

ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE  
**CERN** EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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CERN RESEARCH BOARD

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**MINUTES OF THE 164th MEETING OF THE RESEARCH BOARD  
HELD ON 5 JUNE 2003**

Present G. Altarelli, J. Äystö, J-J. Blaising, M. Calvetti, R. Cashmore, C. Détraz,  
L. Evans, R. Forty (Secretary), M. Hauschild, K. Königsmann, P. Lebrun,  
L. Maiani (Chairman), J. May, S. Myers, T. Nilsson, A. Vacchi\*,  
W. von Rüden, C. Wyss, A. Zalewska

\*part-time

Apologies H. Hoffmann, J.-A. Rubio, W.-D. Schlatter

Items

1. Procedure
2. Status report on the CAPRICE and PAMELA experiments
3. Reports and matters arising from the INTC meeting of 19 May 2003
4. Reports and matters arising from the SPSC meeting of 13 May 2003
5. LHC machine status
6. Reports and matters arising from the LHCC meeting of 21-22 May 2003
7. Any other business



## 1. PROCEDURE

The **minutes** of the Research Board held on 10 April 2003 [1] were approved without modification. Under matters arising C. Détraz reported on three items:

1. Progress has been made in the transition of **REX-ISOLDE** from an experiment to a facility. The setting-up of positions within AB division, funded by the collaboration for this purpose, has been agreed with CERN for a 3-year duration. The situation will be reviewed during this period.
2. K. Königsmann has reached the end of his term of office as chairperson of the **SPSC**, and was warmly thanked for his contributions. The new chairperson will be John Dainton.
3. There will be a break in the fixed target programme at CERN during 2005. The SPSC proposes that an open meeting should be held at which the community can bring forward new ideas for a continuation of the programme beyond 2005, and has suggested a date of September 2004 for that meeting. L. Maiani supported this proposal, and expressed his hope that the incoming CERN management would take up the task of stimulating the discussion of future fixed target possibilities.

## 2. STATUS REPORT ON THE CAPRICE AND PAMELA EXPERIMENTS

A. Vacchi presented a status report on CAPRICE and PAMELA, for which the status of Recognized Experiment was due for review. They are operated by the Wizard Collaboration, consisting of institutes from Germany, India, Italy, Russia, Sweden and the USA, and are both designed to investigate cosmic rays. CAPRICE is a balloon-borne experiment, which has already had a number of successful flights, whilst PAMELA is in preparation for launch in a satellite.

The CAPRICE detector is a magnetic spectrometer weighing about 3.5 tons, with a superconducting magnet, tracking system, calorimeter, time-of-flight and gas RICH detectors. It has been flown a number of times in stratospheric balloons, in collaboration with NASA, most recently in 1998. It flew then for more than 20 hours at altitudes above 36 km, and measured the fluxes and energy spectra of particles and antiparticles at the top of the atmosphere. The measurements of the muon flux were very useful for the interpretation of atmospheric neutrino data from experiments such as Super Kamiokande, and it has been decided to fly the detector again in 2004 to make more precise measurements of the muon flux.

The collaboration is also preparing the PAMELA experiment, to be carried on a Russian satellite, with a launch from Kazakhstan scheduled in early 2004. Its prime objective is the measurement of the antimatter content of cosmic rays. It is also a magnetic spectrometer, but is based around a permanent magnet, with a tracking detector of double-sided silicon microstrips. The total weight is only 450 kg, and the power consumption of 360 W has to be much lower than that allowed for the balloon-borne experiment. The mission is expected to last three years, at a height of between 300 and 600 km. Integration of the detectors into the flight module is underway. A second, engineering, module of the same construction is used for vibration tests, and will stay on the ground for calibration purposes.

J.-J. Blaising enquired how PAMELA compared to the AMS experiment. AMS is much larger, and therefore has a better geometrical coverage, but the compact size of PAMELA may make the control of efficiency easier. If PAMELA flies on schedule next year it will also have some time to perform measurements before AMS becomes operational. In response to a question from J. May, A. Vacchi explained that the main request of the experiments from CERN was for some limited test beam time, for the calibration of the spectrometers. L. Maiani pointed out that approval of requests for test beam is not coupled to the Recognized Experiment status. The manpower for the planned refurbishment of the RICH detector was estimated at about one person-month.

