# Toshiba/KEK MBK for TESLA: Design, Status and Schedule

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TESLA Collaboration Meeting

DESY, Berlin

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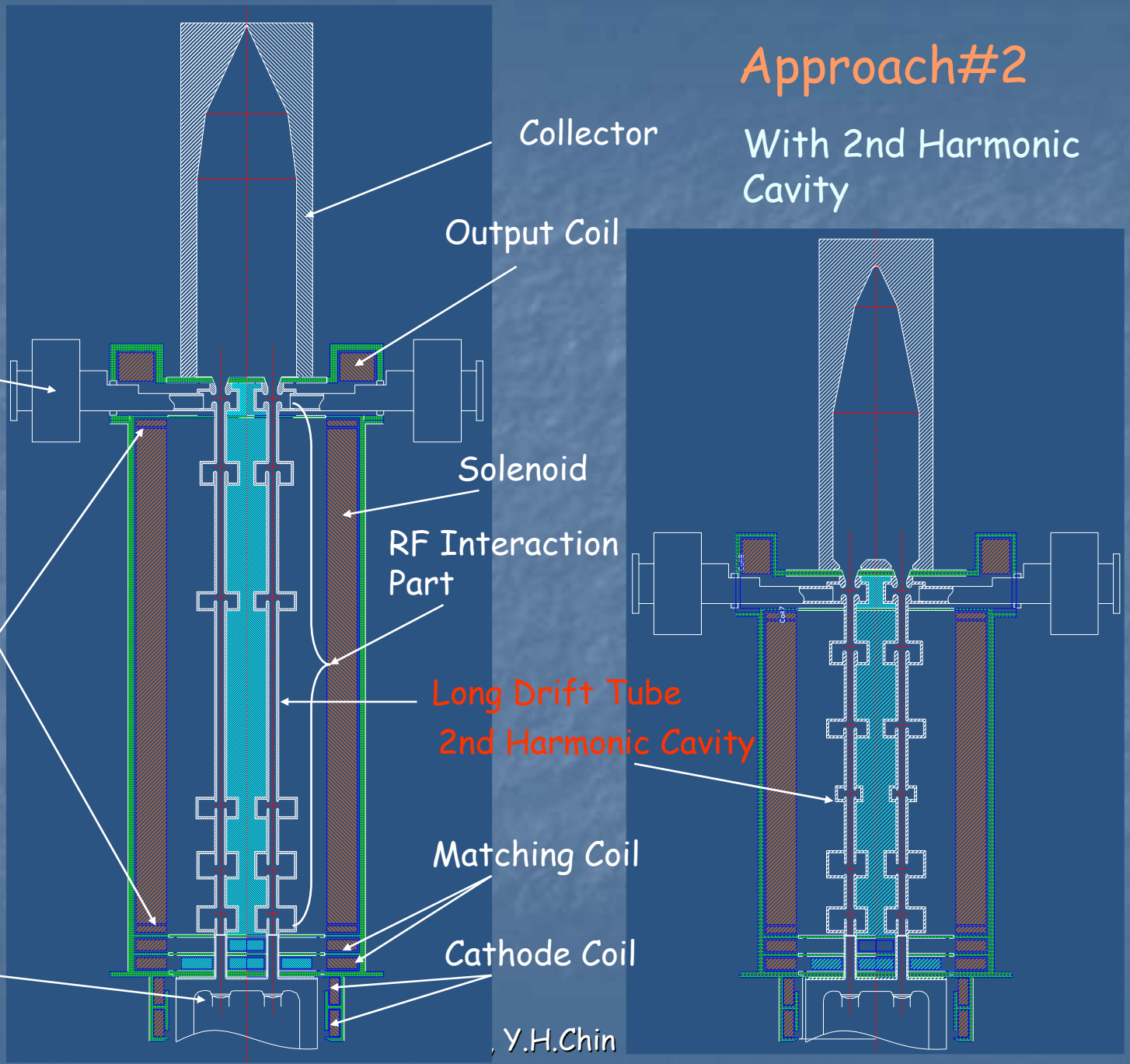
# Reminders from Previous Talk

- Toshiba was inquired by DESY about its interest in production of a MBK for TESLA in summer 2002.
- KEK/BINP team provided a basic design of TESLA MBK to Toshiba, based on our experience of designing a X-band PPM MBK for JLC (Japan Linear Collider).
- Toshiba improved the design for better performance and for meeting the specifications of TESLA.
- The design was approved and the order was placed to Toshiba in early summer 2003.
- The production is under way for the final delivery in October 2004.

# Design Parameters

| | Toshiba E-3736 (design) | Thales TH1801 (measured) |
|---|---|---|
| Operating Frequency | 1300 MHz | 1300 MHz |
| Peak Output Power | 10 MW | 10 MW |
| Average Output Power | 150 kW | 75 kW |
| Beam Voltage | 115 kV | 117 kV |
| Beam Current | 132 A | 131 A |
| Efficiency | 70-75 % | 65 % |
| RF Pulse Duration | 1.5-2.0 ms | 1.5 ms |
| Repetition Rate | 10 pps | 5 pps |
| Saturation Gain | 47 dB | 48.2 dB |
| Number of Beams | 6 | 7 |
| Number of Cavities | 6 | 6 |
| Cathode Loading | <2.1 $A/cm^2$ | 5.5 $A/cm^2$ |
| Solenoid Power | <4 kW | 6 kW |

