

Crab Cavity

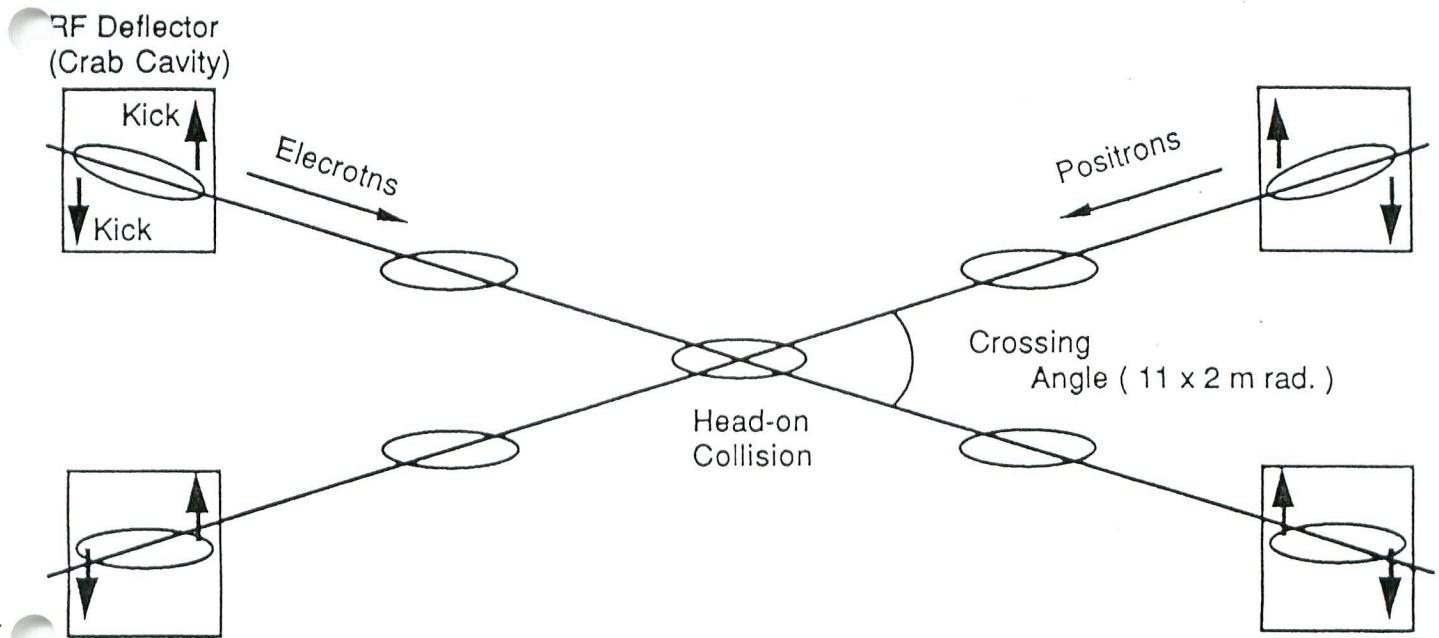
K. Hosogama

Why crab crossing ?

The crab crossing scheme allows a large crossing angle collision without introducing any synchrotron-betatron coupling resonances. 2,3)

- 2) R. B. Palmer, SLAC-PUB-4707, 1988.
- 3) K. Oide and K. Yokoya, SLAC-PUB-4832, 1989.

Crab crossing scheme



Non-Crab crossing scheme



Why superconducting cavity ?

	LER	HER	
Beam Energy	3.5	8.0	GeV
RF Frequency		508.887	MHz
Crossing Angle		± 11	mrad
β_x^*	0.33	0.33	m
β_{crab}	20	100	m
Required kick	1.41	1.44	MV

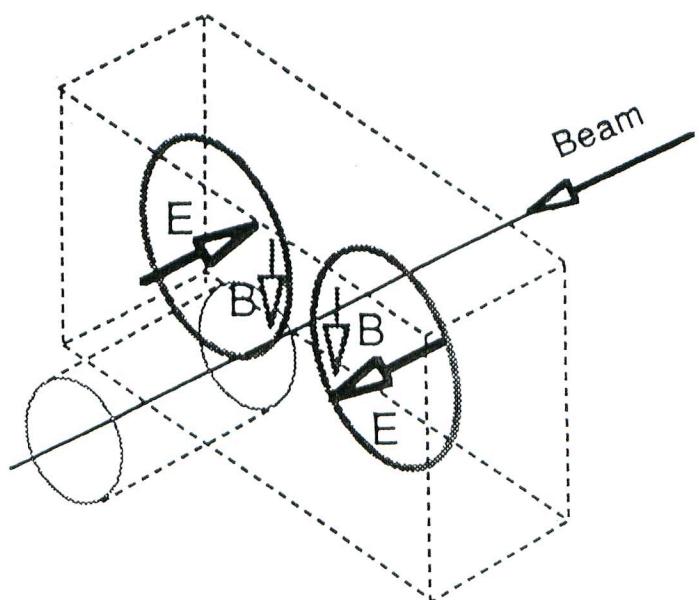
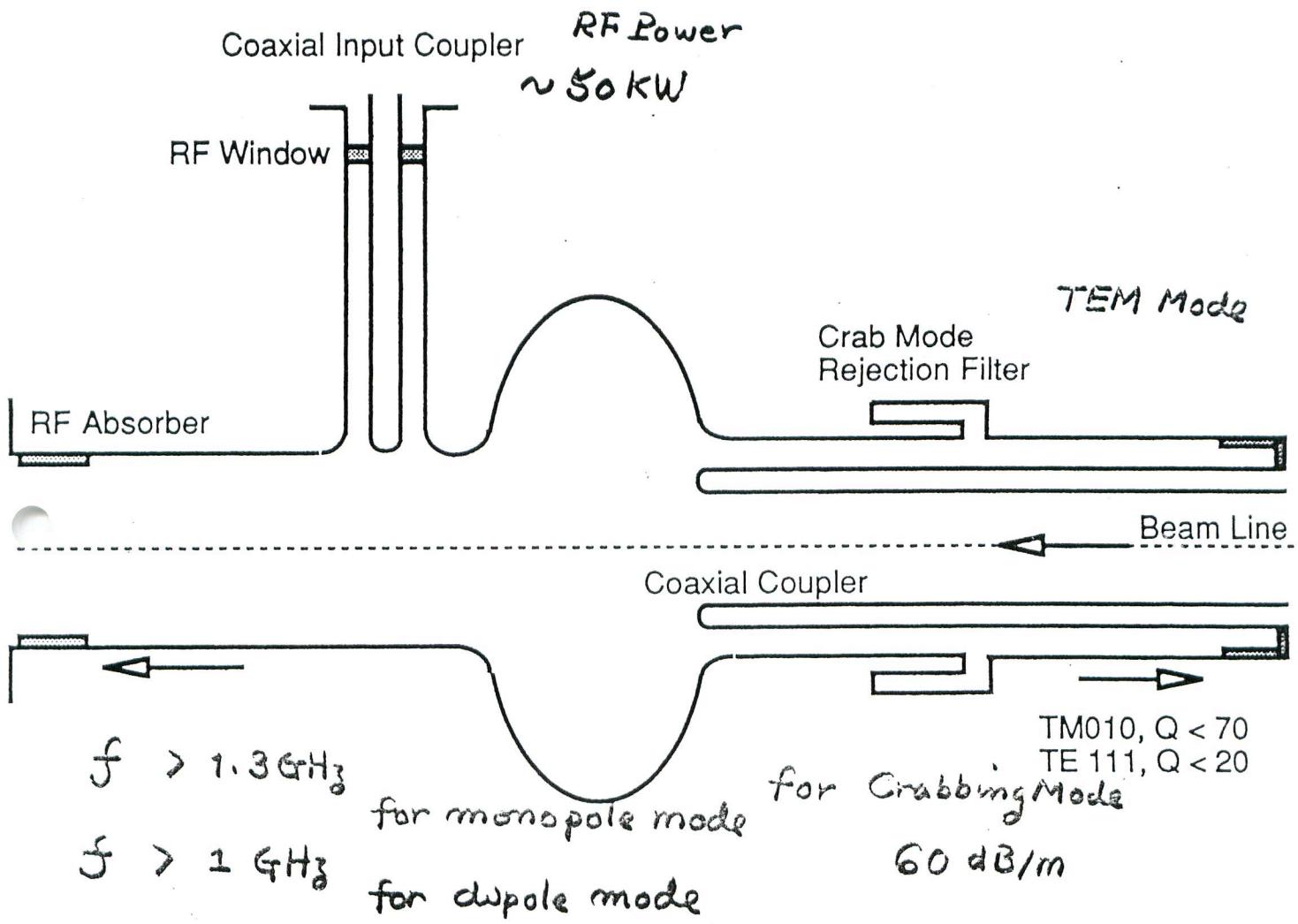
Base line design of KEK-B crab cavity

