

Minutes of the 8th Meeting of the COSY Beam Time Advisory Committee (CBAC)

July 2 and 3, 2018

Location: Forschungszentrum Jülich GmbH, Institut für Kernphysik, 52428 Jülich, Germany

Participants:

CBAC members:

Kurt Aulenbacher,	Univ. Mainz, DE
Oliver Kester,	TRIUMF, CA
James Miller,	Boston Univ., USA
Christian Schmidt,	GSI, DE
Marc Weber	KIT, DE

CBAC Scientific Secretary:

Frank Goldenbaum (IKP-1)

IKP:

Ulf-G. Meißner (IKP-3/IAS-4 Director) (excused)
Dieter Prasuhn (IKP-4)
Ralf Gebel (IKP-4 Acting Director)
James Ritman (IKP-1 Director, Scientific Coordinator COSY)
Hans Ströher (IKP-2 Director, IKP Managing Director Scientific)

Board of Directors FZJ: Sebastian Schmidt

1. General remarks

The 8th CBAC session took place on July 2 and 3 in the Forschungszentrum Jülich GmbH, Institut für Kernphysik. The beam time requests of the individual groups were presented on Monday in the Open Session of CBAC#8. For the programme and the list of applications see the Addendum.

Closed Sessions of the CBAC members were held on Monday morning 9:20-9:45, on Monday evening 17:10-18:45 and on Tuesday morning until 11:30.

The Closed Session on Monday morning was opened by Jim Ritman welcoming the participants (see list above). He thanked Jim Miller from Boston University for joining CBAC as a board member. The panel acknowledged the large interest in COSY beam time and the oversubscription. The assignment of CBAC members to the proposals was confirmed.

Jim Ritman started the Open Session with a compilation of the latest COSY test campaigns, a glimpse at the beam schedule and selected highlights. Then Ralf Gebel reviewed the operation and the status of COSY in the first half of 2018. Again the instrumentation, slow orbit control, diagnostics and user interfaces are being systematically and successfully improved. The COSY extraction septum has been equipped with new coils and should become available after the shut-down. The failure of the injector cyclotron extraction septum was discussed. This year severe sparking was observed twice at the pulsed Caesium ion source and cleaning was required. A broken ConFlat vacuum window was identified and replaced. Significant effort also went into improving the diagnostics of the beam line for the HBS project and providing low energy beam for HBS from the Jülich light ion cyclotron JULIC. The renovated control room is looking great.

At noon, Sebastian Schmidt, member of the FZJ board of directors, addressed the participants of the

CBAC#8 meeting. He welcomed the new CBAC member, James Miller, to the committee and thanked CBAC for their work. Sebastian commented on the status of the TransFAIR processes, in which IKP (with the exception of the theory section, IKP-3) will be transferred to GSI. He stressed the excellence of the science at IKP and COSY which is also reflected in the great evaluation results of IKP, twice “outstanding” and one “excellent”, in the recent Helmholtz center evaluation. It is now time to define the role of IKP at GSI in the next funding period PoF-IV, which is starting in January 1, 2021.

The fourteen proposals were submitted to CBAC#8, asking in total for approximately 25 weeks of beam time. An overview of all the applications and the agenda of the CBAC#8 meeting are given in the Addendum. The electronic versions of all proposals and reports as well as the pdf files of all contributions presented in the open session are located on the web page <http://www.i kp.fz-juelich.de/CBAC/documents/cbac08.html>.

2. Summary of the discussion and recommendations

Below we first comment on the ranking procedure, then summarize the recommendations of CBAC, and finally conclude with a detailed report on each proposal.

2a) Procedure

The rating systems applied in the past to rank the proposals is felt to be effective and adequate and will be continued. It is summarized below for completeness.

