# HiggsTools Mid-Term Review: Raquel Gómez Ambrosio (ESR 12)

#### HiggsTools DFTTO Node Università & INFN @Torino & CMS @CERN

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# My background

- Raquel Gómez Ambrosio (Spain).
- Licenciatura en Física. Universidad Autónoma de Madrid (2006-2011)
- Master in Theoretical physics. Humboldt Universität zu Berlin (2011-2014).



 $\blacktriangleright$  Master's thesis: The Supercorrelator/Superamplitude Duality of  $\mathcal{N}$  =4 Super Yang-Mills Theory applied to Five-Point Objects.

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#### Fellow's research inside the workpackage architecture

# My work in the project

### My Project inside Higgstools:

 Title: Gauge invariant definition and extraction of pseudo-observables like VV-scattering cross-section and partial waves (WP2).

### More concretely:

- Study of Effective field theories and pseudo-observables (with Prof. Passarino).
- Experimental implementation/analysis of the latter (with Prof. Mariotti).

### Secondments

Theory:	Freiburg (with Prof. Dittmaier) $\implies$ Months 23,27,35
Experiment:	CMS-Zürich (with Prof. Dissertori) $\implies$ Months 38-40
Private:	$Maplesoft \Longrightarrow Months 30-32$

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Fellow's research inside the workpackage architecture

# Me inside the workpackage architecture

Task 2.1 Improved predictions for Standard Model-like Higgs scenarios

M 2.1.2 Better control of theoretical uncertainties for the SM-like Higgs boson scenario

Task 2.2 Improved predictions for non-standard electroweak symmetry breaking scenarios

- M 2.2.1 Precision calculations for vector boson scattering
- M 2.2.3 Standardised description for non-standard Higgs boson interactions
- M 2.2.4 Interpretation of experimental data in the light of M2.2.3
- Task 1.4 Future European strategy for particle physics
  - M 1.4.1 Review of the current state and future directions in Higgs boson physics

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main results obtained so far (research, training and publications/attendance to conferences)

# Main results obtained so far

### Conferences attended

- HiggsCouplings (Torino, IT, 2014)
- First HiggsTools Young Researchers Meeting (YRM) (Durham, UK, 2015)
- First HiggsTools Annual Meeting (Freiburg, DE, 2015)
- HiggsHunting (Orsay, FR, 2015)
- ► Second HiggsTools YRM (Brussels, BE, 2015) ⇒ New collaboration!

### Schools

- GGI lectures on the theory of fundamental interactions (Firenze, IT, 2015)
- First HiggsTools Summer School (Pré Saint-Didier, IT, 2015)

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main results obtained so far (research, training and publications/attendance to conferences)

# Highlights

### Publication: JHEP07 (2015) 175



# Planck Conference (Ioanina, GR, 2015)

- Gave a talk in the parallel session, which resulted in a publication: SISSA - Proceedings Of Science Planck2015-049
- Might result in invitations to give seminars at other universities.



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main results obtained so far (research, training and publications/attendance to conferences)

# Highlights

# Second HiggsTools YRM (Brussels, BE, 2015)

- ► Contact person of the "BSM-EFT" group (+ESR5, ESR9, ESR11, ESR14).

### Journal Club

- ► Talk in the Journal Club, where I presented a paper from CMS experiment.
- I will take over the organization of the JC.



Eventual hard technical points and possible strategies to circumvent them

# Eventual hard technical points and possible strategies to circumvent them

### Delay of LHC data taking

- ▶ LHC RUN-2 has started on time and is collecting data at 13 TeV.
- The data collected until now at 13TeV are already very interesting for us, and even in the case of a major problem that would force the accelerator to shut down tomorrow, many analyses could be carried.
- Some particular analyses that need a huge amount of data (i.e. the full RUN-2) would not be possible, but nevertheless we are building the machinery that will be ready the moment the data finally arrive.

### Conclusion

- After the success of RUN-1 we do not expect major problems at LHC. In the case those would happen, we would still be able to perform several analyses that are planned.
- > The theoretical part of my work would not be affected by this problem.



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Eventual hard technical points and possible strategies to circumvent them

# Eventual hard technical points and possible strategies to circumvent them

### Competition and Concurrency

All-time problem in research and development: There are other people working in the same ideas as us, and they might find results earlier.

### Solutions

- HiggsTools is itself a solution, since it is a big (from a theorist point of view) collaboration. Also it is one of the few theory-experiment joint collaborations which puts it in a privileged position.
- HiggsTools can continue with the spirit of the HXSWG at CERN. Where scientists working in the same topic (Higgs properties, in this case) have a space to concur instead of competing.

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Outlook on the remaining part of the research work

# Outlook on the remaining part of the research work

The plan for the remaining research time is to continue the study of the dimension-six effective field theory. In particular:

- Implementing the next-to-leading order calculations in the Monte Carlo generators used at CERN (more concretely, MADGRAPH5\_aMC@NL0).
- ► Confront this with the LHC RUN-2 data and our theoretical predictions.
- Address the vector-boson-scattering case, which is extremely challenging from the experimental point of view but extremely interesting from the theoretical.







### Future career plans

### Plan A

▶ I plan to get a permanent position at CERN as soon as possible.

### Plan B

- ▶ Gain experience and contacts in some multinational company or institution.
- Found my own technological start-up.



Outlook of the fellow on his/her future career

# Thank you . . .





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