

# **WorkStop/ThinkStart 3.0:** ***"Paving the way for alternative NNLO strategies"***

**Nov. 4-6, 2019**

**Galileo Galilei Institute - Firenze**



## **Organizing committee**

**Dr. Stefano Catani (INFN Firenze)**

**Dr. Leandro Cieri (INFN Firenze)**

**Dr. German Sborlini (IFIC - UV & CSIC)**

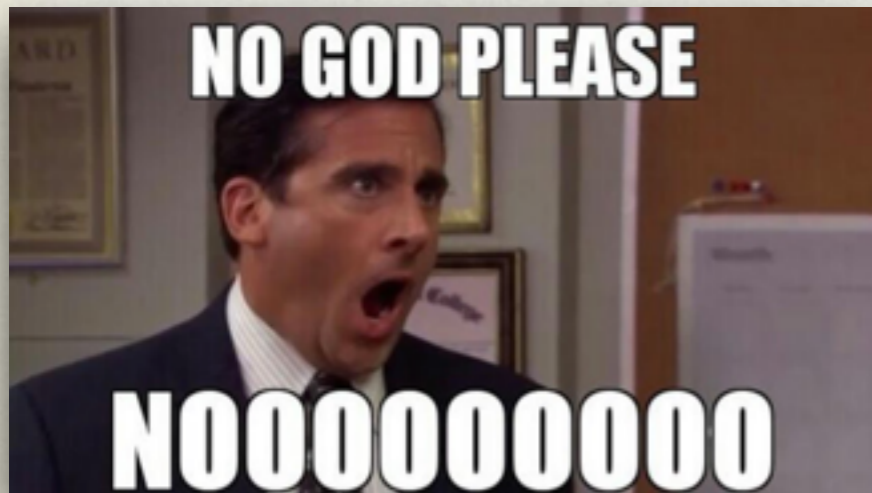
**Dr. William Torres Bobadilla (IFIC - UV & CSIC)**



# *Where did the WorkStop/ThinkStart start?*

@ University of Zurich

with Adrian Signer, Christoph Gnendiger & Dominik Stöckinger



*It is not a standard workshop!!!*

## *What is it about?*

- *Extend new collaborations*
- *Promote discussion as much as possible*
- *Study of regularisation/renormalisation schemes at NNLO*



# What did we obtain/gain?

Eur. Phys. J. C (2017) 77:471  
DOI 10.1140/epjc/s10052-017-5023-2

THE EUROPEAN  
PHYSICAL JOURNAL C



Regular Article - Theoretical Physics

## To $d$ , or not to $d$ : recent developments and comparisons of regularization schemes

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# *New results obtained as a byproduct*

PHYSICAL REVIEW D **97**, 096006 (2018)

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## $\gamma_5$ in the four-dimensional helicity scheme

C. Gnendiger<sup>1,\*</sup> and A. Signer<sup>2</sup>

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PUBLISHED: *February 19, 2019*

## **Small-mass effects in heavy-to-light form factors**

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T. Engel,<sup>a</sup> C. Gnendiger,<sup>a</sup> A. Signer<sup>a,b</sup> and Y. Ulrich<sup>a,b</sup>

# New results obtained as a byproduct

PHYSICAL REVIEW D **98**, 025018 (2018)

## Supercurrent anomaly and gauge invariance in the $N=1$ supersymmetric Yang-Mills theory

Y. R. Batista,<sup>1,\*</sup> Brigitte Hiller,<sup>2,†</sup> Adriano Cherchiglia,<sup>3,‡</sup> and Marcos Sampaio<sup>3,§</sup>

Eur. Phys. J. C (2019) 79:361  
<https://doi.org/10.1140/epjc/s10052-019-6865-6>

THE EUROPEAN  
PHYSICAL JOURNAL C



Regular Article - Theoretical Physics

## NNLO final-state quark-pair corrections in four dimensions

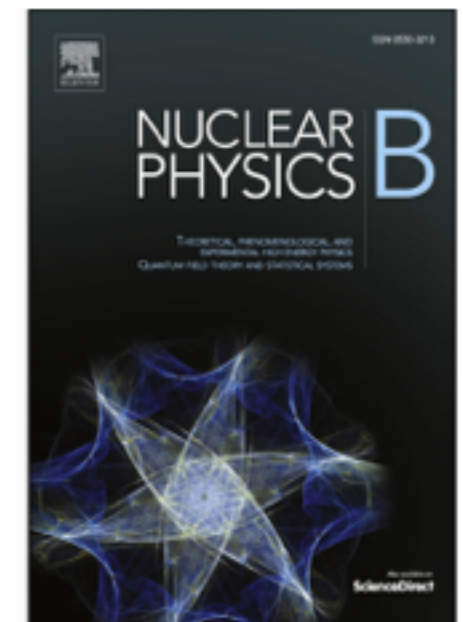
B. Page<sup>1,2,a</sup>, R. Pittau<sup>3,b</sup>

## Accepted Manuscript

Three-loop MSSM Higgs-boson mass predictions and regularization by dimensional reduction

