THIS IS ONLY A PROTOTYPE

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Abstract

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The AEgIS Experiment at the CERN aims to verify the weak interaction principle for antimatter. This document talks about "gAnWeb", a web application designed to simplify the analysis of physical data under the AEgIS experiment. This analysis can be performed using Root Data Analysis Framework by the Linux Terminal, but a graphical interface can ensure a better user experience, eases the user training and improves the productivity. A web application is a smart way to implement the interface because allows users to avoid installations, and centralizes all the eventual modifications. This document explains the choices made during the development of this application, related to the goal of the data analysis.

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Chapter 1

Introduction

First of all is important to understand at least generically what is the AEgIS experiment at the CERN and what are their goals. The acronym AEgIS stands for "Antimatter Experiment: gravity, Interferometry, Spectroscopy", this experiment aims to measure weak equivalence principle for antimatter. In this first chapter are explained some particular about this experiment.

1.1 AEgIS experiment

AEgIS

FIGURE 1.1: AEgIS's Logo

The weak equivalence principle, also known as universality of free fall, states that in the same field all bodies fall with the same acceleration, regardless of the mass and the composition. This principle has been thoroughly tested for the matter, but not for the antimatter: the most important goal of AEgIS experiment is to measure the weak equivalence principle for the anti-matter; to test this principle AEgIS measures gravitational interaction between matter (the earth) and anti-matter (anti-hydrogen). In the context of neutral antimatter, the gravitational interaction is of high interest, because it can potentially revealing new forces that violate the weak equivalence principle. Thomas Phillips, from Duke University, says: "If antimatter fell down faster, it would mean the discovery of at least one new

force, probably two. If it fell up, it would mean our understanding of general relativity is incorrect". In a practical point of view AEgIS tries to mesure the time of flight and the vertical displacement of anti-hydrogen, by a moire deflectometer: this process is quite complex, and it is easier explain it by the following two images [TODO INSERT-THE-NUMBER-OF-THE-IMAGE].

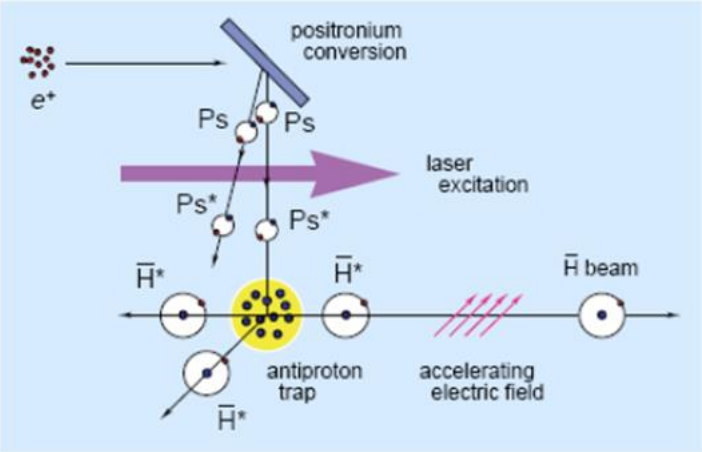

FIGURE 1.2: AEgIS's Scheme, taken from "AEgIS experiment at CERN: measuring antihydrogen free-fall in Earth's gravitational field to test WEP with antimatter" TODO INSERT-bibliographical-reference

In this first image we can see the process that allows to create some anti-hydrogen. To correctly explain this process it is better start with some definitions:

1. Positron: it is the correspondent of the electron in the antimatter. It is an anti-electron, so an electron with positive electrical charge. It is indicated by "e+".
2. Positronium: it is an unstable system consisting of an electron and a positron, bound together into an exotic atom. It is indicated with $\overline{Ps}$.
3. Antiporoton: it is the antiparticle of the proton. Antiprotons are stable, but they are typically short-lived since any collision with a proton will cause both particles to be annihilated in a burst of energy. It is indicated with $\overline{p}$ (pronunced P-Bar).
4. Antihydrogen: it is the antimatter counterpart of hydrogen. Whereas the common hydrogen atom is composed of an electron and proton, the antihydrogen atom is made up of a positron and antiproton. It is indicated with $\overline{H}$ (pronunced H-Bar).

5. Antiproton trap: a devices that uses an axial magnetic field to transversely confine charged particles, in this case antiprotons.

The process shown in the image is the following: a beam of positrons is accelerated and driven to collide against a "positron-positronium converter" (that is a mesoporous silica film). This process creates positronium, that needs to be excited by lasers, to reach the Rydberg State. The positronium in Rydberg state is indicated by $Ps*$, it has a longer life than the unexcited positronium, and can be driven to fly into an antiproton trap. Here $Ps*$ and $\overline{p}$ can combine themselves to generate excited antihydrogen ($\overline{H}*$) and electrons. The antihydrogen beam is accelerated using an electric field towards a moiré deflectometer, during the travel it decays to ground state.

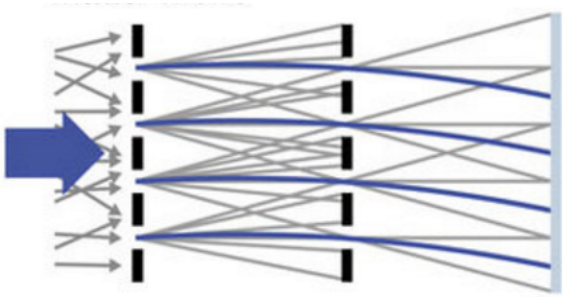

FIGURE 1.3: Moiré Deflectometer's Scheme, taken from "AEgIS experiment at CERN: measuring antihydrogen free-fall in Earth's gravitational field to test WEP with antimatter" TODO INSERT-bibliographical-reference

1.2 User friendly Data analysis framework

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Chapter 2

Data Analysis

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2.1 What is?

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2.2 Relevance in the modern market

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2.3 Root - Physical Data Analysis

2.4 Data Analysis in Aegis Experiment

Chapter 3

User Interface

labelChapter3

3.1 Human Machine Interaction principles

todo todo

3.2 Web interface vs Java Fx vs Xojo

todo todo

3.3 Used Technologies and Framworks

todo general

3.3.1 PHP

todo particular

3.3.2 Javascript

todo particular

3.3.3 Bootstrap

todo particular

3.3.4 Sass

todo particular

Chapter 4

Conclusions

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4.1 Conclusions