

### DARK&BRIGHT

#### Background:

Everything we see and even things we do not see are combinations of a handful of elementary particles. We live in a particle universe. However, experiments indicate that only a few percent of the Universe is made by the same stuff that makes us, i.e. the bright matter. Over ninety percent is made by an obscure form of matter and energy coined dark matter and dark energy. Theoretical physicists are now faced with several fundamental puzzles to unravel: What makes dark matter and energy? When were they created and why? Is there a relation with the bright side of the Universe. Why do we observe only bright matter but very little antimatter? It is a fact that the Universe is skewed towards bright matter.

These questions are related to the Origin of Mass. The Origin of Bright and Dark Mass problem is widely regarded as one of the most fundamental problems in physics.

The Large Hadron Collider (LHC) at the European Centre for Nuclear Research (CERN), Geneva, Switzerland is built to unveil the solution to the Origin of Mass problem. Theoretical models are being used to guide the experimental collaborations in searching for the answer and will help interpreting the data. CP<sup>3</sup>-Origins will provide new models of nature to be tested at the LHC.

#### Goals:

We aim to exploit experimental results, supercomputers and our theoretical expertise to make the next big leap in particle physics:

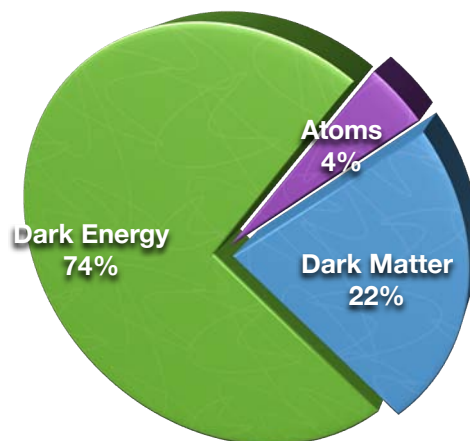
“Uncovering the Origin of Mass of all elementary particles”.

We will also contribute in other equally relevant quests: understanding the phase diagram of strongly interacting theories and the origin of bright and dark matter in the universe.

#### Organization and Contact:

The Centre of Excellence for Particle Physics Phenomenology has been established by the Danish National Research Foundation (DNRF) and opened on the 1st of September 2009 at the University of Southern Denmark in Odense.

The centre is lead by professor Francesco Sannino. Further details and contact information can be found at [cp3-origins.dk](http://cp3-origins.dk).



Three-dimensional distribution of dark matter in the Universe, Hubble Space Telescope, NASA, ESA and R. Massey (California Institute of Technology).

- **Dark matter** can be understood simply as a bunch of heavy particles filling about 22% of the mass of the Universe. Dark matter is not distributed homogeneously in the Universe.
- **Dark energy** is pure distributed pressure. Imagine somebody inflating a balloon. Dark energy inflates our Universe in a similar way.
- **Antimatter:** An example of antimatter is the anti-electron known as the “positron”. The positron is a particle identical to the electron except for its electric charge, which is opposite. If an electron and a positron meet each other they disappear in a burst of energy released in the form of pure light radiation.

