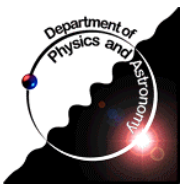
ATLAS
at the
University of Victoria



M. Lefebvre
NSERC Site Visit
October 16th 2000

- **The ATLAS Experiment**
- **Personnel**
- **Responsibilities and Activities**
  - Physics Investigations
  - Endcap Signal Feedthrough Project
  - Endcap Hadronic Liquid Argon Calorimeter
  - Software
- **Future Plans**

The ATLAS Experiment

Probe nature at the energy frontier with 14TeV pp collisions at the LHC

First Collisions expected late 2005

Highlights of the experimental programme:

- **Higgs Boson**

  SM Higgs searches

  MSSM Higgs searches

- **Supersymmetry**

  squarks and gluinos

  SUGRA, gauge mediated SUSY breaking and R-parity breaking models

- **More Searches**

  new gauge bosons, extra dimensions, monopoles, technicolour, excited quarks, leptoquarks, compositeness...

- **Standard Model Physics**

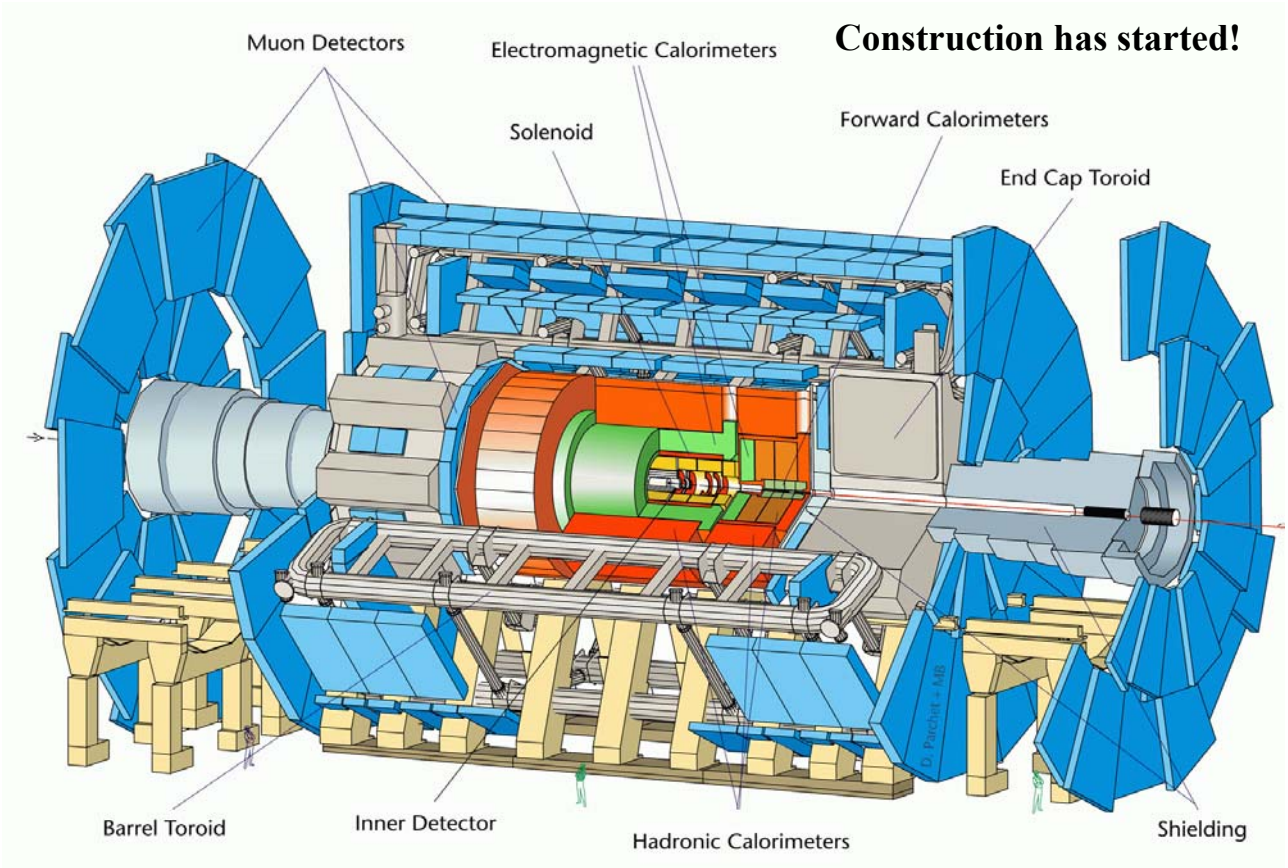
  QCD processes: hard diffractive, jets, photons, heavy flavours

  Electroweak gauge bosons: W mass, gauge boson pair production

  B physics: CP violation, Bs oscillation, rare decays, B hadrons

  Heavy quarks and leptons: top, electroweak single top quark production, 4th generation quarks

The ATLAS Detector



Construction has started!