The requests are rated A (highest rank), B, and C (lowest rank) within the following three categories:

- (i) **Feasibility** Here the committee judges the feasibility of the proposed test or measurement based on its expert knowledge and external input or advice. Other assessments from eg. a PoF review or accepted proposals may enter; also boundary conditions imposed by the facility have to be considered.
- (ii) **Readiness** The committee assesses the possibility that critical elements or components required for the test are not available in time. It should be noted that CBAC as an external group cannot make a complete assessment of all possible delays. The proponents are asked to comment in detail on the readiness of their proposals.
- (iii) **Importance** The relevance to PoF-III and IKP science is an important criterion as is the emerging strategy beyond PoF-III and, for instance, the strategic project HBS. External users with exciting scientific projects are encouraged to use COSY when compatible with other constraints but external requests may be ranked lower in importance.

The recommendations consider the written requests, the oral presentations, and the related questions and answers during the open CBAC session. Following the open session, a detailed comparative discussion takes place in the closed session.

2b) Summary of the Recommendations

The projects presented in the Open Session on Monday (see Sec.1 and the addendum) and the recommendations of CBAC are listed in Table 1. The last four presentations were brief status reports on requests from past CBAC meetings. All other talks related to new proposals. As always an important boundary condition is given by the allocated 5000 hours of beam time per year and the six weeks of maintenance required by COSY mid-year. For the next assignment period, 16 weeks of beam time will be available for users, which considers the very large number of excellent proposals.

Table 1: Summary of requests (for details see table in the addendum), ratings and recommendations of CBAC#8. Request which will not take place in Q4 of 2018 or Q1 of 2019 are indicated.

Experiment	Recommendation	Feasibility	Readiness	Importance
E002.6 JEDI Polarimeter	deferred until installation	A	B	B
E005.5 JEDI Wien Filter	4 weeks + 2MD	A	A	A
E008 Axion EDM	0 weeks, combine with E007.1	A	A	A
A001.7 Stochastic Cooling	2 weeks with elec. cooling	A	A	A
A005.4 COSY Beam Studies	1+1 weeks	A	A	A
A013 HBS Neutron Yield	deferred	A	B	B
A014 Orbit Feedback/BPM	1 week	A	A	A
A015 JEDI Beam-based Alignment	1 week + MD	A	A	B
D002.3 PANDA STT	1 week	A	A	A
D009.2 PANDA Cluster Jet Target	1 week	A	A	A
E007.1 EDM Spin Dynamics	2 weeks + MD combine with axion EDM	A	A	A
D005.2 PANDA KOALA	1 week another week after report to CBAC#9	A	A	A
A002.5 Electron Cooling	1 week with stoch. cooling	A	A	A
A009 Siberian Snake	deferred	A	A	B

2c) Short reports and recommendations on individual proposals

Proposal E002.6 JEDI: Towards the EDM Polarimetry

The development of the LYSO based calorimeter as a very effective polarimeter for the JEDI experiments is making good progress, though the last runtime suffered from reduction of polarized beam availability and other hardware issues such as a defective output window. The energy resolution of the LYSO SIPM combination was demonstrated to be better than 1% at 250 MeV, a correlation of the peak position (light output) with the position of individual SIPM detectors on the surface of the LYSOs was observed. The full set of the position-sensitive plastic scintillator counters has still to be installed, it is also proposed to collect more data for different energies. It is foreseen to install the polarimeter in the ANKE section in Q1 2019 where it could be helpful, in particular to support the EDM precursor experiment and the systematic investigation of polarization (EDM-spin dynamics, E007.1). Given the overbooking of beam time in Q3/Q4 2018, CBAC recommends to proceed with the timely installation of the polarimeter in the ring rather than further extensive testing.

Rating: Feasibility A, Readiness B, Importance B
Recommendation: deferred until installation

Proposal E005.5 JEDI RF Wien Filter

In 2017, the JEDI collaboration had the 2nd commissioning run of the RF Wien Filter (WF). Two out of the three weeks planned were lost, because the polarized source had problems with the Cs oven and the cyclotron extraction septum had to be replaced because of sparking.

It is recognized that it is important to meet the goal of setting a limit for a deuteron EDM in the next two years. Spin polarization studies related to the Wien Filter approach or due to field imperfections are required before this can move forward, specifically more statistics at more combinations of polarizations and WF settings are needed to understand systematic issues.

