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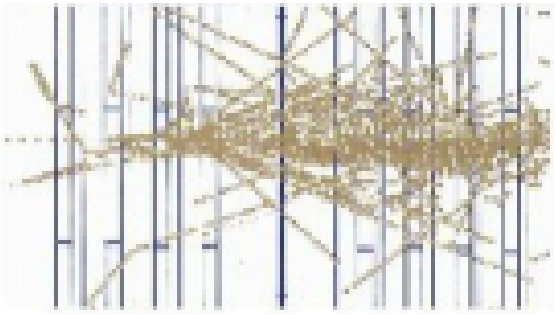

Book of Abstracts

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CMS Electromagnetic Trigger commissioning

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Performance of the combined zero degree calorimeter for CMS

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Calorimetric Techniques / 7

Test beam study of the PANDA Shashlyk calorimeter prototype

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Summary:

The physics program of the PANDA project at the international FAIR facility at GSI (Germany) is based on a state-of-the-art universal detector for strong interaction studies at high intensity cooled antiproton beam with an energy up to 15 GeV. This program relies heavily on the capability to measure photons with excellent energy and position resolution. For this purpose PANDA has proposed to employ electromagnetic calorimeters using two different technologies: a compact calorimeter around the target based on lead tungstate crystals and a fine-segmented Shashlyk-type calorimeter in the forward region.
The Shashlyk calorimeter prototype for the PANDA experiment has been constructed
at IHEP and experimentally tested using the 1-19 GeV electron beam with high precision momentum tagging at the IHEP accelerator. Results of the first measurements for the fine-segmented Shashlyk calorimeter prototype in the wide energy
range up to 19 GeV are presented. Two cell sizes (5.5x5.5 cm^2 and 11x11 cm^2) were
used in the prototype. Fair energy and position resolutions having been obtained are

in a good agreement with the Monte-Carlo simulations. Detection inefficiency due to holes for straight light fibers has turned out to be negligible for PANDA. The results of the Monte-Carlo study of pi0 reconstruction for the both cell size prototypes are also presented in front of an approaching test beam study of this.

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Simulation of the ”4th Concept” calorimeter

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Summary:

The “4th Concept” collaboration is proposing a detector for the International Linear Collider. The Dual Readout technology has been chosen for the calorimeter. A detailed simulation of the detector has been implemented in ILCroot software framework. Results of current Physics studies of the performance of the calorimeter will be presented.

Calorimetric Techniques / **10**

Studies of the effect of charged hadrons on Lead Tungstate crystals

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Summary:

Scintillating crystals are used for calorimetry in several high-energy physics experiments. For some of them,
performance has to be ensured in difficult operating conditions, like a high radiation environment, very large particle
fluxes and high collision rates.
Results will be presented from a thorough series of complementary measurements concerning the effect of charged
hadrons on Lead Tungstate crystals. It will also be shown how these results can be used to predict the effect on
crystals due to a given flux of particles.

Calorimetric Techniques / **11**

New crystal technologies for novel calorimeter concepts

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Summary:

Present calorimetric systems give a global information on the total energy deposit at a given time in large detector cells but provide no details on the cascade mechanism of this energy deposition in space and time, as well as on the physics of the signal generation.
In the domain of High Energy Physics (HEP) high-precision measurement of hadrons and
jets is one of the detector challenges at future high energy colliders. It has been shown that higher segmentation of the calorimter and/or the simultaneous recording of
the scintillation light produced in an active medium, which is proportional to the total energy deposited by the shower particles, and the Cherenkov light, which is only produced by the charged, relativistic shower particles, can significantly improve the performance of present hadron calorimeters.
At low energy, for instance for medical imaging devices, the detailed recording of the whole Compton-photoelectric interaction chain would have a strong impact on the spatial resolution, energy resolution and sensitivity of the imaging cameras.
Recent progress in heavy scintillating crystal production methods as well as in nanotechnologies applied to photonic crystals and to quantum dots (nanocrystals) introduce interesting perspectives for he development of innovative strategies for an homogeneous but finely structured calorimeter. We will describe in this talk how a new class of metamaterials based on these technologies can open the way to new calorimeter concepts allowing to simultaneously record with high precision the maximum of information on the shower such as its direction, the spatial distribution of the energy deposition and its composition in terms of electromagnetic, charged and neutral hadron contents.

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The CALICE test beam programme

Author: David Ward[1]

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Summary:

The CALICE Collaboration

A major programme of R&D has been undertaken by the CALICE collaboration, performing a very challenging test beam programme directed towards the design of an ILC calorimeter optimized for both performance and cost, where particle flow (PFA) calorimetry and software compensation are the main aim of the studies.

This talk will concentrate on describing the experimental set-ups for the 2006, 2007 and 2008 test beams that have been carried out by the CALICE collaboration at DESY, CERN and FNAL.

Calorimetric Techniques / 13

CALICE: status of a data acquisition system for the ILC calorimeters

Author: David Ward[1]

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Summary:

The CALICE Collaboration

A data acquisition system is described which will be used for the next generation of prototype calorimeters for the International Linear Collider and could also the basis for the final system. The design is sufficiently generic such that it should have applications elsewhere, be they either ILC detectors or within high energy physics in general. The data acquisition system will be implemented using FPGAs and built using off-the-shelf components and networking hardware. The EUDET ECAL technical prototype will be used to demonstrate the feasibility of this approach. The design philosophy, the current status of the project and its aims are presented giving an overview of the effort.

Calorimetric Techniques / 14

R&D for a PFA calorimeters

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Summary:

The CALICE Collaboration

The CALICE collaboration is performing R&D for the construction of highly granular central calorimeters for a future dectector to be operated at the International Linear Collider (ILC). In the past five
years the collaboration has successfully desgined, constructed and operated in test beams a protoype Si-W calorimeter involving approximately 10000 pads. The test beam results have delivered valuable information allowing the improvement of the layout of the active part for the next generation of prototypes, namely a full scale
calorimeter module being studied as part of the EUDET program. A detector unit up to 1500mm long is currently under construction. Aspects like mechanical rigidity and thermal heat dissipation will be investigated. A particular novel feature of this prototype is the integration of the very front end electronics into the layer structure
of the calorimeter. The electronics will be power pulsed with on-times
suited to the expected bunch structrue of the ILC, in order to meet

the requirements of a minimal heat dissipation of the ASICS) of the order of 1 MicroWatt per circuit.

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Response of the CALICE Si-W ECAL prototype to electrons

Author: David Ward[1]

[1] *University of Cambridge*

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Summary:

The CALICE Collaboration

The CALICE Collaboration has been testing a prototype silicon-tungsten calorimeter in beams at DESY and CERN in 2006-7. We report on the commissioning of the detector, including studies of calibration, noise, gain, uniformity and stability. We characterise the response of the calorimeter to electrons in the energy range from 1-45 GeV. Key quantities studied include the energy resolution, the linearity and uniformity of the response and the longitudinal and transverse shower profiles. We use these measurements to validate the GEANT4 Monte Carlo simulation tools which are being used to design the future full scale detectors.

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CALICE scintillator HCAL - response to muons and electrons

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Summary:

The CALICE Collaboration

The CALICE collaboration has constructed a test beam hadron calorimeter with 7608 scintillator tiles, individually read out by Silicon Photo-Multipliers, and tested it in muon, electron and hadron beams at CERN. The calibration of each cell is based on minimum ionizing particle signals and at high amplitudes has to take into account the non-linear response of the SiPM, due to its finite number of pixels. The most important validation of the detector modelling and calibration chain is the test of the calorimeter response linearity and resolution for a large range of incident beam energies. Electromagnetic showers are the most demanding test since the energy deposited per single tile in an electromagnetic shower is larger than in a hadronic shower for the same beam energy. Results of the calorimeter response to muons and electrons are discussed and compared to Monte Carlo simulation.

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Hadron showers in the CALICE scintillator HCAL

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Summary:

The CALICE Collaboration

The CALICE test beam calorimeters operated at the CERN SPS facility have collected a large sample of hadronic showers with unprecedented granularity. The analysis of single pion showers, recorded with a scintillator tile HCAL offer the unique possibility to test hadronic shower models using a number of different observables. Total energy, longitudinal and lateral profiles with very high resolution and shower composition are being studied in detail and compared with the available GEANT4 based simulations. Furthermore, studies of shower separation are performed using event mixing techniques. Shower separation is critical for the performance of modern particle flow algorithms, which for the first time can be tested on experimental data here.