D. Schlatter acted as rapporteur for both CAPRICE and PAMELA, investigating in particular their use of CERN resources. He was unable to attend the meeting so had prepared a memorandum summarizing his opinion, which was circulated [2]. He concluded that the institutes of the Wizard collaboration are well integrated into the CERN programme, and their request from CERN continues to be modest: some test beams, technical expertise and a place for meetings. The collaboration has made good progress towards completion of the new detectors. The Research Board **approved** the extension of CAPRICE and PAMELA as Recognized Experiments **RE2a** and **RE2b** for a further three years.

### 3. REPORTS AND MATTERS ARISING FROM THE INTC MEETING OF 19 MAY 2003

J. Äystö reported that one of the two ISOLDE front-ends, the High Resolution Separator (HRS), had failed, which meant that experiments were being rescheduled to use the other one, the General Purpose Separator. T. Nilsson commented that as a result push-pull operation using both separators was not possible, leading to a loss of efficiency. Due to its radioactivity the HRS will not be removed for a few weeks, but it may be possible to repair it for the end of the run. There is no spare, but a replacement will be available for next year. Although the front-ends usually last a few years, it is felt that they should be considered as consumables and a replacement should be kept available.

J. Äystö then reported on the last meeting of the INTC, at which seven experiments were recommended for approval.

**P147 Add. 1** *High accuracy mass measurement of the very short-lived halo nuclide  $^{11}\text{Li}$*  [3]. This experiment has already made an accurate measurement of the two-neutron separation energy for  $^{11}\text{Li}$ , using the MISTRAL spectrometer, with a precision of 25 keV. They now believe that with further running a precision of 5 keV can be reached on this critical parameter for the three-body model calculations of weakly bound halo nuclides. The experiment was **approved** for an allocation of 9 shifts; it will continue to be known as **IS402**.

**P170** *Coulomb excitation of neutron deficient Sn-isotopes using REX-ISOLDE* [4]. The proposal intends to use Coulomb excitation of  $^{108,110}\text{Sn}$  in inverse kinematics, using REX-ISOLDE at 3.1 MeV/u, and the MINIBALL array. This will allow the transition strengths between the ground state and first  $2^+$  state of radioactive neutron-deficient Sn isotopes, which is the first step towards understanding the core polarization and shell structure near the doubly-magic  $^{100}\text{Sn}$ . Originally proposed with a  $\text{Ce}_2\text{S}_3$  target, it will now be performed with a LaC target, but the committee encouraged the proponents to continue tests of  $\text{Ce}_2\text{S}_3$  as a target material. The experiment was **approved** for an allocation of 19 shifts; it will be known as **IS418**.

**P171** *Measurement of gas and volatile elements production cross section in a molten lead-bismuth target* [5]. The proposal intends to measure the production of gases and volatile elements in the MEGAPIE spallation target, to be used in the SINQ facility at PSI, by using an ISOLDE target unit filled with liquid lead-bismuth. The experiment is important for high-power molten metal targets, and is an important step towards the experimental demonstration of the Accelerator Driven System concept. The INTC recommended that some of the shifts for the experiment should be with 600 MeV protons, rather than the

proposed 1 or 1.4 GeV, to better match the MEGAPIE energy: this would require the PS Booster to be run in single-user mode. M. Hauschild pointed out that such lower-energy running would be easiest to schedule at the beginning of next year's run. The experiment was **approved** for an allocation of 12 shifts, with the detailed scheduling left to the PS/SPS coordinator; it will be known as **IS419**.