# General View



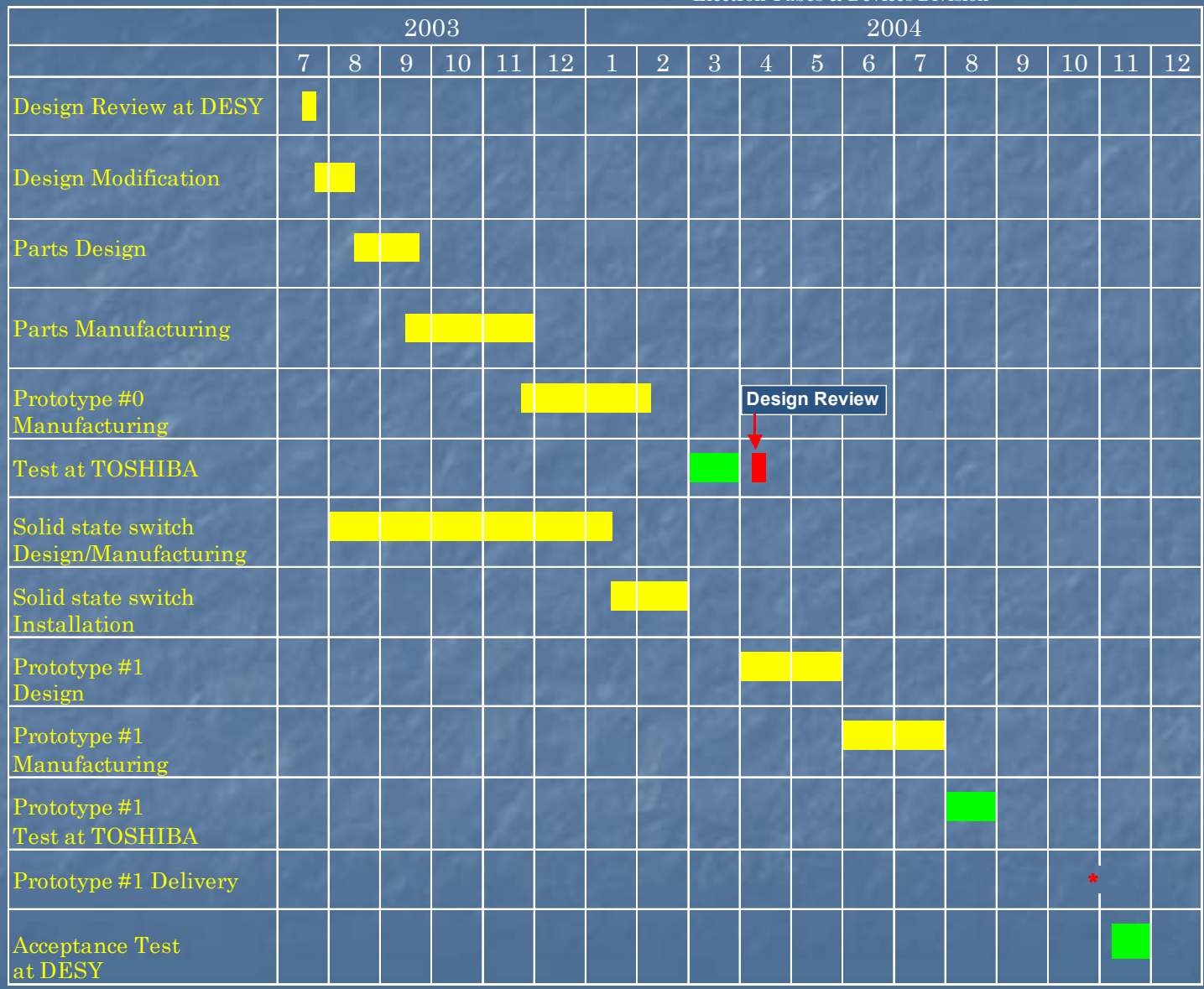

## Approach#2

With 2nd Harmonic Cavity

# Mile Stones, Multi beam Kkystron E3736 for DESY

**TOSHIBA** Corporation
Display Devices & Components Control
Electron Tubes & Devices Division

Sep. 03, 2003

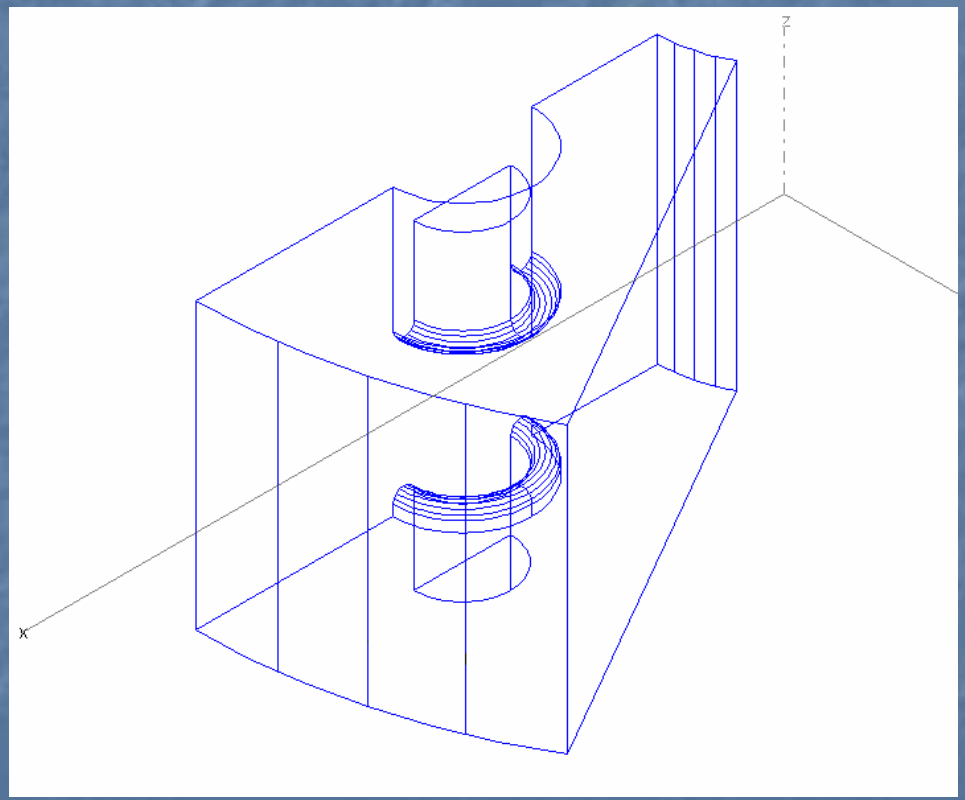


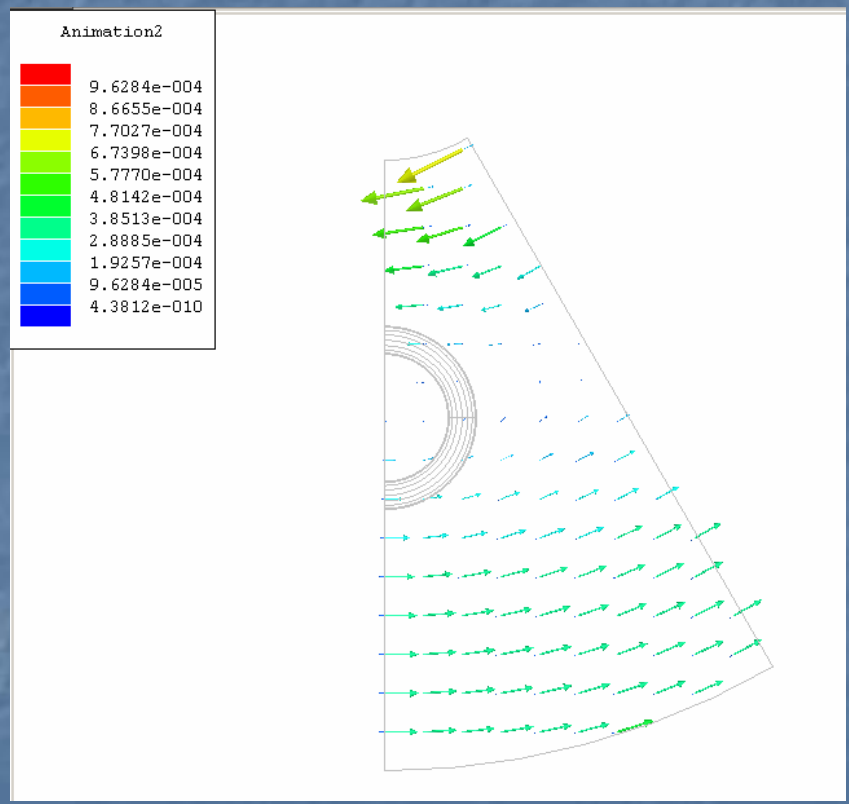
# Design Updates

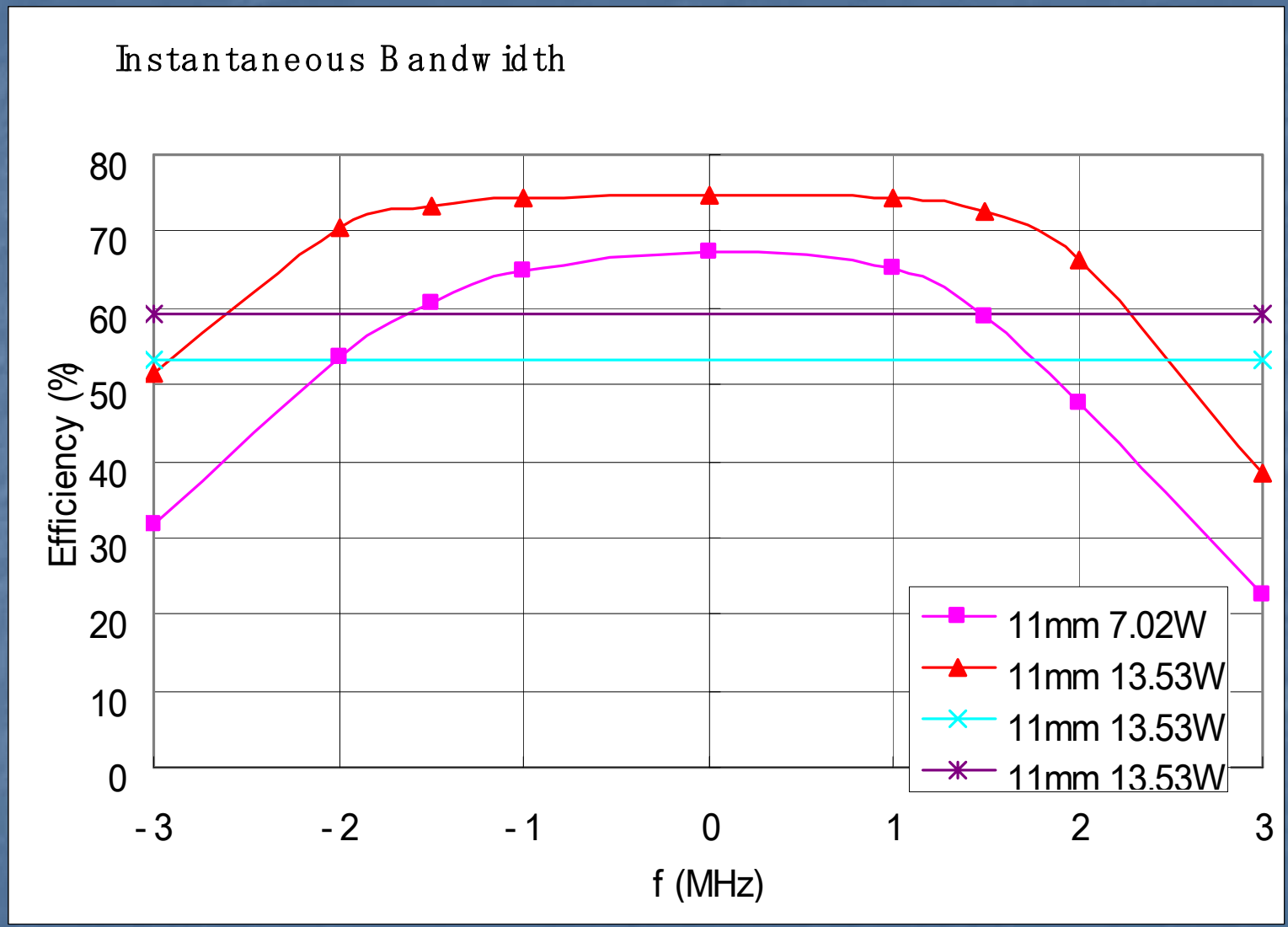
- 3MHz bandwidth requirement at 8.7MW
  - Adding one more bunching cavity was proposed at the last design review.
  - However, it turned out that lowering Q-value of the second gain cavity only can produce enough bandwidth (3.7MHz).
- The hot dimension of the gun (the actual dimension when the cathode on) was calculated using ANSIS thermal code.
  - The mechanical design of the gun was revised accordingly.
- The distance between the input cavity and the output cavity was increased slightly by 4cm.