Calorimetric Techniques / **18**

Calibration and monitoring of a scintillator HCAL with SiPMs

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Summary:

The CALICE Collaboration

This talk will present the operational experience with a highly-granular analogue hadronic calorimeter (AHCAL) consisting of 7608 individual scintillator tiles readout via Silicon-Photo-multipliers (SiPM). The calibration of each cell is based on minimum ionizing particle signals for which a muon beam is used in first approximation. The full calibration of a cell, though, requires to account for the non-linearity introduced by the finite number of pixels (1156) in the SiPM. The aspects of temperature and voltage dependence of SiPM are addressed, and monitoring and calibration procedures are discussed. Such procedures are essential for the extrapolation of calibration factors over several days of data taking with the calorimeter. For this purpose a versatile UV-LED light distribution system was developed, capable of delivering light to all tiles with intensity from a few photo-electrons to the saturation of the SiPM. The procedures are tested using data collected with the AHCAL at the CERN SPS test beam.

Calorimetric Techniques / 19

Towards a realistic calorimeter with SiPM readout

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Summary:

The CALICE collaboration is developing highly granular electromagnetic and hadronic calorimeters for a future high energy electron positron linear collider. We present a conceptual design for a scintillator tile HCAL with SiPM readout. As a first step, a cubic-meter sized physics prototype has been constructed and operated successfully in the CERN SPS test beam; results have been submitted to this conference. In contrast to the test beam HCAL, a realistic calorimeter has to be compact and must have minimal dead zones. The design presented is based on highly integrated, ultra-low power read-out ASICs embedded in the active detector layers with minimized thickness. A scheme for integrating an optical calibration system without light transmission fibers is also proposed. Mechanical, thermal, electronics and DAQ solutions are discussed, and results for component tests are presented.

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CALICE Scintillator tungsten ECAL

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Summary:

The CALICE Collaboration

We have constructed a prototype ECAL which consists of tungsten plates and small scintillators. There are 26 layers of active scintillators which consist of 18 strips in a layer. The size of each scintillator is 4.5 cm x 1cm x 0.3cm. The scintillation light is read out via MPPCs which are newly developed. We describe the construction and performance of this calorimeter. In particular, the results of the beam best of the calorimeter are discussed in detail. A planned further extension of this detector four times bigger will also be covered.

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MPPC performance

Author: David Ward[1]

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Summary:

The CALICE Collaboration

For scintillator calorimeters, the photon sensors are the most important devices. The newly developed multipixel avalanche diode named MPPC is one of the candidates for such sensors. In this talk, we will describe the performance and understanding of MPPCs. In particular, the signal study which indicates the fast recovery after a pulse and rather linear behaviour with many photons will be reported in detail. The radiation tolerance will also be covered.

Calorimetric Techniques / 22

A digital hadronic calormiter with a new readout generation.

Author: David Ward[1]

[1] *University of Cambridge*

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Summary:

The CALICE Collaboration

A new concept of high granularity hadronic calorimeter based on semi-digital readout for future ILC experiments is presented. The readout of the sensitive medium using a chain of detector-embedded low-consumption tiny 64-channel chips was realized and tested. The nice results obtained using GRPC as a sensitive medium readout with four
chained chips show that the concept was successful and could be extended to large area detector.

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Tests of a Digital Hadron Calorimeter

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Summary:

The CALICE Collaboration

We present the concept of a Digital Hadron Calorimeter (DHCAL) for use in a detector optimized for the application of Particle Flow Algorithms to the measurement of jet energies. Resistive Plate Chambers (RPCs) with 1 x 1 cm^2 readout pads are used as active elements. The front-end electronic readout is integrated on the pad-boards of the chambers. We report on detailed measurements with a small scale prototype in the Fermilab test beam using muons, electrons, pions, and protons and in the laboratory using cosmic rays.

Calorimetric Techniques / 24

Design and performance of 2nd generation readout ASICS for CALICE/EUDET technological prototypes

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Summary:

The CALICE Collaboration

Imaging calorimetry depends heavily on the development of high performance, highly integrated readout ASICs embedded inside the detector which readout the millions of foreseen channels.
To demonstrate their feasibility, the CALICE collaboration and the EUDET framework have developed ECAL and HCAL technological detector prototypes, which will be equiped with HaRDROC (Hadronic Rpc Detector Read-Out Chip), SKIROC (Silicon Kalorimeter Integrated Read Out Chip) and SPIROC (Silicon Photomultiplier Integrated Read Out Chip).
These ASICs integrate 36 to 64 channels of low noise amplification, shaping, auto-trigger, zero-suppress, 12 bit digitization and local storage as well as full power pulsing. They have been fabricated in 2006-2007 and show good preliminary performance. Design issues and measurement results will be presented.

LHC / 26

The LHCb Electromagnetic calorimeter calibration & monitoring

Authors: Irina Machikhiligan[1]; Marie-Noëlle Minard[2]

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Summary:

The design and construction characteristics of the Electromagnetic Calorimeter (ECAL) of the LHCb experiment are described. Current status of the detector is reported

together with selected results of performance studies using test beam and cosmic rays. Strategies for ECAL monitoring and calibration are discussed.

LHC / 27

The LHCb Hadronic Calorimeter performance and calibration

Authors: Iouri Guz[1]; Marie-Noëlle Minard[2]

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Summary:

The Hadron Calorimeter of LHCb is a sampling iron-scintillator calorimeter of 5.6 \lambda_I thickness. The light readout is performed with WLS fibres running along the scintillating tile edges. Its expected performance ant its current commissioning will be reviewed.
In addition, the self-calibration system, based on Cs137 radioactive source embeddedinto the calorimeter structure, aimed at obtaining an absolute calibration withprecision of about 2% will be discussed.

LHC / 28

LHCb preshower(PS) and Scintillating pad detector (SPD): calibration and monitoring

Author: Marie-Noëlle Minard[1]

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Summary:

The calorimeter system of the LHCb experiment comprises in front to the electromagnetic and hadronic calorimeters a double detector, aimed at tagging the electric charge and the electromagnetic nature of the calorimeter clusters for the first level of trigger. It consists in two planes of scintillating pads separated by a 2.5 radiation lengthes lead sheet. The first scintillating plane is the SPD. The second plane and the lead form the Preshower Their design and construction are recalled. Their performance and calibration strategies are discussed and illustrated by recent results.

Simulation / 29

Fine shashlik simulation from tests results

Authors: Marie-Noëlle Minard[1]; Mikhael Prokudin[2]

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Summary:

We have studied the response uniformity of the LHCb electromagnetic calorimeter modules in a beam of high energy muons. Tests of prototype module built with thin (0.5mm) absorber and scintillator plates were performed as well as transverse scans of an ECAL module with 50GeV electrons. To understand the light collection uniformity a dedicated Monte Carlo program for the the light propagation in different scintillator tiles was developed. Parameters of this program are tuned and checked using experimental data

Astrophysics and neutrinos / **31**

Performance of the PAMELA Silicon-Tungsten Imaging Calorimeter in Space

Author: Valter Bonvicini[1]

Co-authors: Andrea Vacchi [2]; Emiliano Mocchiutti [2]; Gianluigi Zampa [2]; Mirko Boezio [2]; Nicola Zampa [2]

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Summary:

The Payload for Antimatter-Matter Exploration and Light Nuclei Astrophysics (PAMELA), primarily designed to directly measure antiparticles (antiprotons and positrons) in the cosmic radiation, was launched successfully on June 15th, 2006, and, since then, it is in continuous data taking. The calorimeter of the PAMELA apparatus has been designed to identify antiprotons from an electron background and positrons from a background of protons with high efficiency and rejection power. It is a sampling silicon-tungsten imaging calorimeter, which comprises 44 single-sided silicon sensor planes (380 μm thick) interleaved with 22 plates of tungsten absorber (0.74 X0 each). It is the first silicon-tungsten calorimeter to be launched in space.
In this work we present the in-orbit performance of the calorimeter, including the measured identification capabilities. We show that the calorimeter provides a proton rejection factor of ~10^5 while keeping a high efficiency in selecting electrons and positrons, thus fulfilling the identification power needed to reach the primary scientific objectives of PAMELA. We show also that, after almost two years of operation in space, the calorimeter is still performing nominally.

Astrophysics and neutrinos / **32**

Calorimeter R&D for the Double Beta Decay Experiment SuperNEMO

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Summary:

SuperNEMO is a next-generation double beta decay experiment based on the successful tracking plus calorimetry technology of the NEMO-3 experiment currently running in the Modane Underground Laboratory. Due to the separation of source and detector, SuperNEMO can study a range of isotopes. The baseline isotope choice is 82Se and possibly 150Nd. The total isotope mass will be in the range 100-200 kg. With this isotope mass a sensitivity to a half-life greater 10**26 years can be reached which gives access to Majorana neutrino masses of 50-100 meV. One of the main challenges of the SuperNEMO project is the development of the calorimeter with an unprecedented energy resolution and radio-purity. The collaboration is carrying out a broad R&D programme focusing on the development of liquid and solid scintillators and ultralow-radioactive highly efficient photo-detectors in parallel. Extensive laboratory measurements are complemented by most up-to-date Monte Carlo optical simulations using GEANT4. The results obtained so far will be presented. SuperNEMO sensitivity dependence on the calorimeter parameters such as energy and time resolution, radio-purity, ageing etc. will be discussed.