the "squashed" cell shape cavity scheme with a coaxial beam pipe and notch filter which was designed and extensively studied for CESR-B under KEK-Cornell collaboration

- RF issue
- Mechanical issue
- Cryostat and Cryogenics issue

Crab Cavity Design Concept

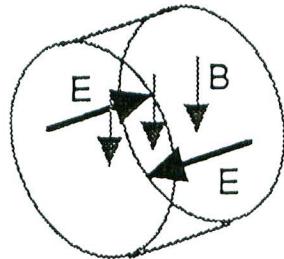
K. Hosoyama



Round Cell Design

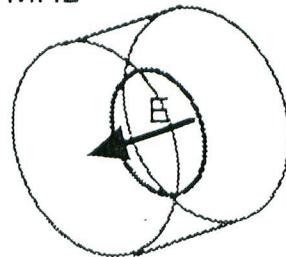
Crabbing Mode

TM110
500 MHz

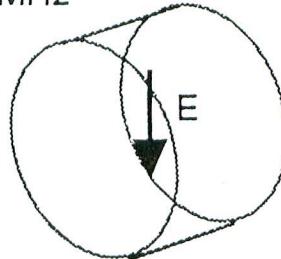


Unwanted Parasitic Mode

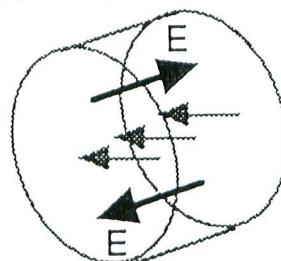
TM010
342 MHz



TE111
720 MHz



TM110
500 MHz



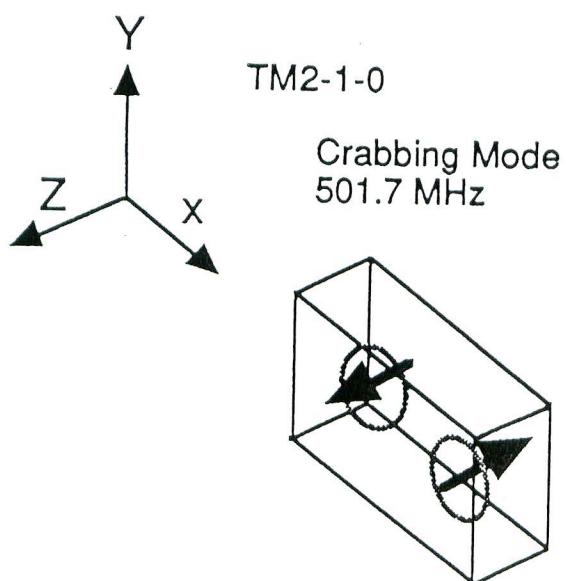
Coaxial Coupler
TEM

Coaxial Coupler

