EPAC`08

Genoa, Italy

Magazzini del Cotone, Porto Antico

23 - 27 June 2008

STUDENT POSTER SESSION

11th
EUROPEAN PARTICLE
ACCELERATOR CONFERENCE
A EUROPHYSICS CONFERENCE

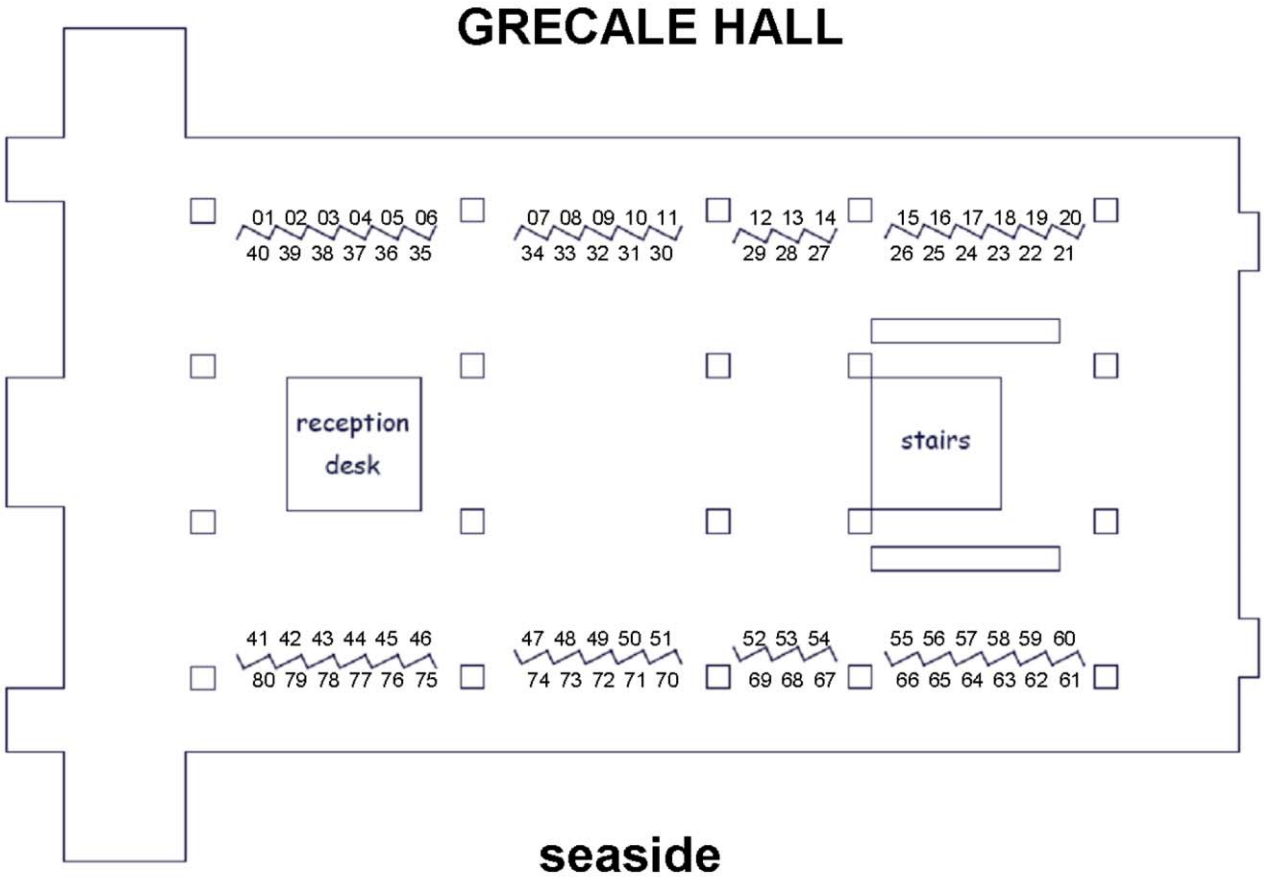
EPAC'08

Special Poster Session for Young Scientists and EPS-AG Prize d) Candidates

Sunday, 22 June 2008 from 17:00 to 19:00
(Setting up from 16:00)

Magazzini del Cotone, Genoa, Ground Floor, Foyer Grecale

Layout of the Special Poster Session for Students



Classification 1: Circular Colliders

Poster Panel 1

Beam Motion Simulation in the Crab-waist Final Focus, **Ivan Nikolaevich Okunev** (BINP, Novosibirsk), Anton Bogomyagkov, Evgeny Levichev, Pavel Piminov, Dmitry Shatilov (BINP SB RAS, Novosibirsk) - In the crab-waist colliders design of the final focus region is a matter of primary importance. The paper describes analysis of final focus quadrupole design and results of particles tracking through the quadrupoles.
Sub Classif.: A15 High Intensity Accelerators

Poster Panel 2

Impact Distribution of the Beam Losses at the LHC Collimators in Case of Magnet Failures, **Andrés Gomez Alonso** (CERN, Geneva) - During LHC operation, magnet failures may affect the beam optics leading to proton losses in the collimators. These losses, with about 360MJ of stored energy per beam at nominal collision operation, are potentially dangerous for the accelerator equipment. The LHC Machine Protection Systems ensure that the beam is extracted safely before these losses can produce any damage. As a magnet failure develops, so does the distribution of the lost particles, longitudinally along the ring as well as transversally at each collimator. The transversal impact distributions of lost particles at the most affected collimators and their evolution with time have been studied for representative magnet failures in the LHC. It has been found that the impact distribution at a given collimator can be approximated by an exponential function with time-dependent parameters. The average impact parameter ranges from about 7 to 620 μm for the cases studied.
Sub Classif.: T19 Collimation and Targetry

Poster Panel 3

High Efficiency Collimation with Bent Crystals, **Said Hasan** (Univ. Insubria and INFN Milano, Como) **-** A revolutionary collimation approach is being developed by the H8RD22 collaboration. The basic idea is to replace the amorphous jaws, which spread the beam halo in the whole solid angle, with bent crystals, which are able to deviate the halo particles in a given direction outside the beam core. Studies to investigate the bent crystal properties have been carried out over the past 3 years at the H8 beam line (CERN SPS) with a 400 GeV/c proton beam. The crucial result of these studies is the observation of the Volume Reflection effect, the coherent scattering of the beam on the crystalline plane which provides a small but very efficient (respectively, 14 μrad and 98% at 400 GeV/c) particle deflection. The high efficiency (which should increase at higher energy) combined with a large angular acceptance (~100 μrad) led to the development of multi-reflection systems to increase the deflection angle. Nowadays this system has reached the stage to be tested in a circular accelerator as a primary collimator to verify the effective collimation efficiency in a complex environment. The second phase of the LHC collimation could be the first application of this crystal based system.
Sub Classif.: T19 Collimation and Targetry

Poster Panel 4

Preliminary Exploratory Study of Different Phase II Collimators, **Luisella Lari,** Chiara Bracco, (CERN, Geneva; EPFL, Lausanne), Ralph Assmann, Markus Brugger, Francesco Cerutti, Alfredo Ferrari, Marco Mauri, Stefan Roesler, Lucia Sarchiapone, Vasilis Vlachoudis (CERN, Geneva), Eric Doyle, Lewis Keller, Steven Lundgren, Thomas Walter Markiewicz, Jeffrey Claiborne Smith (SLAC, Menlo Park, California) - The LHC collimation system is installed and commissioned in different phases, following the natural evolution of the LHC performance. To improve cleaning efficiency towards the end of the low beta squeeze at 7 TeV and in stable physics conditions, it is foreseen to complement the 30 highly robust Phase I secondary collimators with low impedance Phase II collimators. At this stage, their design is not yet finalized. Possible options include metallic collimators, graphite jaws with a movable metallic foil or collimators with metallic rotating jaws. As part of the evaluation of the different designs, the FLUKA Monte Carlo code is extensively used for calculating energy deposition and studying material damage and activation. Using the preliminary design of the Phase II collimators as an example, this report illustrates the simulation approach, defines the critical quantities involved and evaluates the need for simplified and detailed simulations.
Sub Classif.: T19 Collimation and Targetry

Classification 2: Synchrotron Light Sources and FELs

Poster Panel 5

Design of LINAC Based Compact X-ray Source via Inverse Compton Scattering at Waseda University, **Akihiko Masuda**, Tomoko Gowa, Chiaki Igarashi, Takashi Kashino, Naoya Mitsuda, Kazuyuki Sakaue, Masakazu Washio (RISE, Tokyo), Ryunosuke Kuroda (AIST, Tsukuba, Ibaraki), Shigeru Kashiwagi (ISIR, Osaka), Hitoshi Hayano, Junji Urakawa (KEK, Ibaraki), Kiminori Ushida (RIKEN, Saitama) - A table-top size soft X-ray source based on inverse Compton scattering has been developed at Waseda University. We have already succeeded in generating X-rays via inverse Compton scattering between 4.6 MeV electron beam generated from a photocathode RF-gun and 1047nm Nd:YLF laser. The energy of the X-ray is within the 'water window' region which can be applied for the soft X-ray microscope for biological observation. In 2007, new RF-gun cavity with Cs-Te photocathode in place of copper has been installed. The energy of electron beam became up to 5.5MeV due to the increase of Q-value of the gun cavity. According to this achievement, generated X-ray energies will cover overall the 'water window' region. We are planning a multi-pulse inverse Compton scattering X-ray generation system in order to enhance a luminous intensity of the X-rays. For this purpose, we are considering a multi-pulse UV laser system for generating a multi-bunch electron beam, the method for beam loading compensation, and the multi-pulse IR laser system for the Compton collisions. Experimental results of X-ray generation and multi-pulse X-ray plans will be presented at the conference.
Funding Agency: Work supported by MEXT High Tech Research Project HRC707, JSPS Grant-in-Aid for Scientific Research (B)(2) 16340079.
Sub Classif.: A14 Advanced Concepts

