THE ARES CAVITY

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KEKB Accelerator Review

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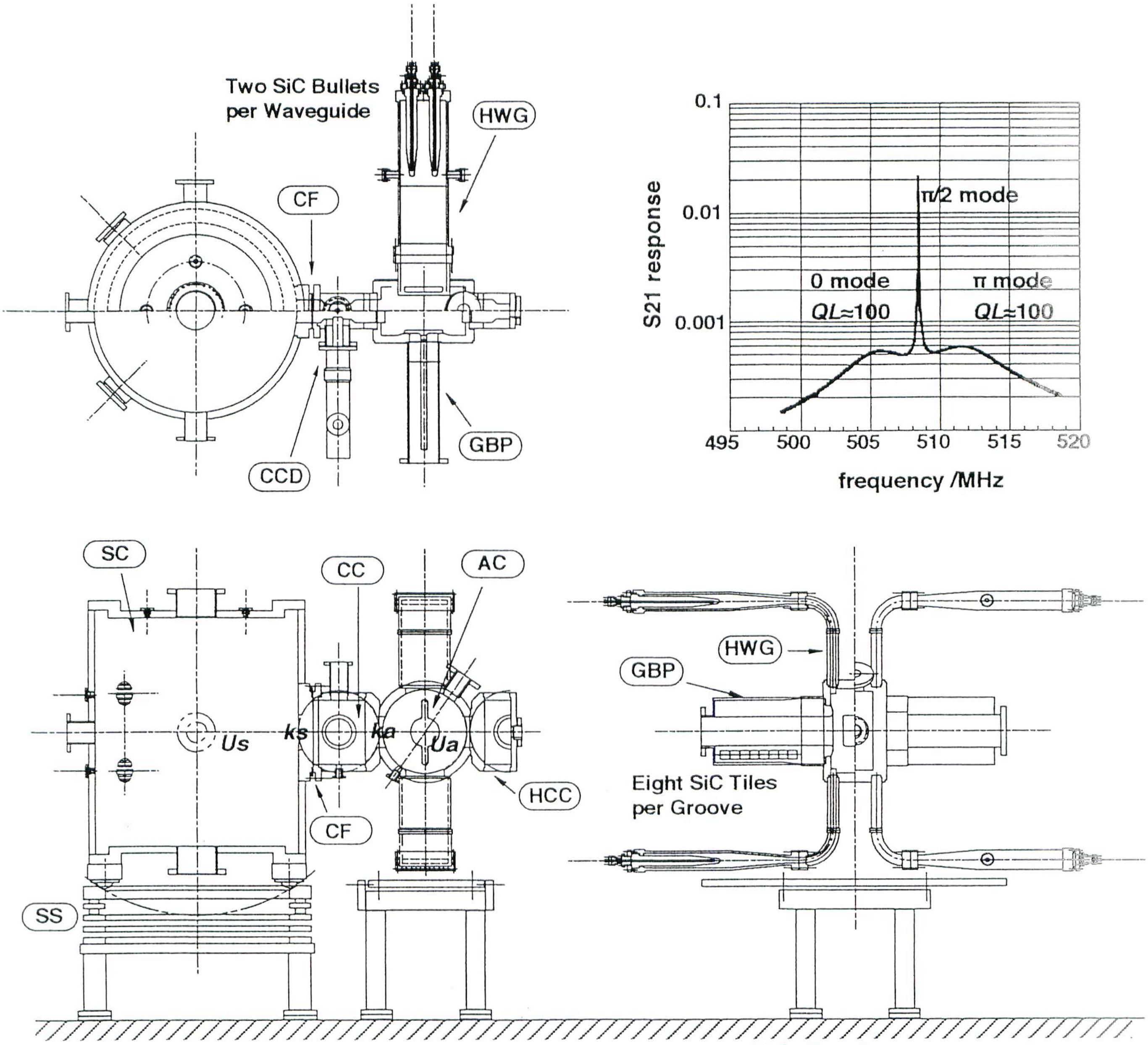
Outline:

- Introduction
- Cavity Parameters
- High-Power Performace
- Installation
- Operation
- Conclusion



A Schematic Drawing of the ARES Cavity

π / 2 - mode basics

$$Ua / Us = ks^2 / ka^2$$

Ua : the stored energy in AC
Us : the stored energy in SC
ka : the coupling factor between AC and CC
ks : the coupling factor between SC and CC

AC Accelerating Cavity
with four HOM rectangular waveguides (HWG's)
for damping monopole and dipole-V HOM's,
with two Grooved Beam Pipes (GBP's) at both end plates
for damping dipole-H HOM's.