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Effects of temperature dependence of the signals from Lead Tungstate

Author: Gabriella Gaudio[1]

Co-authors: Alessandro Cardini [2]; Antonio Policicchio [3]; Cecilia Voena [4]; Davide Pinci [4]; Evelin Meoni [3]; Giancarlo Susinno [3]; Hans Paar [5]; Igor Volobouev [6]; John Hauptman [7]; Laura La Rotonda [3]; Marco Fraternali [8]; Maurizio Mancino [8]; Michele Livan [8]; Mohammad Alwarawrah [6]; Nural Akchurin [6]; Richard Wigmans [6]; Roberto Ferrari [9]; Silvia Franchino [8]; Sorina Popescu [6]; Tommaso Venturelli [3]; Wainer Vandelli [10]; Youn Roh [6]

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Summary:

We present results of beam tests performed in 2007 as part of the DREAM project. Previously, we already demonstrated that Lead Tungstate signals contain both scintillation and Cherenkov components. In order to further assess and evaluate the relative contribution of the Cherenkov component, we performed measurements at different temperatures, ranging from 13℃ to 45℃. Only the scintillation component was affected by the temperature change. Over

this temperature range, the total light yield was measured to decrease by a factor of 2, while the relative Cherenkov contribution to the signals increased by the same factor. We also studied the decay time of the scintillation process and observed it to decrease as well.

LHC / 35

Studies of the CMS Electromagnetic Calorimeter performance in the electron test beam

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Time profile analysis of photodetector signals in multi read-out calorimetry with GHz samplers

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Co-authors: Fabrizio Scuri [1]; Franco Bedeschi [1]; Marco Incagli [1]; Massimiliano Bitossi [1]; Raffaello Pegna [1]

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Summary:

We present possible applications of DAQ systems based on Domino Ring Samplers (DRS) for time profile analysis of photodetector signals used for present and future multiple read-out calorimeters. The example of an 80-channel system in preparation for dual-read out calorimetry (DREAM) is described in detail.

Calorimetric Techniques / 38

The NA62 rare kaon decay experiment photon veto system

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Summary:

The NA62 rare kaon decay experiment photon veto system

The NA62 experiment at CERN SPS is aimed to measure the very rare decay K^+ -> pi^+ nu anti-nu. This poses very stringent requirements on the particle identification capabalities of the apparatus in order to reject

the overwhelming K^+ -> mu^+ nu and K^+ -> pi^+ pi0 background.
In particular, a pi0 detection at the level of (1-10-8) is needed
to complement the kinematical rejection of pi^+pi0 events.
In order to have a full acceptance from 0 to 50 mrad, partly covered by
the NA48 liquid Kripton calorimeter, a set of veto anti-counters
should be placed along the vacuum decay tank, to catch large-angle photons
with a detection efficiency better than (1-10-4) in a wide energy range
[from few hundreds MeV to 35 GeV].
In order to meet the photon efficiency requirement, those calorimetric
detectors should also have a good energy resolution [at the level of 10% at
1 GeV to have a precise definition of the energy threshold], good time
resolution [better than ~ 1 ns] in order to be used at the trigger level,
sensitivity to minimum ionizing particles, in order to allow in-situ
calibration with muons of the beam halo.
Finally a moderate segmentation in the azimutal coordinate is desirable.
Intense R&D programs have been carried out in order to study different
technological solutions: “spaghetti” calorimeter, lead/scintillator sandwich
calorimeter, and -finally- an original re-use of the existing barrel of
the OPAL lead-glass electromagnetic calorimeter.
This last solution is based on the peculiar radial arrangement of the
lead-glass crystals in rings; since in this configuration the incoming
photons hit the crystal laterally -on the short side- multiple staggered
layers of those rings should be arranged to form a single veto detector.
This solution is very cost-effective, since all the detector elements [including
photomultipliers and power supplies] are available, but poses all the problems
typical of longitudinally segmented calorimeters.
Moreover, the actual capability of reaching the required level of detection
efficiency should be studied.
Studies of the performance of all those kind of calorimeters at the Frascati
BTF electron and photon beam in the most interesting, low energy range [100-500
MeV]
are here reported.

Operating Calorimeters / **39**

Belle EM Calorimeter and its sBelle Upgrade

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LHC / **40**

The CMS Barrel Calorimeter Response to Particle Beams from 2 to 350 GeV/c

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Summary:

We report on the response of the CMS barrel calorimeter to hadrons and muons over a wide momentum range from
2 to 350 GeV/c. To our knowledge, this is the widest range of momenta in which any calorimeter system has been
studied. These tests, carried out at the H2 beam line at CERN, provide a welth of information, especially at low
energies. We present the analysis on the calorimeter response to charge pions, kaons, protons and antiprotons and
discuss the underlying phenomena. We also present techniques that deal with the corrections to the signals from
the considerably different electromagnetic (EB) and hadronic (HB) barrel calorimeters in reconstructing the energies
of hadrons. The corrected data set corrected for the combined system is linear over to +/-4% for beam momenta
over 4 GeV/c.

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Status of the CMS-HF Calorimeters

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Summary:

Two hadronic forward (HF) calorimeters extend the acceptance of CMS at large rapidities and are built with rad-hard components (steel absorbers and quartz fibers) to resist the severe radiation levels in the forward regions. Very high energy jets can be measured in HF, detecting Cherenkov light emitted by shower particles in the quartz fibers. The HF calorimeters are now installed in the underground CMS cavern; after commissioning, the detectors are prepared for beam. Progress in calibration work and current plans for the HF calorimeters during the initial LHC runs will be summarized.

LHC / 43

The ATLAS LAr calorimeter: an overview

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Summary:

The various cryostats with the ATLAS LAr calorimeter are installed in the ATLAS cavern since several
years. Following this, an effort to install and commission the front end read-out electronics
(infrastructure, crates, boards) has been ongoing and is converging, in time for the cavern closure.

After the mechanical installation of the LAr calorimeter 99.9% of the read-out channels were working,
hence great care was taken to assure the same high level of quality after the installation of the read-out
electronics.
Following cautious procedures and with continuous testing-campaigns of the electronics at each step of
the installation advancement, the result is a fully commissioned calorimeter with its readout and a small
number of non-functional channels.
The presentation will give a general overview of the installation of the ATLAS LAr calorimeter electronics
and show results of the calibration runs that were taken continuously during the various phases of
commissioning. Different problems observed and addressed will be discussed. It will describe noise studies
that have been performed and shortly review the solutions implemented to reduce noise. The excellent
stability of the calorimeter readout will be demonstrated by showing results from pedestal and pulse height
studies.

LHC / 48

Triggering with the LHCb calorimeters

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Summary:

The calorimeters of LHCb (ECAL, HCAL, PRS and SPD) are used in the level-0 trigger system of the experiment, to detect high transverse momentum hadrons , photons, electrons and pi0. An overview of the LHCb calorimeter triggering system, which consists of several layers of electronics boards is presented. The commissioning and the performances of the system are discussed, in particular the results obtained with cosmic rays.

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Comparisons of Monte Carlo Simulation to data from the ATLAS combined test-beam

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Summary:

In 2004 the ATLAS collaboration carried out a beam test in which a full slice of the ATLAS barrel detector was exposed to beams of electrons and pions in the energy range

from 1 to 350 GeV. The calorimeter was composed of a liquid argon lead calorimeter in the electromagnetic part and a scientillator tile calorimeter in the hadronic part. The mean response, the resolution and the lateral and longitudinal shower topologies to hadrons in the energy range from 1 to 180 GeV have been measured and are compared to Monte Carlo simulations. The ability of the various physics lists in the most recent version of Geant4 simulation framework is discussed.

Simulation / 50

GEANT4 Physics Evaluation with Testbeam Data of the ATLAS Hadronic End-Cap Calorimeter

Author: Hong Ma[1]

[1] *Brookhaven National Lab*

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Summary:

The validation of GEANT4 physics models is done by comparing experimental data from beam tests of modules of the ATLAS hadronic end-cap calorimeter with GEANT 4 based simulations. Various physics lists for the simulation of hadronic showers are evaluated. We present results of studies of the calorimeter performance parameters, such as energy resolution and shower shapes, as well as results of investigations of the influence of Birks' law and of cuts on the time of development of hadronic showers.