Poster Panel 6

The Acceptance and Photon Beam Formation in SLS FEMTO Beamline, **Liza Murad Hovhannisyan**, Davit Kalantar Kalantaryan, Raphael Mikaelyan (CANDLE, Yerevan), Andreas Streun (PSI, Villigen) - The FEMTO insertion at the Swiss Light Source (SLS) produces sub-ps X-ray pulses by modulating the electron energy in a slice of the bunch through interaction with a fs-laser. The radiation from the sliced bunch in the FEMTO undulator of the SLS storage ring has been studied. Only photons passing all apertures of the beam line arrive at the experiment. We derive the transverse phase space distribution of these photons, the radiation spectra, and the spatial and angular distribution. Transmission of the radiated photons through the FEMTO beamline is calculated using the SRW simulation code in order to evaluate the acceptance of the beamline and the photon beam phase space distribution at the experimental station.
Sub Classif.: T15 Undulators and Wigglers

Classification 3: Linear Colliders, Lepton Accelerators and New Acceleration Techniques

Poster Panel 7

Beam-based Alignment for the CLIC Decelerator, **Erik Adli**, Daniel Schulte (CERN, Geneva) - The CLIC Drive Beam decelerator requires the beam to be transported with very small losses. Beam-based alignment is necessary in order to achieve this, and various beam-based alignment schemes have been tested for the decelerator lattice. The decelerator beam has an energy spread of up to 90%, which impacts the performance of the alignment schemes. We have shown that Dispersion-Free-Steering works well for the decelerator lattice. However, because of the transverse focusing approach, modifications of the normal DFS schemes must be applied. Tune-up scenarios for the CLIC decelerator using beam-based alignment are also discussed.
Sub Classif.: A03 Linear Colliders

Poster Panel 8

ATF2 Final Focus Orbit Correction and Tuning Optimisation, **Anthony Scarfe**, Robert Appleby (UMAN, Manchester), Deepa Angal-Kalinin, James Jones (STFC/DL/ASTeC, Daresbury, Warrington, Cheshire - ATF2 is an upgrade to the ATF facility at KEK, Japan consisting of a replacement to the current ATF extraction line and the addition of a final focus section. The final focus system has been designed, and is aiming to test, the local chromaticity correction scheme as proposed for future linear colliders. The final focus system focuses the ultra-low emittance beams at the collision point in the linear collider. To provide the required small beam sizes and to maintain the beam sizes to nanometer level requires optimised orbit correction and tuning procedures. In this paper, the optimisation of the orbit correction using a global SVD method is discussed, along with the progress on final focus tuning knob analysis. The tuning algorithms used at ATF2 will provide an important feedback for future linear colliders (including the ILC and CLIC).
Sub Classif.: A03 Linear Colliders

Poster Panel 9

Wake-fields and Beam Dynamics Simulations for ILC ACD Accelerating Cavities, **Christopher John Glasman**, Roger Michael Jones (UMAN, Manchester) - The ILC aims at colliding bunches of electrons and positrons at a centre of mass energy of 0.5 TeV and in a

proposed upgrade to 1 TeV. These bunches of charged particle are accelerated in superconducting linacs. The baseline design for the ILC relies on the relatively mature TESLA-style cavities, with a proposed gradient of more than 30 MV/m and is known as the baseline configuration document (BCD). However, here we investigate electromagnetic fields in superconducting cavities, with the potential to reach accelerating gradients in excess of 50 MV/m, and these are the subject of the alternative configuration document (ACD). We analyse the band structure and necessary damping requirement of the wake-fields in two design configurations: Cornell's re-entrant cavity and KEK's Ichiro cavity. The emittance dilution arising from beams subjected to injection offsets and from cavity misalignments are studied in beam dynamics simulations.
Sub Classif.: A08 Linear Accelerators

Poster Panel 10

Digital Acceleration Scheme of the KEK All-ion Accelerator, **Tanuja Sushant Dixit** (GUAS/AS, Ibaraki), Yoshio Arakida, Taiki Iwashita, Tadaaki Kono, Ken Takayama (KEK, Ibaraki), Kohji Okazaki (Nippon Advanced Technology Co. Ltd., Ibaraki-prefecture) - R&D works to realize an all-ion accelerator (AIA)*-capable of accelerating all ions of any possible charge state, based on the induction synchrotron concept, which was demonstrated using the KEK 12 GeV-PS in 2006 **, is going on. In the induction synchrotron, unlike an RF synchrotron, operational performance is not limited due to the frequency band-width, since the switching power supply to energize the induction acceleration system is triggered by signals obtained from the bunch monitor. For a POP experiment of AIA, argon ions will be accelerated in the KEK-500MeV booster ring, a Rapid Cycle Synchrotron (f=20Hz) and the RCS requires a dynamic change in the acceleration voltage. Since the induction acceleration voltage per pulse is fixed, a novel technique combining the pulse density control and intermittent operation of multi-acceleration cells has been proposed. The acceleration scheme of the AIA fully employing this technique was verified by computer simulation and demonstrated at our test facility, where a new induction acceleration cell generating an acceleration voltage pulse of 2msec long was triggered by a beam simulator to mimic a circulating Ar beam in the KEK-AIA

* K.Takayama,Y.Arakida, T.Iwashita,Y.Shimosaki, T.Dixit, K.Torikai, J. of Appl. Phys. 101, 063304 (2007).

** K. Takayama et al., Phys. Rev. Lett. 98, 054801 (2007).

Sub Classif.: A13 New Acceleration Techniques

Poster Panel 11

RF-breakdown Experiments at the CTF3 Two-beam Test-stand, **Magnus Johnson**, Tord Ekelöf, Roger Ruber, Volker Ziemann (UU/ISV, Uppsala), Hans-Heinrich Braun (CERN, Geneva) - The Two-beam Test-stand (TBTS) in the CLIC Test Facility CTF3 offers unique possibilities to conduct RF-breakdown related experiments on the accelerating structures and the power extraction and transfer structures with beam. We report on the set-up of two such experiments, one for the measurement of the transverse kick and the other for the measurement of positive ion currents. The purpose of the transverse kick measurements is to determine the effects of a RF-breakdown event on the beam. Five BPMs in the TBTS will be used to study the trajectory of a pulse train after a RF-breakdown event, with important implications for the operation of CLIC. Ion currents ejected from accelerating structures during RF-breakdown events have already been observed at the 30 GHz test stand at the present test facility. Results and their implications for RF-breakdown physics are presented, as well as plans for similar measurements at the TBTS.
Funding Agency: Swedish Research Council, Knut and Alice Wallenberg Foundation.
Sub Classif.: A13 New Acceleration Techniques

Poster Panel 12

WEOBG02 - Experimental Results of a Plasma Wakefield Accelerator Using Multiple Electron Bunches, **Efthymios Kallos**, Tom Katsouleas, Patric Muggli (USC, Los Angeles, California), Igor Pavlishin, Igor Pogorelsky, Daniil Stolyarov, Vitaly Yakimenko (BNL, Upton, Long Island, New York), Wayne D. Kimura (STI, Washington) - We present some preliminary experimental results of a plasma wakefield accelerator technique which utilizes multiple electron bunches in order to drive a plasma wave. The experiments were performed at the Accelerator Test Facility of Brookhaven National Laboratory where 5-8 equidistant bunches with a spacing which was varied between 100-200 m were fed into a 6mm-long capillary discharge plasma. By varying the time delay of the bunches with respect to the discharge different plasma densities could be tuned, and the effects of the plasma on the bunches were recorded. Such multiple bunch schemes are of great interest because they can provide increased efficiencies and high transformer ratios for advanced accelerators.
Sub Classif.: A13 New Acceleration Techniques

Poster Panel 13

Ultrashort x-ray radiation from a Laser Wakefield Accelerator, **Valentine Leurent**, Laurent Divol, Dustin Froula, Siegfried Glenzer, Pierre Michel, John Palastro (LLNL, Livermore, California), Bradley Bolt Pollock (LLNL, Livermore, California; UCSD, La Jolla, California), George Tynan (UCSD, La Jolla, California) - A Laser Wakefield Accelerator (LWFA) is under development at LLNL Jupiter Laser Facility to produce multi-GeV electron bunches promising to provide a bright and compact source of x-ray radiation for high energy density studies. The interaction of a high power (200

TW), short laser (50 fs) pulse with neutral He gas can accelerate monoenergetic electrons up to 1 GeV in a stable self-guiding regime*, over a dephasing length of 1 cm (for a plasma density of 1.5x10^18 cm^-3), overcoming the limitation of vacuum diffraction and allowing long interaction lengths for LWFA. The waveguide can be extended over several centimeters by using a novel scheme, which employs an external magnetic field (up to 5 T uniform along 12 cm) to control the radial heat flux** resulting from the interaction of a high energy (100 J), long pulse (1 ns) laser with a gas tube. The acceleration of electrons over several centimeters can produce multi-GeV bunches and thus a powerful x-ray source. Analysis will be presented on femtosecond x-ray radiation produced by wiggling an electron bunch with energy above 1 GeV in this new LWFA scheme.

* W.Lu et al., Phys. Rev. Spec. Top-ac 10, 061301 (2007)
** D.H. Froula et al., Phys. Rev. Lett. 98, 135001 (2007)

Funding Agency: This work is supported by LDRD 08-LW-070 and performed under the auspices of the U.S. Department of Energy by LLNC under contract DE-AC52-07NA27344.

Sub Classif.: A13 New Acceleration Techniques

Poster Panel 14

Experimental Demonstration of Ultrashort μJ-Class Pulses in the Terahertz Regime from a Laser Wakefield Accelerator, **Guillaume Plateau**, Cameron Guy Robinson Geddes, Nicholas Matlis, Carl Bernhardt Schroeder, Csaba Toth, Jeroen van Tilborg (LBNL, Berkeley, California), Eric Esarey, Wim Leemans (LBNL, Berkeley, California;, Reno, Nevada) - Ultrashort terahertz pulses with energies in the μJ range can be generated with laser wakefield accelerators (LWFA), which are novel, compact accelerators that produce ultrashort electron bunches with energies up to 1 GeV* and energy spreads of a few-percent. Laser pulses interacting with a plasma create accelerated electrons which upon exiting the plasma emit terahertz pulses via transition radiation. Because they are only tens of femtoseconds long, electron bunches can radiate coherently (CTR) in a wide bandwidth (~ 110 THz) yielding terahertz pulses of high intensity**,***. In addition to providing a non-invasive bunch-length diagnostic**** and thus feedback for the LWFA, these high peak power THz pulses are suitable for high field (MV/cm) pump-probe experiments. Here we present energy-based measurements using a Golay cell and a single-shot electro-optic technique which were used to characterize the full waveform of these μJ-class THz pulses, including phase and amplitude information.

