BROOKHAVEN NATIONAL LABORATORY

Collider Accelerator Department

MOPG024

CONCEPTUAL DESIGN OF A HIGH PRECISION DUAL DIRECTIONAL BEAM POSITION MONITORING SYSTEM FOR BEAM CROSSTALK CANCELLATION AND IMPROVED OUTPUT PULSE SHAPES.

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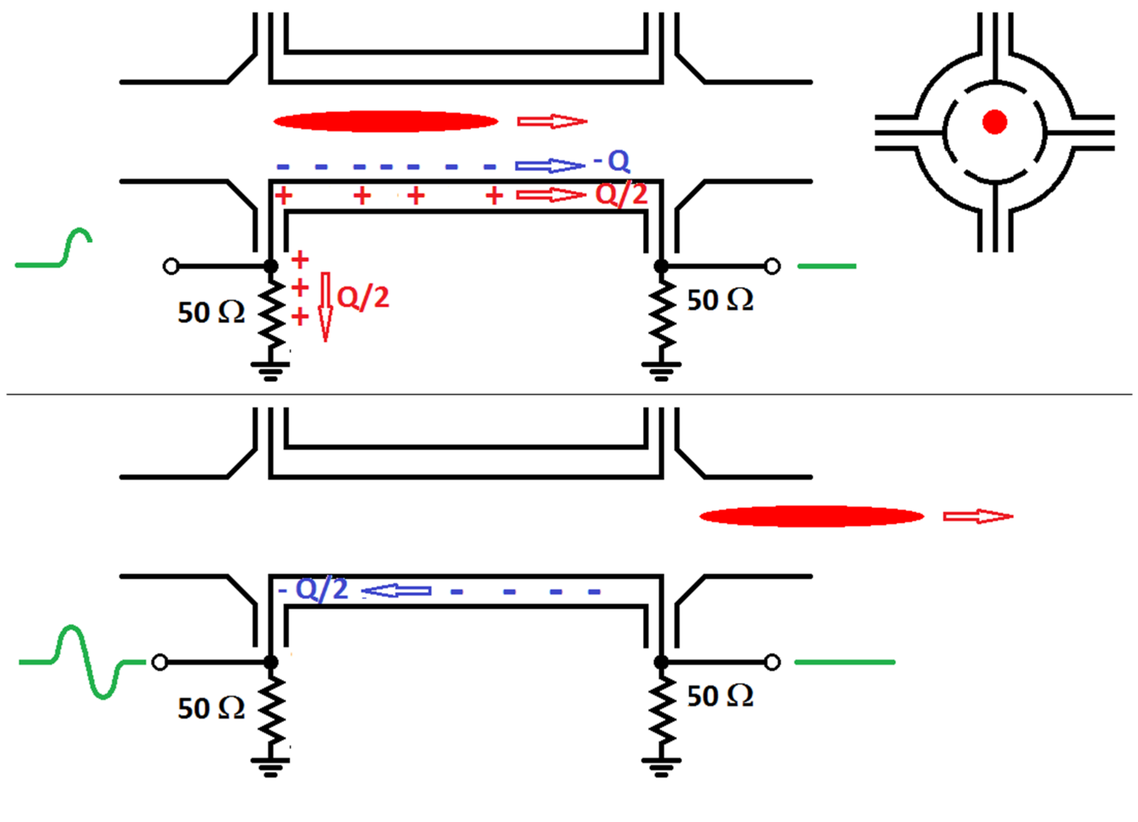
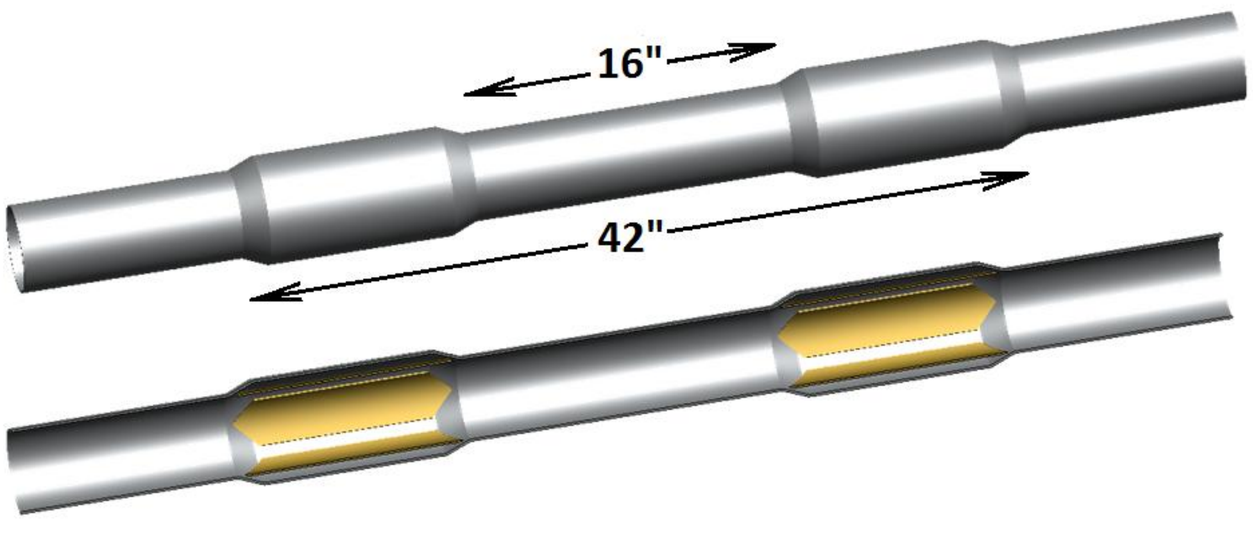
Abstract

