The Early Days of Proton Therapy
Steps along the way and who contributed

Celebrating 20 years of Treatment

Ewart Blackmore
1979: Plans for BL2C (65-120 MeV) – John Vincent
1980-82: Design, installation of BL2C components - layout
1982: First test beams on BL2C with fixed stripping foils - EWB
1983-86: Studies on isotope production with cesium (Xe-127) and NaI targets (I-123) - JV & Dave Pearce
1987: First beam into BL1B experimental area – neutrons for RBE measurements in collaboration with BCCA – Gabe Lam
1988: Protons into BL1B area & Bragg peak measurements on BL2C and BL1B (200 MeV) – JV and EWB
1990: BL2C extraction system installed – Dan Gray, Dave Morris
BL2C Proposal 1979

Fig. 109. Proposed layout of beam line 2C inside the vault.
First Bragg Peak Measurements 1988

BL2C Bragg Meas.

PROTON RANGE CURVE

72.5 MeV (add 5.6mm)
100. MeV (add 27.3mm)
200. MeV (add 201mm)

John Vincent
Ewart Blackmore
1979: First patient treated with negative pions on M8 channel
1981: Patient couch installed, cyclotron reliability/intensity
issues for 15 fraction treatments.
1990: *Pion therapy at TRIUMF. Treatment results for
astrocytoma grades 3 and 4: a pilot study.* Goodman GB¹,
Skarsgard LD, Thompson GB, Harrison R, Lam GK, Lugate C.
1994: Last pion patient treated
1997: *Results of randomized trial using pions (2 papers)
based on ~350 patients.* Tom Pickles et al
Summary: Experiment in radiotherapy, pion flux issues, 15
fraction issues for scheduling and patient accrual.
- but very important for improving cyclotron reliability/intensity
5 year results with pions no better than conventional therapy

**Protons much easier to produce than pions!**
1988: First meeting of Proton Group Planning Committee
  G. Goodman, J. Rootman(Eyes), F. Durity(AVMs)

1988-92: Regular meetings at Cancer Agency: EWB. JV attending

1992: Business plan BCCA to province for tumours of the eye
  (uveal melanoma) and neuroradiosurgery (AVMs) – see layout

1992: Woodward’s Foundation grants $500K for eye therapy
  using BL2C.
1993: Revised business plan for Eye Therapy only.

Medical: Drs T.Pickles, R.Ma, G.Goodman, K.Paton, L.Skarsgard,
  E.El-Khatib, G.Lam, I.Liu

TRIUMF: E.Blackmore, J.Vincent, U.Oelfke, K.Gardey

Fig. 122. Layout of proton therapy facility in present BL1B area.
Proposal to Woodward's Foundation for Eye Therapy

The capital cost estimates for 1991 for this program include construction of a facility at TRIUMF to allow treatment of patients including an eye chair, radiography facilities and satellite viewing stations. The capital costs are broken down as follows.

<table>
<thead>
<tr>
<th>Proposed Capital Costs</th>
<th>$50,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam delivery equipment</td>
<td></td>
</tr>
<tr>
<td>Alignment equipment</td>
<td>100,000</td>
</tr>
<tr>
<td>Eye chair</td>
<td>115,000</td>
</tr>
<tr>
<td>Controls and instrumentation</td>
<td>50,000</td>
</tr>
<tr>
<td>Building/area modification</td>
<td>100,000</td>
</tr>
<tr>
<td>Treatment planning</td>
<td>25,000</td>
</tr>
<tr>
<td>Contingency</td>
<td>60,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>500,000</td>
</tr>
</tbody>
</table>

**Assumptions**
- Land, building maintenance, hydro, etc. will be by assumed by TRIUMF.
- Building of the beam-handling components would be done by existing staff as outside contracting could increase cost by a factor of 3.
- Estimate for materials or purchased parts only. Assumes TRIUMF will provide design office, electronic and machine shop free of charge. Complete outside contracting could increase cost by a factor of 3.

