



ATLAS SCT

The ATLAS Semiconductor Tracker

25ns Testbeam - May 2000

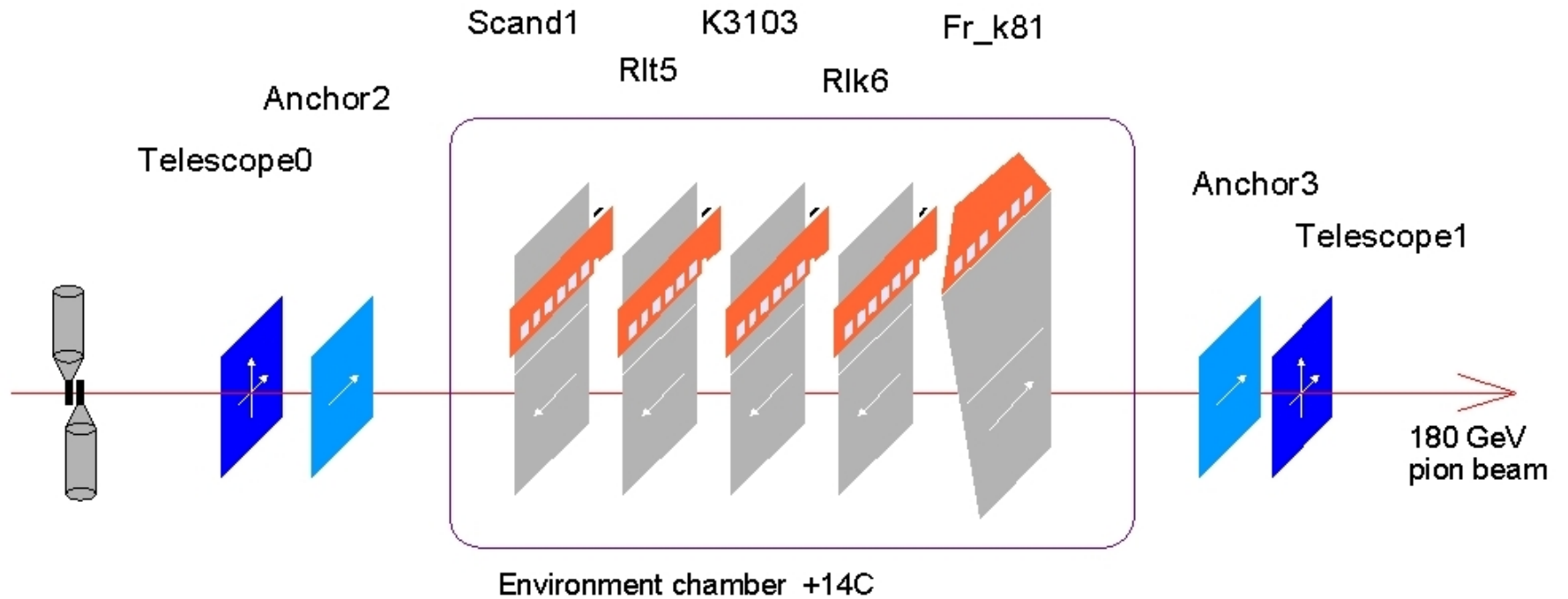
Installation: 8 - 13 May

Beam: 14 - 24 May

- Installation - John, Gareth, Prague team
- Module preparation - Peter, Zdenek, Lars
- Shifts - Vit, Rachel, John, Gareth, Andras, Grant, Brendan, Lars, Jo, Tapio
- Analysis - Alan, Rachel, Lars, Gareth
- Help - Jan Godlewski (cooling), Konrad Elsener (beam), Bruce Taylor (TTCmi), Alan Rudge (TTC translator)



Modules



| | | | | |
|----|---------|--------------|-------------|-------------|
| 0 | rlt5 | Full barrel | UK | |
| 1 | k3103 | Full barrel | KEK | |
| 2 | anchor2 | | Melbourne | |
| 3 | anchor3 | | Melbourne | |
| 4 | rlk6 | Full barrel | UK | |
| 5a | fr_k81 | Full forward | Frieburg | } part-time |
| 5b | scand1 | Full barrel | Scandinavia | } part-time |