Simulation / 51

Test of the ATLAS Pion Calibration Scheme in the ATLAS Combined Test-Beam

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Summary:

In 2004 the ATLAS collaboration carried out a beam test in which a full slice of the ATLAS barrel detector was exposed to beams of electrons and pions in the energy range from 1 to 350 GeV. The calorimeter was composed of a liquid argon lead calorimeter in the electromagnetic part and a scientillator tile calorimeter in the hadronic part. One of the main purposes of this combined test-beam is to test the hadronic calibration strategy based on Monte Carlo simulation to correctly measure the energy of pions.

The strategy to extract the corrections for dead material losses, for the non-compensating nature of the ATLAS calorimeter and for leakage effects is discussed and assessed using test-beam data. The default ATLAS strategy, based on a weighting technique of calorimeter cells, is presented and compared to a novel technique exploiting correlations among calorimeter

layers.

Simulation / 53

Performance of the ATLAS Liquid Argon Endcap Calorimeter in Beam Tests

Author: Giuseppe Francesco Tartarelli[1]

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Summary:

The pseudorapidity region $2.5 < |\eta| < 4.0$ in ATLAS is a particularly complex transition zone between the endcap and forward calorimeters. A set-up consisting of $1/4$ resp. $1/8$ of the full azimuthal acceptance of the ATLAS liquid argon endcap and forward calorimeters has been exposed to beams of electrons, pions and muons in the energy range $E \leq 200$ GeV at the CERN SPS. Data have been taken in the endcap and forward calorimeter regions as well as in the transition region. This beam test set-up corresponds very closely to the geometry and support structures in ATLAS. A detailed study of the performance in the endcap and forward calorimeter regions is described. The data are compared with MC simulations based on GEANT 4 models.

Simulation / 54

Validation of the ATLAS Hadronic Calibration in scheme in Beam Tests (End-Cap)

Author: Giuseppe Francesco Tartarelli[1]

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Summary:

The high granularity of the ATLAS calorimeter and the large number of expected particles per event require a clustering algorithm that is able to suppress noise and pile-up efficiently. Therefore the topo cluster reconstruction is the essential first step in the hadronic calibration. The identification of electromagnetic components within a hadronic cluster using cluster shape variables is the next step in the hadronic calibration procedure. Finally the energy density of individual cells is used to assign the proper weight to

correct for the invisible energy deposits of hadrons due to the non-compensating
nature of the ATLAS calorimeter and to correct for energy losses in material non
instrumented with read-out.

The weighting scheme employs the energy density in individual cells. Therefore
the validation of the MC simulation, which is used to define the weighting
parameters and energy correction algorithms, is an essential step in the
hadronic calibration procedure.

Pion data, obtained in a beam test corresponding to the pseudorapidity region
$2.5 < |\eta| < 4.0$ in ATLAS and in the energy range $E \leq 200$ GeV, have been
compared with MC simulations, using the full ATLAS hadronic calibration
procedure.

Simulation / **55**

Overview on ATLAS Hadronic Calibration

Author: Giuseppe Francesco Tartarelli[1]

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Corresponding Authors: francesco.tartarelli@mi.infn.it, guennadi.pospelov@cern.ch

Summary:

The jet energy scale is one of the main systematic uncertainties in many physics
studies foreseen with the ATLAS detector. Top mass reconstruction or measurements of
inclusive jet cross-section might be just one example relevant for the first data taking phase already. The initial parton energy differs from
the energy of the hadronic shower because of detector effects, like non-compensation
and energy losses in dead material, jet algorithms and effects from the collision physics environment.

We present the concept of the local hadronic calibration for the ATLAS calorimeter
system as a tool to get calibrated jets at particle level for any jet algorithm. The
procedure is based on detailed Geant 4 simulations providing information on energy
deposits in all parts of the ATLAS detector.
In the first step topological clusters are reconstructed and calibrated at the
electromagnetic scale. Clusters which are identified as being electromagnetic
are kept at the electromagnetic scale. In the next step the energy density in
individual read-out cells is used to tag the electromagnetic

fraction in
clusters classified as hadronic and to correct for the invisible
energy
deposits of hadrons. The energy loss in inactive material is
derived for a
given cluster from related cluster quantities. Finally out-of-cluster
corrections and out-of-jet corrections are applied to get the
final jet energy
scale.

LHC / **56**

Performance of the ATLAS Forward Calorimeter

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[1] *MI*

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Summary:

The ATLAS forward calorimeter is a liquid argon calorimeter based on a novel tubular electrode structure. The talk will focus on the performance of the calorimeter for electrons and pions, based on the analysis of beam test data taken in the H6 beamline at CERN. ATLAS requirements on the forward calorimeter performance
will be reviewed, the calorimeter design and construction will be discussed, and the performance for electron and pions will be described.

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Radiation Hard Quartz Calorimetry

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Summary:

Using wavelenght shifting fibers, it is possible collect efficiently the Cherenkov light generated in quartz plates. This paper summarizes the results from various test beams, bench tests, and Geant4 simulations done on methods for collecting light from quartz plates, as well as radiation hardness tests on quartz material.

LHC / **59**

Performance of CMS ECAL Preshower in 2007 test beam

Author: SYUE-WEI LI[1]

[1] *National Central University, Taiwan*

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Summary:

The Preshower Detectors form part of the CMS Electromagnetic Calorimeter and are located in the endcap regions, just in front of the lead tungstate crystals. They consist of two orthogonal planes of silicon strip sensors interleaved with two planes of lead absorbers. A combined beam test of close-to-final prototypes of the Hadron calorimeter, the crystal calorimeter and the Preshower detector was performed in the summer of 2007. Calibrations were made using muon, electron, and pion data and the combined crystal and Preshower energy resolution was studied using electrons. Good signal/noise performance was obtained in both sets of measurements.

LHC / **60**

Calibration of the electromagnetic calorimeter of the CMS detector

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[1] *MIB*

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Summary:

The Electromagnetic Calorimeter (ECAL) of CMS is a hermetic homogeneous calorimeter
made of 61200 lead-tungstate scintillating crystals readout by avalanche-photodiodes in the barrel part, closed by 7324 crystals readout by vacuum-phototrieodes in each of the two end-caps. The calibration of the relative response of the individual channels, or intercalibration, and of the absolute energy scale for electrons and photons are severe technical challenge for the operation of ECAL. The channel response uniformity within ECAL and stability in time will contribute directly to the overall energy resolution. Complex procedures based on the use of events collected during LHC operation have been designed to achieve an ultimate intercalibration precision of 0.5%. A laser monitoring system will be used to track response variations with time, as in the case of changes in crystal transparency caused by irradiation. Trigger, selection and reconstruction procedures of calibration signals and their projected performance are discussed. Results of calibrations accomplished with electron beams and cosmic rays during the commissioning phase of the detector are also reviewed. These set the intercalibration precision at the startup of LHC operation and provide a reference for validation and further development of the procedures based on physics events. Reconstruction algorithms and effects affecting the energy measurement of electron and photons, such as containment effects or issues
related to conversions and bremmstrahlung radiation in the tracker material, are also discussed.

Simulation / **62**

Fast shower simulation in ATLAS Calorimeter

Authors: Adele Rimoldi[1]; Alexander Glazov[2]; Andrea Dell'Acqua[3]; Andrea DiSimone[3]; Anthony Waugh[4]; Bart Butler[5]; Charles Young[5]; Elisabetta Barberio[6]; Emlyn Hughes[7]; James Mueller[8]; Joseph Boudreau[8]; Manuel Venancio Gallas[3]; Pierre Savard[9]; Ringaile Placakyte[2]; Sing Leung Cheung[9]; Vakhtang Tsulaia[8]; Wolfgang Ehrenfeld[2]; Zachary Marshall[7]

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Summary:

The simulation of the ATLAS detector is largely dominated by the showering of electromagnetic particles in the heavy parts of the detector, especially the electromagnetic barrel and endcap calorimeters, when full showering is simulated by GEANT4. The ATLAS simulation includes a fast simulation option that achieves a significant improvement in simulation speed. In this technique, simulated showers from low-energy particles are "frozen" and stored in a library, that is distributed with each software release. These showers are then imported at runtime during physics simulation. The shower libraries are built and stored in separate "bins" in order to follow geometrical variations in calorimeter response. Simulation in the presence of frozen showers is then required to develop the shower down to ~ 1 GeV, at which point the shower is terminated by substituting a frozen shower. The procedure can now be applied in all of the electromagnetic compartments of the ATLAS calorimetry.

