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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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