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In Memory of Professor Helmut Bokemeyer
Peter Braun-Munzinger (GSI)/FJCT

Helmut Bokemeyer, one of the very first members of the scientific staff at GSI and member of the FAIR Joint Core Team, passed away on March 8, 2009 after a long time of fighting against a malicious disease.

Having come to GSI in the year 1973, he joined the activities of installing an Orange electron spectrometer in the 2nd Nuclear Physics Department. In the following years Helmut Bokemeyer found his scientific home in the EPOS solenoidal spectrometer, measuring electron positron pairs in heavy ion collisions.

In the beginning of the nineties he was one of the initiators and group leaders of the HADES program. As a member of the KP1 Department he played a key role in the management of the international collaboration, among other things with collecting international funds for supporting the project and paving the way for a strong contribution of collaborators from Eastern Europe. At the same time he brought into being the pion beam project at GSI, here also acting as the group leader. In the year 2002 Helmut Bokemeyer moved to Brussels to take over the key position as a Scientific Officer for Physics in the INTAS program. There he successfully used his experience to channel the interests of the science community and the funding agencies towards the FAIR project. After his retirement he came back to GSI to support the newly created FAIR Joint Core Team in EU affairs.

During his entire scientific career he developed a strong relationship with the Goethe-University where he was honorary professor and where he graduated numerous diploma and doctoral candidates. Helmut enjoyed world-wide the respect of high-ranking personalities of the physics communities. His colleagues remember him as an engaged scientist, interested in all aspects of experimental physics, from understanding the theoretical background to tricky technological solutions. He highly enjoyed to work together with engineers and technicians.

With much respect we remember his constant optimism while keeping a strong commitment to his work during the years of living between illness and recovery. We will keep the memory to Dr. Bokemeyer alive.
Status of the FAIR Project
Horst Wenninger (Leader FJCT)

Following the development of the international project FAIR - worked out with the help of numerous external users - from first ideas in the year 2001 via the conditional approval by the German Science Council in the year 2002, the elaboration and international evaluation of the scientific and technical details of the project over a period of four years up to the publication of the FAIR Baseline Technical Report in 2006 and finally the FAIR Start Event in November 2007, the FAIR partner countries are now willing to start the FAIR company.

Considering the preparatory work by the scientific collaborations, the FAIR Technical Division and the FAIR Joint Core Team, the agreements prepared by the Working Groups AFI and STI, endorsed by the ISC, the establishment of the FAIR GmbH and its Council will allow to quickly move forward on pending issues such as:

- confirmation of the appointment of the FAIR Scientific Director (see page 4),
- implementation of an adequate company management structure,
- approval of budgets and preparation of construction permits.

It will be possible to advance on staff recruitment, to finalize the development of a business policy, to negotiate and conclude contracts; particularly the business management contract, in-kind agreements, etc.

In spite of pending final financial commitments, the swift start of the FAIR project should be the main focus for all parties involved in the coming months.

Horst Wenninger
FAIR Scientific Director appointed

A Search Committee for choosing a FAIR Scientific director, composed of Chairman Jacek T. Gierlinski, Prof. Witek Nazarewicz (Poland) Prof. V. S. Ramamurthy (India) Dr. Beatrix Vierkorn-Rudolph (Germany, BMBF) and Prof. Oleg O. Patarakin (Russia) announced their outcome at the latest ISC meeting in April: They will recommend Prof. Boris Yu. Sharkov (Institute of Theoretical and Experimental Physics (ITEP) in Moscow to the future FAIR Company’s Council for the position of the FAIR Scientific Director.

Following this, Dr. B. Vierkorn-Rudolph, Director at the German Ministry of Education and Research (BMBF), suggested that GSI may offer Prof. Sharkov a position in the FAIR Joint Core Team with immediate effect. This is to involve Prof. Sharkov early and actively in the business of the FAIR project and to speed up the preparation process for establishment of the Company. Prof. Sharkov has agreed to get in touch with the Ministry on this matter.

FAIR Committees

News from the Working Groups of Administrativ and Financial (AFI) and Scientific and Technical Issues (STI)

The Working Groups of AFI and STI dedicated their meetings in January and March to the preparation of legal documents and resolutions for the International Steering Committee (ISC), e. g.: agreements related to the FAIR Convention signing ceremony, questions around an early creation of the FAIR GmbH, identification and distribution of funds of the Start Version budget.

