Zero Degree Calorimeters for Beam Optimization and Physics Measurements in CMS

Edmundo Garcia, University of Illinois at Chicago

D. d'Enterria, CERN
G. Stephans, Massachusetts Institute of Technology
W. Beaumont, S. Ochesanu, Universiteit Antwerpen
A. S. Ayan, P. Debbins, F. D. Ingram, E. Norbeck, Y. Onel, University of Iowa
O. A. Grachov, B. Metzler , M. Murray, A. Schaeperkoetter, J. Sibbile, J. Snyder, J. Wood, V. Zhukova, University of Kansas
L. Jones, University of Michigan

on behalf of the CMS Collaboration

The zero degree calorimeters (ZDCs) have been built to complement the existing CMS detector in the very forward region (8.1 > η). They are sampling calorimeters made of a tungsten plate/quartz fiber ribbon stack core. The detection in the ZDCs of γ and neutrons will be crucial for: relative and absolute luminosity measurements, global event characterization (centrality, reaction plane in A-A), diffractive and photon-induced processes, and forward particle/energy flows for cosmic-ray physics.

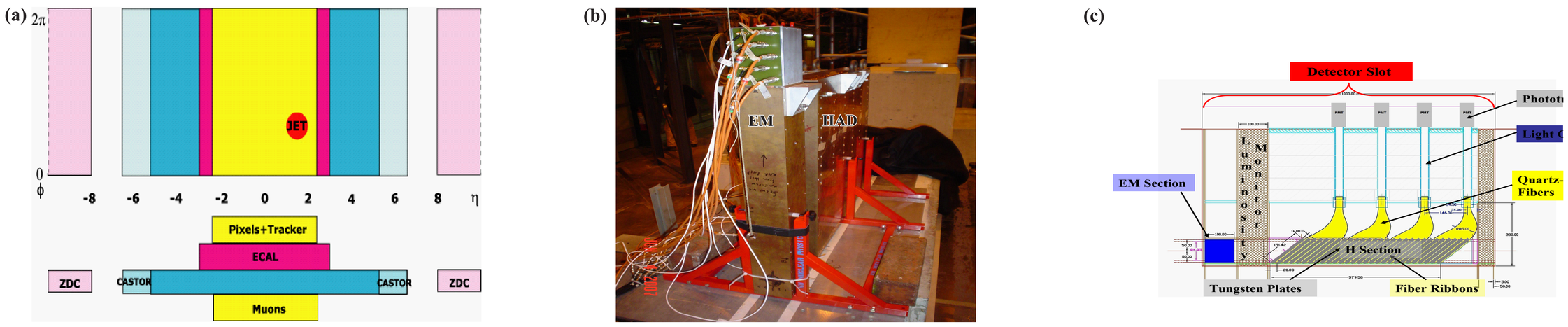


Figure 1. *(a) CMS and ZDC acceptance in η and ϕ [1]. (b) Photograph of one of the ZDC detectors during the 2007 test beam run. (c) Schematic illustration the ZDC.*