ATLAS and Canada

Activities focused on LAr Calorimetry

4 Major Projects Funded by a Major Installation Grant

- **Endcap Hadronic Calorimeter**
- **Forward Hadronic Calorimeter**
- **Front-End-Board Electronics**
- **Endcap Signal Cryogenics Feedthroughs**

Important Activities

- **Radiation Hardness Studies**
- **Physics Studies**

New Initiatives

- **National Computing and OO Software**
- **Pixel Detector Contribution**

Alberta
Carleton
CRPP
Montréal
Toronto
TRIUMF
UBC
Victoria
York

ATLAS Personnel

- **Faculty and Adjunct**
  - Keeler, Lefebvre, McPherson, Sobie
- **Onsite TRIUMF Staff**
  - Birney, Hodges, Langstaff, Lenckowski
- **Research Associates**
  - Fincke, Poffenberger
  - CERN: Sbarra (with OPAL and TRIUMF)
  - New RA to be appointed soon
- **Technicians**
  - Dowling, Vowles
- **Current Students**
  - (Ph.D.) Dobbs (Lefebvre)
  - (M.Sc.) Fortin (Lefebvre)
- **Degrees Awarded**
  - 3 M.Sc. (Bishop, Robertson, White)
  - 1 Ph.D. (O'Neil)
- **Undergraduate Students**
  - typically 1 or 2 terms per year

ATLAS Personnel Leadership

- **LAr DataBase Coordinator**
  - (2000-) Sobie
- **Member of the ATLAS National Computing Board**
  - (1999-) Sobie
- **Advisory Committee to the Collaboration Board**
  - (1998-99) Lefebvre
- **ATLAS-Canada Co-Spokesperson**
  - (1998-99) Keeler
- **HEC Chief Engineer**
  - (1996-2000) Hodges
- **Endcap Signal Feedthrough Project Leader**
- **LAr Hadronic Endcap Beam Test Software Coordinator**
  - (1997-) Lefebvre
- **LAr Cryostat and Cryogenics Steering Committee**
  - (1997-2000) Hodges
  - (1997-) Lefebvre

ATLAS Physics Activities

Single Top Physics

O'Neil (Ph.D. Nov 1999), Lefebvre

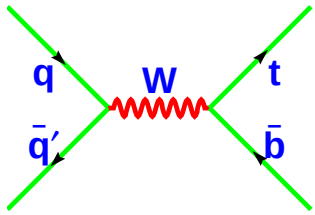
EW production

Source of polarized top

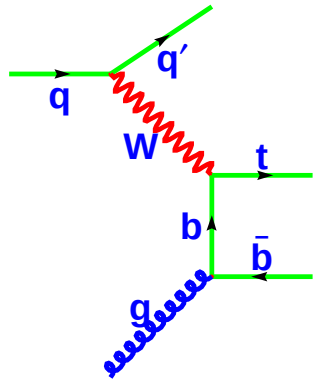
Only means to measure V_{tb} in ATLAS

For 30 fb^{-1} (stat only)
From W* channel:
Expect $\Delta V_{tb} \approx 2.7\%$
From Wg channel:
Expect $\Delta V_{tb} \approx 0.27\%$

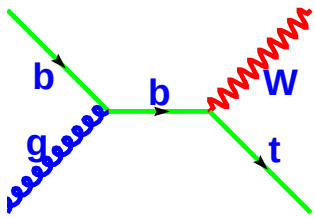
Measure top quark polarization and the helicity of the W
Expect a few %



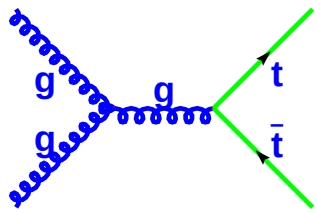
W*



Wg



Wt



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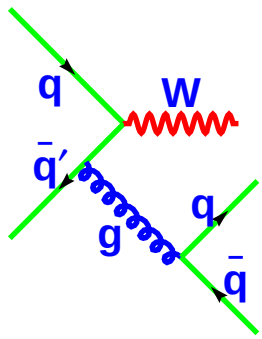