Installation

- New fast trigger system: Prague CU (Zdenek's talk)
- Crates and cables to far-side of control room (neat!)
- Chiller - cold fluid & N₂ gas
 - * Maintained +14 C throughout (no dewing)
- New-style systemtest cables (on loan; thanks Jo)
 - * 30m, 0.6Ω on main conductors
- Signal cables - low-attenuation bundled, shielded pairs
- Viking Telescopes as usual (2 only: 2 to TRT)
- TTC adaptor (single to differential ECL): Alan Rudge
- SCTLV-2 power supplies for 6 modules from Jan Stastny
- MUS/SLOG/CLOAC readout using PC-based SCTDAQ
- HP E3612A 135V detector bias supplies



Anchor Planes

- Standard telescope box & acceptance area
 - ⇒ Simple alignment wrt telescope; stable & easily located
- ABCD2NT chips: 4 per plane
 - (enough for acceptance; no cooling required)
- Barrel KEK hybrid type 2 & glass fan-ins (thanks Nobu)
- Single SCT barrel detector mounted square to box
 - (Sintef 98 p+n; non-standard processing - thanks Bjarne)
- Alumina baseboard as used for systemtest dummies
 - (Detector and hybrid glued direct to baseboard, abutting; thanks Jo)
- Special support card, compatible with SC99, daisy-chain
- Machining, gluing, bonding at Melbourne
 - Allows optional stand-alone (no telescope) space point at high event rate (**2250/burst instead of 125/burst!**)
 - Operated in EDGE 0 COMPRESSION 0 (wide timing)
 - 2 planes built and used; third awaiting only a baseboard



DAQ

- MuSTARD for readout (DECODED mode)
- SLOG for Slow Commands and C&C fanout
- CLOAC for Fast Commands (L1A, BCReset), including external clock & trigger synchronisation

- 6 module fanout; SC99 signal cables

- SCTDAQ with TB extensions, as per KEK Dec99
- National Instruments NI-VXI VME interface
- In-situ calibration and noise scans - very convenient for debugging and characterisation

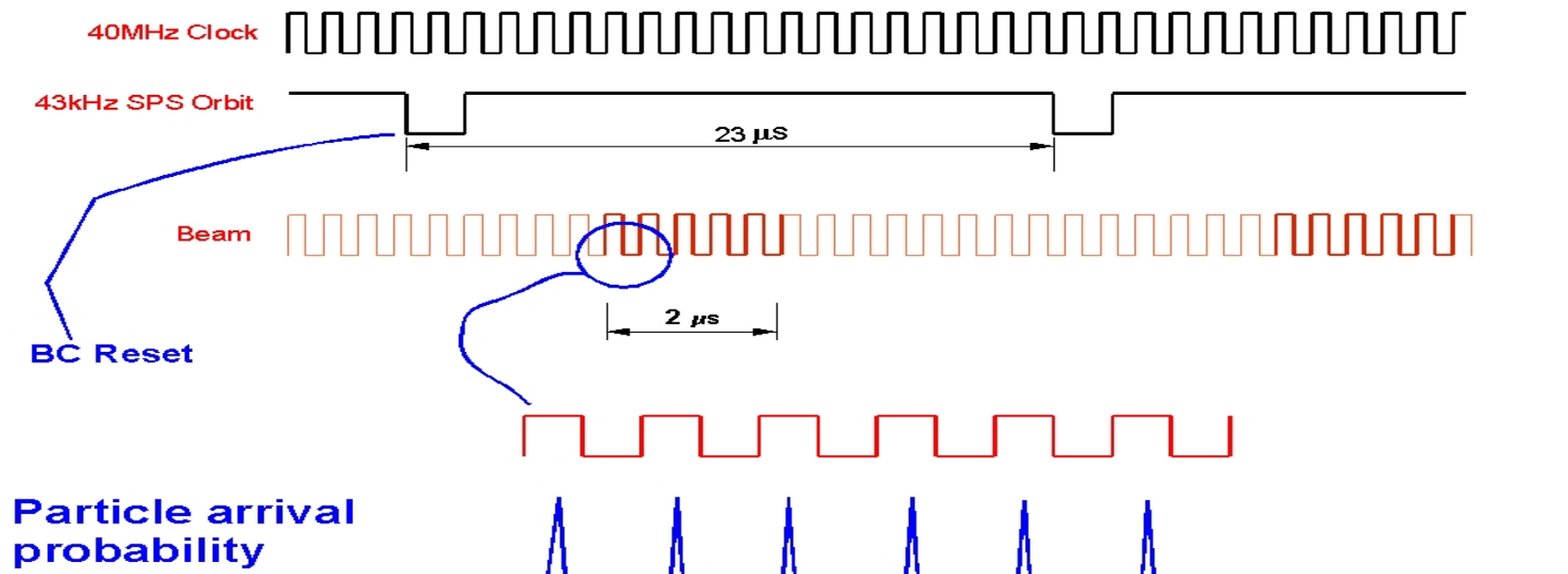
- Data saved on local drive *and* copied to HP
- Central Data Recorder from HP to Tape Store



