EMI test using VXD3 R20 assembly

Nick Sinev, University of Oregon

Outline

- The problem
- Why we want beam test?
- What can we observe and measure ?
- What do we need for test ?
- Conclusion

The problem

- As you already know from M.Breidenbach talk, we had observed Electromagnetic Interference (EMI) effects in VXD3 operation. We could not eliminate such effects, neither we completely understood it's origin, however we could overcome it's consequence on electronics operations by pausing such operations during beam passage. We will not be able to do such trick in ILC, as we need continuous readout during bunch train. So we need to fully understand this potential problem and find the ways to fight it.

Why beam ?

- There were suggestions that we can observe beam electromagnetic interference effects by threading wire in place of beam and generating short electric pulse on it. Here are few examples why we think beam test is better:
  - It is technically very difficult to generate picoseconds scale pulse and maintain it's sharp rise time while passing it through such imperfect transmission line as our beam pipe around IP.
  - We know, that moving charge with relativistic speed leads to compression of it's electric field along speed vector and increase of transverse field (effect causing relativistic rise of energy loss). We can't have such effect with electric pulse on the wire
  - The group speed of mirror charge in the beam pipe exceeds speed of light in the air. It can lead to Cherenkov radiation. We also would not reproduce this effect with electric pulse.

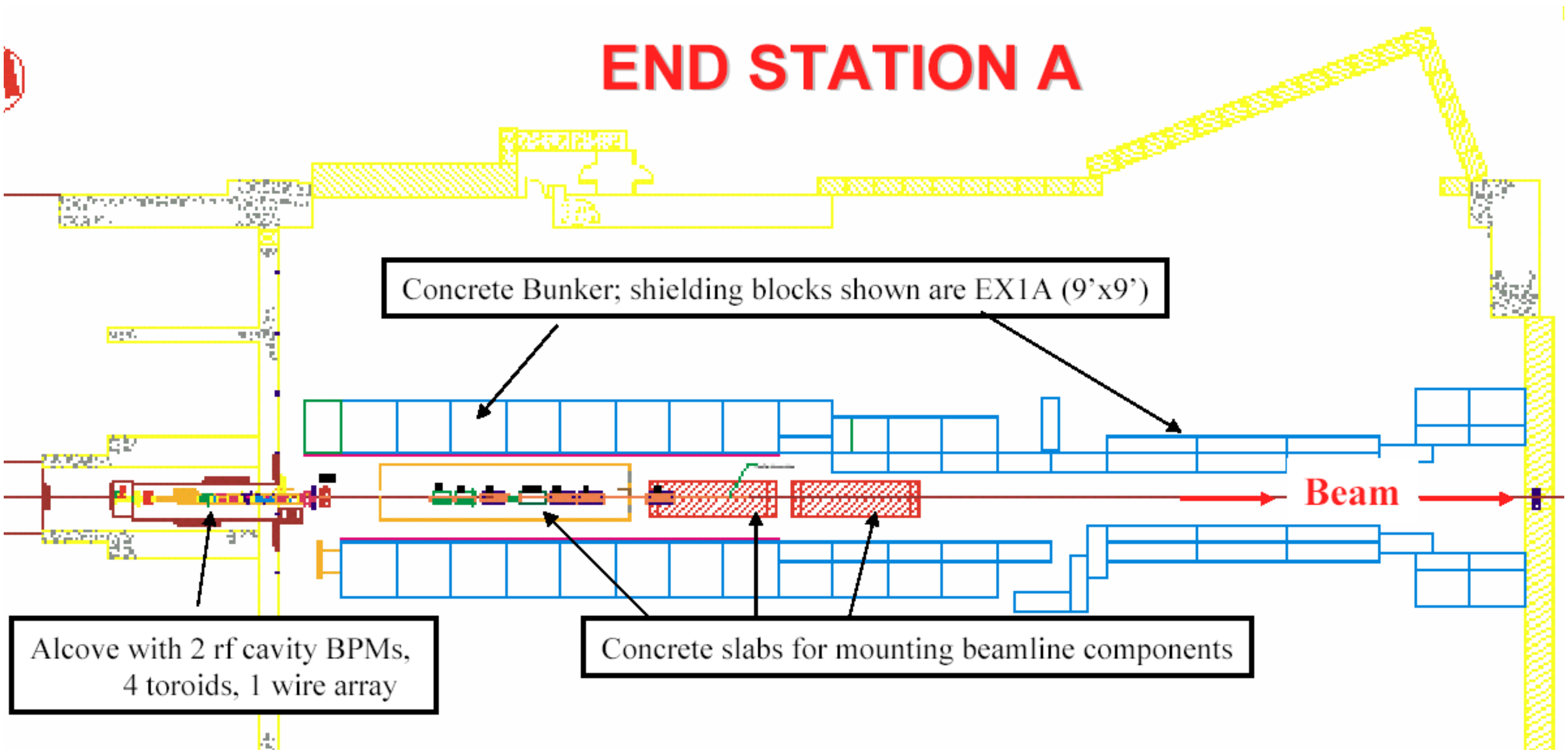
What can we measure

- First, we can try to reproduce failure mode of VXD3 front end electronics. We need to monitor lock signal from PLL. We can put scope probe on the PLL output, or just watch LFM “Link error” red LED.
- We also can put antennas in suspected leak locations and watch signals on them.
- If we are lucky to reproduce failure of VXD3 link, we can try to find out what modification of the shielding / grounding can eliminate such effect. In any case we can measure antennas signal dependence on bunch length and charge and such things as additional beam pipe shielding. And of course we can understand interference signal dependence on the distance from beam pipe. Can it be the problem for another front end electronics, or is it only Vertex Detector concern?

What can we measure - continue

- The measurements with real SLD R20 module will give us confidence, that we can reproduce EMI effect. But the module has too complex geometry for calculations or simulations. So, we may want to try to do comprehensive measurements of EMI with simpler beampipe, in which case we can compare results with calculations and validate our model of EMI effects. From practical point of view we may want to begin measurements with plain beampipe, and use R20 as next step.

