KEK M2 Structure Test at ASTA

Test Setup
- 2 combined klystrons using SLED-II 150ns delay lines at 60 pps.
- RF system conditioned to >300 MW before installing structure.
- No gun but downstream faraday cup to measure dark current.
- Primary interlock was RF reflected arc detector (5MW, next pulse).
- Vacuum pumping poor and most sensitive at input end. [sl]

Conditioning Summary
- Over 560 hours of high voltage running time.
- Over 440 hours of active processing (~78%). [s2]
- Majority of processing done with automated computer system. [s3]
- stopped testing due to schedule and processing progress. [s4]

High Gradient Performance
- Only a few arcs and <25 hours to reach 50 MV/m avg. gradient.
- 75 MV/m avg. gradient without any arcs for -1 hour.
- 85 MV/m peak avg. gradient -10 seconds.
- Dark current an order of magnitude less than DSI (1995). [s5]

Permanent Effects Due To Processing
- Estimated over 3090 arcs at >50 MV/m.
- Noticeable damage to irises at input of structure. [s6]
- Input VSWR comparable but bead-pull shows >2 MHz shift at input end and 30 deg. accumulated phase error! [s7–9]

R. Loewen
ISG3 1/27/99
KEK M2 RF Processing History

Power (MW)

Time (hrs)

Avg Gradient Levels (MV/m)

- Kly Out (MW)
- Acc In (MW)
- Envelope

85 MV/m
NOTES

Read TS08 Summary Interlock from TS06.

Klystron output & structure input power read from peak power analyzer. Structure vacuum read from ion pump controller (through DVM). Drive is signal generator output level.

Keep last power reading to compare. Lower output from signal generator. Set a minimum level for safe turn-on. Reset RF interlock directly.

Set a max allowable level as well as criteria for derivative (time under a set level). Output threshold and derivative charts.

Check gain to stay in allowed range.

If above prescribed power threshold, lower output from signal generator. Run Autotune SLED.

Set a maximum output power on signal generator that saturates both TWTs. Keep constant step increase but possible variable time delay between steps. Increase output from signal generator.
Processing Time Required
For Desired Gradient

KEK M2 Structure Test 9/98

\[ Y = A \cdot e^{B \cdot x} \]

- \( A = 0.33 \)
- \( B = 0.085 \)

Exponential Fit

Reachable Avg. Gradient (MV/m)

Processing Time (hrs)
M2 should measure less than DS1:
1) Shorter: 1.3m vs 1.8m
2) a/lambda smaller (fill time ~equal)
3) cutoff hole smaller
4) cleaner manufacturing (impact?)
M2 E Field from Bead-Pull
Before High Power Test

Tuned at 11.420 GHz
M2 E Field from Bead-Pull
After High Power Test

Tuned at 11.420 GHz
M2 Accumulated Phase Advance Error

![Graph showing accumulated phase advance error over cells from input.](image-url)
DS1 E Field from Bead-Pull
After First High Power Test

Tuned at 11.424 GHz
DS1 Accumulated Phase Advance Error

Accumulated Phase Error (deg)

Cells (from input)
1.8m Section Breakdown Study 5/95: 330 events

Breakdown During Pulse (PW=1 50ns)

Breakdown AT (Rfl - Fwd)

Breakdown In Cell Number

---

Events

ns

0 15 30 45 60 75 90 105 120 135 150

Events

At (ns)

-100 -80 -60 -40 -20 0 20 40 60 80 100

Events

cell number

0 20 40 60 80 100 120 140 160 180 200

3.75 ns bins

5 ns bins

5 cell bins