CC Coupling Cavity
functions as the keystone of the ARES structure
and equipped with a Coupling Cavity Damper (CCD)
to damp the parasitic 0 and π modes.

CCD Coupling Cavity Damper
for reducing the impedances of the parasitic 0 and π modes.
Both 0 and π modes are damped about $QL \approx 100$.

CF Conneciting Flange
The Storage Cavity (SC) and the Coupling Cavity (CC)
are mechanically connected at rectangular flanges with bolts,
and vacuum-sealed by TIG-welding the lips around the flanges.

GBP Grooved Beam Pipe
selectively lowers the cutoff frequency of the TE11 traveling wave
and damps dipole HOM's in the acclerating cavity.
Each groove has 8 SiC ceramic tiles brazed to a water-cooled
copper plate.

HCC Half-cell Coupling Cavity
restores the symmetry of the accelerating cavity (AC)
with respect to the mid vertical plane including the beam axis.

HWG HOM Wageguide (240 mm x 28 mm)
for damping monopole and dipole-V HOM's.
Two bullet-shape sintered SiC ceramic absorbers are inserted
from the end plate of each waveguide.

SC Storage Cavity
is a cylindrical steel cavity with electro-plated copper surfaces.
The operating mode is the TE013 mode with $Q0 = 165000$.

SS Supporting Strucutre
allows the storage cavity (SC) the x- and y-parallel motions
in the horizontal plane, and the pitch-, roll- and yaw-motions
with respect to the connecting flange (CF) direction.

RF Parameters of the $\pi/2$ Accelerating Mode

f (RF) = 508.887 MHz

$U_a : U_s$ = 1 : 9

R / Q = 15 Ω

Q = 1.1×10^5 (in high-power operation)

P_c = 150 kW / ARES Cavity

generating

V_c = 0.5 MV / ARES Cavity

High-Power Performance

High-Power Test Records

achieved with ARES96

Maximum Continuous: P_c = 380 kW

Maximum for 20 minutues: P_c = 450 kW

for production cavity

Maximum Continuous: P_c = 240 kW

(limited by the radiation-safety regulation)

ARES Cavity Status:

- 24 cavities produced.

- 22 cavities RF-conditioned
  up to 180~240kW.

- 18 cavities installed
  before the initial commissioning.

LER: 12 ARES cavities in Fuji RF sections D7&D8.

HER: 6 ARES cavities in Oho RF section D5

and

4 SC cavities in Nikko RF section D11.

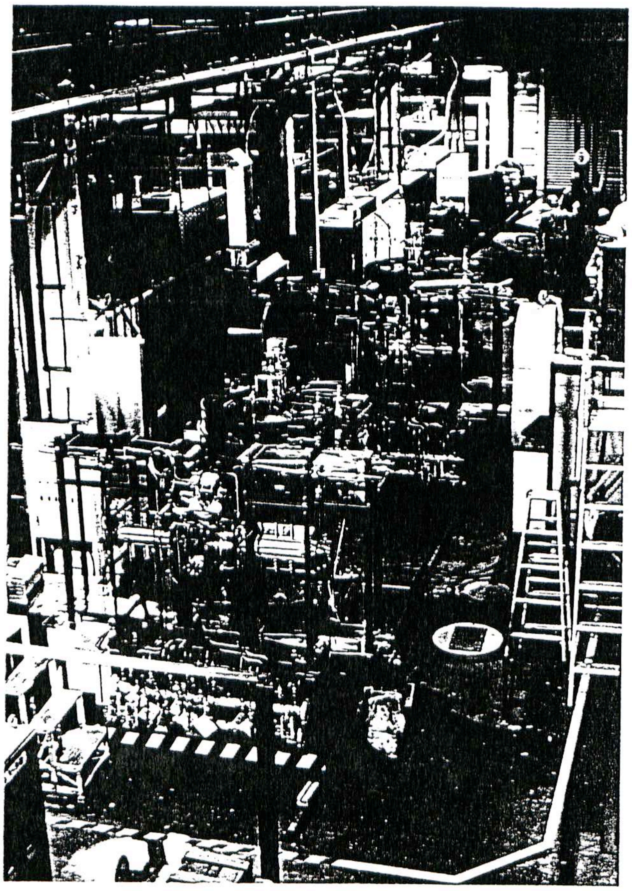
RF Conditioning:

