# Particle Physics Group

## Department of Physics and Astronomy

Visit of President David Turpin
October 2, 2000

- Faculty and Researchers
- Research Directions
  - Overview
  - OPAL, ATLAS, BaBar
- Summary and goals

# Young active group with an Internationally recognized research program

- **Faculty:**
  - Experimentalists: Keeler, Kowalewski, Lefebvre, Roney
    - Astbury (emeritus - Pearce Chair
    - Theorists: Picciotto & New Hire
- **Institute of Particle Physics Fellows:**
  - McPherson, Sobie
- **Onsite TRIUMF Staff:**
  - Birney, Hodges, Langstaff, Lenckowski, Walsh
- **Research Associates:**
  - Onsite: Fincke, Poffenberger, Rensing, Van Uytven & offer to Kanaya, BaBar search
  - CERN: Long, Sbarra
- **Technicians:**
  - Dowling, Vowles

# Faculty

- R. Keeler (83) PhD UBC 81
  - Electroweak physics ( UA1, OPAL , ATLAS)
  - Director (elect 2001) IPP (Institute of Particle Physics)
  - Chair Subatomic Physics GSC (2000-2001)
- R. Kowalewski (97) PhD Cornell 88
  - B physics, particle lifetimes, reconstruction software (OPAL, BaBar, ATLAS)
- M. Lefebvre (91) PhD Cambridge 89
  - Electroweak physics, Calorimetry (UA2, RD3, ATLAS)
  - Founded ATLAS Canada
- C. Picciotto (68) PhD UC-Santa Barbara 68
  - Weak Decay Theory
- M. Roney (96) Carleton 89
  - Electroweak, drift chambers and B & tau physics (OPAL, BaBar, ATLAS)
  - BaBar Executive board (1998- )
- A. Astbury (83) PhD Liverpool 61
  - FRS, FRCS
  - Director of TRIUMF (1994-2001)

# IPP

## Institute of Particle Physics of Canada

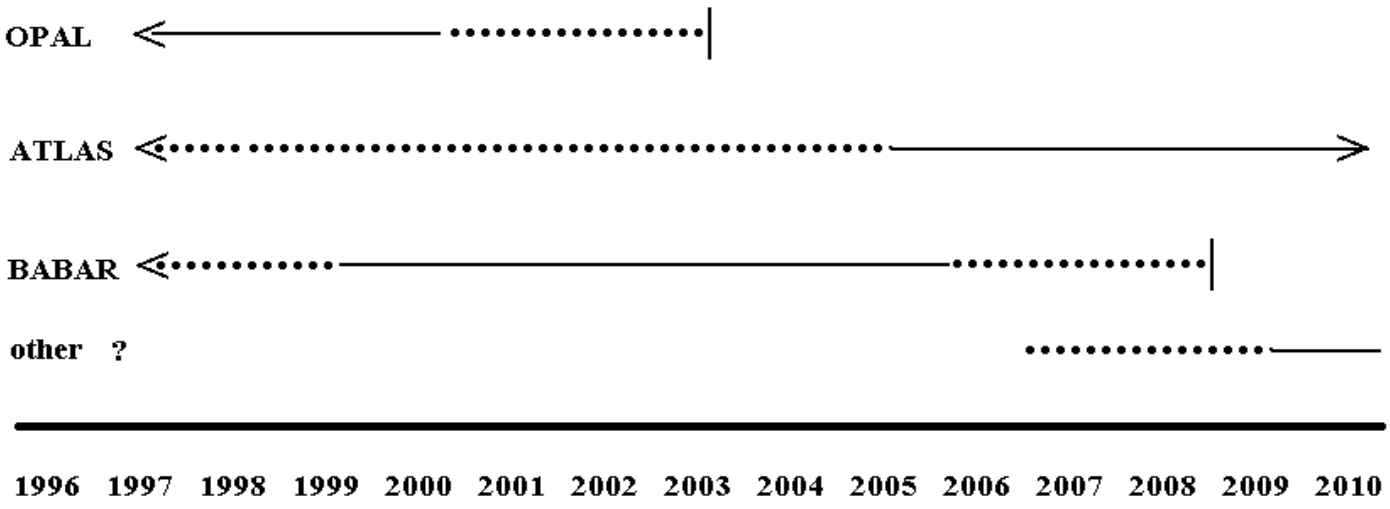
- Coordinates and promotes particle physics in Canada
  - 12 Universities, 150 individuals
- Seven permanent scientists
  - Two chose Victoria:
  - R. McPherson (97) PhD Princeton 95
    - Nonstandard Model (BNL-E787, OPAL, ATLAS)
    - OPAL Physics coordinator (2001-2002)
  - Sobie (92) PhD Toronto
    - OPAL Tau physics coordinator (1998-)
    - Spokesman for Victoria Computer Storage CFI Request
    - IBM SUR Grant ($820,000)
- Director Elect (2001-2006) R. Keeler

