Do we upgrade the FTD ?

S Burke, R C W Henderson and T Sloan

School of Physics & Chemistry

Lancaster University

Lancaster LA1 4YB, UK

Abstract

In view of the possible exotic signals in the forward direction the question arises as to whether we could improve the FTD. There will be two significant shutdowns in which to carry out improvements. The first is from Nov 1997 to May 1998 and the next will be between 1999 and 2000 (since 1998-1999 will be almost continuous running with only a short shut down at the end of 1998).

1 How Can the Forward Tracker be Improved ?

1. Secondary interactions occur in the CJC wall (mean thickness $\sim 0.5\ X_0$). This effect has been simulated with some difficulty (eg. see the P_t paper and Theo Holtom's analysis) since the material is mainly electronic cards and cables which is not uniformly distributed. Improvement of this will require effort in the CJC rather than in the FTD. Currently the cards are oriented end-on along the line of flight of the particles leading to hot spots of material which are difficult to simulate. This situation would be improved if the cards could be rotated through 45 degrees so that the material appears more uniform.

2. $\sim$70% tracking efficiency has been achieved in complicated events (eg in the P_t paper). The overall tracking efficiency could be significantly improved by adding some redundancy within the planar chambers. Currently there is no redundancy and the failure of one orientation means the loss of the whole segment. Any additional redundancy will also make us less sensitive to the shifted data problem. Fig. 1 shows the present lay-out of the forward tracker.

3. Repositioning of the present chambers will improve efficiencies both in finding tracks and linking more segments to make longer tracks which would have improved momentum resolution. Adding extra planar chambers would give the redundancy to improve further the track finding efficiency. This will make it easier to decide if a track is an electron or positron at high momentum which will be a significant improvement for events at high x and Q^2.

4. The transition radiator is not currently used. Removing it would make room for chamber rearrangements and the addition of extra chambers and it would decrease the material in the FTD.

5. Momentum resolution at low momentum could be improved by reducing the material in the planar chambers.

2 Options for upgrades.

2.1 Simple Options

1. Do nothing.

2. Remove the transition radiator to decrease multiple scattering and secondary interactions. This would be a relatively cheap option but it would have little effect in practice.

3. Leave the present configuration (see figure 1) and add in some smaller specially designed chambers which are suspended from the U beam inside the present gas tank. There are several disadvantages with this approach; a) It will require completely new software which would imply a learning period to understand the new chamber characteristics. b) It would preclude the safe options, discussed later, which we know would give us the required improvements.

2.2 Planar-Radial-Planar Arrangements

The spacial precision of a track measurement comes mainly from the planar information while the momentum precision is mainly obtained from the radial chambers. The motivation for a Planar-Radial-Planar arrangement comes from wanting two well measured planar segments at the extremes of a track to optimize the measurement of the track θ and ϕ. The radials can then be grouped as a single block in the centre giving the longest possible radial segment for momentum measurement. We present 3 options.

4. Option B (see figure 2). This would need a new gas tank but no extra chambers. In this option one of the present planar chambers would be split into a two and one orientation set which would be operated separately. The two extra orientations would be placed behind the first planar module and the remaining orientation behind the second planar module. (NB. we believe one extra orientation exists in Manchester and this would be used if so.)

5. Option A (see fig 3). This would need a new gas tank and one new planar supermodule (3 orientations).

6. Option C. If no new chamber build is possible and Option B is not possible then we could have this option which is option A without the last planar module. In this case we would have a six orientation planar module at the front and then just a three orientation at the end.

3 Efficiency improvments for the different options.

3.1 Current position

We believe that the individual orientation efficiencies are $\sim$90%. The reason for this belief is that the segment finding efficiency when we demand all three orientations from the 3 chambers will be 0.9^3=73% which is in reasonable agreement with what we know.

3.2 Other Options

We assume the individual segment efficiencies are 90% and then compute the efficencies for some of the options discussed above. The results are presented in the table below.

