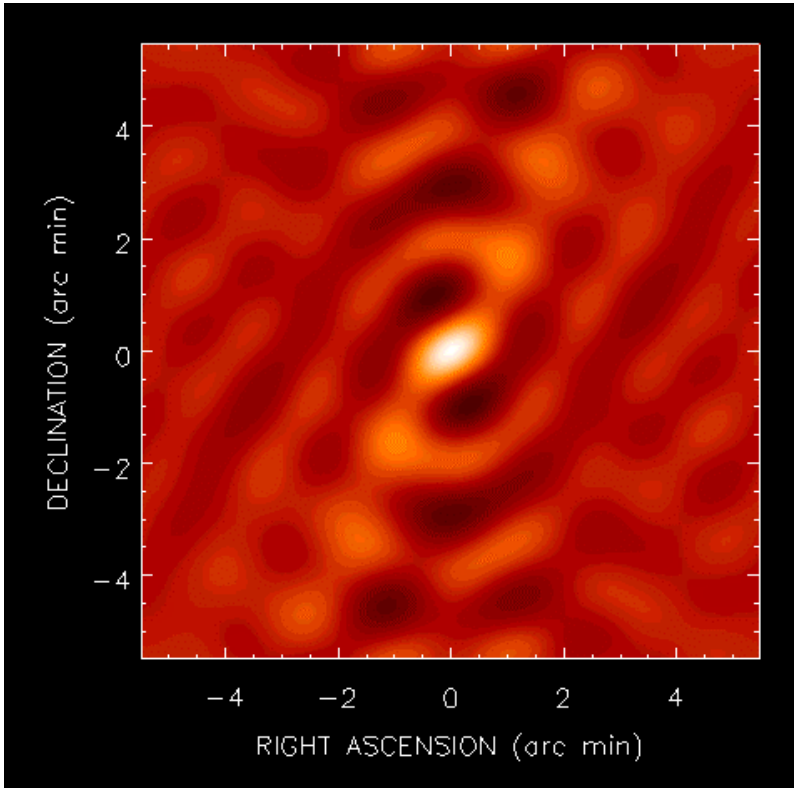
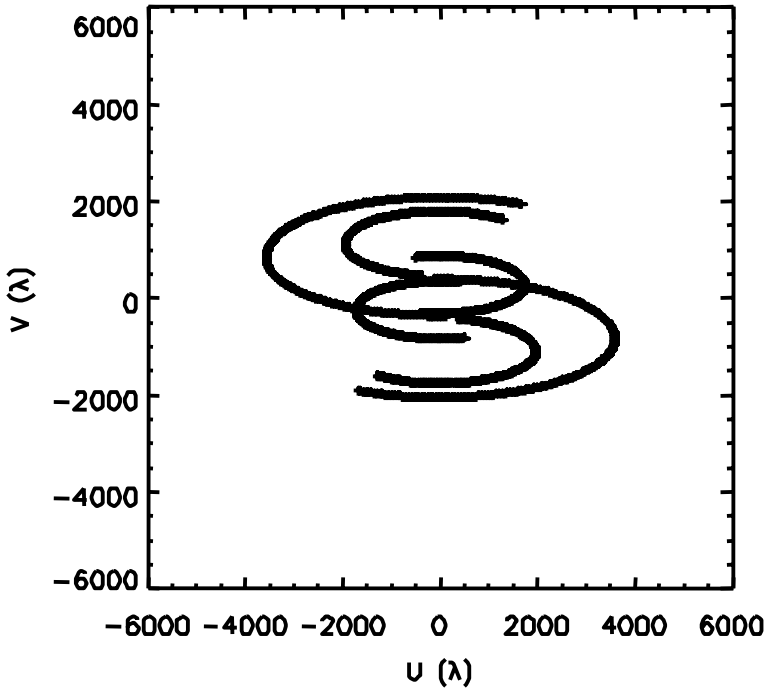


○ 4AUでの木星の大きさ
(視直径0.8')