* W.P. Leemans et al. N.P. 2/696 (2006).
** W.P. Leemans et al. P.R.L. 91/074802 (2003).
*** C.B. Schroeder et al. P.R.E 69/016501 (2004).
**** J. van Tilborg et al. P.R.L. 96/014801 (2006).

Funding Agency: This work supported by US DoE Office of High Energy Physics and DARPA.

Sub Classif.: A13 New Acceleration Techniques

Poster Panel 15

X and Ku Band Metallic Photonic Band Gap Accelerator Structure Design, **Roark A. Marsh**, Michael A. Shapiro, Richard J. Temkin (MIT/PSFC, Cambridge, Massachusetts) - The damping of wakefields is a critical issue in high gradient accelerators, and is very important in the next generation of accelerator structures. Photonic band gap (PBG) structures have uniquely motivated damping properties, and offer significant wakefield damping. The design considerations of PBG structures are similar to those for any accelerator structure, and can be separated into gradient, pulsed heating, coupling, and HOM damping concerns. In all of these areas PBG structures are slightly different than standard pillbox structures, and offer some novel solutions to typical problems, which must be considered when designing PBG structures. In preparation for breakdown studies to be done at SLAC and MIT these concerns are addressed for X-band and Ka band metallic PBG accelerator structures.

Funding Agency: Work supported by DoE HEP, under contract DE-FG02-91ER40648.

Sub Classif.: A14 Advanced Concepts

Poster Panel 16

Studies of Volume Reflection and Channeling Effects in Bent Crystals Using Ultrarelativistic Lepton Beams, **Davide Bolognini** (Univ. Insubria and INFN Milano, Como) - The behaviour of silicon bent crystals with 180 GeV/c electron and positron beams has been investigated by the H8RD22 collaboration on the H8 beamline at the CERN SPS. This work describes the analysis performed on the volume reflection and channeling parameters (deflection angle and efficiency) and the study of the high energy photons (less than ~100 GeV) emitted by particles undergoing these effects. A dedicated spectrometer has been developed to measure the energy spectrum: photon and charged particle beams have been separated by a bending magnet and leptons were detected and tagged by microstrip silicon detectors and a Pb-scintillator sampling calorimeter; the comparison between the experimental and analytical data shows a good agreement. Starting from these results, the collaboration is planning to develop a new setup to obtain a better separation between lepton and photon beams and the evaluation of the energy spectrum with a better resolution.

Sub Classif.: T19 Collimation and Targetry

Classification 4: Hadron Accelerators

Poster Panel 17

The Rapid Cycling Synchrotron of the EURISOL Beta Beam Facility, **Antoine Lachaize** (IPN, Orsay) - The aim of the Beta Beam project is to produce pure beams of electron neutrinos (or antineutrinos) through the beta-decay of radioactive ions circulating in a high energy storage ring. In 2004, it was decided to incorporate a design study of a facility based on the use of existing CERN machines within the EURISOL design study proposal. This poster presents this Beta Beam facility proposed by CERN with an emphasis on the design of the Rapid Cycling Synchrotron which is needed and designed to avoid decay losses at low energy and to inject radioactive ions in the CERN PS.
Sub Classif.: A04 Circular Accelerators

Poster Panel 18

The Study of the Lattice of the Carbon Ion Therapy Facility Synchrotron with Electron Cooling, **Sergey Sinyatkin**, Vladimir Afanasievitch Kiselev, Vasily Parkhomchuk, Vladimir Borisovich Reva, Vladimir Vostrikov (BINP SB RAS, Novosibirsk) - In this paper the preliminary design of magnet lattice of the Carbon Ion Therapy Facility with electron cooling is described. The influence of misalignments of magnetic elements on ring parameters and the layout of orbit correction are estimated. The different methods of ion extractions from the synchrotron are considered, i.e., the pellet extraction, recombination extraction and the extraction on the sextupole resonance.
Sub Classif.: A04 Circular Accelerators

Poster Panel 19

Preliminary Design of a Highly-flexible Extraction Scheme for the USR, **Philipp Schmid**, Manfred Grieser, Kai-Uwe Kuehnel (MPI-K, Heidelberg), Alexander Ivanovich Papash (JINR, Dubna, Moscow Region), Carsten Peter Welsch (KIP, Heidelberg; MPI-K, Heidelberg; GSI, Darmstadt) - In the future Facility for Low-energy Antiproton and Ion Research (FLAIR) at GSI, the Ultra-low energy electrostatic Storage Ring (USR) will provide cooled beams of antiprotons and possibly also highly charged ions down to energies of only 20 keV/q. Beams with small momentum spread and low emittance will enable a wide range of hitherto impossible experiments. The large variety of planned experiments requires a highly flexible longitudinal time structure of the extracted bunches, ranging from ultra-short pulses in the nanosecond regime to quasi DC beams. In this contribution, a preliminary design of the extraction scheme is presented. Furthermore, possible solutions for the compensation of effects from the extraction region on the very-low energy beam are shown, including results from beam transport calculations.
Sub Classif.: A07 Electrostatic Accelerators

Poster Panel 20

Laser Cooling of Bunched Ion Beam at S-LSR, **Hikaru Souda**, Masahiro Ikegami, Takehiro Ishikawa, Masao Nakao, Akira Noda, Toshiyuki Shirai, Mikio Tanabe, Hiromu Tongu, Masako Yamada (Kyoto ICR, Uji, Kyoto) - S-LSR is an ion storage ring equipped with an electron cooler and a laser cooling system. The laser cooling experiments of coasting beams were carried out during last year*. Now we started bunched beam laser cooling. 40keV Mg+ beams are bunched by an untuned RF cavity for harmonic number 5-50, and is cooled by a single 280nm laser. Bunch length are measured by electrostatic pickups. When RF harmonic number is five, bunch lengths is shorten from 1m to under 0.14m by laser cooling. Since the bunch length after cooling is shorter than present monitor resolution, fluorescence measurement is in preparation. We have installed another small RF cavity for harmonic number 100. Synchrotron-betatron coupling will be induced by dispersion at the place of this cavity**. This effect is expected to realize three dimensional laser cooling. In this paper we present the result of bunched beam cooling and the trial to three dimensional laser cooling.
* M. Tanabe et al. Appl. Phys. Express, in press.
** H. Okamoto. Phys. Rev. E 50, 4982 (1994).
Funding Agency: This work is supported by Advanced Accelerator Development Project of MEXT, the 21st COE program "Centre for Diversity and Universality in Physics" and the Grant-in-Aid for JSPS Fellows.
Sub Classif.: A11 Beam Cooling

Poster Panel 21

IFMIF-EVEDA RFQ Design, Andrea Pisent, Michele Comunian, Antonio Palmieri (INFN/LNL, Legnaro, Padova), **Francesco Grespan** (INFN/LNL, Legnaro, Padova;, Milano), Enrico Fagotti, Piero Antonio Posocco (INFN/LNL, Legnaro, Padova;, Padova), Adriano Pepato (INFN-Sez. Di Padova and U. degli Studi di Padova, Padova) - The RFQ of IFMIF-EVEDA project is characterized by very challenging specifications, with 125 mA of deuteron accelerated up to 5 MeV. After the long period of conceptual and comprehensive design of IFMIF accelerator, the decision of the construction of its low energy part has implied a new analysis of the RFQ design. In particular the beam dynamics design has been optimized, with a consistent reduction of the structure length and power consumption, and improvement of the performances in terms of beam losses. The resonator, of four vanes kind, has been designed taking advantage of the theoretical background and experimental experience gained in Europe with IPHI and TRASCO projects. The mechanical design has been analysed considering

different approaches, involving vacuum brazing, laser or e-beam welding.
Sub Classif.: A15 High Intensity Accelerators

Poster Panel 22
Beam Dynamics Studies and Triple-spoke SC Cavity Design for the EURISOL Driver, **Aurélien Ponton** (IPN, Orsay) - The EURISOL project is aimed at the design - and subsequent construction - of the 'next-generation' European ISOL radioactive ion beam (RIB) facility. Exotic nuclei production will be at least 100 times higher than the one attainable in current facilities or those under construction (HIE-ISOLDE, SPES, SPIRAL2). In this frame, IPN Orsay is coleading the design of a superconducting (SC) linear driver dedicated to the acceleration of high intensity primary beams of protons, deuterons and 3He2+ up to, respectively, 1GeV, 250MeV and 2GeV with a maximum power of 5MW into the production targets. We will firstly present the beam dynamics studies such as end-to-end and beam losses calculations of the Linac. Then, we will detail the electromagnetic design of a 352 MHz, beta 0.3, triple-spoke SC cavity, for which a high accelerating gradient of 8MV/m is expected.
Sub Classif.: A15 High Intensity Accelerators

Poster Panel 23
Residual Activity Induced by High-energy Heavy Ions in Stainless Steel and Copper, **Ivan Strasik**, Ingo Hofmann, Ekaterina Kozlova, Edil Mustafin (GSI, Darmstadt), Andrey Smolyakov (ITEP, Moscow), Ludmila Nikolaevna Latysheva, Nikolai Sobolevskiy (RAS/INR, Moscow), Marius Pavlovic (STU, Bratislava) - The activation of accelerator structures due to beam loss is already intensity limiting problem for existing (SNS or RHIC) and planned (LHC or FAIR) hadron facilities. While beam-losses of 1 W/m are recognized as a tolerable beam-loss level for proton machines, the beam-loss tolerances for high-power heavy-ion accelerators have not yet been quantified. In this work the residual activity was calculated by Monte-Carlo particle transport codes and compared with experimental data. Simulations were performed for projectiles from proton to uranium. Experiments were performed with uranium ions at 120, 500 and 950 MeV/u irradiating copper and stainless steel targets. It was found that the isotope inventory contributing over 90% to the total activity does not depend on the projectile species, it depends only on the target material and projectile energy. This allowed establishing a scaling law for induced activity as a function of ion mass. The activity per nucleon induced by ion scales down with increasing ion mass. For example, 1 GeV/u uranium ion induces 5-times less activity per nucleon compared to 1 GeV proton. Thebeam-loss criteria for different projectile species are presented.
Sub Classif.: A15 High Intensity Accelerators