Number of coincident planes to form segment	Option	6	5	4
		Planes in Orientation		
3	B	-	99%	95 %
4	B	-	92 %	66%
3	A	100%	-	-
4	A	98.5%	-	-

It should be noted that option B gives acceptably high efficiency demanding a coincidence of 3 or 4 planes for the 5 plane module but not for 4 planes in the 4 plane module. Option A gives a very high efficiency for either 3 or 4 plane coincidences. Being able to demand 4 plane coincidences reduces the occurence of random segments which produce ghost tacks.

We need to choose which option to adopt. In doing this we should keep in close contact with the Forward Silicon tracker group.

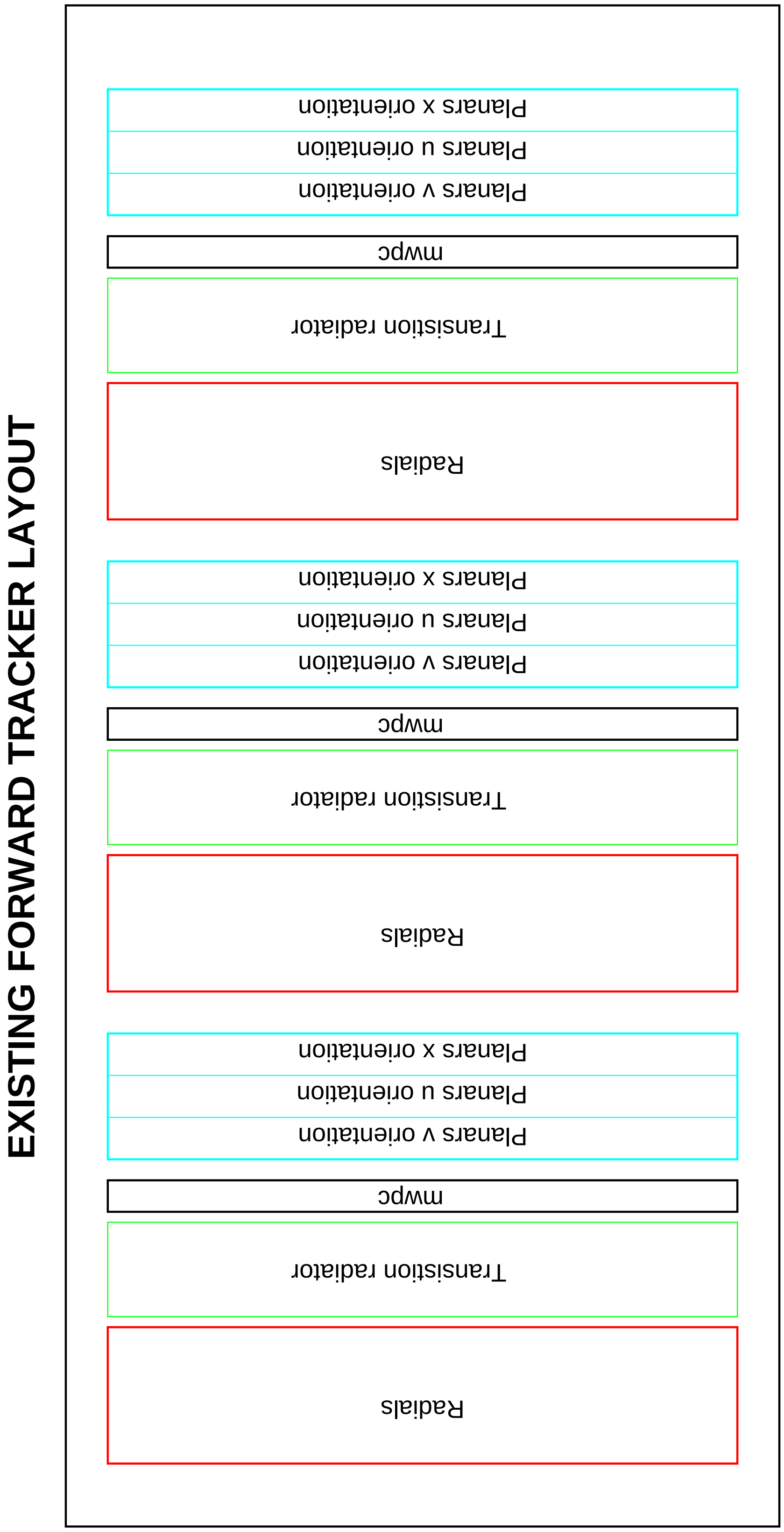

Fig 1. The existing Forward Tracker layout.

