Contribution ID: **61** Type: **Poster**

X17 search project with the EAR2 neutron beam

Tuesday, 6 September 2022 19:26 (2 minutes)

Two significant anomalies have been recently observed in the emission of electron-positron pairs in the 7Li(p,e− e+)8Be and 3H(p,e− e+)4He reactions [1, 2]. These anomalies have been interpreted as the signature of the existence of a boson (hereafter referred to as X17) of mass M_X17 = 16.8 MeV that could be a mediator of a fifth force, characterised by a strong coupling suppression of protons compared to neutrons (protophobic force). Beyond the importance of such a discovery - if confirmed -, this scenario could explain, at least partially, the long-standing (recent) anomaly on the muon (electron) magnetic moment. More in general, the possible existence of a new particle is of paramount importance in particle physics and in cosmology (dark matter). Therefore, the ATOMKY claim [1, 2], clearly calls for new experimental studies.
We are carrying on an experiment at n_TOF, where the excited levels of 4He, 8Be can be populated via the conjugated 3He(n,e− e+)4He and 7Be(n,e− e+)8Be reactions. This approach has two relevant advantages: (i) for the first time X17 existence is investigated through neutron induced reactions; and (ii) the experimental setup is completely different with respect to the one used by the ATOMKY group. More in detail, the ATOMKI experimental setup used for the 3H(p,e− e+)4He reaction (a very similar one was used for the other reaction) consists of a tritium target adsorbed on Ti layer, bombarded with a 900 keV proton beam with a current of about 1 μA.
The main limitations of ATOMKI measurement are: (i) a monochromatic beam of 900 keV, i.e. no information about the X17 production at different energies is available; (ii) no tracking and vertex recognition, (iii) only particles produced orthogonally to the beam line are detected; (iv) no charge and particle identification, i.e. the ejectiles are only deduced to be e− e+ pairs.
Our approach aims to realise a suited detection setup for the determination of particle kinematics and able to discriminate particles, i.e. the reaction ejectiles (assumed to be e− e+ pairs) in a wide energy range. If the existence of X17 is confirmed, with the here-
proposed experimental setup it will be possible to establish quantum numbers and mass of the X17 boson, and to shed light on the so-called protophobic nature of a fifth force. In fact, state-of-the-art ”ab-initio”calculations are in good agreement with present literature data (in particular for the ”few body”4He nucleus) and would provide quantitative
predictions to establish the X17 nature, e.g. if it is a scalar, pseudoscalar, vector or axial boson and to get information on the interaction of the X17 boson with quarks and gluons.
The study of the 3He(n,e− e+)4He and 7Be(n,e− e+)8Be reaction can be performed at the EAR2 station of the n_TOF facility at CERN. In fact, the facility provides a pulsed neutron beam in a wide energy range, which broadly covers the region of interest for this experiment, i.e. 10ˆ3 < E_n(eV) <10ˆ7 . In addition, count-rate estimations have demonstrated that the neutron intensity at EAR2 is high enough to carry on a conclusive experiment within about 1 month of measurement. We present and discussthe project of this measure at EAR2: the detection setup and the final goals in order to say a definitive word about X17 puzzle.

References

[1] A.J. Krasznahorkay et al., Phys. Rev. Lett. 116, 042501 (2016)
[2] A.J. Krasznahorkay et al., arXiv:1910.10459

Field of work

Primary author: GERVINO, Gianpiero Renato (Universita e INFN Torino (IT))

Presenter: GERVINO, Gianpiero Renato (Universita e INFN Torino (IT))

Session Classification: Poster session