# New Undulator Diagnostics

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# Diagnostics List

- Beam loss monitors
  - MPS PEPII monitors to supplement prototype ANL monitors
  - Physics / beam steering: Fiber (PLIC) loss monitor
- Temporary X-ray diagnostic:
  - FEE not expected to be ready for first beam
- X-ray stopper test: B4C damage
- Future X-band TCAV


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# Beam Loss Monitors for MPS

- Sensor
  - Use Cherenkov radiators (fused silica)
  - PMT readout
  - 5 units from ANL,
  - 28 rest from PEPII
- Readout
  - MPS “Link Node”
  - Averaged data also available to control system

# MPS Beam Loss Monitor Status

- 28 PEP II loss monitors installed on girders
- 5 ANL loss monitors expected Nov 17
  - Cables almost ready
- 4 additional monitors on collimators
- Link nodes ready in a few weeks
- Will calibrate loss by inserting OTR foils and Beam Finder Wires.
  - FLUKA / MARS simulations underway.


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# Loss Monitor for Beam Operations

- Fluorescent fiber
  - Operates similar to PLIC cable: signal propagates against beam direction.
  - 2 X 2mm fiber should have good sensitivity.
- Data Acquisition
  - 119 MHz digitizer interfaced to EPICS control system.
  - Same system  used for bunch length monitors – should have synchronous data available


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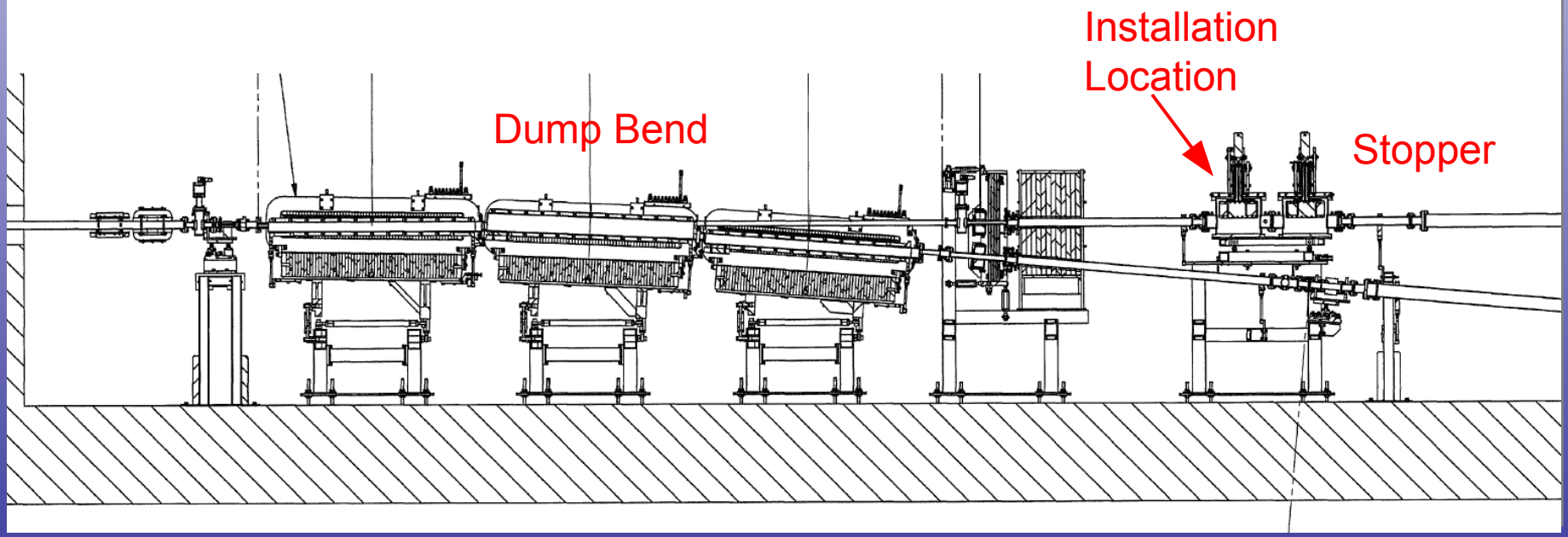
# Temporary X-Ray Diagnostic