Test beam at end station A

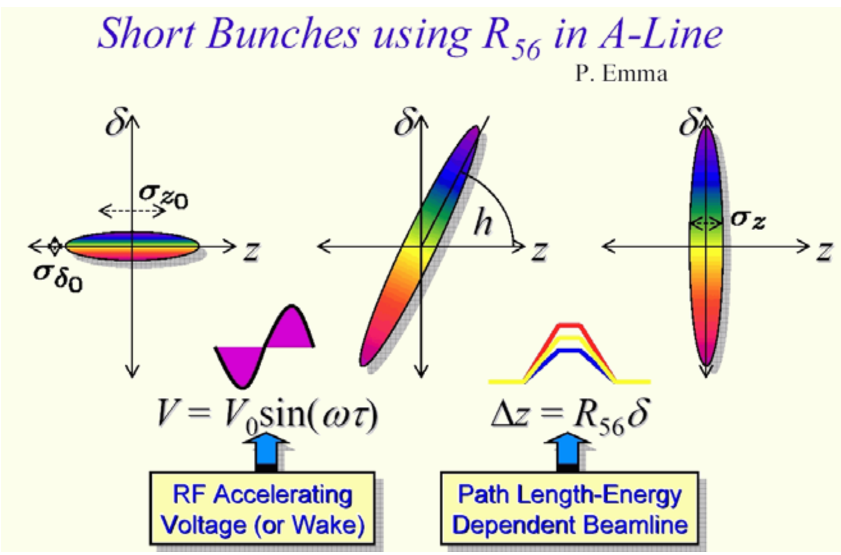


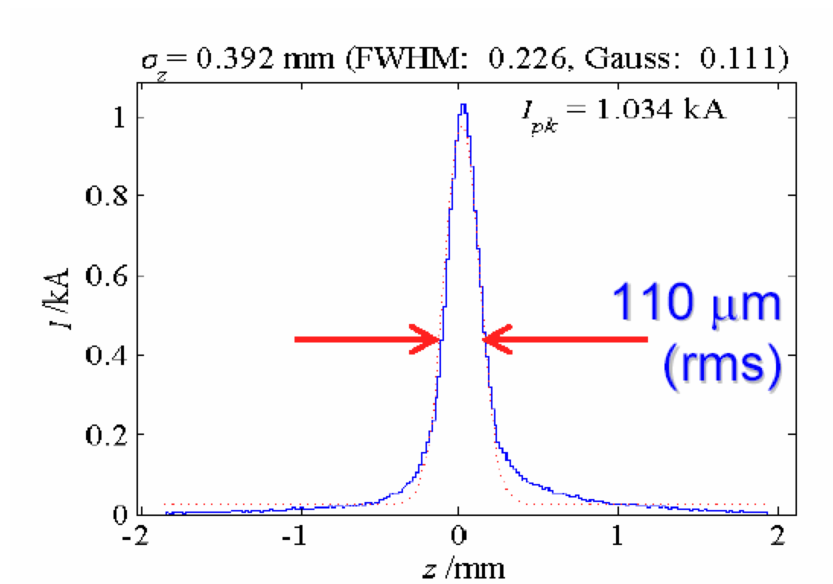
Test beam - parameters

Beam Parameters at SLAC ESA and ILC

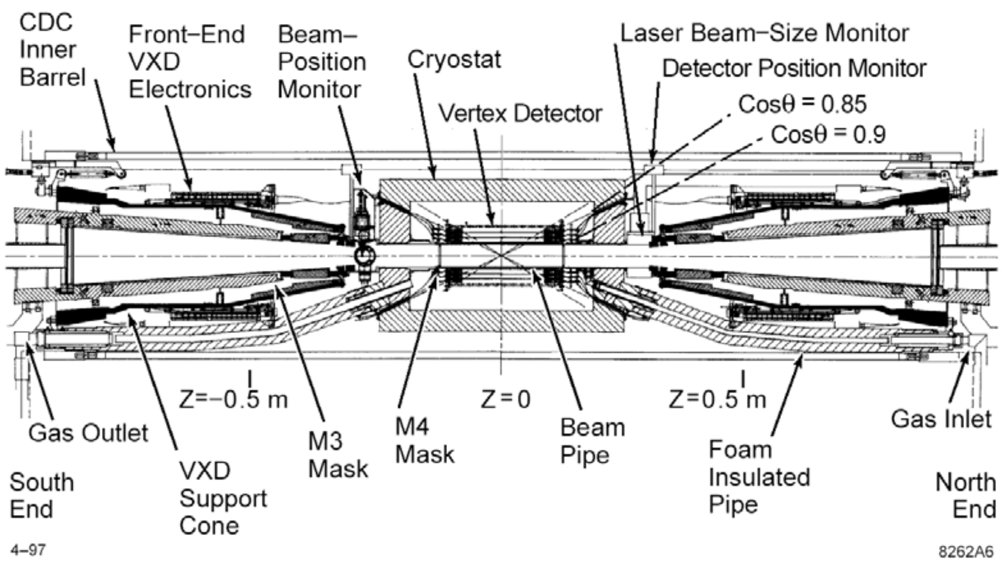
Parameter	SLAC ESA	ILC-500
Repetition Rate	10 Hz	5 Hz
Energy	28.5 GeV	250 GeV
e^- Polarization	(85%)	>80%
Train Length	up to 400 ns	1 ms
Microbunch spacing	20-400 ns	337 ns
Bunches per train	1 or 2	2820
Bunch Charge	2.0×10^{10}	2.0×10^{10}
Energy Spread	0.15%	0.1%

