



Baptiste Cabouat

University of Manchester

Supervisor: Professor Michael Seymour



The University of Manchester



Short biography

- From Paris, France.
- 2013 - 2015: Engineering school in France.
- 2015 - 2017: Masters in Theoretical Physics at Lund University, Sweden.
- 2018 - now: PhD in Theoretical Particle Physics at the University of Manchester, UK, funded by MCnet.



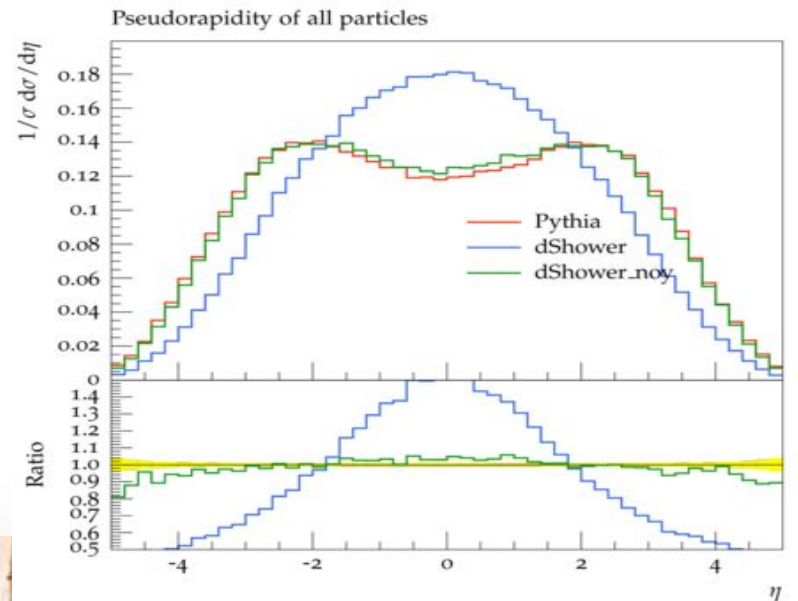
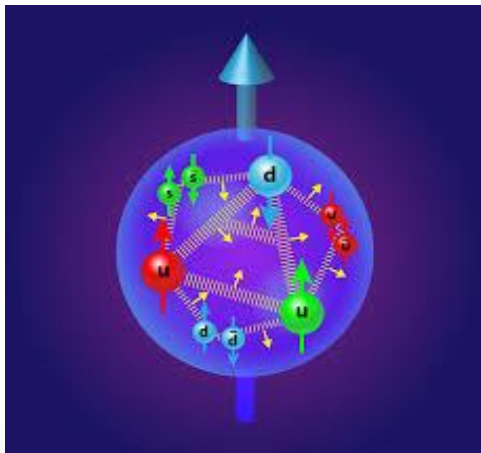
MCnetITN3: travel & learning

- September 2017: 16th MCnet meeting in Karlsruhe.
- April 2018: 17th MCnet meeting at CERN + MCnet training event: Presentation Skills.
- July 2018: 12th MCnet summer school in Prato.
- August 2018: BUSSTEPP 2018 in Oxford.
- September 2018: 2nd MCnet Computing school in Göttingen.



My Project

- Project: MC modeling of proton-proton collisions.
- Proton: “bag” of partons. Current event generators model pp collisions as a single parton-parton collision.
- In this project, pp collisions are described as two separate parton-parton collisions.



Impact

- My MCnet experience will provide me with advanced knowledge in MC methods, computing, data analysis, etc ...
- During my PhD, I will be developing a deep understanding of the fundamentals of particle physics.
- The MCnet schools (presentation skills, computing) participate to this apprenticeship, especially regarding the communication of scientific results.
- Being part of the MCnet network gives me job opportunities (partnership) and the possibility to collaborate with other nodes.



Alan Price

IPPP, Durham University



Short biography

- *BSc Theoretical Physics, UCD*
- *MSc Theoretical Physics, UoE*



MCnetITN3: travel & learning

- *Presentation Skills - CERN*
- *MCNet Summer School –Prato*
- *MCNet Computing School – Göttingen*
- *High Performance Computing Course - Durham*



My Project

SHERPA for Next Generation Electron-Positron Colliders

- *EP colliders are precision machines*
- *FCC-ee type machine will produce 10^{12} Z , 10^8 W^+W^- and 10^6 Higgs*
- *Requires very precise theory predictions*
- *Need to model ISR/FSR, beam polarization*

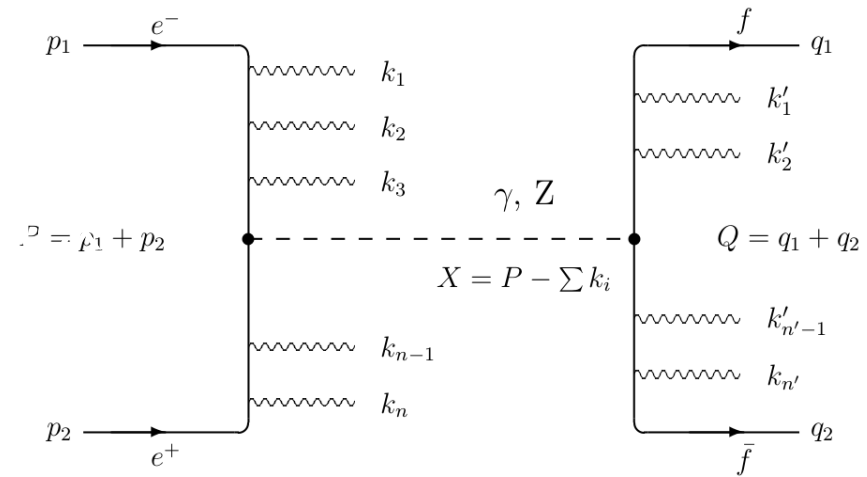


Fig. Initial and final state radiation

Impact

- The ITN has provided training that will be useful in both academia and the private sector
- Provided experience working with a large software project
- It has improved my critical thinking and complex problem solving
- These are all highly desirable traits in the workplace



Marian Heil

IPPP, Durham



Short biography

- Bachelor & Master in Göttingen
- PhD at the IPPP, Durham since 2017



MCnetITN3: travel & learning

- MCnet Meeting & Presentation Skill training
April '18 at CERN
- MCnet Summer School
July '18 in Prato
- MCnet Scientific Computing School
September '18 in Göttingen
- HP2 Conference
October '18 in Freiburg



My Project

- High Energy Jets (HEJ)
 - Supervisor: Jeppe Andersen
 - Modelling well separated Jets
- Focus on Higgs with Multijets
 - Distinguish different Higgs productions
 - Highly sensitive to corrections



A banner for "Monte Carlo net" featuring a background of mathematical formulas and Feynman diagrams. The text "Monte Carlo net" is prominently displayed in a serif font. Visible formulas include $\frac{1}{\sigma_0} \frac{d\sigma}{dx_1 dx_2} = \frac{\alpha_s}{2\pi} C_F \left\{ \frac{x_1^2 + x_2^2}{(1-x_1)(1-x_2)} - \frac{2m_0^2}{s} \left(\frac{1}{(1-x_1)^2} + \frac{1}{(1-x_2)^2} \right) \right\}$ and $\int_{x_{\min}}^{x_{\max}} f(x) dx = R \left(F(x_{\max}) - F(x_{\min}) \right)$.

