

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text is centered on the page.

REPORT FROM THE INTERACTION WORKING GROUP

CONVENORS:

CHARLES HYDE (ODU), VASILIIY MOROZOV (JLAB),
ALEXANDER KISELEV (BNL), CHRISTOPH MONTAG (BNL)

WORKING GROUP GOALS

- Point of contact with Laboratory based Interaction-Region design efforts
- Engage the EICUG Community
 - Luminosity measurement is a physics experiment(s) requiring interaction between Accelerator and Nuclear Physicists
- UNIQUE Challenges for EIC
 - Absolute Precision $< 2\%$, Relative Precision $< 1\%$
 - Luminosity (and its measurement) are (p, d, ^3He , Li) Polarization dependent
 - Bunch-Bunch dependencies?
 - Techniques required for ep to eU

FIRST GENERAL MEETING (VIDEO)

15 FEBRUARY 2019

LUMINOSITY MEASUREMENT

- [HTTPS://INDICO.BNL.GOV/EVENT/5743/](https://indico.bnl.gov/event/5743/)

10:00 AM	→ 10:15 AM	Brief overview of the purpose of this meeting Speaker: Charles Hyde (Old Dominion University)	🕒 15m	✎
10:15 AM	→ 10:45 AM	Luminosity measurement requirements for an EIC detector and constraints imposed by the current eRHIC accelerator and Interaction Region design Speaker: Dr E. C. Aschenauer (BNL) 	🕒 30m	
10:45 AM	→ 11:15 AM	JLEIC IR summary: Forward e⁻ acceptance and Geometrical constraints on detector space in 0° photon line Speaker: Vasily Morozov (Thomas Jefferson National Accelerator Facility)	🕒 30m	
11:15 AM	→ 11:45 AM	Experience with Van der Meer scans to measure absolute luminosity at RHIC Speaker: Angelica Drees (Collider-Accelerator)	🕒 30m	
11:45 AM	→ 12:15 PM	Review of the ZEUS luminosity measurement Speaker: William Schmidke (BNL)	🕒 30m	
12:15 PM	→ 1:00 PM	Discussion	🕒 45m	

VAN DER MEER (VERNIER) SCANS

- **Absolute determination of Luminosity**
 - Monitor a physics rate as the colliding beams are scanned across each other in 2D
 - Requires precision measurement of beam currents and collision centroid stability (3-D)
 - Does not require *a priori* knowledge of cross section.
- **Interrupts experimental data taking:** Not a continuous monitor
- **V. BALAGURA, NIM A 654 (2011) 634–638**
 - RHIC: (IPAC'10, KYOTO JAPAN, PROCEEDINGS)
 - K.A. DREES, S.M. WHITE, VERNIER SCAN RESULTS FROM THE FIRST RHIC PROTON RUN AT 250 GEV,
 - LHC:
 - M. FERRO-LUZZI, DETERMINATION OF THE LUMINOSITY AT THE LHC EXPERIMENTS, IN: PROCEEDINGS OF ICHEP'10, PARIS, JULY 2010, PUBLISHED IN POS (ICHEP 2010) 010:
 - S.M. WHITE, ET AL., FIRST LUMINOSITY SCANS IN THE LHC, IN: PROCEEDINGS OF IPAC'10, KYOTO, JAPAN, MAY 2010.

HERA SUMMARY

Luminosity Detector

Concept:

Use Bremsstrahlung $ep \rightarrow e\gamma$ as reference cross section

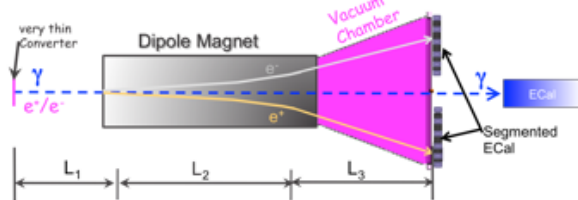
- different methods:
- Bethe Heitler, QED Compton, Pair Production
- Hera: reached 1-2% systematic uncertainty

