



Beam Line Monitoring from the Physics Side - Status

Alexander Booth

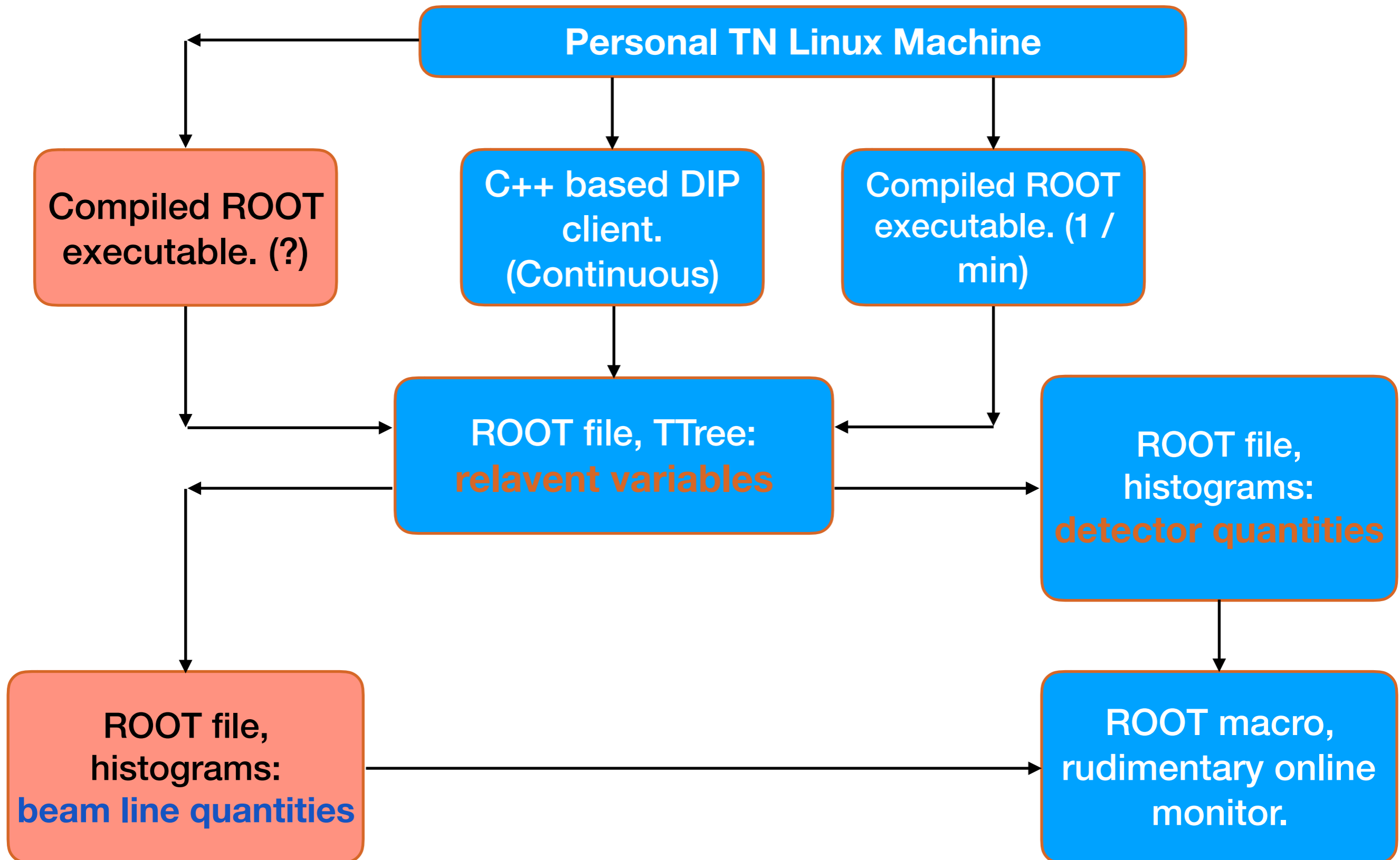
Beam Instrumentation Group Meeting, CERN. August 22, 2018

Overview

- Outline task and motivation.
- The tools that exist.
- What work is still to do.
- Specific questions which need to be addressed.

Work Flow

GOAL: Compute and display 'higher level' beam line variables (TOF / PROF detectors) in online way to be viewed in NP04 control room by shifter.



DIP Extraction & Unpacking

	TTree Variables						
TOF / PROF	Sub name	Detector name	Detector type	Acquisition TS			
TOF	TS count	TS seconds	TS coarse	TS frac			
PROF	Counts rec	TTS LSB	TTS MSB	Event TS LSB	Event TS MSB	6 x Fibre words	BField?