Moreover the Working Group of STI appointed a new Chairman, as Horst Wenninger took over the position as leader of the FAIR Joint Core Team. With effect from January 2009 he has been succeeded by Alex C. Müller, Deputy Scientific Director at IN2P3 in France.
News from the International Steering Committee (ISC)
FJCT

Within the past weeks the ISC met at GSI on February 24 and April 1, 2009. The most important issues discussed were the preparations for the FAIR Convention signing ceremony as well as the swift establishment of the FAIR GmbH. The Convention text needs to be translated into 5 languages apart from German and English (see NL No. 11). This process is in the hands of the Foreign Offices of the respective countries and the German Foreign Office (FO). The latter recently delivered their reviewed versions of the English versions of the founding documents and a cross-checking conference might be scheduled in due time. Prior to this, some countries now need to rework their translations in order to be in line with the changes requested by the German FO. A date for the official act of signing the FAIR Convention and related papers can be fixed immediately after the cross-checking conference took place.

In summary:

- AFI completed its work on documents required to start the FAIR GmbH
- Translations of the FAIR Convention are in progress
- STI started to evaluate Technical Design Reports (TDR) of experiments and via the
  FAIR Machine Advisory Committee (MAC) also evaluations of accelerator TDRs o
- ISC adopted various resolutions to ease an early formation of the FAIR Company

A New Committee for FAIR: CFU – Committee for FAIR Users
Catalin Borcea (FJCT)

The FAIR Company will soon be created, giving a decisive impetus to proceed in organizing basic structures for the project.

In view of important forthcoming events, the research coordination section of the FAIR Joint Core Team initiated the formation of a “Committee of FAIR Users” (CFU). The committee is composed of representatives of all FAIR experiments and sees a main task in facilitating the dialog between the experiment collaborations and FAIR and GSI organizations.

The experiment collaborations delegated the following persons to the CFU:

Klaus Peters (Chairman, PANDA)
Wolfram Korten (Vice Chairman, NuSTAR)

Angela Bräuning Demian (FLAIR) Thomas Stoehlker (SPARC)
Marco Durante (BIOPHYS) Andreas Tauschnitz (WDM)
Dieter H. Hoffman (HEDgeHOB) Zbigniew Majka (FJCT, ex officio member)
Walter Mueller (CBM)

The two Chairmen had been elected by the committee members at the first CFU meeting, held March 17, 2009 at GSI. It was also decided to immediately collect proposals from the collaborations for defining the mandate and the main topics of future CFU activities.
Activities to evolve the GSI accelerator systems towards FAIR Injector
Hartmut Eickhoff (GSI)

General remarks
The existing GSI accelerator chain (UNILAC and SIS18) will serve as the injector to provide the new FAIR systems the requested ion beams. The beam properties of FAIR are not only challenging with respect to the demanded high intensity requirements. In addition, the availability of the existing sections has to be assured, taking into account the age of more than 30 years of some of these systems. The main requirements can be summarized as follows:

- the beam intensities of accelerated ion species have to be pushed towards their intensity limits, represented by the ‘space charge limits’ of the SIS18 synchrotron;
- the repetition rate of the SIS18 synchrotron has to be increased in order to enhance in addition to the pulse intensity the time averaged ion intensity;
- the flexibility of operation scenarios towards pulse to pulse change of ion species, beam parameters and beam destinations has to be further extended;
- for the users reliable beam times and a high availability of the installations has to be assured for a long operation period;
- in addition to the modifications, the accelerator systems have to provide beams for the GSI experimental program according to their demands.

Figure 1 gives an overview of the GSI accelerator complex, showing the UNILAC and the SIS18 accelerators which will be linked to the new FAIR complex.

Figure 1 Overview of the GSI accelerator complex. The part which will be used for FAIR is marked in red and labelled with the year of start of initial operation.

From the beginning of the FAIR project definition it was recognised that modifications and extensions of the existing accelerators represent a major challenge and precondition. To start the upgrade process as early as possible a lot of efforts – under responsibility of Winfried Barth for the UNILAC and Peter Spiller for the SIS18 - have already been made. The technical measures were identified and new systems have already been installed. Results of the improvements by now can be read about in...
various reports and conference articles. In the following, some aspects of the intensity increase will be described.