Goals for Luminosity Measurement:

- Integrated luminosity with precision $\delta L/L < 1\%$
- Measurement of relative luminosity:
physics-asymmetry/10 $\rightarrow \sim 10^{-4} - 10^{-5}$

EIC challenges:

- with $10^{33} \text{ cm}^{-2}\text{s}^{-1}$ one gets on average 23 bremsstrahlung photons/bunch for proton beam
 \rightarrow A-beam Z^2 -dependence
- Need more sophisticated solution
- BH photon cone $< 0.03 \text{ mrad}$
 \rightarrow acceptance completely dominated by lepton beam size



pair spectrometer low rate

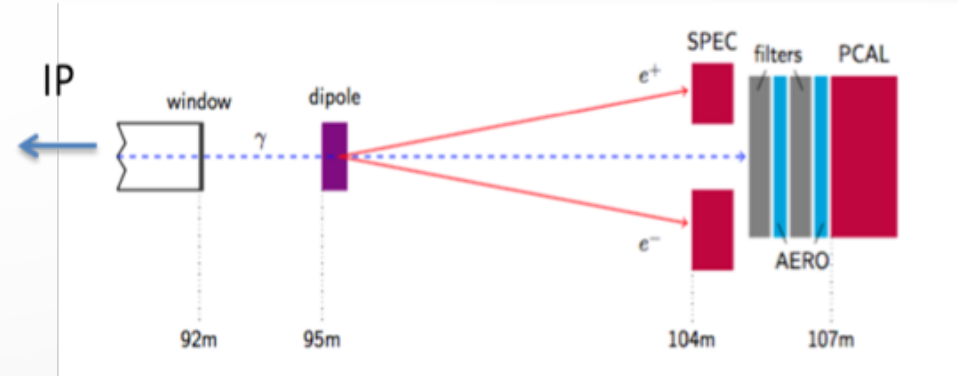
- High precision measurement for physics analysis
- The calorimeters are outside of the primary synchrotron radiation fan

zero degree photon calorimeter high rate

- Fast feedback for machine tuning
- measured energy proportional to # photons
- subject to synchrotron radiation