Test beam – short bunches



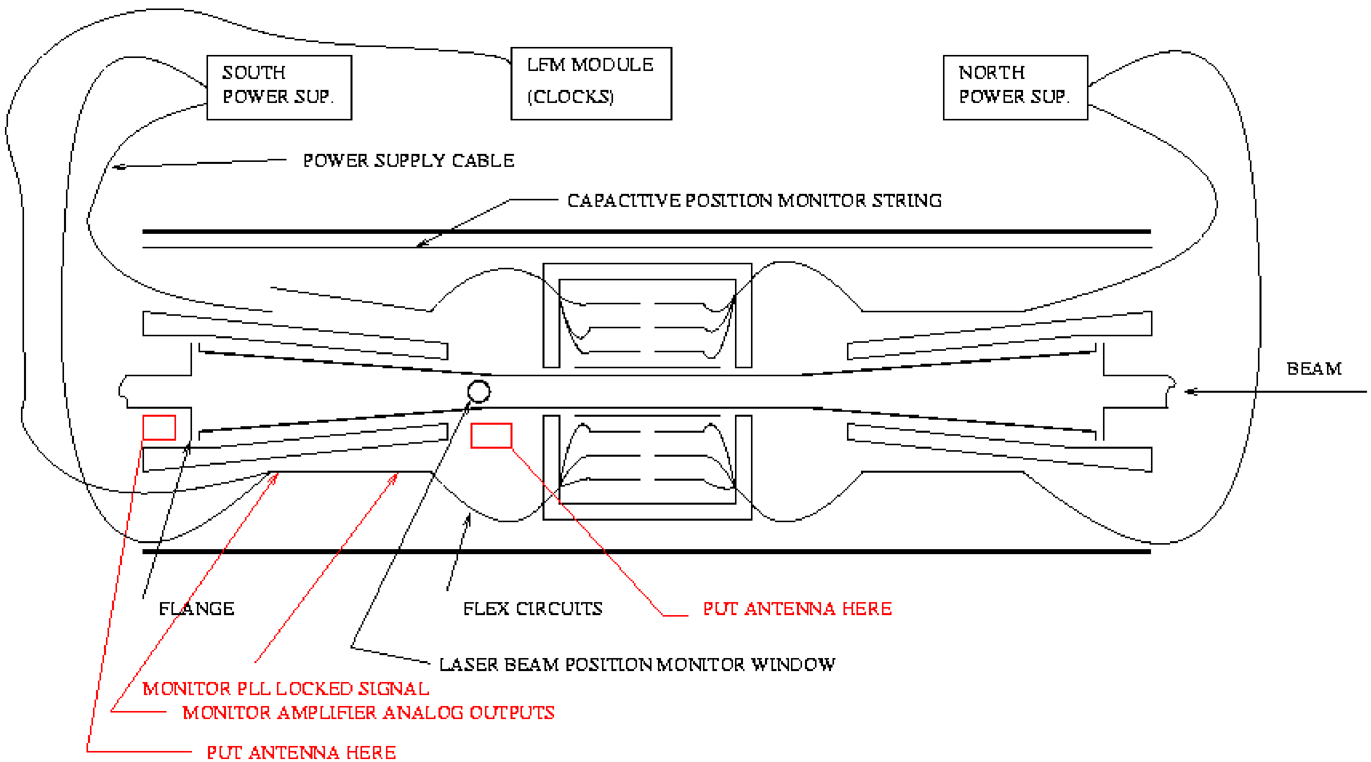


Equipment to use



- R20 module assembly

Equipment - continue



- What can we monitor

Conclusion

- Having example of electronics, suffered from EMI and the ability to put it next to the test beam close in parameters to ILC beam gives us the opportunity to investigate this potential problem in details.
- Measurements of EMI with plain beampipe will help us validate our model of the effects.