INSTITUTE OF PARTICLE PHYSICS
INSTITUT DE PHYSIQUE DES PARTICULES

IPP:
50 years and more

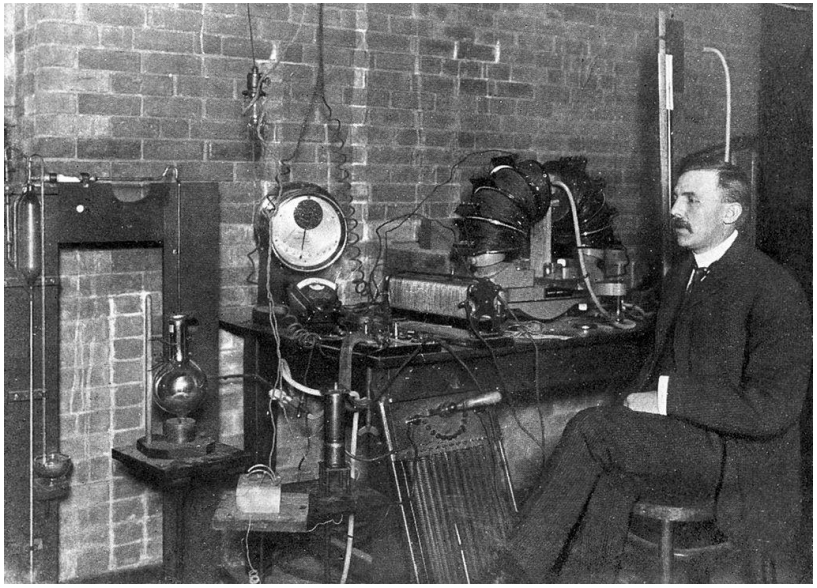
Rob McPherson

University of Victoria and IPP

Material swiped from talks by Bill Frisken, Richard Hemingway, many IPP Director reports and archives, and random things from the web

Particle Physics in Canada - long history in brief

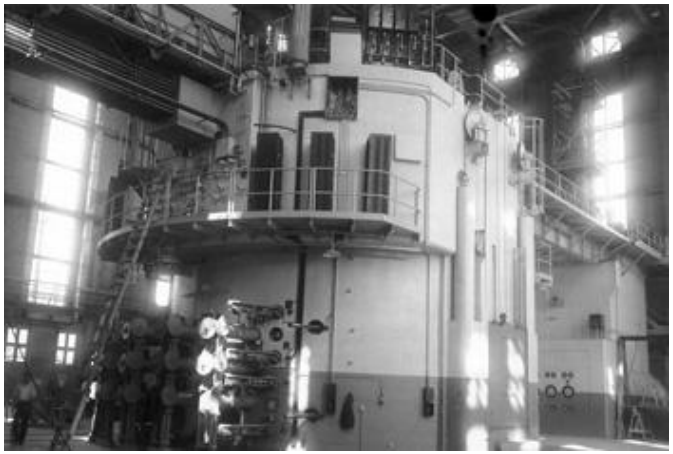
- **Ernest Rutherford**
  - **Moved to McGill in 1898 for about a decade**
  - **1903 paper "Radioactive Charge" was revolutionary**
    - **Led to 1908 Nobel Prize (Chemistry)**
  - **Worked closely with a demonstrator Frederick Soddy who also won a Nobel Prize in Chemistry, 1921 (but for work done mostly in the U.K. later)**



Rutherford, McGill, 1905

Particle Physics in Canada - long history in brief

- Skip ahead to ~1942 with the formation of the Montréal Laboratory (NRC) working on nuclear reactor development
  - John Cockcroft (then director) moved reactor construction to Chalk River in 1944 (AECL)
  - Many huge contributors: Bruno Pontecorvo, Bernice Weldon Sargent, E.P.(Ted) Hincks, John Robson, …



NRX reactor
1947–1993

NRU reactor
1957–2018

- Part of the AECL team moved (back) to Britain, the U.S.
  - in 1950s, many Canadian particle and nuclear physicists were educated at home, but then moved away

1960s

- Some stayed in Canada of course
  - Hincks to NRC/Carleton, Robson to McGill
  - NRC began funding individual professors to participate in HEP experiments at U.S. labs
    - The NRC "Allocation Committee" (mainly senior members of NRC Council) decided on amount allocated per research discipline, three of which were
      - "Mainline" Physics, Nuclear Physics, High Energy Physics (HEP)
        - The precise amounts awarded were then negotiated by Grant Selection Committees and NRC reps in one-on-one meetings with grantees (not really a peer-review process)

- 1966: U.S. Congress approved the National Accelerator Laboratory (NAL) in Weston, IL
  - Initial goal was a set of accelerators leading to the main ring, a 200 GeV proton accelerator
  - The CAP formed the Canadian 200 GeV study group (1968–1969) to examine Canadian participation

CAP notice - Oct 1967

CANADIAN ASSOCIATION OF PHYSICISTS

Dear C.A.P. Member:

We are writing to inform you of the present status of a recent proposal which is intended to stimulate the development of Canadian activity in experimental high energy physics. It is generally realized that the total Canadian activity in this field is anomalously low compared with that of most scientifically advanced countries and while this, in itself, is not a reason for expanding the Canadian effort, other cogent reasons may be cited for doing so. (See "Physics in Canada: Survey and Outlook", pp. 274-277.)

You may remember that during the C.A.P. Congress in Toronto last June reference was made to a suggestion that Canada might make a significant contribution towards the development of the 200 GeV proton accelerator facility which is to be build at Weston, Illinois, near Chicago. During the past Spring and Summer a number of informal discussions of this idea have taken place both amongst Canadian high energy physicists and between members of the C.A.P. High Energy Committee and U.S. physicists. In the following paragraphs we attempt to summarize the results of these discussions and to show why a collaboration with U.S. physicists on the Weston project appears to be both attractive and realistic for Canadians.