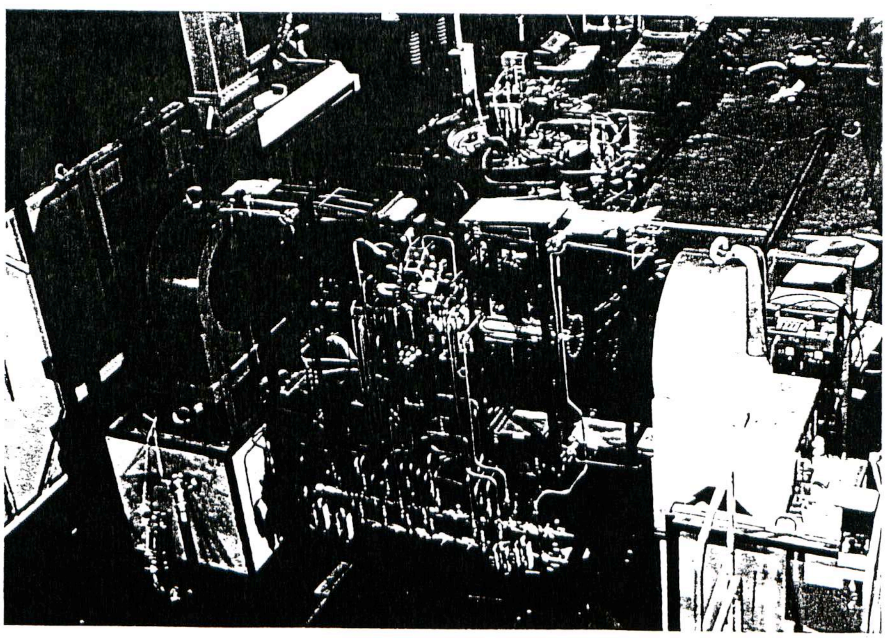
- All cavities RF-conditioned over 180kW in a teststand before installation.

- Auto RF-conditioning engaged, keeping vacuum below ~3E-7 Torr.

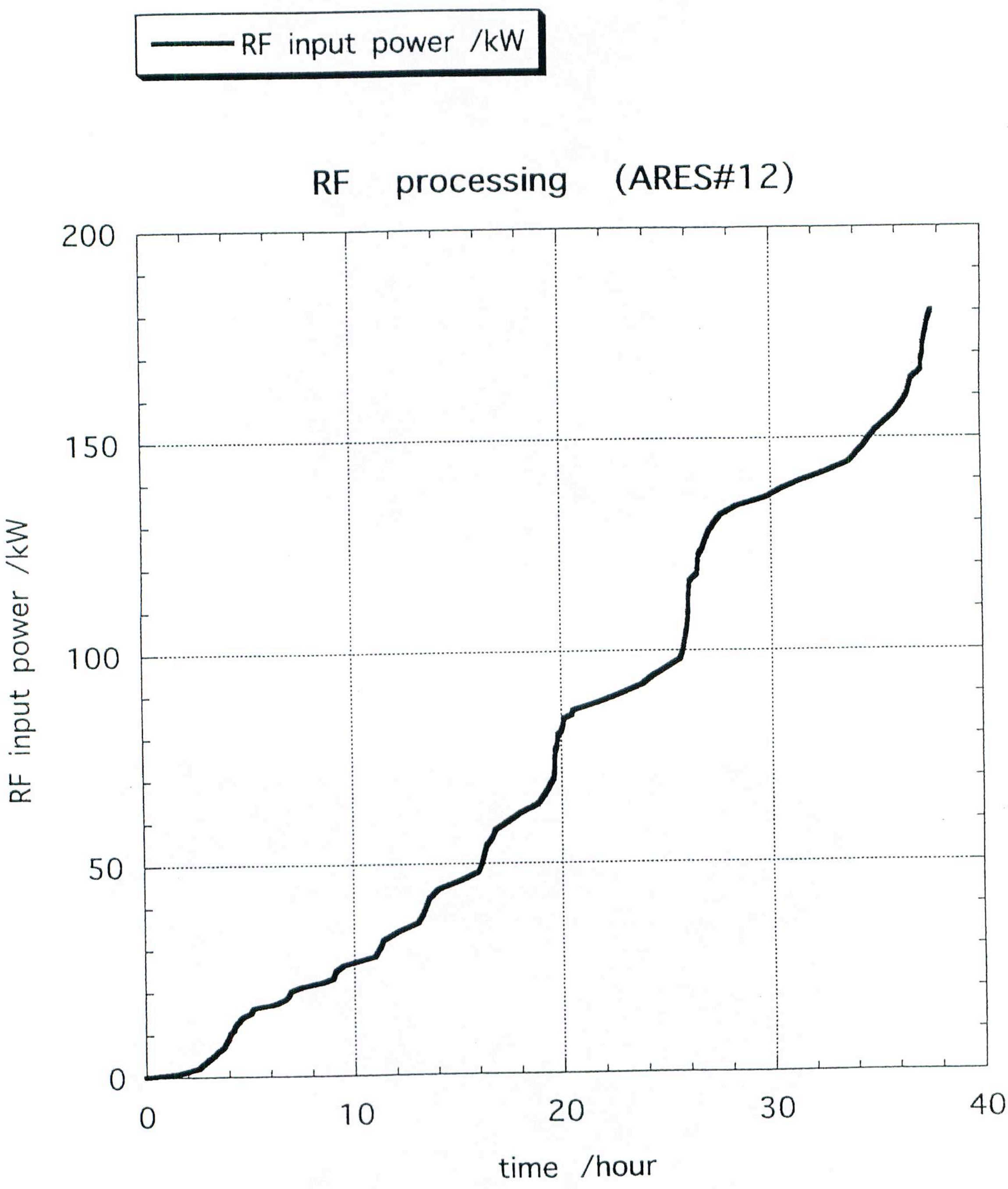
- The input coupler for TRISTAN APS cavity with a cylindrical ceramic window capable of ~300 kW employed for RF-conditioning in the teststand.