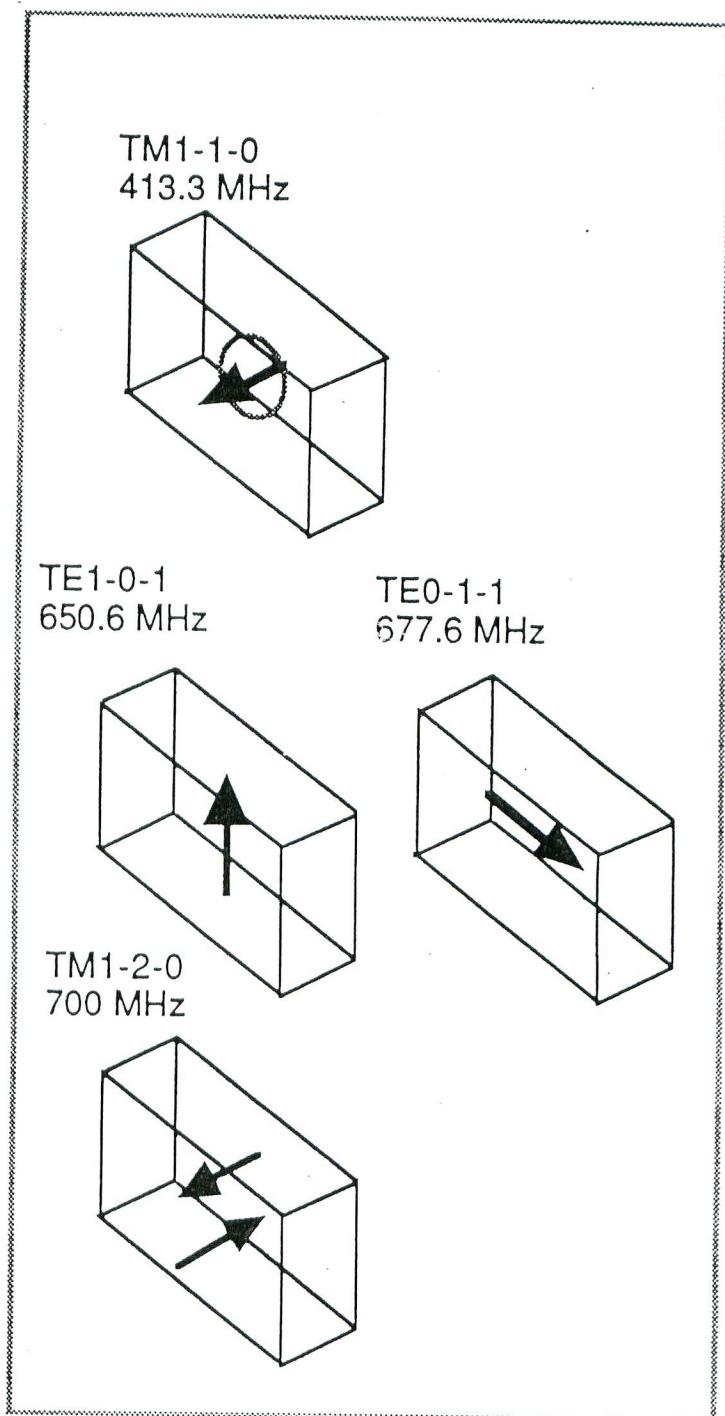
$f_c = 600 \text{ MHz}$
dipole like

Squashed Cavity
700 MHz

Squashed Cell Design



Unwanted Parasitic Mode



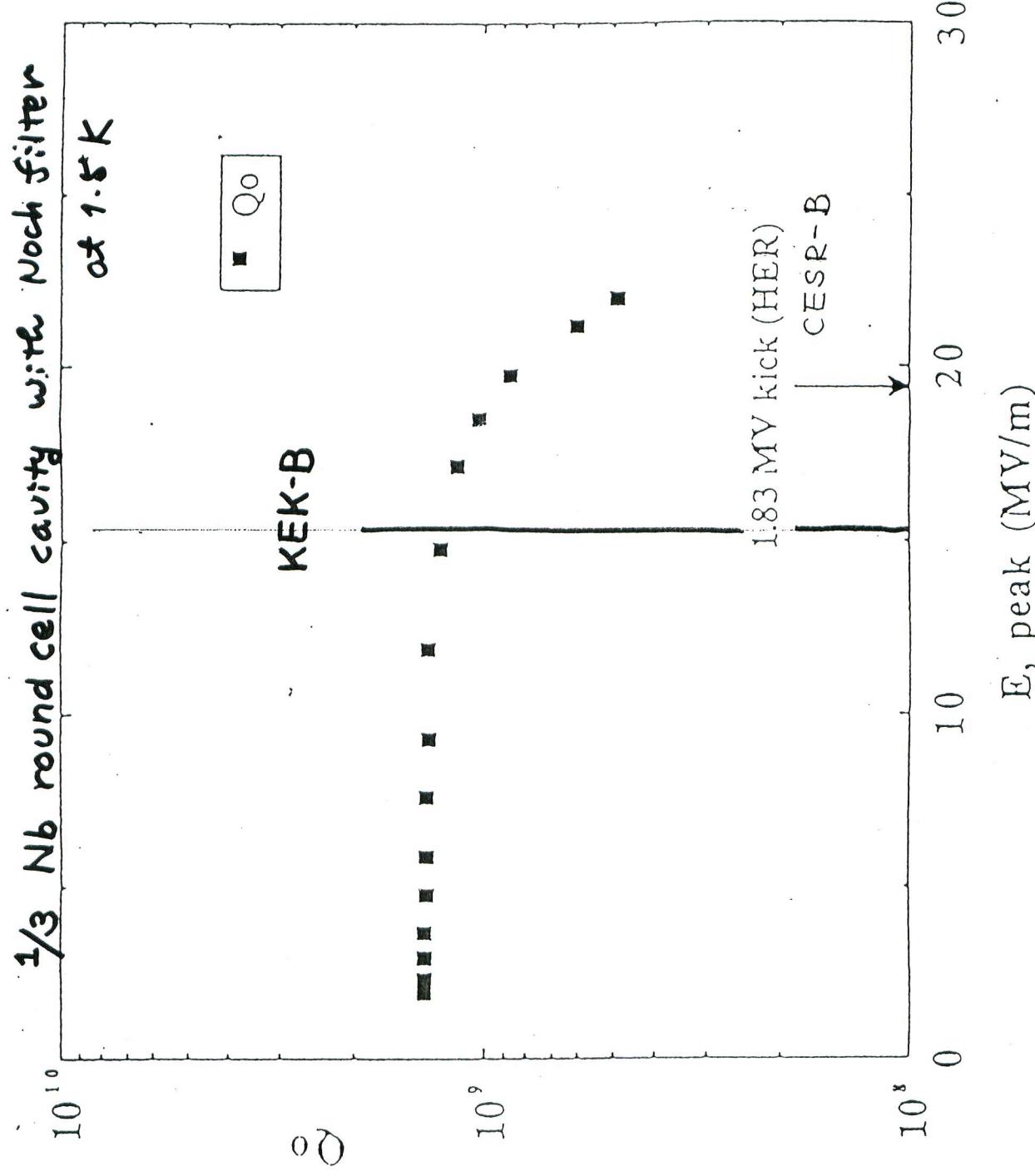
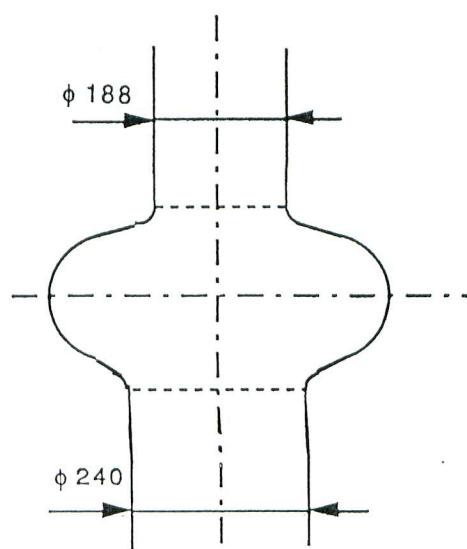
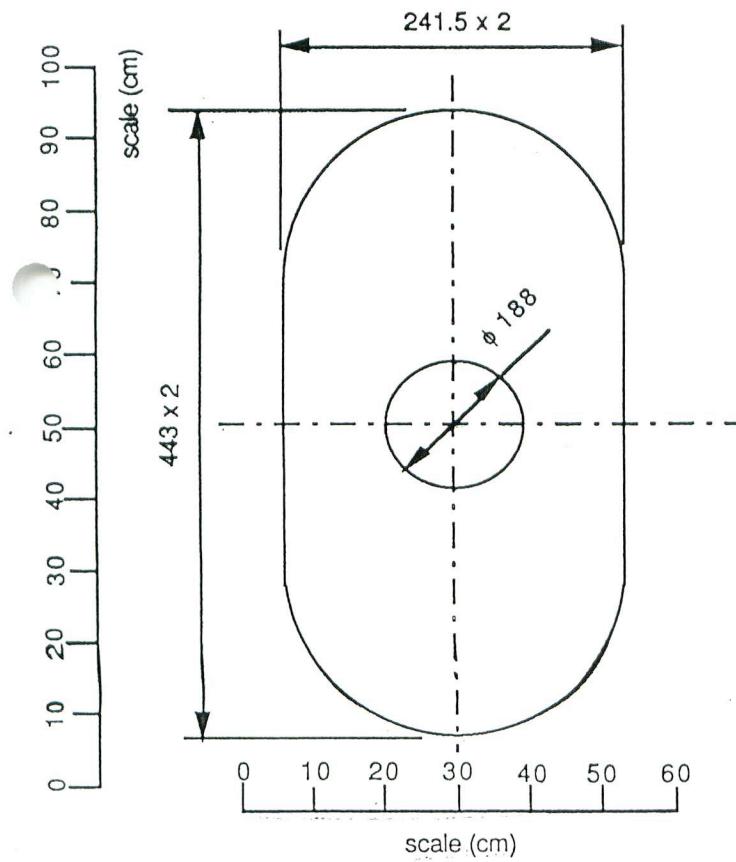
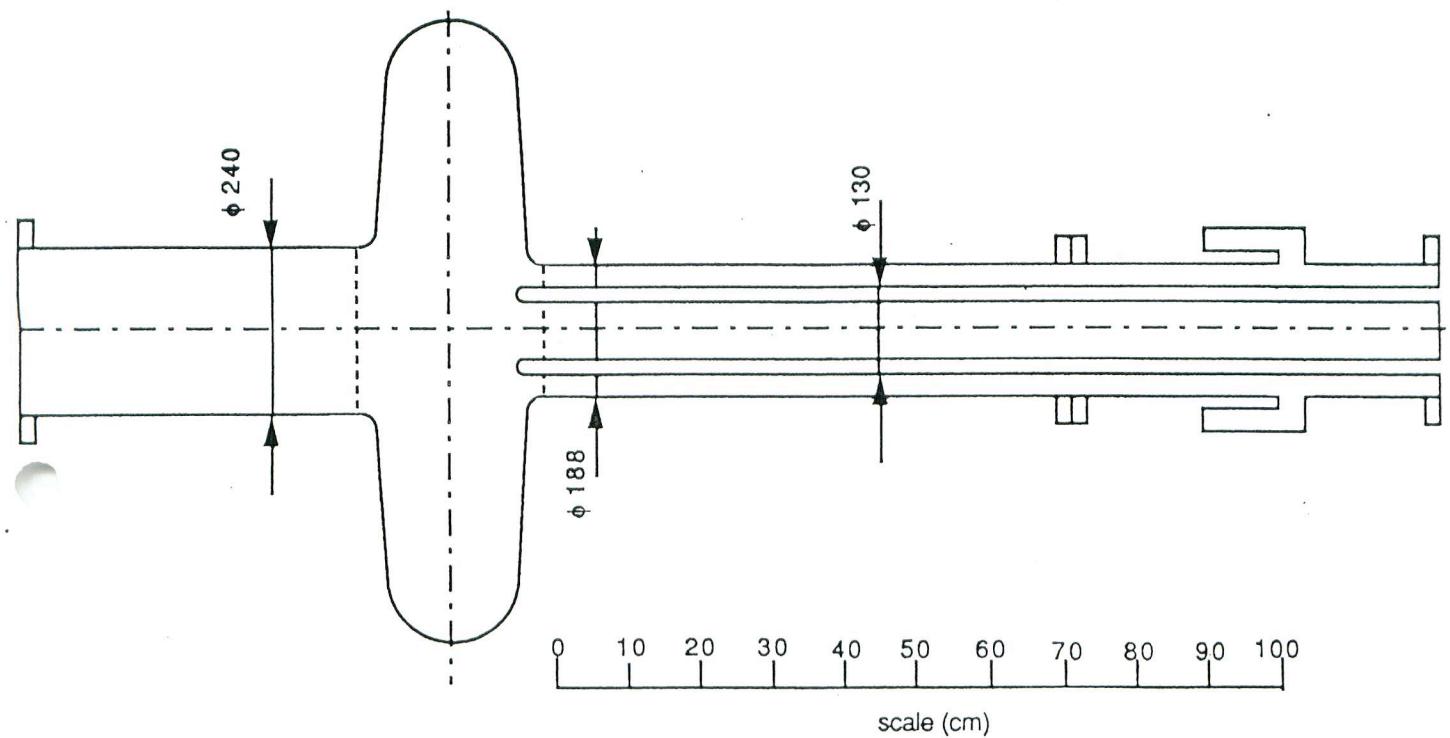