# TRIUMF

## National Laboratory supporting accelerator based research

- **Victoria was one of three founding universities**
- **A design group is located at Victoria**
  - Provides Engineering & Infrastructure Support for particle physics ---- Essential requirement
    - SLD Calorimeter
    - BaBar Drift Chamber
    - ATLAS Endcap Hadronic Calorimeter and Feedthroughs Engineering Support
  - Hodges ( TRIUMF Engineer)
    - Langstaff ( TRIUMF Senior Designer )
    - Lenckowski (TRIUMF Junior Designer )
    - Birney (TRIUMF Senior Technologist)
    - Walsh (TRIUMF Admin Assistant )

# Research Overview

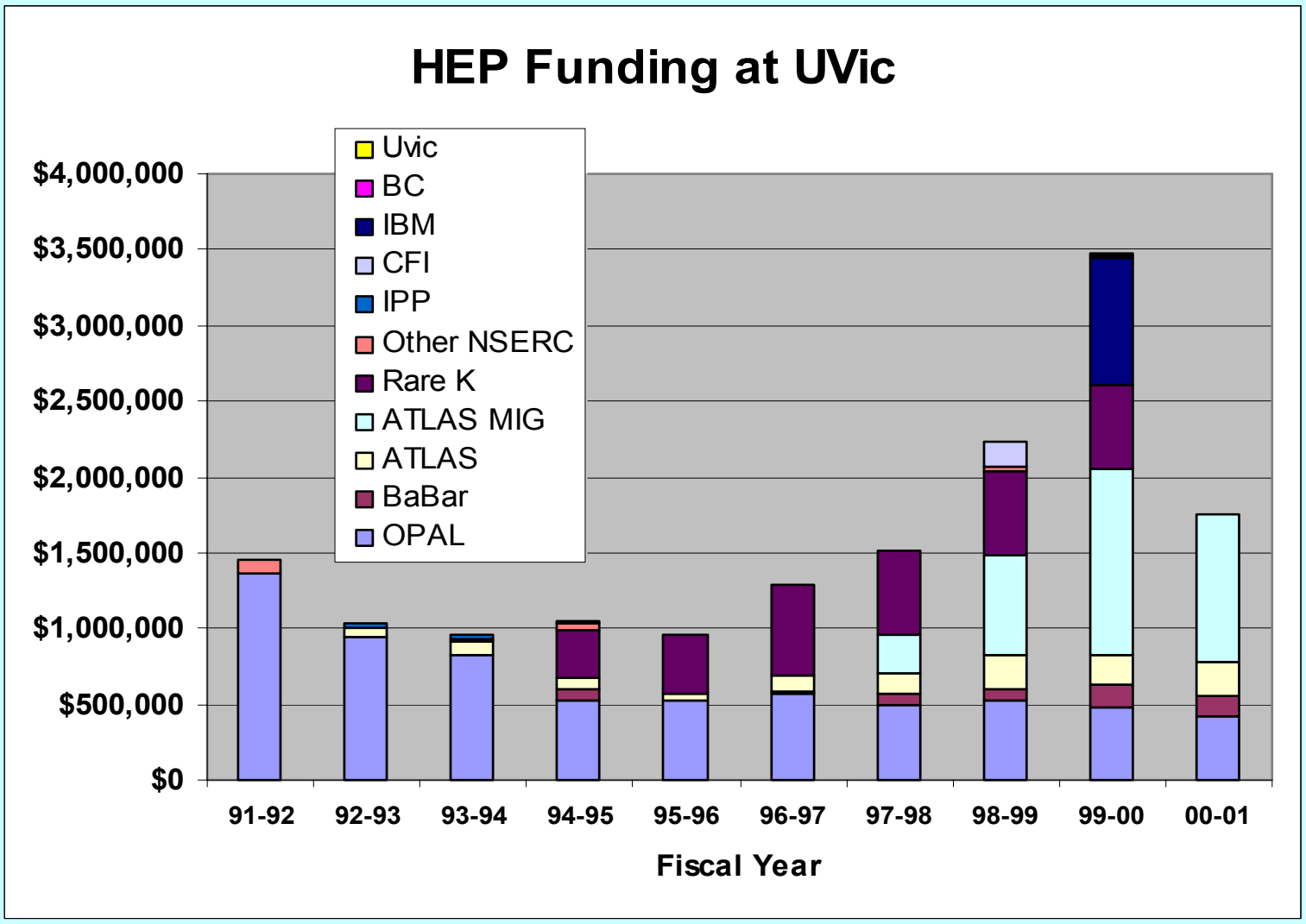