In order to push the ion intensity to the limit, intermediate charge states of heavy ions have to be chosen. Uranium ions with a charge state of \(28^+\) serves as a reference ion for the FAIR heavy ion program and the article will thus concentrate on this ion species.

**Progress of the UNILAC upgrade**

Several measures have been undertaken at the UNILAC to increase the pulse intensity of heavy ions. They affected all accelerator sections, starting from the ion source over the pre- and poststripper-sections to the TK transfer channel to SIS18.

![Figure 2](image-url) Evolution of the Uranium beam current during the last years in the UNILAC. The target beam current for FAIR is drawn as a reference and seven dedicated points along the UNILAC are shown.

Figure 2 clearly demonstrates the already achieved intensity improvements at the different locations of the UNILAC. The beam current is shown for the starting point in 2001, two intermediate times and the beam performance measured mid 2007. The design needs for FAIR are given as reference. It should be noted, that nearly 6 mA of \(U^{28+}\), which is about 35% of the requested FAIR-intensity, could be transported to the injection point of SIS18. This is equivalent to an enhancement factor of nearly 10 compared to the situation in 2001. Many individual measures lead to these improvements: hardware extensions, an improved operating and also beam diagnostic investigations; The latter, evaluated in dedicated machine experiments, resulted in optimized beam properties and transmission figures.

Figure 3 shows – as hardware modification - the new charge state separator in the TK transfer channel, commissioned in 2008. Performances are a better charge resolution, improved beam diagnostics and versatile operating modes for both, low and high intensity operation.

Continuing the UNILAC upgrade program, new power supplies for the Alvarez quadrupoles will come into operation within this year. They improve the beam properties to allow a better injection process at SIS18. In addition, the electrodes of 10 RFQ tanks in the pre-stripper section will be exchanged to enhance the transmission in these sections.
Within the next 2-3 years hardware modifications of the LEBT (Low Energy Beam Transport) are planned as well as the installation of a new superconducting ECR-source. Both will enhance the beam intensities by a factor of 5 -10 (compared to the existing ECR-source) and will allow a better duty factor for GSI experiments.

**Progress of the SIS18 upgrade**

Although with respect to the ‘space charge limit’ higher SIS18 beam intensities can be provided for intermediate charged heavy ions, significant losses are related to these ions due to enhanced stripping probability that induce particle loss (see Fig. 4) and leads to a dynamic pressure rise. As this pressure rise again is the source of increased stripping processes an intensity dependent “avalanche effect” takes place, which has to be fought against.

**Figure 3** Schematic view of the charge state separator

**Figure 4** Measurement and consistent simulation of the beam intensity along the SIS18 cycle from beam injection to extraction taking into account the effect of dynamic pressure rise.
Extensive theoretical and experimental investigations have been performed to define the measures to minimize this effect aiming at the installation of ‘ion catchers’ with low desorption yield in each of the 12 SIS18 sections and the replacement of the vacuum chambers with NEG-(Non Evaporable Getter) coated ones to enhance the pumping speed and to improve the static vacuum pressure to the $10^{-12}$ mbar region. Besides that, the operation of FAIR requires optimized beam performances with minimized beam losses and reduced cycle times.

With respect to reduced cycle times an upgrade of the pulse power connection was realized and successfully commissioned in 2006. This allows an increase of the acceleration ramping speed from 1.5 to of 10 T/s, representing the SIS18 design parameter for a dipole magnetic field up to 60% of its nominal value of 1.8 T, required at FAIR. In addition, the total injection system has been replaced in 2008 in order to achieve a larger horizontal acceptance with reduced particle loss and to allow a higher injection energy for intermediate charged heavy ions.

Beam intensities for heavy ions above $10^{10}$ per cycle are currently possible, still being about one order magnitude below the FAIR requirements.

Conclusion and outlook

By now, the upgrade programs for UNILAC and SIS18 have to a significant extend been realized to meet the requirements for serving as FAIR-injector sections. There is a remarkable progress for the achieved intensities of heavy ions in both accelerator systems.

