



Detector Interface Issues

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Physics-related Beam Instrumentation

- Beam Polarimeters
- Beam Energy Spectrometers

Forward Detectors

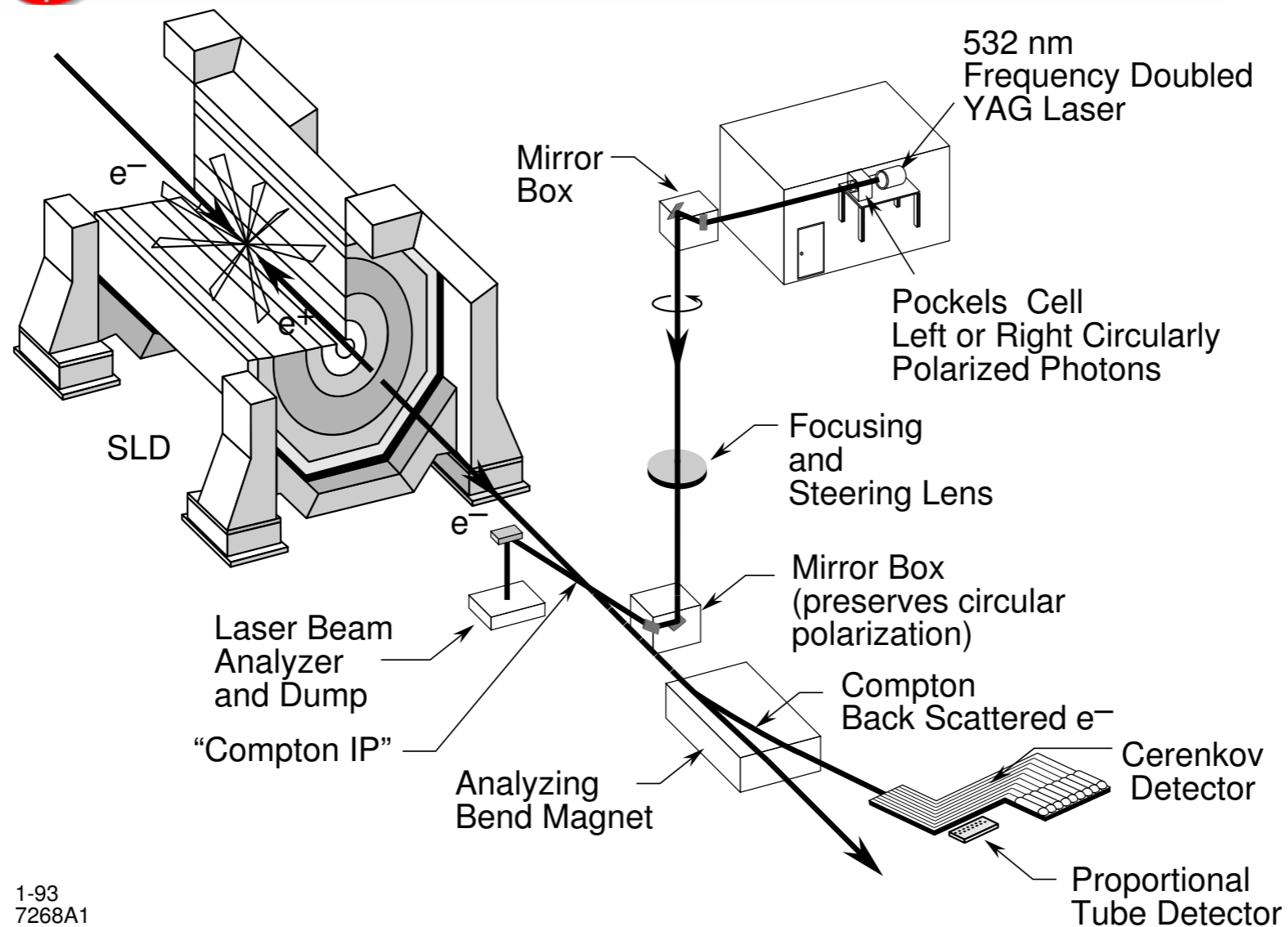
- Traditional Luminosity Monitor
- Pair Monitor
- $\gamma\gamma$ veto counter
- Forward Tracker?