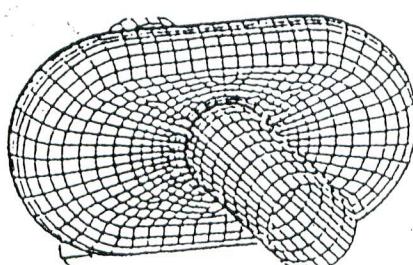
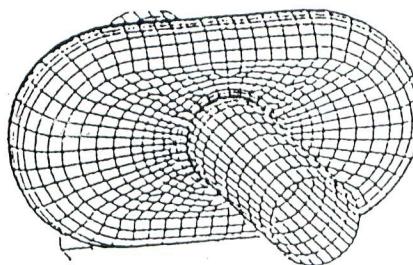
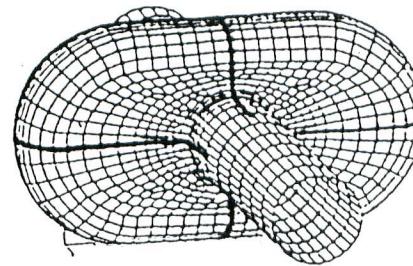
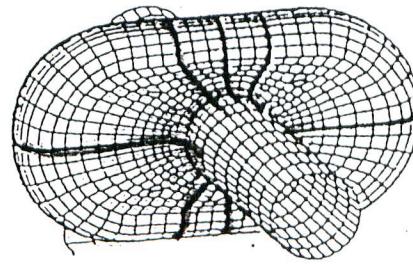
Figure 6. Surface peak field versus Q curve.



KEK-B Crab Cavity

Mar.24, 1995
K. Hosoyama
(revised from Mar. 16)



Case 1		thickness $t = 4 \text{ mm}$	σ_{\max} 17.6 kgf/mm ²
Case 2		thickness $t = 7 \text{ mm}$	7.15
Case 3		thickness $t = 4 \text{ mm}$ 4 ribs (10 mm x 20 mm)	7.41
Case 4		thickness $t = 4 \text{ mm}$ 8 ribs (10 mm x 20 mm)	6.86

$$\sigma_a = 8.1$$

kgf/mm²

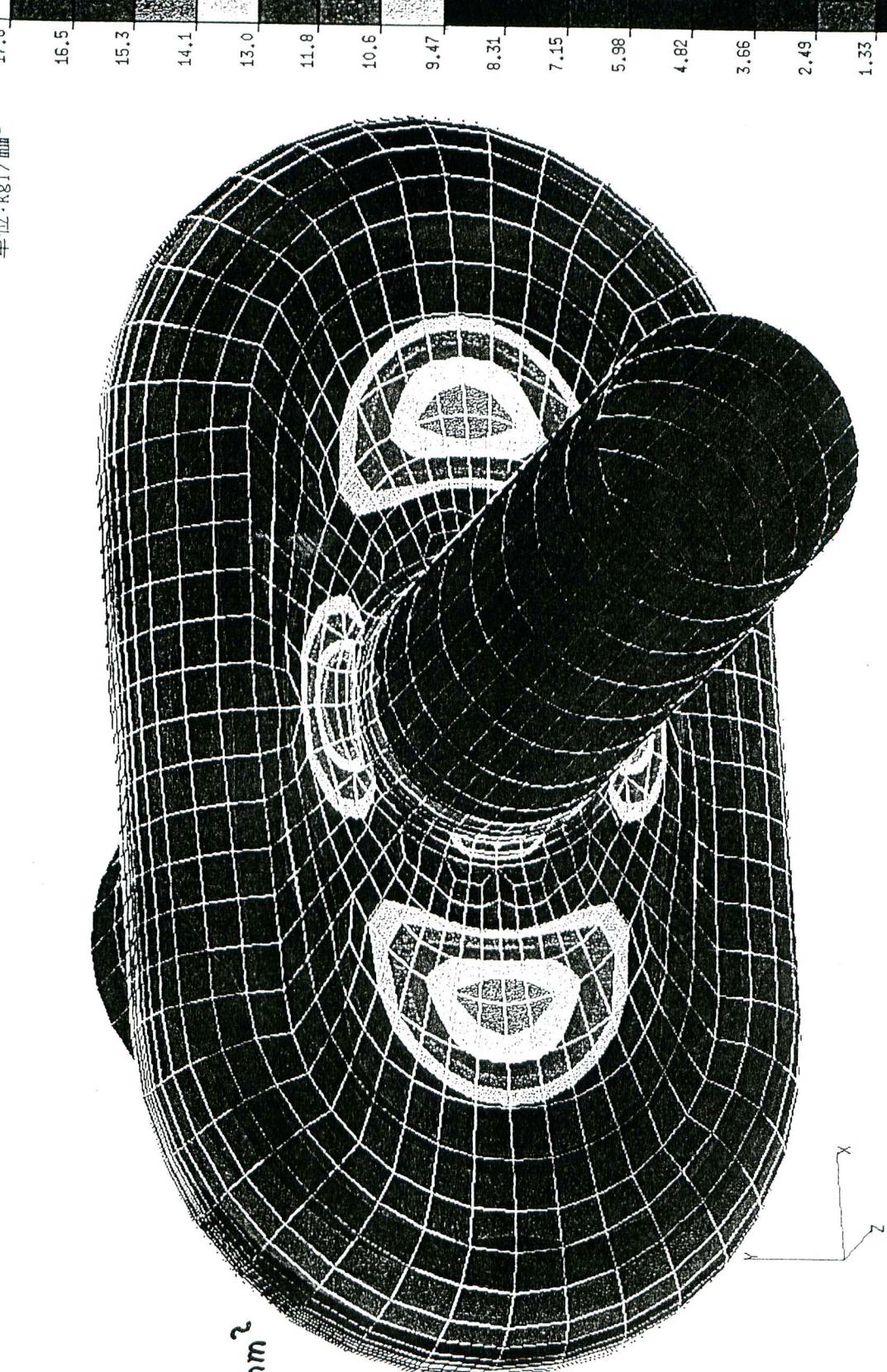
Case1

$$t = 4 \text{ mm}$$

$$\sigma_{\text{max}} = 17.6 \text{ kgf/mm}^2$$

$$\sigma_a = 8.1$$

単位: kgf/mm²



T = 4.0
PATRAN POST-PROCESS FILE CREATED BY MARPAT3.1a-1 09-MAY-95 18:04;
TIME = .000000E+00 FREQUENCY = .000000E+00 GENERALIZED MASS = .00
HIDE? 1.RENDER 2.DISPLAY TRIANGULATION 3.NEW SCREEN 4.END
MISES STRESS (CASE1-1) INNER_