Poster Panel 24
Development of Piezoelectric Pulse Gas Valve for Small ECR Ion Source, **Masahiro Ichikawa**, Hiroshi Fujisawa, Yoshihisa Iwashita, Yujiro Tajima, Hiromu Tongu, Masako Yamada (Kyoto ICR, Uji, Kyoto) - In a conventional ion source, the source gas is continuously fed even in its pulse operation. This requires a high load to a vacuum pumping system. The situation is prominent when the gas load is relatively higher in such a high current ion source. In order to improve this situation, we try to supply gas only when it is needed by synchronizing the gas feed with the extraction of the ion beam. We have developed a small pulse-gas-valve using a commercially available disc-shape piezoelectric element. This valve is small enough to be mounted in our ECR ion source and is capable of very fast open-and-close operation of an order of kHz repetition. A small ECR ion source with this valve will be presented.
Sub Classif.: T01 Proton and Ion Sources

Poster Panel 25
Measurement of Ion Beam from Laser Ion Source for RHIC EBIS, **Takeshi Kanesue** (Kyushu University, Fukuoka), Masahiro Okamura (BNL, Upton, Long Island, New York), Jun Tamura (Department of Energy Sciences, Yokohama) - Laser ion source (LIS) is a candidate of the primary ion source for the RHIC EBIS. LIS will provide intense charge state 1+ ions to EBIS for further ionization. We measured plasma properties of a variety of atomic species such as Si, Fe and Au using the second harmonics of Nd:YAG laser (532 nm wave length, up to 0.82 J / 6 ns). Since a suitable laser power density for production of charge state 1+ ions is different from different species, laser power density was optimized to obtain a maximum beam intensity in each species. Also the results of emittance measurement using pepper pot after ion extraction with about 20 kV extraction voltage will be shown. Based on the obtained results, performance of the LIS as the primary ion source for EBIS will be discussed in this paper.
Funding Agency: **W**ork performed under contract No. DE-AC02-98CH10886 under the auspices of the United States DOE and with the support of RIKEN (Japan).
Sub Classif.: T01 Proton and Ion Sources

Poster Panel 26
Efficiency and Time Response Measurement of Diverse Target Ion Sources with Stable Alkali, **Alexandre Pichard**, Juan Antonio Alcantara Nunez, Robert Alves Conde, Mickael Dubois, Pascal Jardin, Jean Yves Pacquet, Marie Genevieve Saint Laurent (GANIL, Caen) - Developments of new radioactive beams and thus of new isotope-separator-on-line (ISOL) production systems are being undertaken at GANIL. The measurement of total efficiency and time behaviour of these new target-ion-source (TIS) systems is a crucial step for these devices devoted to the production of very short

lived isotopes with an high intensity. The overall efficiency can be extracted from the ratio between the flux emerging from the TIS and the flux implanted. Several methods have already been developed to achieve these measurements: using a stable beam from an accelerator*, using a variable gas leak** or by implantation of radioactive beams***. This paper deals with a method using stable and condensable elements. A pulsed alkali ion gun has been built and will be used to gauge diverse TIS: NanoNaKe, a compact 1+/N+ alkali production system for Spiral I, SISTHE a surface ionisation source prototype to study the alkali ion source for Spiral II, and the target ion source prototype for Spiral II.

* R. Kirchner NIM B70 (1992)186

** Welton R.F. et al., RSI vol. 67 n°3 (1996) p. 1353

*** N. Lecesne et al., NIM B126 (1997) 141-145

Sub Classif.: T01 Proton and Ion Sources

Poster Panel 27

Beam Dynamics and Extraction of SCENT, a 300 AMeV Superconducting Cyclotron Dedicated to Hadrontherapy, **Daniela Campo**, Luciano Calabretta, Mario Maggiore, Leandro Amos Cristiano Piazza (INFN/LNS, Catania) - SCENT is a superconducting cyclotron able to deliver proton and C beam at 260 and 300 AMeV respectively. The isochronous magnetic fields for the acceleration H2 and Carbon beam together with the isochronous phase and the Nr and Nz along the acceleration path will be presented and discussed. During the acceleration the beam has to cross some resonance, the most dangerous being the Nr=4/3. The simulation study here reported shows that it is possible to cross this resonance without a serious emittance grow. The beam simulation for the beam injection trough the central region and the beam extraction through the Electrostatic deflector for Carbon beam, and by stripper for the proton beam will be also presented.

Sub Classif.: T12 Beam Injection/Extraction and Transport

Classification 5: Beam Dynamics and Electromagnetic Fields

Poster Panel *28*

Correction of Round Beam Lattice of VEPP-2000 Collider Using Orbit Response Technique, **Alexander Leonidovich Romanov**, Dmitry E. Berkaev, Alexander N. Kirpotin, Ivan Koop, Evgeny Perevedentsev, Yury Rogovsky, Dmitry Shwartz (BINP SB RAS, Novosibirsk) - Round colliding beams option in VEPP-2000 puts a number of strict requirements on the collider lattice. Orbit Response Matrix (ORM) technique is a versatile tool for lattice analysis and correction. For linear optical function study and correction, the orbit response to the dipole correctors is collected and processed, while for the orbit correction the quadrupole trimming is used. Theoretical and experimental responses of closed orbit on the same perturbations are compared to determine the most probable deviations of chosen parameters from its project values. Various approaches are presented in using this technique for correcting the lattice of VEPP-2000.

Sub Classif.: D01 Beam Optics**,** Lattices, Correction Schemes, Transport

Poster Panel 29

Beam Loss and Collimation Studies for the PS2, **Javier Barranco**, Wolfgang Bartmann, Michael Benedikt, Yannis Papaphilippou (CERN, Geneva) - The high intensity beams with different emittances foreseen to be delivered by the PS2, an upgraded version of the actual CERN Proton Synchrotron, require strict control of beam losses in order to protect the machine components and enable their hands-on maintenance. Beam loss simulations based on dedicated numerical tools are undertaken for a variety of PS2 beams and for different loss mechanisms, along the whole accelerating cycle. In this respect, the design of a collimation system is presented and its performance is compared within different lattice options.

Sub Classif.: D02 Non-linear Dynamics**,** Resonances, Tracking, Higher Order

Poster Panel 30

Field Interference of Magnets in the Large Acceptance Storage Ring CR of the Fair Project, **Oleksii Gorda**, Christina Dimopoulou, Alexei Dolinskii, Fritz Nolden, Markus Steck (GSI, Darmstadt) - The large acceptance storage ring CR is planned to be used for accumulation and cooling of rare isotope and antiproton beams at the future FAIR accelerator facility. The huge apertures as well as the close arrangement of the dipoles and quadrupoles make overlapping between the end fields of the magnets unavoidable. In addition, corrector magnets are planned to be installed in the drift sections between the dipoles and quadrupoles for closed orbit corrections. The presence of additional iron can have a significant influence on the magnetic field distribution. This interference can lead to a reduction of the integral field quality decline that is undesirable since it can affect the beam dynamics. In this contribution we present the results of 3D magnetic field simulations performed using the OPERA computer code. The field maps were derived and further analyzed. The corresponding sets of multipole components were calculated and were then implemented into one of the codes for the beam dynamics calculations. The MAD code was used to calculate the dynamic aperture and to estimate the effect of the fieldinterference

on the beam dynamics of the ring.
Sub Classif.: D02 Non-linear Dynamics, Resonances, Tracking, Higher Order

Poster Panel 31

Closed Orbit Correction and Sextupole Compensation Schemes for Normal-conducting HESR, **Dominic Markus Welsch**, Andreas Lehrach, Bernd Lorentz, Rudolf Maier, Dieter Prasuhn, Raimund Tölle (FZJ, Jülich) - The High Energy Storage Ring (HESR) will be part of the future Facility for Antiproton and Ion Research (FAIR) located at GSI in Darmstadt, Germany. The HESR will be operated with antiprotons in the momentum range from 1.5 to 15 GeV/c, which makes a long beam life time and a minimum of particle losses crucial. This and the demanding requirements of the PANDA experiment lead to the necessity of a good orbit correction and an effective multipole compensation. We developed a closed orbit correction scheme and tested it with Monte Carlo simulations. We assigned different sets of angular and spatial errors to all elements (magnets, bpms, etc.) within the lattice of the HESR. For correction we applied the orbit response matrix method. We carried out investigations concerning higher-order multipoles and created a scheme for chromaticity correction and compensation of arising resonances utilising analytic formulae and dynamic aperture calculations. In this presentation we give an overview of the correction and compensation schemes and of the corresponding results.
Sub Classif.: D02 Non-linear Dynamics, Resonances, Tracking, Higher Order

Poster Panel 32

The VEPP-4M Dynamic Aperture Determination with Beam-beam Effects, **Andrey N. Zhuravlev**, Vladimir Afanasievitch Kiselev, Evgeny Levichev, Oleg I. Meshkov, Pavel Piminov, Dmitry Shatilov, Victor Smaluk (BINP SB RAS, Novosibirsk) - To determine experimentally the particle stable area under the influence of beam-beam effects in the electron-positron collider VEPP-4M we measure the beam lifetime with high accuracy as a function of moving aperture. The measurement is performed by a photodiode installed in the collider diagnostic beam line. The experimental setup and the measurement results are described. Comparison with the tracking simulation is presented.
Sub Classif.: D02 Non-linear Dynamics, Resonances, Tracking, Higher Order

Poster Panel 33

Gamma Transition Jump for PS2, **Wolfgang Bartmann**, Michael Benedikt, Elias Métral, Dieter Möhl (CERN, Geneva) - The PS2, which is proposed as a replacement for the existing ~50-year old PS accelerator, is presently considered to be a normal conducting synchrotron with an injection kinetic energy of 4 GeV and a maximum energy of 50 GeV. One of the possible lattices (FODO option) foresees crossing of transition energy near 10 GeV. Since many intensity dependent effects can take place in both the longitudinal and the transverse planes a fast jump of gamma transition is necessary in order to pass the non-adiabatic region rapidly. The aim of the present paper is on the one hand to scale the gamma transition jump, used since 1973 in the PS, to the projected PS2 and on the other hand based on these results the analysis of the implementation and feasibility of a gamma transition jump scheme in a conventional FODO lattice.
Sub Classif.: D03 High Intensity, Incoherent Instabilities, Space Charge, Halos, Cooling

