Development of Radiation Hard Silicon Sensors for the CBM Silicon Tracking System Using Simulation Approach

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Study of Super-Dense Baryonic Matter with Heavy-Ion Collisions at FAIR/SIS-300

Facility for Anti-proton and Ion Research, Darmstadt, Germany

Heavy-Ion Synchrotron SIS-300:
- magnets: 300 Tm bend
- high-intensity DC beam
  - 10⁹ ions/s at CBM
- max. beam energies:
  - heavy ions: 45 GeV/u
  - protons: 90 GeV

Detector R&D

Double-sided micro-strip detectors
GSI-CIS Erfurt, MSU-RIMST, Moscow.

SYNOPSIS TCAD

3D simulation grid

Charge collection efficiency in double-sided sensors

Simulated IV/CV behavior

Interstrip parameters simulation

Measurements with prototypes

CIS detectors characterized by M. Merkin et al, MSU Moscow

Simulation of signal transmission through low-mass micro-line cables

Structure of analog microcable used in CBM module demonstrators
- 2 signal layers of 14 μm Al, 10 μm Kapton
- Spacer 50 μm Kapton mesh
- Shielding layer
GSI-SE SRTIIE Kharkiv, Ukraine

Strip clusters due to charge sharing of signals (²⁹Si β-particles)

Summary and Outlook

- Silicon Tracking System of the CBM experiment is the central detector for track reconstruction and momentum determination.
- Challenges are: high track densities, high collision rates, low material budget, radiation hardness.
- Detector module R&D program:
  - Radiation tolerant detectors.
  - Module prototypes include:
    - double-sided microstrip sensors, multi-layer analog cable, self-triggering front-end electronics.
  - Microcable electrical simulations using RAPAEL package
  - 3D simulations of double-sided sensors with stereo angle using SYNOPSIS TCAD.
  - Characterization of irradiated sensors.