34m＋ 26m＋ 11mアンテナの 場合

δ=20°， El>0°　　f = 2.2 GHz

U－V



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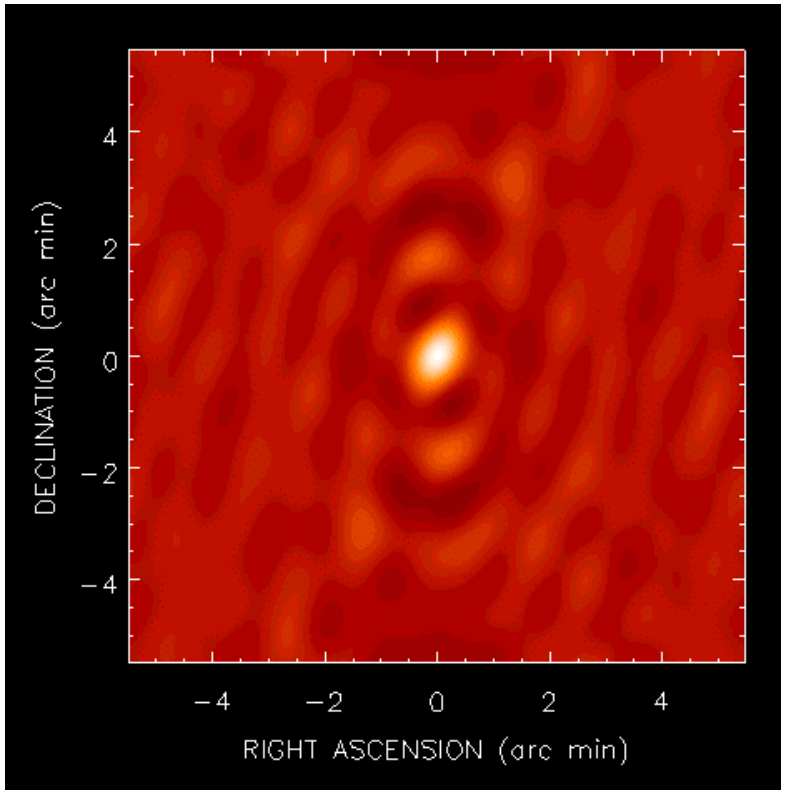
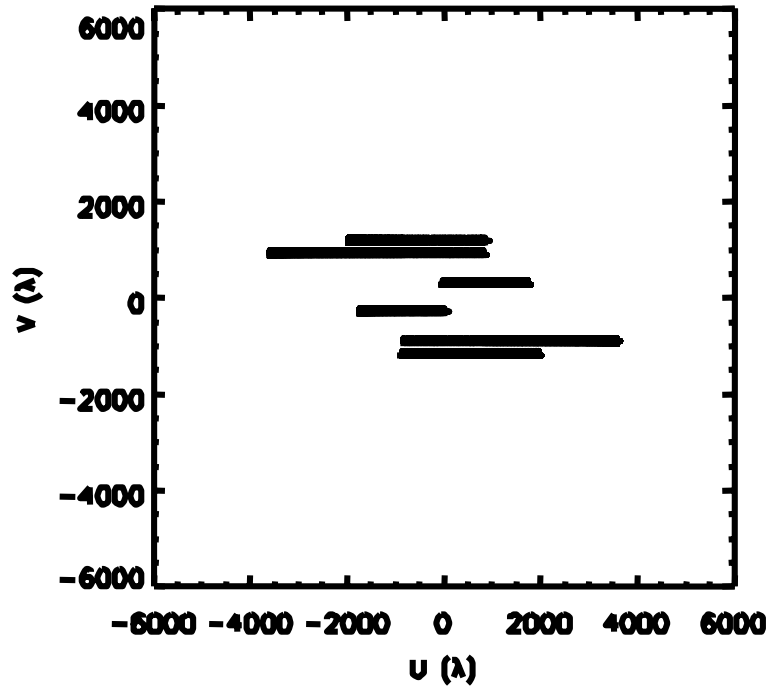


○ 4AUでの 木星の 大きさ
(視直径0.8')