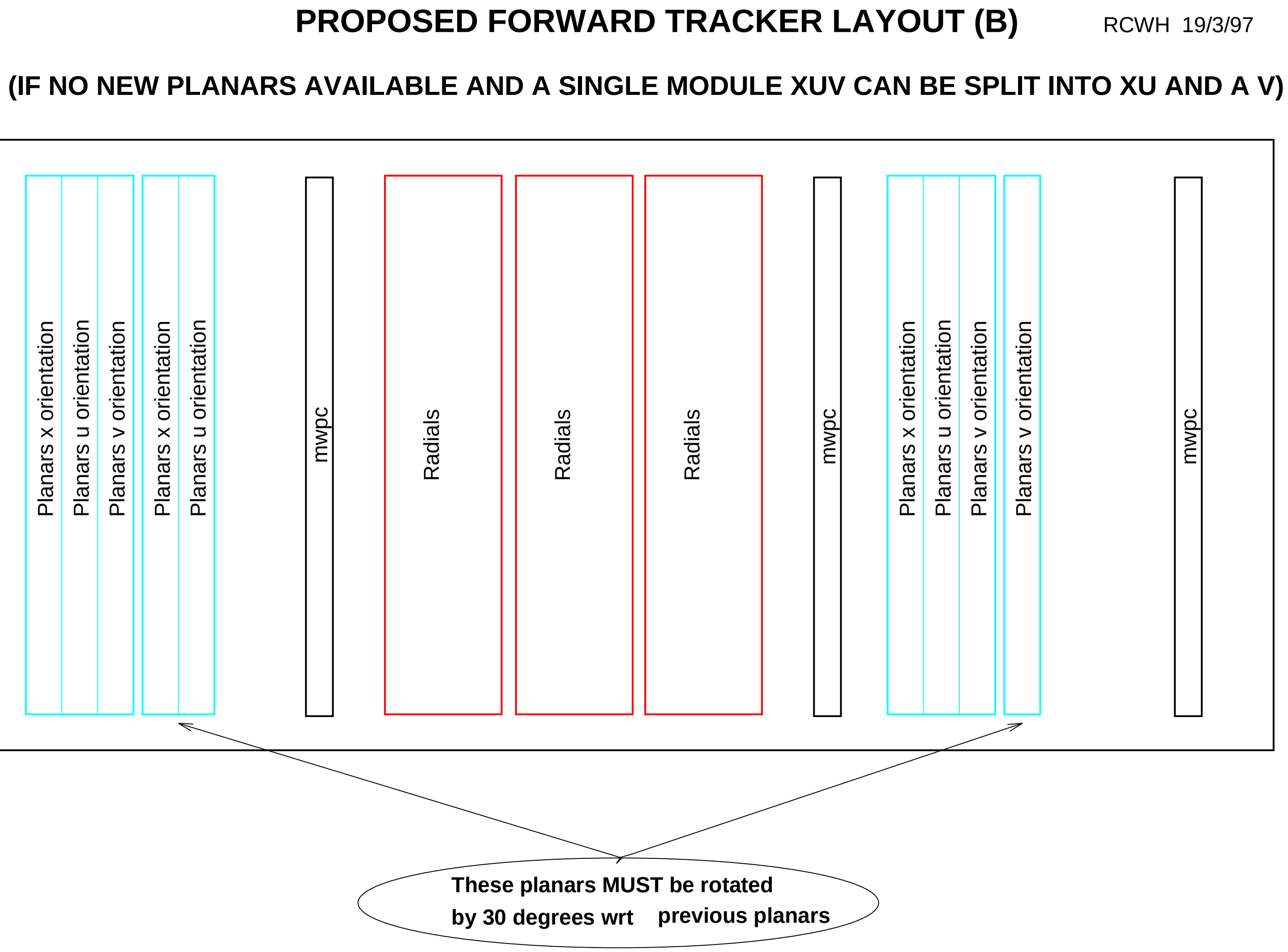

Fig 2. Option B with Minimal chamber building.

