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Antimatter annihilation detection with AEGIS using silicon detectors

AEgIS (Antimatter Experiment: Gravity, Interferometry, Spectroscopy) is an antimatter experiment based at CERN, whose primary goal is to carry out the first direct measurement of the Earth's gravitational acceleration on antimatter. AEgIS will attempt to measure the gravitational acceleration for antihydrogen with 1% relative precision, which would be the first precision

test of the Weak Equivalence Principle for antimatter. The principle of the experiment is based on the formation of antihydrogen through a charge exchange reaction between laser excited (Rydberg) positronium and cold (100 mK) antiprotons. The antihydrogen atoms will be accelerated by an inhomogeneous electric field (Stark acceleration) to form a pulsed cold beam. The free fall of the

antihydrogen
due
to
Earth's
gravity
will
be
measured
using
a
moiré
deflectometer
and
a
hybrid
position
detector.
This
detector
will
consist
of
an
active
silicon
part,
where
the
annihilation
of
antihydrogen
takes
place,
followed
by
an
emulsion
part
coupled
to
a
fiber
time--
of--flight
detector.
This
overview
presents
the
current
results
from
the
R&D
efforts
for
the
construction
of

the silicon position detector. Low energy antiproton annihilations in silicon were studied in detail using different silicon sensor technologies. A first comparison between experimental data and Monte Carlo simulations for low energy antiproton annihilation is also reported, suggesting areas where the improvement of simulation models is possible. The outcome of these tests defined the basis for the final design

parameters of the silicon position detector. This detector will consist of a 50 μm thick silicon strip sensor bonded to an application specific integrated circuit (ASIC) with self-triggering readout capabilities and a timing resolution in the order of μs.

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