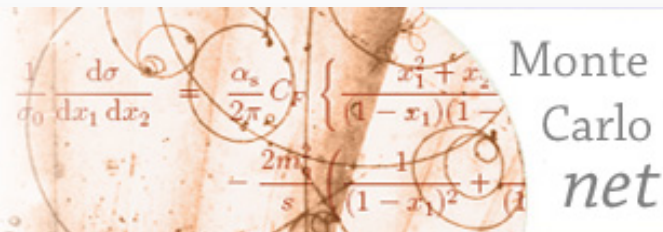
Monte Carlo net

A banner for "Monte Carlo net" featuring a background of mathematical formulas and Feynman diagrams. The text "Monte Carlo net" is prominently displayed in a serif font. Visible formulas include $\int_{x_{\min}}^{x_{\max}} f(x) dx = R \left(F(x_{\max}) - F(x_{\min}) \right)$ and $\int_{x_{\min}}^{x_{\max}} f(x) dx = R \left(F(x_{\max}) - F(x_{\min}) \right)$.

Monte Carlo net

Impact

- Meet different groups in same research field
- Experience in Coding/Program development
in particular: MCnet Computing School '18



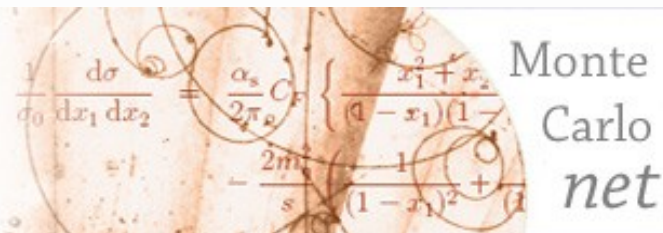
Emma Simpson Dore

KIT - Karlsruhe



Short biography

- 2012 - Finished school in Glasgow, final exams in Physics, Maths and Chemistry
- 2013 – 2017 Studied MSci Natural Sciences(Physics and Physical Chemistry) at UCL, London
- Masters project using MC generator RAPGAP for future DIS experiment VHEeP
- Masters courses in Particle Physics → MC PhD



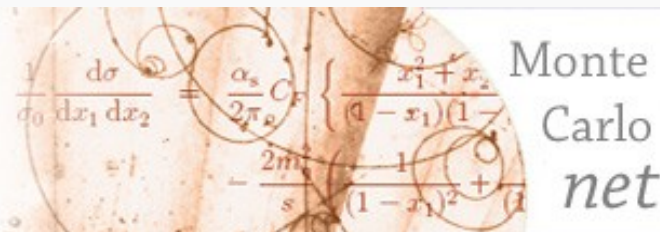
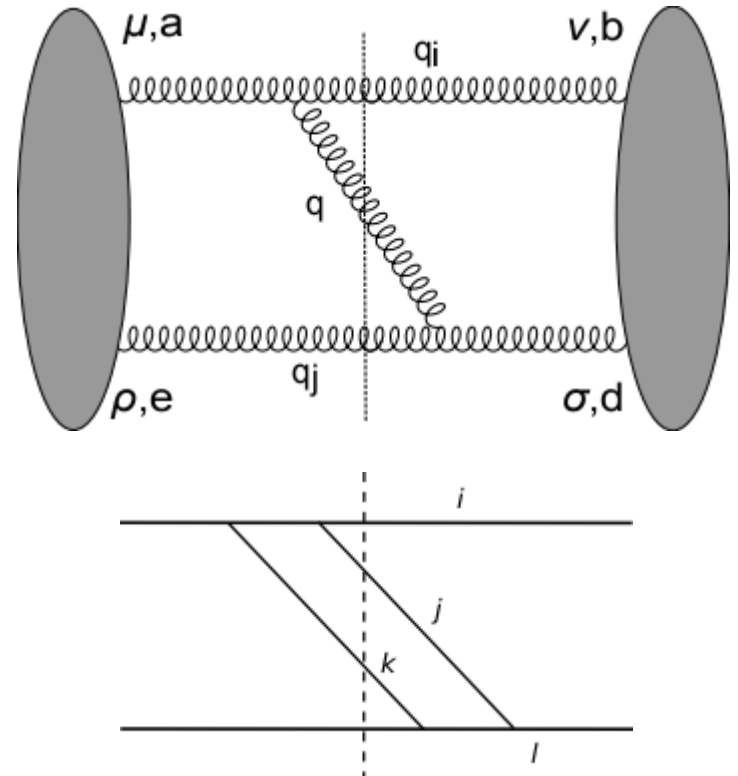
MCnetITN3: travel & learning

- Attended Masters lecture course in Karlsruhe, advanced particle physics theory
- German language courses, have completed B1 level
- MCnet presentation skills course, CERN April 2018
- MCnet summer school, Prato July 2018
- MCnet computing school, Göttingen Sept 2018
- 3 month secondment to Vienna(Uni Wien), Autumn 2018, attended Vienna Central European Seminar and lecture course(QCD and Jet Physics)



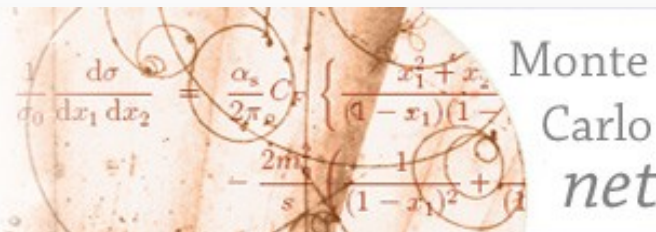
My Project

- Was interested to learn more about theory behind simulation
- Parton Shower is key component of event generation, work needed to go to higher orders
- Have reproduced known results within a new framework
- Aim to have algorithmic implementation with better fits to data, soon some tests in Herwig