34m＋ 26m＋ 11mアンテナの 場合

δ =0°, El>0°　　f = 2.2 GHz

U－V



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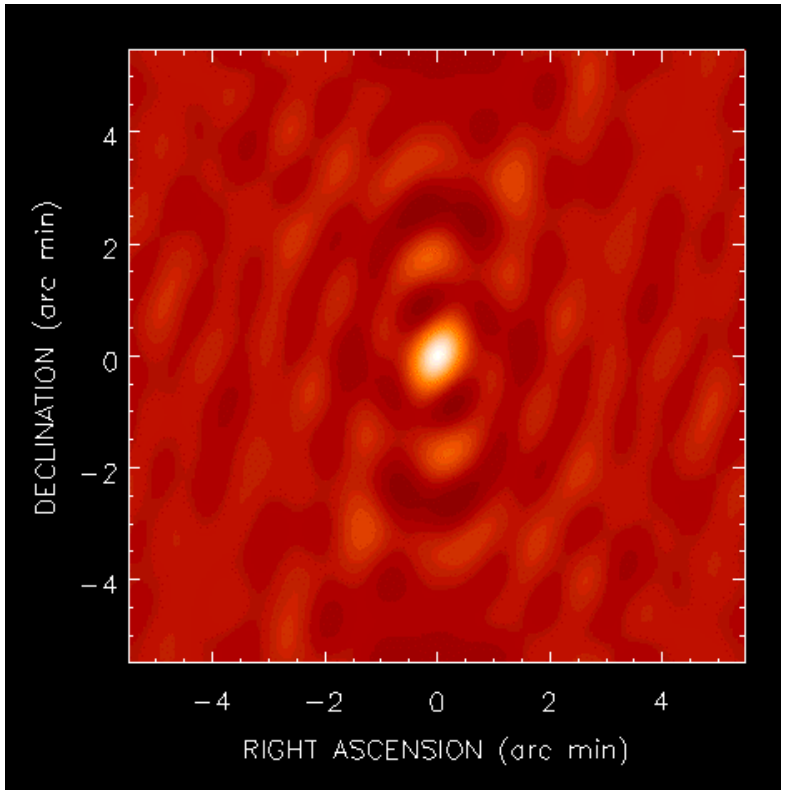
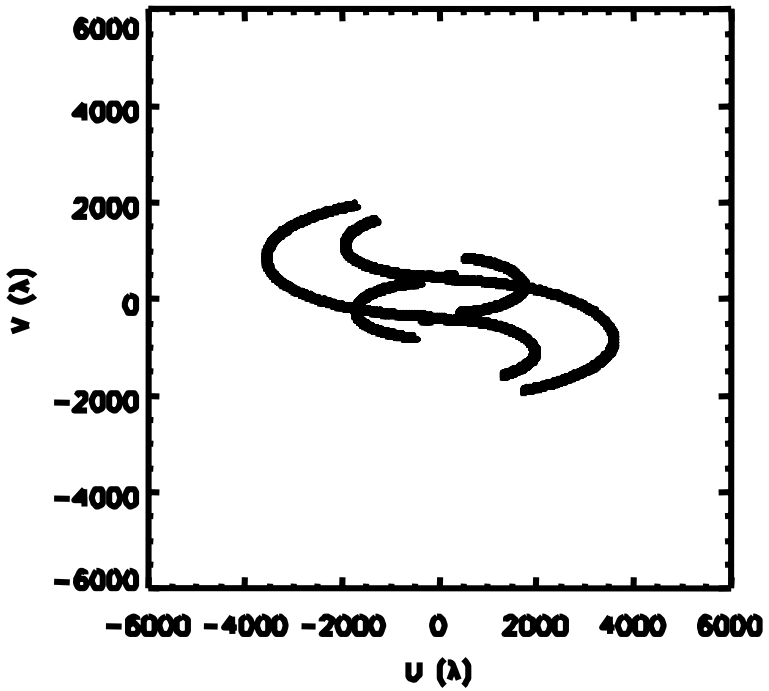


○ 4AUでの 木星の 大きさ
(視直径0.8')