# Bandwidth Requirement

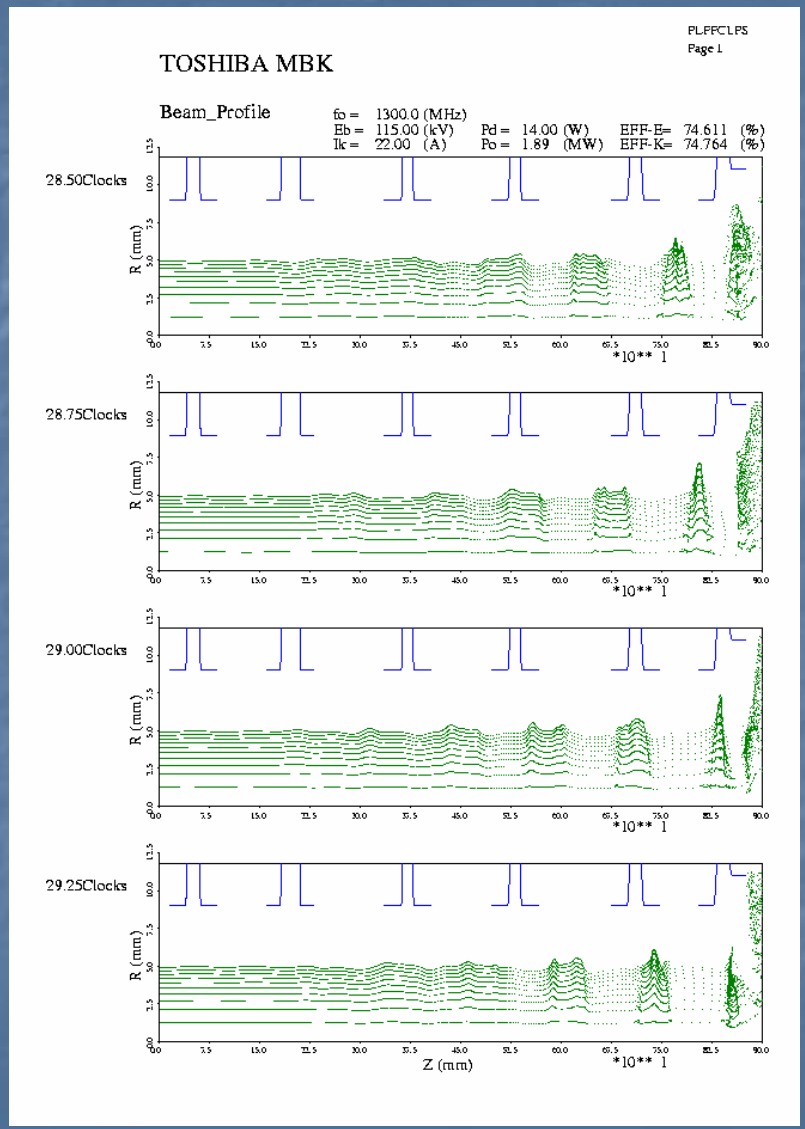
## The second gain cavity

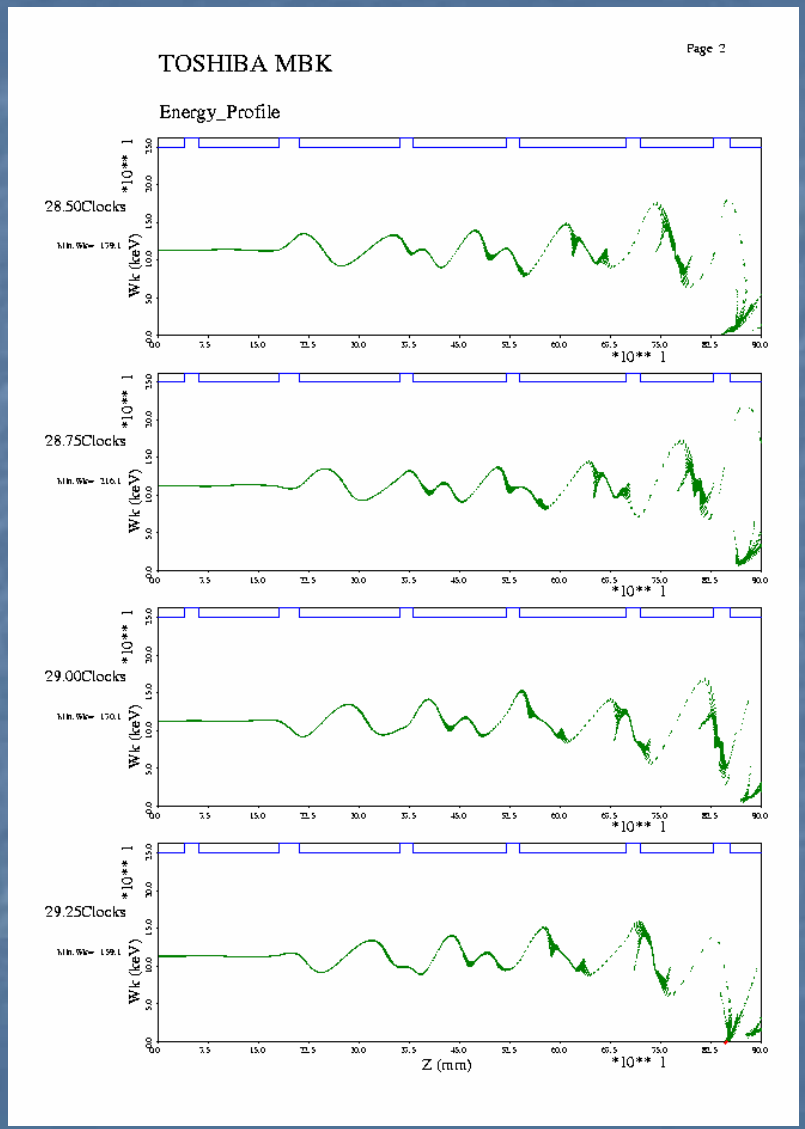


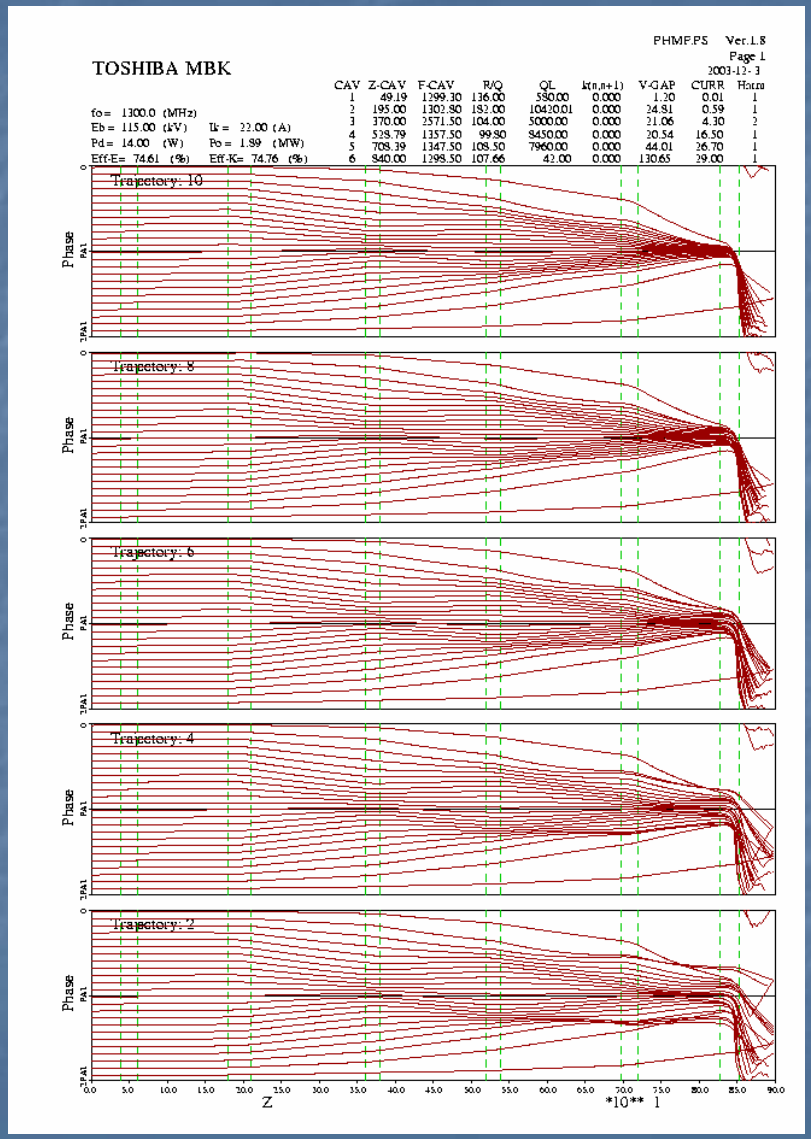

Instantaneous Bandwidth
Efficiency (%)
80
70
60
50
40
30
20
10
0
-3
-2
-1
0
1
2
3
f (MHz)
11mm 7.02W
11mm 13.53W
11mm 13.53W
11mm 13.53W