Impact

- Lots of opportunities to travel, contacts at all the MCnet nodes
- Secondments also give more options for future research projects and/or insight into related work in industry
- Language courses help with integration and improve chances when applying to industry
- Training/schools to pick up new skills and learn in areas beyond the PhD project



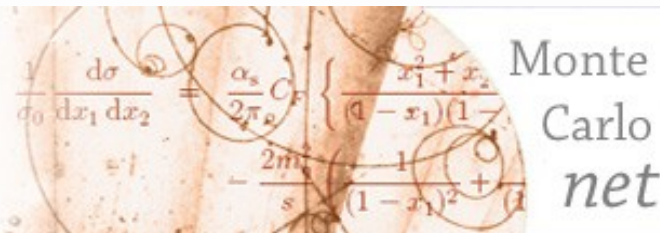
Xiaoran Zhao

Louvain



Short biography

- Born in 1994 in China.
- Bachelor and Master in China
- Studying particle physics since last year of Bachelor, from performing Monte Carlo simulations.
- Move Louvain for PhD since April 2017.



MCnetITN3: travel & learning

- Local lecture courses on SM, SUSY, etc.
- GGI school in Italy, MadGraph school in China
- Two conferences in France
- One workshop in Germany
- Biannual MCnet meetings and workshops.
- Visits to Netherlands and CERN.



My Project

- Future **e+e- colliders**: FCC-ee, ILC, CLIC, CEPC
- High precision measurements
- Requiring **high precision** theoretical predictions
- For both Standard Model,
and New Physics Beyond Standard Model
- Example: initial state radiation

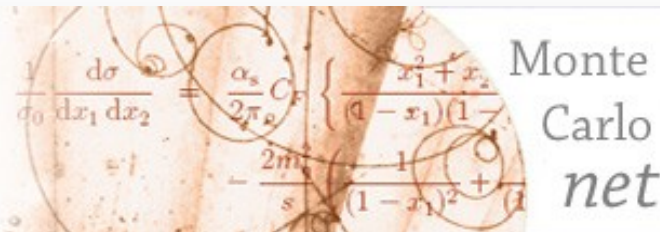
```

res=-beta*(1d0+x)/2d0
res=res-beta*beta*(
c  (1d0+3d0*x*x)/(1d0-x)*dlog(x)
c  +4d0*(1d0+x)*dlog(1d0-x)+5d0+x)
c  /8d0
res=res*(1d0-x)**(1-beta)
    
```



Impact

- Broaden my horizons
- Important skills: communication, collaboration, presentation
- Methods, experiences, habits: boost future research
- Building a network of solid collaborators





Luca Mantani

Louvain-la-Neuve



Short biography

- *Always been passionate about science and math*
- *B.sc. And M.S. at University of Bologna*
- *Short period of study abroad in Louvain la Neuve to write M.S thesis*
- *Started PhD in september 2017*



MCnetITN3: travel & learning

- *MCnet schools and trainings:*
 1. *MCnet summer school in Prato, Italy*
 2. *Scientific computing school*
 3. *Presentation skills*
- *MCnet secondment in B12 consulting company*
- *Non-MCnet activities*
 1. *GGI Winter School in Florence*
 2. *IRN Terascale Meeting in Strasbourg*
 3. *ICTP Summer School on Particle Physics*



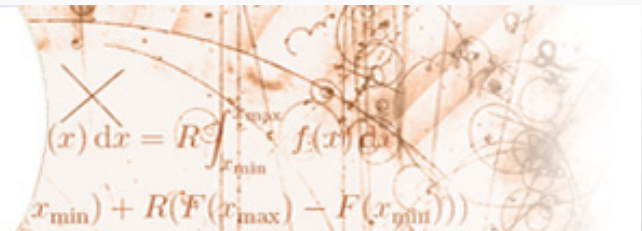
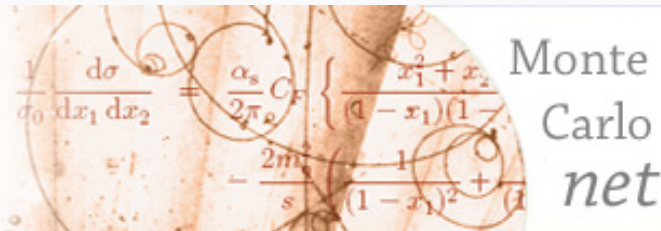
Non-academic secondment

- Worked on real consulting projects, being part of the data science team.
- Studied problems of demand forecasting and predictive maintenance.
- Instructive experience:
 1. Got to know the data science world
 2. Deal with tight deadlines
 3. Relations with clients (their needs, demands and expectations).



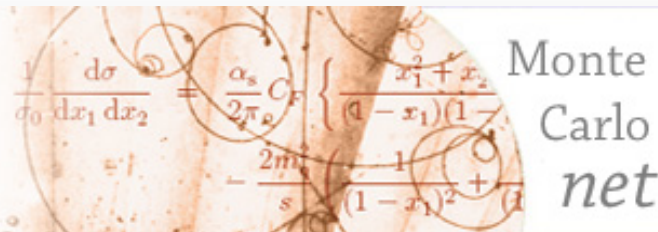
My Project

- *SMEFT: look for new physics at collider with a model independent approach.*
- *Extensive use of collider simulations with Monte Carlo tools such as MadGraph, Pythia, etc.*



Impact

- *Opportunity to travel is important for networking.*
- *The secondment opportunity in industry helps to have a look outside of scientific research.*
- *Trainings helps broaden the knowledge and be better at what we do.*



Marius Utheim

Lund





Short biography

- Originally from the cold wastes of the North (i.e. Norway)
- Did a master in applied mathematics at the University of Tromsø before changing to physics. I still sometimes program and do maths for fun.
- I changed to physics because I'm darn curious and amazed by the universe we live in.



$$\frac{1}{\sigma_0} \frac{d\sigma}{dx_1 dx_2} = \frac{\alpha_s}{2\pi} C_F \left\{ \frac{x_1^2 + x_2^2}{(1-x_1)(1-x_2)} - \frac{2m_s^2}{s} \frac{1}{(1-x_1)^2 + (1-x_2)^2} \right\}$$

Monte Carlo net

$$\int_{x_{\min}}^{x_{\max}} f(x) dx = R \int_{x_{\min}}^{x_{\max}} f(x) dx$$
$$x_{\min}) + R(F(x_{\max}) - F(x_{\min}))$$