The sense of the previous recommendation from the Dec 2017 CBAC meeting, to improve the statistical significance of the WF map, is reaffirmed. In addition, the committee recognizes that the chances are good that the experiment can meet some of the systematic challenges to allow a modest measure of the deuteron EDM, and therefore supports both a setup period and a following data run.

Note that the proposal calls for moving forward without the ferrite upgrade.

Rating: Feasibility A, Readiness A, Importance A
Recommendation: 4 weeks + 2 MD

Proposal E008 Axion EDM

The proposed axion search with a storage ring is an innovative and attractive use of COSY. The approach offers unique sensitivity over a large range of relatively unexplored axion masses and is very much worthwhile, albeit arguably it does not aim at the theoretically most favoured mass range. The approach is possible with COSY today and does not require major modifications of the ring. COSY could make a significant contribution to the flourishing and topical field of axion searches and we recommend strongly exploring this further.

As usual, the scanning strategy is not obvious and a difficult trade-off of higher sensitivity versus larger mass range coverage. In the interest of saving valuable beam time we propose as a starting experiment to combine this request with Proposal E007.1 and minimize frequency scanning around a well-understood region. CBAC recommends to aim for publication quality and a timely journal publication in order to make the best possible for extended axion searches in the future.

Ratings: Feasibility A, Readiness A, Importance A
Recommendation: 0 weeks, but combine with request E007.1

Proposal A001.7 Stochastic Beam Cooling

In the successful beam-time in 2017 longitudinal cooling with filter and time-of-flight (TOF) method, as well as transverse cooling were demonstrated for the first time with the new HESR stochastic cooling structures. A two-dimensional cooling (longitudinal and one transverse plane) was achieved as well. The installation of an additional optical transmission line for the other transverse plane and of additional high-power amplifiers is being completed during this summer shutdown.

Lab tests of the hollow fiber revealed a noise pattern, which cannot be explained. Any influence on the performance online need to be investigated. The commissioning of fully 3D cooling with HESR stochastic cooling tanks and cooling at different energies shall be done as well. Finally, a test of stochastic cooling with running target and barrier bucket and studies in conjunction with electron

beam cooling are foreseen in Q4 2018. CBAC agrees that the actual status of the system will allow systematic measurements which need additional beam time of 2 weeks, which should be in conjunction of the electron cooling tests.

Ratings: Feasibility A, Readiness A, Importance A
Recommendation: 2 weeks in conjunction with electron cooling

Proposal A005.4 COSY Beam Studies

COSY beam studies are supported by CBAC to conduct a number of machine studies, which are not possible to carry out during normal user operation or machine development periods. It comprises COSY injection studies at 50 MeV for deuterons, which will be the standard operation mode in the future, the orbit feedback and correction system as well as benchmarking and optimization of the model based ORM determination via LOCO (Linear Optics from Closed Orbit).

The team will perform data taking of the orbit response function for the preparation of automatic tune scan and control and to benchmark LOCO model by determination of correct lattice parameters. A reliable automatic COSY orbit control with feedback to stabilize the detector rate in horizontal and vertical ring planes has been demonstrated to be beneficial for EDM measurements. The lower injection energy of 50 MeV for deuterons allows a reduced voltage at the cyclotron extraction septum and a reduced excitation of the injection beam line magnets, which are prone to failure at 75 MeV. Hence, stable COSY injection tunes at 50 MeV need to be investigated.

Ratings: Feasibility A, Readiness A, Importance A
Recommendation: 1+1 weeks + MD

Proposal A013 HBS Neutron Yield

HBS remains an exciting and ambitious project and aims for the design of compact accelerator-based neutron sources. The recent campaign proved rather successful. The setup was significantly improved by better shielding, collimation and better instrumentation. The background was reduced by an order of magnitude. The measurement results are plausible and consistent with the expectations from the TENDL databases. The advisory board agrees with the proponents that the exploration of more sophisticated multi-layer targets is a good next step. Before these measurements CBAC recommends performing detailed simulations and entering with well-defined target arrangements to maximize the use of beam time. Also the use of further gamma detectors is strongly recommended. While the steady progress is acknowledged, the committee feels that improving the precision of the measurements and the exploration of systematic errors (in line with our previous recommendations) and a slightly less heuristic approach is worthwhile for a project of the complexity and strategic importance of HBS. We are very much looking forward to an updated request at CBAC#9.