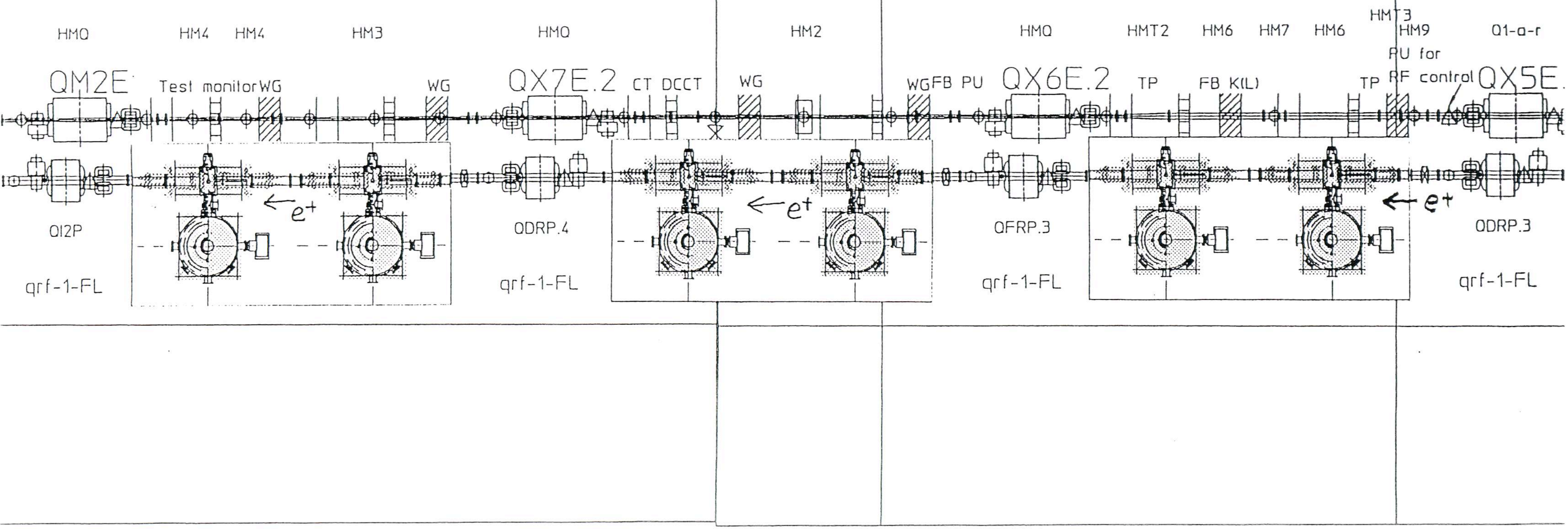
- Each installed cavity equipped with a newly developed input coupler with a ceramic disk window capable of ~800 kW. Auto RF-conditioning of installed cavities carried out keeping vacuum below ~5E-8 Torr.