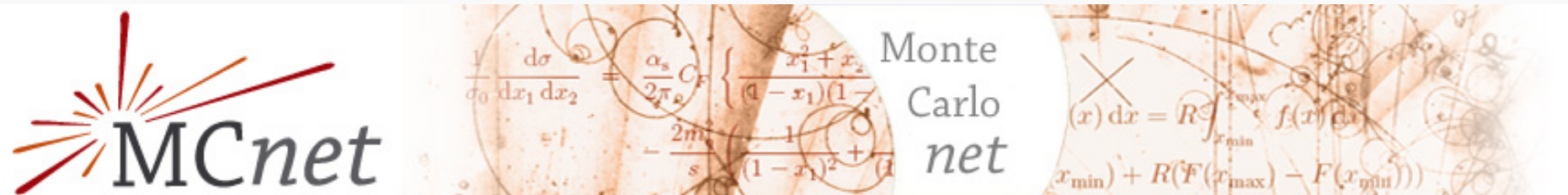


MCnet **Travel & learning**

I have attended several MCnet events:

- Summer school 2017 and 2018
- Course on scientific presentations during the 17th MCnet meeting
- Scientific computing school in Göttingen

The best thing about taking part in MCnet arrangements is seeing familiar faces and meeting awesome people.



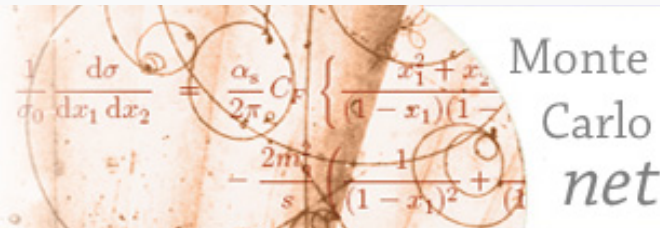


My Project

The project: Implementing hadronic rescattering in Pythia. After hadrons have been produced, they can collide and scatter off each other on their way out. This is a part of the event that Pythia cannot simulate yet.

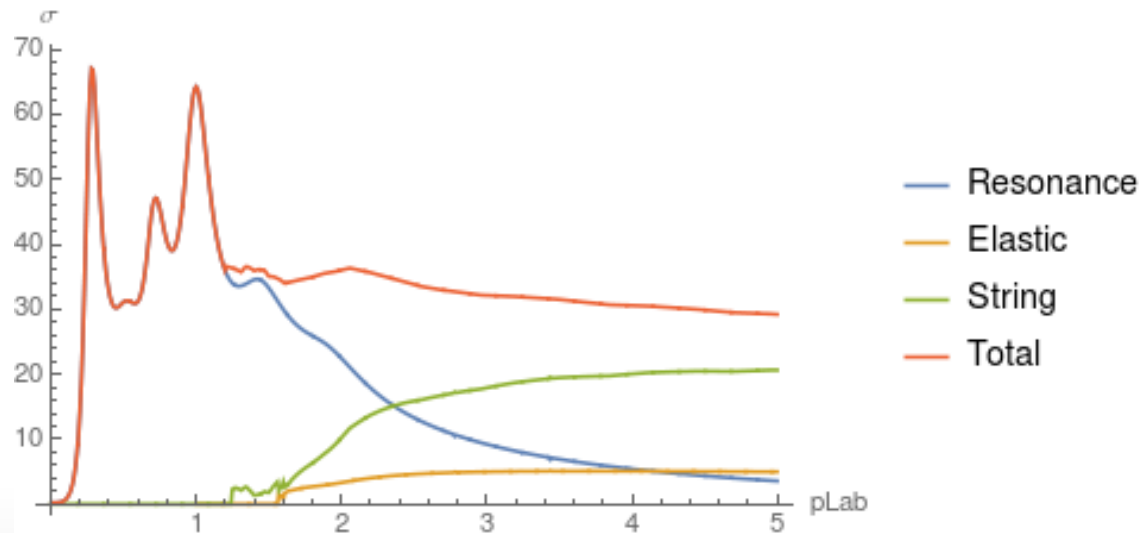
Why it matters: This part might be significant for accurate simulating phenomena like collective behaviour, which is a telltale sign of quark-gluon plasma

Why I chose it: Working on further developing Pythia is a useful experience, and it is suitable for me considering my strong background in programming



My Project

The results: The overall structure is done, and it is now a matter of implementing the details. We hope to submit our work for publication before summer.



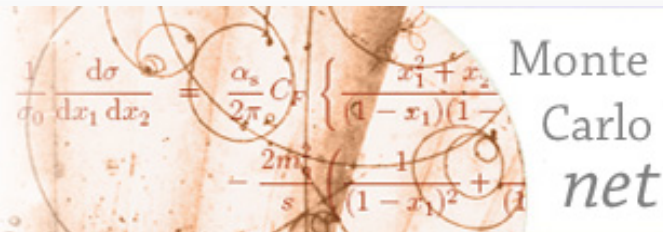


Impact

As someone with a passion for physics, I wish to continue doing science all my life.

MCnet has given me an excellent opportunity to keep working towards this goal.

Thank you!



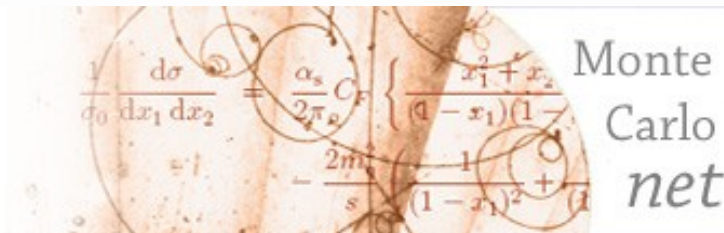
Leif Gellersen

Lund



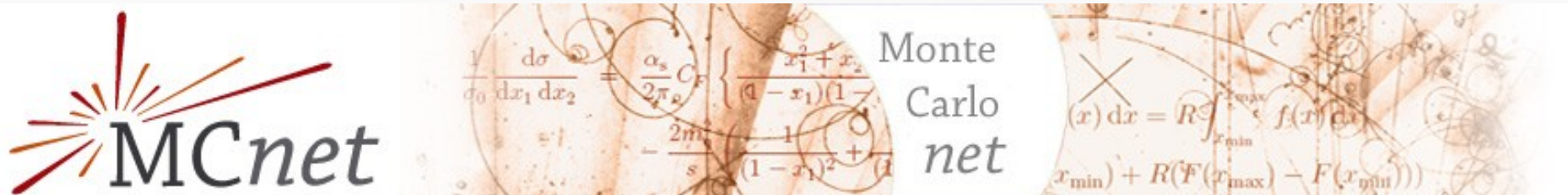
Short biography

- Physics Bachelor and Master in Göttingen, Germany
- Summer student at CERN in 2016
→ interest in Monte Carlo event generators
- Since 10/2017 PhD student in Lund, Sweden