- Expect first electron beam through undulator in March 09
- FEE expected ready May 09
- Want a temporary diagnostic to look for lasing during the 2 month “gap”
- X-ray integrated energy not sufficient to detect lasing
  - Spontaneous energy similar to lasing energy
- Need an imaging detector

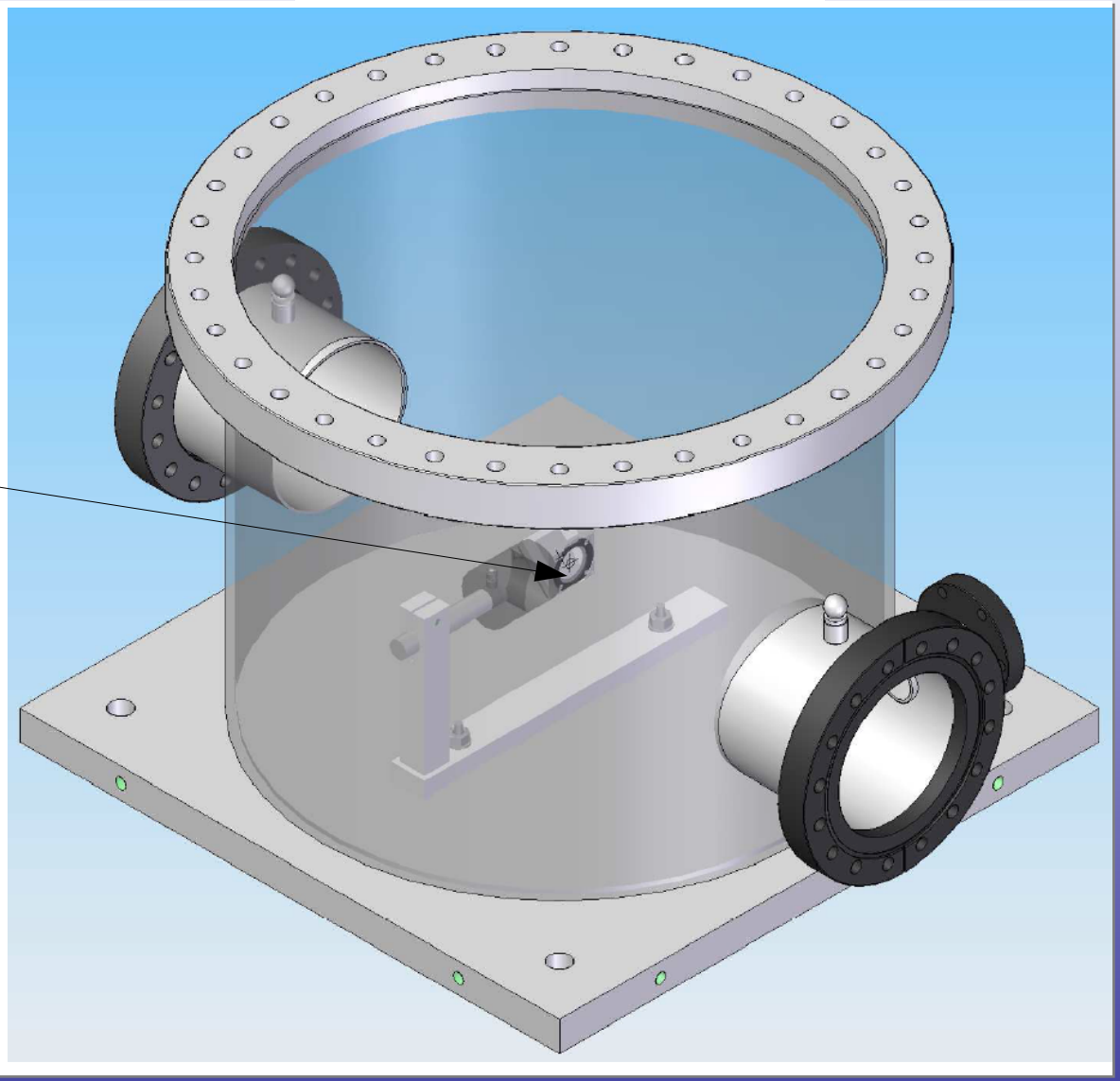
# Installation Location

YAG screen will be located in unused stopper can after beam dump bend

Screen is not remotely controlled: will be removed when FEE is ready



YAG screen with mirror



# YAG Screen Operation

- Spontaneous light will generate a ~ 1cm spot.
- Lasing light will be bright <1mm spot within spontaneous area
- Will use existing camera software to collect images
  - May add special purpose Matlab code to look for lasing
- Full saturation will destroy the YAG:
  - SUCCESS!

