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Thermal performance of carbon foams used as heat sink for the MVD-Panda.

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The Micro Vertex Detector (the MVD) for the Panda experiment is optimized for the detection of the secondary vertices and for maximum acceptance close to the interaction point. The experimental set-up requires sophisticated solutions for the detector integration in order to maintain a stringent material budget. The thermal power produced by the "on board"read-out electronics is fast removed using carbon foam as heat sink. Two types of carbon foam are under evaluation. Both, the mechanical and thermal properties behaviour under radiating field are studied. Results from finite element thermal analyses and test bench are also presented.

Summary 500 words

The four cylindrical layers in the region around the interaction point, the barrel, and the six planar layers in the forward region, the disks, are equipped with silicon detectors: pixel in the innermost layers and double sided micro-strip in the outermost layers.
Thermal power produced by the electronics, evaluated as 1 W/cm2 in the pixel layers, is removed by a water cooling system operating below atmospheric pressure mode.
For the cooling system design a material with low density, high thermal conductivity, low thermal expansion coefficient, easily machined, feasible to glue, stable at different temperatures and radiation resistant has been searched. The material which answer to all these requirements is the carbon foam: his open pore structure graphite combined with a dense graphite matrix produces a material with high thermal properties and low density.
The material properties, mechanical and thermal, of the carbon foams produced by the POCO Ind., are known without reference to damage from electromagnetic radiation. With the aim of measuring the properties of the material, specimens of two types of carbon foam, POCO FOAM and POCO HTC, were immersed in a radiation field at the TRIGA MARK II reactor in Pavia. Four sample per foam type are immersed in the radiating field at different reactor power for a time of 1000 s, while one sample per type was non irradiated and used as reference.
The elastic modulus or Young's modulus and the thermal conductivity were measured. A set of four strain gages glued on every specimen allow us to survey both the longitudinal and the transversal strain while two thermocouples are able to read the heat produced by a resistor and removed by a water cooled socket glued in the opposite surface.
Results shows that the Young's modulus is increased by the radiation, while radiation does not induce changes in the thermal conductivity coefficient.
Behaviour for both, one barrel element and one semi-disk component, is first simulated with finite element analysis (FEA). After that the prototypes have been build following the guidelines of the FEA and tested.
The construction method and test results will be presented.

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