TTC

- 25 ns "special beam" prepared in PS and injected to SPS
 - 40MHz clock and 43kHz "Orbit Clock" to all experiments
(prototype LHC optical fibre laser TTC distribution)
 - Very stable timing
- TTCmi "Machine Interface" for whole ATLAS barrack
SCT ECL receiver to SCT CLOAC, also PIX & TRT

SCT H8 Testbeam - 25ns Beam Structure 12-24 May 2000





Module Preparation

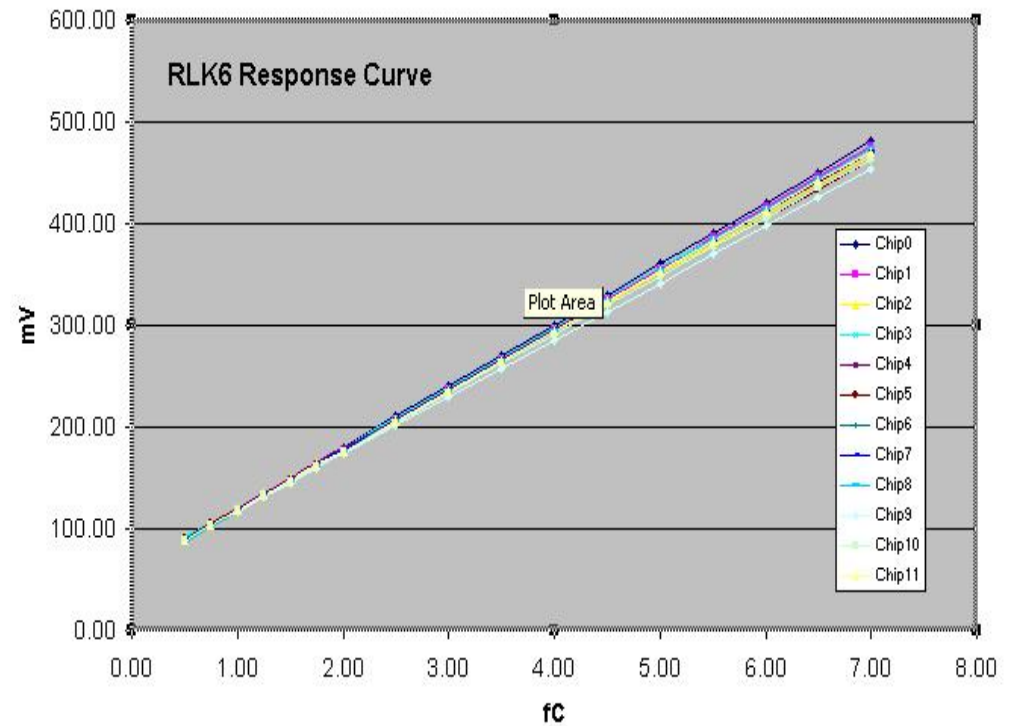
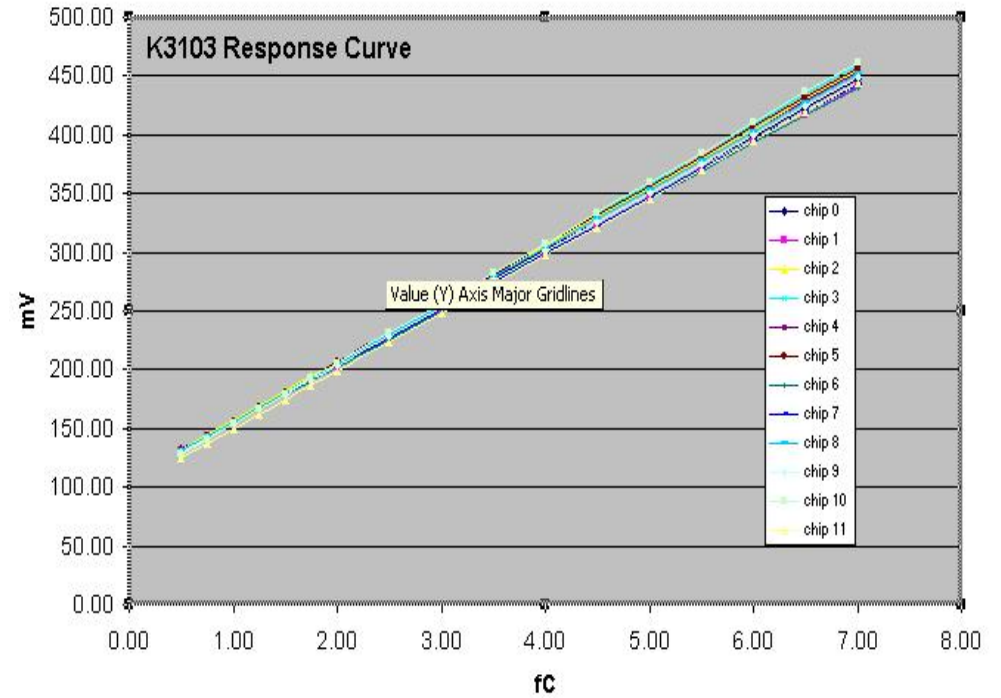
