Contribution ID: **33** Type: **Poster**

Feasibility study of a multipoint laser alignment system for CLIC linear collider

Tuesday, 11 September 2012 14:30 (5 minutes)

CLIC (Compact Linear Collider) is a study for a future electron-positron collider that would allow physicists to explore a new energy region beyond the capabilities of today's particle accelerators. Alignment is one of the major challenges within the CLIC study in order to achieve the high requirement of a multi-TeV center of mass colliding beam energy range (nominal 3 TeV). To reach this energy in a realistic and cost efficient scenario all accelerator components have to be aligned with an accuracy of 10 μm over a sliding window of 200 m. The demand for a straight line reference is so far based on stretched wires coupled with wire positioning sensors. These solutions are currently further developed in order to reduce the drawbacks which are mainly given by their costs and difficult implementation. However, it should be validated through inter-comparison with a solution ideally based on a different physical principle. Therefore, a new metrological approach is proposed using a laser beam as straight line reference. Optical shutters paired with CCD based cameras are proposed to visualise the laser beam. This new technology is currently studied and developed in an optical laboratory. The paper presents the alignment principle and its theoretical background, and introduces related key-parameters. First experiments were performed based on a 2 m long setup in order to validate the principle. Low cost components were implemented for these tests which are however showing encouraging results. The conclusion allows a first approximation of achievable measurement accuracy, uncertainty and repeatability. In addition these experiments are building up a basis for a first extrapolation of the accuracy over a longer distance.

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Session Classification: Poster Presentations (5 minutes per poster)

Track Classification: Poster Presentations