In this talk discuss mostly the frozen shower algorithms and their performance, but we also include a discussion of alternate approaches to fast shower simulation (e.g. Parameterization) that can have been applied in ATLAS.

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measurement and simulation of the neutron detection efficiency with a PB-scifi calorimeter

Author: Stefano Miscetti[1]

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Low angle calorimetry for KLOE-2

Author: Stefano Miscetti[1]

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Operating Calorimeters / 67

Calorimeters for absolute luminosity measurement at upgraded DAFNE

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Summary:

In order to provide a precise, fast and reliable measurement of the luminosity for
the e+e- collider of Frascati [DAFNE] during the crabbed waist collision tests in the
2008 run a set of calorimetric detectors have been designed, realized and put in
operation:
- a set of 2x2 half rings [back-to-back with respect to the interaction point],
realized by 5 trapezoidal sectors [covering 30 degrees in phi each] of sandwich
calorimeters [lead and scintillator read by WLS fibers]; these detectors have been
optimized for detecting Bhabha events in the angular range 18 to 27 degrees.
- a couple of back-to-back radiative Bhabha proportional counters, each made up of
four PbWO4 crystals, at very small angle [~1.7 mrad]. Those counters, thanks to the
very high rate, are essential for real-time optimization of the machine, even though
are sensitive to backgrounds and particles lost by the beams.
Those calorimeters have been carefully characterized and calibrated at the Frascati
BTF facility with electron beams [linearity, resolution and uniformity have been
measured]. Moreover, a full simulation of the setup has been performed using GEANT,
in order to have a precise determination of the acceptance, including the most
precise event generators for Bhabha processes and calculated paths for Touscheck
backgrounds.
The data acquisition system, capable of several kHz of rate and of measuring the dead
time with good accuracy, is based on the KLOE experiment DAQ and acquirese both the
analog signal fed into charge ADC and the digitized signals fed into TDC and scaler
for rate measurement and offline correction of the luminosity.

Calorimetric Techniques / 69

Recent results from the DREAM Project

Author: Richard Wigmans[1]

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Summary:

High-precision jet spectroscopy will be increasingly important in future high-energy accelerator experiments, particularly at a Linear e+e− Collider. DREAM (Dual REAd-out Method) calorimeters seem to be well suited for this task. The key aspect of DREAM
detectors is the simultaneous measurement of scintillation light and
Cherenkov light generated in the shower development process. By comparing these two signals,
the electromagnetic shower fraction can be measured event by event, both for single hadrons and
for jets, and the detrimental effects of fluctuations in this fraction can be eliminated. The merits of this technique were first illustrated with a calorimeter in which the two signals are provided by two different types of optical fibers. More recently, we have been concentrating on crystals (PbWO4 and BGO), which have the potential of eliminating (or at least reducing) the contributions of the next two important sources of fluctuations: photoelectron statistics and sampling fluctuations. I will describe the techniques used to unravel the signals from these crystals into Cherenkov and scintillation
components. The detailed time structure measurements we performed for these studies
also make it possible to measure the contributions of neutrons to the signals. This would
help to reduce the effects of fluctuations in nuclear binding energy losses, which is the last frontier in the quest for ultimate hadronic calorimetric performance.

Astrophysics and neutrinos / 70

Electromagnatic shower reconstruction with emulsion films in the OPERA experiment

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Summary:

OPERA is a long-baseline neutrino oscillation appearance experiment designed to obtain an unambiguous signature of $\nu_\mu \rightarrow \nu_\tau$ oscillation. The detector, located in the underground Gran Sasso Laboratories,
plans to detect ν_τ's in the CERN to Gran Sasso (CNGS) ν_μ
beam,
which is optimised for ν_τ appearance.
OPERA is an hybrid experiment with electronic detectors, iron magnets and Emulsion Cloud Chambers (ECC).
The ECC combines in one cell the high tracking precision of nuclear emulsions ($\sim$0.1 μm) and the large
target mass of the lead plates. The basic element, the "brick", has

dimensions of 12.7×10.2×7.5 cm^3; it is a sequence of 56 lead (1
mm
thick) and 57 emulsion films
(44 μm thick emulsion layers on either side of a 205 μm plastic base). The
total length of an OPERA ECC
module is about 10 X_0.
In addition of its very good tracking information capabiliy,
allowing for instance the detection of short-lived particles, the
ECC can be used as a fine sampling
electromagnetic calorimeter. We will report the method developped to reconstruct the
electromagnetic showers with ECC and the energy measurement in the 1-10 GeV
range.
The achieved energy resolution
is about $\frac{\sigma_E}{E} = \frac{40\%}{\sqrt{(E)}}$.
We will also
present the momentum measurement of the charged hadron using Mutiple Coulomb
Scattering used for the
hadronic shower reconstruction.

LHC / **72**

The ATLAS Tile Calorimeter: Commissioning and Preparation for Collisions

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Summary:

The ATLAS tile calorimeter is designed to measure the energy of hadron showers in the region of pseudo-rapidity up to eta=1.7 and is in charge of providing excellent hermiticity in this region, to allow for detection of missing energy due to escaping massive weakly interacting particles. The ATLAS tile calorimeter is made of steel absorbers, alternated with scintillating tiles, read out by wave length shifting fibers and photo-multiplier tubes. The ATLAS tile calorimeter incorporates three different calibration systems, that allow to separately calibrate the response of i) the scintillating tiles, ii) the photo-tubes and iii) the front end electronics. The calibration systems also allow a precise timing of the data acquisition in preparation for collisions.

The ATLAS tile calorimeter assembly in the underground ATLAS cavern was completed in 2006. Since then all calorimeter services have been installed, and all front end electronics have been tested and commissioned on site. The tile calorimeter is now completely operated from the ATLAS surface control room and has been used to acquire large data sets of cosmic rays used to test the stability of operation and to validate the data acquisition system, remote detector control systems, data quality monitoring and offline data processing. Results of the nearly completely commissioned tile calorimeter are shown as well as the outcome of the first operations with cosmics rays. The status of the calibration systems and first calibration results are also shown.

Simulation / **73**

Progress in hadronic physics modeling in Geant4

Authors: Alberto Ribon[1]; Dennis Wright[2]; Giacomo Cuttone[3]; Gunter Folger[1]; John Apostolakis[1]; Sunanda Banerjee[4]

[1] *CERN*

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Summary:

Geant4 offers a set of models to simulate hadronic showers in calorimeters. Recent improvements to several models relevant to the modeling of hadronic showers will be discussed. These improvements include improved cross sections, a revision of the FTF model, the addition of quasi-elastic scattering to the QGS model, and improvements in the nuclear precompound and de-excitation models. The validation of physics models against thin target experiments has been extended especially around and below 10 GeV. Examples of new validation results will be shown.

Calorimetric Techniques / **74**

Detection of K+ mesons in segmented electromagnetic calorimeters

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Summary:

The combination of the CrystalBall and TAPS electromagnetic calorimeters were installed in the MAMI A2 hall in 2003. Here they are able to detect the reaction products from photo-induced reactions in combination with the Glasgow photon tagger.
In the first round of data taking they allowed a diverse series of experiments such as the study of eta decays, radiative delta decay, multi-pion photoproduction using a proton target as well as coherent pion production and medium modifications on nuclear
targets.
In the last two years the MAMI-B electron beam was upgraded from 880MeV to the 1.5GeV MAMI-C, the A2 photon tagger underwent a similar upgrade. One significant aspect of this was it crossed the threshold for strangeness photoproduction experiments. The intense photon beam with excellent energy resolution from the tagger
now give the A2 collaboration the opportunity to make detailed measurements of strangeness photoproduction close to threshold. The challenge is to identify K+ mesons above the background from other charged hadrons, where the relative Kaon cross
section is very small and the detector setup does not benefit from a magnetic field to help separate particle species. One solution outlined in this presentation is to identify the decay of the K+ stopped in the either of the calorimeters through different time signatures in neighbouring crystals and use this to tag a strangeness reaction.