**P174** *Study of the  $\beta$ -delayed particle emission of  $^{17}\text{Ne}$*  [6]. This proposal involves the investigation of multiparticle decay modes of  $^{17}\text{F}$ , populated in  $\beta$  decay of  $^{17}\text{Ne}$ , and is a benchmark experiment for the newly-commissioned ISOLDE Silicon Ball.  $^{17}\text{Ne}$  is a Borromean nucleus, in that none of its binary subsystems is bound, and it has been considered as a candidate two-proton halo nucleus. The interest in  $^{17}\text{Ne}$  also arises from the population by  $\beta$ -delayed proton decay of states in  $^{16}\text{O}$ , of astrophysical importance. The experiment was **approved** for an allocation of 12 shifts; it will be known as **IS420**.

**P175** *Study of neutron-rich  $^{124,126,128}\text{Cd}$  isotopes; excursion from symmetries to shell-model picture* [7]. This proposal concerns the properties of neutron-rich even-even Cd nuclei, in particular excited two- and three-phonon vibrational states populated in the  $\beta$ -decay of Ag isotopes. Cd isotopes provide an ideal test for the verification of a number of theoretical ideas on how collective motion builds up, near closed shells, taking into account both valence and core nucleons. The experiment was **approved** for an allocation of 20 shifts; it will be known as **IS421**.

**P176**  *$^{204\text{m}}\text{Pb}$ : A new probe for TDPAC experiments in biology complementing the well established probes  $^{111\text{m}}\text{Cd}$  and  $^{199\text{m}}\text{Hg}$*  [8]. This proposal involves the study of the structure and dynamics of metal sites in biomolecules, employing the Time Differential Perturbed Angular Correlation method and a new probe,  $^{204\text{m}}\text{Pb}$ , in addition to  $^{111\text{m}}\text{Cd}$  and  $^{199\text{m}}\text{Hg}$ . As a result of the highly sensitive spectroscopic method, these will be important measurements for the further understanding of biological processes of macromolecules such as DNA and proteins, in situations close to physiological conditions. The experiment was **approved** for an allocation of 28 shifts over two years; it will be known as **IS422**.

**P177** *Measurements of fission cross sections of actinides* [9]. This proposal concerns the measurement of the neutron-induced fission cross sections of  $^{237}\text{Np}$ ,  $^{241,243}\text{Am}$  and  $^{254}\text{Cm}$ , employing the Parallel Plate Avalanche Chamber and Fast Ionization Chamber fission detectors at the nTOF facility. The fission cross sections of several transuranium isotopes are fundamental elements in assessing the strategy to be followed in the detailed feasibility studies of nuclear waste transmutation. The proposal is a straightforward continuation of the approved nTOF6 experiment. An example was shown of the discrepancies that exist in the currently available data, and C. Détraz pointed out that resolving such discrepancies

was one of the major goals of the nTOF programme. The experiment was **approved** for an allocation of  $5 \times 10^{18}$  protons; it will be known as **nTOF9**.

#### 4. **REPORTS AND MATTERS ARISING FROM THE SPSC MEETING OF 13 MAY 2003**

K. Königsmann reported on the recent meeting of the SPSC. **ASACUSA/AD-3** have made excellent progress in the detailed study of antiprotonic helium. They have made precision measurements of the transition frequencies in very dilute gases, improving the precision of the proton-antiproton mass ratio to the level of  $10^{-8}$ . They were congratulated on their achievements in 2002. This year they aim to reach higher precision with two-photon excitations, to search for meta-stable protonium and to improve their trap extraction efficiency.

**COMPASS/NA58** have completed their initial layout and taken data for 57 days with longitudinal polarization and 19 days with transverse polarization, leading to a total of 5 billion events on tape, corresponding to 260 terabytes of data. They now have first analysis results concerning  $\Lambda$  polarization and vector-meson production, but have not yet shown a D meson signal, important for their measurement of  $\Delta G/G$ . The SPSC urged the collaboration to concentrate on spin physics until the end of 2004, and this point was **reinforced** by the Research Board. W. von Rüden commented that it should be possible to accommodate the collaboration's request for extra computing capacity.

**CAST** is searching for axions from the sun, using a decommissioned LHC test magnet mounted on a platform to orient its aperture towards the sun. It is instrumented to detect the X-ray photons that could be produced by an axion in the magnetic field via the reverse Primakoff effect. From about 5 hours of solar tracking data, they are already able to set an interesting limit, improving on previous results, and data taking is now continuing.