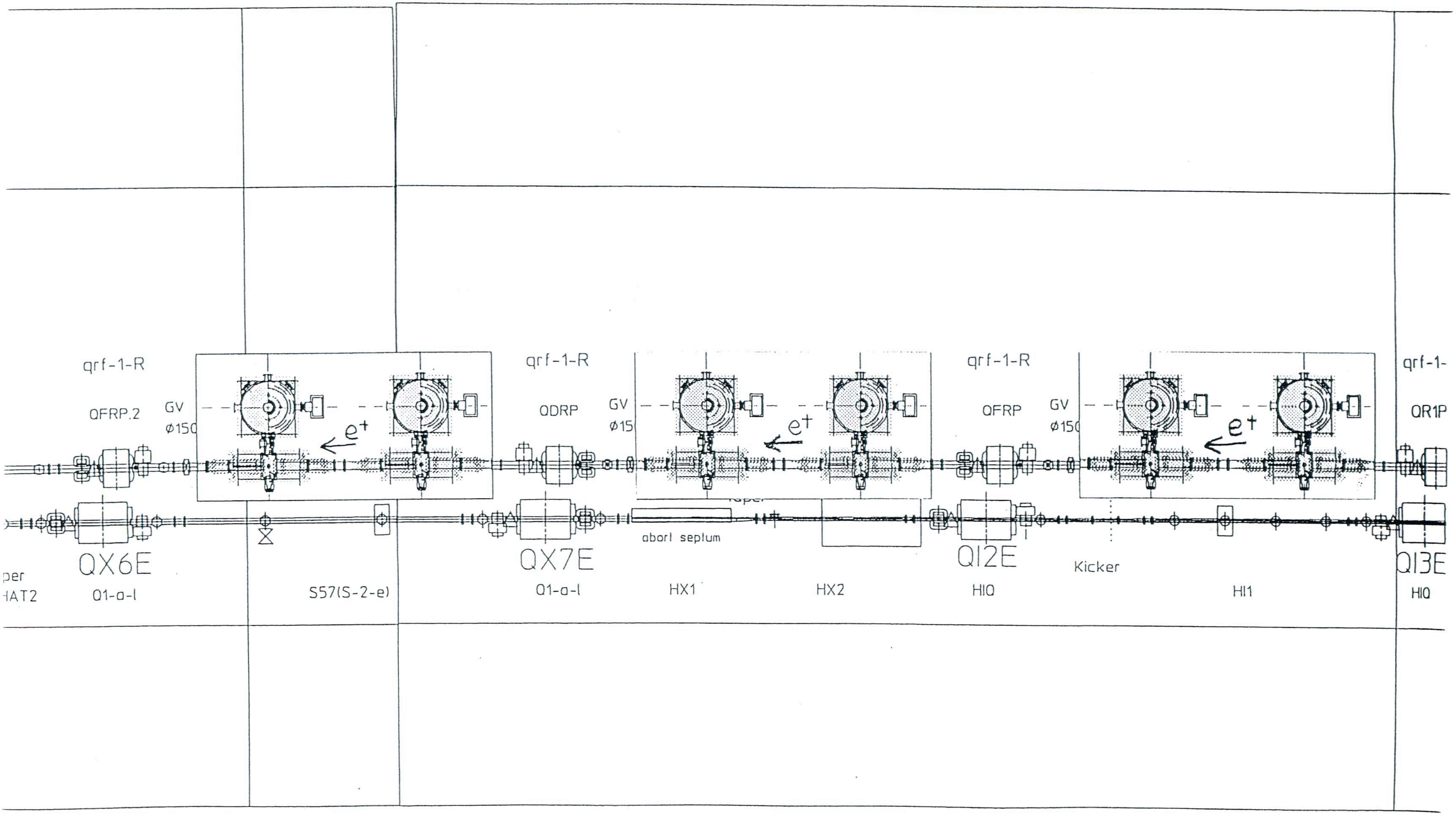


Cavity Teststand

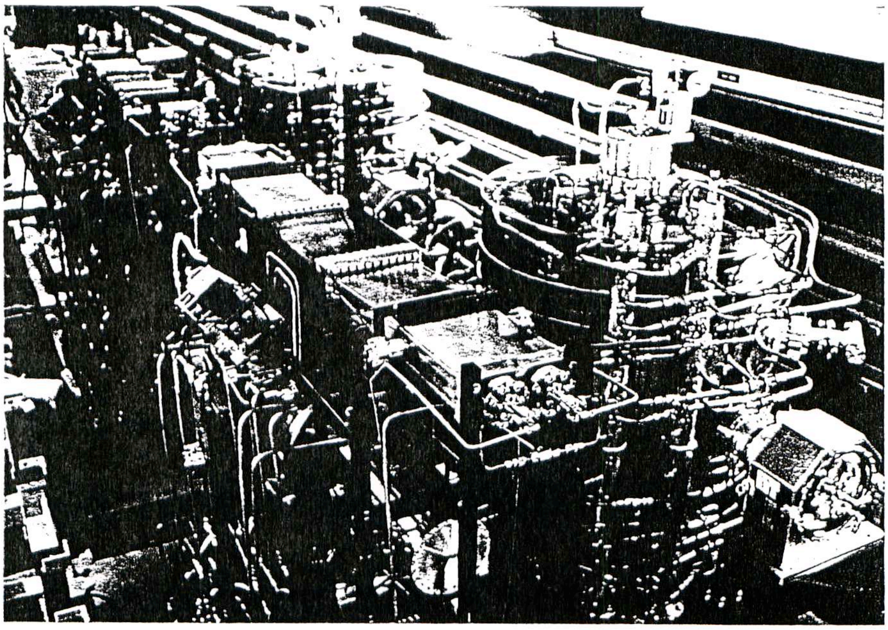

RF input power /kW
RF processing (ARES#12)
200
150
100
50
0
0
10
20
30
