

Lectures “Numerical Methods”

H.J. Bulten, Fall 2011

AIM

The aim of the course is that you learn to apply numerical techniques to solve problems that cannot be solved analytically. You should gain understanding of various techniques (e.g. Fourier transforms, integration, solving linear equations, etc), of errors and uncertainties related to the methods you use, and how to verify the results of your coding.

BOOK

The lectures follow the book

“Numerical Recipes” by W.H. Press et al, Cambridge UP.

The first edition of this book is available on-line, see <https://www.fyzika.umk.pl/nrbook/bookcpdf.html>

There are C, C++ and FORTRAN versions of the code available, each can be used, although I will use the C++ code from edition 3 in the discussion of the exercises.

The routines from the second edition of the book are available on my homepage :

<http://www.nikhef.nl/~henkjan/CODE>

The lecture notes, exercises and examples will be on my homepage too:

<http://www.nikhef.nl/~henkjan> click on Computational Methods

FIGURES

Probably you know how to make simple drawings and figures. A simple drawing may be made with xfig (/usr/local/bin/xfig

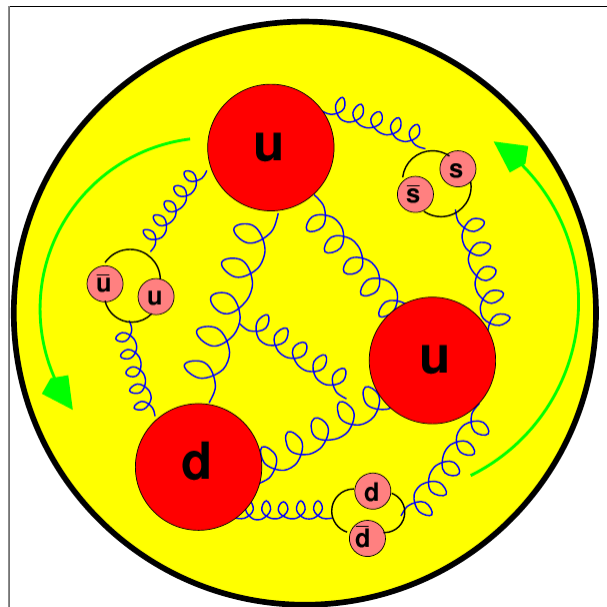


Fig. 1. Schematic display of quarks and gluons contributing to the spin of the proton in deep-inelastic scattering.

and e.g. with /usr/local/bin/xmgrace.

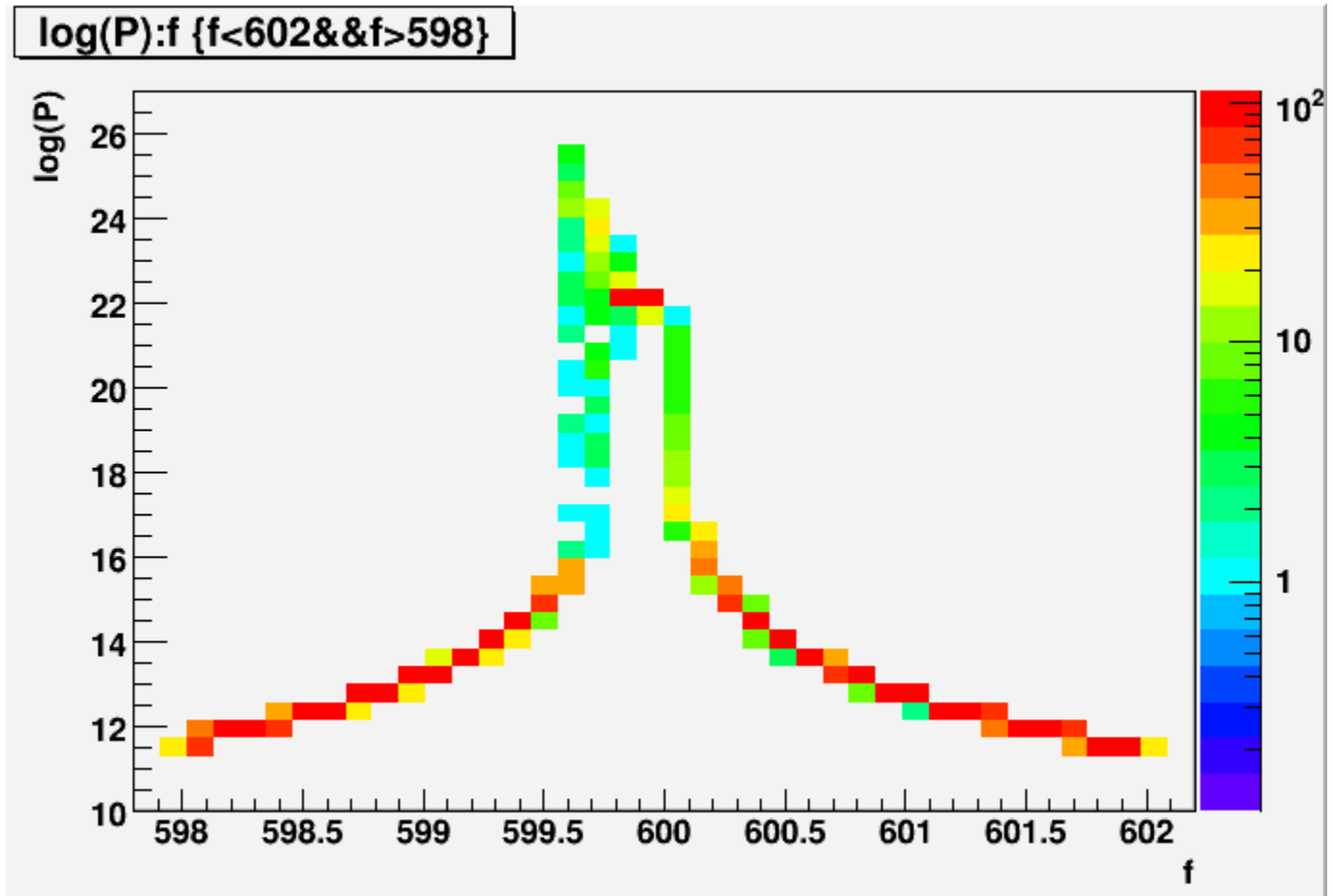


Fig. 2. Logarithm of the power as a function of the frequency. Plot produced with root.

Personally, I use root (<http://root.cern.ch>). It may be that you prefer mathematica or matlab to make figures like the above.

LIBRARIES

Apart from the methods, described in the book, there are several libraries available, such as NAG. These are described at the VU website (theory department).

COURSE

PART 1:

Interpolation and extrapolation, chapter 3
Evaluation of functions, chapter 5
Roots, Minima and maxima, chapters 9 and 10
Fourier methods, chapters 12 and 13

PART 2:

Systems of linear equations, chapter 2
Eigensystems, chapter 11
Integration of functions, chapter 4

PART 3:

Integration of differential equations, chapter 17
Boundary value problems, chapter 18
Monte Carlo techniques chapter 7

EXAM

During the course I assign a couple of exercises. These will be discussed during the lecture next week. The final grade will be based on the completion of these exercises. The first exercises are small and will be weighted less in the final grade than later exercises.