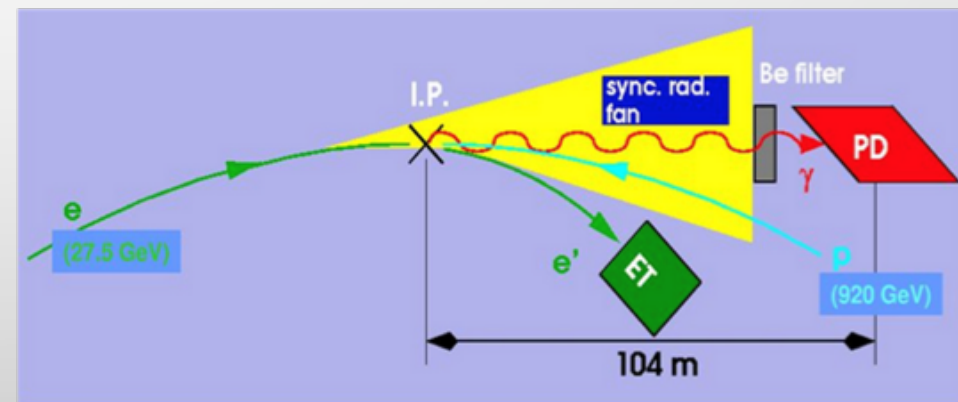
E.C. Aschenauer

Set up at ZEUS



At H1