40
RF input power /kW
time /hour

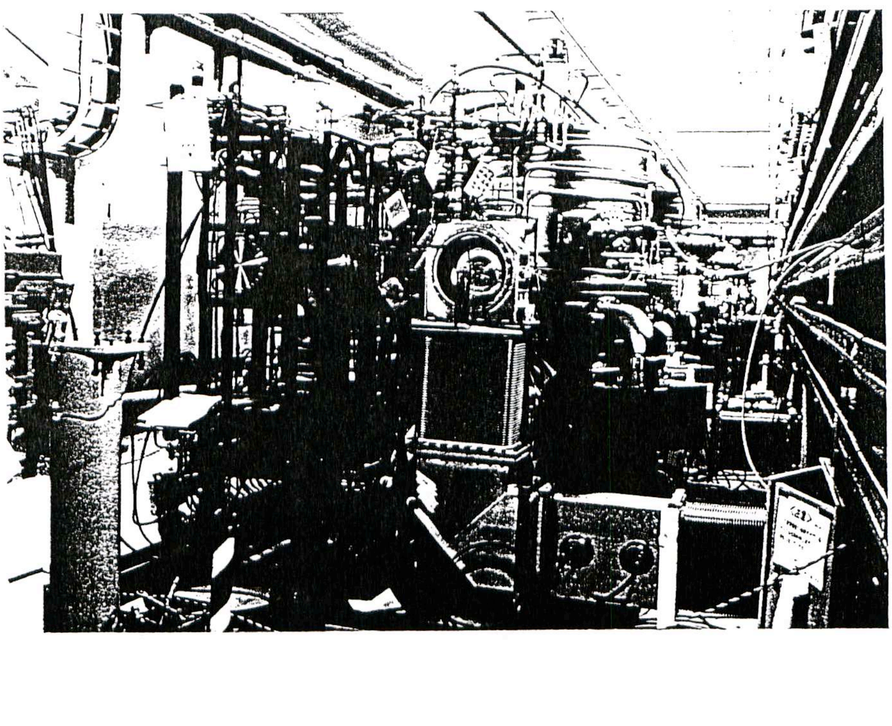


LER Fuji RF Section D7



LER Fuji RF Section D8





ARES Cavities in KEKB Tunnel

Input Coupler:

