Menu

- The MoEDAL Experiment Intro
  - The MoEDAL Detector
  - The Physics Program
- Progress since last report
  - MoEDAL Collaboration – new faces
  - MoEDAL Construction and deployment
- Conclusion & Timescale
The MoEDAL detector design consists of 4 subdetectors, the:

- **Low Threshold** (≥ 5xMIP) Nuclear Track Detector (LT-NTD) system
- **High Charge Catcher** (HCC) NTD array (≥ 50 xMIP)
- **Magnetic Monopole/Exotics Trapper** (MMT) Al trapping volumes
- **TimePix pixel device** (TMPX) array online radiation monitoring system
Scanning & Analysis of MoEDAL NTDs

• Analysis of MoEDAL NTDs by High Rate Optical Scanning (AMPHROS) – developed by Muenster-MoEDAL group
  – Computer controlled, online adjustable sub-micron resolution, CCD readout optical scanning microscope – 3D scan capable for signal pits
  – Very high scan rate 60-100 frames /sec → 100 cm² in 40 minutes
  – Specialized image enhancement/pattern recognition software

CR39 exposed (1 yr) at IP8 & to a Fe ion beam at BNL

Pits made by Fe ions (signal)

Minimally enhanced no magn.
Physics Program (34 Scenarios)

The search for the highly ionizing particle avatars of new physics

- Magnetic Charge: 6 scenarios, eg EW Monopole, D particles, etc.
- SUSY: 9 scenarios, eg metastable stop quarks and sleptons, etc
- Extra Dimensions: 5 scenarios: eg BH remnants, KK particles etc.
- “Other Scenarios” involving singly electrically charged particles: 6 scenarios: eg long lived massive quarks, 4th generation fermions, etc
- Multiply charged particles: 8 scenarios: eg doubly charged Higgs, doubly charged leptons, Q-balls, strangelets, quirks

To be published in IJMPA

The Physics Programme Of The MoEDAL Experiment At The LHC


(Submitted on 29 May 2014)
The Analysis Effort & MoEDAL Software


- MoEDAL is using the LHCb software framework (GAUSS, etc.)
- Active priority for all MoEDAL analyses- define the material & detector map in the VELO cavern:
  - Current LHCb map only accurate enough for our needs in LHCb accept.
- Active priority for all MoEDAL analyses - implement monopole physics ($E_{loss}$ etc) in the LHCb framework for $\beta \geq 10^{-4}$
MoEDAL’s Complementarity

Optimized for highly ionizing particles
Insensitive to SM particles
Can directly detect & trap magnetic charge
Calibrated by heavy-ions

Optimized for SM relativistic MIPs & photons
Cannot directly detect magnetic charge
Cannot be directly calibrated for highly ionizing particles

The totally different systematics of the MoEDAL and the ATLAS/CMS experiments will yield important validation of and insights into a joint observation of new physics
IN PREPARATION

1. “Search for magnetic monopoles with the MoEDAL NTD detectors at the LHC with 7 TeV & 8 TeV Ecm”, in prep., to be submitted to Phys.Rev. D

2. “Search for magnetic monopoles with the MoEDAL Trapping detectors at the LHC with 7 TeV & 8 TeV Ecm”, in prep., to be submitted to Phys.Rev.D

3. “The ATLAS Detector at the LHC” in prep., to be submitted to NIMA.
The Collaboration

Now 64 physicists from 12 countries and 23 institutions:
Three New MoEDAL Groups

Institute of Nuclear Physics, Polish Academy of Sciences
Konkuk University, Seoul South Korea
Gangneung Wonju University, South Korea

Twenty-two New MoEDAL Collaborators

Make That Four New Groups

In Jan. 2014 the STAR Centre Simon Langton Grammar School for Boys in the UK joined the MoEDAL Collaboration.

The responsibility will be to help monitor the highly ionizing radiation background in MoEDAL using the TimePix array.

Senior MoEDAL collaborators: B. Parker & T. Whyntie
June MoEDAL Meeting at CERN

Key issues: preparing for installation and finalizing the MoU
Installation of MoEDAL – Fall 2014

- Installation document supplied to LHCb
- Presentation to LHCb technical coordination on 17th June
- Present plan has installation starting in June and ending in October
- All critical components obtained or on order.

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Prep. and Installation of TMPX

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7-10 TimePix devices placed at various points around the MoEDAL cavern to monitor HIP radiation background

TimPix devices will be monitored via the web.
Fabrication & Installation of MMT

- **Trapping volumes comprised of ~1 Tonne of 1” Al bar deployed under the LHCb-VELO detector (supported from concrete floor)**
- **Bars are replaced once a year and the exposed volumes monitored by a remote SQUID magnetometer and UG detectors**
Prep. + Installation of LT-NTDs

- The LT-TDR detector consists of 3 sheets of CR39 and 3 sheets of Makrofol – the threshold for the CR39 is ~5 MIPs
- Response of NTDs monitored with alpha particles & heavy ions
- Total area of plastic 60 sqm of CR39 & 60 sqm of Makrofol
The HCC detector consists of 3 Makrofol foils in an aluminium foil envelope. – the threshold for the Makrofol is ~40-50 MIPs

MCC detectors are low mass (0.4% RL) and flexible - total area of HCC plastic 30 sqm of Makrofol

Propose to place these HCCs on DS face of LHCb-TT1 housing
Sensitivity to Highly Ionizing Particles

Cross-section limits for magnetic (LEFT) and electric charge (RIGHT) (from arXiv:1112.2999v2 [hep-ph]) assuming:

- Only one MoEDAL event is required for discovery and 10 (left) – 100 (right) events in the other (active) LHC detector.
Summary: Progress Since last Report

- The size of the collaboration increased again by ~50%
- A program detailing the physics program of MoEDAL is now available on the arXiv (to be published in IJMPA)
  - Papers detailing results of test deployments at Ecm of 7 & 8 TeV running in preparation.
- Plan for construction and installation of full detector by end of October 2014 in progress and under discussion with LHCb
  - Prototype of Analysis of MoEDAL NTDs by High Rate Optical Scanning (AMPHROS) – being studied but looks good so far
- No show stoppers evident for the first official run of MoEDAL in the Spring of 2015.
- Plan to run until we have ~10 fb\(^{-1}\) or a discovery!