CAP notice summary - Oct 1967

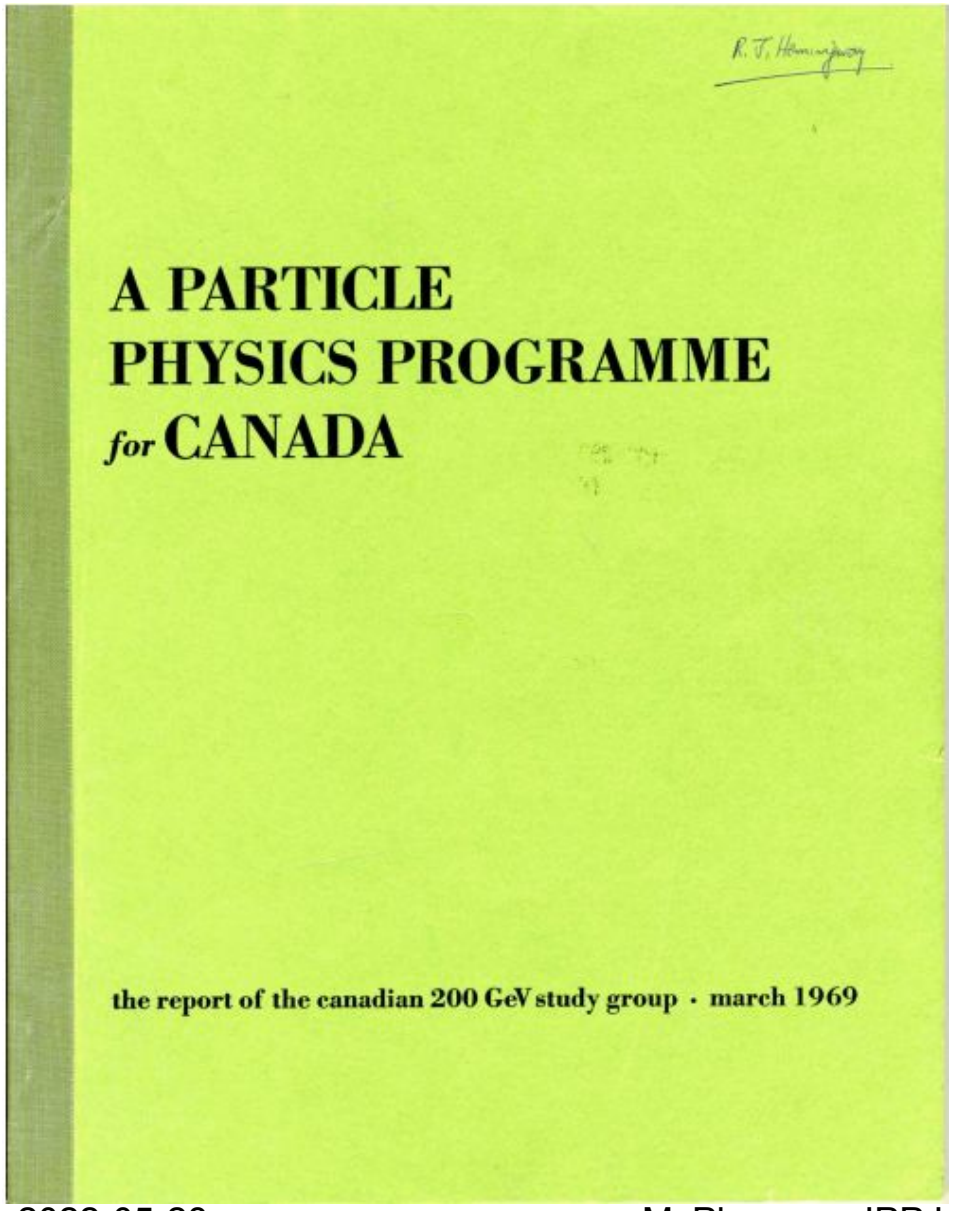
In order to obtain reliable answers to these and other questions upon which the merits of the proposal must rest, this Committee plans to request jointly through its members and their universities a grant from the National Research Council that would make possible a study of the highest possible professional calibre of the feasibility of Canadian participation in the 200 GeV project.

Yours truly,

E.P.H. for
B. Margolis,
J. D. Prentice,
W. T. Sharp,
D. G. Stairs,
E. P. Hincks,
Chairman,
THE C.A.P. HIGH ENERGY COMMITTEE.

P.S.--We would like to bring to your attention the 1967 Canadian High Energy Physics Conference which is to be held in Ottawa on November 10th and 11th, and at which it is anticipated there will be a discussion of the 200 GeV accelerator.

Genesis of IPP



A PARTICLE PHYSICS PROGRAMME

FOR CANADA

The Report of the Canadian
200 GeV Study Group

March, 1969

This study was supported by a grant
from the National Research Council.

E.P. Hincks
A.W. Key
B. Margolis
J.D. Prentice
W.T. Sharp
D.G. Stairs

IPP: incorporation and bylaws

- **Formation bylaw: 10 March 1971**

By-Law Number 1

(General By-Law)

BE IT ENACTED as a general by-law of the

INSTITUTE OF PARTICLE PHYSICS - L'INSTITUT DE LA PHYSIQUE DES PARTICULES

(hereinafter referred to as the "corporation")

as follows:

1. CLASSES OF MEMBERS & CONDITIONS OF MEMBERSHIP

A. INSTITUTIONAL MEMBERS

(1) Admission

Any Canadian charitable organization and any establishment of the Government of Canada which is actively involved in Particle Physics may be determined to be eligible for admission to the corporation as an institutional member upon receiving the approval of a majority of the Trustees, and any such organization or establishment shall become a member when it gives written notice to the secretary of its acceptance of membership.

(2) Right to Vote

Each institutional member shall be entitled to one vote at each general or special meeting of institutional members of the corporation, provided that each institutional member shall be entitled to one additional vote for each individual member of the corporation who is a member of the staff or faculty of such institutional member at the time any such meeting is held.

IPP: Two Tier Organization

- **Trustees (member institutions)**
  - Currently 17 Institutional Members, 6 Trustees (BOT) with a President, plus two officers (Director and Secretary/Treasurer)

- **Individual Members (mostly faculty, some senior RAs)**
  - Currently 280 across 32 institutes and 8 provinces
  - Individual members elect the IPP Scientific Council

- **The BOT proposes the Director who is then elected (endorsed?) by the Individual Members**
  - Side note: the IPP Director was referred to as the *Council Chair* up until the time of Alan Astbury

They had a plan …

- **Proposal: IPP Council to administer**
  - **$4M/yr to NAL (FNAL)**
  - **$1M/yr to experiments**
  - **Council Chair would recommend distribution to the BOT for approval**

- **Response: NRC approved**
  - **only $200k for NAL (nuisance level)**
  - **but still $1M/yr for experiments**

- **1971/1972:**
  - **100% of funds distributed by IPP Council**
    - **Over a few years NRC moved to funding experiments semi-directly (more later)**
    - **25% left to IPP Council to fine-tune programme**

Big decision: what kind of institute?

1) Bricks and Mortar (B&M) or 2) Distributed Institute (DI)

"C'mon, c'mon—it's either one or the other."

Big decision: what kind of institute?

1. **Bricks and Mortar (B&M eg: NIKHEF)**
   - **Ted Hincks, NRC HEP & Carleton, sought a bricks & mortar institute with NRC at Carleton**
   - **Visiting professors & students**
   - **Host IPP Research Scientists**
   - **First step: setup S&T workshops at Carleton**
   - **Something of a "TRIUMF East"?**
   - **Didn't fit government view of NRC *applied* science labs**
     - **Big problem: B&M needed large NRC funding package**
2. **Distributed Institute (eg: INFN)**
   - **Removed competition from different host universities**
   - **Alleviated worry that**
     - **funding would come out of projects**
     - **specialized expertise would constrain future projects**

Debate continued through 1980s, but with no large dowry, only distributed institute was possible

Transition in 70s/80s

- IPP Council received all funding project proposals as drafts
  - reviewed them critically, bound into book
  - submitted: BOT, then to (NRC/NSERC) for 1 year award
    - Experimental particle physicist only funded via this route
- Each project: one spokesperson (submitting grant *etc*)
  - Each participating institution in project: one fundee
- Each eligible faculty/scientist: declared FTE % per project
  - Unitarity was imposed
- IPP Council vetted the projects by the physics, FTE, feasibility, cost and schedule – essentially a peer review committee
  - NRC/NSERC sent part of each grant to IPP (100%→25%)

- IPP led the transition of funding a field like ours fairly and efficiently
  - Resulted in more funding for Canadian Particle Physics
  - Science-driven allocation of available funding partly via IPP or via more expert input into decisions

Moving ahead

- **Experimental groups become established with direct funding, initially from NRC and later NSERC**
  - **But the funding criteria followed very much from those established by IPP**

- **In 1978 NSERC is formed, and funding migrates with time completely to allocations via the GSC/SAPES**

- **By early 1990s, IPP Council's *direct* financial control over programme finances gone**
  - **IPP continued to run programmes including the Research Scientists, CERN summer students, PDF fellowships, and also advocacy and strategic planning**