Calorimetric Techniques / **75**

The ALICE Electromagnetic Calorimeter Project

Author: Federico Ronchetti[1]

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Summary:

The ALICE Experiment (A Large Ion Collider Experiment) aims to study the properties of quark-gluon matter using Pb-Pb collisions at a center of mass energy (per nucleon pair) of sqrt(sNN) = 5.5 TeV with the Large Hadron Collider (LHC) at CERN.
The EMCAL consists in a large area electromagnetic calorimeter able to extend the measured momentum range of photons and electrons by over an order of magnitude. In addition, the EMCAL will enhance the capability of the overall ALICE setup to perform better jet reconstruction by measurement of the neutral energy component of jets, photons and neutral pions. The EMCAL will also produce a fast high-pT trigger: the anticipated minimum bias average Pb-Pb interaction rate is very high (around 8 kHz), thus a fast high-pT trigger will provide an enhancement in high PT events in central collisions.
The EMCAL covers a geometrical region from -0.7≤eta≤0.7 (in pseudo-rapidity eta) and 120deg in the azimuthal angle phi. In particular, the phi-coverage of the EMCAL has been chosen to allow the detection of gamma-jet events in coincidence with the other ALICE complementary calorimeter, the PHOS.
The EMCAL is a modular sampling calorimeter: it can measure showers up to 20 radiation lengths. Each module is composed by 4 towers of a Pb-scintllator sandwich (shashlik). The shape of the basic module is tapered to allow a projective geometry of the final assembly with respect to the interaction point. An assembly of 12x24 modules is called a super-module. The complete EMCAL is a high granularity detector containing 11 super modules for a total of 12.672 towers.
An independent optical readout of each tower is provided using wavelength shifting fibers coupled to an APD (Avalanche Photo Diod). The APD readout was chosen since the EMCAL has to operate in a high B-field environment created by the solenoidal magnet. The gain of the APD is monitored using LED activated scintillator installed on into each module.

Astrophysics and neutrinos / **77**

The ArDM project: A Liquid Argon TPC for Dark Matter Detection

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Calorimetric Techniques / **78**

The electromagnetic calorimeter of the PANDA experiment at FAIR.

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Summary:

The electromagnetic calorimeter of the PANDA experiment at FAIR.
P. Rosier, IPN Orsay, for the PANDA collaboration.
The PANDA electromagnetic calorimeter will be installed on the HESR ring of the FAIR accelerator. Based on the CMS experiment, this calorimeter comprises 19040 lead-tungstate crystals on a nearly 4π coverage. The large dynamic range from several GeV down to a detection threshold of some MeV for EM radiation and the expected high background rate of neutrons and ions will impose severe requirements on crystals and light sensors. This paper presents the status of the R&D studies performed on different aspects: behaviour of PWO-II crystals and photo sensors especially on the radiation hardness, electronics development, particle rate simulations, mechanical design and integration of the cooling at -25℃ stabilized at +/-0.1℃. All these informations rely on the construction and tests of a real-size prototype of 60 crystals. The writing of the EMC Technical Design Report is almost performed and presents the advanced level of the definition. The crystals production and quality control are in preparation and are foreseen to be in the continuity of the CMS production.

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Dual-Readout Calorimetry with Crystals

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Summary:

The energy resolution of a calorimeter is determined by fluctuations. In almost all calorimeters the electromagnetic shower fraction fluctuation dominate the energy resolution for hadrons and jets. The DREAM sampling calorimeter was built to eliminate this source of fluctuations by allowing a determination, on an event-by-event basis, of the electromagnetic shower fraction. This is achieved by sampling the energy deposited in the calorimeter with two different active media, scintillating and quartz fibers, which measure respectively the scintillating and the Cherenkov light produced by the shower. The energy resolution of the DREAM calorimeter is however not only limited by the sampling fluctuations but also by the small Cherenkov light yield (8 photoelectrons per GeV) which contributes more than 35%/sqrt(E) to the measured hadronic energy resolution. In order to improve this we investigated the possibility of using the dual-readout

approach in homogeneous calorimeters. This can be done provided that a way is found to distinguish the Cherenkov and the scintillating light produced by the shower in the homogeneous medium. In this presentation a report on the studies performed with lead-tungstate and BGO crystals will be given.

LHC / 80

ATLAS Tile Calorimeter performance for single particles in beam tests

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Summary:

The modules of the ATLAS Tile hadronic calorimeter (Tilecal) underwent extensive tests in the SPS beams at CERN. Studies were carried out with electrons, muons and hadrons ranging in energy from 10 GeV to 350 GeV.
The Tilecal calibration systems and energy reconstruction algorithms were also studied in great details, the associated systematics has been evaluated. The updated calibration scheme led to improved linearity and uniformity of the response.
Electrons and muons were used to set and understand the EM scale and the uniformity of the calorimeter. The pion response shows the expected behaviour with energy. The performance of the real Tile calorimeter modules to pions in terms of linearity and resolution corresponds well to that of earlier Tilecal prototype modules, after accounting for the different lengths and segmentations of the calorimeters.
The experimental results are also compared to several MC simulation samples.

LHC / 83

The ALICE PHOS Calorimeter

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Summary:

The ALICE detector has been designed to study the strongly interacting matter created in nucleus-nucleus collisions at the Large Hadron Collider~(LHC). Measurement of direct photons is probing the initial state of the interactions. In the heavy ion collisions program at LHC, it is very critical to measure thermal radiated photons, which is known to carry the temperature information of created hot medium, with very fine energy and position resolution.

The ALICE PHOton Spectrometer~(PHOS) consists of 17920 PWO crystals to each having size of $22 \times 22 \times 180mm$ and Avalanche Photo Diode~ (APD) for readout of scintillation light. First PHOS module consisting of 3584 crystals was constructed and tested by utilizing 2GeV/{\it c} electron beam in the summer of 2006 and cosmic rays in 2007. The HV bias for APDs were calibrated in order to obtain equal gain for better trigger performance. Second PHOS module is under construction and installed for the first p+p collisions at LHC. Further research and development program for improved performance of PHOS as a electro-magnetic calorimeter are under studying.

In this paper, we will present the construction and installation status of the PHOS modules and performance results. In addition, physics potential with the PHOS module during the first physics run of LHC will be discussed.

LHC / **85**

Calorimetry triggering in ATLAS

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Summary:

The ATLAS experiment is preparing for data taking at 14 TeV collision energy. A very rich discovery physics programme is being prepared in addition to the detailed study of Standard Model processes which will be produced in abundance. The ATLAS multi-level trigger system is designed to accept one event in 2*10*5 to enable the selection of rare and unusual physics events. The ATLAS calorimeter system is a precise instrument, which includes liquid Argon electro-magnetic and hadronic components as well as a scintillator-tile hadronic calorimeter. All these components are used in the various levels of the trigger system. A wide physics coverage is ensured by inclusively selecting events with candidate electrons, photons, taus, jets or those with large missing transverse energy.

In this paper, we will present the ATLAS calorimetry triggers in detail, focusing on the overall design, the selection algorithms and their performance as well as the preparation of the associated trigger menus. ATLAS is now preparing for initial data taking expected to start in summer 2008. The commissioning of the trigger system using cosmic ray events and by replaying simulated Monte Carlo events through the trigger and data acquisition system will also be presented.

Simulation / **86**

The response of the ATLAS Tile Calorimeter to pions and protons

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Summary:

The response of pions and protons in the energy range of 20 to 180 GeV produced at CERN's SPS H8 test beam line in the ATLAS iron-scintillator Tile hadron calorimeter has been measured. The test-beam configuration allowed to measure the longitudinal shower development for pions and protons up to 20 nuclear interaction lengths. It is found that pions penetrate deeper in the calorimeter than protons. However, protons induce showers that are wider laterally to the direction of the impinging particle. Including the measured total energy response, the pion to proton energy ratio and the resolution, all observations are consistent with a higher electromagnetic energy fraction in pion induced showers. The data are compared with GEANT4 simulations using several hadronic physics lists.

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Study of the response of the central ATLAS calorimeters to pions from 3 to 9 GeV

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89

Estimate of neutrons event-by-event in the DREAM module

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Summary:

Dual readout calorimetry has so far focussed on the large fluctuations in the electromagnetic content of hadronic showers (\fem) which degrade the performance in several respects: poor energy resolution, a non-Gaussian response function, and a non-linear response with increasing hadron energy. The next largest fluctuation is the binding energy loss that is proportional to the MeV neutrons liberated in nuclear break-up.

These liberated neutrons have velocities about $v \sim 0.05c$ and fill the volume of the module like a gas. We expect to find the neutron signal in the long-time tails of the plastic scintillating fibers which record the recoil protons in $np \rightarrow np$ elastic scatters, through which the neutrons rapidly lose kinetic energy as $\Delta E_n/E_n \approx 1/2$ per elastic scatter. The \dream collaboration is seeking a means to attain the 'ultimate' calorimeter energy resolution, and a measurement of the neutron content shower-by-shower is one component of that goal.