## Three large projects

- OPAL is completing data taking this year
  - Analysis will continue
- Babar has just started data taking and will continue for several years
- ATLAS is under construction
  - First beam in ~2005
- New physics - Next Linear Collider, Neutrino physics

# Research Funding

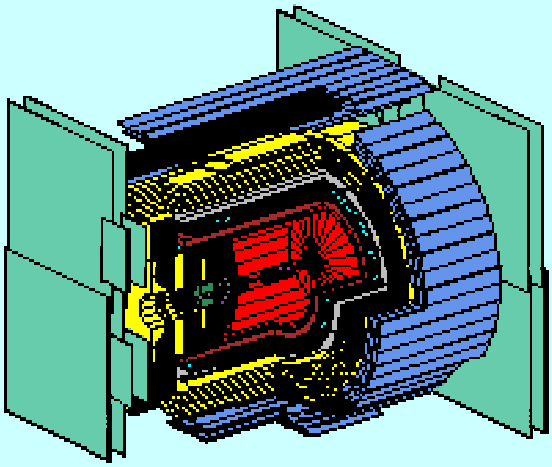
## Excellent track record for attracting funding

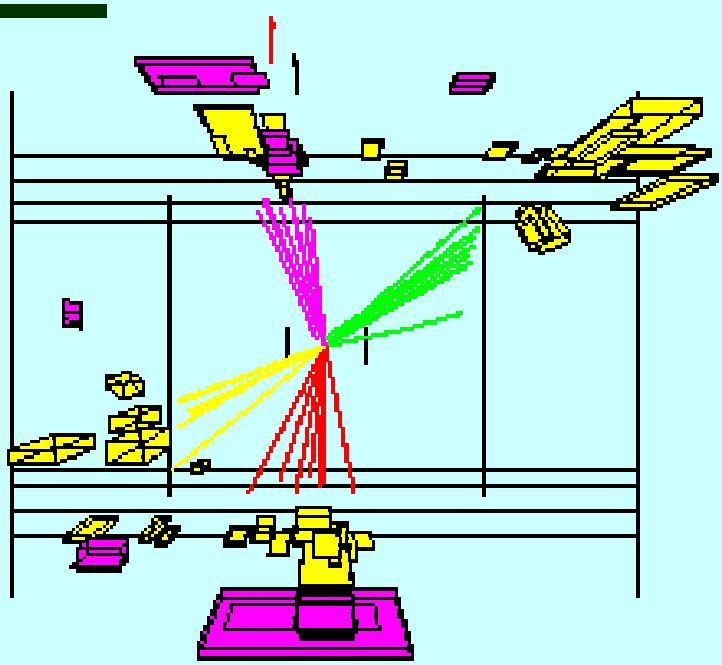



- Operating ~ $750K per year
- ATLAS MIG is $4.3M over 7 years
- Rare K - D.Bryman is now Warren Chair (UBC)
- IBM grant - February 2000
- CFI grant for MUSE Computer Farm

