SPACE FLIGHT EXPERIENCE WITH THE AMS INFRARED TRACKER ALIGNMENT SYSTEM (TAS)

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The large acceptance Antimatter Spectrometer (AMS) experiment (cit.) has been flown successfully on the STS91 shuttle flight (02-June-98 - 12-June-98). AMS-01 particle tracking is based on 6 planes of double-sided Si detectors providing a maximum detectable rigidity (MDR) of 500 GV by measuring the sagitta of the tracks in a moderate field strength permanent magnet (NdFeB). The sagitta can be measured with an accuracy of 25 micrometers. In AMS the position stability of the tracking elements has been controlled using straight tracks.
Artificial straight tracks are produced by 1082nm Laser radiation. A Laser ray can penetrate all 6 Si layers in sequence. It is detected by generating electron hole pairs in the fully depleted Si particle detectors (cit.). Signals from the alignment rays are recorded exactly like the charged particle tracks. 1082nm Laser radiation is generated with high efficiency in Laser diodes coupled to monomode optical fibres that deliver via miniature projection optics low divergence circular rays into the tracker. This approach allows high precision (<1 µm) tracker stability tests in very short time (<1 s). The fully operational system (4 beams) weighs less than 3kg.
Overall the AMS-01 tracker has been extraordinarily stable. Over the whole flight - including lift-off and landing- all tracking elements were found at their expected positions whithin ±15 µm. Laser measurements (once per 3 orbits (on manual command)) were confirmed by observation with straight tracks comparing extrapolated tracker hits with actually measured ones.
AMS-02 the successor of AMS-01 will be installed on the ISS late in 2003. The AMS-02 tracker (8 planes Si, SC magnet) will be equipped with 2 sets of 10 laser rays each, that traverse the Si in 2 opposite directions. Based on AMS-01 experience a tracker stability verification with better than 4 µm can be expected 4 times per orbit. This work has been generously supported by NASA, DoE and DLR. We like to thank the AMS collaboration and the Si tracker team for their cooperation.