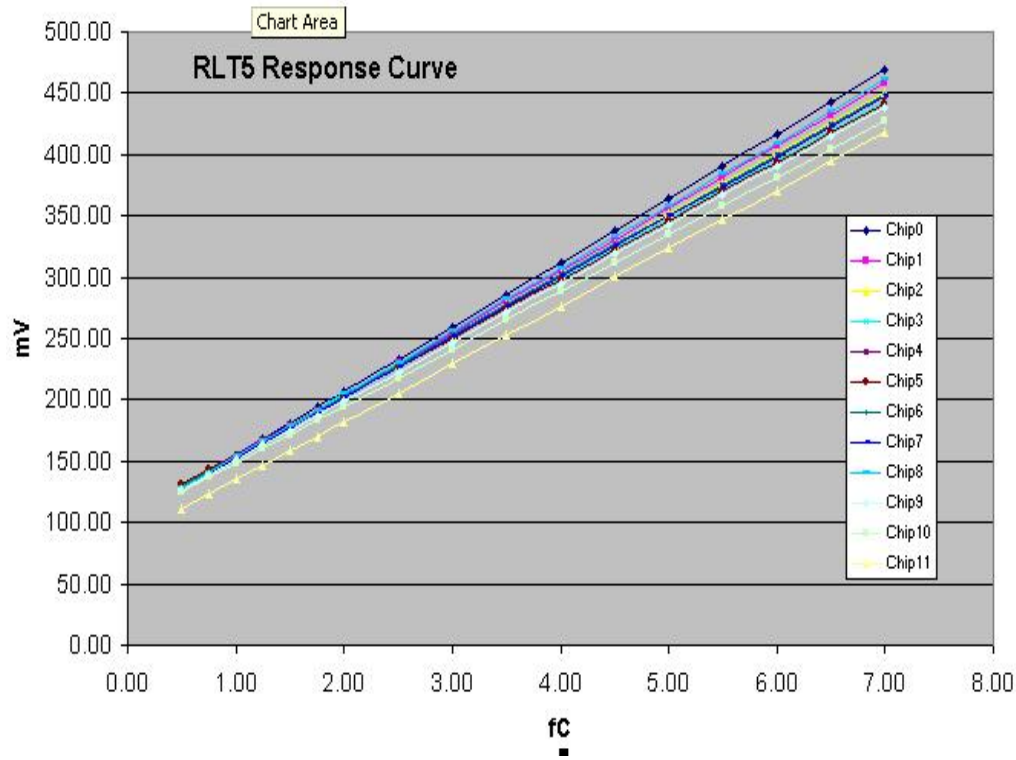
- In-situ characterisation using integrated SCTDAQ
- All modules prepared similarly
- Linear response curve forced through noise-occupancy offset

- QMW-style metal boxes (without cover plates)
- SC99-style support cards
- DGND connected to box from support card

- 30m "new" Systemtest cables (prototype conventional cable)
[problem: connectors difficult to mate]



Module Response Curves





Run Plan (c.f. 1998 request by SCT, PIX, TRT)