# OPAL

McPherson
Kowalewski
Keeler
Roney
Sobie





Large Detector at the LEP electron-positron Collider at CERN

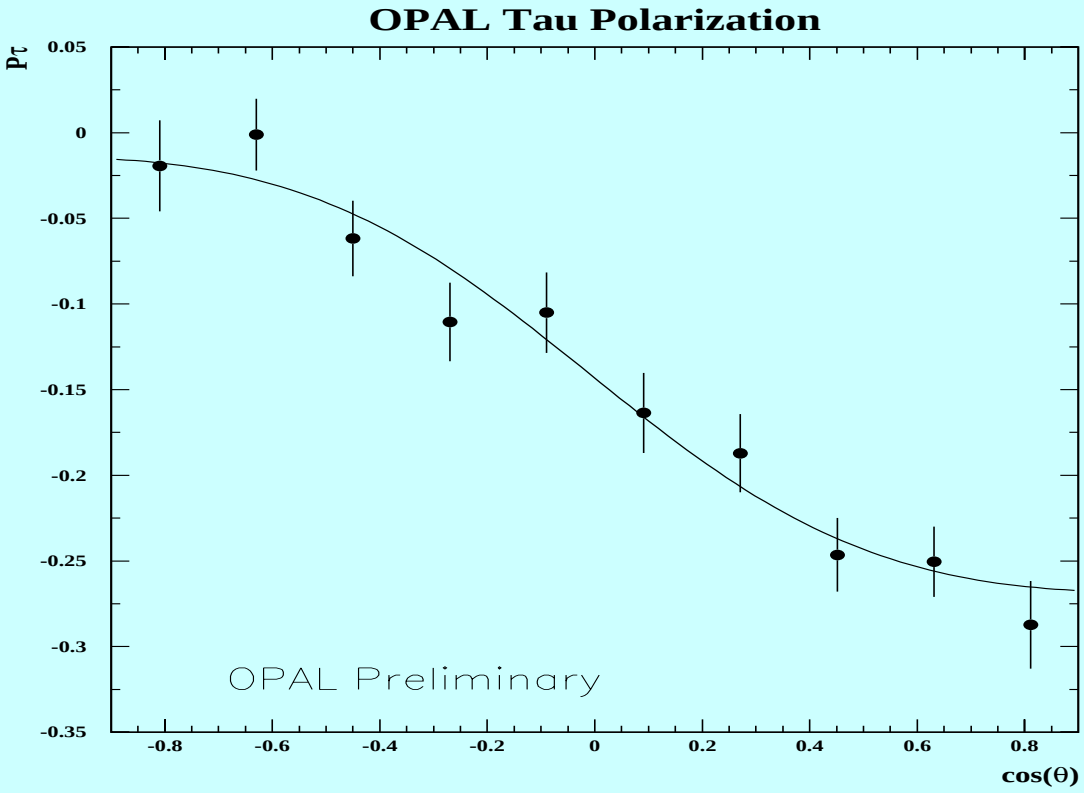
## Precision Measurements

- Collect and analyze W pair data from LEP2
  - Triple Gauge Couplings (substructure)
  - W-tau coupling
- Precision data from LEP1 (5 Million events)
  - Recognized tau lepton experts

