

## **Review of GEM Electronics Review / SBS Rear GEM Tracker**

### **Findings:**

- Two APV25 based readout systems have been so far considered as readout options for the SBS Rear GEM Tracker:
  - Scalable Readout System (SRS) designed at CERN
  - MPD APV25 system designed at INFN
- The routing of readout strips to readout chips assumes that 2 strips are combined. This step is mainly done to reduce the large number of readout channels. Combining 4 strips would exceed limits on charge saturation.
- 12 128-channel APV25 cards are required to readout a single module, leading to 480 cards for all modules; with approximately 10% spares, leading to 530 cards in total.
- A series of bench tests and test beam experiments have been conducted to evaluate the performance for each readout option in terms of:
  - Pedestal noise
  - DAQ speed
  - Radiation tolerance
  - Timing

### **Comments:**

- Both options are compared in terms of their cost. The quoted amount is clearly similar for both options:
  - SRS: \$332k
  - MPD: \$334k
- The UVa group has clearly developed a solid background in operating the SRS system. It is however clear that the integration as stated into the experimental environment at high rate requires significant amount of manpower. No details are provided.
- It is stated that the 2-to-1 combination scenario ‘may’ present a workable compromise. It cannot be judged from the details provided what ‘may’ really means.
- Conceptually, both systems could provide generally a readout system for the SBS Rear GEM Tracker. The concern however has to do with integration and required upgrades.
- The basis of the cost comparison is not identical. It is clear that both systems require an upgrade. Any R&D cost and cost of firmware development is not

included in the MPD estimate. The assumption is made that this development step can be covered by the front tracker development. No further details are provided on the timescale. This should be carefully evaluated!

- The cost estimate for both systems relies on the APV25 chip. This chip is no longer produced. It is not mentioned in the write-ups that sufficient cards can be ordered and are even available in the requested amount and the timescale needed.
- It is not clear if the required number of readout components are consistent with the schedule for the rear tracker, i.e. can all readout component be acquired well in advance? A detailed schedule presented as a Gantt chart or a even a simple table could not be found.
- The operation of the system at 5kHz DAQ rate and other required performance criteria requires a substantial upgrade. Very few / hardly any details are provided on the basis of the costing for such an upgrade. It is clearly stated that there is some uncertainty about the priority of the APV25 based SRS R&D at CERN. *Priorities at CERN are given to CERN experiments. This should be clearly taken into consideration when relying on assumptions about commitments from CERN.*
- The ability to upgrade the system is difficult to evaluate since it relies on the generic APV25 chip which is no longer produced. The connection with a commercial partner in Germany for the production of various readout components is however a positive development to not rely on CERN only.

### **Recommendations:**

- None