Contribution ID: **202** Type: **poster**

# Computation of Nearly Exact 3D Electrostatic Field in Multiwire Chambers

*Monday, 13 February 2006 11:00 (20 minutes)*

The three dimensional electrostatic field configuration in a multiwire proportional chamber (MWPC) has been simulated using an efficient boundary element method (BEM) solver set up to solve an integral equation of the first kind. To compute the charge densities over the bounding surfaces representing the system for known potentials, the nearly exact formulation of BEM has been implemented such that the discretisation of the integral equation leads to a set of linear algebraic equations. Since the solver uses exact analytic integral of Green function [1,2] to compute the electrostatic potential for a general charge distribution satisfying Poisson's equation, extremely precise results have been obtained despite the use of relatively coarse discretization. The surfaces of anode wires and cathode planes in the MWPC have been segmented in small cylindrical and rectangular elements, carrying uniform unknown surface charges distributed over the elements. The capacity coefficient matrix for such a charge distribution has been set up using the exact expressions of the new formulation. Finally, the surface charge densities have been computed by satisfying the boundary conditions, i.e., potentials at the centroid of the elements known from the given potential configuration. We have used a lower upper (LU) decomposition routine incorporating Crout's method of partial pivoting to solve the set of algebraic equations. From the computed surface charge densities, the potential or electric field at any point in the computational domain can be obtained by superposition of the contribution of the charge densities on the boundary elements. Using the solver, we have performed a detailed study of the three dimensional field configuration throughout the volume of the device. The solutions have been validated by successfully comparing the computed field with analytical results available for two-dimensional MWPCs. Significant deviations from this ideal mid-plane field have been observed towards the edges of the detector. We have also studied the influence of the edge configuration of the detector on these deviations. Utilizing the high precision and three-dimensional capability of this solver, a study has been carried out on the nature of the electrostatic forces acting on the anode wires and its variation with the change in the wire position. Significant positional variations have been observed which can have impact on future design and construction of MWPCs.

References
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[2] S.Mukhopadhyay, N.Majumdar, Development of a BEM Solver using Exact Expressions for Computing the Influence of Singularity Distributions accepted for presentation in ICCES05.

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**Session Classification:** Poster

**Track Classification:** Event processing applications