Minutes PhysCom, Ezuce, 24th of October 2016

Participants: Alaa Ddeyssi (AD), Albrecht Gillitzer (AG), Frank Nerling (FN), Johan Messchendorp (JM), Karin Schoenning (KS), Klaus Goetzen (KG) (on behalf of Computing group), Marc Pelizaeus (MP)

This PhysCom meeting was devoted to the "day-one" physics paper and related topics. The focus of the paper is to formulate and highlight the PANDA physics program for phase-1 (aka "day one") of FAIR (2022-2025) including feasibility studies using the results of Monte Carlo simulations. The aim is to release such a paper in the first half of next year. The following items were on the agenda:

1. Discussion on the skeleton and basic contents of the paper

A link to a draft (updated in the course of time) of the skeleton can be found at

https://www.overleaf.com/6629725pvgxkd#/22481493/

The basic principle/motivation of the skeleton is to 1) sell the "day-one" physics program of PANDA as a "whole" and avoid too much explicit subdivision into the traditional subtopics to avoid a series of stamp collection; 2) emphasis on impact of program in the field in connection to flagship projects that we foresee to be able to carry out at "day-one". In this meeting, we reviewed various items from the subgroups that could serve as highlights to address in the paper.

Baryon spectroscopy and hyperon production dynamics (KS, AG)

The fact that PANDA is a true strangeness factory can be considered as a high impact opportunity that can be carried out with relatively low luminosities in "day-one". Highlights that are well suited to show in paper because of their uniqueness are 1) cascade (S=-2) spectroscopy and 2) hyperon production dynamics exploiting various spin observables for various S. For both aspects, simulations are presently being carried, and, hence, could nicely serve to promote PANDA.

Charmonium-like spectroscopy (FN, KG, MP)

The energy scan (X(3872)) would be a posterboy for the day-one in this field. It serves two purposes: 1) demonstrate the power of using scan technique with antiprotons that can in principle be applied to many (narrow) resonance (=unique); 2) to resolve the nature puzzle of the X(3872) itself. Since results of MC simulations have been carried out already and results are available, it should be fairly easy to publish these results in the "day-one" paper as well. The question on whether to rerun these simulations using the "official" day-one setup configuration is discussed later.

Another aspect that is unique and (likely) feasible for "day-one" are the antiproton-deuteron studies (charged Z states studies). It would be good to

qualitatively highlight these aspect in the day-one paper. One cannot expect to have quantitative results ready on time.

Another aspect that falls in the same category, is the high-spin states. Also here, very promising and unique to PANDA, but MC studies are too preliminary and, hence, no hard conclusions yet.

Nucleon structure (AD)

The flagship for a day-one program would be here the electromagnetic FF (GE, GM) at low q^2 using dimuon and electron-positron probes. The precision will be spectacular with respect to results from, mostly, e+-e- collider experiments, and for the first time, dimuons can be used with PANDA. The latter is of relevance since it would give a handle on radiative corrections which are clearly different between the various dilepton probes.

A study with PANDA in the unphysical regime would also be possible using additional pi0 production. From a physics-perspectives, this is a highly interesting channel and results will have a large impact. However, the feasibility of using such a reaction with PANDA has not yet been demonstrated. The Orsay group has started to look into it, but have left the collaboration. Hence, nobody is presently looking into this.

Light-meson spectroscopy (MP)

The advantage/uniqueness of antiprotons here are 1) statistical power; 2) gluon-richness. The competition is, however, very high and a rigorous PWA is presently not available to unambiguous demonstrate the potential of PANDA for this topic. For the “day-one” paper, we do not expect a PWA to be ready to quantitatively address this potential of PANDA for light-meson spectroscopy (because of the complexity). It is, therefore, proposed to mention qualitatively the corresponding highlights in a broader context of the whole PANDA program, but not to put too a strong emphasis on this topic for day-one. It would, actually, more advantageous to invest on the short term (“day-one” paper) human resources on topics that require less complication in demonstrating the feasibility.

Open-charm spectroscopy (JM)

The spectroscopy part and weak part of the open-charm program of PANDA would not be a highlight of “day-one” for PANDA since it requires the highest luminosity. A study of the dynamical aspect sin open-charm production, e.g. cross section measurements, is feasible at lower luminosities and would be a first step towards the full MSV.

A next iteration of the skeleton for the paper will be made, based on the above items.

Antiproton – A reactions (AG)

At present nobody is carrying out MC simulations, and hence, it will be difficult to quantitative present results for the day-one paper on this aspect. Moreover, the charmonium studies with nuclear targets require higher luminosities. In principle, it would be feasible to study, f.e. lambda pair production for a day-one program. Those aspect could be qualitatively mentioned in a broader context in the paper.

2. Role of the TAG in the "day-one" discussions

The role of the theory advisory group with respect to "day-one" paper activities was discussed. Their role is twofold: 1) they could help in sharpening the physics formulation in the paper; 2) advisor for defining our day-one program. In light of this, it would be advantageous that the physics group of PANDA first finishes the outline of the day-one paper, after which, this can be presented on the next collaboration meeting with the presence of TAG members. With this, one hopes to initiate an iteration process with an active participation of TAG members.

3. The "day-one" setup in the MC code

The following items and conclusions came up during the corresponding discussion.

a. From the computing side (KG), a macro is available that can enable and disable any detector. People are welcome to test it. Hence, no show-stopper from the software perspectives.

b. The approach we will take in defining day-one paper will be "a physics-driven setup" and *not* "a setup-driven physics program". Hence, our priorities will primarily concern the physics with low luminosities as constrain. It is clear that the PID capabilities of PANDA at day-one will be limited.

c. The inclusion of the GEMs has been discussed at the last CM and it has been decided to move forward in realising its implementation in the setup. Hence, we should take it as a green light for that aspect.

d. We discussed extensively the tracking system behind the dipole. For cascade hyperon studies it is absolutely necessary in order to achieve the mass resolution. Similar to the GEM discussion, also this has to be brought up in the collaboration. Lars will be contacted by JM to see what the situation is on this and whether we have possibilities to place an alternative and existing setup if necessary. In other words, we would like to push for some kind of realisation for this.

e. Question came whether to rerun the existing MC results, such as the X(3872) scan, with "day-one" setup including GEMs. Here it would be useful to carry out some estimates on what the added value would be or whether the changes are

significant at all, before one starts spending time on rerunning the whole business. Klaus will think about on how to estimate this.

4. Any other business

It was decided to keep the day/time of the PhysCom meeting during the CM fixed and that we stick to the Monday afternoon.

JM, 27/10/2016