

n. 1 PhD position in Physics will be assigned on a topic related to the EU ERC project *ASYMOW* – “Power to the LHC data: an ASYmptotically MOdel independent measurement of the *W* boson mass”

The successful candidate of this position, instead of the PhD scholarship, will benefit of a research grant of € 22.663,00. (gross amount), according with the article 22 of the Italian Law n. 240 of 30 December 2010.

ASYMOW – “Power to the LHC data: an ASYmptotically MOdel independent measurement of the *W* boson mass”

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Institution hosting the project: **UNIVERSITA' DI PISA, ISTITUTO NAZIONALE DI FISICA NUCLEARE, SCUOLA NORMALE SUPERIORE, PISA, ITALY**

SUMMARY:

Despite its success in describing the sub-nuclear realm, the Standard Model (SM) of particle and field interactions cannot account for a number of experimental facts that constitute evidence of new and unknown physics. Sitting at both the energy and intensity frontier, the LHC grants the highest chances for solving the current puzzle. By exploiting the data collected by the CMS experiment at the LHC, **ASYMOW aims at attaining an unprecedented experimental accuracy on a fundamental parameter of Nature: the mass of the *W* boson.** As of today, there is a tension between the Standard Model expectation and the measured value of the *W* boson mass: tension which might hint at new physics, possibly beyond the direct reach of the LHC. A new measurement with a 10 MeV uncertainty, i.e., twice as small as the single best measurement, is a breakthrough: it could either rule out the tension or build a convincing case that this anomaly is real, thus implying the existence of new physics.

The collider physics community has been pursuing this goal for decades. The quest now seems to have hit the wall of systematic uncertainty. **This project proposes a new approach towards the *W* boson mass measurement**, which will circumvent the systematic uncertainties that are currently limiting the precision. The novelty of the proposed method lies in its agnosticism with respect to the microscopic picture of *W* boson production in hadron collisions. The loss of prior knowledge inherent to this new approach will be asymptotically compensated by the large amount of data available for the measurement, as will be collected at the LHC.

ASYMOW will be conducted by a small group of scientists and comes with great experimental and theoretical challenges. The main expected result is the measurement of the *W* boson mass with a precision better than the state-of-the-art. **This may open new scenarios in particle physics.**

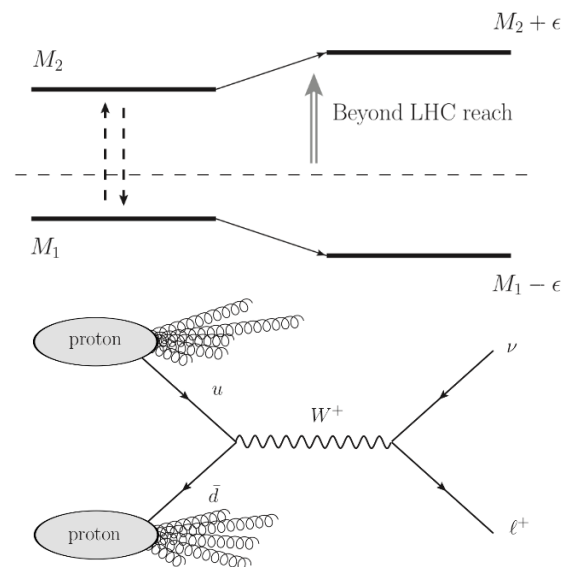


Fig. 1 (top). A state of energy M_1 mixes with a state of higher energy M_2 , possibly beyond the LHC reach. Their interaction affects both energies. **(bottom)** Sketch of the production of a *W* boson in proton collisions.

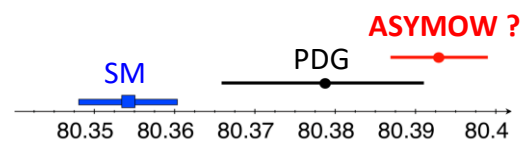


Fig. 2. The SM fit for M_W , the PDG combination (pdg.lbl.org, 2020), and a hypothetical outcome of ASYMOW.

This project offers young and brilliant students the unique opportunity to be formed within a vibrant community encompassing three distinguished and tightly connected institutions, each one with a long-standing leading role in CMS and in other numerous High Energy Physics collaborations. By profiting from well-established expertise at the host institution and from a direct involvement in the CMS experiment, successful candidates will have the opportunity to get a solid education on state-of-the-art research at the LHC and on emerging technologies and techniques in the field. At the same time, the novelty of the scientific program proposed by ASYMOW and the number of experimental and computational challenges leave much room for independent thinking and personal ingenuity.

In light of these considerations, graduates in Physics with a keen motivation towards fundamental research, data analysis, and innovation are strongly invited to apply to this position (within the PhD Program in Physics at Scuola Normale Superiore).