As the GSI experimental programs for both, the various UNILAC and SIS/ESR experiment will continue, a long-time term coordination with respect to the additional accelerator facilities and the beam-time/shut-down schedule is necessary. First concepts are currently being worked out, taking into account the demands for both, the accelerator measures and the research programs.

According to the present schedule the upgrade programs - with further extensions and modifications - will continue until the year 2012.
FAIR Experiments
Zbigniew Majka (FJCT)

Since the last issue of the FAIR Newsletter the FJCT Research Coordination Group has met twice, on February 17 and March 17, 2009. The following FAIR experiment-related issues have been considered:

- preparation of the 1st Annual Report of the FAIR Preparatory Phase EU Contract,
- organization of the Committee of FAIR Users (CFU, see page 6),
- preparation of the Technical Design Report (TDR) evaluation for the PANDA solenoid and dipole spectrometer magnets,
- re-organization of the FAIR Monthly meetings,
- the distribution of the guaranteed minimum commitments of the FAIR member countries to experiments.

Moreover, the 2nd meeting of the FAIR Experiment Spokespersons had been held on February 25, 2009 at GSI, where the status of preparation of all FAIR experiments had been reviewed. The presentations are available at http://www-win.gsi.de/fjct/Research/Meetings/2009/Spokesperson_Meeting_20090225/

The FAIR experiment presentations were followed by a round table discussion. The discussion had been opened by the Chairman of the International Steering Committee, Jacek T. Gierlinski, who informed on the FAIR GmbH formation status. The discussion was then focused on the distribution of the guaranteed minimum commitments of the FAIR member countries to the FAIR experiments.
According to the principle of the famous American architect Louis Henry Sullivan "Form follows function" (Louis H. Sullivan), the assigned architects, the collaboration of "ion42", have chosen the motto "Form follows beam" as motive for their design concept for the new facility. The architectural idea is to make the beam lines visible. Besides the design the main task of FAIR CC is to provide construction technologies and technical systems to fulfil the requirements of the clients for the accelerator and the experiments.

The planning concept arranges different building alongside and above the beams, concentrating masses at important junctions and showing correspondent soft and fluent forms. As a formal contrast, the experiment buildings at the end of each beam appear with defined edges to visually emphasize the respective termination of the FAIR complex at that point. The present architectural proposal represents an interesting and suitable urban design layout for FAIR.

In December 2008 the GSI management signed 11 planner contracts. This is a big deal on the German part in 2008 and an important step for obtaining the Z-Bau approval.

As for the preliminary civil construction planning, FAIR CC has held meetings on functionality and construction with all representatives of the future users, investigating their needs regarding the individual buildings.

With the results of these meetings, the planning process will successfully proceed up to summer 2009. On the basis of the approved preliminary design the planners and the FAIR CC department will prepare the Z-Bau documents accordingly.
Status of FAIR Radiation Safety
Georg Fehrenbacher (GSI)

Radioactive Activation of Components at FAIR
The operation of the FAIR heavy ion accelerators will be associated with the production of short-lived radioactivity. Two main paths dominate this: The fragmentation of projectile and target nuclei and the causation of spallation reactions by high energy neutrons, being released in heavy ion nuclear reactions.

Fig. 1: Shielding design and dose distribution in the target area of the Super-FRS and in the maintenance channel.

In the framework of two research projects, SAFERIB (EURONS contract 506065) and GSI-INTAS (EU-contract 03-54-3588), the production of radioisotopes was measured and calculated. Measurements for uranium beams were performed at GSI at energies of 500 and 950 MeV/u, Copper and stainless steel were chosen as targets. The experiment was modeled using the FLUKA\(^1\) Monte Carlo (MC) code. The key results of the measurements can be summarized as follows: The overall production of radioactivity can be estimated with FLUKA within a factor of two, and the magnitude of the activity of the produced radioisotopes is dominated by target fragmentation\(^2\).

The building up of radioactivity and the exposure of personnel to potential radiation in specific experiment and accelerator structures can be estimated on the basis of MC computations and on assumptions for operation modes and beam parameters. Refining of layouts of such areas improve the radiological circumstances.

The target area of the Super Fragment Separator (Super-FRS) is an example for the development of a shielding layout for an area with radioactivity production.