Dominik Stöckinger, Josua Unger

PII: S0550-3213(18)30223-2  
DOI: <https://doi.org/10.1016/j.nuclphysb.2018.08.005>  
Reference: NUPHB 14420



# New results obtained as a byproduct

Eur. Phys. J. C (2018) 78:231  
<https://doi.org/10.1140/epjc/s10052-018-5692-5>

THE EUROPEAN  
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Regular Article - Theoretical Physics

## Universal dual amplitudes and asymptotic expansions for $gg \rightarrow H$ and $H \rightarrow \gamma\gamma$ in four dimensions

Félix Driencourt-Mangin<sup>1,a</sup>, Germán Rodrigo<sup>1,b</sup>, Germán F. R. Sborlini<sup>1,2,c</sup>

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## Universal four-dimensional representation of $H \rightarrow \gamma\gamma$ at two loops through the Loop-Tree Duality

Félix Driencourt-Mangin,<sup>a</sup> Germán Rodrigo,<sup>a</sup> Germán F.R. Sborlini<sup>a,b,c</sup>  
and William J. Torres Bobadilla<sup>a</sup>

+ preprints

+ conference proceedings

# People aware of our paper

from 39 cites

{Abreu, Aguilera–Verdugo, Akhundov, Andersen, Anger, Arbuzov, Bai, Batista, Bellm, Bendavid, Berger, Bhatia, Biedermann, Blondel, Boels, Bondarenko, Borowka, Bräuer, Britzger, Bruque, Buckley, Camacho, Caola, Carloni Calame, Catani, Chachamis, Chatterjee, Chen, Cherchiglia, Chiesa, Ciulli, Colferai, Currie, Denner, Diessner, Dreyer, **Driencourt–Mangin**, Dubovyk, Dydyska, Engel, Fazio, Febres Cordero, Ferri, Flieger, Forte, Freitas, Garzelli, Gehrman, Gehrman–De Ridder, Gieseke, Glover, Gluza, Gnendiger, Gras, Greiner, Grzanka, Gütschow, Gwenlan, Hahn, Harlander, Heil, Heinrich, Hekhorn, Hernandez–Pinto, Hernández–Pinto, Herndon, Hiller, Hirschi, Hoang, Höche, Huber, Huss, Huston, Ita, Jadach, Janot, Jones, Kälin, Kalinovskaya, Kallweit, Kar, Karlberg, Kassabov, Kataev, Kazantsev, Kerner, Klappert, Kotlarski, Kuttimalai, Lang, Larkoski, Lee, Liebschner, Lindert, Loch, Long, Lönnblad, Luisoni, Maier, Maierhöfer, Maître, Marquard, Marzani, McFayden, Mogull, Montagna, Moul, Mozer, Mrenna, Nachman, Napoletano, Nicrosini, Ochirov, Page, Pandini, Papadopoulos, Papaefstathiou, Pellen, Pérez–Victoria, Perrozzi, Piccinini, Pires, **Pittau**, Placzek, **Plastino**, Plätzer, Plenter, Porto, Pozzorini, Prausa, Prestel, Pruna, Quackenbush, Rabbertz, Ramírez–Uribe, Rauch, Re, Reuschle, Reyes R., Richardson, Riemann, **Rocca**, **Rodrigo**, Rojo, Röntschi, Rottoli, Runkel, Sadykov, Samitz, Sampaio, Samui, **Sborlini**, Schönherr, Schumann, Scyboz, Seth, Shao, **Signer**, Siódmok, Skands, Skrzypek, Smillie, Sotnikov, Soyez, Stepanyantz, **Stöckinger**, Sun, Sutton, Szór, **Tackmann**, Thaler, Theofilatos, **Torres Bobadilla**, Torrini, Tracz, Uccirati, Ulrich, Unger, Usovitsch, Vesga, Vieira, Ward, **Weinzierl**, Wu, Yang, Yazgan, Yost, Yuan, Zamora}

## To $d$ ,

### traditional dimensional schemes

- 't Hooft / Veltman (HV) '72
- conventional dim. reg. (CDR) '73
- dim. reduction (DRED) '79
- four-dim. helicity (FDH) '92

### reformulations of dimensional schemes

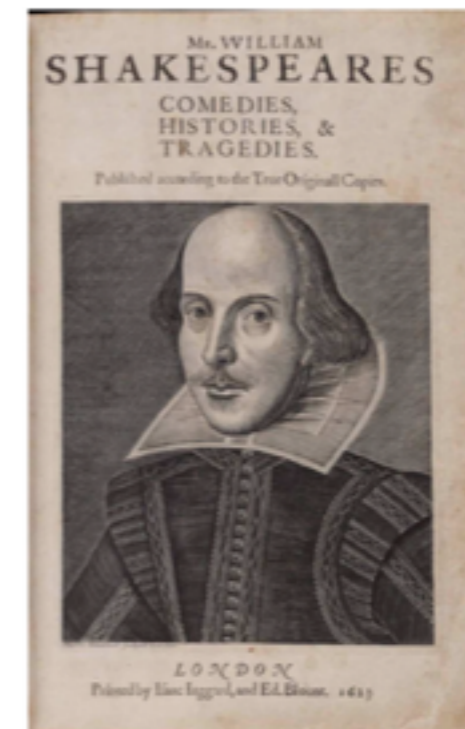
- six-dim. formalism (SDF) '09
- four-dim. formalism (FDF) '14