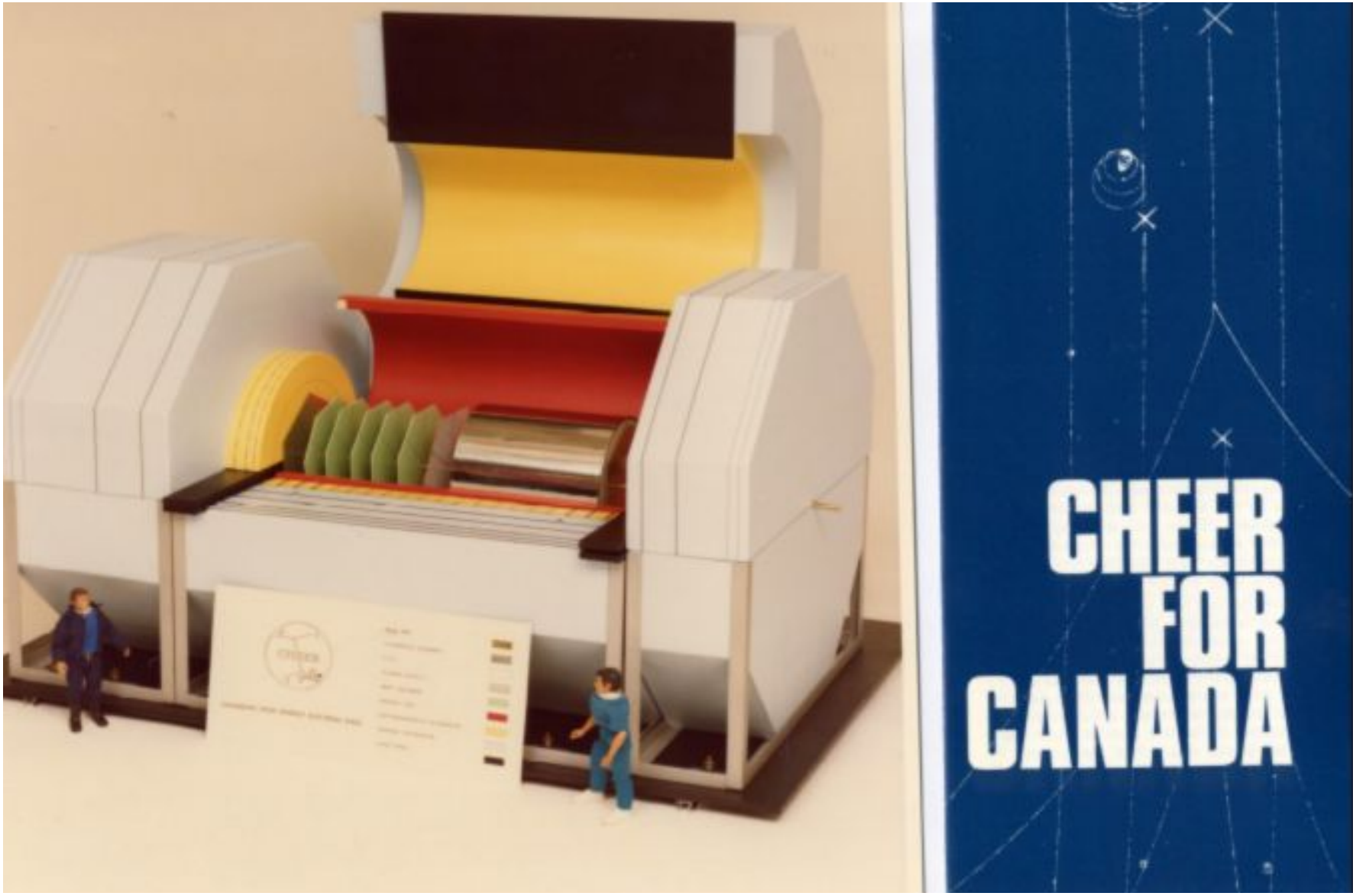
IPP: Early Scientific Evolution

- Back to 200 GeV study group 1968, and IPP's incorporation in 1971 to administer Canadian participation in NAL
- Bernie Margolis: Chair of IPP Council 1971-1976
  - steering experimental engagement at FNAL, ANL, SLAC
  - IPP Research Scientist Programme beings!
    - Tenure-track research professors holding grants

- Jim Prentice: Chair of IPP Council 1976-1981
  - Sought large scale project for Canadian collaboration
    - CHEER

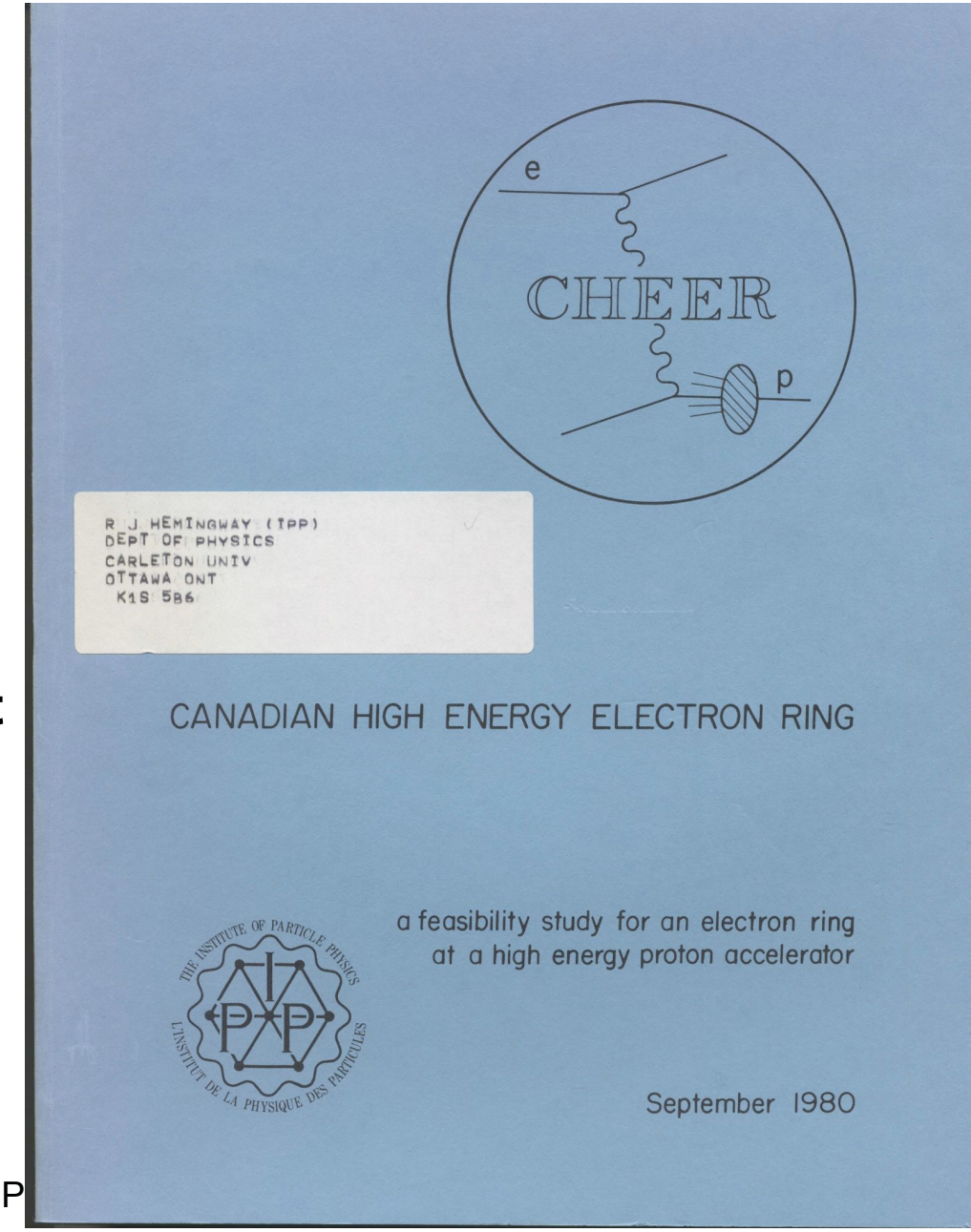
- Doug Stairs: Chair of IPP Council 1981-1991
  - Developed interactions with the new NSERC
  - Three *large projects* on frontier of science
    - ARGUS
    - ZEUS
    - OPAL