The Relativistic Heavy Ions Collider (RHIC) would benefit from improved beam position measurements near the interaction points that see both beams, especially as the tolerances become tighter when reducing the beam sizes to obtain increased luminosity. Two limitations of the present beam position monitors (BPMs) would be mitigated if the proposed approach is successful. The small but unavoidable cross-talk between signals from bunches traveling in opposite directions when using conventional BPMs will be reduced by adopting directional BPMs. Further improvements will be achieved by cancelling residual cross-talk using pairs of such BPMs. Appropriately delayed addition and integration of the signals will also provide pulses with relatively flat maxima that will be easier to digitize by relaxing the presently very stringent timing requirements..



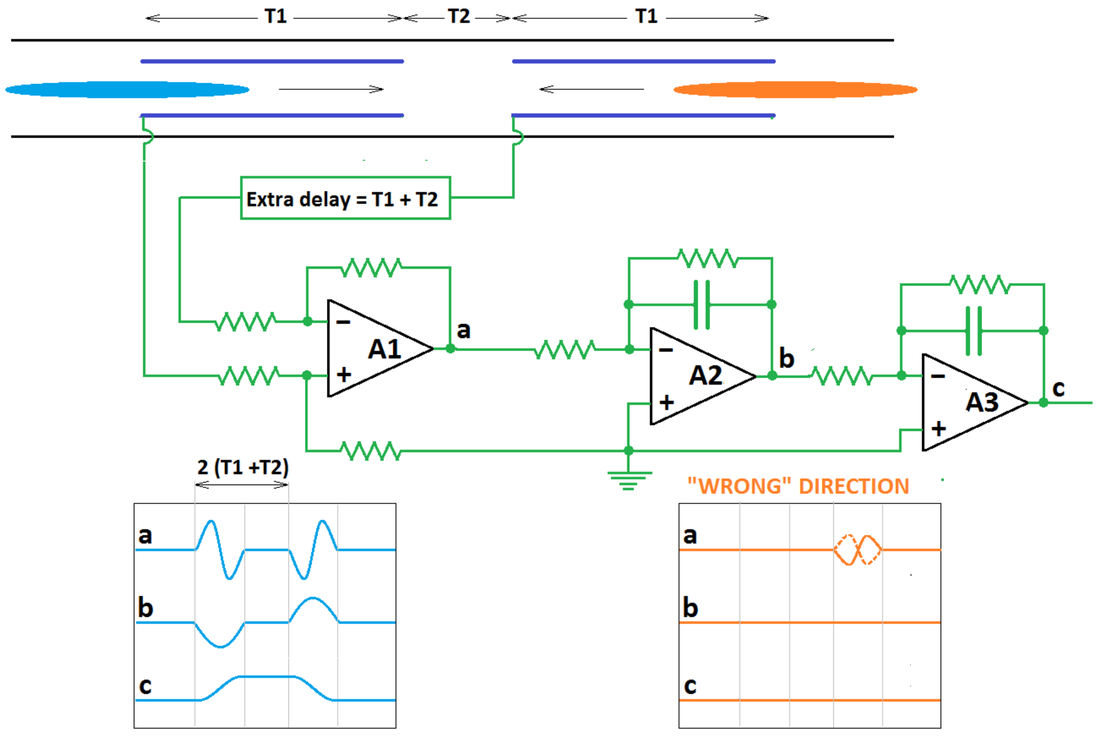
Schematic representation of charges induced by a bunch on one of the striplines of an ideal directional BPM. Only two outputs are shown out of a total of eight (for a dual plane BPM). The directionality of real single directional BPMs is far from perfect.