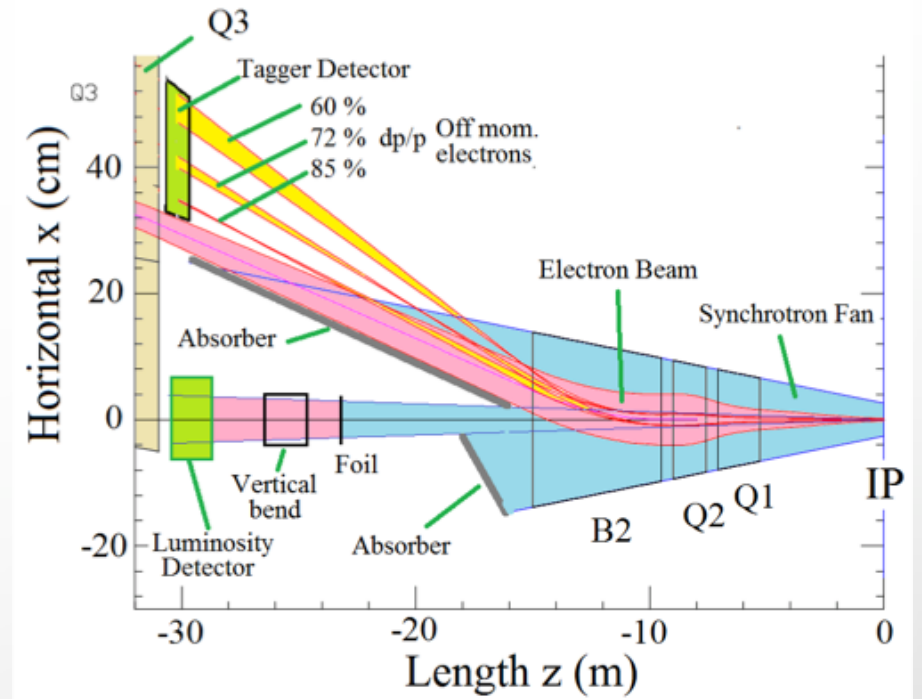
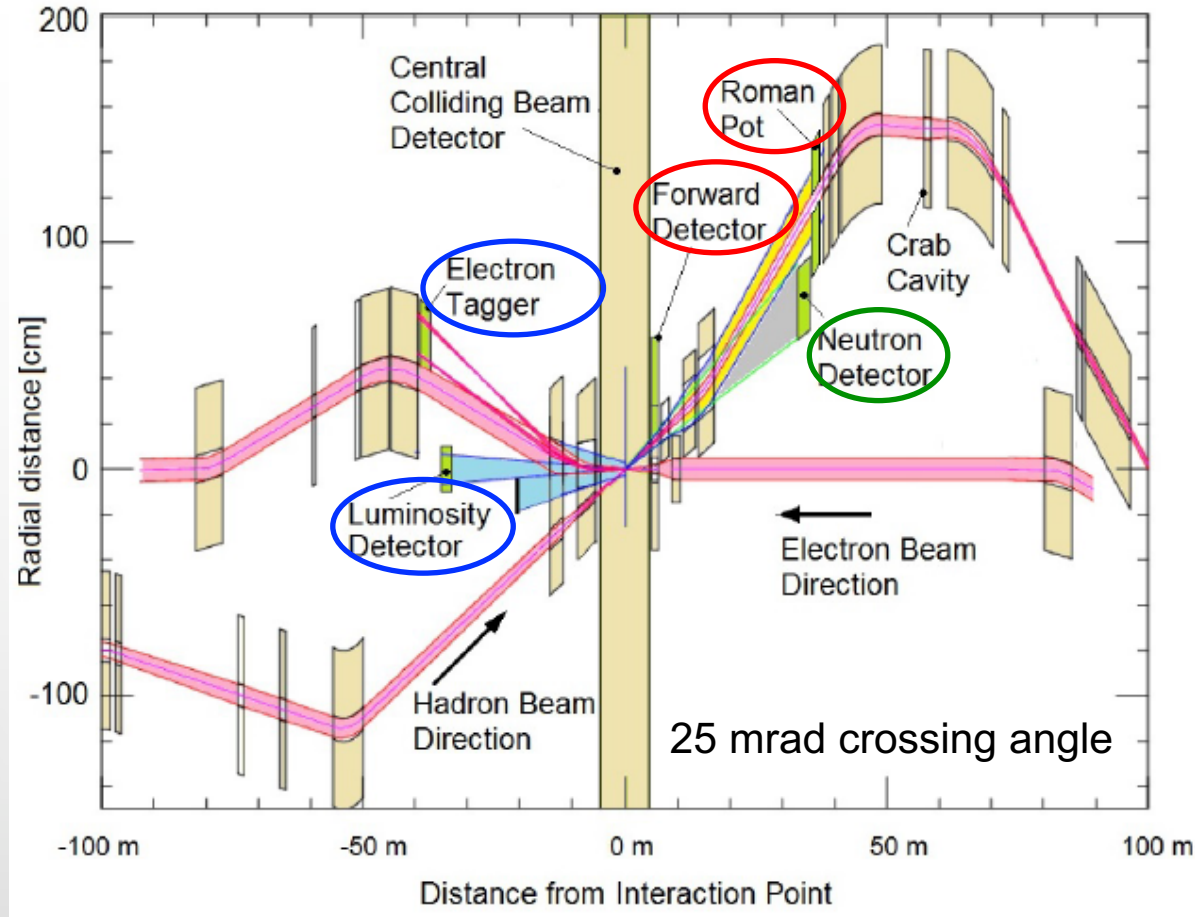
R. Yoshida