Filled per Acquisition

TOF arrays:

1 event = 1 array entry
1 array of length 3000 / acquisition
3000 events / acquisition

PROF arrays:

1 event = 10 array entries (32-bit words)
1 array of length 30000 / acquisition
3000 events / acquisition

ROOT executables unpack raw data and make following histograms:

Detector Quantities

Beam Line Quantities

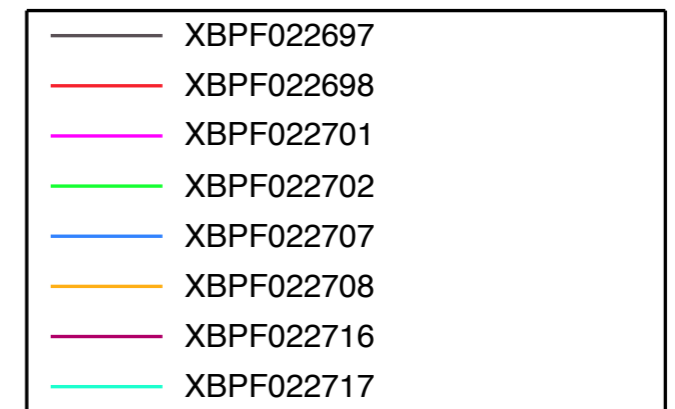
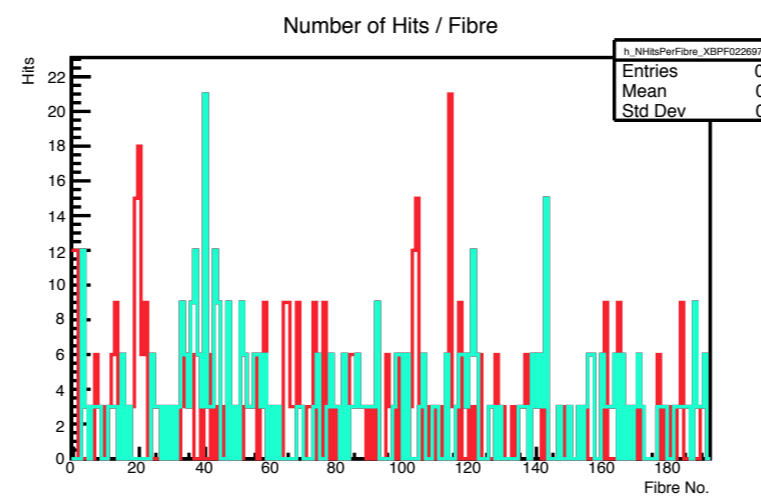
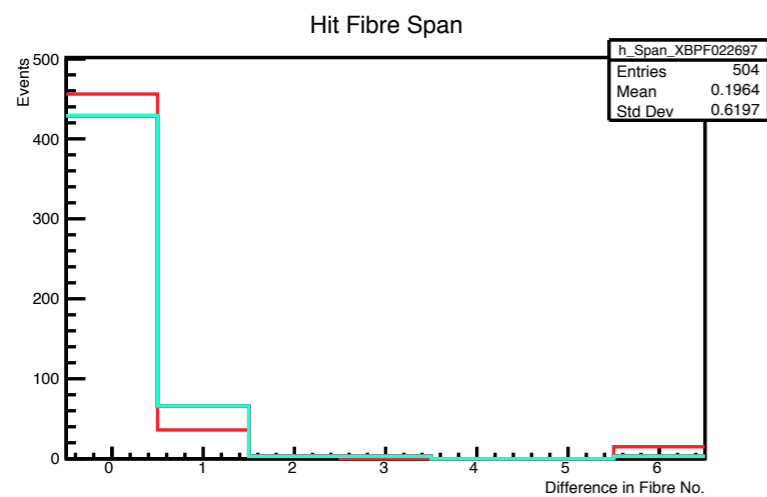