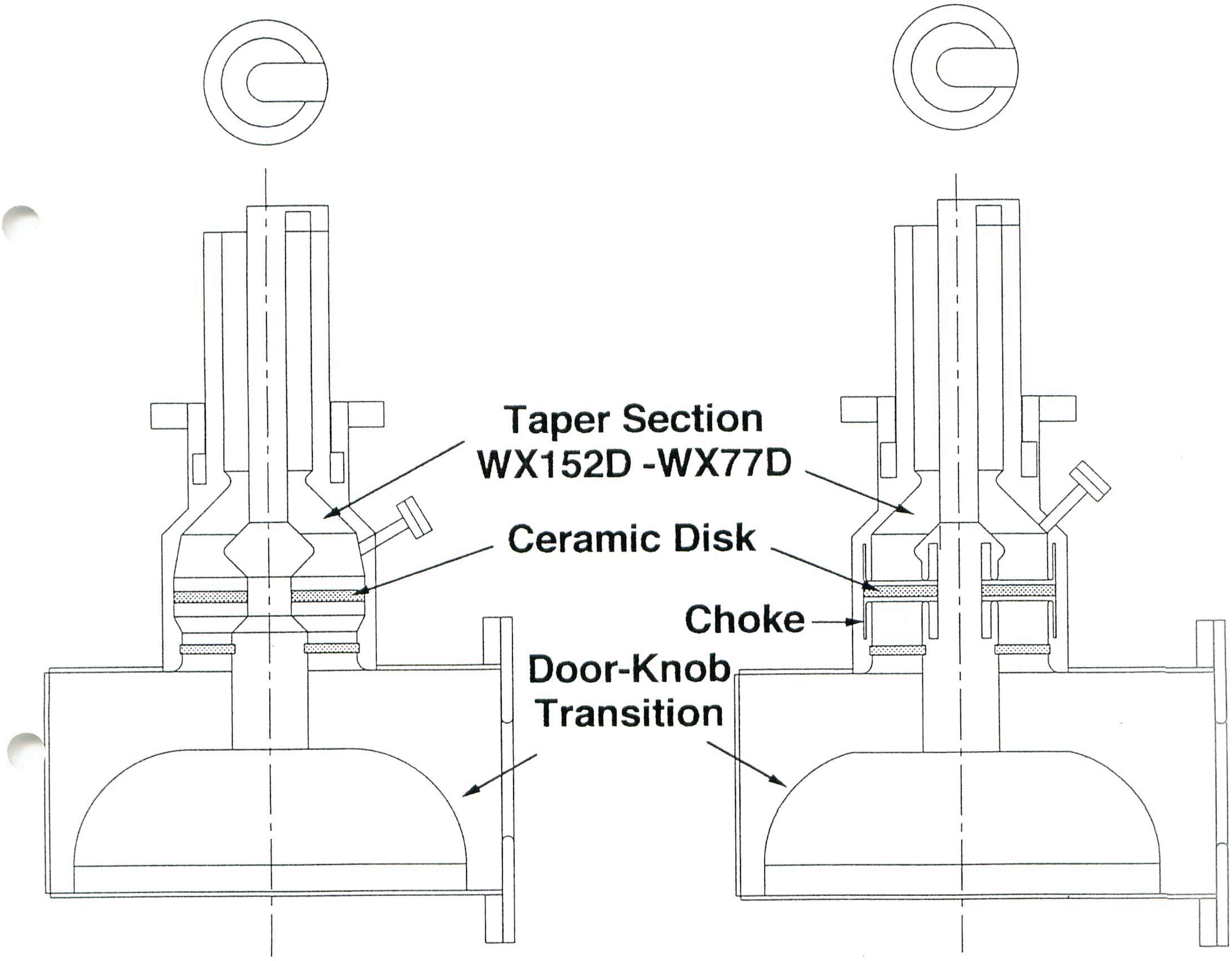
- Door-knob transition with a capacitive iris from the rectangular waveguide WR1500 to the coaxial waveguide WX152D.

- A ceramic disk in the coaxial waveguide (WX152D). Two types of window matching structures CHK (choke type) and OUC (over- and under-cut) developed.

- Both types successfully tested over ~800kW.

- All input couplers RF-conditioned up to ~800kW in another teststand before installation.

- The cylindrical window type capable of RF power of ~300kW is durable under poor vacuum environment while the disk window type should be carefully conditioned under good vacuum to fully utilize its capability over ~800kW.



Type OUC
over- and under-cut

Type CHK
choke

HOM loads:

- Bullet-shape sintered SiC ceramic absorber

  Two absorbers (ϕ 55mm x 400mm) per HOM waveguide.

  Power capability tested up to 3.3 kW (CW) per absorber.