Poster Panel 34

Halo Characterization of Initially Mismatched Beams through Phase-space Modeling, **Roger Pizzato Nunes**, Felipe Barbedo Rizzato (IF-UFRGS, Porto Alegre) - This work will show a method of characterizing the beam halo particles with just some assumptions about the entire beam phase-space topology. At equilibrium, the beam phase-space can be segmented in almost two distinct regions: a thin horizontal branch over the r axis that is populated by the core particles, and a curve branch in the dr/ds x r plane, which is populated by the halo particles. Since these regions have a regular shape, then it is readily possible to convert them to an analytical expression. This is useful because with this approach both halo and core populations can be expressed thought particle densities, propitiating that any desired beam macroscopic quantities, like the envelope and emittance, can be analytically evaluated. Two distinct shapes has been employed (circular and elliptical) to model the beam halo branch, once this phase-space region has been shown to be dependant of the initial beam mismatch. With this, all usual initial beam mismatch values are covered with accuracy. Full self-consistent N-particle beam simulations have been carried out and its results compared with the ones obtained with the model. Results agreed nice for all analyzed mismatch cases.
Sub Classif.: D03 High Intensity, Incoherent Instabilities, Space Charge, Halos, Cooling

Poster Panel 35

Anisotropic Kinetic and Dynamics Process in Equipartitioned Beams, **Wilson Simeoni** (IF-UFRGS, Porto Alegre) - This paper examines the transition from isotropic to anisotropic beam profiles in a linear focusing channel.Considering a high-intensity ions beam in space-charge dominated regime and large mismatched beam size-rms initial, observe its a fast anisotropy situation of the beam characterized for a transition of the transversal section round to elliptical with a coupling of transversal emittance driven for instabilities of space-charge forces.The anisotropization phenomena suggest a kind of route to equipartition.In order to understand the initial dynamical behavior of an anisotropic beams, in particular,

to study possible mechanisms of equipartition connected with phase space we have to know how we can compute the variables (volume, area and area projected) that characterize the anisotropic beam in phase space.An important question is to understand why non-uniform distributions emerge in a system.We argue that non-uniform distributions arise when microscopic constraints are in action.In that case, the accessible phase space can have complicated geometrical structure. The purpose of the present paper is to formulate a Boltzmann-type kinetic theory on phase space of anisotropic beams.
Sub Classif.: D03 High Intensity**,** Incoherent Instabilities, Space Charge, Halos, Cooling

Poster Panel 36

Analysis of Collective Effects at the Diamond Storage Ring, Riccardo Bartolini, Chris Christou, **Richard Fielder**, Morten Jensen, Alun Morgan, Shivaji Apparao Pande, Guenther Rehm, Cyrille Thomas (Diamond, Oxfordshire) - The Diamond storage ring has achieved its nominal operating current of 300 mA in multi-bunch mode and up to 10 mA in single bunch mode. Several collective instabilities have been observed and their dependence on machine parameters such as chromaticities, RF voltage and fill pattern have been investigated. We report here the analysis of the observed current thresholds and rise times of the instabilities compared with analytical estimates and tracking simulations. We also present the results of the MAFIA simulations performed with the aim of understanding the main contribution to the impedance of the ring and establishing a machine impedance database.
Sub Classif.: D04 Instabilities**,** Processes, Impedances, Countermeasures

Poster Panel 37

Transverse Mode-coupling Instability in the CERN SPS: Comparing MOSES Analytical Calculations and HEADTAIL Simulations with Experiments in the SPS, **Benoit Salvant** (EPFL, Lausanne), Rama Calaga (BNL, Upton, Long Island, New York), Gianluigi Arduini, Owain Rhodri Jones, Elias Métral, Giulia Papotti, Giovanni Rumolo, Ralph Steinhagen, Rogelio Tomas (CERN, Geneva) - Since 2003, single bunches of protons with high intensity (1.2e11 protons) and low longitudinal emittance (0.2 eVs) have been observed to suffer from heavy losses in less than one synchrotron period after injection at 26 GeV/c in the CERN Super Proton Synchrotron (SPS) when the vertical chromaticity is corrected. Understanding the mechanisms underlying this instability is crucial to assess the feasibility of an anticipated upgrade of the SPS, which requires bunches of 4e11 protons. Analytical calculations from MOSES and macroparticle tracking simulations using HEADTAIL with an SPS transverse impedance modelled as a broadband resonator had already qualitatively and quantitatively agreed in predicting the intensity threshold of a fast instability. A sensitive frequency analysis of the HEADTAIL simulations output was then done using SUSSIX, and brought to light the fine structure of the mode spectrum of the bunch coherent motion. A coupling between the azimuthal modes -2 and -3 was clearly observed to be the reason for this fast instability. The aim of the present paper is to compare the HEADTAIL simulations with dedicated measurements performed in the SPS in 2007.
Sub Classif.: D04 Instabilities**,** Processes, Impedances, Countermeasures

Poster Panel 38

Wakefields and Impedance Model in the CSNS/RCS Ring, **Na Wang**, Qing Qin (IHEP Beijing, Beijing) - With the more general expressions developed for the wakefield generated by nonrelativistic beam*, the impedances of some main vacuum parts of the Rapid Cycling Synchrotron (RCS) of the China Spallation Neutron Source (CSNS) are calculated and compared with the relativistic case. An impedance model is then proposed for the ring. With this impedance model, beam instabilities in the CSNS/RCS are investigated.

* N. Wang and Q. Qin, Phys. Rev. ST Accel. Beams 10, 111003 (2007)

Sub Classif.: D04 Instabilities**,** Processes, Impedances, Countermeasures

Poster Panel 39

Beam Dynamics Using Graphical Processing Units (GPUs) and the GPMAD Code, Robert Appleby, David Bailey, **Michael David Salt** (UMAN, Manchester) - Simulation of particle beam dynamics in accelerators is computationally expensive, and requires very high particle statistics and accuracy. Conventional beam tracking tools operate sequentially on particle phase space to compute the trajectories of particles through many turns of circular, and linear, machines. Graphical Processing Units (GPUs) utilise stream processing techniques to dramatically speed up parallel computational tasks, and offer considerable performance benefits to particle beam dynamics processing. In this paper, the stream processing beam dynamics code GPMAD is presented, which exploits the NVidia GPU processor, and demonstrates the considerable performance benefits to particle tracking calculations. The accuracy and speed of GPMAD is benchmarked using the Diamond Light Source BTS lattice, and the collimation system is evaluated.
Sub Classif.: D05 Code Developments and Simulation Techniques

Poster Panel 40

A Kinetic Model of Multipaction for SRF Cavities for Accelerator Driven Sub-critical System (ADSS), **Shreya Ghatak**, Nandini Gupta (IITK, Kanpur), Asavari Santosh Dhavale, Kailash Chandra Mittal (BARC,

Mumbai) - This work simulates multipaction in a 700 MHz elliptical SRF cavity. The cavity design was optimized using SUPERFISH. Then the electromagnetic field was re-computed with FEMLAB, a package using the finite element method, to obtain a more accurate field-mapping, and to make the field values available for computation of multipaction. In the multipacting subroutine, electrons were assumed to be released into the system from various points with different initial parameters. The electrons trajectories were tracked until they hit the cavity surface. Leap-frog scheme was used to solve the Lorentz force equation for primary electrons, as it is easy to use and is accurate up to second order. The position, velocity, phase and kinetic energy of primary electrons at each time step were calculated and stored. An interpolation function was used to calculate secondary emission yield (SEY) at different impact energies. With the emission of secondary electrons, their trajectories too were tracked along with primary electrons, in order to identify parameters responsible for multipaction. By repeating this process for large number of electrons, the multipacting trajectories were identified.
Sub Classif.: D05 Code Developments and Simulation Techniques

Poster Panel 41
Crystalline Beam Simulations, **Dmitry Krestnikov** (JINR/DLNP, Dubna, Moscow region), Igor Meshkov, Anatoly O. Sidorin, Alexander V. Smirnov, Grigory Trubnikov (JINR, Dubna, Moscow Region) - A new program code was elaborated for the simulation of crystalline beams on the S-LSR storage ring (Kyoto Univ., Japan) under action of the cooling system. For the investigation of ordered proton beams, which recently were observed in first time on S-LSR, a special molecular dynamics technique was used. This article presents results of the numerical simulation and comparison with experimental data.
Sub Classif.: D05 Code Developments and Simulation Techniques

Classification 6: Instrumentation, Controls, Feedback & Operational Aspects

Poster Panel 42
TUOCM01 - First Measurements of the Longitudinal Bunch Profile at SLAC Using Coherent Smith-Purcell Radiation, **Victoria Blackmore**, George Doucas, Colin Perry (OXFORDphysics, Oxford, Oxon), Mike Woods (SLAC, Menlo Park, California), Maurice Kimmitt (University of Essex, Colchester)
Registered Victoria Blackmore - Coherent Smith-Purcell radiation has been demonstrated as a technique for measuring the longitudinal profile of charged particles bunches in the low to intermediate energy range. However, with the advent of the International Linear Collider, the need has arisen for a non-invasive method of measuring the bunch profile at extremely high energies. Smith-Purcell radiation has been used for the first time in the multi-GeV regime to measure the longitudinal profile of the 28GeV SLAC beam. The experiment has both successfully determined the bunch length, and has also demonstrated its sensitivity to bunch profile changes. The challenges associated with this technique, and its prospects as a diagnostic tool are reported here.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 43
Numerical and Experimental Investigation of the Contamination of X-ray Beam Position Monitors by Bending Magnet Edge Radiation, **Christopher Bloomer**, Guenther Rehm, Cyrille Thomas (Diamond, Oxfordshire) - The details of an investigation into bending magnet edge radiation at Diamond are discussed, reviewing the effects of this radiation on X-ray Beam Position Monitoring (XBPM) equipment. For some time it has been recognized that there are difficulties using XBPMs for determining the centre of mass position of an undulator beam due to contamination from bending magnet radiation. While the geometry of the XBPM blades is designed to help reduce background dipole interference, this radiation is known to account for approximately 1% of the signal received, skewing the calculated beam position by several micrometres. We made detailed models of the bending magnet edge radiation using the SRW program and used Matlab to analyse the data. We present this model and compare our prediction to experimental results obtained at Diamond.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 44
Beam Diagnostics with IR Light Emitted by e+ at DAFNE, **Alessio Bocci**, Mariangela Cestelli Guidi, Alberto Clozza, Alessandro Drago, Antonio Grilli, Augusto Marcelli, Agostino Raco, Rossano Sorchetti (INFN/LNF, Frascati (Roma)), Pace Emanuele, Lisa Gambicorti (, Firenze), Massimo Piccinini (, Roma; INFN/LNF, Frascati (Roma)), J. Piotrowski (, Warsaw) - Real-time beam diagnostics is mandatory in accelerators and represents one of the most challenging issues of modern storage rings and future FEL's. Recently, compact mid-IR fast uncooled photo-detectors have been used at DAFNE to monitor single e- bunches using the SINBAD IR beamline installed on the e- ring*. Electron bunches have a FWHM of 150-300 ps and are separated by 2.7 ns**. Detectors performances are then suitable for a compact and low cost bunch-by-bunch longitudinal

diagnostic device. To improve the DAFNE diagnostic a bending magnet SR port on the e+ ring has been set-up with a HV chamber, a gold-coated plane mirror and a ZnSe window. To collect the SR light and focus radiation on IR detectors allowing the diagnostic of e+ a compact optical system has been installed in air after the window. Here we will present the status of the apparatus, the source characteristics, the optical setup and the complete acquisition system. This IR port will allow comparison in the ns time domain between data collected on both rings, and could be also used to improve DAFNE diagnostics, i.e., identify and characterize bunch instabilities and/or increase the current in the e+ ring.

