PPM Klystron Update

MAC Meeting
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Klystron Overview

• TRC Requirement:
  – No R1 Requirement (KEK PPM-2 Klystron is Existence Proof)
  – R2 Requirement
    • Fully-Tested at Full Repetition Rate
    • Tested as Part of Linac Sub-Unit Test

• JLC/NLC Requirement
  – Conventional Solenoids Would Require 100 MW So Must be Permanent-Magnet-Focussed Tube
  – 75 MW for 1.6 µsecs at 120/150 Hz (14.4kW/18kW Average Power)
  – Efficiency as High as Feasible (55% or Better)

• Tubes to Date:
  – Four at KEK/Toshiba, Five at SLAC, Two Industrial
  – Built Over a Span of Six Years
  – No “Spec” Tube Yet
KEK Klystron Performance
(R1 Requirement)

Maximum PPM-2
Average Power
73 MW
1.5 µsecs
25 Hz
2.7 kW

Output Power (MW)
Efficiency (%)

Cathode Voltage (kV)
PPM Klystron Performance
Pulse-Width

Output Power (MW)

Joules/Pulse Requirement

Pulsewidth μsecs

PPM Klystron Update
PPM Klystron Performance
Average Power

Average Power (Watts)

Output Power (MW)

Requirement
Current Klystron Status

• KEK/Toshiba tubes
  – PPM-2 at Test at SLAC
  – PPM-4 at Test at KEK (Now at 46 MW 500 ns 50 Hz)
  – PPM-2 and PPM-4 are Effectively Identical

• SLAC Tubes
  – XP3-3 at Test
  – XP3-4 to Begin Test in October
  – XP4 to Begin Test in January, 2004
  – XP3-3 is a Rebuild of XP3-1 with Clamp-On Magnets, Fix for 11.7 GHz Oscillation, and Better Focussing
  – XP3-4 and XP4 Will Have Integral Polepiece Bodies and Will be Nearly Identical
Current Problems

• KEK PPM-2 is Processing Very Slowly
  – Both RF Windows are Protected
    • Visible Light and Gas Sensing/Interlocks
    • Window Areas are Limiting the Processing
      – Window, Waveguide, Pumping, Load Issues
  – Tube is Processing at Best at One-Third SLAC-Tube Rate
  – Tube Now at 60 MW at One µsec at 60 Hz
    • Repetition Rate Seems Not to Be a Factor
    • No Other Problems on Tube Yet Observed

• XP3-3 Has Break-Up/Tearing in Output Power Pulse
  – Peak Power and Pulse-Width Dependant
  – Good News:
    • Output Power Over 75 MW; Tube Runs Trouble-Free at 120 Hz; Focusses Extremely Well; Efficiency is Good (>55%)
XP3-3 Pulse Break-Up

- **Continuous Break-Up**
- **Two Events Per Minute**

**Output Power (MW)**

**Pulse-Width (ns)**
This Seal is Welded on the Outside Diameter. It May Have Opened in "Z" Enough to Allow Electric Fields to Enter and to Cause Arcing. The Arcing Does Not Produce Gas.

This is a Known Problem on the SLAC S-Band Klystrons Powering the Linac.
XP3 Output Window (2 per Tube)
(PPM-2 Drawings Not Available)

- Thin Ceramic Window
  TiN-Coated to Suppress Multipactor

- Transition from Circular to Rectangular
- Transition from Rectangular to Circular
- WR90
- Pumping Manifolds
Plans

• PPM-2
  – Continue to Process After Load System Refurbished
  – If Window Replacement is Required:
    • Replacement Would be Done at Toshiba
    • Window Drawings Already Sent to KEK
    • SLAC Can Build Extra Assemblies

• PPM-4
  – Send to SLAC for Additional Testing When Reach Modulator Limit at KEK (Around 50 Hz)

• XP3-3
  – Re-Test Following Attempt to Compress Weld Area
  – Open Tube if Not Successful
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