Ratings: Feasibility A, Readiness B, Importance B
The importance grade reflects that simulations should provide a fair guidance in optimizing the multi-layer target and thus a delayed confirmation by experiment is acceptable.
Recommendation: Deferred

Proposal A014 Orbit Feedback/BPM

The project aims at investigating the orbit feedback method under realistic circumstances. Closed orbit correction is relying on an underlying accelerator model. Deviations of the model may include inaccurate knowledge of accelerator parameters like quadrupole strength or beam dynamics related parametrizations of the space charge tune shift. The deviations can be characterized by the relative change of the largest values of the SVD decomposition, as was demonstrated during the ramp of SIS-18 during which quad settings change while the model was kept fixed. COSY offers the possibility to

introduce these so-called “model mismatches” in a more controlled fashion. Measurements will use varying quadrupole settings and different space charge tunes. Moreover, the failure of diagnostic systems (missing BPM scenario) will be investigated. Such cases may happen due to failing electronics in high radiation environments, in particular at GSI/FAIRs SIS-18 under high bunch charge conditions. The necessary ingredients are all in place. The program appears to have positive implications in several directions. Firstly, a better knowledge of the model properties w.r.t. to potentially changing mismatch will enable even better performance during upcoming EDM experiments. On the other hand, the collaboration between SIS-18 and COSY teams will certainly bear fruit for further improvements and may lead to even more effective common projects in the future.

Ratings: Feasibility A, Readiness A, Importance A

Recommendation: 1 week

Proposal A015 JEDI Beam-based Alignment

The JEDI-BBA is dedicated to determine the offset between the COSY magnets and the beam position monitors (BPMs). With these offset values the orbit correction can be improved by more precise beam positions inside the magnets and not only inside the BPMs. The procedure has been successfully tested with QT12, by using the additional steerer coils for variation of the quadrupole strength and an orbit bump to find the correct offset in the quadrupole.

The proposal asks now for beam time to perform the alignment of beam towards the magnet axis of all remaining 12 quadrupoles with steerer windings in COSY. This project should be carried out after the COSY beam studies have been concluded to simplify the measurements with an automatic tune/scan system. CBAC proposes to conduct these measurements after the COSY beam studies and/or in conjunction with the Wien filter campaign.

Ratings: Feasibility A, Readiness A, Importance B

Recommendation: 1 week + MD

Proposal D002.3 PANDA STT/FTS

The PANDA STT will, as a straw tracker, serve PANDA as the central tracking system together with the silicon based MVD. The same technology of self-supporting straws pressurized to 2 atmospheres will be employed in double layer planes for the PANDA forward tracker (FTS) further downstream in the forward arm of the spectrometer. The newly engaged working group lead by young scientist Rafal Lalik of Jagellonian University Krakow combines the highly matured straw technology for Panda with advanced readout system experience from HADES and a real, highly visible FAIR phase 0 application. The beam time requested is needed as a high rates system commissioning phase prior to exposure within the FAIR phase 0 program, targeting modest but real physics goals. The working group has shown readiness through extensive studies on cosmics. They have tackled the severe challenges in system noise performance, EMI shielding and grounding. Only in a high rates beam time at COSY can this system be commissioned for a statistics-seeking joint endeavor at HADES. The envisioned additional FPGA-layer for on-line tracking procedures is experimental in nature but needs track hits at high rates to be evaluated and developed further. In view of the FAIR phase 0 beam time scheduled in summer 2019, the requested beam time for commissioning cannot be delayed.