# OPAL Research

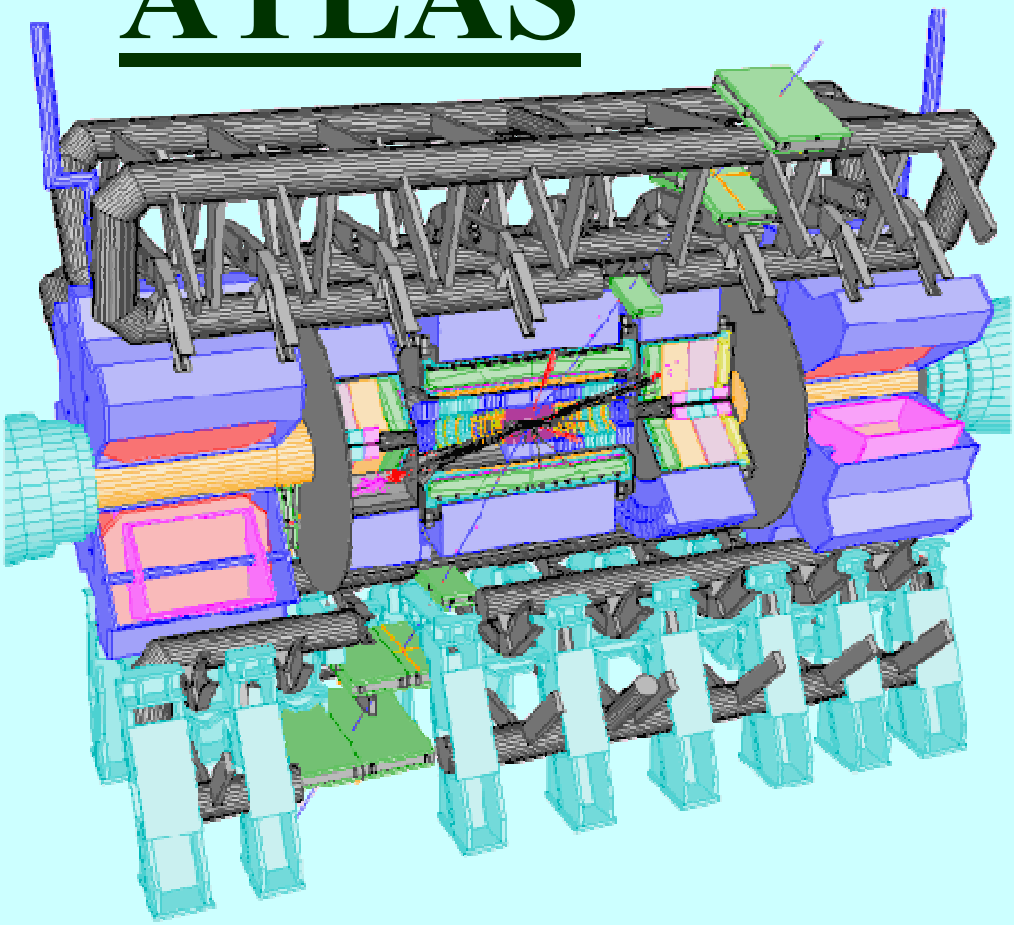
- Graduate Students (1991-)
  - Degrees Awarded : 5 MSc 6 PhD
  - Presently 4 PhD students
    - One located at CERN in Geneva
- Undergraduate students ~1-2 per year

One of the worlds most precise electroweak measurements recently completed in Victoria