34m＋ 26m＋ 11mアンテナの 場合

δ = -20°， El>0°　　f = 2.2 GHz

U－V



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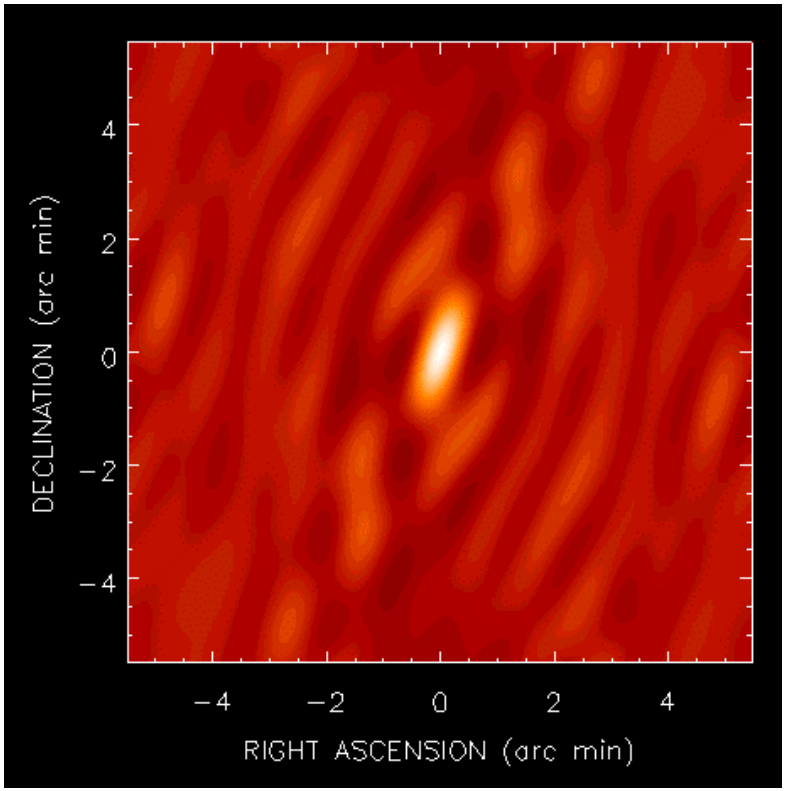


○ 4AUでの 木星の 大きさ
(視直径0.8')