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2 E. Kozlova et al. Validation of the FLUKA MC code for residual production with 500 MeV/u and 950 MeV/u Uranium Beam on Copper and Stainless Steel Target, ICRS11, Georgia, USA (2008) accepted for publication in Nuclear technology (2009)
Fig. 1 shows the layout of the facility with concrete and steel shielding layers. For the activation calculations for a periodically alternating beam operation (90 days) and a shut down period (120 days) there was a scenario with uranium beams at an energy of 1.5 GeV/u and a beam intensity of $10^{12}$ ions per second.

The activation pattern (spatial distribution of activity) depends on the selected isotopes in the fragment beams and the selected beam dump. Parts of the primary beam and minor parts of the secondary beams are deposited in this beam dump. The goal for the shielding design is to plan a layout resulting in a radiation exposure allowing personnel to perform unavoidable maintenance critical work during shut down periods. In the following example, the beams are directed to the BC1 beam catcher.

Fig. 1 also shows the residual dose distribution in the target area of the SuperFRS and in the maintenance channel. It can be seen that the maximum dose rate near the beam catcher area will be about 50 µSv/h. For the other areas in the maintenance channel the dose rates are expected to be lower than 1 µSv/h. On basis of this shielding design planning, reliable estimations on the radiation exposure associated with maintenance work can be accessed. This is evidence that the potential exposure of personnel will not exceed the limits of the radiation protection laws.
First PANDA Crystals Have to Withstand their Test Program
Ulrich Wiedner (U Bochum)

Thanks to a grant of the German BMBF, the PANDA collaboration could recently order 4775 lead-tungstenate (PbWO₄) crystals at the firm of BTCP in Russia for the electromagnetic calorimeter of PANDA (see NL No 10, FAIR Newsletter Archive). In this connection, very good news came only on December 12: The Swedish Research Council decided to finance another 1620 crystals for PANDA. This allows our Russian supplier to continue their production for FAIR until February 2009.

First crystals arrived already end of September at the University of Bochum, Germany, and by now, a regular schedule of delivery and tests has started.

The quality control is diverse: Prior to their transport to Bochum a first screening of the crystals is done immediately after production in order to detect instabilities in the production line already at an early stage and prior to any further actions. Transported to CERN then, a second step is to run the crystals through the same quality test procedure that proved already successful for the CMS experiment. The PANDA collaboration was able to take over the machine from CMS and it was modified according to the geometry of the PANDA crystals. With a radioactive source, a semi-automatic ACCOS machine (see pictures) tests the light output and response at different positions along each individual crystal.

A next step of the quality control will be that of radiation hardness. This will be done at the University of Giessen, Germany, where a special radiation facility has been built up only for this purpose. Here, each crystal will be exposed to a very high radiation dose, simulating the operational demands of several years of PANDA running.
A meeting devoted to the development and construction of the SIS300 accelerator ring was held at the Institute for High Energy Physics, Protvino, Russia on March 19, 2009. The meeting was designed to discuss a roadmap towards the realization of SIS300, to review the status of the preparatory work and to establish a pre-consortium to take over responsibilities.

Sergey Ivanov, the Deputy Director of IHEP, welcomed the participants and gave an overview on the activities at the IHEP accelerator, the largest facility of this kind in Russia. Hans Gutbrod (FJCT) informed about the status of FAIR and Peter Senger (GSI Germany) justified the necessity of a SIS300 from a physics point of view. He pointed out that the scientific mission of the FAIR project can only be fully accomplished with SIS300. In particular he discussed the plans to explore the properties of neutron star matter in the laboratory with the Compressed Baryonic Matter (CBM) experiment. Nils Pyka (GSI Germany) presented the layout of the SIS300 magnet lattice with the main parameters of the SIS300 dipole, quadrupole, and corrector magnets. The list of work packages together, with the existing Expressions of Interest for SIS300 components, was shown by Peter Shcherbakov from IHEP.

