

Zahari Dimitrov Kassabov

Curriculum Vitae

Ph.D thesis

Supervisor Professor Stefano Forte

Title Characterization of Parton Distribution Functions and their uncertainties.

ITN Network My work is supported by a FP7 Marie Curie Initial Training Network Fellowship, *HiggsTools*.

Description

The project focuses on the NNPDF collaboration, but extends beyond it, in particular, to the PDF4LHC combined determination of PDFs. It is focused on the characterization of Parton Distribution Functions and their uncertainties.

Several improvements in the NNPDF fits are being discussed and implemented, and this is expected to lead to a new release in the short term. These include the inclusion of new experimental data, the development of statistical methods to assess the consistency of the methodology, and improvements in the underlying theory and improved statistical learning techniques.

In addition part of the project has been dedicated to develop representations of PDF uncertainties and characterize their trade-offs. Parts of this work have been used in the combined PDF4LHC sets. Notably, the way these combined sets are delivered, when intended to be used for high precision results, is based on methodologies developed and published by our group. Furthermore we developed a more advanced methodology which allows to retain precision while improving computing performance, which we have published in a separately.

A longer term project is to arrive at a full characterization of theoretical uncertainties of PDFs. This part will undergo beyond PDF determination and will include analytic studies of the behavior of the perturbative expansion in QCD.

Publications

An Unbiased Hessian Representation for Monte Carlo PDFs,
Phys. J. C (2015) 75: 369.

PDF4LHC recommendations for LHC Run II, *J. Phys. G 43 (2016) 023001.*

Les Houches 2015: Physics at TeV Colliders Standard Model Working Group Report, *Proceedings of the Standard Model Working Group of the 2015 Les Houches Workshop*.

Specialized minimal PDFs for optimized LHC calculations, *Eur. Phys. J. C* 76 (2016) 205.

SMPDF Web: a web-based application for specialized minimal parton distribution functions, *7th Workshop italiano sulla fisica pp a LHC (pp @ LHC 2016)* .

Handbook of LHC Higgs cross sections: 4. Deciphering the nature of the Higgs sector (Section 1.2: Parton distribution functions).

Talks

- April 2015 **Common tools to study PDF uncertainties**, *First Annual Meeting of ITN HiggsTools*, Freiburg.
- October 2015 **Specialized minimal PDFs**, *PDF4LHC meeting*, CERN.
- April 2016 **PDF Calculations for the LHC**, *Second Annual Meeting of ITN HiggsTools*, Granada.
- November 2016 **Parton distributions for high precision measurements at the LHC**, *HiggsCouplings 2016*, SLAC.

Education

All marks follow the Spanish convention: marks range from 0 to 10 where 10 is the best.

2009–2014 **University**, Universidad de Zaragoza, Spain.

I have obtained an average mark of 9.2 and a distinction (“*Matrícula de Honor*”) in 20 of the 45 modules I have completed. I have also obtained the prize “*Premio de Licenciatura García Galdeano*” for my academic record.

2012–2013 **University**, University of Southampton, UK.

I participated in the Erasmus programme, in the fourth year of my Physics Degree.

Final year project

Title Automation of data acquisition and analysis.

Supervisor Professor Nicolás Medrano

Scholarship I was awarded a scholarship funded by the Spanish Government for my work in collaboration with the department.

Grade I defended this project before a tribunal and obtained 10 points out of 10 as well as a distinction “*Matrícula de Honor*”.

Participation in schools

January 2015 **GGI lectures on the theory of fundamental interactions**, Florence.

June 2015 **HiggsTools Summer School on Higgs Physics**, Pallesieux.

August 2016 **PSI Summer School**, Zuoze.

Practical skills gained during my career

- Scientific collaborations I carry on most of my work within the NNPDF collaboration, with members located in eight different international research institutions. I have contributed to successfully defending a proposal regarding the representation of combined PDFs before the colleagues at the broader PDF4LHC working group. I regularly meet and discuss with fellow HiggsTools students.
- Machine learning My work at the NNPDF collaboration involves improving and understanding the neural network based algorithm used to perform the PDF fits, in particular characterizing the uncertainty obtained from the prediction.
- Algorithms In collaboration with my colleagues, I have developed original algorithms solving problems such as the the Hessian representation of PDFs and their compressed representation.

Past job experience

- September- November 2016 **Industrial secondment**, *Wolfram Research*.
I worked on the Statistics team where I made improvements to the *Wolfram Language* kernel which included developing some original algorithms. I was offered a position at the company at the end of the secondment.
- July 2014 **OpenLab Summer Student**, *CERN*.
I was one of the 23 selected among more than 850 candidates to participate in the *OpenLab Summer Programme* at CERN. I worked to improve the data reporting capabilities of the CERN control systems while having the chance of attending a series of Particle Physics and IT lectures.

Languages

- Bulgarian Native
- Spanish Native
- English C1 level *I conduct most of my work and scientific writing in English.*
- Italian C1 level *I am currently living and working in Italy.*
- German B2 level *I have studied German for Sat Secondary school. I have been in Germany and taken German courses in 2005, 2008 and 2011.*

Computer skills

I have acquired knowledge on computer architecture, programming, web developing (both server and client side), security and User-Interface design by self-learning. My work routinely involves maintaining the NNPDF code as well as developing programs for custom projects.

Operating systems	Windows, and Linux (including operating remotely and within a container).
Programming languages	I use extensively Python, C, and C++, in particular their scientific libraries, and know in some detail the inner working of these languages. I have also used JavaScript, PHP and ActionScript.
Version control	Git, SVN. I have also set up automated remote build systems integrated with git.
Web servers	I know how to set up and operate a basic server based on Nginx.
Scientific software	Mathematica, Matlab, Labview.
Typography	L ^A T _E X, Microsoft Word.

Other achievements

- 2016 I organized a series of 8 online colloquia as a part of the *HiggsTools Journal Club*.
- 2013 Among some friends, I discovered a flaw in a Blackjack offer at the *Grosvenor Casino Southampton* which allowed for positive expected income when playing. I wrote a program to calculate the strategy that exploits the flaw optimally, earning substantial profits.
- 2009 Obtained a bronze medal in the Spanish National Physics Olympiad.
- 2009 Won the Aragón Regional Physics Olympiad.
- 2009 Finalist of the Aragón Regional Mathematics Olympiad.
- 2005 Won the Aragón Regional Mathematics Junior Level Olympiad.

Referees

The following persons are willing to submit recommendation letters on my behalf:

- Professor Stefano Forte: University of Milan (Stefano.Forte@mi.infn.it)
- Professor Nigel Glover: IPPP Durham (e.w.n.glover@durham.ac.uk)
- Doctor André David: CERN and CMS (andre.david@cern.ch)
- Doctor Juan Rojo: Nikhef (j.rojo@vu.nl)