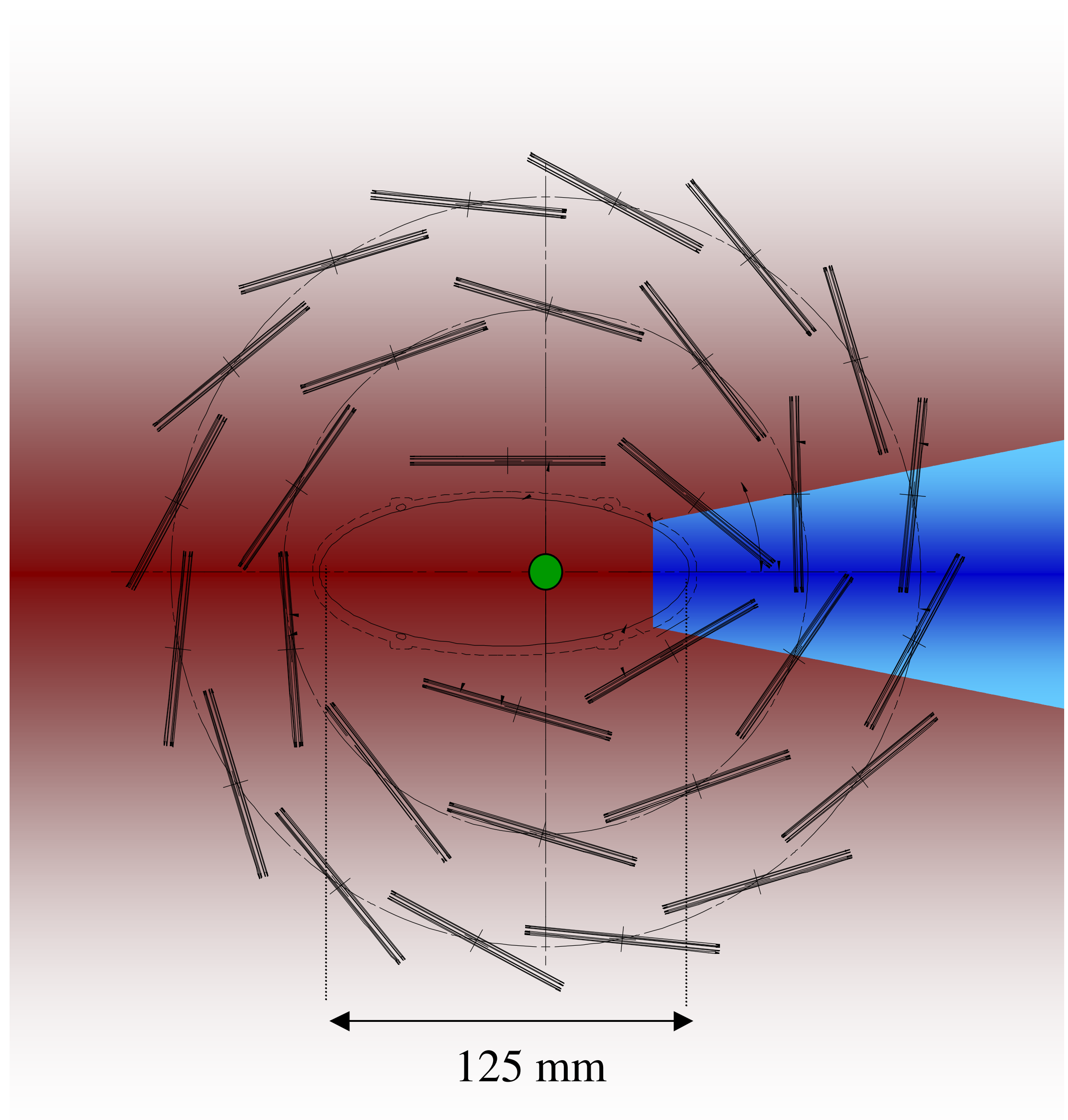
The ZEUS radiation monitor for the new microvertex (MVD)

R.C. 13 Nov 2000

Expected radiation field at MVD

- irradiation from IP negligible
- off-momentum-e^- $\rightarrow \gamma$ and e^- (<20 GeV)
  ⇨ surface- and bulk-damage
- Proton-beam loss
  ⇨ bulk damage
- Synchroton-radiation, backscattered from collimators (<1MeV γ) complex pattern
  ⇨ surface damage