* M. Cestelli Guidi et al. J. Opt. Soc. Amer. A 22, 2810 (2005).

** A. Bocci et al. NIM-A, 580, 190 (2007).

Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 45

Fermi Low-energy Transverse RF Deflector Cavity, Paolo Craievich, Sandra Biedron, Cristian Bontoiu, Simone Di Mitri, Mario Ferianis, Marco Veronese (ELETTRA, Basovizza, Trieste), Luca Ficcadenti (, Roma), **Marco Petronio** (DEEI, Trieste), David Alesini, Luigi Palumbo (INFN/LNF, Frascati (Roma)) - The layout of FERMI@Elettra will include a transverse S-band RF deflector that will be located after the first bunch compressor (BC1) at 250 MeV. The deflector will operate in a vertical deflecting mode and coupled to a downstream dipole will be used to measure the electron bunch length and in particular to allow time-resolved beam quality measurements such as horizontal slice emittance and slice energy spread. In this paper we discuss the electron bunch deflection at 250 MeV taking into account the principal elements that dominate the selection of the transverse peak voltage specification: the finite transverse emittance, the resolution of OTR screens and the desired number of the slice divisions along the bunch that we wish to observe. The RF deflector proposed here is a frequency scaled version of the 5-cell standing wave SPARC structure.

Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 46

Studying Image Charge Effects with WARP, **Karen Fiuza** (IF-UFRGS, Porto Alegre), Irving Haber, Rami Alfred Kishek (UMD, College Park, Maryland) - In the presence of significant mismatch and misalignment, the image charges in a conducting pipe can strongly influence beam dynamics. If sufficiently large, emittance growth* and particle loss are expected. Computer simulations using the WARP particle-in-cell code** are presented that examine the beam dynamics and compare to previous analytic calculation*** on the centroid displacements that can be tolerated without loss of particles to the beam pipe. Image charges are also used in a capacitive beam position monitor (BPM) to measure centroid displacement. These simulations are used to examine the evolution of a beam passing through a set of segmented conductors for use as a BPM. This method provides a realistic picture of the influence of the BPM on the beam, as well as a providing ability to calculate, the charge that is accumulated on the BPM electrodes as the beam passes by. Related work will also be discussed.

* C. K. Allen and M. Reiser. Phys. Rev. E 54(3), 2884 (1996).

** A. Friedman et al. Phys. Fluids B 4(7), 2203 (1992).

*** K. Fiuza et al. Phys. Plasmas 13, 023101 (2006).

Funding Agency: Financial agency of Brazil: CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 47

Microstrip Metal Detector for Beam Diagnostics, **Oleksii Kovalchuk**, Alexey Mikhailenko, Valery Pugatch (NASU/INR, Kiev) - The Microstrip Metal Detector (MMD) design, production technology, readout electronics and software as well as areas of the MMD applications are described. The MMD prototype has been used for measuring with a resolution of ~20 microns the beam profile of the synchrotron radiation with an energy of 20 keV. The MMD has a three-layer structure: The sensor layer is surrounded by two accelerating layers. The sensors are connected to sensitive charge integrators with a frequency output while 20 V positive voltage is applied to the accelerating strips. Advantages of the MMD such as high radiation tolerance (gigarads), low sensor mass (micrometer thickness), good spatial resolution (micrometer level), wide (6 orders) dynamical range of operation are discussed in details. We discuss its application for mass spectrometry. The design of the 128-channel readout microchip for such application as well as a design and technology for a production of mass spectrometry´s focal plan based on MMD technology is described. The results of the first prototype test are presented.

Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 48

Laser-based Ion Beam Diagnostics for the Front End Test Stand at RAL, **David Alexander Lee**, Jürgen Klaus Pozimski (Imperial College Technology, London), Christoph Gabor (STFC/RAL/ASTeC, Chilton, Didcot, Oxon) - The RAL Front End Test Stand is being constructed to demonstrate that a chopped H– beam of 60 mA at 3 MeV with 50 pps and sufficiently high beam quality as required for future high-power proton accelerators can be produced. Because of the high beam power and a preference for online beam monitoring non-intrusive, non-destructive beam diagnostics are desirable. Two novel instruments, based on the photo-detachment of the outer electron of the H– ions with a laser, are being developed to precisely determine the transverse beam

density distribution and the beam emittance at full beam power. This paper discusses the proposed experimental layout of the devices and the progress that has been made towards realizing them. The design of the optical system is presented along with measurements of the laser beam propagation for the beam density distribution experiment. Investigations of the influence of laser beam misalignment along with measurements of the positioning accuracy of movable stages that will be used are given in light of the total expected errors.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 49

Beam Emittance Measurement for the New Full Energy Injector at ELETTRA, Giuseppe Penco, Laura Badano, Silvano Bassanese, Giulia Ciani, Paolo Craievich, Simone Di Mitri, Mario Ferianis, Marco Veronese (ELETTRA, Basovizza, Trieste), **Alberto Andrea Lutman** (DEEI, Trieste) - An emittance measurement station was set up and operated with the quadrupole scan technique to characterize the electron beam transverse phase space at the Elettra laboratory. The diagnostic station, based on a YAG:Ce scintillation screen imaged by a CCD digital camera, was installed at the end of the 100 MeV booster pre-injector together with a beam longitudinal structure monitor. This equipment plays an important role for the bunching system optimization and for the optical matching of the injection transfer line to the booster ring. Experimental results and comparison with multi-particle tracking codes simulation are presented in this paper.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 50

Wire Scanner Transverse Beam Parameter Measurements for BEPCII, **Yan-feng Sui**, Jianshe Cao, Li Ma (IHEP Beijing, Beijing) - The wire scanner has been installed in the linac injector of BEPCII (Beijing Electron-Positron Collider II) to provide the transverse beam parameters. In the several fellowing months, some experiments will be done. The result will be presented and the reason will be analysed.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 51

Data Acquisition and Analysis in SSRF BPM System, **Yingbing Yan**, Yongzhong Chen, Yongbin Leng, Weimin Zhou, Yi Zou (SINAP, Shanghai) - The beam position monitor (BPM) system in Shanghai Synchrotron Radiation Facility (SSRF) is fully (Linac, transfer line, booster and storage ring) equipped with Libera Electron BPM Processors. Primary data acquisition and position calculation has been done in Libera FPGA. EPICS support package developed by Diamond Light Source has been adapted to link BPM system with accelerator control system. Two dedicated soft IOCs are introduced to collect beam position data from all Libera IOCs and calculate RMS noise, histogram, spectrum and phase space, etc. online. Other BPM based analyses are completed via MATLAB scripts. The initial results during booster and storage ring commissioning will be described in this paper.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 52

Beam Energy Compensation by RF Amplitude Control for Thermionic RF Gun and Linac Based Mid-infrared FEL, **Heishun Zen**, Toshiteru Kii, Ryota Kinjo, Kai Masuda, Hideaki Ohgaki, Satoshi Sasaki, Takumi Shiiyama (Kyoto IAE, Kyoto) - Institute of Advanced Energy, Kyoto University has constructed a mid-infrared FEL facility which consists of a thermionic RF gun, a traveling-wave type accelerating tube and a halbach type undulator. The electron beam quality is critical for lasing FEL. However, we found that the beam energy after the accelerator tube decreased from 25 to 23.5 MeV (around 6%) during macro-pulse duration (~4 micro sec), because.the beam current increases from 65 to 120 mA during the macro-pulse due to the backbombardment effect in the RF gun. To compensate the energy drop and to minimize the energy spread over the macro-pulse, the amplitude of RF power fed to the tube was controlled. Since a precise micro-bunch interval required to build up the FEL, the RF phase was also controlled. As the result, the energy spread of the electron beam was greatly reduced from 6 to 0.8% in FWHM which was same with micro-pulse energy spread (~0.8%). The phase stability during macro-pulse was also improved from 10 to less than 2 degree.
Sub Classif.: T03 Beam Diagnostics and Instrumentation

Poster Panel 53

Orbit and Dispersion Tool at FLASH, Eduard Prat, Vladimir Balandin, Nina Golubeva (DESY, Hamburg), Jernej Kamenik, Igor Kriznar, **Tilen Kusterle** (Cosylab, Ljubljana) - Based on a former MATLAB tool, a java-based application to measure and correct orbit and dispersion has been developed at FLASH. In this paper we discuss the algorithm used in this tool as well as its functionality. First tests on machine operation are also presented.
Sub Classif.: T04 Accelerator/Storage Ring Control Systems

