

Minutes of the PWA Brainstorm Meeting at Bochum 20.04.2010

Participants

Niklaus Berger (IHEP Beijing); Fritz-Herbert Heinsius, Bertram Kopf, Marc Pelizäus, Matthias Steinke, Ulrich Wiedner (Bochum); Klaus Götzen, Klaus Peters (GSI); Albrecht Gillitzer (Jülich), Miriam Fritsch, Mathias Michel (Mainz); Sebastian Neubert (München);

Idea of the meeting

The idea of the meeting was to discuss and brainstorm about the basic concept on how to develop and realize the PWA software package for PANDA. One major topic was therefore to identify the needs and objectives for such a package. Experts who are currently involved in other experiments (Nik (BES), Sebastian (COMPASS)) were also invited and gave helpful input for general and specific issues and reported about important aspects in the day to day business as well.

In this kick-off meeting organizational items have also been addressed and first decisions have been made.

List of topics and first decisions

Bertram opened the meeting with a presentation which serves as a guideline for the discussion. He proposed to discuss about:

- organizational matters
- PWA use cases at PANDA and potentially at other experiments
- which formalisms for the calculation of the amplitudes have to / should be supported?
- which PWA strategies should be supported?
- software: general layout, program design, etc.

During this presentation first decisions about organizational matters have been made:

- for general PWA discussions we will make use of the GSI forum. We agreed upon to start all kinds of discussions and announcements in the already existing sub-thread *PWA \rightarrow PWA General Issues*.
- we will have bi-weekly EVO meetings (tuesday at 13h30). The first one is scheduled for May 4th.
- we make use of the PANDA-Wiki for all documentations related to the PWA activities (software, helpful links to external packages, theoretical aspects of PWA, etc.). Klaus volunteered to set up the PWA-PANDA-Wiki which is now already existing with some basic structures.
- the PANDA indico system will be used for archiving all talks presented at the PANDA PWA meetings.
- it is foreseen to have an internal meeting at the next Collaboration Meeting in Stockholm.

- the presentations of the PWA activities devoted to our collaboration will be held in the physics sessions.
- it was decided that Bertram is the coordinator of the PWA software group.

Ideas for nextPWA framework

Klaus presented about his thoughts on how a next generation PWA software has to look like. He brought up a lot of points which are important requirements and objectives for the PANDA PWA software. He pointed out that the software has to be user-friendly, highly modular and should automatically produce detailed output of the fitting procedure and fit results (e.g. latex-output, histogramms, etc.). Good performance is required for the calculation of the amplitudes and for the very time-consuming fitting procedure. In general, lots of different hypotheses have to be tested. Therefore it is important that the software is able to persist and to re-load the individual amplitudes.

Klaus mentioned also that it is needed to calculate the amplitudes in different formalisms (i.e. helicity, canonical, covariant tensor, etc.). Even within one decay chain it must be possible to combine amplitudes obtained from different models.

The software should also be flexible enough to perform fits with data from other experiments.

Furthermore it is mandatory to support coupled channel analyses as well as mass scans / momentum analyses.

Proposal of a class structure

Matthias presented a draft of a class diagram for the PWA software. All essential parts of the software are covered. Interfaces to the event reader, amplitude generator, amplitude calculator, minimizer, documentation stream, fit results etc. ensure the highly modular code structure. The configuration parser and the amplitude loader using a plugin mechanism make it possible to make use of various PWA models and strategies. Anyhow, Matthias pointed out that this diagram is not the final design and it should be seen as starting point for a more detailed and sophisticated structure. The elaboration of the software design is one of the most important topics for the upcoming EVO meetings.

In addition, Matthias proposed to make use of the external libraries Boost, qft++ and the minimizers MINUIT2 and GENEVA.

General discussion

During the general discussion lots of specific topics have been touched. Among other things, Albrecht mentioned that PANDA intends to perform also PWAs for baryons. Final state interactions (especially for low momentum baryons) and the mechanism for the baryon-antibaryon production (e.g. t-channel exchange) must be considered.

Sebastian pointed out that actually only spinless final state particles are properly described in the helicity formalism. This is caused by the fact that the amplitudes are calculated in an inconsistent way by projecting the spin in different helicity systems.

Specific issues about different minimization strategies have been addressed. This discussion has been focused on pros and cons of MINUIT (makes use of gradient and simplex algorithms) and deepest-descent-minimizer (e.g. GENEVA).

In addition it was agreed upon

- to provide a documentation on the PWA wiki where the outcome of this brainstorm meeting is summarized. It should be focussed on the requirements, objectives and ideas for the PANDA PWA software. Everybody from the PANDA PWA group is welcomed to contribute to this document.
- to use the software repository tool *git* which is a second generation version control system.
- to use the C++ standard wherever possible.