Wjj

ATL-PHYS-99-011
ATL-PHYS-00-017

Paper in preparation

ATLAS Physics Activities

NLO(α_s) Di-Boson Event Generation

Dobbs, Lefebvre

Handling of divergences currently involves the phase space slicing method, leading to the generation of weighted (often negative) events

But experiments need unweighted events, which cannot be obtained from negative weighted events

An algorithm has been devised involving a two-stage integration

Recently demonstrated to work for the case study

$$pp \to W^{\pm}Z(j), \qquad W^{\pm} \to l^{\pm}\nu$$

Dobbs invited to the

"Workshop on Marix Elements for Parton Showers"
Institute for Particle Physics Phenomenology
University of Durham, Dec 13-15 2000.

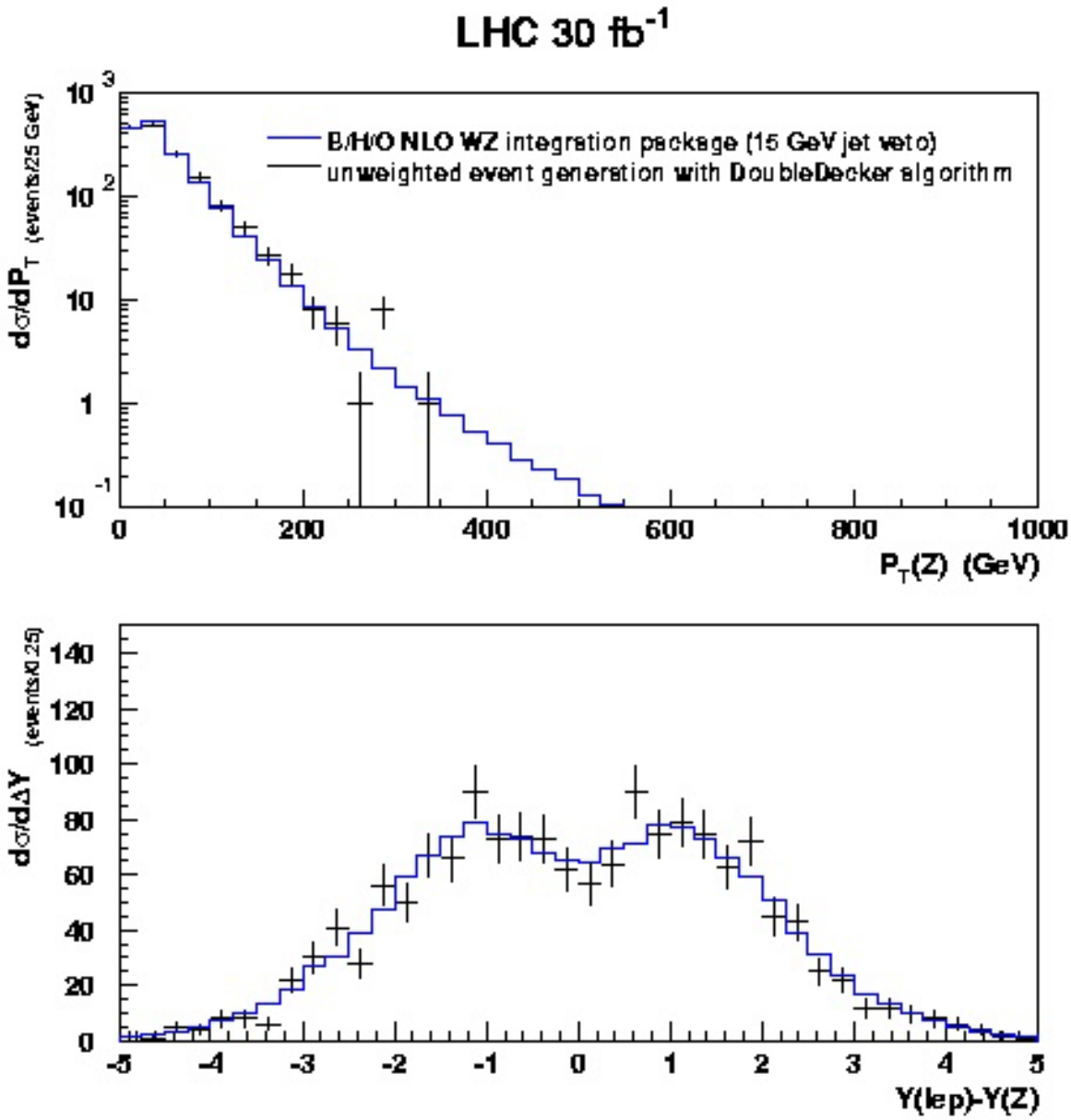
Publication: Dobbs, Hansen, Comp. Phys. Comm. 2016 (2000)