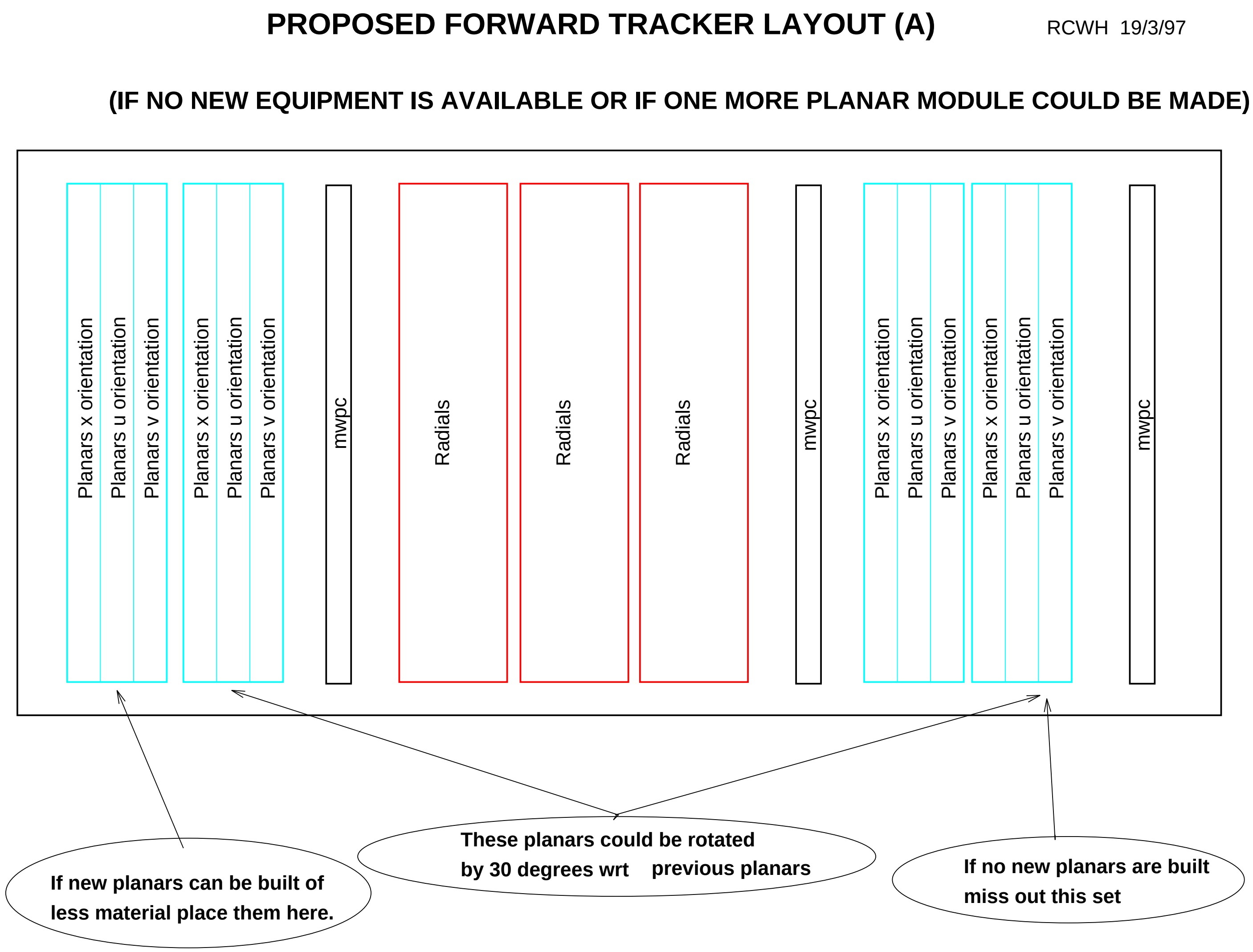

Fig 3. Option A with significant chamber building.