Documents for application

Curriculum Vitae

Personal data

Name: Alessio Maiezza
Born in: L'Aquila, Italy
Citizenship: Italian
Foreign languages: English.
E-mail address: **alessio.maiezza@aquila.infn.it** and **alessiomaiezza@gmail.com**

Education

Laurea in Physics obtained in July 2008 at University of L'Aquila with full marks. Title of thesis: *Fenomeni di violazione di numero leptonico nei modelli Left-Right (Leptonic number violation phenomenology in Left-Right models).* Supervisors profs. Francesco Vissani, Piero Monacelli.

Ph.D. in Physics obtained in March 2012 at University of L'Aquila. Title of thesis: *Left-Right Symmetry at LHC and Phenomenological Implications.* Supervisors doct. Fabrizio Nesti, prof. Zurab Berezhiani.

Scientific collaborations

My work is realized thanks also the formative collaboration with Goran Senjanovic (ICTP), which has reinforced my interest in many issues of present high energy physics, as neutrino mass, zero neutrino double beta decay and in general physics beyond the Standard Model.

Recently I have collaborated with Stefano Bertolini (SISSA), in the field of effective theories for flavor physics.

Activities

Ph.D. courses at 'Universitá Dell'Aquila': Statistical Mechanics, Cosmology and Astro-Particles.

Participation at intensive courses in Ljubljana (2010): *Neutrino Mass, LHC and Grand Unification Theory*, by Prof. Goran Senjanovic and *Flavour physics and CP violation*, by Prof. Damir Becirevic.

Sojourns: Several periods spent at ICTP and SISSA, for collaboration with G. Senjanovic and S. Bertolini respectively.

Talk in the conference 'Convegno Informale di Fisica Teorica' at Cortona (2012): *Flavor physics, epsilon-prime and Parity restoration at LHC.*

References

- Fabrizio Nesti, 'Universitá De L'Aquila' (v. Vetoio, I-67010, L'Aquila), mail: **fabrizio.nesti@aquila.infn.it**
- Goran Senjanovic, ICTP (strada Costiera 11, I-34151, Trieste), mail: **goran@ictp.it**
- Francesco Vissani, INFN-LNGS (I-67010, Assergi(Aq)), mail: **vissani@lngs.infn.it**

Publications

Left-Right Symmetry at LHC
Alessio Maiezza, Miha Nemevsek, Fabrizio Nesti, Goran Senjanovic,
Phys.Rev. D82 (2010) 055022

New physics in ϵ' from chromomagnetic contributions and limits on Left-Right symmetry
Stefano Bertolini, Jan O. Eeg, Alessio Maiezza, Fabrizio Nesti,
Phys. Rev. D 86 (2012) 095013

Cover letter

Scientific interests and research activity

My interests range overall the field of high energy physics, particularly in the phenomenology beyond the Standard Model, looking at both indirect low energy manifestations of new physics and direct ones through detection by colliders.

My research is about the Left-Right extensions of the Standard Model.

The issue of chiral asymmetry in the weak interaction is again open since the original work, where Lee and Yang discussed the possibility of restoring parity at high energies, through the existence of mirror fermions. The Left-Right symmetric theories represent an alternative. The more economical of them, in terms of new required fermions, is the minimal Left-Right model, which altogether provides a rich phenomenology. In the LHC era this model arouses a renewed interest since the possibility of a parity restoration at low energy, as hinted by the phenomenology of neutrinoless double beta decay, which fits very well with the bounds and constraints on the model from flavor physics phenomenology. At this purpose I develop a complete analytic and numerical study on the model parameters. As a result of the research emerges that the Left-Right symmetry can be restored in the LHC reach (*Phys.Rev. D82 (2010) 055022*).

Recently I dealt with the non-perturbative evaluation within the Chiral Quark Model and Chiral Perturbation Theory of hadronic matrix elements, useful to analyze the manifestation of new physics in flavor changing process. The focus is on the chromomagnetic operators, which can play a crucial role in CP-violation of the neutral kaon system, as their large enhancement derived from Left-Right model shows (*Phys. Rev. D 86 (2012) 095013*). The same situation is for a wide class of theories where the strong GIM suppression on flavor changing transition $s \to dg^*$ is avoided. This is a result of the non-chiral interactions. In the Standard Model, in fact, the GIM mechanism is intimately related to the chiral nature of the weak interaction.

Work in progress

Currently I am continuing with the analysis of meson dynamics due to manifold operators by possible physics beyond the Standard Model, through the Chiral Quark Model. In particular I focus on non-chiral current-current operators. The issue matters also in view of the actual middle CP-violation discrepancy between Standard Model and data.

A possible research project

At the present there are many candidate theories as news physics beyond the Standard Model. One of them could be confirmed directly through LHC. There is also the possibility of indirect signals, for example from flavor physics. This field, in any case, could hint in a right direction. There are many experiments which produce data about flavor transition, with CP-violation or not. Frequently the matching between theory and experiment is complicated because of the intrinsic QCD uncertainty on amplitude transitions. There is some effective theory which can provide a suitable description of flavor physics processes. One of these is the Chiral Quark Model. The natural field of its application is the light SU(3) mesons interaction but it can be exploited also to describe processes involving heavy quarks. This approach has been used in the past by the theoretical physics group (S. Bertolini, M. Fabbrichesi, J. Eeg, V. Antonelli, I. Lashin) to compute kaon transitions, $\Delta S = 1$ and $\Delta S = 2$, in the framework of the Standard Model (see for example: *Rev.Mod.Phys. 72 (2000) 65-93*). They deal with both ϵ'/ϵ and Δm_k issues. The lagrangian for $\Delta S = 1$ and $\Delta S = 2$ is written as a linear combination of (four-quark or two-quark) operators, which form a (over)complete set. The Chiral Quark Model method is based on the translation of the lagrangian as a function of mesons (bosonization). In this way Feynman rules are defined and the meson transitions can be evaluated. Hence Chiral Quark Model provides a effective description for short-distance QCD interactions in terms of (Goldstone)octet mesons. The free parameters of the model are fitted with $\Delta I = 1/2$ rule in $k \to 2\pi$ decays. The final result is a non-perturbative evaluation of the matrix elements. The approach provide a calculation of ϵ'/ϵ and Δm_k CP-violation and CP-preserving parameters, in quite agreement with experimental values.

The quark operators considered by the above group are generated at high energy by the Standard Model. I retain straightforward to wonder what happens when such a new physics is involved. Clearly an extension of the operators set becomes necessary, because new operators are generated by the theories beyond the Standard Model. So the previous work can be revisited and generalized to have a wide theoretical pattern for matching with experimental data.

The project idea begins within one popular extension of the Standard Model, Left-Right symmetry, which altogether gives a framework for restoration of parity in fundamental interactions, nonzero neutrino masses, as well as violation of lepton number and flavor, both at the reach of the coming round of experiments, fitting especially well with the scenario of TeV right-handed scale.

At the present I am continuing with the bosonization of some fundamental operator generated by the Left-Right models as well as others theories. However the method is model-free.

I think that these studies can be useful in the near future, in the era of LHC and B-factories. Probably there are only two possible scenarios: the first one is that LHC will detect directly a new physics. In this case evaluating all the possible new contributions to phenomenology will be a priority, hence also to the flavor violation. The second scenario would be that LHC will not show a new physics. In this case flavor violation remains a hope to see indirect signals of such a physics beyond the Standard Model. It is clear that in both cases an adequate theoretical framework for flavor physics is needed. In my opinion the prospectives of the near future gives importance to these researches.