Also paper in preparation (Dobbs, Lefebvre)

ATLAS Physics Activities

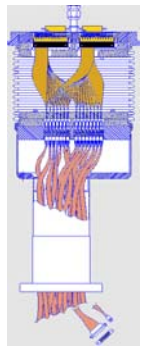
First partonic NLO(α_s) unweighted event generator!

$$pp \to W^{\pm}Z(j), \quad W^{\pm} \to l^{\pm}\nu$$



Endcap Signal Feedthrough Project

ATLAS liquid argon calorimetry has over 180k signal channels which must come through the cryostats.

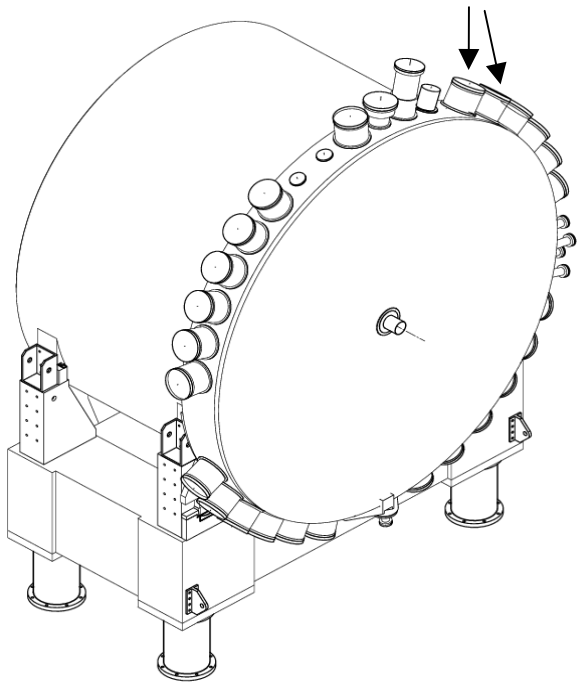


Each feedthrough unit carries 1920 electrical channels.

Barrel: 64 feedthrough units

Endcap: 50 feedthrough units total

The endcap signal feedthrough project is an ATLAS common fund contribution from Canada



One endcap cryostat shown during assembly

All endcap signal feedthrough units being assembled in Victoria

Project Leader: Lefebvre
Engineer: Hodges

Onsite TRIUMF staff crucial to the project

Endcap Signal Feedthrough Project

Production has started in Victoria

Aim at a production rate of about 3 per month

Currently on budget and on track

Many challenges…

- **procurement**
- **QA/QC**
- **4 types of units**

Production to end August 2002

Birney
Dowling
Fincke
Hodges
Keeler
Langstaff
Lefebvre
Lenckowski
van Uytven
Vowles

Welding of first production unit, July 2000

Endcap Hadronic LAr Calorimeter

Covers the region $1.5 < |\eta| < 3.2$

Half the HEC produced and assembled in Canada

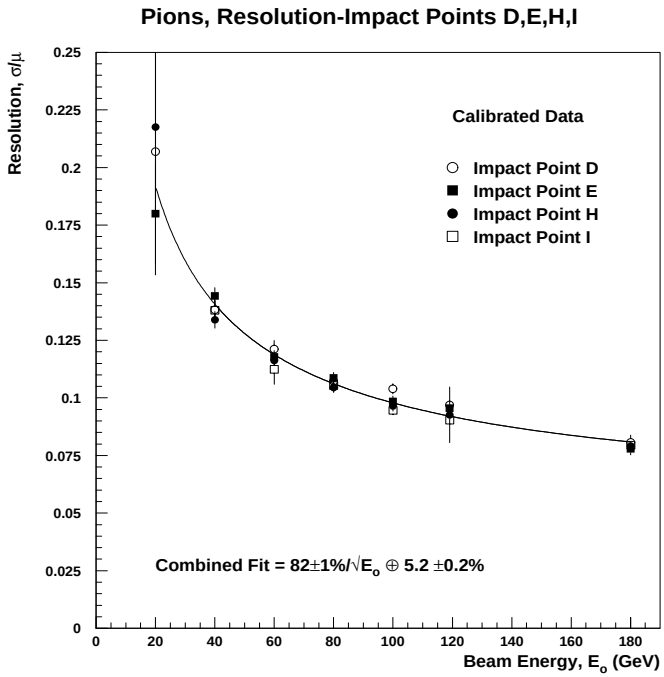
Responsibilities

- **Mechanical Design: Hodges (Chief Engineer)**
  - **–Assembly and installation tooling: Langstaff**
  - **–UVic was involved in the Prototype design and construction: Birney, Fincke, Lefebvre**
- **Beam Test Software: Lefebvre (Coordinator)**
  - **–HEC prototypes and production modules have been or will be subjected to particle beams at CERN**
  - **–The necessary data access, monitoring and analysis software has been written, and is maintained, by the UVic group since 1996 (Lefebvre, O'Neil, Sbarra, with help from many others).**