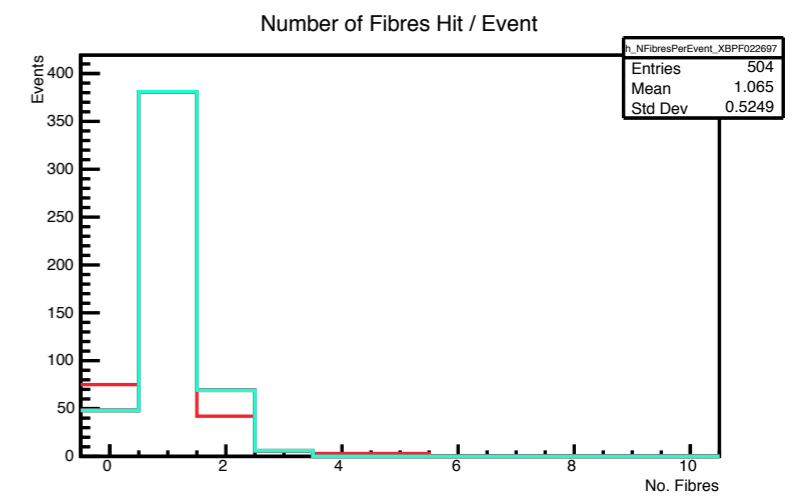
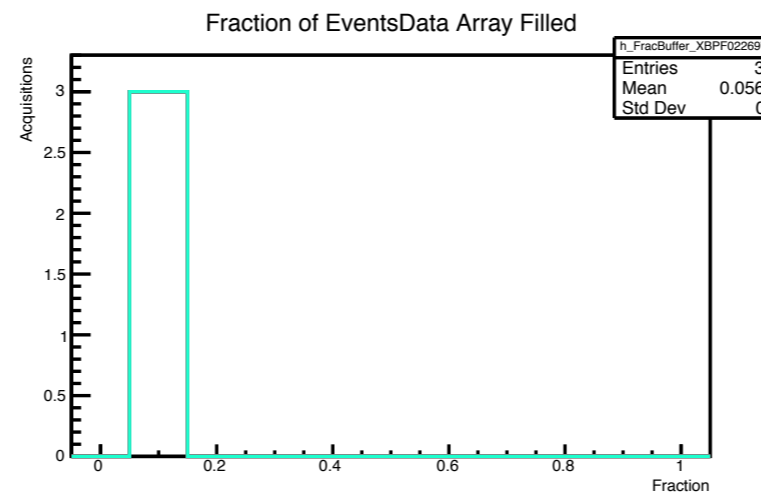
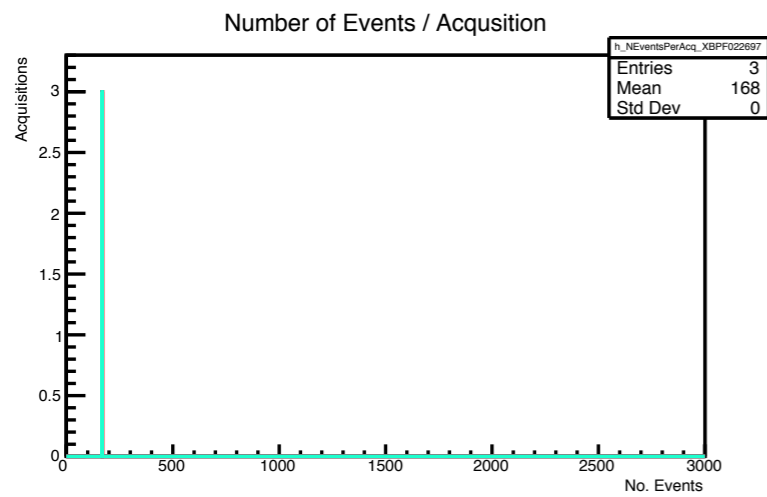
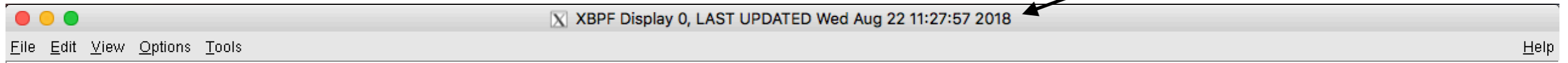
- Time between adjacent acquisitions.
- Number of events / acquisition.
- Fraction of buffer used / acquisition.
- Number of fibres hit / event.
- Distance between fibres when >1 are hit.
- Number of hits / fibre.
- Trigger and event TS.
- Time elapsed since first TS of acquisition.