# ATLAS

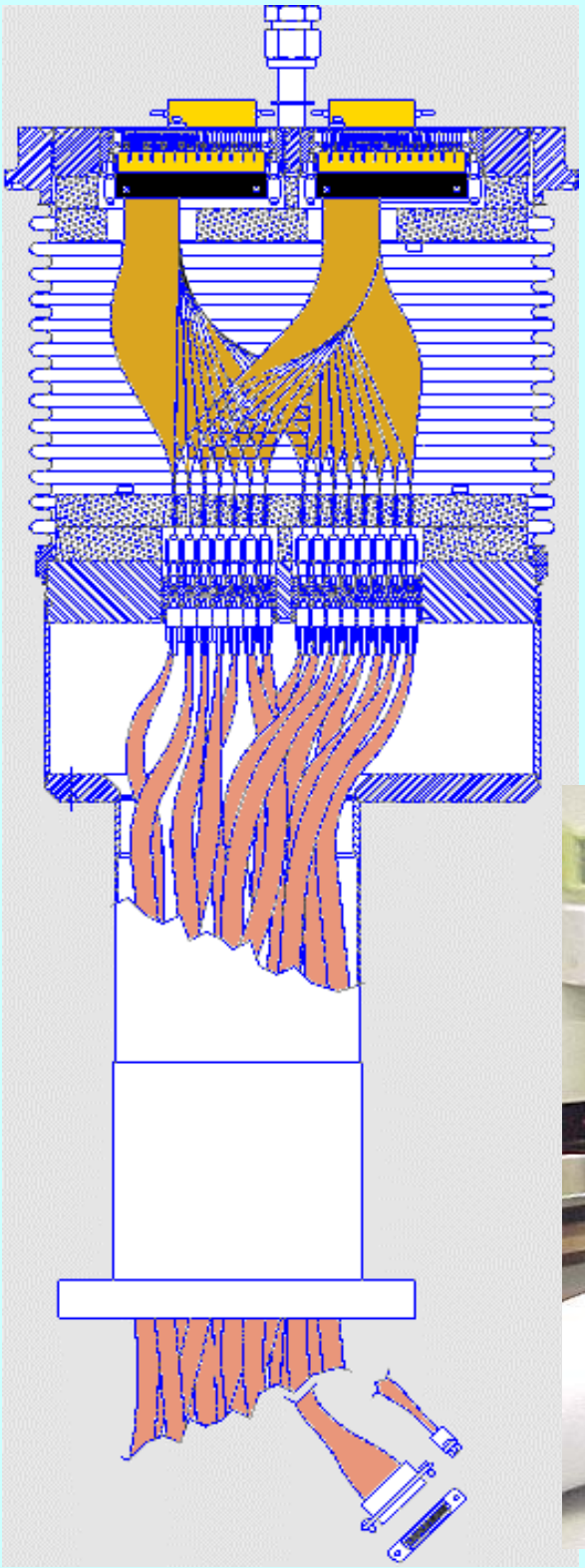
Lefebvre
Keeler
Sobie
Birney
Fincke
Hodges
Langstaff
Lenckowski



## General Purpose Detector for the Large Hadron Collider at CERN

- Proton-proton collisions at the energy frontier
  - Understand Electroweak Symmetry Breaking
  - Search for Supersymmetry
- Degrees awarded: 3MSc & 1 PhD
  - Currently 1 MSc & 1 coming