- mathematical consistency
  - unitarity, causality (equivalence to  $\overline{\text{MS}}$  / BPHZ)
  - symmetries (gauge invariance, SUSY, ...)
- 
- computational efficiency (analytical/numerical automation)

## or not to $d$ ?

### non-dimensional schemes

- implicit reg. (IREG) '98
- loop regularization (LORE) '03
- four-dim. reg. / ren. (FDR) '12
- four-dim. unsubtraction (FDU) '16



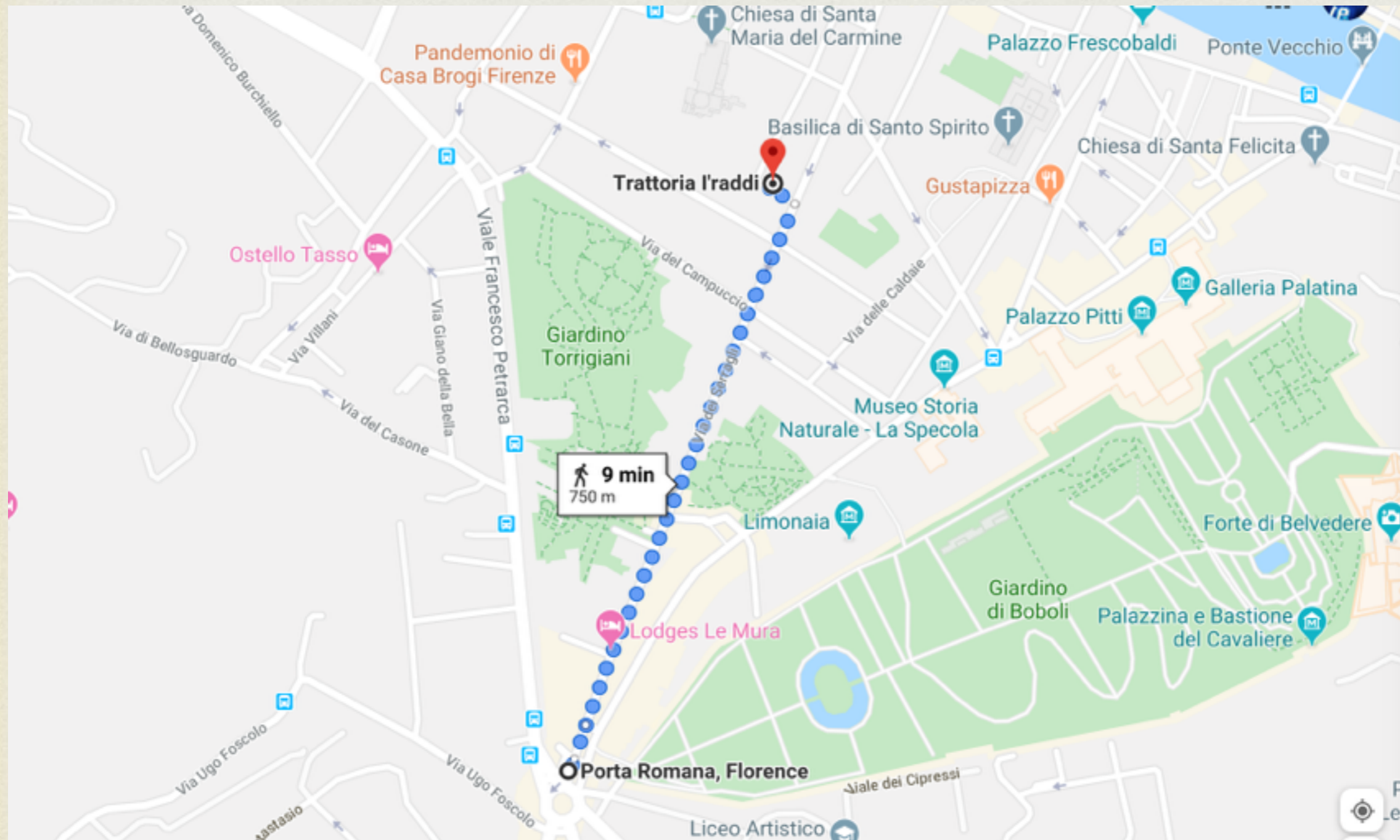
# Timetable

MONDAY	TUESDAY	WEDNESDAY
TORRES	DRIENCOURT-MANGIN	RODRIGO
GNENDIGER & STOECKINGER	ULRICH	CATANI
CIERI	PITTAU	SBORLINI & TORRES
TRAMONTANO	SIGNORILE-SIGNORILE	
PIRES	HILLER	
BANERJEE		

- *Plenary talks + discussions*
- *where we are, where we are going to...*
- *General remarks*



# Conference dinner → Tomorrow (Tuesday 5/11/2019)



*Time: 8:00 PM*

*Trattoria I'raddi*

*Via D'Ardiglione, 47, 50125 Firenze FI, Italia*