Concerning the Heavy Ion experiments, **NA49** showed results on the energy scan from 20 to 80 A GeV. At the onset of deconfinement they expect anomalies in the energy dependence of relevant observables, such as the charged pion multiplicity and the K to  $\pi$  ratio, and interesting features are seen in the data. **NA50** gave a status report on J/ $\psi$  suppression from the runs taken between 1995 and 2000. The SPSC encouraged them to combine the different data sets. The issue was raised whether the NA45, NA49 and NA57 experiments should now be removed from the beam line, but this was considered to be a question for the directorate rather than the Research Board. A. Zalewska commented that the detailed study of the low-energy region would be difficult at RHIC, and she encouraged

the preparation of ideas for the further study of Heavy Ions at CERN beyond 2005, to be discussed at the meeting that was mentioned above under matters arising.

The Research Board **took note** of the various status reports.

## 5. LHC MACHINE STATUS

L. Evans gave a brief status report of the LHC machine, concentrating on two items: the magnetic field quality and the schedule. He illustrated his presentation with plots taken from the LHC Dashboard, available on the Web from the CERN welcome page.

The magnetic field quality of the main LHC dipoles can be characterized by the parameters  $b_n$ , which parameterize the multipole content. L. Evans showed a plot of parameter  $b_3$  for the magnets that have been produced to date. They cluster around a value towards the high end of the acceptable range. An adjustment can be made to correct this value by adding a shim to the mid-plane of the magnets, but it has been decided to delay the introduction of that correction until the magnets required for the first octant of the machine have been produced. K. Königsmann enquired why the target value of  $b_3$  is not centred on zero: this is because the value referred to is at injection, and there is a correction due to persistent currents.

Concerning the LHC machine schedule, L. Evans distributed copies of the General Coordination Schedule of LHC Construction and Installation, which can also be found on the LHC Project Web pages. This is a graphical representation of the schedule displayed versus time and position around the machine. By looking at the current date on the time axis one can see which tasks are expected to be in progress. A black line that spans the chart indicates the actual status, and one can easily follow whether the work is proceeding on schedule. A red line indicates the status as it was one month ago, to help monitor the rate of change of any delay. At present there is a few months' delay in part of the first octant, but no cause for concern for the rest of the machine.

R. Cashmore recommended that the Research Board members keep an eye on the LHC Dashboard, as it provides an excellent means of monitoring progress. The Research Board **took note** of the report.

## 6. REPORTS AND MATTERS ARISING FROM THE LHCC MEETING OF 21-22 MAY 2003

M. Calvetti reported on two items from the recent LHCC meeting: the CMS Technical Design Report for data acquisition and high-level trigger [10], and the LCG project.

The **CMS trigger and data acquisition** is designed to inspect the detector information at the full crossing frequency and select events at a maximum rate of order 100 Hz for archiving and later offline analysis. The trigger is split into two steps, the first of which, Level-1, is designed to reduce the rate of accepted events to less than 100 kHz, and was documented in Volume 1 of the TDR, submitted in December 2000. The second step, the high-level trigger (HLT), is designed to reduce the maximum Level-1 accept rate to a final output rate of 100 Hz. The data acquisition and high-level trigger system therefore has to perform the read-out of the front-end electronics after a Level-1 trigger accept, to execute physics selection algorithms on the events read out in order to accept those with the most interesting physics content, and to forward the selected events, along with a small number of rejected events, to the online services that monitor the performance of the CMS detector and to archive them in mass storage. In addition, it must also provide control and monitoring of the detector components.