CHEER



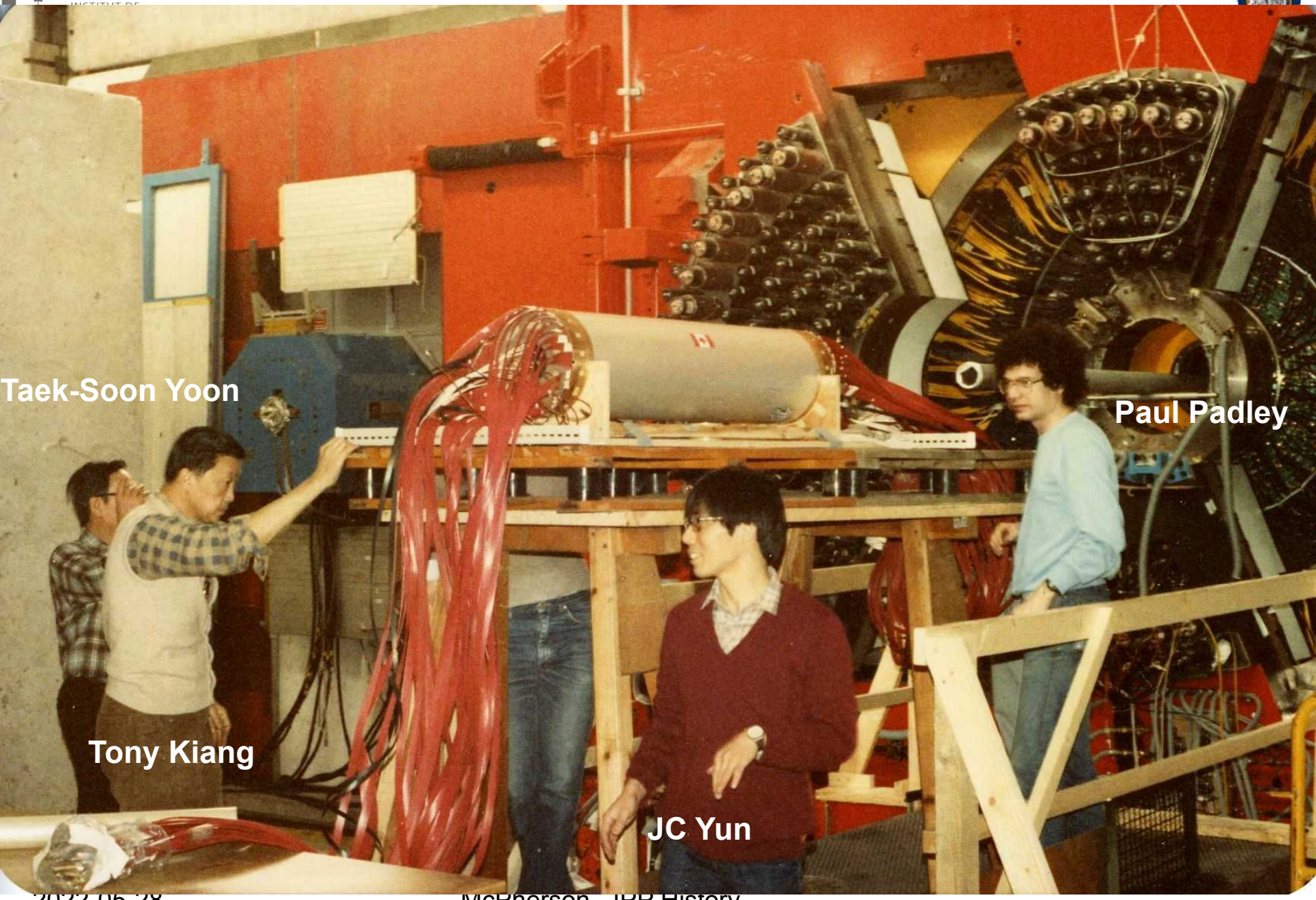
CHEER - Canadian High Energy Electron Ring

- **1978/9: IPP setup large projects debate**
  - e-p collider selected by majority vote
- **1980: e-p workshop at Carleton**
  - CHEER report
- **1981: CHEER proposal submitted to FNAL**
  - Well received by PAC, but not Directorate
- **1981: CHEER join e-p at HERA/DESY**
  - ARGUS as warm-up
- **1982: Carleton/NRC join OPAL/CERN**