図5-1 内表面のMises相当応力分布 (Case1-1). P = 1.333kg/cm²

Case 1

$$\delta = 0.362 \text{ mm}$$

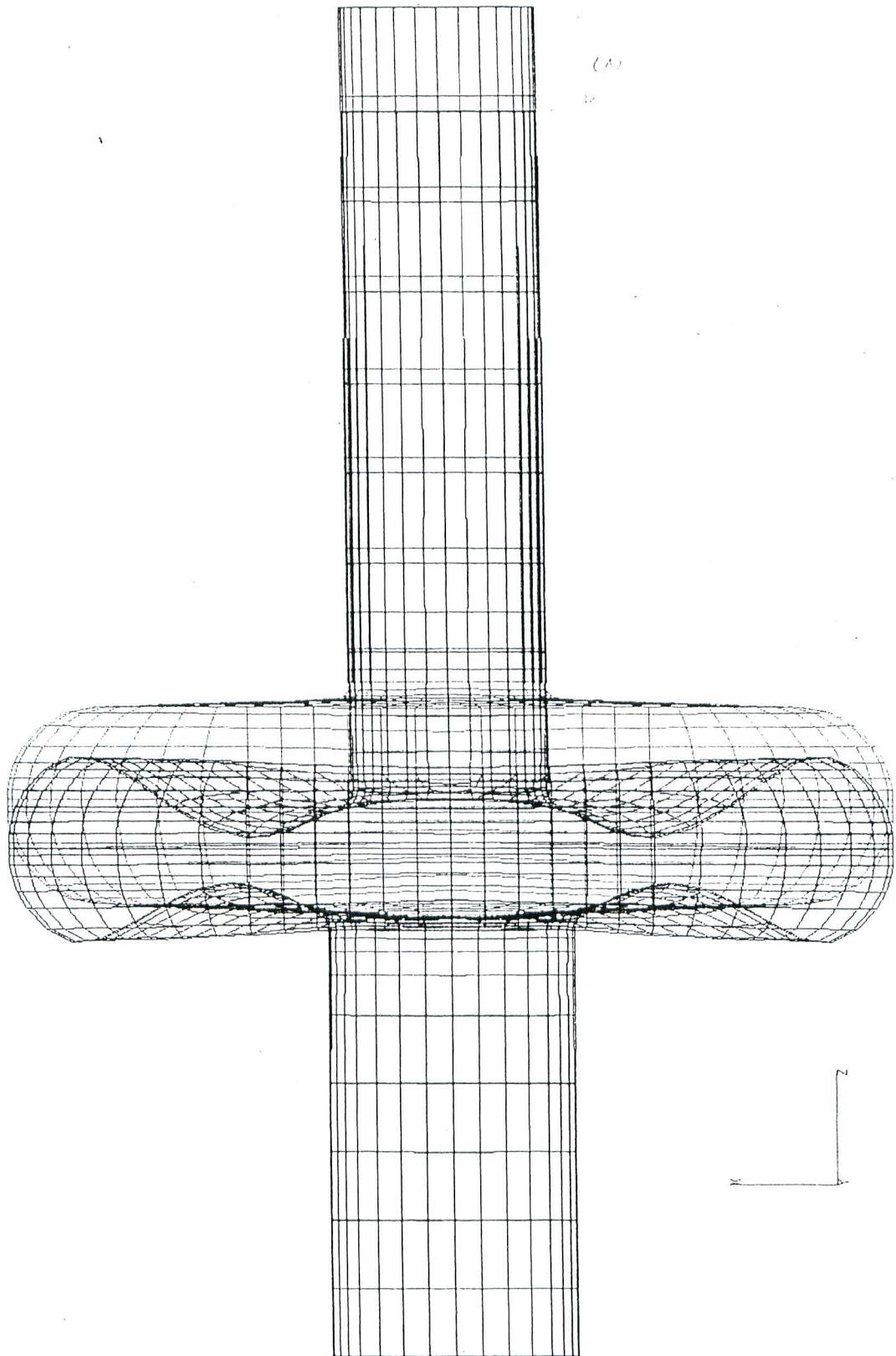
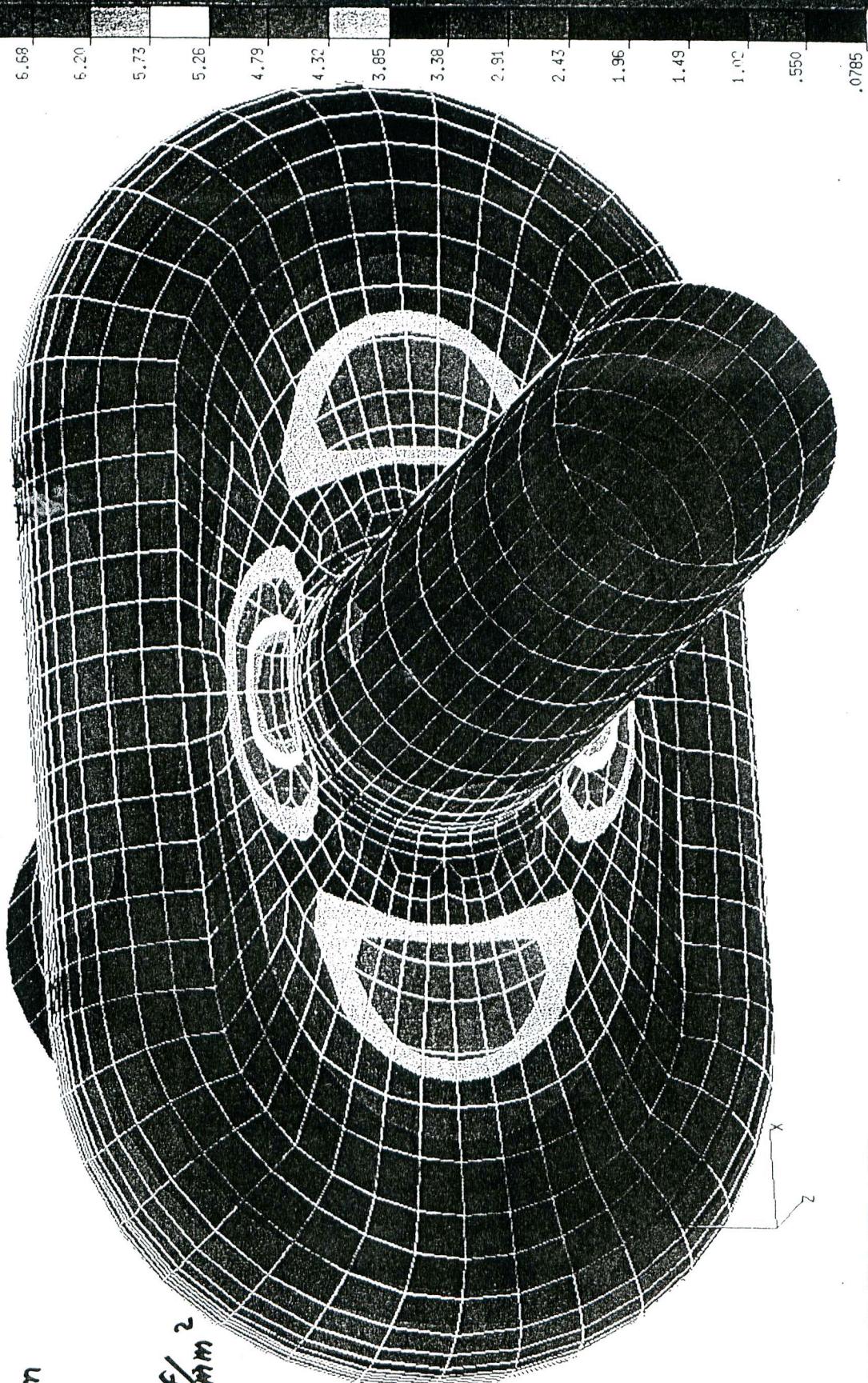


