

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA 15108

STSM title: Exotic proton decay signatures

STSM start and end date: 04/03/2020 to 13/03/2020

Grantee name: Ilja Doršner

PURPOSE OF THE STSM:

The main reason behind this STSM, which concerned a visit to Jožef Stefan Institute from March 4 through March 13, 2020, was the scientific collaboration between a member of Jožef Stefan Institute, prof. Svjetlana Fajfer, and I with regard to exotic proton decay signatures due to a scalar leptoquark mediation. These processes, if and when observed, could help deduce the underlying flavor structure of the quark-lepton-leptoquark interactions.

The study in question was a natural continuation of the previous collaboration between dr. Olcyr Sumensari, prof. Svjetlana Fajfer, and I that resulted in a catalogue of all one-loop level leptoquark contributions towards anomalous magnetic moment of muon (arXiv as arXiv:1910.03877) since it also calls for mixing of different types of leptoquarks via the Standard Model Higgs field and/or other scalar fields that can get vacuum expectation value.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

We have primarily concentrated our efforts on systematic investigation of those scenarios where the leptoquark mediation yields exotic proton decay signatures such as when proton goes into three charged leptons. These signatures require that the mediator leptoquarks mix with some additional fields such as the Standard Model Higgs boson in order to generate the process(es) of our interest. This is also one of the reasons why there is a direct connection between this study and our previous work on the loop generated new physics contributions to the muon anomalous magnetic moment.

During the STSM prof Fajfer and I also worked on our arXiv submission arXiv:1910.03877 in order to address the JHEP referee's comments and objections. More concretely, we have revisited our manuscript to clarify and support our existing conclusions with additional numerical analysis of the correlation between the electroweak precision constraints and the need to accommodate rather large corrections to $g-2$ of muon. The latter are needed if one is to address the mismatch between experimental measurements and theoretical predictions of the Standard Model.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

We have clarified the objectives for our proton decay study and isolated processes of interest. We have also set up the numerical analysis that is at the core of our study.

We have also prepared the corrections for our arXiv submission arXiv:1910.03877 to meet the objections raised by the JHEP referee. This should, in our view, lead to the successful journal publication.

FUTURE COLLABORATIONS (if applicable)

Prof. Sjetlana Fajfer and I will continue to work towards completion of this project and pursue several new research directions that have been indentified during numerous discussion we have had during this STSM. Our long-term strategy is to study the physics of leptoquarks at all potentially accessible energy scales. The effects we are interested could be relevant for low-energy experiments, colliders, and neutrino oscillation/proton decay detectors.