ARGUS VDC - wired at Carleton STC

- York & UofT physics shops
- NRC Mech.Eng. & Carleton STC

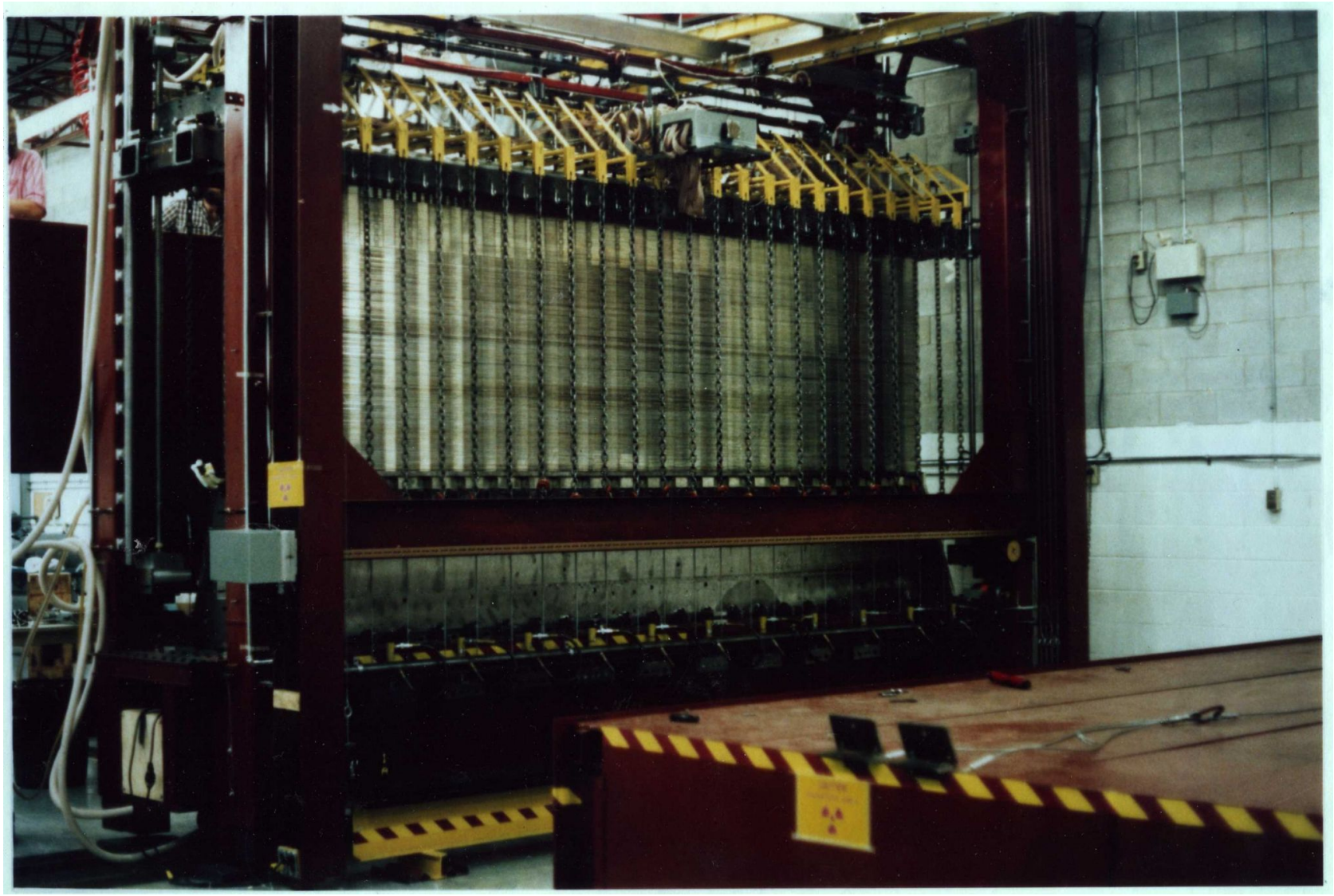

Taek-Soon Yoon
Paul Padley
Tony Kiang
JC Yun

ZEUS at HERA/DESY

- **Manitoba, McGill, Toronto, York**
  - calorimeter factory in industrial space 1987-1990
  - 26 large (up to 14 tonnes) modules built

- **Also accelerator contributions**
  - AECL: proton ring RF cavities
  - TRIUMF proton transfer line
  - Later: LHC and T2K both have TRIUMF accelerator contributions

ZEUS Calorimeter Stacker

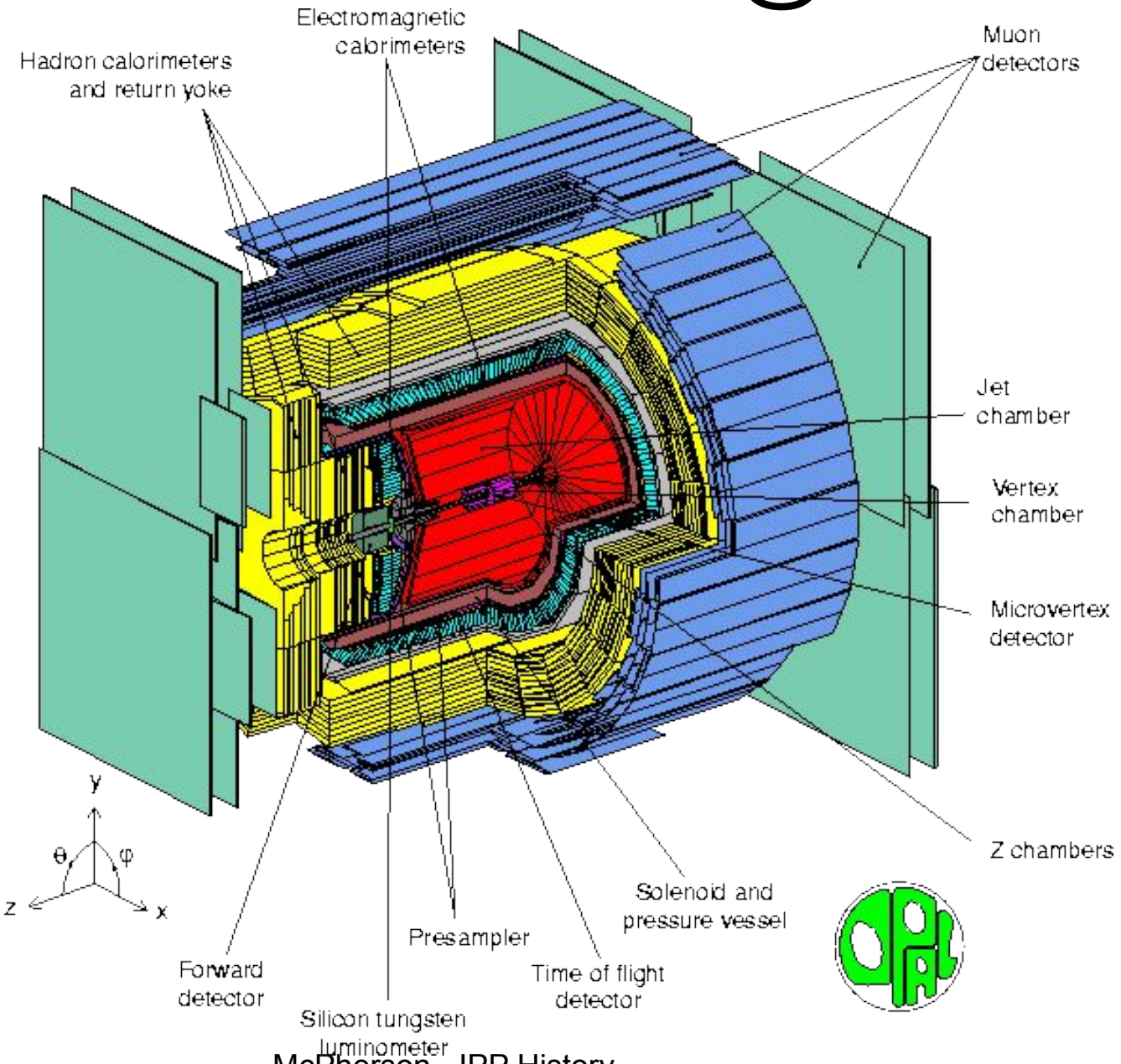


ZEUS Calorimeter

First FCAL module with crew. Photograph by Doug Hasell (York), missing from picture.

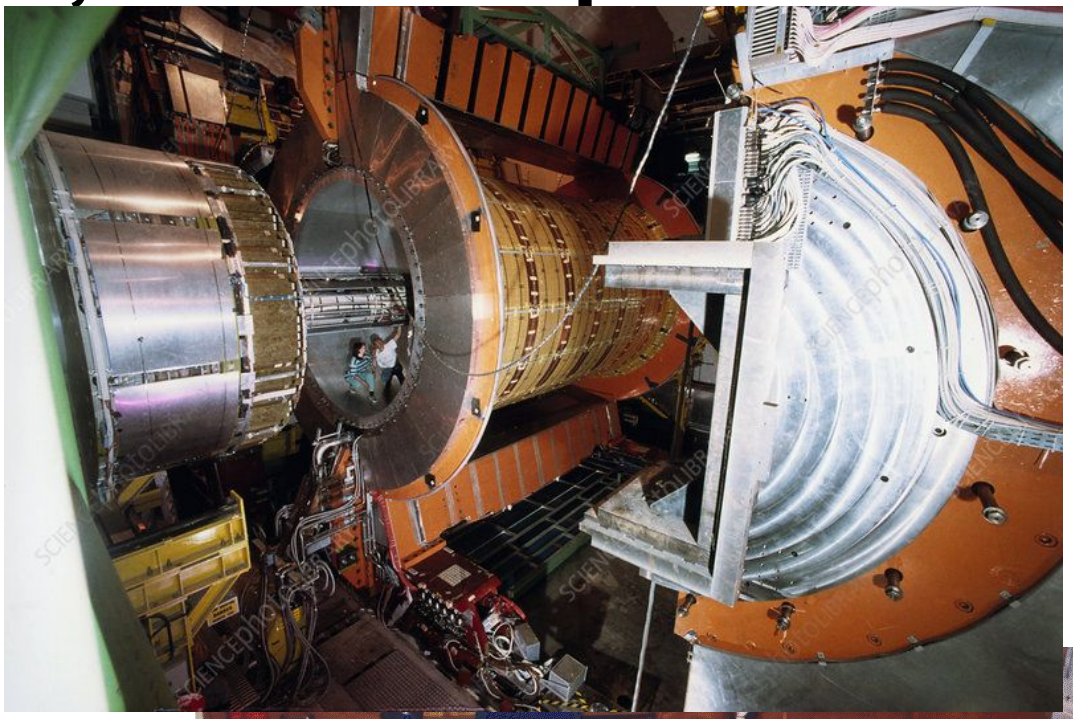
David Hanna McGill
Tony Kiang Toronto
Gavin Stairs Toronto
Rob Snihur York
Bill Frisken York
Rod Abarca York
Sergio Iaccino York
Peter Greenwood York
Cathy Farrow York
Burk Burrow Toronto
John Martin Toronto
Helen Fawcett York
Kerry York
Angel Cerrato York