图 5-3 变形状况 (Case 1) $P=1.333 \text{ kgf/cm}^2$

CLUB KIDD 1/3 SCALE MODEL < CONTROL >
PATTERN POST+PROCESS FILE CREATED BY MARPAT3.1A-1 13-OFR-95 10:53;
TIME = .000000E+00 FREQUENCY = .000000E+00 GENERALIZED MASS = .00
5. ANIMATE 6. ANIMATE CHILDREN 7. NEW CASE 8. END

Case2

$$\begin{aligned} t &= 7 \text{ mm} \\ \sigma_{\max} &= 7.15 \text{ kgf/mm}^2 \end{aligned}$$



CLUB KURODOKU FULL SCALE MODEL (STIFNA NASHI) I = 7.0
PATRAN POST-PROCESS FILE CREATED BY MARPAT3.1A-1 25-APR-95 11:36:
TIME = .000000E+00 FREQUENCY = .000000E+00 GENERALIZED MASS = .00

HIDE? 1.RENDER 2.DISPLAY TRIANGULATION 3.NEW SCREEN 4.EXIT
MISES STRESS (INNER) (CASE1-6).

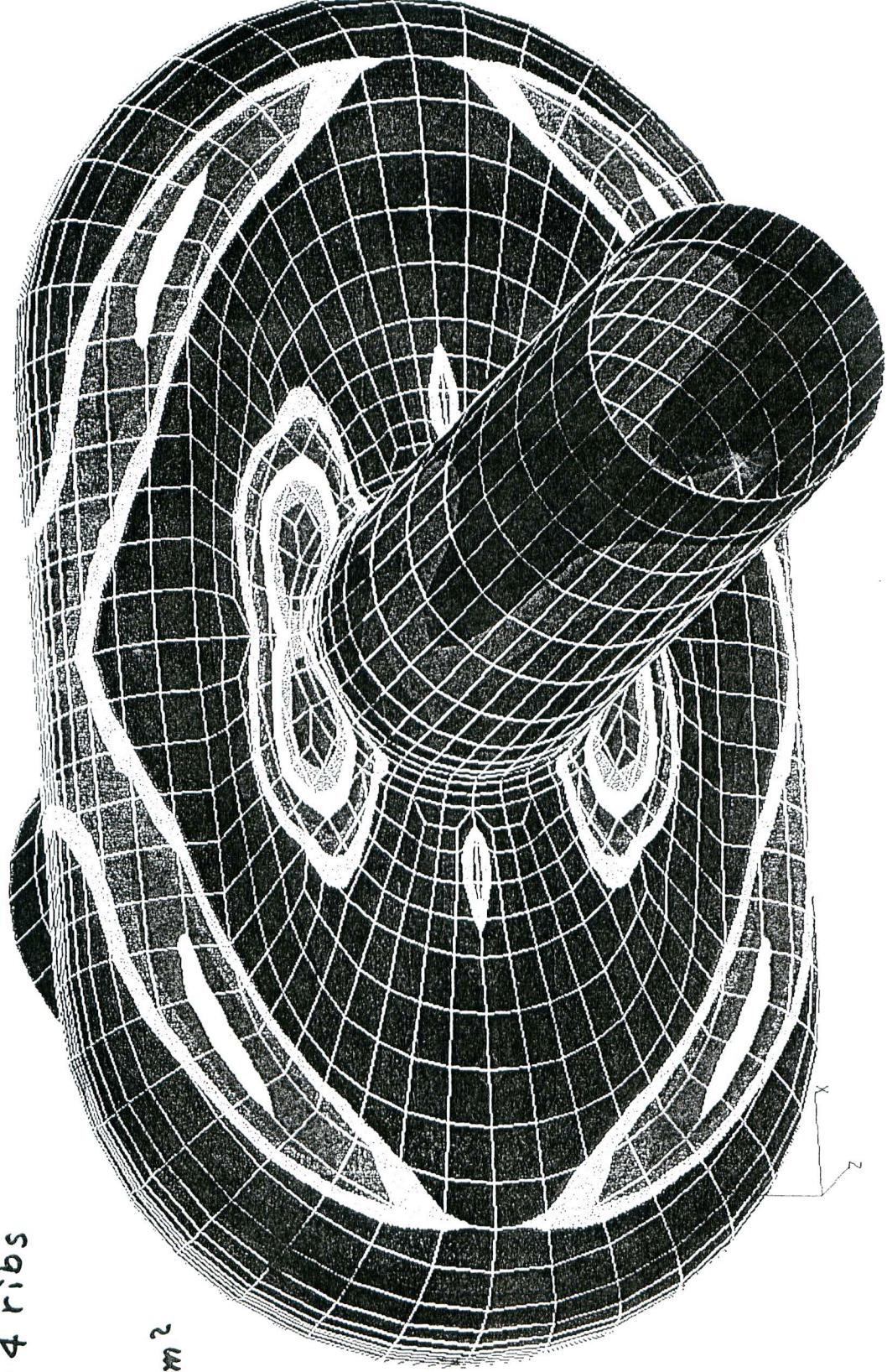
図6-1 内表面のMises相当応力分布 (Case 2). P = 1333kg/cm²