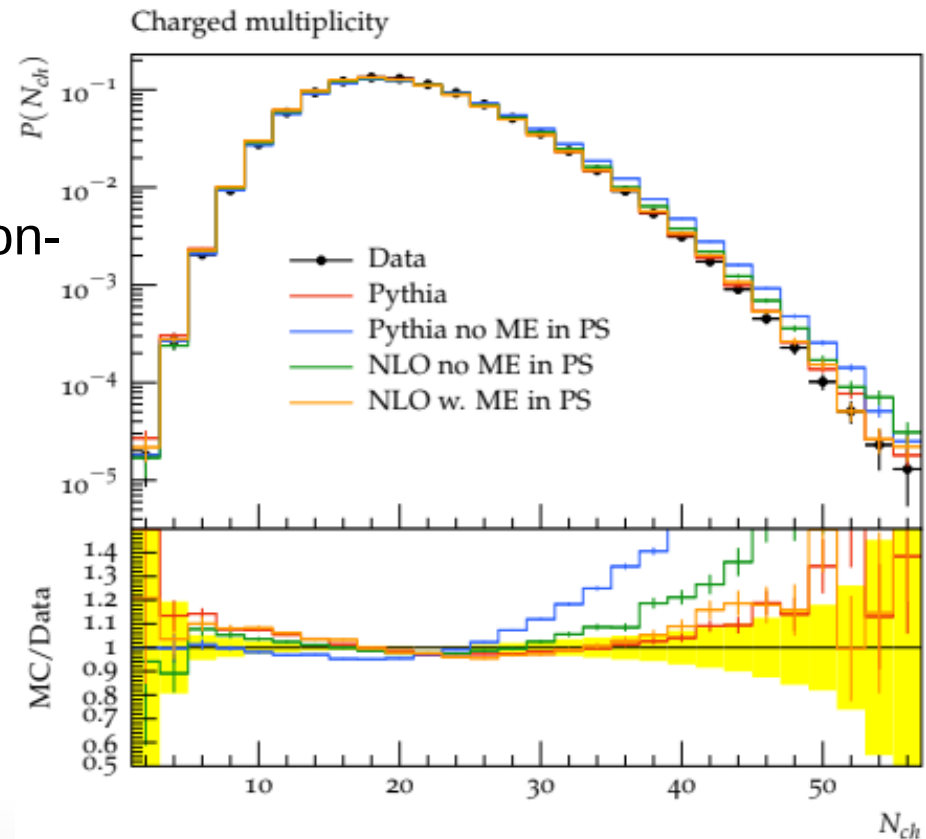
MCnetITN3: travel & learning

- PhD studies in Lund: Project + 75 ECTS
 - Courses include theoretical physics and scientific computing
- Summer schools attended
 - MCnet Summer School 2017 (Lund), 2018 (Prato)
 - MCnet Scientific Computing School 2018 (Göttingen)
- Conferences attended
 - In Lund 2018: PSR, Partikeldagarna
 - MCnet Meetings: CERN 2017, now
- Visit Fermilab in 2018



My Project: Improve parton showers with additional matrix elements

- Precision predictions → better constraints
 - esp. for planning future electron-positron colliders
- First step: matching and merging tune of parameters
- Scale variations: estimate theoretical uncertainties



Monte Carlo net

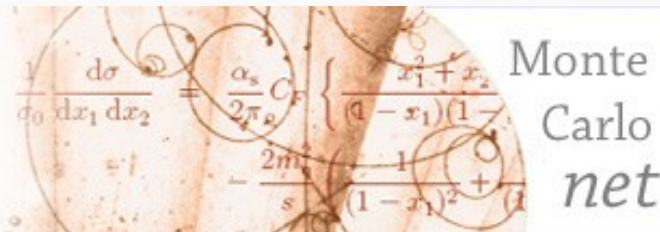
$$\frac{1}{\sigma_0} \frac{d\sigma}{dx_1 dx_2} = \frac{\alpha_s}{2\pi} C_F \left\{ \frac{x_1^2 + x_2^2}{(1-x_1)(1-x_2)} - \frac{2m_c^2}{s} \frac{1}{(1-x_1)^2 + (1-x_2)^2} \right\}$$

$$(x) dx = R \int_{x_{\min}}^{x_{\max}} f(x) dx$$
$$x_{\min}) + R(F(x_{\max}) - F(x_{\min}))$$

Impact

MCnet has positive impact on my studies

- Funding of my position
- Interesting training opportunities (e.g. summer schools)
- Contacts & community (network meetings)
- Funding of conference participation, visits, secondments





Smita Chakraborty

*Lund University
Lund, Sweden*



Short biography

- B.Sc. Physics Honours 2012-2015 from Jadavpur University, Kolkata.
- M.Sc. in Physics 2015-2017 from Indian Institute of Technology Bhubaneswar, BBS.
- MCnet ESR at Lund U., since September 2017.



MCnetITN3: travel & learning

Training at network node:

1. 60 credits of courses
2. Research work within the group and further insights into similar research groups working in the same node
3. 3-6 months of secondment based on the current research and its progress

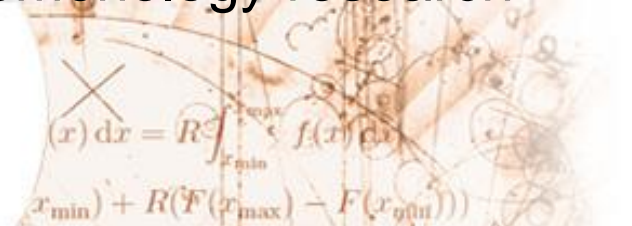
Training within network:

1. Schools at different nodes, depth into specific research areas each time
2. Workshops on scientific computing and presentation skills