Meanwhile: OPAL @ LEP

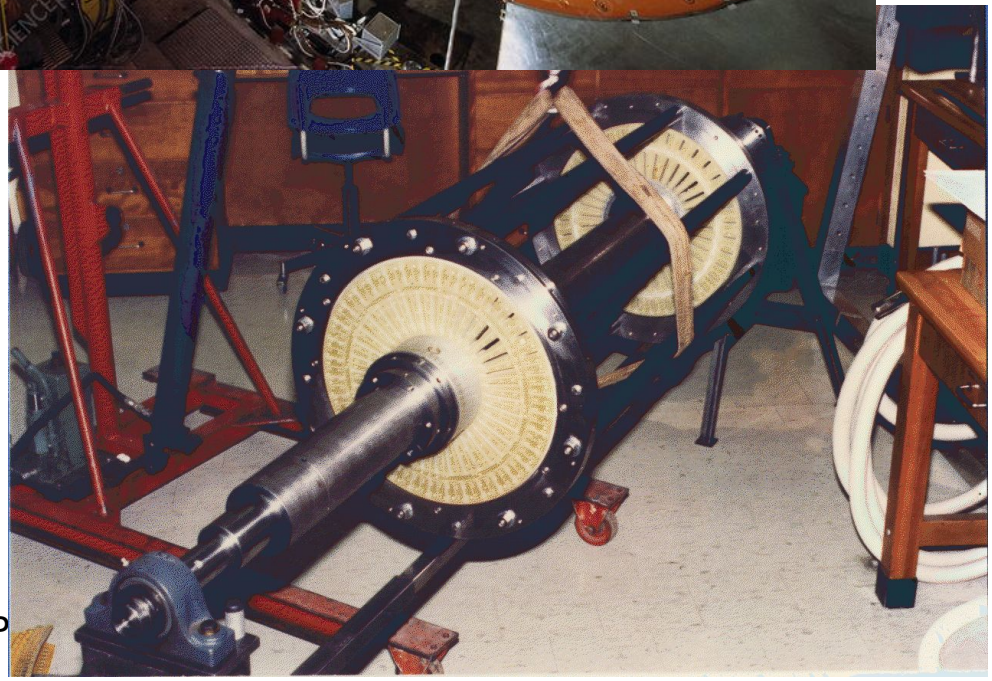


CV,CZ, Online Rope

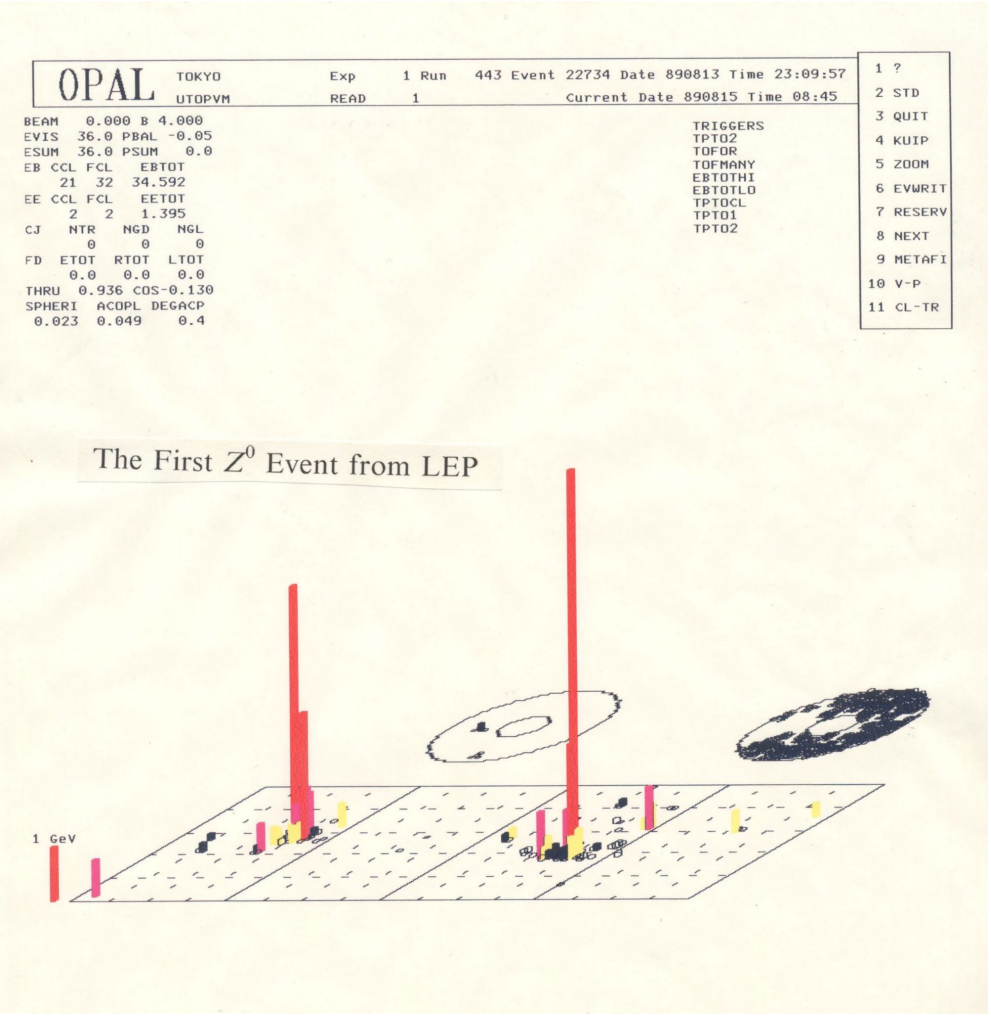
- **Carleton/CRPP**
  - Vertex wire chamber
  - "Zed" chambers
- **Montréal**
  - Zed chamber DAQ