Poster Panel 54

LHC Transverse Feedback Damping Efficiency in the Presence of Coupled Bunch Instabilities and Noise, **Gerd Kotzian**, Wolfgang Höfle (CERN, Geneva), Elmar Vogel (DESY, Hamburg) - A simulation model has been developed to predict the damping efficiency of the LHC transverse feedback system in the presence of coupled bunch instabilities and under realistic assumptions for the injection error. The model tracks both

the centre of gravity of a bunch and the r.m.s beam size during and after injection. Since the transverse resistive wall impedance and nonlinearities in the beam optics will cause the bunches to filament, the effect of multi-bunch instabilities and de-coherence leads to an increase of the transverse beam dimensions. The model also allows the effect of noise injected into the loop on the beam emittance to be studied. In addition a numerical simulation model for the analogue signal processing in the LHC transverse feedback loop has been implemented to investigate the importance of imperfections in the actual hardware as well as its performance in the presence of noise. In this paper the expected efficiency of the LHC feedback system is estimated. Possibilities for enhancing the performance by signal processing schemes are outlined and quantified.
Sub Classif.: T05 Beam Feedback Systems

Poster Panel 55

Radiological Hazards Assessment for the Beam Dump of High Intensity Deuteron Accelerators, **Daniel López**, Mauricio Garcia, Francisco Ogando, Javier Sanz, Patrick Sauvan (UNED, Madrid) - Several of the most important aspects with regards to the radiological potential hazards assessment in the beam dump of a high intensity deuteron accelerator are analyzed. Deuteron and neutron induced activation as well as neutron production for the beam dump cartridge, in order to select low activation materials; evaluation of the tritium production due to the implanted deuterium in the material and the presence of water in the cooling and local shielding systems, relevant for the associated radiotoxicity; estimation of gamma dose rate in beam-off phase in the vicinity of the cartridge, important issue for accessibility and maintenance works of the system. All these points are assessed both for normal operation and commissioning phase in the IFMIF-EVEDA accelerator prototype. Several materials are studied according to neutron production using transport codes (MCNPX and PHITS) and EAF2007 libraries. Activation calculations with ACAB code use irradiation fluxes obtained with MCNPX. Evaluation of tritium production due to implanted deuterium is calculated with SRIM-TMAP7 coupled code. Tritium in water is calculated by activation procedures. Gamma dose rate is computed with MCNPX.
Sub Classif.: T18 Radiation Monitoring and Safety

Poster Panel 56

Automatic Implementation of Radiation Protection Algorithms in Programs Generated by GCC Compiler, **Adam Piotrowski**, Dariusz Radoslaw Makowski, Andrzej Napieralski, Szymon Tarnowski (TUL-DMCS, Lodz) - Radiation influence on microprocessor-based systems is serious problem especially in places like accelerators and synchrotrons, where sophisticated digital devices operate closely to the radiation source. Reliability of such systems is significantly decreased due to effects like SEU or SEFI. One of the possible solutions to increase radiation immunity of the microprocessor systems is a strict programming approach known as Software Implemented Hardware Fault Tolerance. SIHFT methods are based on the redundancy of variables or procedures. Sophisticated algorithms are used to check the correctness of control flow in application. Unfortunately, manual implementation of presented algorithms is difficult and can introduce additional problems with program functionality cased by human errors. Proposed solution is based on modifications of the source code of the C language compiler. Protection methods are applied at intermediate representation of the compiled source code. This approach makes it possible to use standard optimization algorithms during compilation. In addition, a responsibility for implementing fault tolerant is transferred to the compiler and is transparent for programmers.
Funding Agency: We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 'Structuring the European Research Area' program (CARE, contract number RII3-CT-2003-506395).
Sub Classif.: T18 Radiation Monitoring and Safety

Poster Panel 57

The Use of Software in Safety Critical Interlock Systems of the LHC, Alejandro Castaneda, Frederic Bernard, Pierre Dahlen, **Iván Romera**, Benjamin Todd, David Willeman, Markus Zerlauth (CERN, Geneva) - This paper will provide an overview of the software development and management techniques applied to interlock systems in the CERN accelerator complex. Despite the in essence hardware based approach, software and configuration data is present in various forms and has to be treated with special care when aiming at safe, reliable and available protection systems. Several techniques and methods deployed in the LHC machine protection systems are highlighted, regarding data management and version tracking, hardware choices, commissioning procedures, testing methods and first operational experiences with the systems in CERN's accelerator complex.
Sub Classif.: T22 Machine Protection

Poster Panel 58

Beam Scraping to Detect and Remove Halo in LHC Injection, **Paul Anton Letnes**, Stephane Bart Pedersen, Arnaud Brielmann, Helmut Burkhardt, Daniel Kramer (CERN, Geneva) - Fast scrapers are installed in the SPS to detect and remove beam halo before extraction of beams to the LHC, to minimize the probability for quenching of super-conducting magnets in the LHC. We shortly describe the current system and then focus on our recent work, which aims at providing a system which can be used as operational tool for standard LHC injection. A

new control application was written and tested with the beam. We describe the current status and results and compare these with detailed simulations.
Sub Classif.: T22 Machine Protection

Classification 7: Accelerator Technology Main Systems

Poster Panel 59

Work Function Dependence of RF Breakdown in Pressurized RF Cavities, **Mahzad BastaniNejad**, Abdelmageed Elmustafa (Old Dominion University, Norfolk, Virginia), Alfred Moretti, Milorad Popovic, Katsuya Yonehara (Fermilab, Batavia, Illinois), John Byrd, Derun Li (LBNL, Berkeley, California), Rolland Paul Johnson, Sergey Korenev, Richard Sah (Muons, Inc, Batavia) - Previous studies of RF breakdown in a cavity pressurized with dense hydrogen gas have indicated that breakdown probability is proportional to a high power of the surface electromagnetic field. This behavior is similar to the Fowler-Nordheim description of electron emission from a cold cathode, and it implies that breakdown is a quantum mechanical effect that is characterized by the work function of the cavity metal. We describe our present efforts to measure the distributions of work functions at the nanoscale level on the surfaces of the electrodes used in breakdown studies, and to understand how the RF conditioning process affects them.
Funding Agency: Supported in part by DOE STTR grant DE-FG02-05ER86252.
Sub Classif.: T06 Room Temperature RF

Poster Panel 60

Thermal-electromagnetic Simulations of Single Layer Superconducting Coatings for Pulsed Mode High Gradients, **Alberto Canabal**, Tsuyoshi Tajima (LANL, Los Alamos, New Mexico) - SRF cavities are ultimately limited by the temperature dependent maximum magnetic field that the superconductor withstands. However, in theory the maximum magnetic field of a superconductor can be greatly increased if thin layers (less than a London penetration depth) are employed. Our study shows that even a single layer of MgB2 (~100 nm) coated on Nb through a dielectric layer could potentially double the achievable electromagnetic field of bulk Nb. In this paper the electromagnetic and thermal responses of multilayer structures of superconductors in the presence of very high pulsed RF fields are analyzed. A fully coupled non-linear thermal-electromagnetic model has been developed, which allows for the determination of the pulse width and duty cycle of a transversal electromagnetic mode (TEM) or plane wave impinging on a multilayer structure. The model calculates the electromagnetic fields in the frequency domain and the thermal heat conduction equation is solved in the time domain through a finite difference scheme.
Sub Classif.: T07 Superconducting RF

Poster Panel 61

A Control and Systems Theory Approach to the High Gradient Cavity Detuning Compensation, **Rocco Paparella** (INFN/LASA, Segrate (MI)) - The compensation of dynamic detuning is of primary importance in order to operate TESLA type cavities at the high accelerating gradient foreseen for the ILC (31.5 MV/m). This article firstly resumes recent successful experiences of open loop compensation of the Lorentz force detuning, repetitive and synchronous to the RF pulse, using fast piezoelectric actuators with different fast tuning systems. Possible strategies and results for the closed loop compensation of the stochastic microphonic detuning are also presented. Lastly, a deep characterization of the system under control is given, exploiting the system transfer functions acquired through both installed piezo actuators/sensors and phase locked measurements. This ultimately allows the analytical modeling of the behavior of cavity detuning and of its active compensation with piezoelectric actuators.
Sub Classif.: T07 Superconducting RF

Poster Panel 62

High Field Q-slope in Niobium Cavities: Dissection Studies, **Alexander S Romanenko**, Hasan Padamsee (CLASSE, Ithaca) - All types of surface treaments used in the current process of superconducting niobium cavities' production result in the high field Q-slope appearence unless a cavity was baked at mild temperatures of 100-120C in high vacuum. High field Q-slope heating of cavity walls is not uniform with some areas in the high magnetic field region being heated up stronger ("hot" spots) than the other ("cold" spots). Small and large grain BCP and EP niobium cavities were tested, "hot" and "cold" spots identified with the thermometry system attached during the test, the cavities dissected and the samples analyzed with the range of surface analytical techniques, i.e. XPS, EBSD, SIMS.
Funding Agency: NSF
Sub Classif.: T07 Superconducting RF

Poster Panel 63

Fabrication and Cold Testing of an L-band Deflecting Cavity for Emittance-exchange at ANL, **Jiaru Shi**, Huaibi Chen, Wenhui Huang, Chuanxiang Tang (TUB, Beijing), Wei Gai, Chunguang Jing, Kwang-Je Kim, John Gorham Power (ANL, Argonne, Illinois), Derun Li (LBNL, Berkeley, California) - An L-band RF deflecting cavity has been built for a planned transverse-to-longitudinal emittance exchange experiment at Argonne National Laboratory (ANL). The deflector is a

1.3 GHz, 3-cell cavity operated in a TM110-like mode that delivers a deflecting voltage of 3.4 MV. In this paper, we review the cavity design and present the detail fabrication, cold testing and tuning progress. Residual amount of cell radii are left for cold testing before final cut and the frequency difference is removed by the last tuning on machine. Field distribution on axis is measured using 'bead-pull' and tuned to flat.
Sub Classif.: T07 Superconducting RF

Poster Panel 64
Compact Design of Race-track Microtron Magnets, Miquel Ferrer Ballester, Yuri Alexandrovich Kubyshin, **Juan Pablo Rigla** (UPC, Barcelona), Anton Vladimirovich Poseryaev, Vasiliy Ivanovich Shvedunov (MSU, Moscow) - A novel design of the end magnets for race-track microtrons (RTMs) is proposed. It consists of four-poles with the REPM material being used as a source of the magnetic field. For a proper choice of parameters of such magnetic system it can provide both the closure of the first orbit after beam reflection and required focusing properties. It is shown that such end magnet can be made quite compact thus allowing to build miniature RTMs. The procedure of design of the four-pole magnetic system and its optimization using the ANSYS code is described in detail.
Sub Classif.: T09 Room-Temperature Magnets

