Possible topics for Bachelor/Master theses in the XENON-Mainz group

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The list of topics presented hereafter is not a permanent one: it is supposed to give an idea of what kind of work can be done in our group. If you are interested in a particular topic, just pass by our office or send us a mail:

Prof. Dr. Uwe Oberlack (ask for an appointment by mail before)
E-Mail : oberlack@uni-mainz.de
Tel. : 25167
Office : Staudinger Weg 7, Raum 04-691

Pierre Sissol (PhD student)
Topic : Mainz TPC
E-Mail : sissol@uni-mainz.de
Tel. : 24151
Office : Staudinger Weg 7, Raum 04-621

Christopher Geis (PhD student)
Topic : XENON1T
E-Mail : geisch@uni-mainz.de
Tel. : 25168
Office : Staudinger Weg 7, Raum 04-525

Stefan Schindler (PhD student)
Topic : XENON1T
E-Mail : schindler@uni-mainz.de
Tel. : 24151
Office : Staudinger Weg 7, Raum 04-621

Dr. Matteo Alfonsi (Post-Doc)
Topic : Compton Telescope
E-Mail : malfonsi@uni-mainz.de
Tel. : 23667
Office : Staudinger Weg 7, Raum 04-317

More information can be found on our website:
http://xenon.physik.uni-mainz.de/

Possible topics

- <u>General:</u> Data analysis (Python / C++)
  - Multiple analysis topics available: Simulations, WIMP physics, detector physics, energy scale, backgrounds and efficiencies
  - Developing a background model using Bayesian statistics and Dirichlet processes
  - Implementation of a WIMP velocity independent analysis using Bayesian inference

- <u>XENON1T and its Muon Veto, XENONnT and its Neutron Veto:</u>
  - Data / Monte Carlo (MC) comparison of XENON1T Muon Veto
  - Feature implementation and modification of the XENON1T Muon Veto Event builder
  - Development of an event display for muon events in the XENON1T Muon Veto
  - Development of a Neutron Veto, based on liquid or plastic scintillator for XENONnT

- <u>Development of future multi-ton liquid xenon detectors:</u>
  - Field simulations for a single-phase radial field xenon Time Projection Chamber (TPC) (COMSOL)
  - Comparison of the advantages and disadvantages between dual-phase TPCs and radial field TPCs (Geant4)

- <u>MainzTPC:</u>
  - Hardware
    * Test of Ar-37 as an internal calibration source for liquid xenon TPCs
    * Data acquisition (DAQ): Evaluation of a fast FADC board
    * Study of PMT electronics reponse using a picosecond-laser (timing measurements, afterpulses)
    * R&D of the field cage high voltage performance for application in dual-phase xenon TPCs
  - Simulations
    * Study of the capability of the TPC to identify and reject multiple-scatter events (Geant4)
    * Estimation of the light collection efficiency of the MainzTPC and comparison with actual measurements (Geant4)

- <u>Compton Telescope:</u> Simulations and Hardware
  - Compton sequence reconstruction (improvements using coarse electron tracking)
  - Image reconstruction with a combined Compton / pair telescope
  - Data analysis of SiPM operation in liquid xenon
  - Simulation of the charge readout of a liquid xenon TPC (COMSOL)