REFERENCES: QED COMPTON, ETC

- E. AARON (H1 COLLABORATION) EUR. PHYS. J. C (2012) **72**:2163
 - DOI 10.1140/EPJC/S10052-012-2163-2, ERRATUM DOI 10.1140/EPJC/S10052-014-2733-6
 - ELECTRON GAMMA DETECTION AT 10° TO 25° FROM E^- BEAM
- THEORY:
 - A. COURAU, P. KESSLER, PHYS REV D 46 (1992) P. 117
 - K. GAEMERS, M. VAN DER HORST, NUCLEAR PHYSICS B **316** (1989) 269-288:
(SMALL ANGLE THEORY, SIMULATION)
- COMPTON22 GENERATOR:
 - V. LENDERMANN, *ET AL.*, EUR. PHYS. J. C **31**, 343 (2003). HEP-PH/0307116

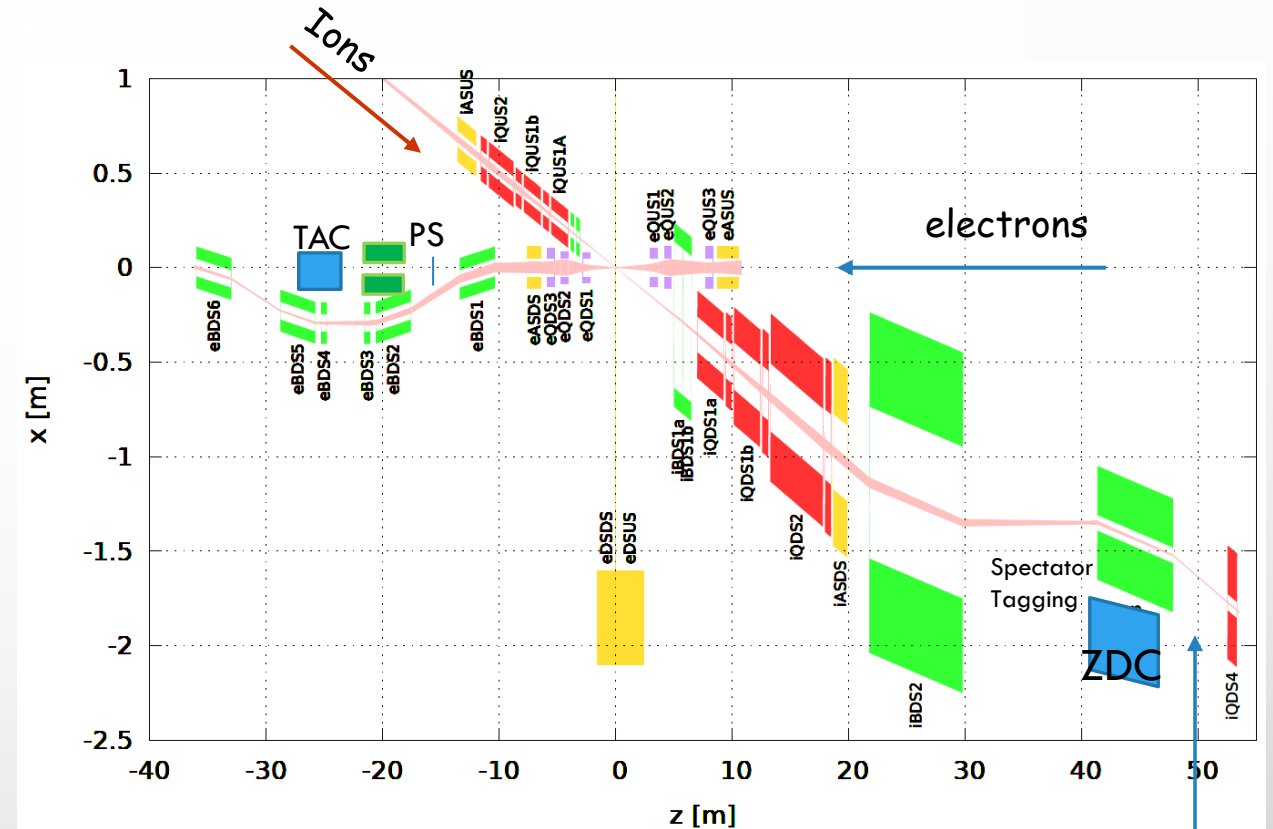
ERHIC: IR DESIGN



- main emphasis on integrating requirements for hadron beam direction
 - BOFp: **Forward Spectrometer** (6 - 20 mrad)
 - **Roman pots** (Sensitive 1 to 5 mrad)
 - **Neutron Detector** (0 to 4 mrad)
- B1Re and B2Re: separate **BH photons** from beam, separate **low Q^2 electrons** from beam and lepton beam from SR-fan
 - ➔ electron and hadron polarimetry at IP-12

JLEIC IR DESIGN

- ❑ 0° LINE IN EBDS1
 - VACUUM LINE TO TAC
- ❑ BREM FLUX INTO TAC
 - 5 GEV/BUNCH @ $L=10^{34}/\text{CM}^2/\text{SEC}$
 - TOTAL ABSORPTION CALO (TAC) CHALLENGING,
 - LIQUID AR IONIZATION?
 - QUARTZ-W SAMPLING?
- ❑ VERTICAL BEND PAIR-SPECTROMETER (PS)
- ❑ QED-COMPTON IN CENTRAL DETECTOR, OR DEDICATED SMALL ANGLE ECAL.
- ❑ Y. Sharabian (JLAB): Add Optical Transition Radiation (OTR) detector: bunch-bunch luminosity monitor



High Dispersion
Secondary Focus

2ND GENERAL MEETING IN PREPARATION: BACKGROUNDS (DATE TBD)

- SYNCHROTRON RADIATION
 - VERTEX TRACKER OCCUPANCY
 - BEAM-PIPE DESIGN
 - IMPACT ON 0° BREMSSTRAHLUNG CALORIMETER
- BEAM-GAS,
 - BEAM-PIPE DESIGN
 - LOCAL PUMPING
 - BACKGROUNDS FROM SMALL ANGLE FAR UPSTREAM SCATTERING
- NEUTRON “GAS”
 - LIFETIME OF CRITICAL COMPONENTS, FRONT-END ELECTRONICS

Suggestions of Speakers,
Topics Welcome