- Scan particle bunch arrival ($\pm 1-2\text{ns}$) against clock phase to study **Timewalk**
- Use **synchronous TTC** to study efficiency of several **representative full barrel modules** with "**LHC-like**" timing:
 - Clock-phased bunch arrival (2-3ns in 25ns)
 - Bunch-trains (particles for only $2\mu\text{s}$ in $23\mu\text{s}$)
 - BC-resets synchronous with bunch train
 - L1A-resets / event to allow multiple L1As / trigger
- Standard Threshold Scan (fC set using Response Curve):
0.5, 0.75, 1.0, 1.25, 1.5, 1.75, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0
- Extra points: 0.625, 0.875, 2.25, 2.75, 3.25 etc., 7.0, 8.0
- Timewalk scans (clock cable delay) with telescope at low intensity (approx. 1 particle per bunch train) at 80V and 100V
- Synchronous TTC studies without telescope (but with anchor XY) at medium (4-5 particles/train) and high (40-50 particles/train) intensities at 100, 135V
- Noise scans in-situ under same conditions



Scans taken

| | | Clock Delay vs Threshold | | | | | | | | | | | | | |
|------------|-------|--------------------------|---------|------|--------|---------|------|------|------|---------|------|---------|------|------|------|
| | | Qth/IC | | | | | | | | | | | | | |
| 80V | | 0.50 | 0.75 | 1.00 | 1.25 | 1.50 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 | 6.00 |
| | 4.00 | 392 | 373 | 376 | 377 | 370 | 379 | 380 | 381 | 383 | 384 | 385 | 386 | 390 | 391 |
| | 6.00 | | 357 | 358 | 359 | 356 | 360 | 361 | 362 | 363 | 364 | 365,366 | 367 | 368 | |
| Delay/ns | 10.00 | | 355 | 340 | 342(*) | 339 | 343 | 344 | 346 | 347,348 | 350 | 352 | 354 | 353 | |
| | 16.00 | | | 328 | 329 | 327 | 330 | 331 | 332 | 333 | | | | | |
| | 20.00 | 395 | 396 | 397 | 399 | 394 | 400 | 401 | 402 | 404 | 405 | 411 | 414 | 415 | 417 |
| | 24.00 | 435 | 436,438 | 418 | 433 | 419 | 420 | 421 | 422 | 424 | 431 | 426 | 430 | 428 | 429 |
| (*)1.30 fC | 28.00 | | 454 | 453 | 452 | 439,440 | 441 | 442 | 443 | 445 | 447 | 448 | 449 | 450 | 451 |

| | | Q th/IC | | | | | | | | | | | | | | |
|----------|-------|---------|-------------|---------|------|------|------|---------|------|---------|------|------|---------|------|---------|---------|
| 100V | | 0.50 | 1.50 | 1.00 | 1.25 | 0.75 | 1.75 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 | 6.00 |
| | 4.00 | 644 | 645,646 | 647 | 648 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659,660 | 662 |
| | 6.00 | 681 | 682,683 | 684 | 685 | 686 | 687 | 688 | 690 | 692 | 693 | 694 | 695 | 696 | 696 | 697 |
| | 8.00 | 624 | 623,629 | 625,630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 |
| Delay/ns | 10.00 | | 821 | 822 | 823 | | | | | | | | | | | |
| | 12.00 | 606 | 605 | 603 | 608 | 607 | 609 | 610 | 613 | 614 | 615 | 616 | 617 | 619 | 621 | 622 |
| | 14.00 | | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810,811 |
| | 16.00 | 601 | 563,584,585 | 586 | 588 | 591 | 589 | 590 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 |
| | 18.00 | 780 | 779 | 782 | 783 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 |
| | 20.00 | | | | | | | | | | | | | | | |
| | 22.00 | 778 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769,720 | 721 | 722 | 723 | 724 | 725 | 726 |
| | 24.00 | 547 | 546 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 558 | 559 | 560 | 561 | 562 | |
| | 26.00 | 664 | 665,666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 |
| | 27.00 | 743 | 744 | 795 | 727 | 728 | 729 | 730,731 | 732 | 733 | 734 | 735 | 736,737 | 738 | 739 | 740 |
| | 28.00 | 663,702 | 701,703 | 705 | 713 | 714 | 715 | 716 | 717 | 706 | 718 | 719 | 720 | 721 | 722 | 723 |
| | 29.00 | 742 | 725 | 726 | 727 | 728 | 729 | 730,731 | 732 | 733 | 734 | 735 | 736,737 | 738 | 739 | 740 |