In the second part of the meeting the status of the SIS300 subsystems was presented and discussed. Pasquale Fabbricatore (INFN Italy) reviewed the Italian activities concerning the manufacturing and test of the SIS300 curved 4.5 T dipole prototype as well as the development of a superconducting wire. The test results of the 6 T straight SIS300 dipole model were presented by Sergey Kozub (IHEP Russia). This model reaches a magnetic field of 6.8 T and the critical current of the magnet is not reduced up to a ramp rate of 1.15 T/s. Leonid Tkachenko (IHEP Russia) reviewed the SIS300 prototype quadrupole design. He reported that the engineering drawings of the magnet were completed and that the tooling for its production has been manufactured.

The test results of the superconducting wire for the SIS300 magnets were presented by Ludmila Potanina (Bochvar’s institute Moscow). Vasily Zubko (IHEP Russia) reviewed the design of the SIS300 multipole magnets as calculated by IHEP and Sergey Zintchenko (IHEP Russia) presented plans of the SIS300 cryogenic system, while Timur Kulevoy (ITEP Moscow) introduced the SIS300 beam diagnostics.

The final part of the meeting was devoted to discussions on the SIS300 roadmap and to the foundation of a SIS300 pre-consortium. Sergey Kozub presented the proposal for a roadmap towards the construction of the SIS300 subsystems. The meeting ended with the election of the pre-consortium management board, consisting of persons responsible for the different SIS300 subsystems:

**Sergey Kozub (IHEP, Russia, spokesperson)**

Pasquale Fabbricatore (INFN Italy)  
Timur Kulevoy (ITEP Russia)  
Peter Spiller (GSI Germany)  
Peter Senger (CBM observer)
FAIR Meetings and Events

FAIR Monthly 2009

The meeting "FAIR Monthly" will – as usual - take place each month on the 3rd Tuesday, 02:00 – 04:00 p. m., in the GSI lecture hall. The next meeting is scheduled for

Tuesday, May 19, 2009

Please take detailed information about FAIR Monthly from

http://www-win.gsi.de/fjct/monthly/index.html

In case of any further questions you may turn to Walter Mueller (w.f.j.mueller@gsi.de) or Lars Schmitt (l.schmitt@gsi.de)

Research Coordination Meetings 2009

The research coordination meetings will take place each month on the 3rd Tuesday, 10:00 – 12:00 a. m. at building C27, room 1.004. The next meeting is scheduled for

Tuesday, May 19, 2009

Please take information about previous meetings from

http://www-win.gsi.de/fjct/research

In case of any further questions you may turn to the FJCT Head of Research, Zbigniew Majka (z.majka@gsi.de).

CBM

April 27, 2009
"Workshop on Nuclear matter Physics at SIS100", GSI (Germany)

May 19-22, 2009
1st CBM-Russia-JINR Collaboration meeting: "CBM at SIS100", Dubna (Russia)

http://cbm2009-may.jinr.ru/

June 1-4, 2009
3rd Workshop of the CBM-MPD STS Consortium: "Challenges of the CBM and MPD Silicon Tracking Systems – 2009", Karelia (Russia)

http://sts-karelia09.jinr.ru/info/id.html

October 5-10, 2009
14th CBM Collaboration Meeting, Split (Croatia)
**PANDA**

June 15 – 19, 2009  
PANDA Collaboration Meeting, Turin (Italy),

September 7 – 11, 2009  
PANDA Collaboration Meeting, Jülich (Germany)

December 7 – 11, 2009  
PANDA Collaboration Meeting, GSI (Germany)

**NUSTAR**

June 30 – July 4, 2009  
International Conference on “Nuclear Structure and Related Topics”, Dubna (Russia)

October 5-6, 2009  
HISPEC/DESPEC Collaboration Meeting, GSI (Germany)

**FAIR calendar**

[https://www.gsi.de/gsitools/fair.shtml](https://www.gsi.de/gsitools/fair.shtml)

**FAIR Links**

- [www.fair-center.org](http://www.fair-center.org)
- [FAIR Baseline Technical Report](http://www.fair-center.org)
- FAIR brochure
- [FAIR flyer](http://www.fair-center.org)
- [FAIR newsletter archive](http://www.fair-center.org)
- [FAIR in the CERN Courier](http://www.fair-center.org)
- [FAIR in Nuclear Physics](http://www.fair-center.org)
- [FAIR Memorandum of Understanding](http://www.fair-center.org)
- [FAIR Communiqué](http://www.fair-center.org)
- How to reach the location
- First steps on site