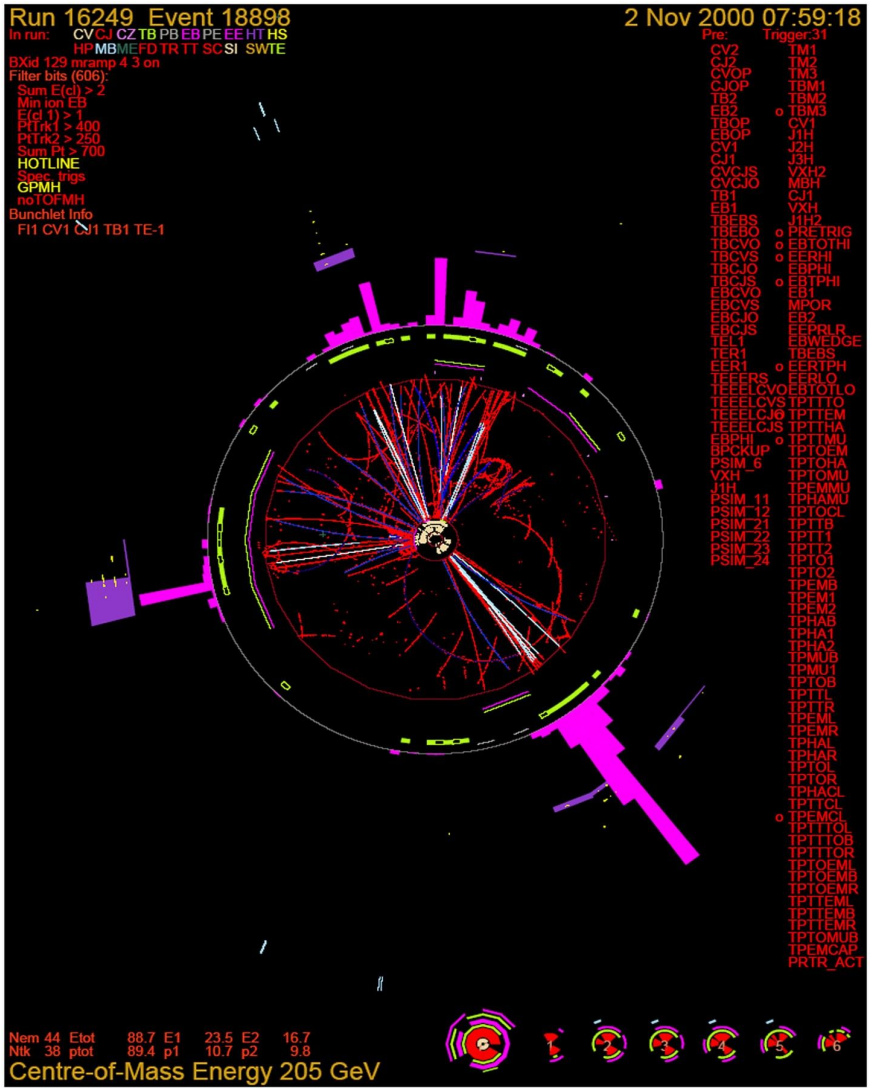


- **UVic, UBC, TRIUMF**
  - Online processing farm
- **Alberta**
  - Tile endcaps