Ratings: Feasibility A, Readiness A, Importance A

Recommendation: 1 week

Proposal D009.2 PANDA Cluster Target

The cluster target is a core element of PANDA as a whole. The device comprises complicated hardware that has been thoroughly and extensively tested in the home lab of the applicant. It is now equipped even with an optical laser and camera system to make the beam visible to allow for better beam manipulation. The prudent experimental team has prepared the cluster target in a way that leaves no doubt about its readiness. It will be exciting for the entire community to see its performance as a cluster target for PANDA. Similarly, any technical surprises that might arise from such a first beam experience need to be uncovered soon to allow for potentially necessary severe reengineering on this key element of the entire PANDA spectrometer. One week of beam time has been granted to the team for this summer already. An additional week is applied for with enough time in between to realize modifications. This is more than justified since such a complex system cannot be commissioned in all detail in just one week. Further requests indicated in the presentation will be considered at CBAC#9

Ratings: Feasibility A, Readiness A, Importance A

Recommendation: 1 week.

Proposal E007.1 JEDI: Further Exploration of Spin Dynamics Issues for EDM Search

This experiment has been recommended by CBAC but has been deferred. Installation of the LYSO polarimeter would be helpful which leads to a shift of the earliest date towards Q1/2019. It seems that the already installed polarimeters are sufficient to support the first EDM “precursor” until that date, so that the impact of the delay is tolerable. The ratings and the recommendations remain in place. This proposal should be combined with E008.

Ratings: Feasibility A, Readiness A, Importance A

Recommendation: 2 weeks (in combination with the E008/Axion EDM)

Proposal D005.2 PANDA KOALA

This experiment was presented as a short status report as demanded as a precondition by a previous CBAC#7. With the goal of luminosity measurements for the operation of the cluster beam target for PANDA it is an essential preparation for later PANDA operation and optimization. The endeavor was rated AAA, a rating that has not changed but rather improved in readiness through the availability of the cluster jet target. It may be seen as direct next step for target optimization after taking the target into operation within the proton beam. The data on the target and luminosity performance gained will be an essential ingredient to the scope of PANDA and its physics case.

Ratings: Feasibility A, Readiness A, Importance A

Recommendation: 1 week (likely in Q1 2019), with a second week to be assigned in CBAC#9

Proposal A002.5 Electron Cooling

The 2 MeV cooler at COSY will be the first device utilizing magnetized cooling in this energy range, being an important step towards relativistic electron cooling required for future accelerators. Encouraging results were obtained and effective electron cooling of proton beams at COSY was demonstrated. Intense work on the modelling of the electron cooler is carried out, to improve beam quality and by correction of the fields in the e-beam optical elements, but need to be concluded.

Computer simulations of the cooling process in COSY and HESR have been carried out based on the current e-cooling theory. The most recent study using a multi-particle tracking code suggests that an additional, yet unknown heating term needs to be included into the simulation in order to have full

agreement of experimental and simulation results for the transverse cooling. Resolving this issue is one of the goals of the requested beam time.

A list of investigations for the requested beam time has been presented, addressing the particle distribution on the bunches, investigating the effect of electron cooling on beam lifetime vs target thickness and e-current and studying the cooling performance, beam lifetime and luminosity evolution vs electron beam profile with and without target. CBAC supports 2 weeks dedicated to the beam dynamics experiments with electron cooling and internal cluster jet target, but in conjunction with the stochastic cooling.

Ratings: Feasibility A, Readiness A, Importance A
Recommendation: 1 week due to synergies with stochastic cooling

Proposal A009 Siberian Snake

A009 is a long pending experimental issue to test a solenoid with a variable field integral of 4.5 Tm which allows stabilizing the longitudinal spin axis in COSY. Spin dependent scattering experiments such as polarization build-up (PAX) and measuring specific analyzing powers for the TRIC experiments depend on the successful operation of the snake. The experiments have several times been recommended by CBAC. There is no doubt that the experiments and the device itself should remain an important part of the COSY program and are scientifically exciting, but currently this request is not a strategic priority of COSY.

Ratings: Feasibility A, Readiness A, Importance B
Recommendation: deferred

3. Summary and Conclusions

We would like to thank all speakers and participants for an inspiring day of scientific presentations.