The solution chosen by CMS relies on the rapid advance of communication and processing technologies, using a large switching fabric for the event-builder network and a farm of processors to implement the high-level trigger algorithms. The architecture is designed to be scalable, allowing the system capacity to be increased in line with the requirements imposed by the increasing luminosity of the machine. When the existing HLT algorithms are run on a 1 GHz Pentium III processor they take about 300 ms per event on average. Allowing for the expected improvement in performance of processors with time, this leads to an estimated requirement of 1000 dual-processor PCs for the start of LHC operation in 2007. In summary, M. Calvetti expressed the opinion that the TDR describes an elegant solution to the problem of high-level trigger and data acquisition for CMS, and the TDR was recommended for approval by the LHCC. The Research Board **congratulated** the collaboration on the excellent work, and **approved** the TDR.

Concerning the **LHC Computing Grid** (LCG), M. Calvetti reported that good progress was being made in the Applications area. This involves projects on the software process and infrastructure (SPI), persistency framework (POOL), core tools and services (SEAL), physicist interface (PI) and simulation. The team are developing the coherent, component-based architecture that they have been charged to build, and are on target for a major POOL/SEAL release in June. The manpower is considered to be at an appropriate level.

There is project activity in all the expected areas, *except* grid services, which should be delivered by the European Data Grid (EDG) project. A firm cut-off date has now been set for this delivery, of October 2003. W. von Rüden commented that he was pleased to see progress in the interface between LCG and EDG, and that now was the time to focus on delivering the product that will actually be used by the experiments. R. Cashmore complemented the Applications group for their excellent work, and the Research Board **took note** of the progress that has been achieved.

## 7. ANY OTHER BUSINESS

M. Hauschild presented a revised PS and SPS schedule for approval [11]. As a result of the magnet problem discussed at the last meeting, the startup of the SPS had been delayed by two weeks. The revised schedule extends the accelerator running time by two weeks to compensate for that loss. As the run will now extend into November there is the possibility that a day might be declared critical by the electricity supplier. However, in the previous five years no such critical day occurred in the corresponding period, so the probability of losing a day from the run in this way is small. In response to a question from C. Wyss, M. Hauschild confirmed that he had checked with the accelerator groups that there would not be any impact of this extension on their foreseen shutdown activities. The revised accelerator schedule was **approved**.

The next meeting of the Research Board will take place on **4 September**.

## REFERENCES

- [1] Minutes of the 163<sup>rd</sup> meeting of the Research Board held on 10 April 2003 (CERN/DG/RB 2003-349, M163)
- [2] Memorandum from D. Schlatter (enclosed)
- [3] High accuracy mass measurement of the very short-lived halo nuclide  $^{11}\text{Li}$  (INTC-2003-007/P147 Add. 1)
- [4] Coulomb excitation of neutron deficient Sn-isotopes using REX-ISOLDE (INTC-2003-010/P170)
- [5] Measurement of gas and volatile elements production cross section in a molten lead-bismuth target (INTC-2003-014/P171)
- [6] Study of the  $\beta$ -delayed particle emission of  $^{17}\text{Ne}$  (INTC-2003-017/P174)
- [7] Study of neutron-rich  $^{124,126,128}\text{Cd}$  isotopes; excursion from symmetries to shell-model picture (INTC-2003-018/P175)
- [8]  $^{204\text{m}}\text{Pb}$ : a new probe for TDPAC experiments in biology complementing the well established probes  $^{111\text{m}}\text{Cd}$  and  $^{199\text{m}}\text{Hg}$  (INTC-2003-020/P176)
- [9] Measurements of fission cross sections of actinides (INTC-2003-021/P177)
- [10] The trigger and data acquisition project, Vol. II, data acquisition and high-level trigger TDR (LHCC-2002-026-CMS TDR 5.2)
- [11] Accelerator schedule (enclosed)

## ENCLOSURES

1. Memorandum from D. Schlatter concerning the request from CAPRICE and PAMELA for extension as Recognized Experiments
2. Minutes of the 16<sup>th</sup> INTC meeting held on 19 May 2003 (INTC 2003-023/INTC 16)
3. Minutes of the 63<sup>rd</sup> SPSC meeting held on 13 May 2003 (SPSC 2003-021/SPSC 63)
4. Minutes of the 64<sup>th</sup> LHCC meeting held on 21-22 May 2003 (LHCC 2003-024/LHCC 64)
5. Accelerator schedule