Detector - Machine Data Flow

- Detector -> Machine diagnostic info (slow)
- Detector -> Machine feedback inputs (fast)
- Machine -> Detector information



Polarimeter



1-93
7268A1

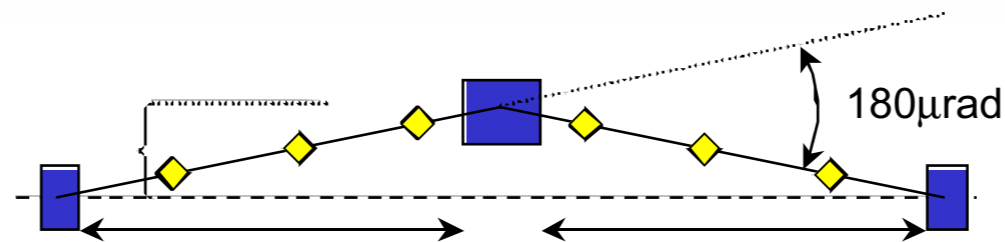
- Gas Cherenkov electron detector ~ 10 channels, dual gain
- Photon calorimeter ~ not read out in collisions
- Laser diagnostics ~ few dozen channels
- Machine diagnostics ~ few dozen channels*

Estimate: 2 x 200 channels at $192 \times 120 = 23$ kHz (save all raw data?)

Also slow monitoring ~ few dozen channels @ 1 Hz

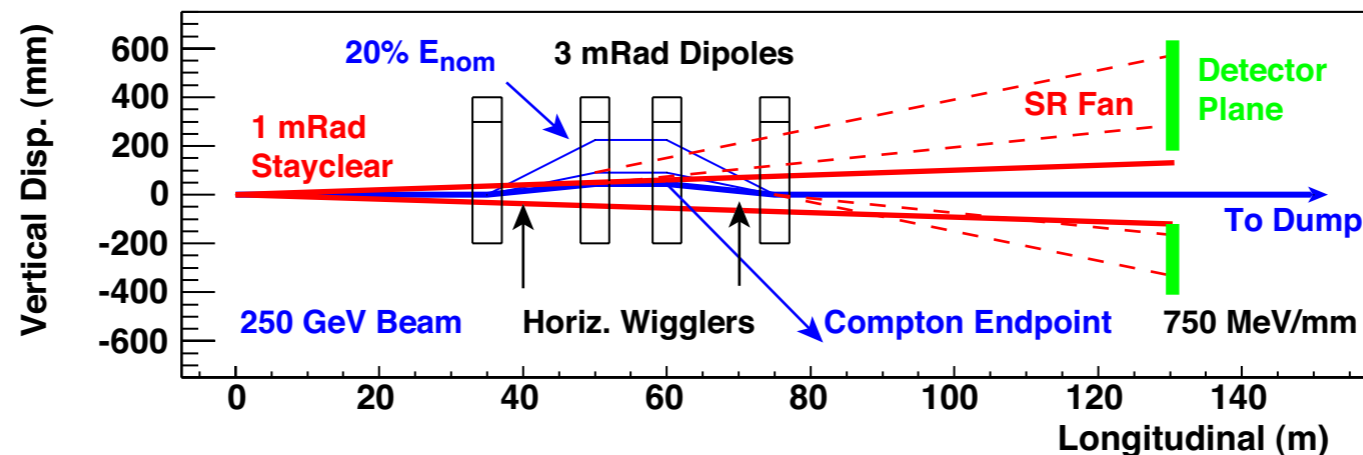


Energy Spectrometer



Chicane + RF BPMs ~ 1 km upstream of IP (x2)

- Dozen BPM channels at crossing rate
- Dozen fast position monitoring channels (ie: interferometer)
- Many many slow monitoring channels (LEP spectrometer had ~100 temperatures alone @ 1 Hz)
- Fast machine input (orbit information, currents, RF status, ...)



