



Research and Department/Community Activities

Marcela Carena

Theoretical Physics Department Retreat

November 18, 2019

Research Activities (2018-2019)

- **Study of phase transitions relevant for EWBG**

- 1) Electroweak phase transition in a SM singlet extension with spontaneous Z_2 -breaking
MC, Z. Liu and Y. Wang (to appear this week) (New thermal histories, Higgs Pheno, GW)
- 2) Electroweak Multiplets and the EWPT (New SFOPhT solutions)
MC, C. Krause, Z. Liu and Y. Wang (to appear early next year)
- 3) SUSY theories: NMSSM for EWBG and DM (new well-tempered DM region + SFOEWPhT)
S. Baum, MC, N Shah, C Wagner, Y Wang. (to appear early next year)
- 4) Probing the electroweak phase transition via enhanced di-Higgs boson production
(enhanced interference effect on Di-Higgs production in SM plus Singlet extension)
MC, Z. Liu and Riembau <http://arxiv.org/abs/arXiv:1801.00794> PRD97 (2018)

- **Dark Sector Models for Baryogenesis and Dark Matter**

- 1) Dark CP Violation and Gauged Lepton/Baryon Number for Electroweak Baryogenesis
MC, M. Quiros, Y. Zhang, <http://arxiv.org/abs/arXiv:1908.04818> (To appear in PRD)
Pheno study of EDMs, Higgs pheno, DM, Z' pheno
- 2) Electroweak Baryogenesis From Dark CP Violation (New mechanism for EWBG with CPV
in a DS, a Scalar + New Force portal, spontaneously broken gauged lepton number)
MC, M. Quiros, Y. Zhang, <http://arxiv.org/abs/arXiv:1811.09719> PRD 98 (2018)

Research Activities (2018-2019)

- **More of DM models**

1) The Return of the WIMP: Missing Energy Signals and the Galactic Center Excess

MC, J. Osborne, N. Shah, C. Wagner, <http://arxiv.org/abs/arXiv:1905.03768> PRD 100 (2019)

2) Supersymmetry and LHC Missing Energy Signals

MC, J. Osborne, N. Shah, C. Wagner <http://arxiv.org/abs/arXiv:1809.11082> PR D98 (2018)

3) Higgs portals for thermal Dark Matter. EFT perspectives and the NMSSM

(New bino-singlino well tempered Dark Matter region. EFT discussion beyond SUSY)

S. Baum, MC, N Shah, C Wagner <http://arxiv.org/abs/arXiv:1712.09873> JHEP 1804 (2018)

- **The Strong CP problem**

1) A v solution to the Strong CP Problem (u-quark mass from instantons, u-v mass connection)

MC, D Liu, J Liu, N. Shah, C. Wagner, X.P. Wang <http://arxiv.org/abs/arXiv:1904.05360> (PRD)

- **Flavor Anomalies**

1) $R_D^{(*)}$ in custodial warped space (SM embedding in warped space w/ an

$SU(2)_L \otimes SU(2)_R \otimes U(1)_{B-L}$ bulk gauge symmetry)

MC, E Megias, M Quiros, C Wagner <http://arxiv.org/abs/arXiv:1809.01107> JHEP 1812 (2018)

- **Higgs Physics (beyond Phase Transitions and DM)**

1) Higgs Pair Production as a Signal of Enhanced Yukawa Couplings

M. Bauer, MC, A Carmona <http://arxiv.org/abs/arXiv:1801.00363> PRL 121 (2018)

Community Activities 2019

- **US Representative of the Physics Preparatory Group for the European Strategy Update 2020**

Physics Briefing Book : Input for the European Strategy for Particle Physics Update 2020

<http://arxiv.org/abs/arXiv:1910.11775>

(Lost of meetings, prepare the Granada Symposium, Convenor of the DM/DS chapter, essential role from Gordan Knrjaic)

- **Contributions to other community studies**

1) Higgs Boson Pair Production at Colliders: Status and Perspectives

<http://arxiv.org/abs/arXiv:1910.00012>

2) Higgs Physics at the HL-LHC and HE-LHC

<http://arxiv.org/abs/arXiv:1902.00134>

3) Opportunities in Flavour Physics at the HL-LHC and HE-LHC

<http://arxiv.org/abs/arXiv:1812.07638>

- **Review of Particle Physics: Status of Higgs Physics**

MC, C Grojean, M Kado, V Sharma <https://doi.org/10.1103/PhysRevD.98.030001>

Phys.Rev. D98 (2018) + online update Nov. 2019

Community/Management Activities 2019

- **PI of the Neutrino Theory Network (NTN)**
Yearly DOE Support at the \$ 360K level, Managed by Fermilab Theory Department for the US Neutrino Theory Community
(essential role from P. Machado, Steering C. member, and A. De Gouvea, SAB chair)
- **PI of the QIS DOE QuantISED award (\$ 1.25 M/year for a consortium between Fermilab/Caltech/UWash)**
Ongoing renewal with enlarged consortium
Fermilab/Caltech/UWash + MIT/Purdue/UIUC (\$ 2.75 M/year)
(essential role from Roni Harnik, other co-Pis: Savage, Thaler, El Kahdra, Preskill and Kruczenski)

Work on International connections with EU, CERN, UK, Italy, Spain, Germany, France, Australia, Brazil, Peru, Argentina, Japan, others, to enhance Theory department international visibility and open new funding opportunities

Suggestions and ideas welcome!!!