Experience at RHIC

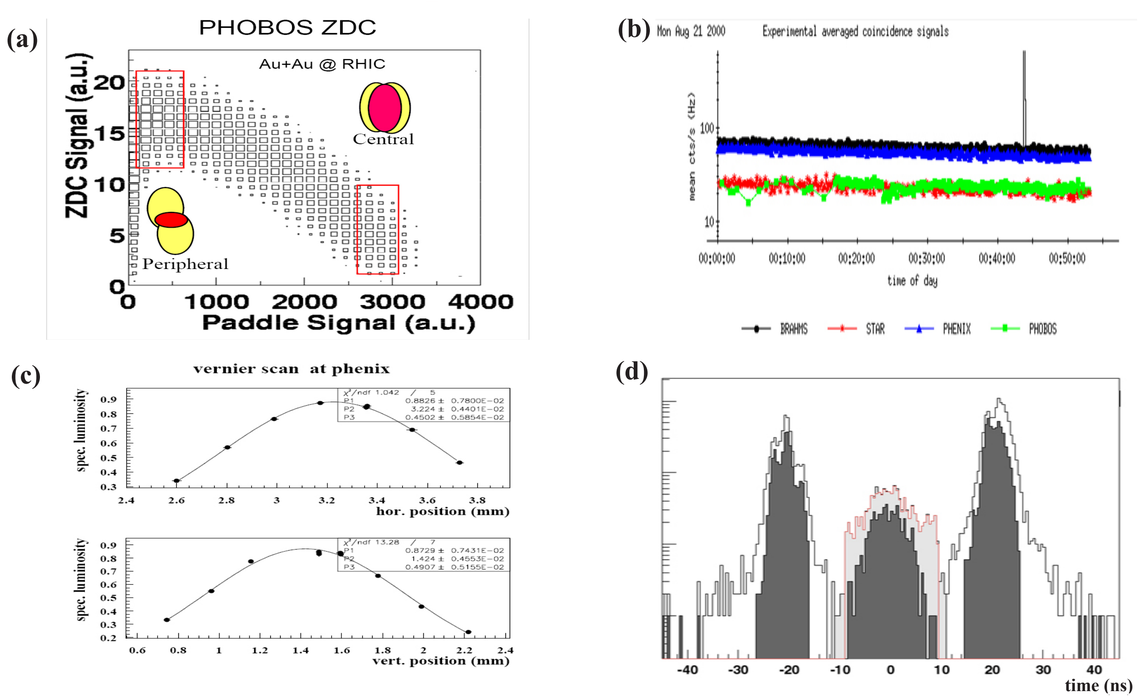
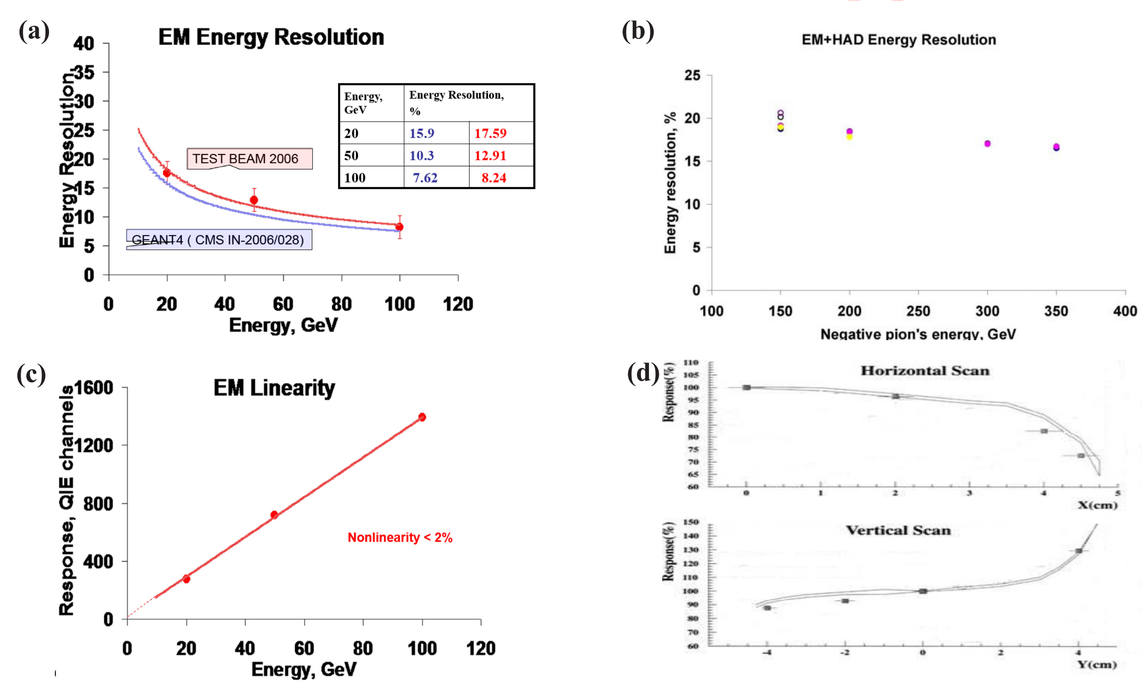