Tolerable dose in MVD

- Expected ~ 5 Krad/year (present situation before upgrade)
  - 500 μ rad/s
- Detector and F/E electronics tested to 300 krad.
  - Possible to operate but with degradation of the performances (the S/N decreases)
  - Max tolerable dose 10-30 Krad/yr
    - 1-3 mrad/s

Demands for the MVD radiation monitor system

- monitor radiation at the position of the MVD in order to avoid radiation damage of MVD silicon sensors:
  - trigger fast e^- beam dump. We are considering 2 options:
    1. trigger on dose rate (100 times higher than tolerable, 0.1÷ 0.3 rad/s) ⇒ discriminator with programmable threshold.
    2. trigger on integrated dose (1 ÷ 5 rad), dump time proportional to the dose rate. ⇒ leacky bucket mechanism.
  - online dose-rate information with warning message if dose-rate exceeds maximum tolerable dose-rate
  - measure integrated dose over lifetime of MVD system
  - provide post mortem record of data causing the dump

Proposal for radiation monitor system

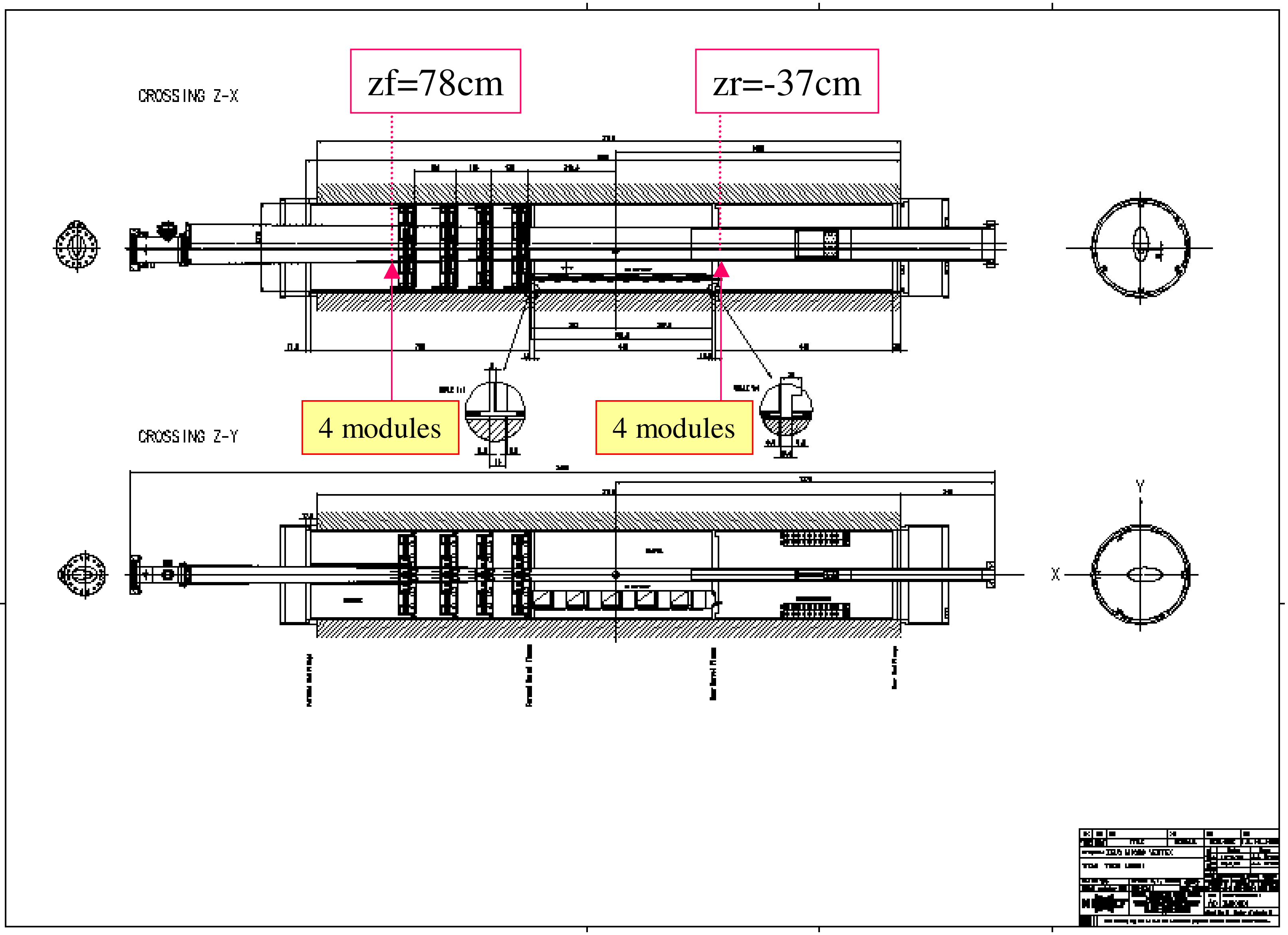
Silicon PIN diodes (1 cm^2) inside MVD, front-end electronics outside