- Cosine of angle and angle of deflection.
- Momentum of deflected particle.
- Magnetic field.
- Fibres used in the calculation of deflection.
- Time of flight between TOF detectors.
- Time of flight between outer PROF detectors.

ROOT macro that looks ~ every 30 sec for newly generated histogram file.

Example of 1 / 4 displays. 'Nonsense' data.

Last time a new histogram file was found



Legend

Problem: Can't currently interact with the canvases.

Looking into possible fixes.

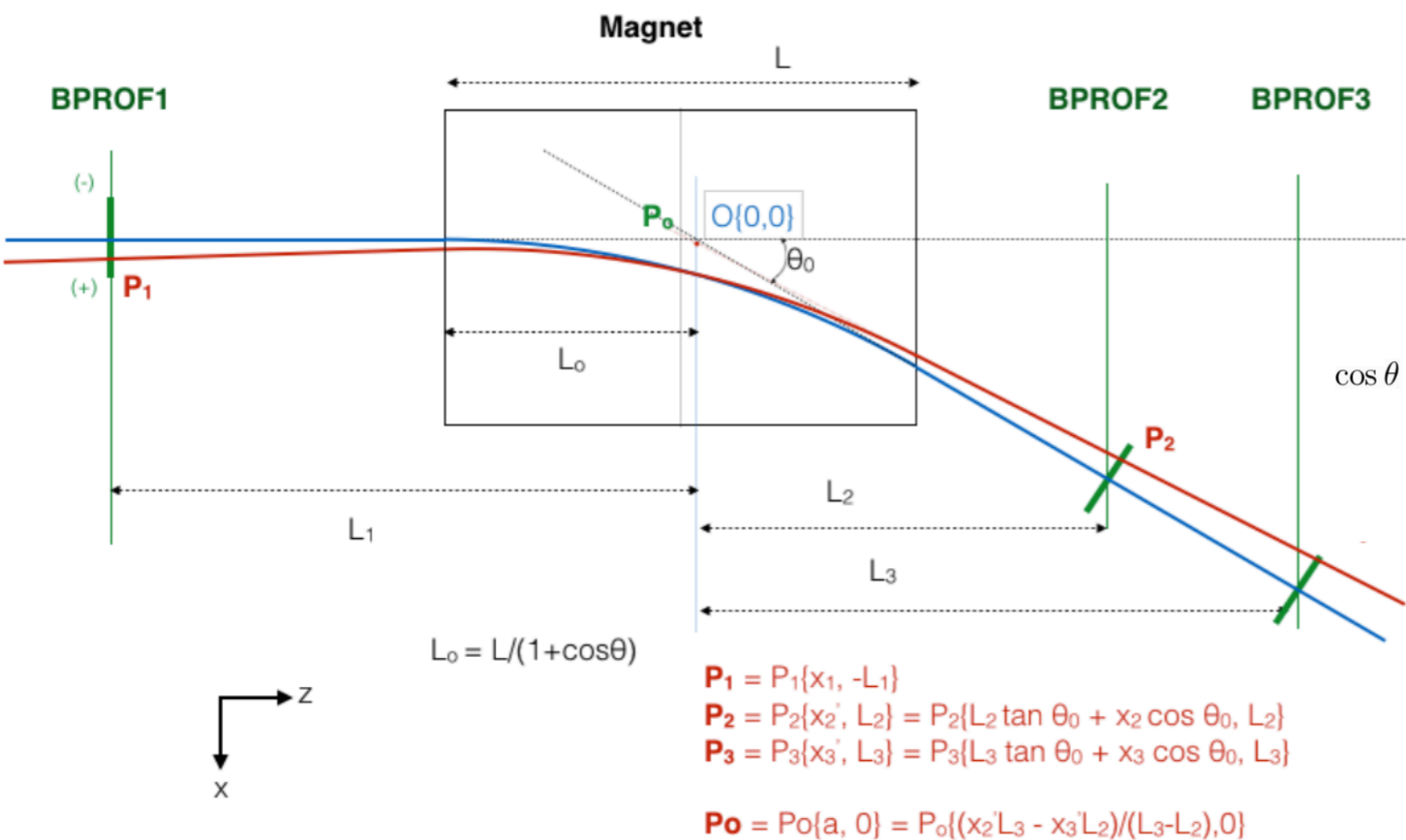
Move this to official OM?

Beam Line Quantities

Deflection / momentum calculation requires position information from 3 beam profilers.

Look through the trigger timestamps of BPROF1 and BPROF4. Coincidences within some time tolerance.

Coincidence - > check BPROF2 for a trigger between two times.



Use fibre hits (x_i) and this formula for deflection.

$$\cos \theta = \frac{(a - x_1)(x_3 - x_2) \cos \theta_0 - (L_3 - L_2)[L_1 + (a - x_1) \tan \theta_0]}{\sqrt{L_1^2 + (a - x_1)^2} \sqrt{(L_3 - L_2)^2 + [(L_3 - L_2) \tan \theta_0 - (x_3 - x_2) \cos \theta_0]^2}}$$

$$a = \frac{x_2 L_3 - x_3 L_2}{L_3 - L_2}$$

Momentum, p [GeV/c] = $(cLB)/(10^9 \cdot \theta)$

Small angle approximation

Current Issues: 1) Code needs *proper* debugging and optimisation on real data. 2) Speed? Depends on event degeneracy. 3) How to obtain BField? 4) Accurate values of magnet length, L and declination, θ_0 .

- Live extraction of data to ROOT trees from DIP for TOF and PROF detectors. DONE.
- Live monitoring of detector variables via rudimentary ROOT macro. DONE.
- Code to extract time of flight and momentum information. EXISTS but is far from perfect.
 - ▶ Needs debugging on real data.
 - ▶ Needs to be optimised for the real data.
 - ▶ Couple of geometric parameters need clearing up.
- Histograms to display angle / momentum / time of flight for non-degenerate trigger combinations. 99% DONE. Code for their live generation and monitoring is already complete.
- Need to establish on which machine this will run / where data will be stored going forward. I think Geoff Savage has a plan?
- Get all of these plots into the 'official' online monitoring. OM group looking at the easiest way to do this.