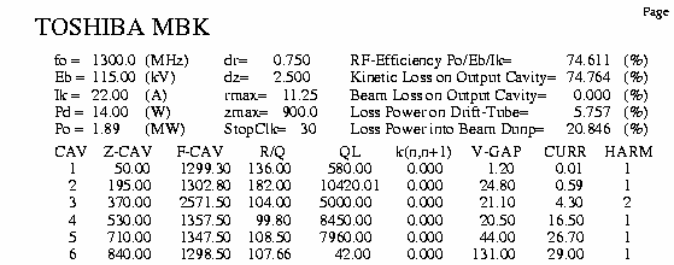
# Simulations results by FCI

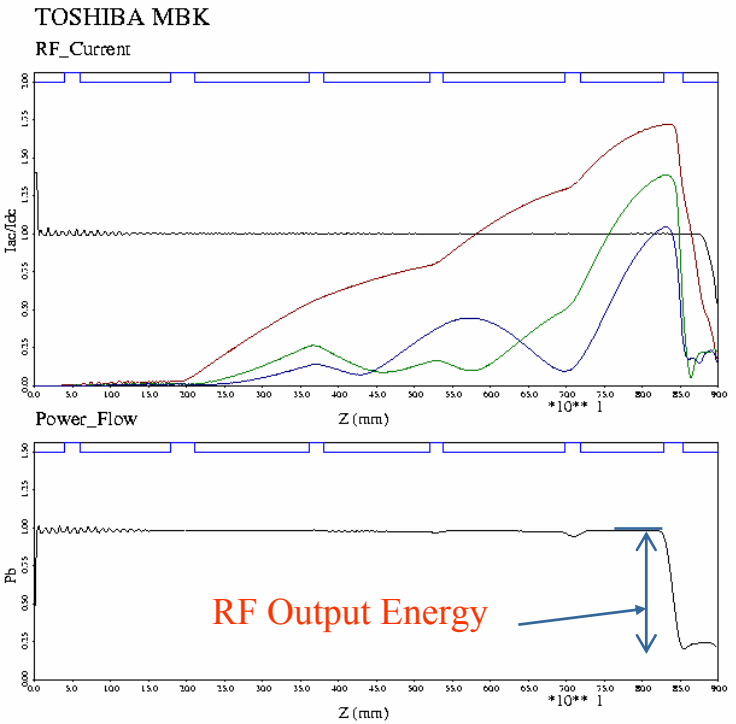


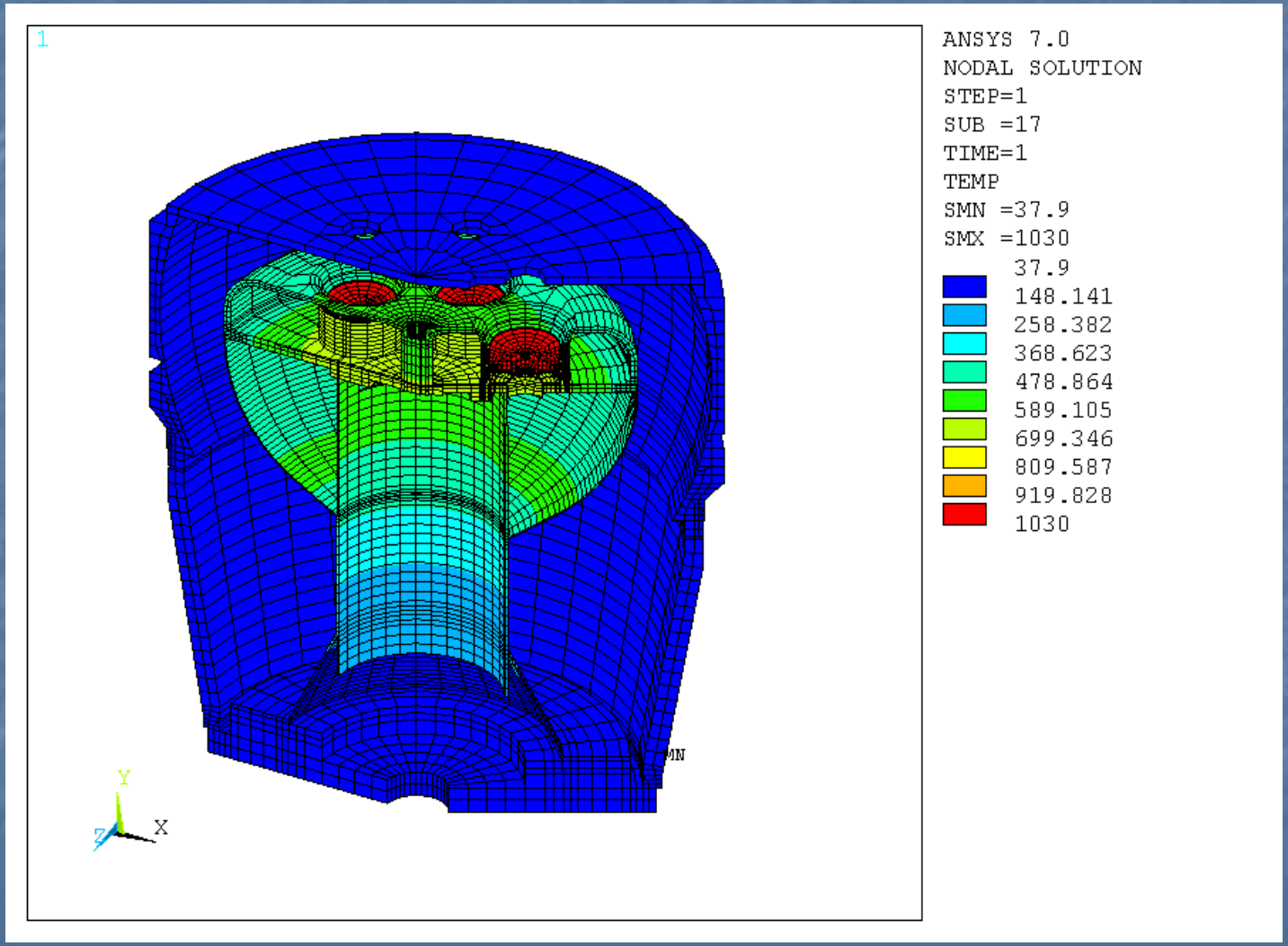
# Simulations results 2 by FCI



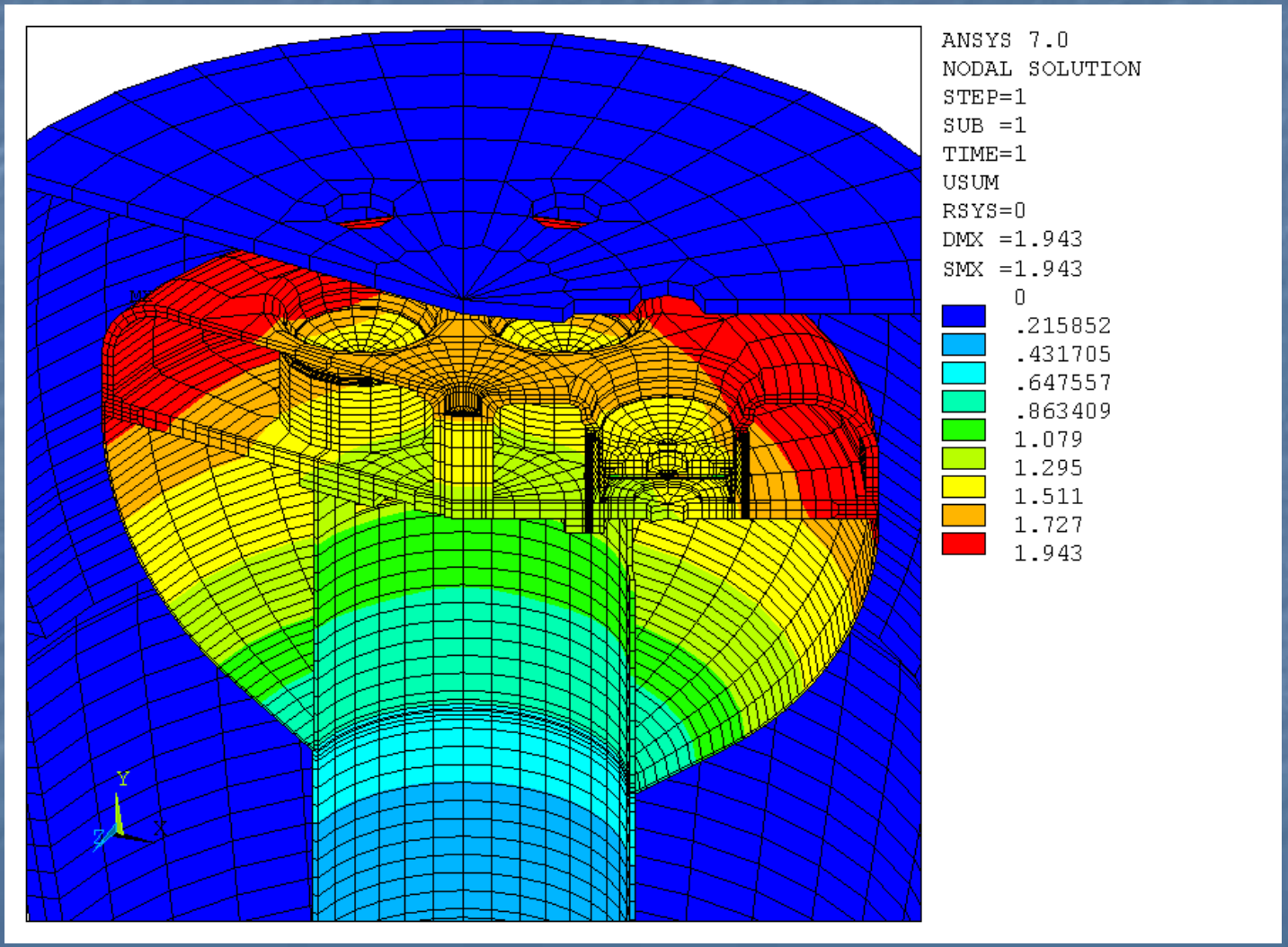



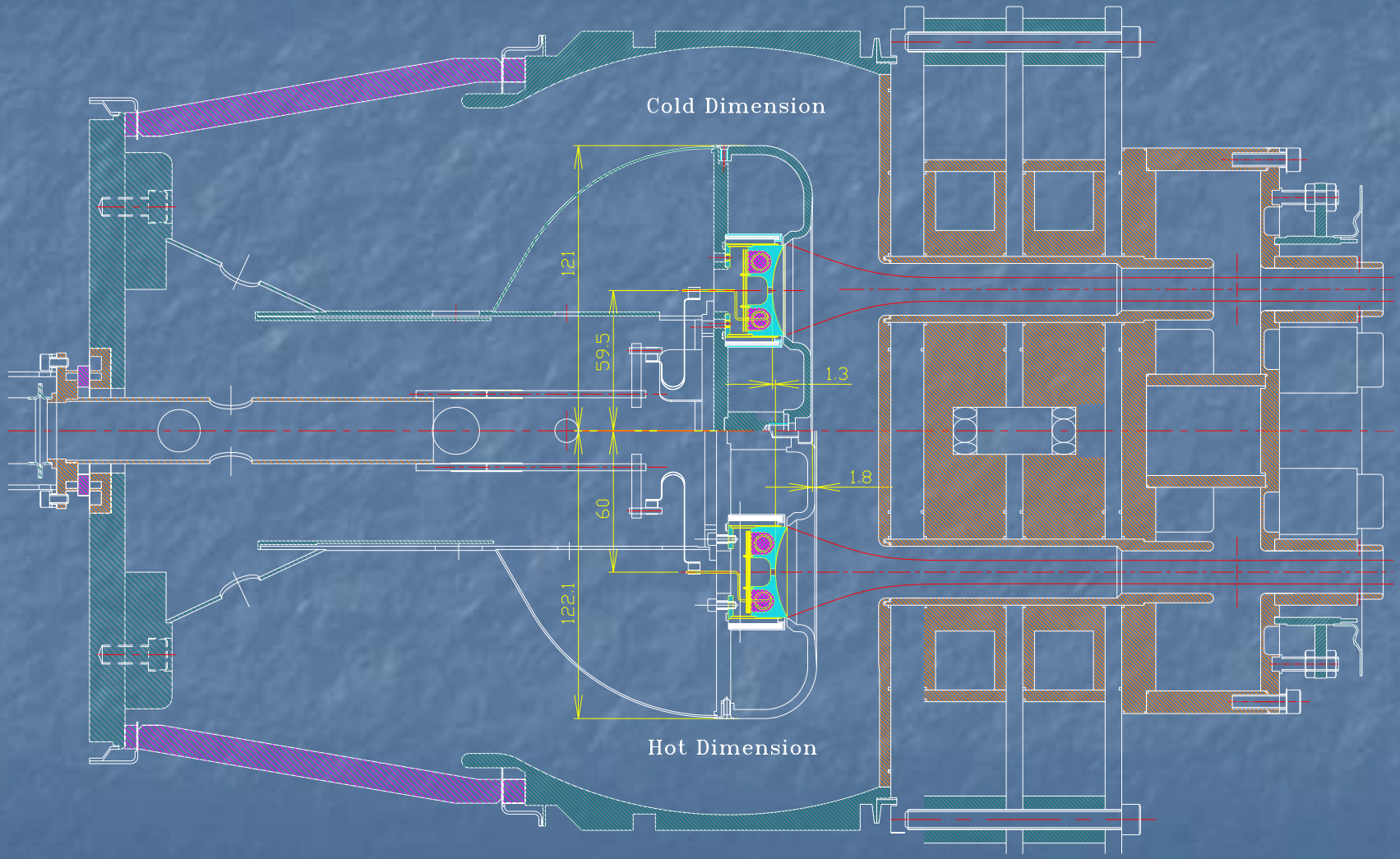