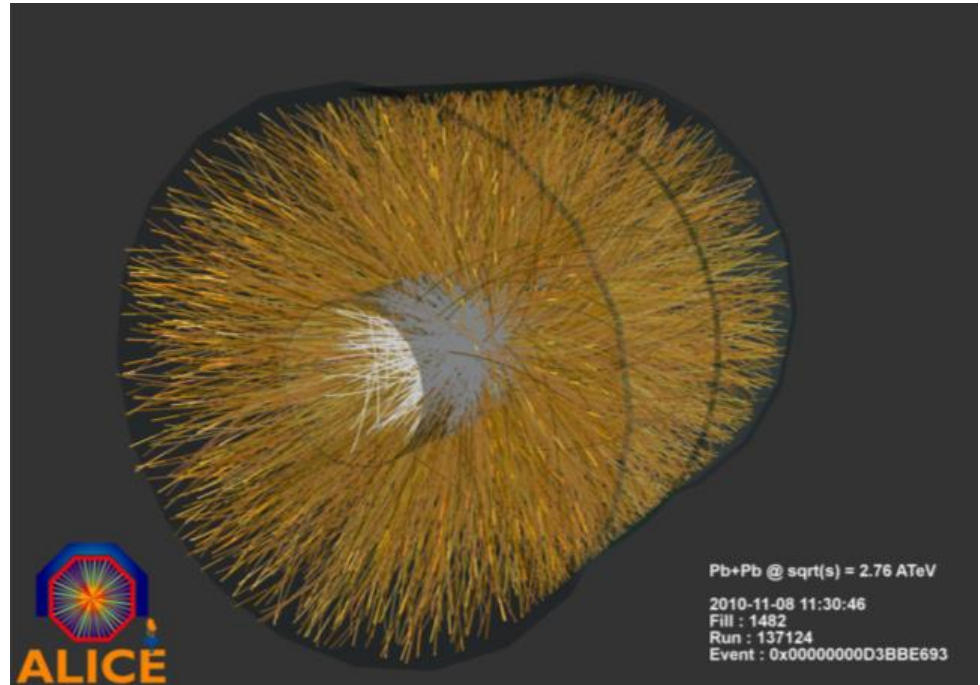
Impact

- Gain knowledge to simulate a new system using established models or build a new one
- Excellent chance to get to know nearly all activity in phenomenology - through network nodes, or collaborators
- Chance to experience other research institutes first hand – travel grants for schools and training activity
- Better insight into own research with discussion among ‘MCnetters’ at yearly meetings
- A great start for a further career in phenomenology research



My Project

- Developing and using the Lund model in heavy ion collisions (currently running at the LHC)
- Shedding light on new processes→new physics?
- Possibility of answering broader questions in physics like in cosmology
- Gives an opportunity to learn both particle nature and simulations for particle processes, developing new software for the upcoming years





Danping (Joanna) Huang

University College London



Short biography



UNIVERSITY OF
TORONTO

- Astrophysics
- Biophysics
- High energy physics
 - ATLAS read-out chip radiation hardness

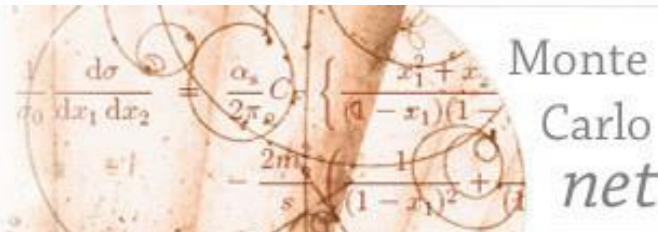


Imperial College
London

- CMOS sensor radiation-hardness for ATLAS upgrade



- MCnet ITN3 ESR & ATLAS



MCnetITN3: travel & learning

Schools:

- University of London HEP lectures
- MCnet summer school
- STFC HEP summer school

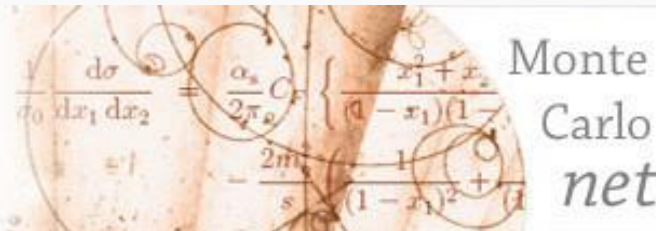
Conferences and Workshops

- ATLAS UK, ATLAS SM/Exotics
- MCnet network meeting (training event: Presentation Skills)
- Re-interpreting results of new physics searches
- ATLAS Met+X analysis meetings
- Rivet hackfest
- MC4BSM
- ATLAS software tutorial
- YETI 2019 (New Techniques for New Physics)



My Project

- Contur: using MC generators to reinterpret measurements and constrain new physics
- ATLAS 4-lepton: correcting the 4-lepton mass distribution of detector effects (i.e. unfolding)
 - *Validation of Herwig (MC generator) using detector corrected experimental data*



Impact

Computational skills



Schools & trainings



Project opportunities



International network





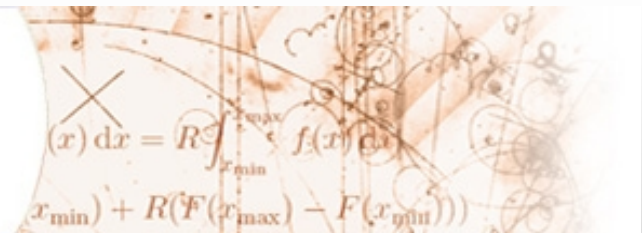
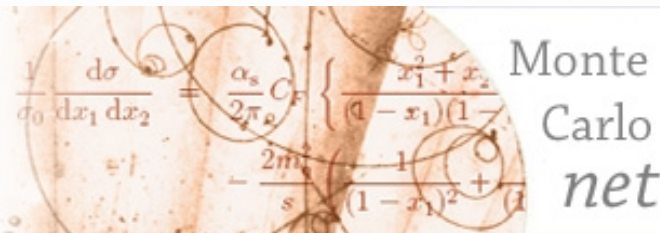
Oleh Fedkevych

Lund University



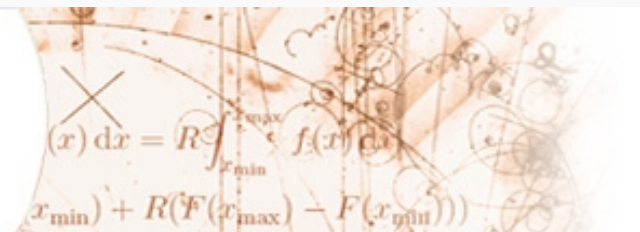
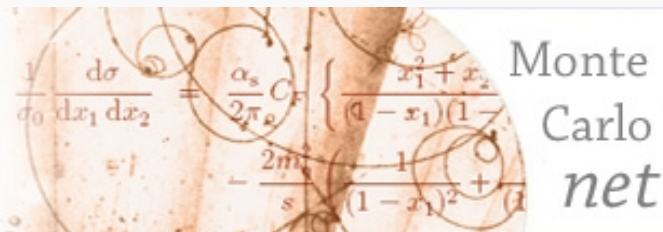
Academic career