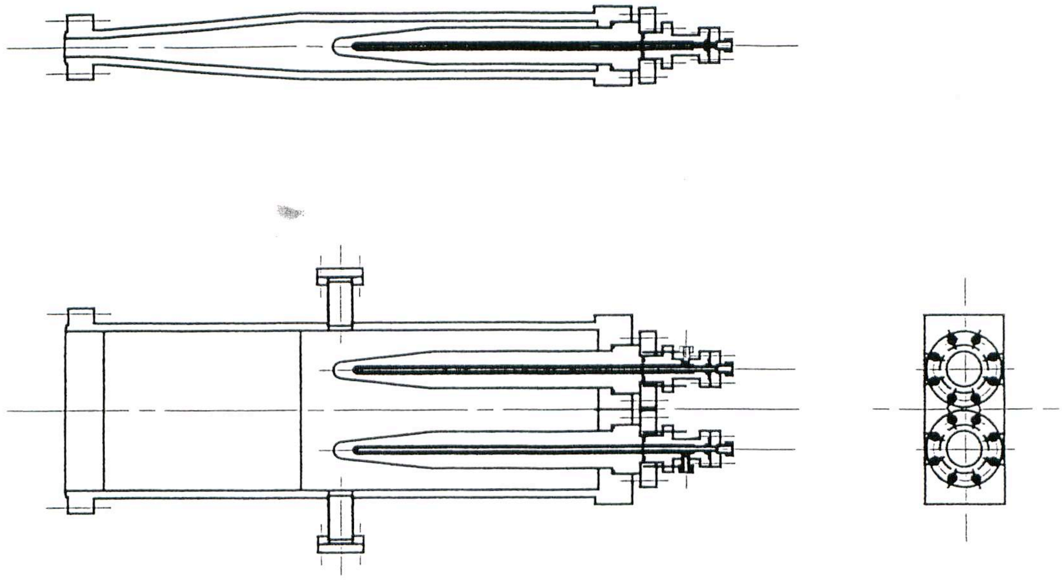
- SiC ceramic tiles for GBP HOM load

  Eight tiles (48 x 48 x 20 or 10 mm^3) per groove.

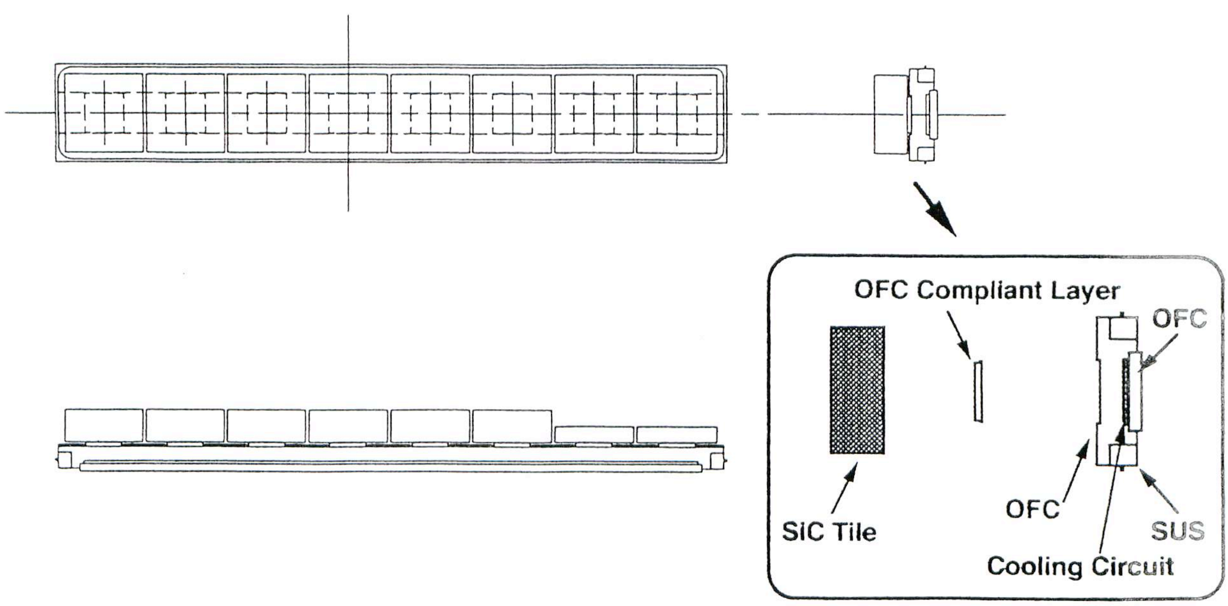
  Power capability tested up to 0.5 kW (CW) per groove.

- Total HOM power dissipated in 8 bullet-shape SiC absorbers per ARES cavity ~100W for 200mA of beam current (every 10 buckets filled) in LER, while no significant HOM power dissipation observed for GBP HOM loads.

Bullet-shape sintered SiC Ceramic Absorber



SiC Ceramic Tiles for GBP HOM Load



Conclusion:

- Although the present cavity voltage ~0.33 MV,
  66% of the design value of 0.5 MV,
  all installed ARES cavities function well.

- Environmental EM noise triggering arc detectors
  should be reduced.

- The input coupling factor to be readjusted
  from the maximum value of 3.3 at present
  to the design value of 2.7 for both LER and HER,
  reducing the reflection RF power from the cavity
  without beam.

- +14 ARES cavities to be installed in the summer of 1999,
  where (12 at present) + 8 (= 20 in total) in LER
  and (6 at present) + 6 (= 12 in total) in HER.
  The second stage of cavity produciton in progress.