# Thermal Calculation of Gun



# Expansion

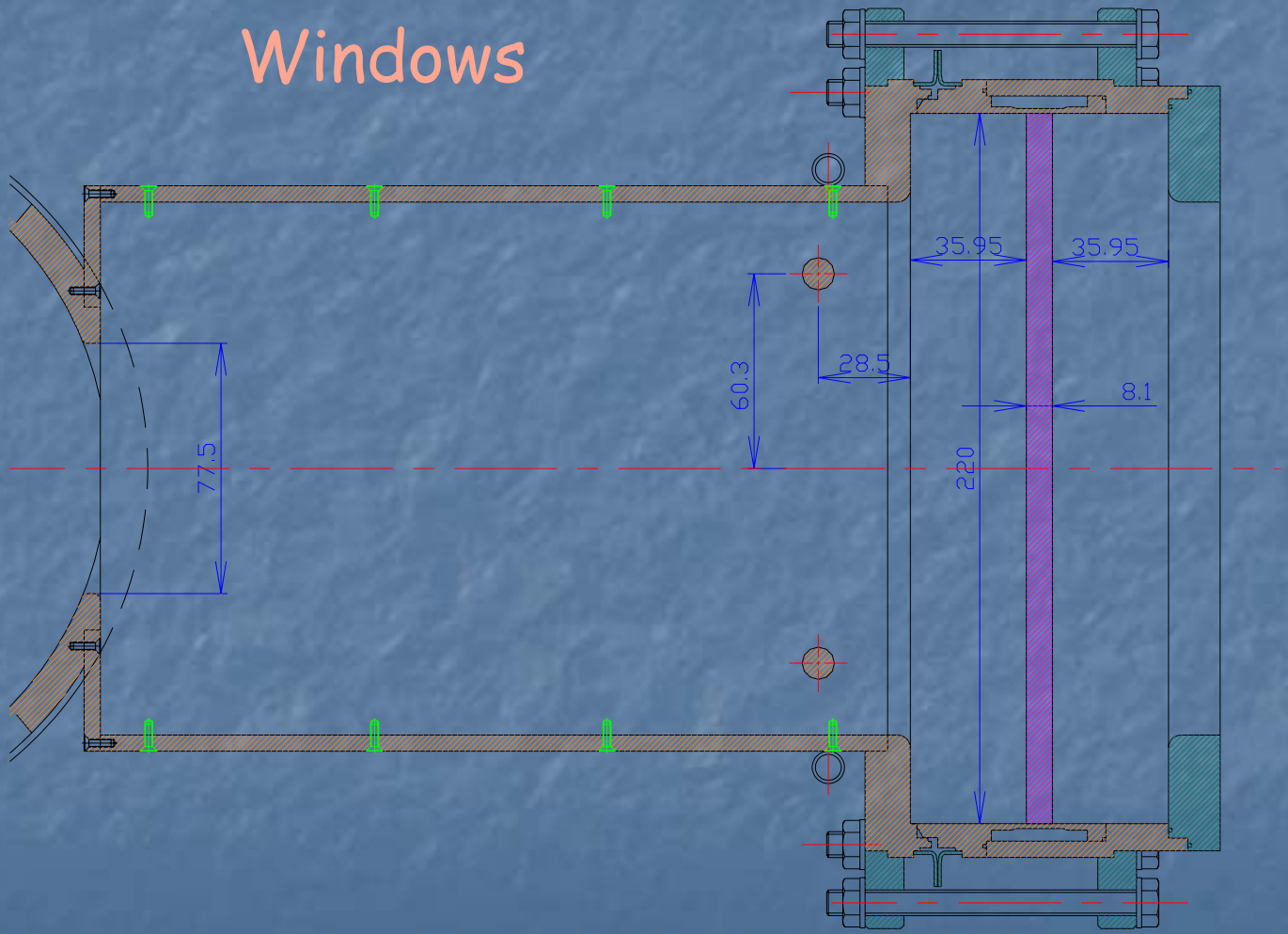

ANSYS 7.0
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
USUM
RSYS=0
DMX =1.943
SMX =1.943
0
.215852
.431705
.647557
.863409
1.079
1.295
1.511
1.727
1.943
Y
Z
X