This year COSY is particularly oversubscribed with a request of 25 weeks of beam time. The committee had to prioritize strongly, and the 2018/2019 schedule will be dense. This has been considered by the COSY operation team and an exceptional long operation time of 16 weeks is envisaged.

The requests relate to

- detector tests for FAIR (D002, D005, D009),
- accelerator physics experiments (A001, A002, A005, A009, A014),
- R&D for the HBS neutron sources project (A013)
- and to preparations for the EDM (E002, E005, E007, A015) and axion searches (E008).

As always, the detailed scheduling of the prioritized proposals is left to the local COSY coordination committee. The beam time recommendations for the period Q2 and Q3 of 2019 will be subject of a detailed evaluation by CBAC#9.

The next Helmholtz funding period PoF-IV is now known to begin January 1, 2021. While the precise date of the strategic evaluation for PoF-IV is not yet known, it is scheduled to take place between September and December 2019. CBAC recommends engaging now in discussions with GSI scientists in order to identify the most promising role and contribution of IKP and COSY in the context of the strategic evaluation for PoF-IV. This would also include identifying in which programs contributions are best made, be they ‘Matter and the Universe’ or ‘Matter and Technologies’.

Next CBAC session

The CBAC#9 meeting is tentatively scheduled to take place on January 14/15 2019 at IKP of Forschungszentrum Jülich GmbH.

Marc Weber (CBAC Chair)

AGENDA

Monday, July 2nd, 2018

08:30	Bus transfer Stadthotel Jülich to IKP (for CBAC members)		
09:00 – 09:30	Closed session J. Ritman M. Weber (chair)	(IKP, room 311) Welcome, issues t.b.d., ... Organization, committee work	
09:30 – 09:40	Open session J. Ritman	(IKP, room 312) Welcome	
09:40 – 10:00	R.Gebel	Status of COSY	

Proposals are scheduled for 15' presentation + 10' discussion

10:00 – 10:25	E002.6	JEDI-Pol.	I. Keshelashvili
10:25 – 10:50	E005.5	JEDI Wien-Filter	F. Rathmann

10:50 - 11:10

Coffee

11:10 – 11:35	E008	Axion-EDM	S. Park
11:35 – 12:00	A001.7	Acce. stoch. cooling	R. Stassen
12:00 – 12:25	A005.4	COSY beam studies	B. Lorentz
12:25 – 12:35	Words of Board of Directors VS-1		S.M. Schmidt

12:45 – 14:00

Lunch Break

14:00 – 14:25	A013	Neutron yield HBS	P. Zakalek
14:25 – 14:50	A014	Orbit feedb./BPM	S.H. Mirza
14:50 – 15:15	A015	JEDI- BBA	T. Wagner

15:20 – 16:00

Coffee

16:00 – 16:25	D002.3	PANDA-STT	R. Lalik
16:25 – 16:50	D009.2	PANDA-Clust-targ	A. Khoukaz

Status reports of previously approved experiments

16:50 – 16:55	E007.1	EDM spin Dyn.	H.Ströher
16:50 – 16:55	D005.2	PANDA-KOALA	H. Xu
16:55 – 17:00	A002.5	COSY e-cool	V. Kamedzhiev
17:00 – 17:05	A009	Siberian Snake	A. Lehrach

17:10 – 18:45 parallel:	Closed session (IKP, room 311) Internal coordination planning for installations at COSY (IKP, room 312)		
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19:00 – 20:30	Dinner (FZ-Seekasino) also for speakers		
20:30	Bus transfer to Stadthotel Jülich (for CBAC members)		

Tuesday, July 3rd, 2018

- 08:30 Bus transfer Stadthotel Jülich to IKP (for CBAC members)
- 09:00 – 11:45 **CBAC closed session** (IKP, room 311)
representatives of the experiments should be available for
additional information or questions
- Open session** (IKP, room 312)
- 11:45 – 12:15 Summary of CBAC Recommendations M. Weber
- 12:30 – 14:00 Lunch (for CBAC members) (IKP, room 310) /
End of meeting**