# Detector Construction



## Feedthrough Project

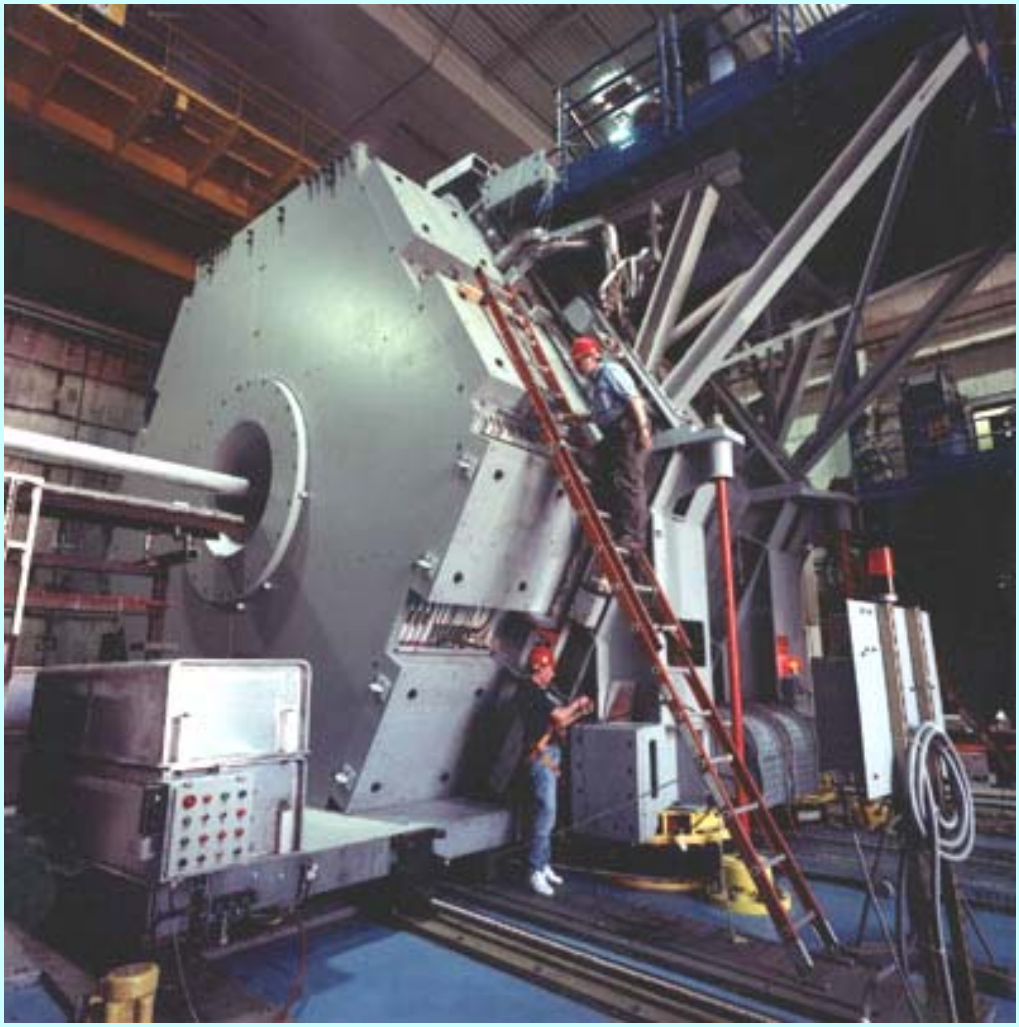
- 4.3M$ over 7 years

## University of Victoria ATLAS Laboratory

# BaBar

## BaBar Detector at the PEP II B Factory at SLAC

Kowalewski
Roney

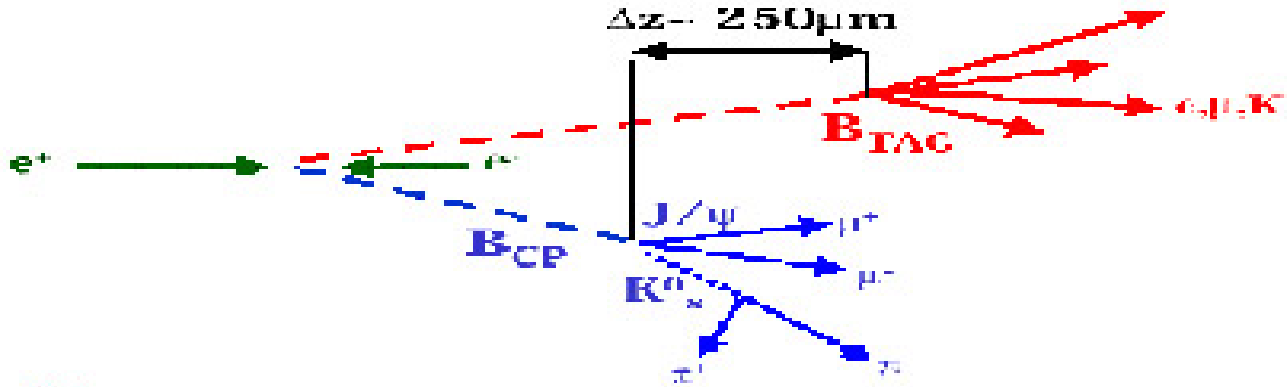


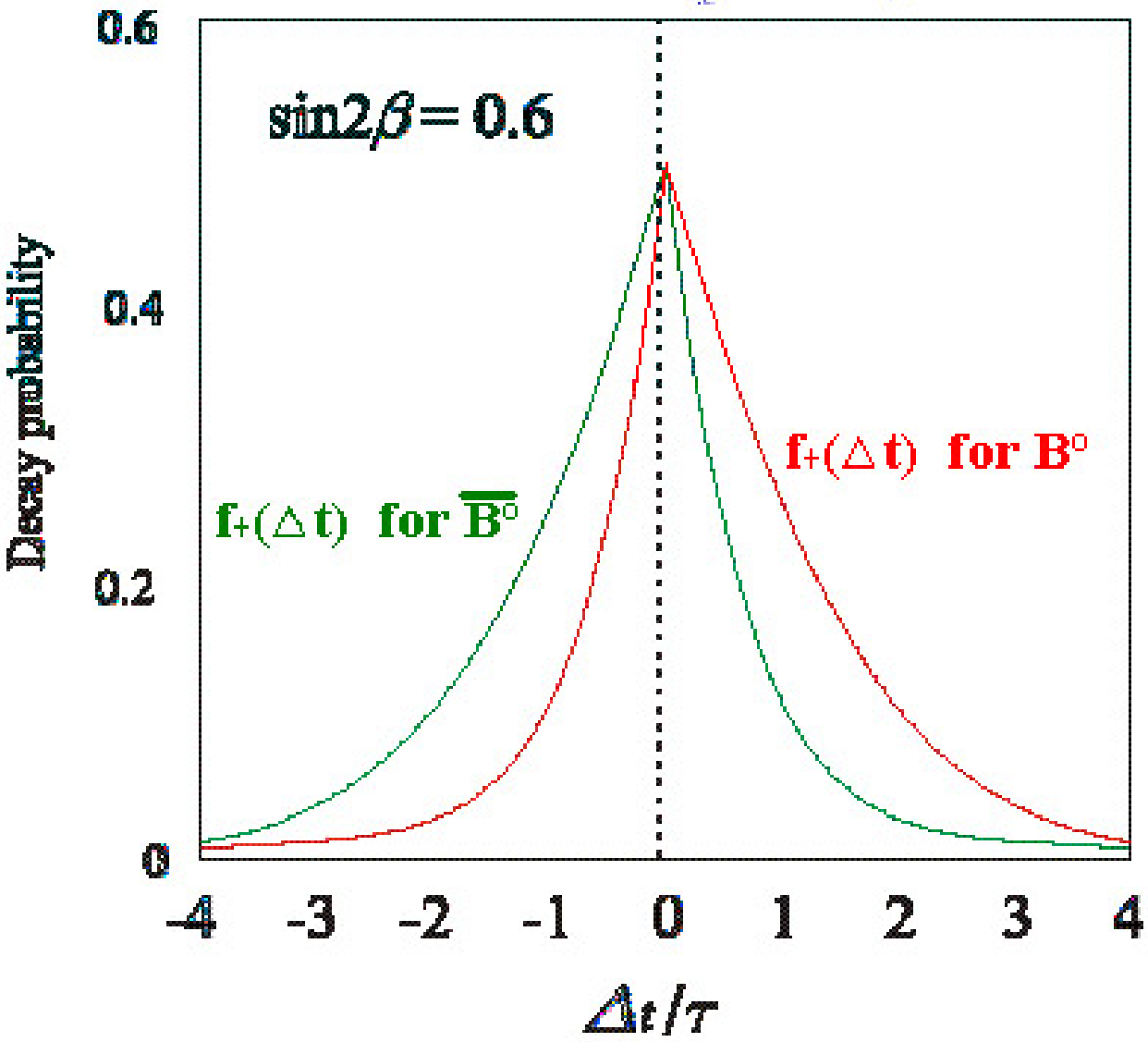
### Measure Fundamental Symmetries

- CP Violation, Precision Measurement
  - b-quark CP asymmetry
  - quark mixing (CKM)
  - tau electroweak physics
- Currently 2 MSc & 1 PhD starting January

# Measuring $CP$ violation at the $\Upsilon(4S)$

**Measure time distributions for $B^0$ and anti-$B^0$**




The $CP$ asymmetry is

$$\mathcal{A}_{CP} = \frac{f_+(\Delta t) - f_-(\Delta t)}{f_+(\Delta t) + f_-(\Delta t)} = \mathcal{D} \sin 2\beta \times \sin \Delta m_d \Delta t$$

# Summary and Goals

- **Strong group in subatomic particle physics**
- **Excellent research program that is internationally recognized.**
  - Data analysis of world's highest energy electron-positron collisions with the OPAL detector.
  - Detailed study of fundamental symmetries with BaBar just starting.
  - Detector Construction for ATLAS - a detector for physics at the high-energy frontier.
- **Replacement for Pearce Chair**