- Bachelor in Physics (2008 – 2012) at Taras Shevchenko National University of Kyiv, Ukraine
- Master in Physics (2013 – 2015) at École Polytechnique, Paris, France
- PhD in Physics (01.09.2015 – current time) at the Institute of Theoretical Physics, University of Münster, Germany
- MCnet student (01.10.2018 – 31.01.2019) at the Lund University, Sweden



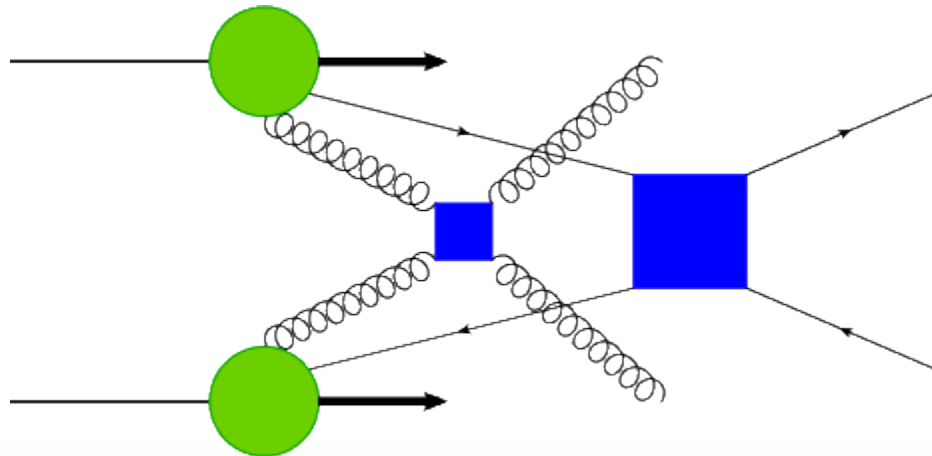
MCnetITN3: travel & learning

I have presented some of my MCnet results at 10th International Workshop on Multiple Parton Interactions at the LHC, 10.12.18-14.12.18, Perugia, Italy.



Double parton scattering (DPS) phenomenon within Pythia's framework

- Monte Carlo event generators are our guiding tools in our understanding of nature at small scales.
- Correct description of DPS processes is required for deeper understanding of proton's structure.



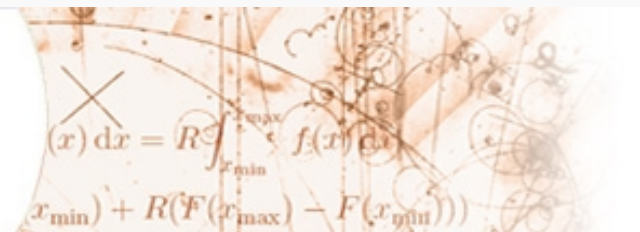
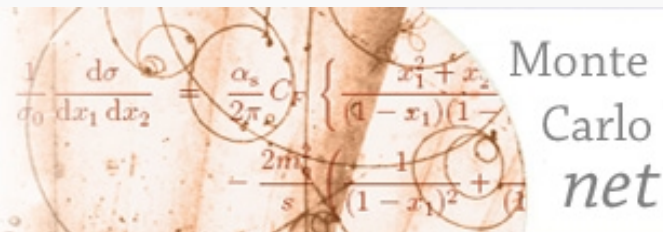
$$\frac{1}{\sigma_0} \frac{d\sigma}{dx_1 dx_2} = \frac{\alpha_s}{2\pi s} C_F \left\{ \frac{x_1^2 + x_2^2}{(1-x_1)(1-x_2)} - \frac{2m_0^2}{s} \frac{1}{(1-x_1)^2 + (1-x_2)^2} \right\}$$

Monte Carlo net

$$\int_{x_{\min}}^{x_{\max}} f(x) dx = R \int_{x_{\min}}^{x_{\max}} f(x) dx = R(F(x_{\max}) - F(x_{\min}))$$

Double parton scattering (DPS) phenomenon within Pythia's framework

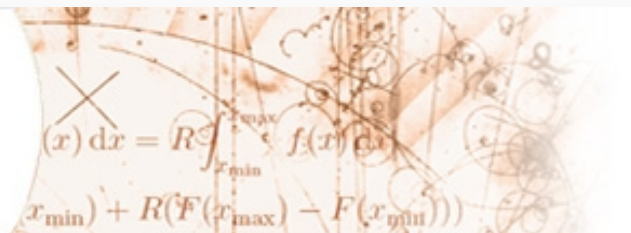
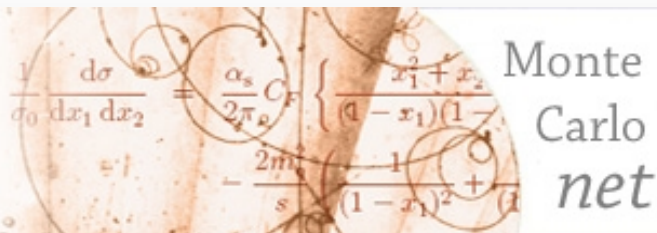
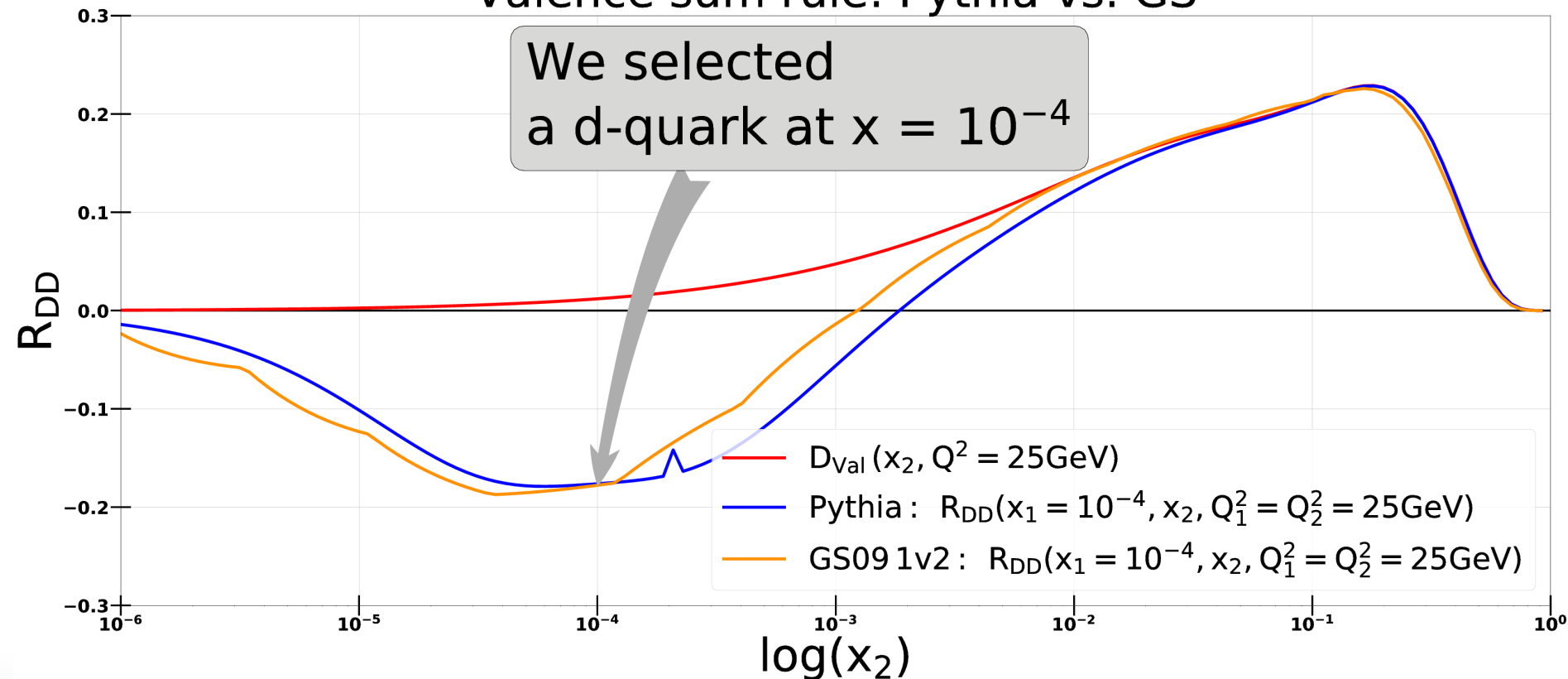
- There is a “gap” between Monte Carlo and “Field Theory” DPS models. Our goal was to find to what extent these two classes of models differ between each other and, ideally, to find a room to improve Pythia's approach.
- A detailed study of four-jet DPS production in proton-proton and proton-nucleus collisions within both Pythia and Field Theory DPS frameworks was performed (for details please see my talk at the Mid-Term Review meeting).
- Some corrections to Pythia's model of DPS were introduced (available starting from version 8.240).