# Cold and Hot Dimensions

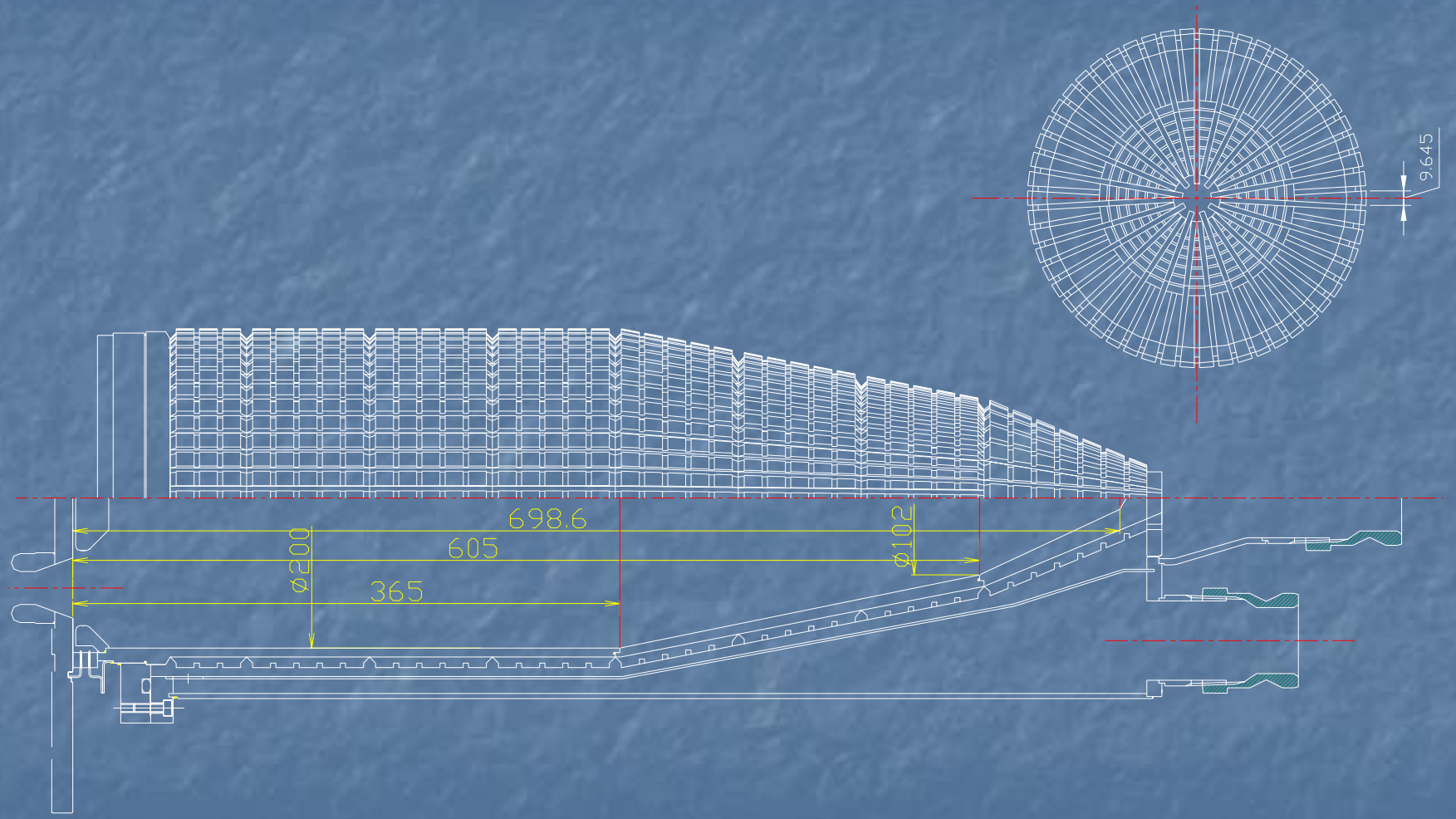


# Windows

## Windows

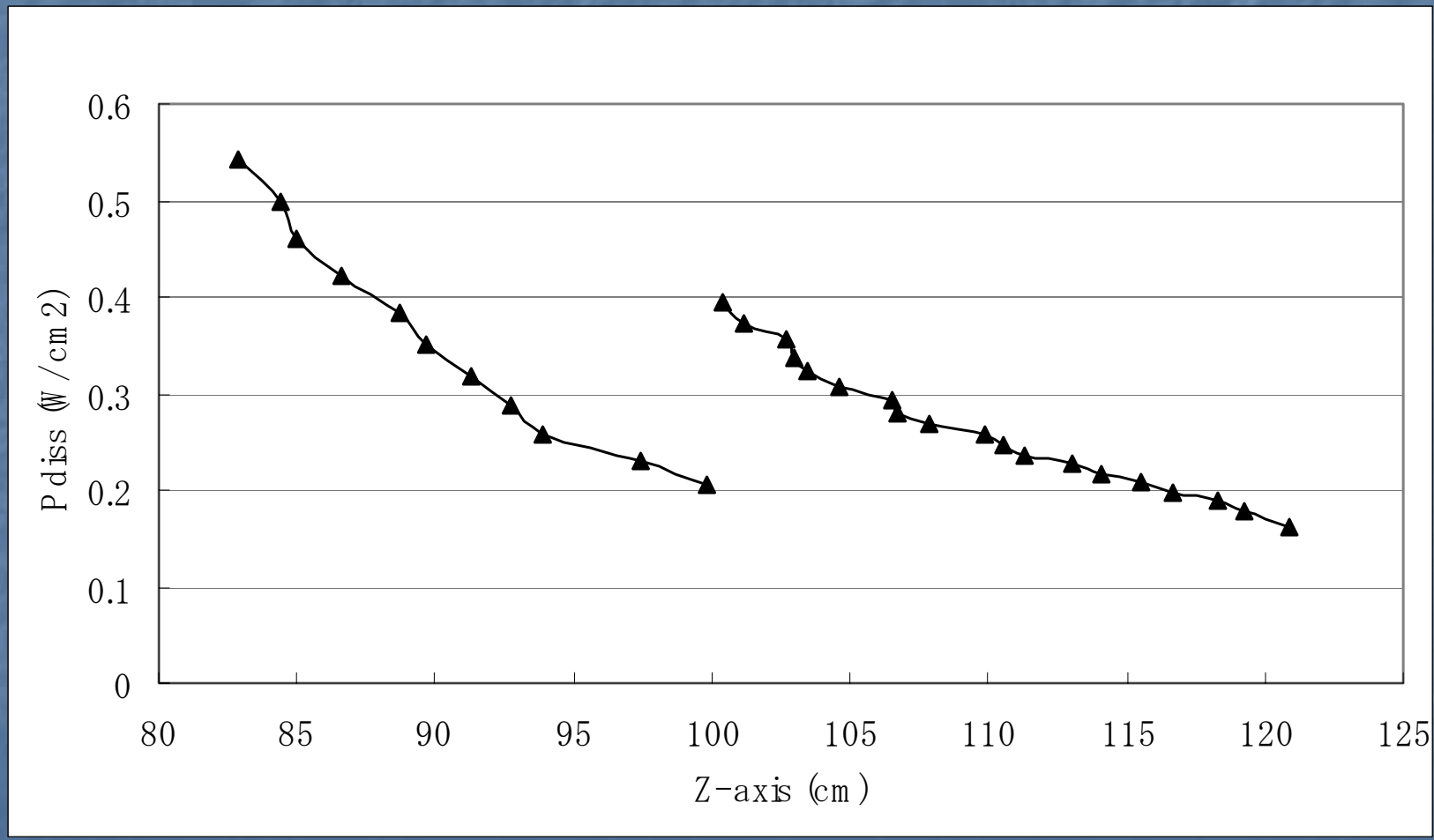


# Collector

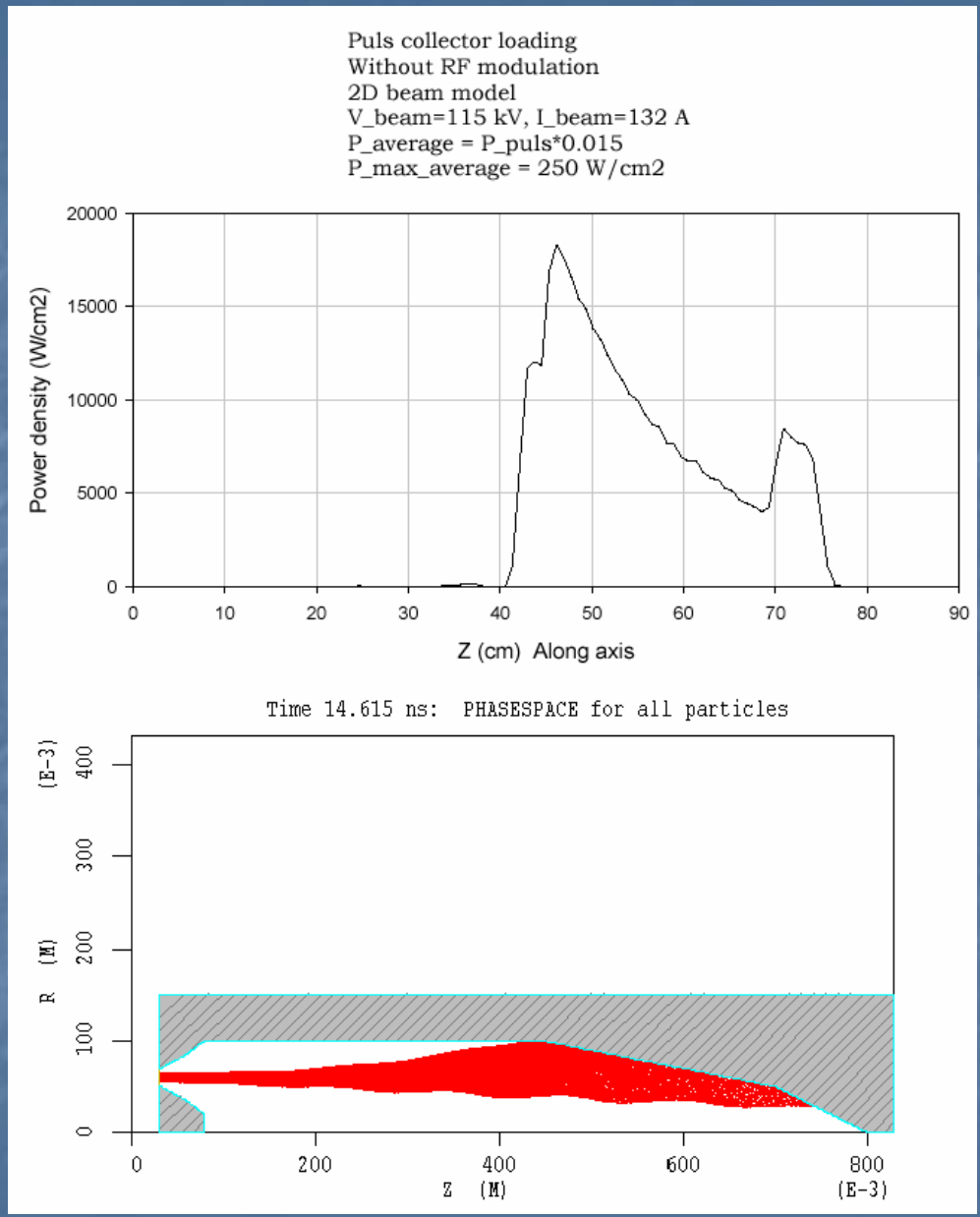


# Distribution of Power Loss in the Collector

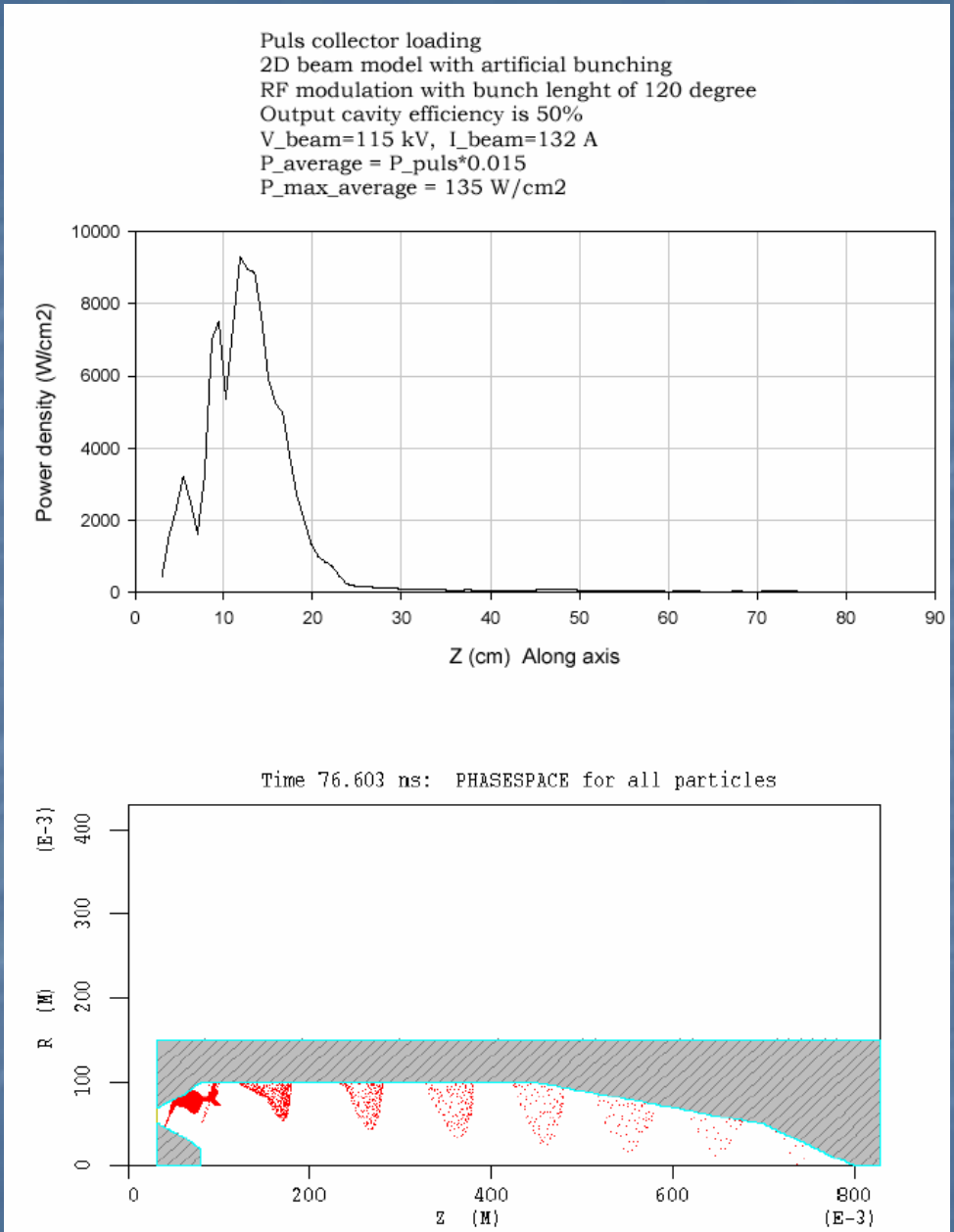
## For DC beam by Arsenal



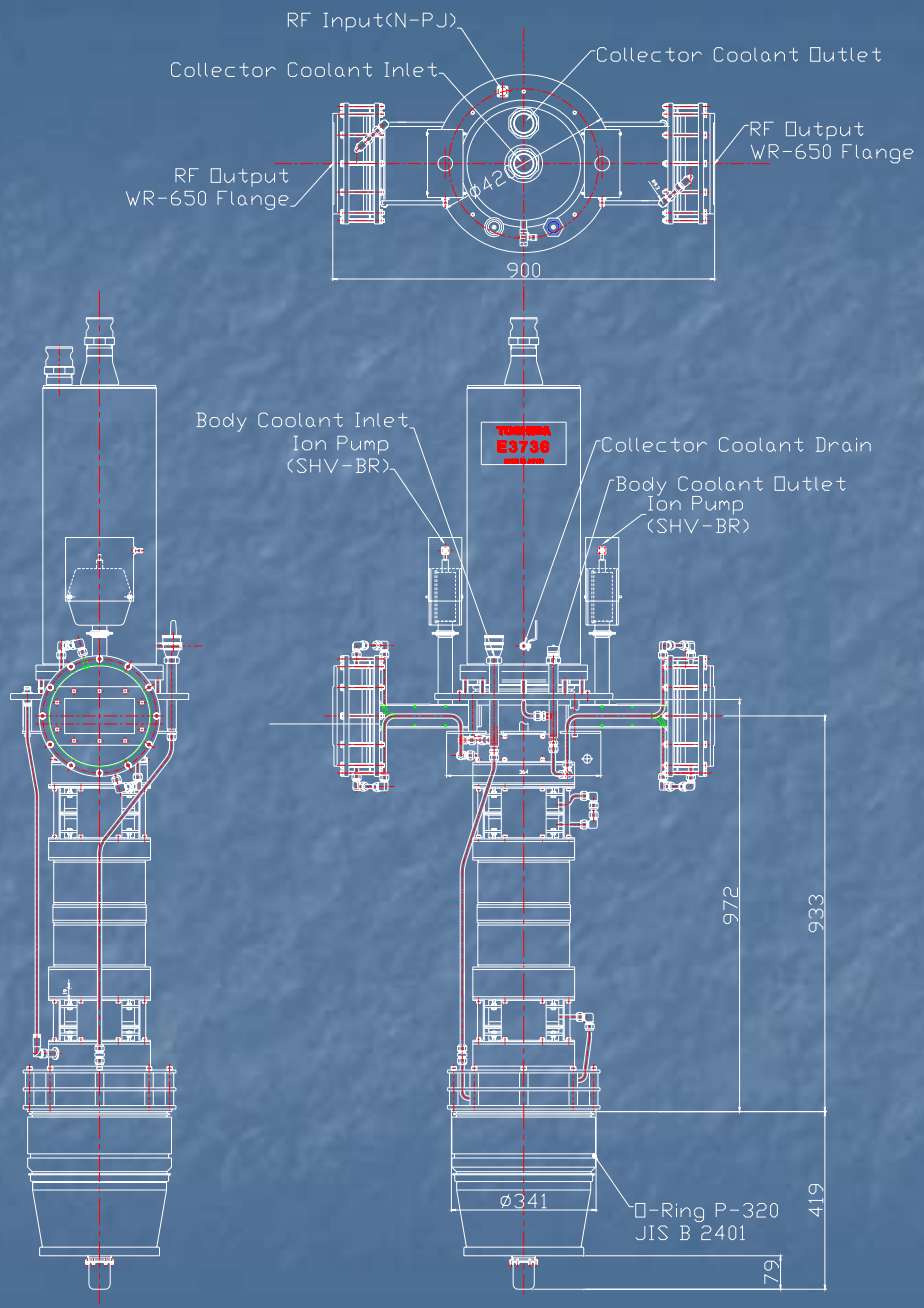
# DC sheet beam by MAGIC



# Sheet beam With 50% efficiency by MAGIC



# MBK Outline


RF Input(N-PJ)
Collector Coolant Inlet
Collector Coolant Outlet
RF Output
WR-650 Flange
RF Output
WR-650 Flange
900
Body Coolant Inlet
Ion Pump
(SHV-BR)
Collector Coolant Drain
Body Coolant Outlet
Ion Pump
(SHV-BR)
E3736
972
933
ø341
O-Ring P-320
JIS B 2401
419
79

# Status and Schedule

- About 60% of brazing was already finished.
- The baking of the tube will  start in early February.
- So, by the end of February, the Prototype-0 will be ready for testing at Toshiba, as scheduled.
- The delivery of waveguide components has been a bit slow.
- If the delivery of the waveguide system can meet the schedule, the testing of Prototype-0 will start in March.