**Purchases Outside**
- Eye chair - Benchmark
- X-ray equipment - Toshiba
- Room modifications

**Rest done by TRIUMF**

EWB visited Harvard, PSI, Clatterbridge (UK) to learn about Eye Therapy techniques & equipment
Design Phase 1993-1994

During the last years of the KAON PDS
Design Phase 1993-1994

PROTON THERAPY CONTROL SYSTEM

SAFETY
AREA ACCESS
PROTON THERAPY TRIP

TRIP SUMMARY
FAST SHUTTER P.L.C.
BIAS MODULATOR
DOSE RATES
X-RAY!
ASTMERTISTRY

DOSE TRIP
WATCHDOGS

CAMAC CRATE
ADCS
SCALERS
TRIMAC

PROTON THERAPY VAX

NIM CRATE #1
ORTEC 439
AMP/V-F
BIAS SUPPLY

BACK-UP PRINTER

NIM CRATE #2
ORTEC 439
BIAS SUPPLY (BACKUP)

BACK-UP COUNTER

ROOM MONITOR
AUDIO/VIDEO CONTROL
BACK-UP DOSE SET
CONTROL CONSOLE

EYE MONITOR
CHAIR RANGE SHIFTER
EMERGENCY
FAST SHUTTER IN/OUT

VISUAL SCALERS CALIBRATION EQUIP.
X WINDOWS TERMINAL
KEYBOARD

November 26, 2015
Proton Therapy 20th
Overall coordination – EWB

**Mechanical design & ass’y:** F. Cifarelli, E. Knight + Machine Shop
**Fast Shutter, profile monitor:** D. Gray, B. Rawnsley
**ISIS pepperpot:** R. Ruegg
**Ion chambers:** W. Faszer, P. Vincent, C. Lim
**Modulators & Range Shifter:** EWB, U. Oelfke, K. Gardey
**Controls hardware, software, cameras, console:** B. Evans, P. Bennett, R. Moore, J. Nelson, D. Morris, B. Roberts
**Operator Interface software:** M. Mouat, T. Kadantseva, E. Klassen
**Room modifications:** H. Mertes
**Safety hardware & overview:** J. Drozdoff, L. Moritz, I. Thorson
**Control room operations & BL2C coordination:** A. Hurst, M. Stenning, J. Vincent, D. Pearce.
**Summer students:** R. Van Varsveld
Main Challenge – Getting AECB Approval

- System commissioned and ready for patient treatment by December 1994
- Dosimetry checked, beam profiles checked
- RBE measurement using V79 cells & mouse feet
- Treatment planning software EYEPLAN and patient alignment checked.
- TRIUMF TSAC approved Safety Analysis Report but AECB wanted more reviews.
- February 1995: External Expert Review Dr. L. Verhey
- April 1995: Structured Peer Review (control system)
Eye Care Centre/UBC: Dr. Katherine Paton, Dr. Jack Rootman

Oncologists: Dr. Tom Pickles, Dr. Roy Ma

Medical Physics: Dick Kornelson, Gabe Lam, Ellen El Khatib, Cheryl Duzenli, William Kwa, Richard Lee, Conrad. Yuen

Physics Ass’t: Ivan Liu, Vince Strgar

Radiotherapy Technologists: Chris Alexander, Pat Ho, Sarah Conibear

TRIUMF: Ewart Blackmore, Conny Hoehr (since ~2009)

Typically 5-9 present at TRIUMF for each treatment
First Patient August 21-25 1995

PRESENT:

Dr. T. Pickles
Dr. E. Blackmore
Dr. R. Ma
Dr. K. Paton
Dr. U. Oelfke
Dr. C. Duzenli
Chris Alexander

Dr. J. Vincent
Dr. L. Skarsgard
Dr. G. Lam
Mr. K. Gardey
Mr. I. Lui
Bob Harrison

DATE

Monday, July 31
Tuesday, August 8
Thursday, August 10
Thursday, August 17
Friday, August 18
Saturday, August 19
Sunday, August 20
Monday, August 21
Tuesday, August 22
Thursday, August 24
Friday, August 25

Clip insertion
Simulation 8:00 a.m. at TRIUMF
Planning 8:30 a.m. at TRIUMF
Final measurements, if needed
Final Simulation
First fraction
Second fraction
Third fraction
Fourth fraction

The first patient, Mr. Lorne Scott, immediately after proton treatment to his right eye at TRIUMF in August 1995.
Thank you!

Merci