Case 3-1

$t = 4\text{ mm} + 4\text{ ribs}$

$\sigma_{\text{max}} = 7.41 \text{ kgf/mm}^2$

$\sigma_a = 8.1$

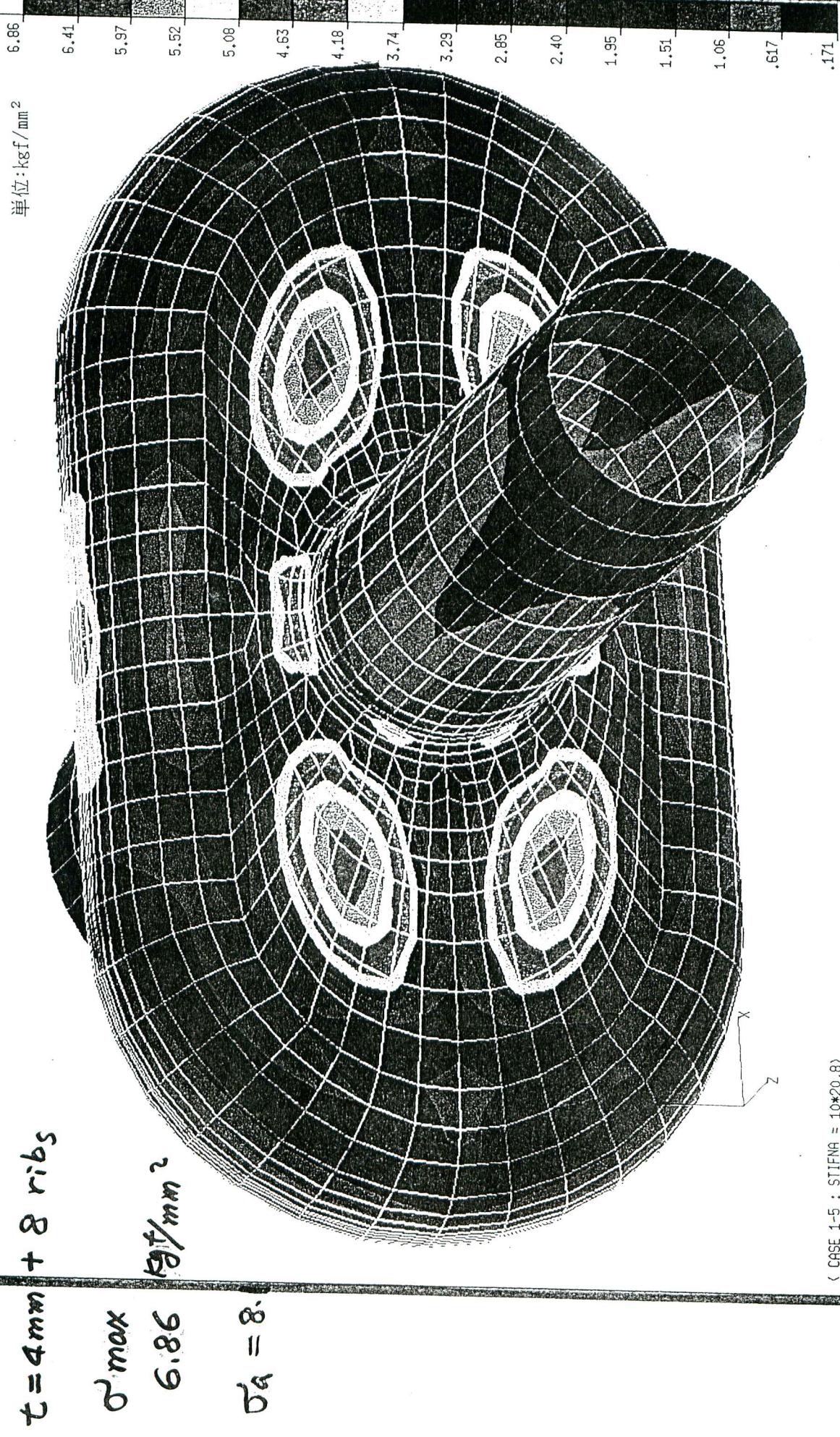


(STIFINA = 10*20)
PATRAN POST-PROCESS FILE CREATED BY MARPAT3.1A-1 20-APR-95 14:15:
TIME = .000000E+00 FREQUENCY = .000000E+00 GENERALIZED MASS = .00
HIDE? 1.RENDER 2.DISPLAY TRIANGULATION 3.NEW SCREEN 4.EXIT
MISES STRESS (OUTER)_

外表面のMises相当応力分布 (Case 3-1) $P = 1.333\text{kg/cm}^2$

Case 3-2

$t = 4 \text{ mm} + 8 \text{ ribs}$



CASE 1-5 : STIFNA = 10*20.8)
PATRAN POST-PROCESS FILE CREATED BY MARPAT3.1A-1 25-APR-95 10:43:
TIME = .000000E+00 FREQUENCY = .000000E+00 GENERALIZED MASS = .00

Mises Stress (Inner) (CASE1-5) -
Mises Stress (Outer) (CASE1-5) -
Mises Stress (Bottom) (CASE1-5) -
Mises Stress (Top) (CASE1-5) -
Mises Stress (Left) (CASE1-5) -
Mises Stress (Right) (CASE1-5) -

HIDE? 1.RENDER 2.DISPLAY TRIANGULATION 3.NEW SCREEN 4.END

内表面のMises相当応力分布 (Case 3-2) $P=1.333 \text{ kgf/cm}^2$

図 5-1 内表面のMises相当応力分布 (Case 3-2) $P=1.333 \text{ kgf/cm}^2$



CRAB - CAVITY R&D SCHEDULE (1995)

Mar. 1995
K.Hosoyama

	FY 1994						FY 1995						FY 1996													
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1/3 Scale Model																										
Cornell Cavity																										
Cryostat (Vert.)	1.5 GHz																									
Vacuum System	1.8 K																									
RF System	Test																									
Stand	Stand																									
Nb-Cavity	Design	D																								
Nb Sheet		#1					#2						#3													
Forming	R&D						R&D						R&D													
E.B.W.							#1						#2													
E.P.																										
Anneal																										
Cu-Model																										
Co-axial Coupler																										
Full Scale Model																										
Cryostat (Vert.)	500 MHz																D									
Vacuum System	4.2 K																D									
RF System	Test																C									
Stand	Stand																D									
Nb-Cavity	Design																D									
Nb Sheet																	C									
Forming	#1																D									
E.B.W.	R&D																C									
E.P.																	D									
Anneal	R&D																Reform									
Cu-Model																										
Co-axial Coupler																										
Cryostat (Hori.)																										
RF Absorber																										

C : Construction

D : Design