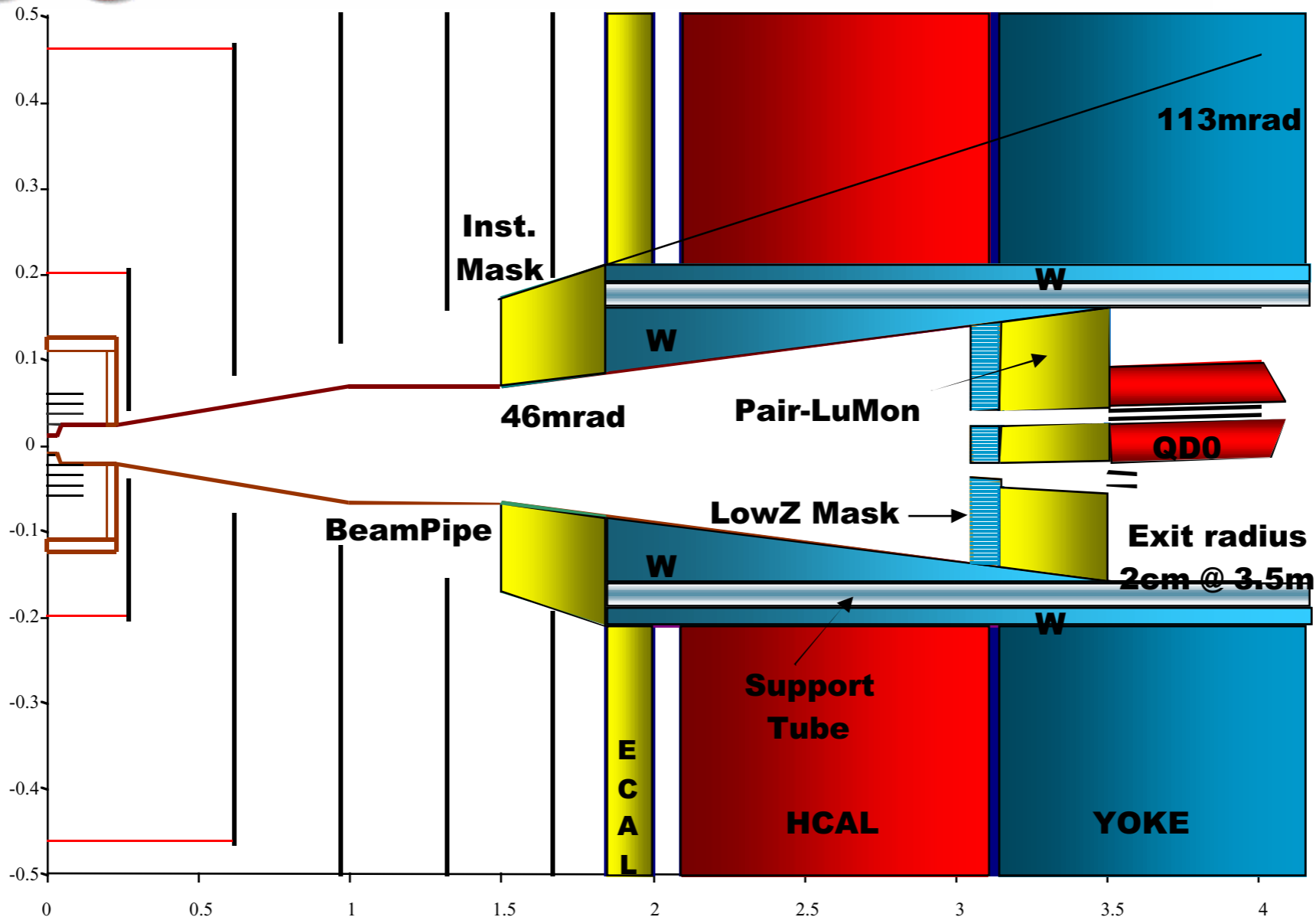
Chicane + position-sensitive SR detector downstream (x2)

- $2 \times 20 \text{ cm} / 100 \mu\text{m} = 4\text{k}$ at crossing rate
- Modest slow monitoring needs
- May not need to save all raw data

Need machine inputs, filtered data useful in real time for feedbacks?



Forward Detectors



Different Functionality

- **Classic luminosity monitor** (outside pair background, 20-100 mRad)
- **Pair monitor** (front surface of pair region, 5 - 20 mRad)
- **$\gamma\gamma$ veto monitor** (find ~ 100 GeV electrons in 50 TeV pair backgrounds)

Could potentially all be the same detector technology



Forward Detectors II



LUMCAL

- Sampling calorimeter, guesstimate 0.3 m^2
- Identical readout to main Ecal?
- 20ish layers, 16 mm^2 pixels \rightarrow 400 k pixels (x2)
- Probably survive with 120 Hz readout + time tag

PAIRMON

- Unique device (3D silicon has been proposed)
- Sample pair distribution for machine diagnostics
Collision parameters, real-time lumi measurement, ...
- Read out as fast as possible (crossing rate ideal)
- $100 \mu\text{m}$ pitch, 6cm radius \rightarrow 1M pixels (x2)
- Processing to provide info for IP feedbacks?

PAIRCAL

Many technologies proposed, numbers from
Zeuthen forward-cal collaboration

- 30 layer diamond-tungsten sampling calorimeter
- 15k channels in total (x2)
- Single crossing & single channel readout mandatory to find single electrons in pair background
- Hardware-based algorithm dangerous...



Machine <-> Detector Data Flow



Machine -> Detector

Need exquisite understanding of beam parameters to control systematics in Lumi, Pol, and Energy

Need machine information “available” to analyses

- IP collision parameters
- Deflection scan results
- Currents, bunch lengths, RF status, orbit information
- Collimator settings, Enom, source settings, ...

Some devices (ie: polarimeter) may need this in near real time to do online data reduction

Detector -> Machine

Need as much diagnostic information as possible to maintain integrated luminosity

Some detector information useful for IP feedbacks?

- PAIRMON integrated and differential rates
- Downstream spectrometer tails
- Background monitoring
- Dithering/feedback for pol and energy?



Putting it all together



Beam Instrumentation historically runs in a semi-autonomous manner from either machine or detector. **I consider this a virtue.**

Good reasons to coordinate with machine BI thinking. Common framework/technology for collecting data from distributed detectors might make everyone's life easier.

Need to think harder about what is useful machine information, but my prejudice is to save **EVERYTHING.**

Similarly, essentially any detector channel should be available to log to the machine DB just as any other machine element.