Operating Calorimeters / 90

Calibration of the BaBar CsI(TL) Calorimeter

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Operating Calorimeters / **91**

Status of Electromagnetic Calorimeter in BESIII（Beijing Spectrometer）

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Summary:

According to the general physics requirements of BES, the design
of EMC is
based on CsI(Tl) crystals. There are a total piece of 6272
CsI(Tl) crystals are
used and with a total weight of about 24 tons.
Mass production Quality Control : 1. Crystal Light Production and
Uniformity, 2.
Crystal Dimension, 3, Crystal Radiation Hardness,
4. Cosmic Rays test 。
Up to now EMC assembly were finished and cosmic-ray test were down .

Astrophysics and neutrinos / **93**

The AMS-02 3D Imaging calorimeter : a tool for cosmic ray physics in space

Authors: Franco Cervelli et al,[1]; Sylvie Rosier Lees[2]

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Summary:

AMS-02 is an astroparticle experiment that will operate on board of the ISS for a period of about three years. The main scientific goals of the experiment are the search for antimatter and dark matter, the high precision measurement of charged cosmic ray spectra and fluxes and the study of gamma rays, in the GeV to TeV energy range. In AMS-02 the Electromagnetic Calorimeter (ECAL) is required to measure e+, e-
and gamma spectra and to discriminate electromagnetic showers from hadronic cascades.
To fulfill these requirements ECAL is based on a lead/scintillating fiber sandwich, providing a 3D imaging reconstruction of the showers. The electronics equipping the

detector, with low noise and challenging dynamic range readout, was designed following stringent requirements on mechanical and thermal stability, power consumption, radiation hardness and double redundancy. The full system had successfully gone through the space qualification tests. the ECAL Flight Model has been calibrated during Summer 2007 in a test beam at CERN, using 6 to 250 GeV electron and proton beams. Results on the measurements of ECAL parameters and performance are reported.

Operating Calorimeters / **94**

The Crystal-Barrel/TAPS-Experiment at ELSA

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Summary:

One aim of the Crystal-Barrel-Experiment is to gain a detailed knowledge on the
spectrum and the properties of baryon resonances to contribute to a better
understanding of strong QCD in the non-perturbative regime. The experimental setup
includes three different φ-symmetric calorimeters covering almost the
complete solid angle. The Crystal-Barrel/TAPS detector system together with a
polarized target and a linear or circular polarized photon-beam, allows in addtion to
the measurement of cross sections also the measurement of double-polarisation
observables. Resonances up to masses of 2.5~GeV can be investigated.\\
In the talk the readout system of the two CsI(Tl) calorimeters will be discussed as
well as their performance including the time-, energy-resolutions reached and their
charge identification capabilities.\\
While Crystal-Barrel-Calorimeter is presently read out with photodiodes, the
Forward-Detector features a photomultiplier readout including an online cluster
finder for first-level-triggering. For the future it is planned to improve the
trigger capabilties of the Crystal-Barrel-Calorimeter, presently included in the
second level trigger only; two options, APDs and SiPMs, will be discussed.

LHC / **95**

Commissioning and calibration of the ALICE Zero Degree Calorimeters

Author: Nora De Marco[1]

Co-authors: Alberto Masoni [2]; Alessandro De Falco [3]; Alessandro Ferretti [4]; Alfredo Musso [5]; Anna Piccotti [5]; Chiara Oppedisano [5]; Corrado Cicalo' [2]; Diego Stocco [4]; Elisabetta Siddi [3]; Emilio Chiavassa [4]; Enrico Scomparin [5]; Ermanno Vercellin [4]; Francesca Poggio [4]; Gianluca Usai [3]; Giovanna Puddu [3]; Giuseppe Dellacasa [6]; Grazia Luparello [4]; Martino Gagliardi [4]; Mauro Gallio [4]; Michele Floris [3]; Paolo Mereu [5]; Pietro Cortese [6]; Roberta Arnaldi [5]; Roberto Gemme [6]; Sergio Serci [3]

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[4] *Universita' di Torino and INFN-TO*

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[6] *Universita' del Piemonte Orientale and INFN-TO*

Summary:

The Zero Degree Calorimeters (ZDCs) for the ALICE experiment will measure
the energy of the spectator nucleons in heavy ion collisions at the CERN LHC.
The ZDCs consist of a neutron (ZN) calorimeter, placed between the two beam
pipes, and a proton (ZP) calorimeter, positioned externally to the outgoing
beam pipe at 116 m from the interaction point.
The ZDCs are spaghetti calorimeters, which detect the Cherenkov light
produced by the shower particles in silica optical fibers embedded in a dense
absorber.
In summer 2007 the ZN and ZP calorimeters have been integrated on the surface
on a movable platform and then installed in the LHC tunnel.
The results of the commissioning on the surface, in particular the solutions adopted to control the stability of the PMTs response will be shown: light injection with a laser diode and cosmic rays.
The forseen physical calibration in Pb-Pb collisions will be also discussed.
Finally the first measurements of the commissioning in the LHC tunnel will be
presented.

Astrophysics and neutrinos / **97**

The Mini-Calorimeter onboard AGILE: the first year in space

Author: Martino Marisaldi[1]

Co-authors: Alessio Trois [2]; Andrea Argan [2]; Andrea Bulgarelli [1]; Claudio Labanti [1]; Fabio Fuschino [1]; Fulvio Gianotti [1]; Guido Di Cocco [1]; Marcello Galli [3]; Marco Tavani [2]; Massimo Trifoglio [1]

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[3] *ENEA*

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Summary:

AGILE, the Italian space mission dedicated to gamma and hard-X astrophysics, was succesfully launched on 23 April 2007 and is currently fully operative. The Mini-Calorimeter (MCAL) onboard the AGILE satellite is a scintillation detector made of 20 kg of segmented CsI(Tl) scintillators with photodiode readout with a total geometrical area of 1400 cm2. MCAL can work both as a slave of the AGILE Silicon tracker and as an independent detector for gamma-ray bursts (GRB) detection in the 300 keV - 200 MeV energy range. Despite its limited thickness, due to weight constraints, MCAL has proven to succesfully self-trigger GRBs at MeV energies providing photon-by-photon data with less than 2 microsec time resolution and almost all-sky detection capabilities. The MCAL design and characteristics, as well as the inflight performance after one year of operation in space and the scientific results obtained so far will be reviewed and discussed.

Operating Calorimeters / **98**

Performance and Operation of the Crystal Calorimeter of the BaBar Detector

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Calorimetric Techniques / **99**

Construction and tests of a fine granularity lead-scintillating fibers calorimeter

Authors: Antonio Passeri[1]; Biagio Di Micco[2]; Filippo Ceradini[2]; Paolo Branchini[2]

[1] *INFN e Universita' Roma Tre*

[2] *RM3*

Summary:

We present a fine granularity development of the KLOE lead-scintillating fibers calorimeter. A 23x15x55 cm^3 prototype, made of 200 grooved lead foils, 0.5 mm thick, glued with scintillating fibers at 1.35 mm pitch, has been instrumented on one side with an array of 3x5 light guides and PMTs each covering a 4.2x4.2 cm^2 cells, while on the opposite side the granularity has been increased by a factor of 16 by means of small light guides and multianode photomultipliers. Scintillating light is collected on the calorimeter side surface in 1.05x1.05 cm^2 cells, corresponding to about 64 scintillating fibers, by means of truncated pyramid light guides made of UV trasparent material (Bicron BC800), and is driven to 16 anode PMTs (Hamamatsu R8900-M16) with an area reduction factor of 4. A total of 240 readout pixels is obtained in this way, making of this detector a real tracking calorimeter.
Each multianode PMT corresponds to a single anode PMT on the opposite calorimeter side. Also, the first raw is equipped with high quantum efficiency multianode PMTs. Each multianode provide also an OR of the 16 last dynodes which can be udes for triggering. A dedicated electronic to collect and amplify the multianode signals has been developed. Signals

are then split, summed to make trigger patterns and digitalized in ADCs and TDCs using the standard KLOE calorimeter electronic chain.
Here we describe the construction details, the measurement of the multianode PMTs response and intrinsic cross talk using a ps laser pulse, the measurement of the optical cross talk between adjacent light guides using the same laser to illuminate single scintillating fibers on the side opposite to the readout, and finally a cosmic ray test of the full device. A first comparison of cosmics data with a detailed simulation of the detector based on the FLUKA code is also possible.

Operating Calorimeters / **100**

STAR Detector Calorimetry

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Astrophysics and neutrinos / **101**

Atmospheric Calorimetry above 10^19 eV: Shooting Lasers at the Pierre Auger Cosmic-Ray Observatory

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Summary:

The Pierre Auger Cosmic-Ray Observatory uses the earth's atmosphere as a calorimeter to measure extensive air-showers created by particles of astrophysical origin. Some of these particles carry joules of energy. At these extreme energies, test beams are not available in the conventional sense. Yet understanding the energy response of the observatory is important because the distance the highest energy cosmic-rays propagate through the cosmic microwave background radiation is predicted to be strong function of energy. This talk will discuss recently reported results from the observatory and the use of calibrated laser "test-beams" that simulate the optical signatures of ultra-high energy cosmic rays. The status of the much larger (200,000 km^3) companion detector planned for the northern hemisphere will also be outlined.