# B4C Stopper Material Test

- Need to test safety stopper materials
  - Calculations indicate they will survive maximum power beam, but would like an experiment
- No existing source of high intensity X-rays
- LCLS power likely to increase y over time.
- Install a remotely insertable / removable sample in the same enclosure as the YAG
- Occasionally test during operation.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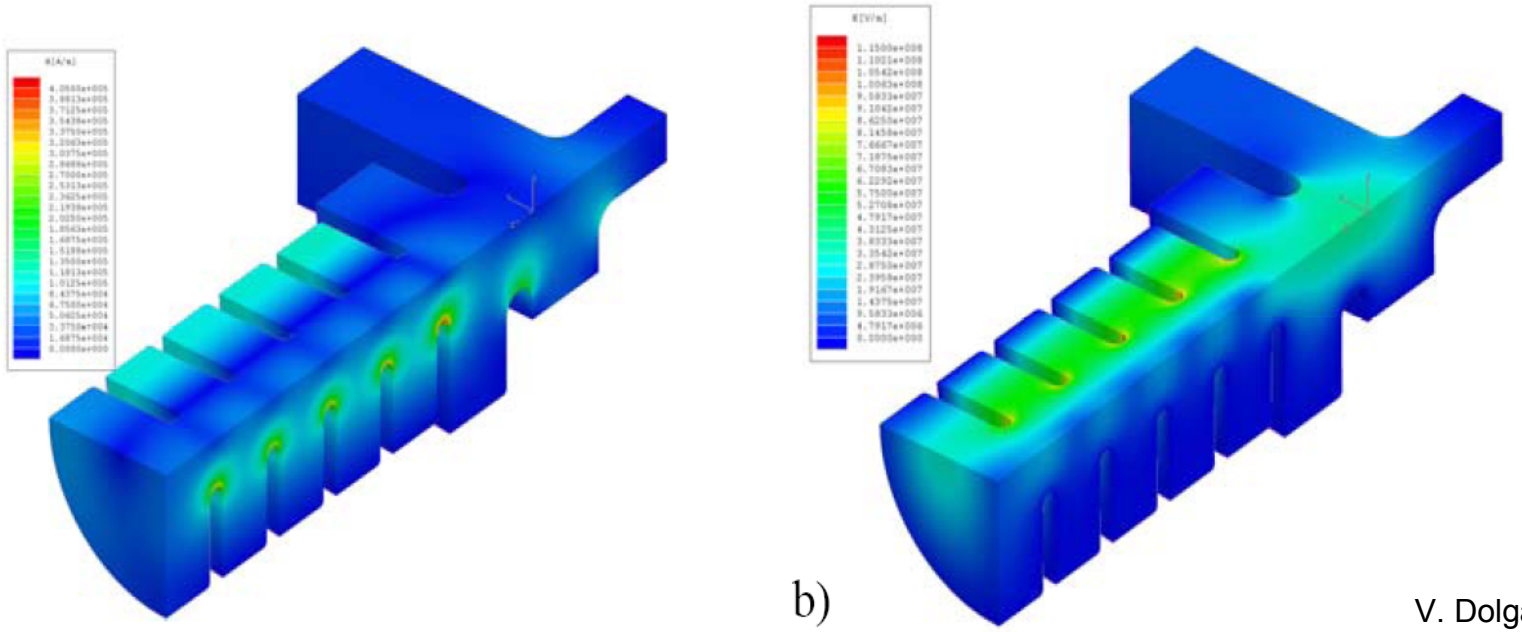
# X-band Transverse Cavity

- Temporal profile measurement AFTER undulator.
- Image on dump OTR should give E vs. T.
  - Potentially can see which part of the electron pulse is lasing (increased energy spread)
- X-band gives 4X temporal resolution of S-band
  - Existing S-band system can resolve 10 micron bunch length

# X-Band Cavity Design




V. Dolgashev

**Figure 2: Finite-element electromagnetic simulation of one quarter of traveling wave x-band deflector input: *a)* surface electric fields; *b)* surface magnetic fields. The fields are calculated for 20 MW of transmitted power, or 21.3 MeV/c kick for an 89-cm structure.**

# X-Band System Block Diagram

- Use existing X-band klystron
- LLRF system needs good phase control
- Possible future upgrade to more cavities and SLED system for ultra-short bunch measurement.