| Med Inten | | Edge | V | 0.500 | 0.625 | 1.500 | 1.000 | 1.250 | 0.750 | 1.750 | 2.000 | 2.500 | Qth/IC | | | | 4.5 | 5 |
|-----------|----|------|-----|-------|-------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---|
| | 4 | 0 | 100 | 1011 | 1012 | 1010,1013,1040 | 1014,1038 | 1015,1039 | 1016 | 1017 | 1018,000 | 1019,000 | 1020,000 | 1021,000 | 1022,000 | 1023,000 | 1024,000 | |
| | 14 | 1 | 100 | 1042 | 1043 | 1041,1044 | 1045,1061 | 1046,1062 | 1047,1063 | 1049,1064 | 1050,1065 | 1051,1066 | 1052,1067 | 1053,1068 | 1054,1069 | 1055,1070 | 1056,1071 | |
| | 14 | 0 | 100 | 1084 | 1085 | 1083,1086 | 1087 | 1088 | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 | 1097 | |
| | 28 | 1 | 100 | 1112 | 1113 | 1111,1114 | 1115 | 1116 | 1117 | 1118 | 1119 | 1120 | 1121,1126 | 1122,1127 | 1123,1128 | 1124,1128 | 1130 | |
| | 28 | 0 | 100 | 1135 | 1136 | 1137 | 1138 | 1139 | 1140 | 1141 | 1142 | 1143 | 1144 | 1145 | 1146 | 1147 | 1148 | |
| Delay/ns | 22 | 1 | 135 | 1164 | 1165 | 1163,1166 | 1167 | 1168 | 1169 | 1170 | 1171 | 1172 | 1173 | 1174 | 1175 | 1176 | 1177 | |
| | 22 | 0 | 135 | 1191 | 1192 | 1193 | 1194 | 1195 | 1196 | 1197 | 1198 | 1199 | 1200 | 1201 | 1202 | 1203 | 1204 | |
| | 4 | 1 | 100 | 1267 | 1268 | 1266,1269 | 1270 | 1271 | 1272 | 1273 | 1274 | 1275 | 1276 | 1277 | 1278 | 1279 | 1280 | |
| | 10 | 0 | 100 | 1247 | 1248 | 1246,1249 | 1250 | 1251 | 1252 | 1253 | 1254 | 1255 | 1256 | 1257 | 1258 | 1259 | 1260 | |
| | 22 | 0 | 100 | 1219 | 1220 | 1218,1221 | 1222 | 1223 | 1224 | 1225 | 1226 | 1227 | 1228 | 1229 | 1230 | 1231 | 1232 | |

| All 22ns Delay | | Edge | V | 0.500 | 0.625 | 1.500 | 1.000 | Qth/IC | | | | | | | | | | 4.5 | 5 | 5.5 |
|----------------|---|------|------|-------|----------------|-------|---------|--------|------|------|------|------|------|------|------|------|------|-----|---|-----|
| | 0 | 100 | 1301 | 1302 | 1299,1300,1303 | 1304 | 1305(*) | 1306 | 1307 | 1308 | 1309 | 1310 | 1311 | 1312 | 1313 | 1314 | 1315 | | | |
| | 0 | 135 | 1322 | 1322 | 1323,1324,1325 | 1326 | 1327 | 1328 | 1329 | 1330 | 1331 | 1332 | 1333 | 1334 | 1335 | 1336 | 1337 | | | |
| | 1 | 100 | 1365 | 1366 | 1367,1364 | 1368 | 1369 | 1370 | 1371 | 1372 | 1373 | 1374 | 1375 | 1376 | 1377 | 1378 | 1379 | | | |
| | 1 | 135 | | | 1347 | 1348 | 1349 | 1350 | 1351 | 1352 | 1353 | 1354 | 1355 | 1356 | 1357 | 1358 | 1359 | | | |

(*) Coll. Changed to 10mm



Problems & Issues

- Systemtest power cables good - need to make some more especially for testbeam (25m instead of 30m)
- SCTLV-2 Power Trips
 - Often at module startup (when executing configs)
 - Occasionally for any module during runs (prevented unattended running)
 - More often with chokes installed (so not used)
 - More often for certain module / power supply combinations (so had to remove FR_K81 and SCAND1 at times)

Apart from these soluble problems, system worked very well. Well-prepared working modules in QMW-style boxes are easy to install and run. Support for 10 modules & 2-4 anchors.



Future - Next runs in 2000

- General purpose run 14 - 21 June: Bring out your modules
- Irradiation run (cold, magnet) 21 - 28 June
- Currently scheduled run 23 - 30 August
 - Magnet not permitted (Tiles)
 - Is this run useful: **what for ?**
 - Is there a strong argument for trying to shift this week ?

[Neither JCH nor myself are available in July]