Beam Test Data Analysis

- **Since 1996 (Dobbs, Fortin, Lefebvre, O'Neil)**
- **Paper in preparation**

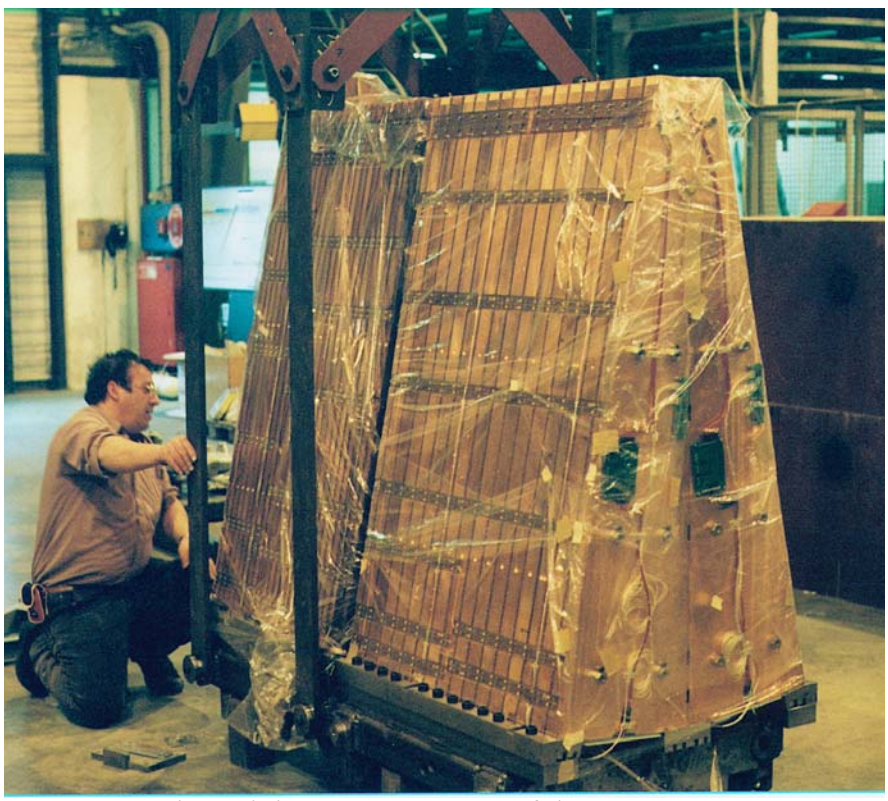
Endcap Hadronic LAr Calorimeter



Beam Test Pion Resolution (Dobbs, O'Neil)

$$\frac{\sigma}{E} = \frac{82 \pm 1\%}{\sqrt{E_0(\mathrm{GeV})}} \oplus (5.2 \pm 0.2\%)$$

4 modules at CERN



Software

ATLAS chose

OO approach with **C++**

Objectivity for event storage manager

Operating Framework for Reconstruction and Analysis

GAUDI (LHCb) ➔**ATHENA** (ATLAS)

ATHENA not yet with Objectivity

Software Activities

- **Training** (Fincke, Lefebvre, Sobie)
- Contributions to **LAr Database**
  - **Sobie is now LAr Database Coordinator**
- Development of **LAr Reconstruction Classes** including **Objectivity**
- Identify the requirements of future computing for ATLAS

Future Plans

Short Term

•Endcap signal feedthrough production, with emphasis on QA/QC

•Increase LAr OO and general ATLAS software involvement

- –Sobie now LAr Database Coordinator
- –Fincke getting involved
- –New RA to be appointed soon

•Recruit M.Sc. Students

- –LAr OO reconstruction software
- –HEC beam test data analysis

•Maintain the HEC Beam Test Software and participate in the HEC-EMEC combined tests

Medium Term

•contribute to the ATLAS data analysis software

•increase participation in physics working groups