

# ANSWERS TO HOMEWORK eRD12

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*a passion for discovery*



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arXiv: 1212.1701 & 1108.1713

□ Question:

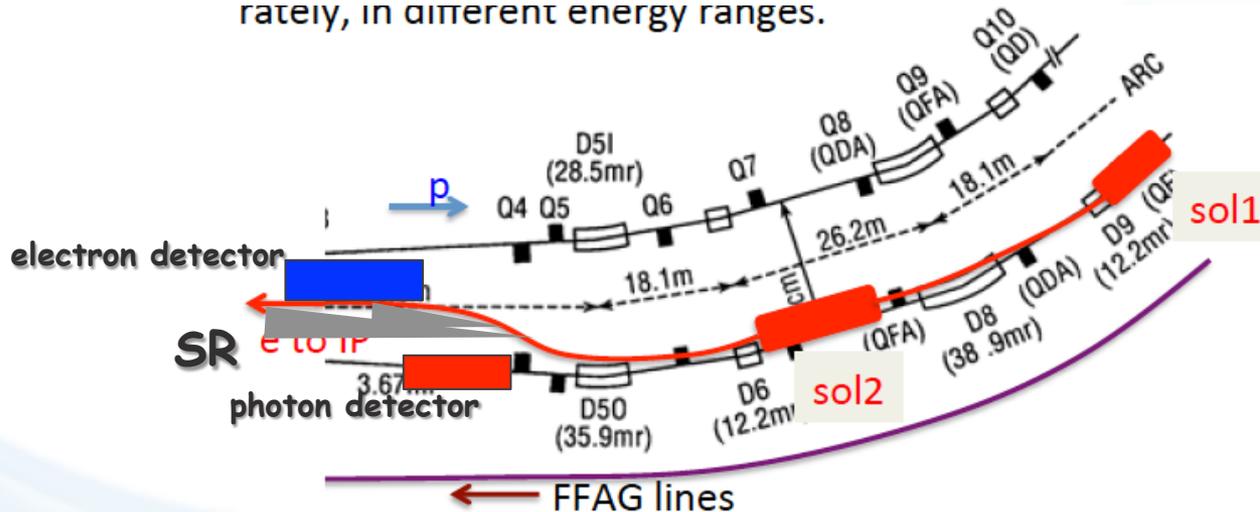
Please provide some more information about the laser system and data acquisition system for the polarimetry, that is, what is the required laser rep rate and laser power required, background rates, event rate for the readout system and how long it would take to collect 20,000 events.

# ANSWERS TO HOMEWORK QUESTIONS

## □ Background

- dominant source: synchrotron radiation
- bend of electron beam into the IR soft, to have a full estimate of the critical energy of the SR and the rate a full design of this section of the beamline is needed
- Some considerations:
  - electron detector on the other side of the SR-fan
  - photon detector close to bend to avoid large SR

ately, in different energy ranges.



## □ DAQ

the daq will be the same for the lumi detector, the low  $Q^2$  tagger and the polarimeters

we will built on the design for the main detector, which is a free streaming daq, with trigger capabilities first design idea documents can be provided,

But it is to early with the fast development of electronics to log down things.

→ will use experience of JLab, FAIR and the new ALICE upgrades

→ a similar system was already used for the HERA Tpol and FP cavity and H1 lumi system

## □ Lasersystem:

- the system can be run in a single ( $n_g \ll 1$ ) few ( $n_g \sim 1$ ) and multi-photon ( $n_g \gg 1$ ) mode
- $n_\gamma = \Delta t \int d\Omega (d^3 n_\gamma / dt d\Omega)$  backscattered Compton photons per bunch
- single photon mode:

### advantage:

one can calibrate the calorimeter in an absolute way using two reference points of the photon energy spectrum independently of the electron beam polarisation: firstly the Compton kinematic edge, located at 10 GeV at HERA for a 1064nm laser beam wavelength, and secondly the bremsstrahlung kinematic edge, located around 27.5 GeV which corresponds to photons radiated from the scattering of the electron beam with the residual gas of the vacuum beam pipe

### disadvantage: low statistics

- multi photon mode:

### advantage:

The multi-photon mode becomes advantageous when the background is large. For a high energy pulsed laser and typically a thousand photons per bunch are produced per laserbeam interaction. This corresponds to about 10TeV energy measured in the calorimeter.

### potential disadvantage:

energy linearity of the calorimeter which is only calibrated at significantly lower energy.

The statistics is limited by the laser pulse frequency

Polarimeter	Mode	Laser	frequency	time for $dN/N$ 0.01
TPOL	single	10 W 514.5 nm	continuous	1 min
LPOL	multi	532 nm 100 mJ	100 Hz	~30 min
FP Cavity	few	0.7 W $\rightarrow$ few kW	10 MHz	2 min / bunch
ILC	multi	532 nm 0.2-0.5W		1 sec

### References:

TPol: Nucl. Instrum. and Meth. A329 (1993) 79

Lpol: Nucl. Instrum. Meth. A479 (2002) 334

FP-Cavity: JINST 5 (2010) P06005 arXiv:1005.2741

ILC: <http://arxiv.org/pdf/1405.2156v1.pdf>