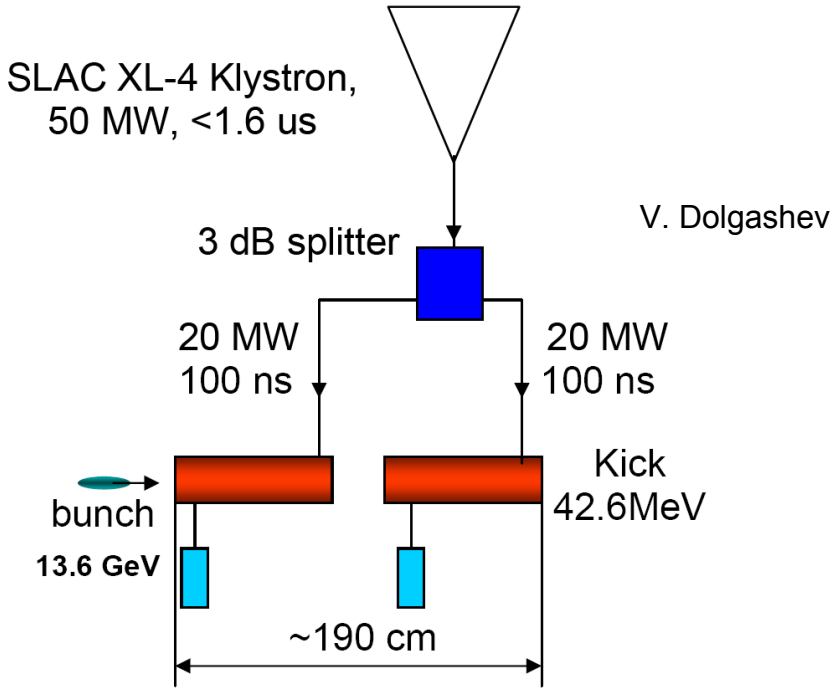
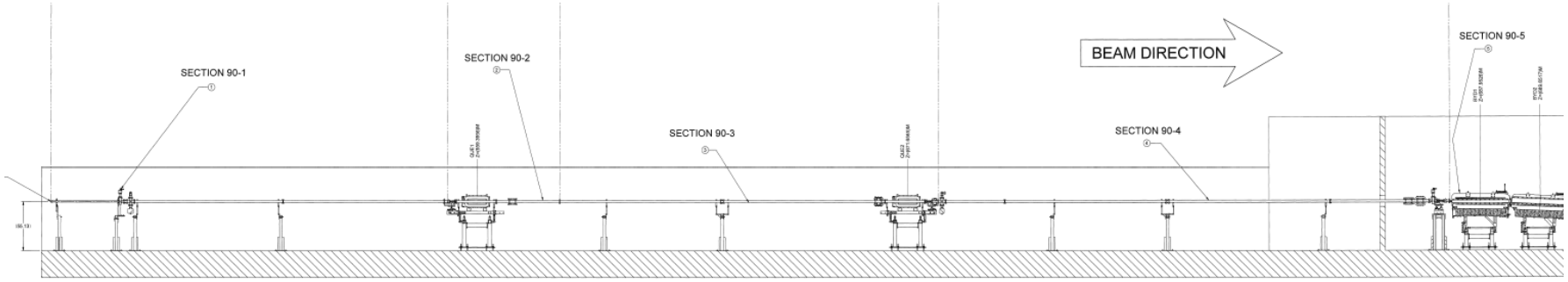



**Figure 1: Schematic of the longitudinal bunch diagnostic instrument based on two traveling wave X-band deflectors.**

# X-Band Cavity Installation Location

- Install in “spare” undulator locations
- Want 90 degree vertical phase advance to dump
- Investigating best location / optics



# Undulator Diagnostics Status

- MPS Beam Loss Monitors:
  - Mostly installed
- Physics / Tuning PLIC fiber:
  - Parts on order, installation quick,
- YAG early lasing diagnostic
  - Parts installed in chamber.
- B4C damage test
  - Insertion device being designed
- XTCAV: Future project