Figure 2. *(a) ZDC signal vs. centrality [2]. (b) Coincidence rate monitoring (c) ZDC coincidence rate vs. beam displacement [3](d) Time difference signal from beam-beam counters, light gray is the vertex cut generated with the ZDCs [2].*

SPS H2 Test Beam at CERN [4]



Energy, GeV	Energy Resolution, %	
20	15.9	17.59
50	10.3	12.91
100	7.62	8.24

Figure 3. *(a) Resolution EM section. (b) Resolution EM+HAD section. (c) Linearity response (d) Relative resolution (EM+HAD) as function of transversal position.*

Physics Potential

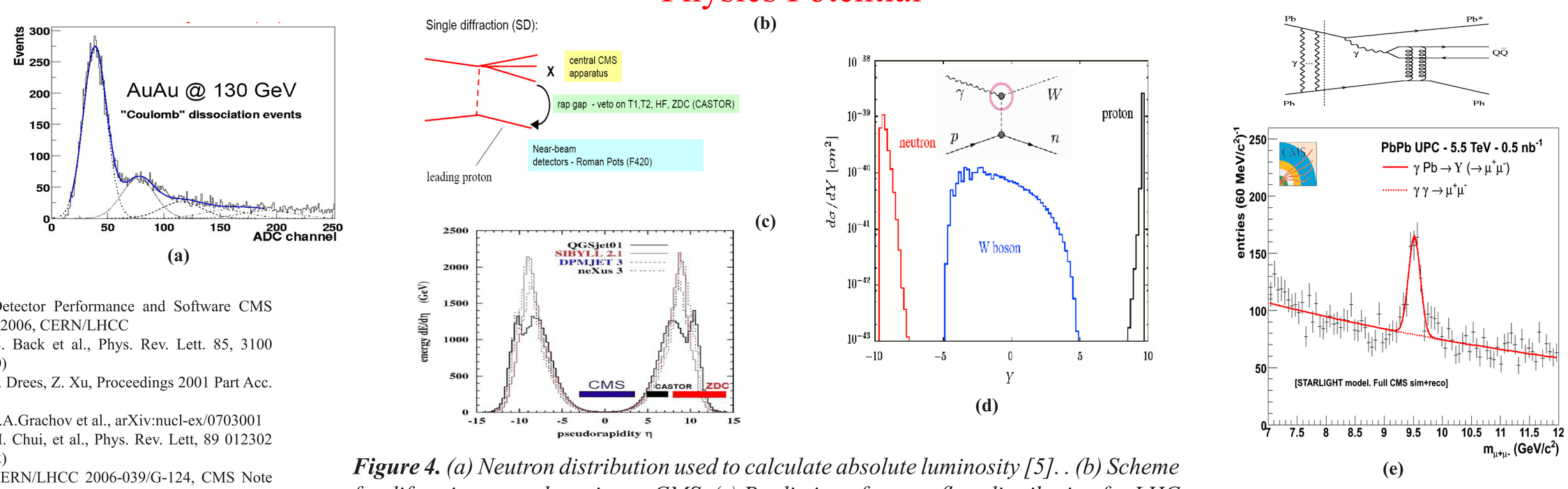


Figure 4. *(a) Neutron distribution used to calculate absolute luminosity [5]. . (b) Scheme for difractive event detection at CMS. (c) Prediction of energy flow distribution for LHC pp [6] (d) W boson photo production [7]. (e) Illustration of UPC γγ measurement [8].*

[1] Detector Performance and Software CMS TDR 2006, CERN/LHCC
[2] B. Back et al., Phys. Rev. Lett. 85, 3100 (2000)
[3] A. Drees, Z. Xu, Proceedings 2001 Part Acc. Conf.
[4] O.A.Grachov et al., arXiv:nucl-ex/0703001
[5] M. Chui, et al., Phys. Rev. Lett, 89 012302 (2002)
[6] CERN/LHCC 2006-039/G-124, CMS Note 2007-02, Totem Note06-05
[7] arXiv:hep-ph/0702212
[8] CMS AN-2006/107

Corresponding author: E. Garcia (ejgarcia@uic.edu)
UIC Physics Department, Chicago IL 60607