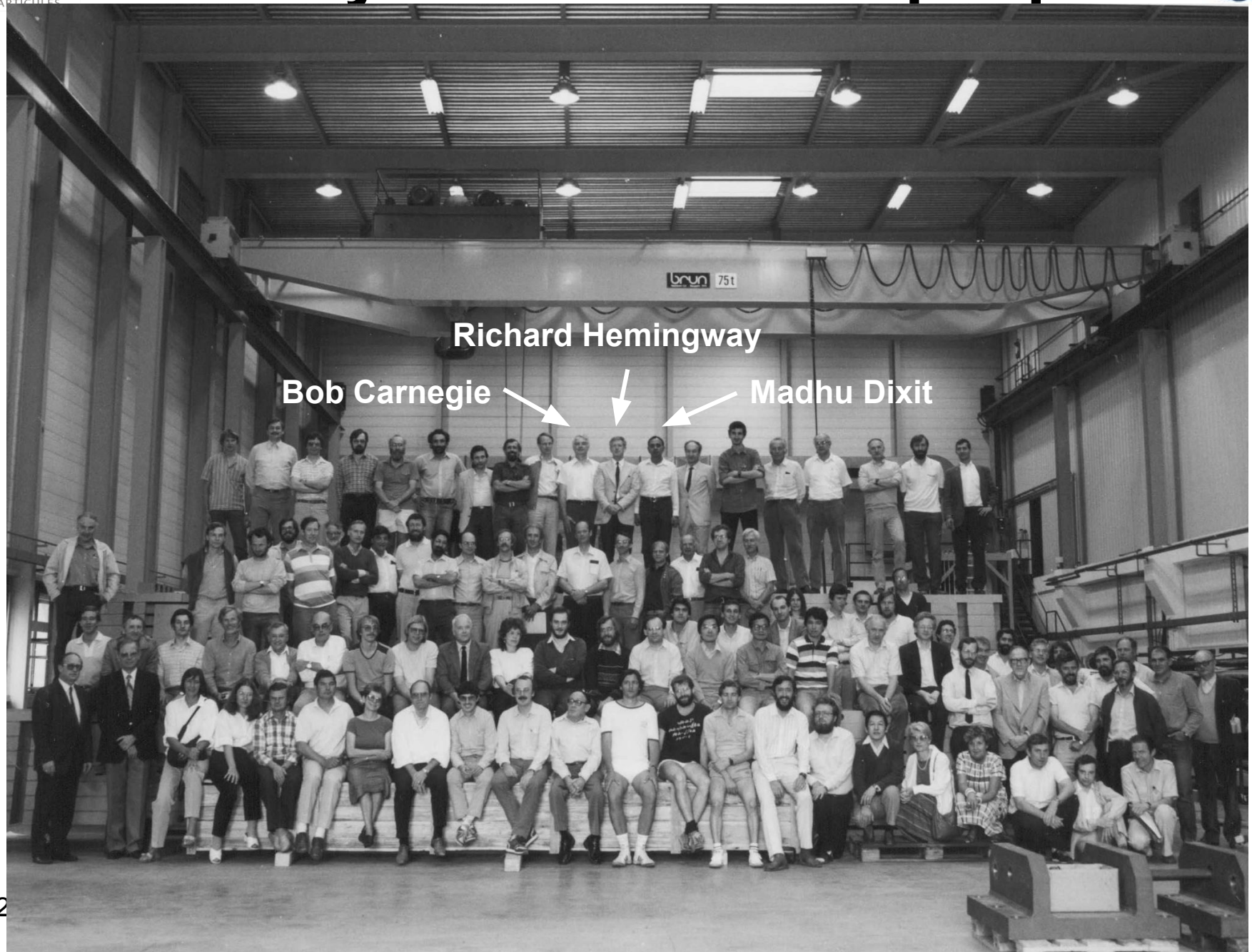
OPAL: first event 1989, last event 2000





INSTITUTE OF PARTICLE PHYSICS
INSTITUT DE PHYSIQUE DES PARTICULES

As always: it's about the people



IPP: later evolution

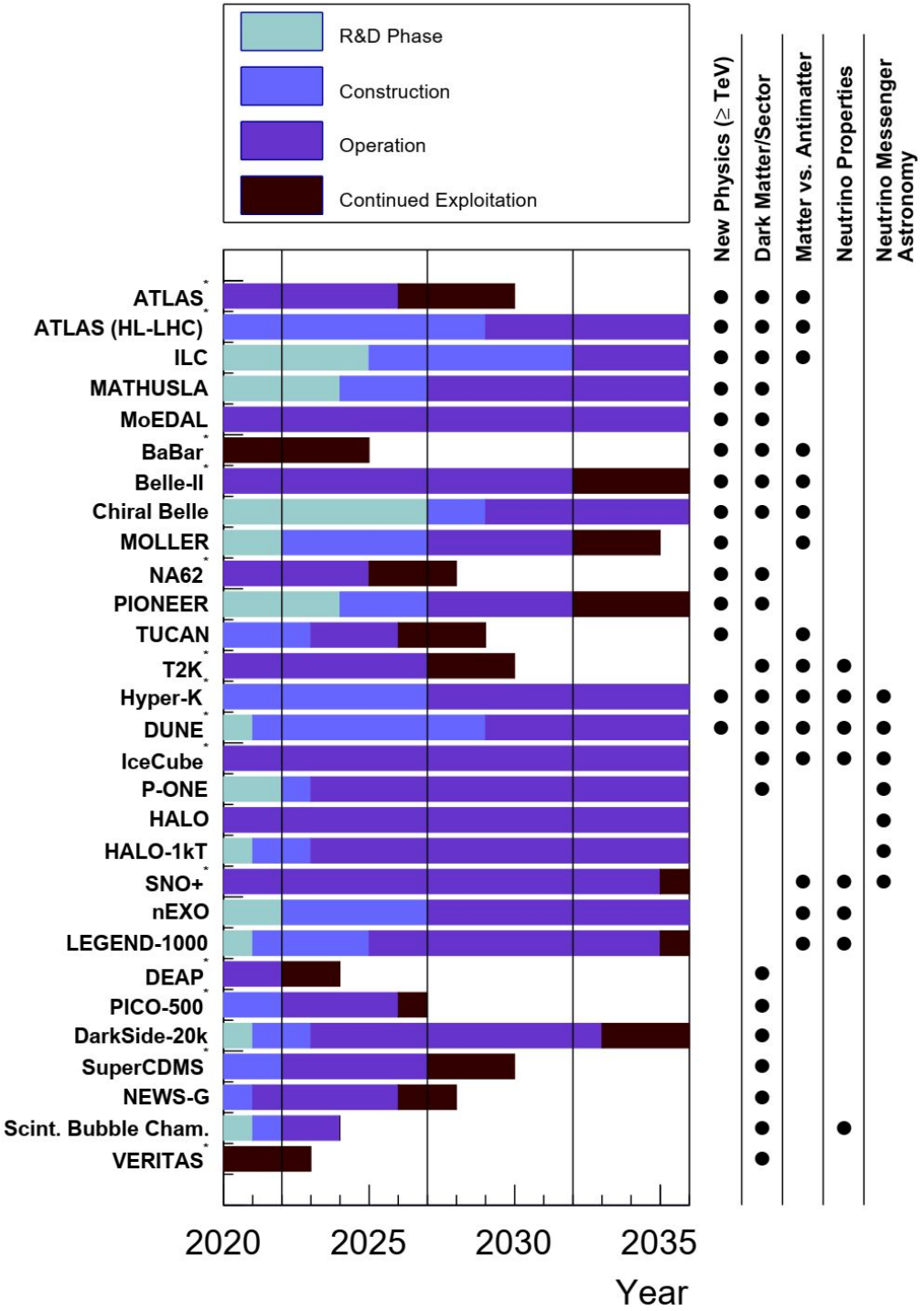
- Alan Astbury: Chair→Director 1991–1994
- Bob Carnegie: Director of IPP 1994–2001
- Richard Keeler: Director of IPP 2001 – 2004
- William Trischuk: Director of IPP 2004 – 2013
- Michael Roney: Director of IPP 2013 – Present

- Financial control of the experimental programme:
  - Direct process between projects and NSERC's GSC-19/SAPES
- IPP Council still reviews new and continuing projects
- IPP Council administers the IPP Research Scientist programme, as well as several other programmes including expanded role in theory community
- Longer-term planning, advocacy with NSERC, CFI and directly to government ministers, plus national and international liaisons (ICFA, Canadian and international labs, CC/DRAC computing alliance, MRS steering, …)

IPP: Scientific evolution

- Beyond colliders like ARGUS, OPAL, ZEUS + HERMES, SLD, BaBar, CDF … *these follow from foundation of IPP*
  - and now ATLAS, Belle-II
- IPP has always had other accelerator-based programmes
  - Fixed-target / DIF experiments
    - LASS@SLAC, E691@FNAL, E705@FNAL, E787/949@BNL, NA62@CERN, TUCAN@TRIUMF, MOLLER@JLAB, PIENU@TRIUMF/PIONEER@PSI
  - Long baseline neutrinos
    - T2K, HyperK, DUNE
- Expansion into particle astrophysics key to IPP, including Canadian "bedrock"projects
  - SNO ! – *Art McDonald's talk in previous session*
  - SNO+, DEAP, HALO(1kT), EXO, nEXO, PICO, DarkSide, SuperCDMS, NEWS-G, Scint.Bubble chamber, …
  - Neutrino telescopes: IceCube, P-ONE
  - *These projects: add to the breadth & diversity of IPP*

Current IPP Project snapshot



IPP Today

- **The Mission (https://particlephysics.ca/about-ipp/mission/)**
  - **To promote Canadian excellence in particle physics research and advanced education.**
  - **To maximise the impact of Canadian particle physicists by employing an outstanding group of IPP research scientists playing key roles in our highest priority projects, organising long-range planning that articulate the community's scientific priorities and maintaining close ties to the Canadian particle physics laboratories.**
  - **To serve as the focal point for particle physics activities in Canada and a point of contact for our partners in laboratories and universities around the world.**
  - **To train highly qualified personnel, expose the next generation of Canadians to the opportunities in particle physics world-wide and maintain an active outreach programme to all stakeholders including the broader Canadian public.**

IPP Today

- The Missi -ipp/mission/)
  - To pro sics research and advanc
  - To max ysicists by emplo n scientists playin , organising long-ra ity's scientific prioriti dian particle physic
  - To serv ctivities in Canad n laboratories and un
  - To trai ext generation of Canadi cs world-wide and ma ll stakeholders includi

"Henry! Our party's total chaos! No one knows when to eat, where to stand, what to.... Oh, thank God! Here comes a border collie!"

Previous IPP RS (& projects)

	RS	IPP Projects	Where are they now
1	Winkelman		LBL → Retired
2	Hemingway	LASS, OPAL, SNO	Retired 2007
3	Martin	…, ZEUS, T2K	Retired 2012
4	Conetti	FNAL Fixed Target	Faculty U.Virginia→ Retired
5	Estabrooks	LASS, FNAL F.T., OPAL, ATLAS	Retired 2000
6	Orr	…, ARGUS, ZEUS	Faculty Toronto
7	Goddard	ARGUS	Motorola
8	LeRoy	CERN Fixed Target	Faculty Montréal
9	Mättig	OPAL	Faculty Wuppertal
10	McKenna	OPAL	Faculty U.B.C.
11	Roney	OPAL	Faculty Victoria
12	Krieger	OPAL, ATLAS	Faculty Toronto
13	Tanaka	T2K, SuperCDMS	Faculty SLAC/Stanford

Current IPP RS (& projects)

	RS (start)	IPP Projects	University Affiliation (current)
1	Sobie (1987)	SLD, OPAL, ATLAS, BABAR, Belle II	Victoria
2	Corriveau (1991)	ZEUS, ATLAS	McGill
3	Hearty (1994)	*BABAR*, T2K, Belle II	UBC
4	McPherson (1997)	OPAL, ATLAS	Victoria
5	Robertson (2003)	*BABAR*, Belle II, ATLAS	McGill
6	Teuscher (2005)	ATLAS	Toronto
7	Wright (2012)	SNO+, PICO	Queen's
8	Ilic (2019)	ATLAS, DUNE	Toronto

- **Plus a long history of other projects that (so far) haven't had an RS**
  - **CDF, E787/E949, DEAP, (n)EXO, PIENU, VERITAS, IceCube, NA62, MOLLER, HyperK, SBC, …**
- **IPP RS work(ed) on projects which are not (yet) IPP projects**

Conclusions, outlook

- IPP grew from Canadian History in particle physics
  - Built programme
  - Expand and secure funding
  - Science and excellence-based peer review
  - Continues to grow and diversify programme
  - Discussion of the IPP Science history during round-table after the tea break

- Recording this history should be done before it's forgotten! (IPP Archive? *cf.* Bill Frisken's initiative)
  - Also reach out, document, advertise... Eg, see: https://cerncourier.com/a/canadian-particle-physics-at-50/

- Particle Physics in Canada owes a lot to IPP, and IPP owes a lot to new ideas, avenues, and fields
  - The core remains the science, and securing the future of PP in Canada

… and also the spirit of adventure

"C'mon, Sylvia … where's your spirit of adventure?"