ATCA 2.3 GHz

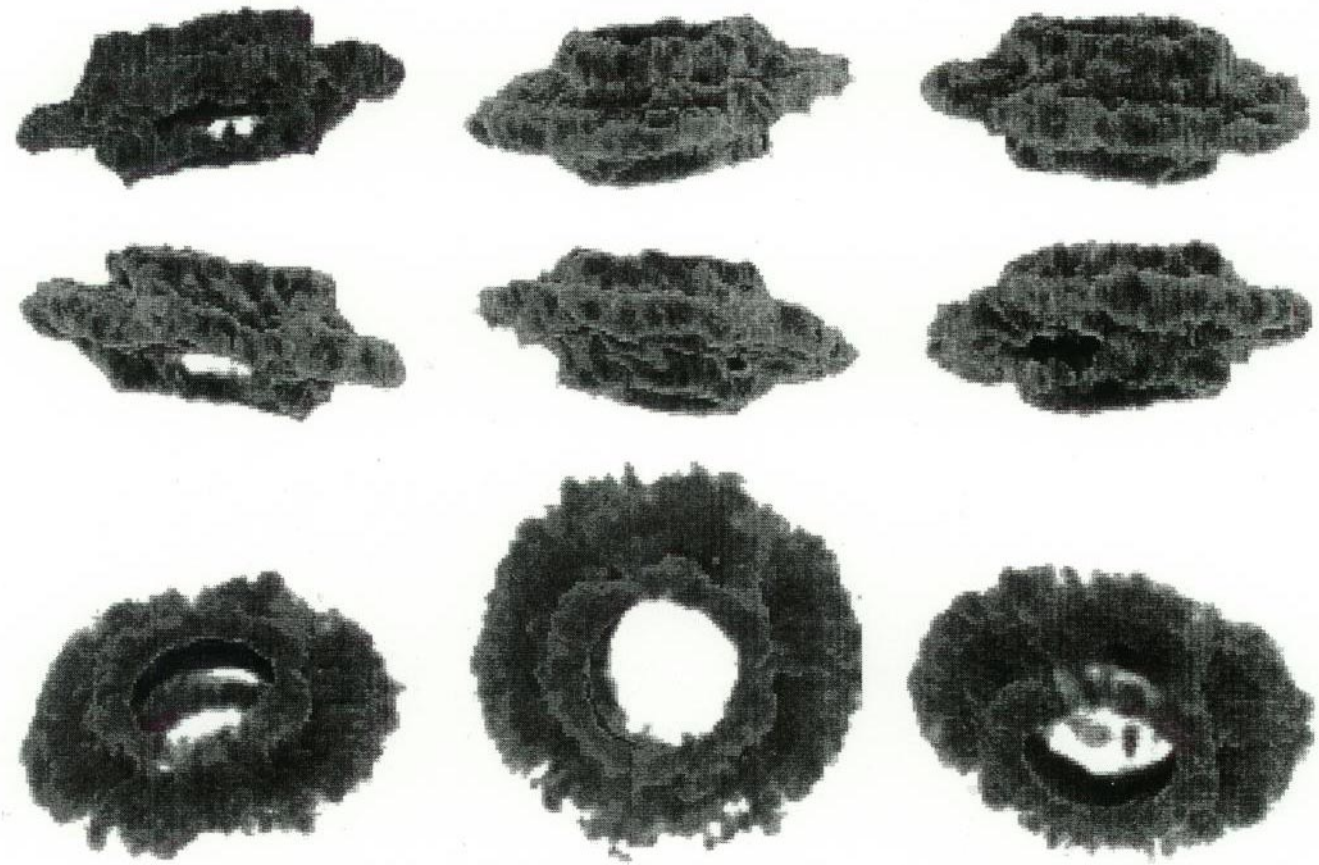
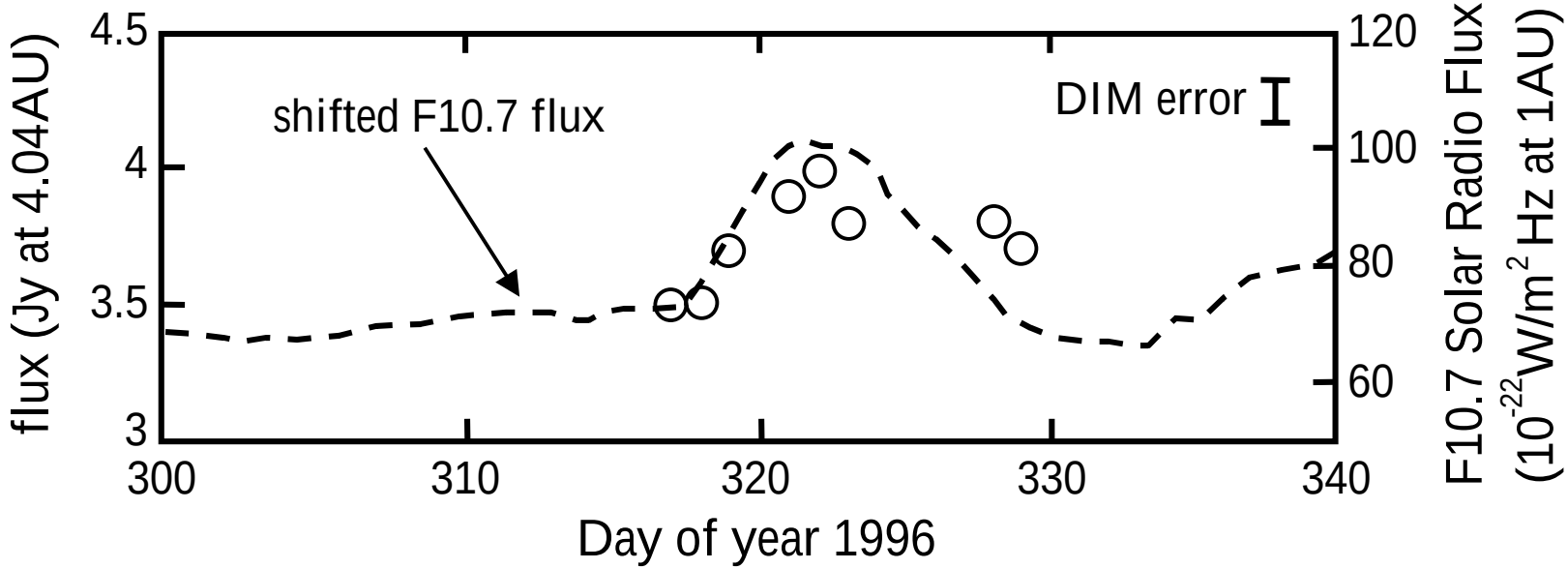


Fig. 3. Three-dimensional reconstructions of Jupiter's radiation belts at 13 cm. These are derived from ten 12 h days of observing. The first six reconstructions correspond to Jupiter viewed with a central meridian longitude of 90° to 330° in increments of 60°. The last three correspond to a central meridian longitude of 90°, but viewed at an angle of 40°, 90° (i.e. the north pole) and 130° to the ecliptic. The planet's thermal emission has been subtracted before the reconstruction process.

(Sault et al., 1997)

鹿島 34mアンテナ 観測で得られた 木星シンクロトロン放射の 短期変動



(Miyoshi et al., 1999)