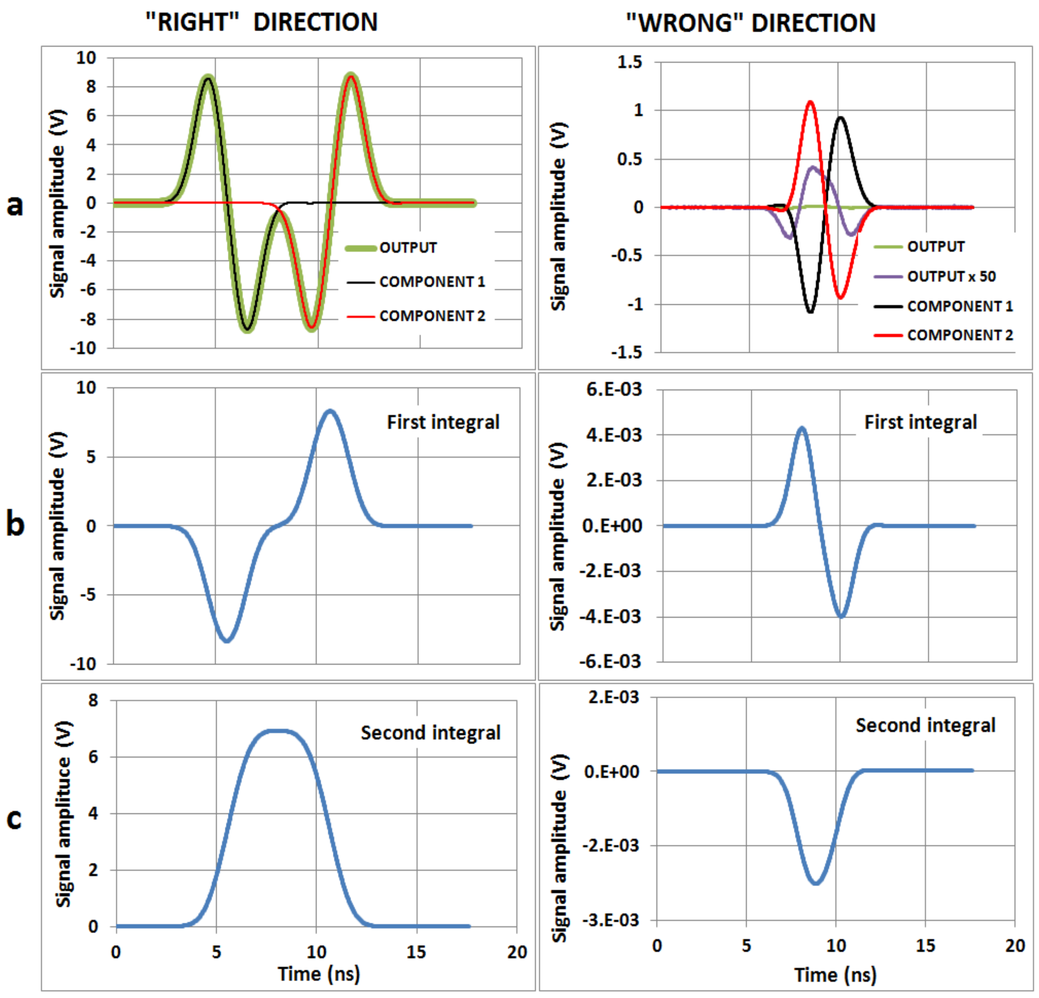
Dual, 5” diameter directional BPM model used for the Particle Studio simulations

CONCLUSIONS

- **Cross-talk due to parasitic “wrong direction” signals can be very large for single directional BPMs.**
- **The dual directional BPM system proposed here solves this problem by cancelling the unwanted signals from bunches traversing it in opposite directions..**
- **The improved output pulse shapes may reduce the timing accuracy required for digitizing the signals.**



Schematic illustration of the precision dual directional beam position monitoring system. Only one channel out of four is shown. The delays are arranged in such a way that residual signals from “wrong” direction bunches cancel in each of the four (or eight for a dual plane BPM) channels. Positions are obtained in the usual way; difference/sum of opposite side signals obtained after two stages of integration shown schematically only. The two “wrong” direction signals labeled “a” cancel each other and are only shown separately for illustration.



Results from the Particle Studio simulation showing good compensation of the unwanted signals which for this example have an amplitude of 14% of the main signal when not compensated.