- charge amplifier, shaper and integrator (≈ 100μs integration time)
  - ⇒medium and high dose rates for automatic beam dump and online monitoring
- leakage current measurement (+ temperature monitoring)
  - ⇒long term dose monitoring

TLD dosimeters

- control measurement of integrated dose
- calibration of online dose measurement
- accessible during monthly shutdown

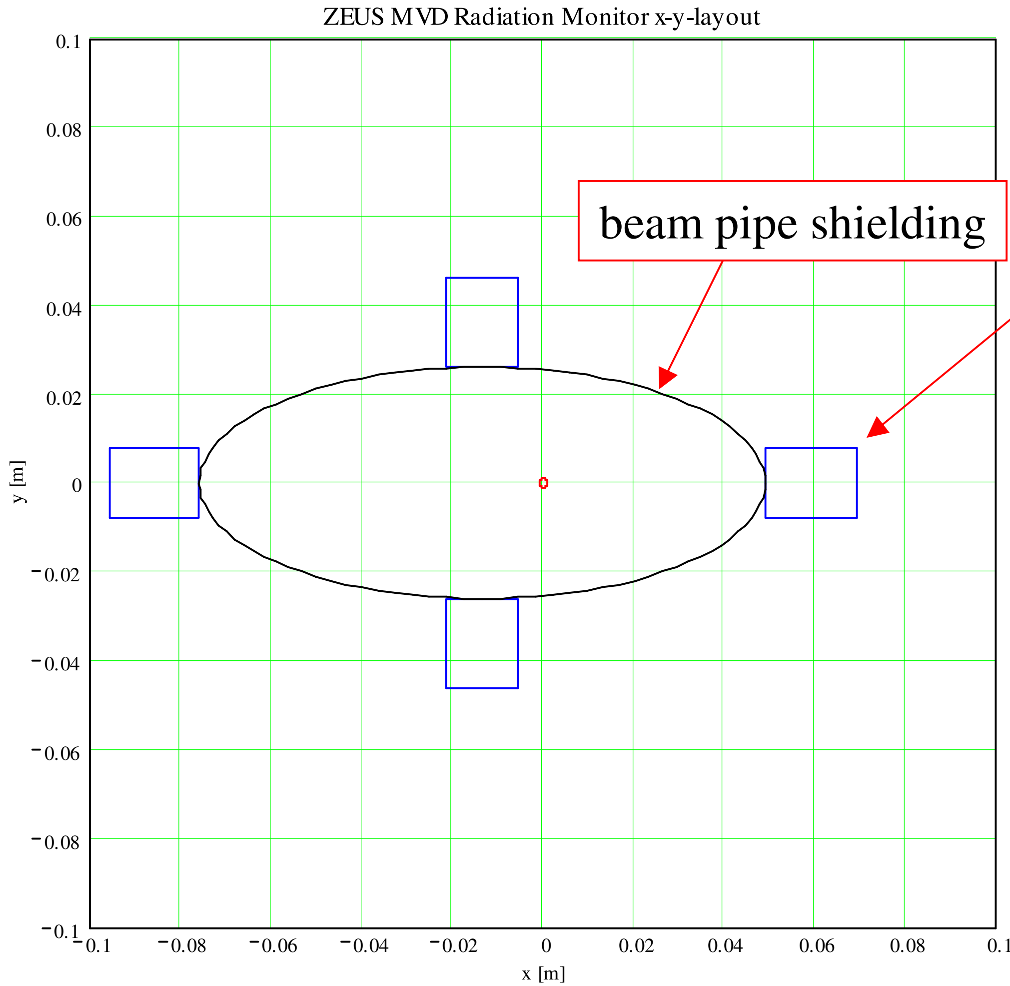
z-Position of MVD radmon modules



xy-Position of MVD radmon modules