Some of my results

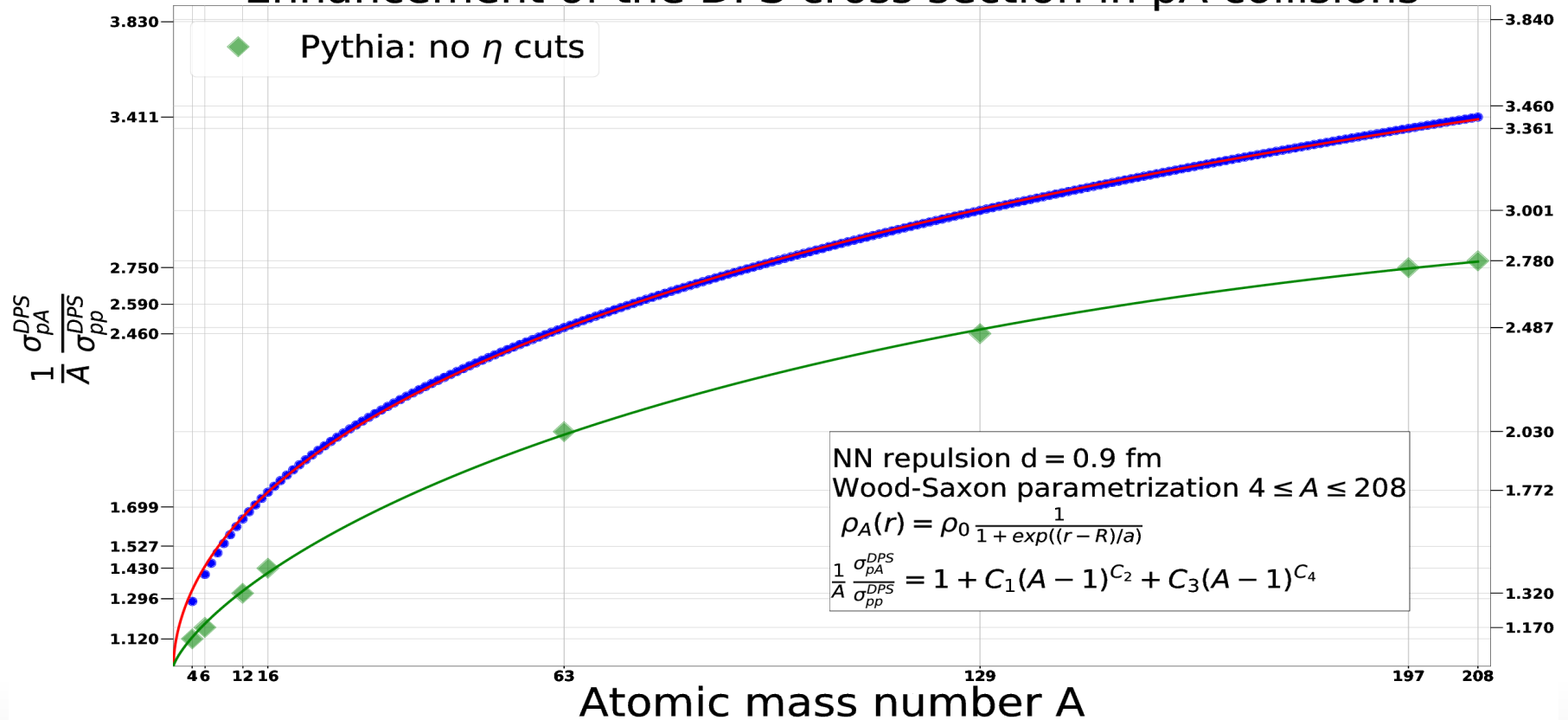
Valence sum rule: Pythia vs. GS

We selected
a d-quark at $x = 10^{-4}$



Some of my results

Enhancement of the DPS cross section in pA collisions



Impact

- This studentship provided me a deep insight into the DPS model of the Pythia event generator as well as into modern Monte Carlo models of proton-proton and proton-nucleus collisions
- The results I have got during my MCnet studentship naturally connect to my PhD project and will be included into my PhD thesis
- I plan to publish MCnet results either in separate publications or in publications combined with my old PhD results