Astrophysics and neutrinos / **102**

SciBar Detector for SciBooNE

Author: Hideyuki Takei[1]

[1] *Tokyo Institute of Technology*

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Astrophysics and neutrinos / **104**

The electromagnetic calorimeter (EC) at SciBooNE

Author: Camillo mariani[1]

[1] *Columbia University*

Corresponding Author: mariani@fnal.gov

Summary:

EC operation and performance are discussed in this talk.

Operating Calorimeters / **105**

The Performance and Operation of the D0 Calorimeter

Author: Daniel Duggan[1]

[1] *Florida State University*

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Summary:

The operation and performance of the D0 calorimeter is presented. We review the overall design of the three cryostat 17 layer, ~50,000 readout channel liquid argon sampling detector. A review of the calorimeter operations will be presented with specific focus on calibration techniques, hardware monitoring and stability, and overall data quality strategies. The aim of this talk is to review the techniques and systems that were developed to optimize the resolution and performance of the D0 calorimeter.

LHC / **106**

CMS HCAL Installation and Commissioning

Author: Kerem Cankocak[1]

[1] *Iowa University*

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Summary:

The CMS hadron calorimeter system consists of brass/scintillator sampling hadron calorimeter (HCAL) with coverage up to $|\eta| \leq 3.0$, followed by the iron/quartz-fibre Hadron Forward (HF) calorimeter with coverage $3.0 \leq |\eta| \leq 5.0$, comprising 9528 readout channels in total. The installation and commissioning of the Hadron Barrel

(HB), Hadron Outer (HO), Hadron Endcap (HE) and Hadron Forward (HF) calorimeters using local and global runs is described. The performance of the various monitoring systems, the progress in the calibration work and the current plans for the HCAL calorimeter during the low luminosity run will be summarized. During the commissioning period, various technical and cosmic ray data were taken using the global trigger system of the CMS detector. The preliminary results of those runs will be reported.

Astrophysics and neutrinos / 107

The ANTARES underwater neutrino telescope

Author: Oleg Kalekin[1]

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Calorimetric Techniques / 109

Crystal Calorimeters in the Next Decade

Author: Ren-yuan Zhu[1]

[1] *Caltech*

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Summary:

Crystal calorimeter has traditionally played an important role in precision measurements of electrons and photons in high energy physics experiments. Recent interest in calorimeter technology with dual readout extends its application to measurement of hadrons and jets. Potential application of new generation scintillating crystals of high density and high light yield, such as LSO and LYSO, in high energy physics experiment will be elaborated. Candidate crystals for the proposed homogeneous hadron calorimeter will also be discussed.

Calorimetric Techniques / 112

Jet Energy Scale at D0

Author: Jeroen Hegeman[1]

Co-author: Stefan Soldner-Rembold [2]

[1] *NIKHEF*

[2] *University of Manchester*

Corresponding Author: jhegeman@nikhef.nl

Summary:

The talk will present the overview of the jet energy calibration procedure at D0 followed by the discussion of systematic uncertainties and the validation studies. An extension of previously used methods together with careful treatement of additional biases yields significant improvements in the precision which reached the level of 1-1.5% over a wide range of jet energies and rapidities. The results obtained have a direct impact on the quality of physics measurements, because the jet energy scale calibration is a leading systematic uncertainty in many measurements. The procedures developed and the experience gained at the Tevatron could benefit LHC experiments.

Operating Calorimeters / **114**

CDF Calorimetry

Author: Giovanni Pauletta[1]

[1] *Università di Udine*

Summary:

All electromagnetic and hadronic components of the The CDF run II calorimeter system are scintillator - based sampling calorimeters employing both older (Run I) and newer fiber - based techniques for light collection and extraction. The system has now been operating successfully for several years and is presently taking data at high luminosity thanks to its design characteristics and upgrades of its
frontend daq and trigger electronics. The calorimeter system will be
described with due consideration for calibration and maintenance techniques required for the preservation of data quality and stability
and its performance will be summarized with reference to design expectations.

Operating Calorimeters / **115**

The MEG liquid xenon calorimeter

Author: Giovanni Gallucci[1]

[1] *INFN Pisa*

Summary:

The MEG experiment at PSI, starting data taking this year, searches for the muon
decay into one electron and one photon with a sensitivity to branching ratios around
10-13, two order of magnitudes better with respect to the present best experimental

limit. To reach this goal a new kind of large acceptance, large mass (roughly 2.2
Tons) calorimeter based on liquid xenon scintillation light was developed. The
several calibration techniques developed to monitor the calorimeter behaviour during
all the experiment data taking will be shown together with the experimental
resolutions obtained.

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pluto 3

Author: Diana Scannicchio[1]

[1] *INFN Pavia*

Astrophysics and neutrinos / 118

Results of the Pierre Auger Observatory on Ultra High Energy Cosmic Rays

Author: Julio Lozano Bahilo[1]

[1] *University of Granada*

Summary:

The Pierre Auger Observatory is a detector for cosmic rays that makes special
emphasis on the study of primaries with energies greater than 1019 eV. It consists of
1600 water tanks covering a surface of 3000 km2 and fluorescence detectors located in
4 stations overlooking that area which take data in coincidence with the tanks on
clear moonless nights.
This hybrid arrangement allows a determination of the energy and incidence angles of
each cosmic ray with small systematic errors. Data has been gathered steadily for the
last years while the detector components were being installed. Results on the
spectrum, composition, high energy photon and neutrino flux limits and anisotropy of
cosmic rays with energy in excess of 1019 eV will be presented.

New Techniques: Simulation and Particle Flow Calorimetry / 119

Simulation of the 4th concept calorimeter

New Techniques: Simulation and Particle Flow Calorimetry / 120

The CALICE test beam programme

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Effects of temperature dependence of the signals from Lead Tungstate

New Techniques: Simulation and Particle Flow Calorimetry / 122

Response of the CALICE SiW ECAL prototype to electrons

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Separation of Cerenkov and Scintillation signales in BGO and PBWO4 crystals

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Tests of a Digital HCAL

New Techniques: Multi-Readout Calorimetry / 125

Dual-readout Calorimetry with Crystals

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Semiconductor Sensors of the CALICE SiW ECAL and Study of the cross-talk between pixels and guard rings

New Techniques: Multi-Readout Calorimetry / 127

Estimate of neutrons event-by-event in DREAM

New Techniques: Multi-Readout Calorimetry / 128

Time profile analysis of photodetector signals in multi read-out calorimetry with GHz samplers

New Techniques: Simulation and Particle Flow Calorimetry / 129

Test of Digital HCAL

New Techniques: Simulation and Particle Flow Calorimetry / 130

Semiconductor sensors for the CALICE SiW EMC and Study of the Cross-talk between Guard Rings and Pixels in the CALICE SiW Prototype

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New Techniques: Multi-Readout Calorimetry / 131

Effects of temperature dependence of the signals from Lead Tungstate

New Techniques: Multi-Readout Calorimetry / 132

Separation of BGO/PbWO4 signals into Cherenkov and scintillation component

LHC / 133

Calorimeters: key detectors for LHC physics

LHC / 134

The CMS crystal calorimeter

LHC / **135**

Performance of the ATLAS LAr barrel calorimeter in the 2004 combined test beam

Corresponding Author: nicolas.kerschen@cern.ch

Simulation / **136**

MC comparison in the ATLAS Combined test-beam

Corresponding Author: peter.speckmayer@cern.ch

Simulation / **137**

CALICE scintillator HCAL - electromagnetic and hadronic shower analysis

Corresponding Author: erika.garutti@desy.de

LHC / **138**

The electronics calibration of the ATLAS LAr Calorimeter and commissioning of the detector with cosmic muon signals

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Calorimetric Techniques / **139**

The CMS-HF Calorimeters: the radiation hard quartz calorimetry

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Calorimetric Techniques / **140**

measurement and simulation of the neutron detection efficiency with a PB-scifi calorimeter

Calorimetric Techniques / **141**

The CALICE SciW Calorimeter Prototype

Corresponding Author: danjeans@gmail.com

Conference Opening Session / **143**

The contributions of the University of Pavia to scientific culture

Conference Opening Session / **144**

Physics with calorimeters

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Conference Opening Session / **145**

Welcome