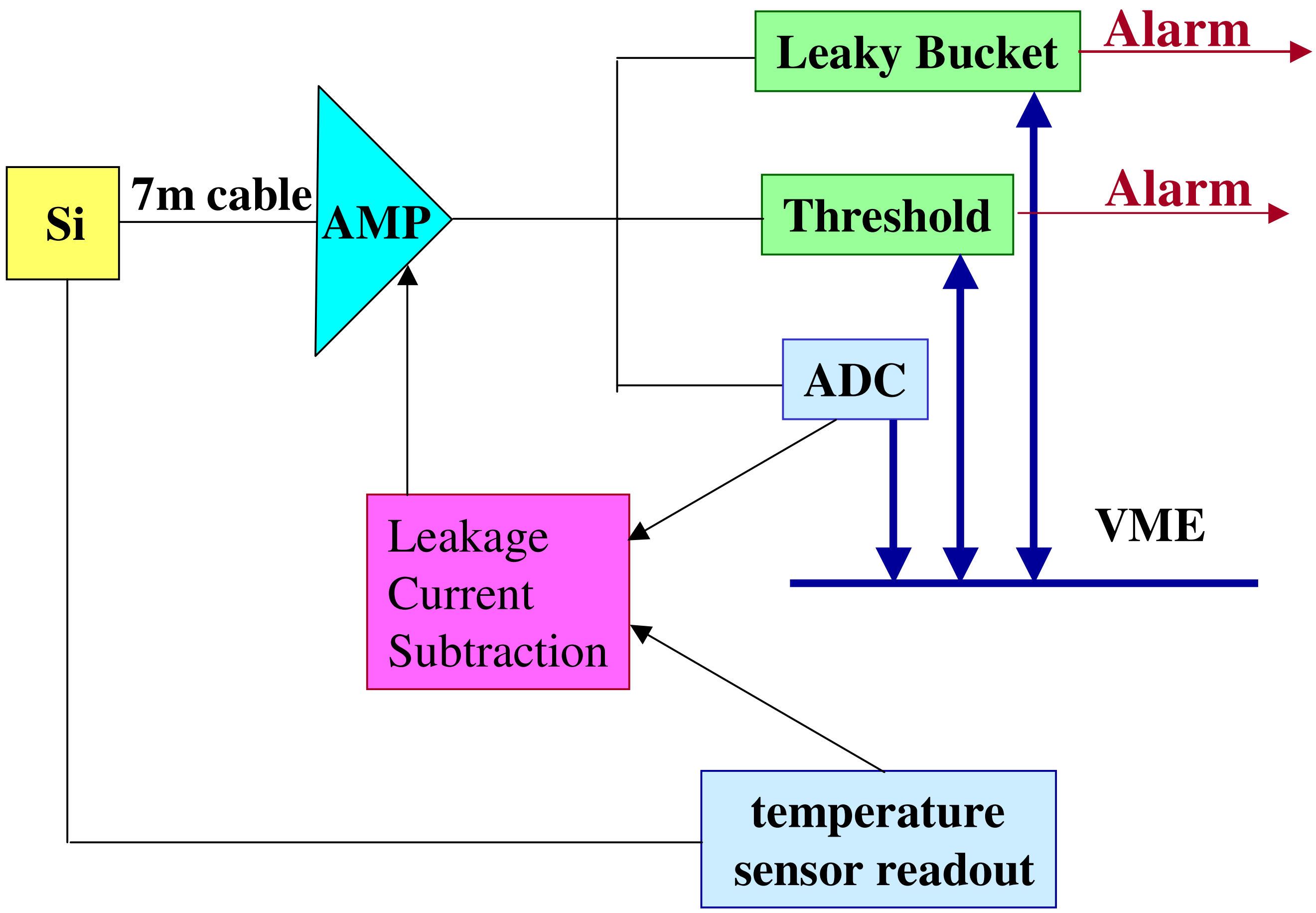
z := zf

modh := 20mm
modw := 16mm

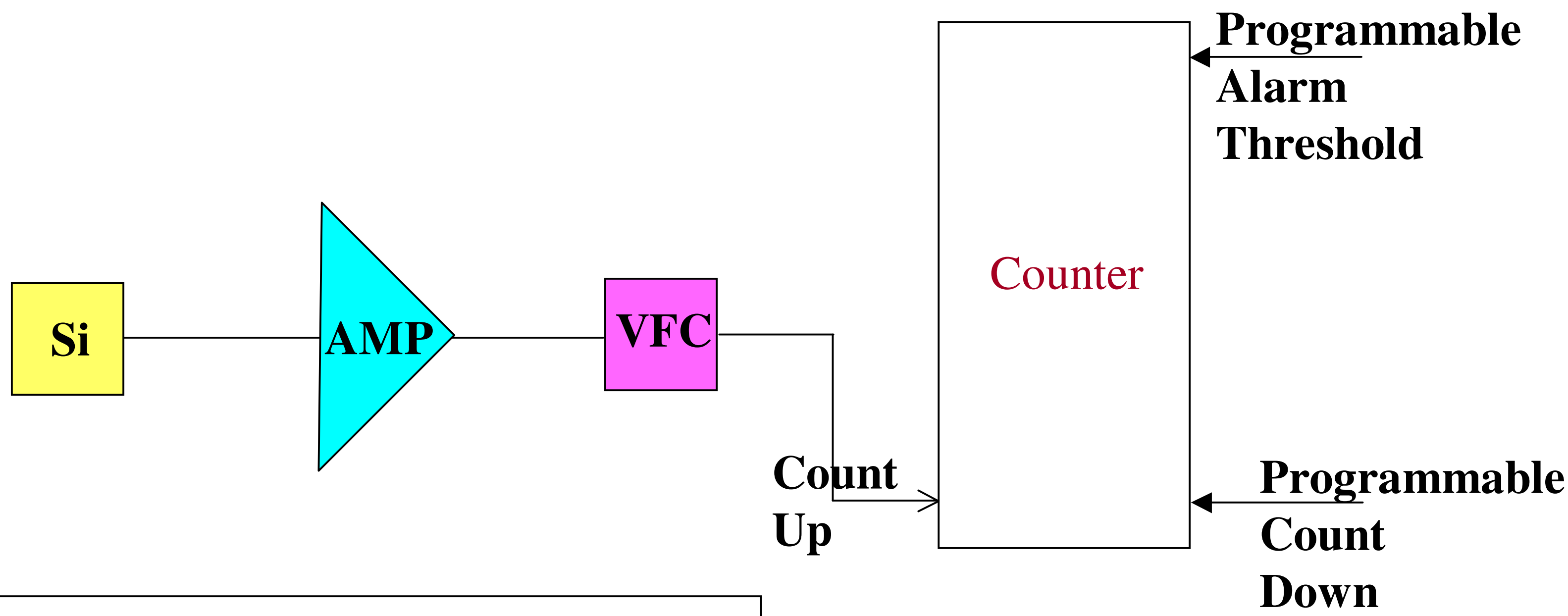


1 radmon module:
- 2 PIN diodes (for coincidence)
- 1 NTC temp. sensor
- [absorber (for soft γ and MIP separation) (?)]
- faraday cage
- 2 Coax, 1 TP-cable, common shielding

Readout schematics



The leaky bucket



Count Up rate = Input rate*Amp gain
Abort Time = Threshold/(Cup-Cdown)

Problems

- Define the range and gain of the system
  - Lower and higher dump threshold
  - Fastest dump speed with the leaky bucket
- Subtract the Si PIN leakage current
  - Up to 5 µA at life end (with highest irradiation)
    - 100 pA signal at 500 µrad/s
    - Leakage current very sensitive to T
  - 2 options:
    - Measure very accurately the temperature
    - Sample on the empty bunches

Status

- F/E electronics designed and tested
  - Reading of Si PIN diodes after 7m cable possible
- Mechanics and cables for Si PIN ready
- Conceptual design of the readout being finalised