Poster Panel 65
Hybrid Quadrupoles Designs for the RAL Front End Test Stand (FETS), **Dan Ciprian Plostinar**, Michael A. Clarke-Gayther (STFC/RAL/ASTeC, Chilton, Didcot, Oxon) - The Front End Test Stand project being constructed at Rutherford Appleton Laboratory (RAL) aims to deliver a high current (60 mA) H- chopped ion beam, at 3 MeV and 50 pps. The main components of FETS are the H- ion source, the Low Energy Beam Transport line (LEBT), the Radio Frequency Quadrupole (RFQ) and the Medium Energy Transport (MEBT) line with beam chopper. Space restrictions in the MEBT line place constraints on component length and drive the requirement to identify compact component configurations. A description is given of a novel compact hybrid quadrupole magnet, whose design is based on the concentric combination of a permanent magnet quadrupole (PMQ) and a laminar conductor electromagnetic quadrupole (EMQ). Simulations of magnetic field distribution in 2 and 3D are presented, together with measurements of field distribution and adjustment range for a prototype hybrid quadrupole.
Funding Agency: We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" program (CARE, Contract No. RII3-CT-2003-506395).
Sub Classif.: T09 Room-Temperature Magnets

Poster Panel 66
Scaling Laws for Magnetic Energy in Superconducting Quadrupoles, **Franck Borgnolutti**, Ezio Todesco (CERN, Geneva), Alain Mailfert (ENSEM, Vandoeuvre lès Nancy) - The stored energy in superconducting magnets is one of the main ingredients needed for the quench calculation and for desingin quench protections. Here we proposed an analytical formula based on the Fourier transformation of the current density flowing within the winding to determine the magnetic energy stored in superconducting quadrupoles made of sector coils. Two corrective coefficients allowing to estimate the energy enhancement produced either by current grading or by the presence of an unsaturated iron yoke are respectively derived from a numerical and an analytical study. This approach is applied to a set of real quadrupoles to test the validity limits of the scaling law, which are shown to be of 5-10%.
Sub Classif.: T10 Superconducting Magnets

Poster Panel 67
Magnetic Design of the Final Focus Quadrupoles in the SuperB Large Crossing Angle Collision Scheme, Eugenio Paoloni (, Pisa), **Simona Bettoni** (CERN, Geneva), Maria Enrica Biagini, Pantaleo Raimondi (INFN/LNF, Frascati (Roma)) - The vertical focusing element closest to the interaction point of the SuperB factory based on the large crossing angle collision scheme (~50 mrad), must provide a pure quadrupolar field on each of the two beams. This allows to avoid the high background rate in the detector which would be produced by the over-bend of the off-energy particles if a dipolar component were present. Because of the small separation of the two beams in the transverse dimension (only 2 cm) the influence of each winding on the other one is not negligible and, for the same space limitation, a multi-layer configuration is not suitable to compensate the high order multipoles. A novel design, based on 'helical-type' windings, has therefore been investigated. The windings generates the pure quadrupolar field as a superposition of the inner field of the surrounding coil and of the outer fringe field of the neighbor one. The same idea may be used to produce two pure quadrupolar fields with opposite strength, suitable for the final focus elements in colliders, as LHC, where the sign of the circulating particles are the same. In this paper the 2D concept and the 3D model of this design are presented.
Sub Classif.: T10 Superconducting Magnets

Poster Panel 68
Stability of Superconducting Wire in Magnetic Field, **Kailash Ruwali** (GUAS/AS, Ibaraki), Kenji Hosoyama, Kota Nakanishi (KEK, Ibaraki), Yoshihiko Teramoto, Atsuhiko Yamanaka (Toyobo Research Institute, Shiga) - Main cause of premature quench in superconducting magnet is the heat generated due to

superconducting wire motion. The wire motion occurs where electromagnetic force to conductors exceeds frictional force on surfaces of the conductors. Hence, frictional properties of the conductors and winding structures are important parameters for characterizing stability of the superconducting windings. An experimental setup was prepared to detect wire movement by observing spike in voltage of the superconducting sample wire. A detailed study was carried out in order to study superconducting wire motion under different experimental conditions such as varying applied load to specimen wire, back up field, varying the interface of superconductor and base material. The base materials used are polyimide film and Dyneema. The Dyneema has low frictional coefficient and negative thermal expansion. In the case of Dyneema, it is found that amplitude of voltage generated due to wire motion reduces and also relatively smooth motion of wire is observed. These effects are attributed to the low frictional coefficient. The experimental observation will be discussed in detail.
Sub Classif.: T10 Superconducting Magnets

Poster Panel 69

Measurements on an A/D Interface Used in the Power Supply Control System of the Main Dipoles of CNAO, **Giovanni Franzini**, Donato Pellegrini, Mario Serio, Angelo Stella (INFN/LNF, Frascati (Roma)), Marco Donetti, Marco Pezzetta, Marco Pullia (CNAO Foundation, Milan) - The CNAO (the Italian Centre of Oncological Hadrontherapy, near Pavia) is in its final step of construction and is about to be fully operative. It is based on a synchrotron that can accelerate protons up to 250MeV and carbon ions up to 400MeV/u for the treatment of patients. In this paper we describe an A/D interface, used in the power supply control system of the synchrotron main dipoles, called B-Train. The field is measured in a dedicated dipole connected in series with the sixteen ones of the synchrotron and is then fed back to the power supply. The field is obtained integrating and digitizing the voltage induced on a pickup coil inserted in the gap of the seventeenth dipole. The A/D interface under study is based on a 64-channel current to frequency converter ASIC, in CMOS 0.35 μm technology, followed by a counter and uses a recycling integrator technique. The digital signal obtained is then used to generate a feedback signal for control system of the dipoles power supply. We present the electronic structure, the lab measurements and the behavior for various setups of the A/D interface described.
Sub Classif.: T11 Power Supplies

Poster Panel 70

Thermal and Structural Modeling of the TTF Cryomodule Cooldown and Comparison with Experimental Data, **Serena Barbanotti**, Paolo Pierini (INFN/LASA, Segrate (MI)), Kay Jensch, Rolf Lange (DESY, Hamburg) - The study of thermal and structural behavior during cooldown/warmup of long SRF cryostats is important for both the XFEL and ILC, which base the design on the successful TTF design. We present the finite elements analysis of the main internal components of the cryomodules during the transient cooldown and warmup, comparing the data obtained with data taken at DESY on the linac.
Sub Classif.: T13 Cryogenics

Poster Panel 71

High-voltage Power Supply Distribution System, Matjaz Kobal, Damjan Golob, Robert Kovacic, Mark Plesko, Aljaz Podborsek (Cosylab, Ljubljana), **Miha Pelko** (JSI, Ljubljana) - High-voltage splitters enable connecting a larger number of ion-pumps to a single ion-pump controller. In particle accelerator facilities where relatively small pumps are used, using high-voltage splitters can significantly reduce costs and rack space. By using simple high-voltage splitters some functionality of the conrollers can be lost. The presented high-volage splitter is one of the most advanced devices on the market. It measures current going to every pump in the range 100 pA to 100 mA with an accuracy of 5%. Fully configurable tables are used to convert the measured current to the pressure at the pump. Current measurements are also used to monitor cable and ion-pump aging which results in linear increase of current with time. Hardware interlocks are used to disconnect individual pumps in case of poor vacuum to avoid pump damage. The limits can be set by the user, who can also set the number of active pumps. EPICS support was developed for the device with graphical user interfaces writen in EDM, java and WebCA. Since the presented device covers or exceeds a lot of the ion-pump controller functionality, simpler controlers can be used.
Sub Classif.: T14 Vacuum Technology

Poster Panel 72

Development of a New Low Level RF Control System for the S-DALINAC, **Asim Araz**, Uwe Bonnes, Ralf Eichhorn, Martin Konrad, Markus Platz, Achim Richter (TU Darmstadt, Darmstadt), Rolf Stassen (FZJ, Jülich), Ulrich Laier (GSI, Darmstadt) - The Superconducting DArmstadt electron LINear ACcelerator S-DALINAC has a maximum energy of 130 MeV and beam currents of up to 60 μA. To reach this energy conveniently in cw, superconducting cavities with a high Q at a frequency of 3 GHz are used. In order to achieve minimal energy spread, the amplitude and phase the cavities have to be controlled strictly in order to compensat the impact of microphonic perturbations. The existing analog rf control system based on a self-exited loop, converts the 3 GHz signals down to the base band. This concept will also be followed by the new digital system currently under design. It is based on an FPGA in the low frequency part, giving a great flexibility in the control algorithm and providing additional diagnostics.

For example it is possible to change the operational mode between self-exited loop and generator driven resonator within a second. We will report on the design concept, the status and the latest results measured with a prototype, including different control algorithms as well as beam loading effects.
Funding Agency: Supported by DFG through SFB 634.
Sub Classif.: T25 Low Level RF

Poster Panel 73

Performance of 24 Cavity Vector Sum Controller with Distributed Architecture, **Wojciech Jalmuzna**, Andrzej Napieralski (TUL-DMCS, Lodz), Stefan Simrock (DESY, Hamburg) - The paper presents the test results of the digital vector sum control applied for 24 superconducting cavities driven by 1 klystron. The controller is based on FPGA chips and consists of multiple processing boards which communicate via optical fiber links. Flexible and scalable distributed architecture was designed and implemented to provide framework for the control algorithms. The tests were performed at FLASH (DESY,Hamburg) facility using ACC4, ACC5 and ACC6 modules. Results were compared to the existing DSP based system.
Sub Classif.: T25 Low Level RF

Poster Panel 74

FPGA Implementation of Multichannel Detuning Computation for SC Linacs, **Konrad Przygoda**, Jacek Andryszczak, Wojciech Jalmuzna, Andrzej Napieralski, Tomasz Pozniak (TUL-DMCS, Lodz) - The paper presents a multi-cavity system for active compensation of SC cavities' deformations in linear accelerators like Free Electron Laser. Described system consists of digital controller, analog amplifiers and mechanical actuators. The previously developed control algorithms were implemented in SIMCON 3.1 board and allow online calculations of Lorentz force detuning only for one cavity. The recent development in the field is based on serial pipelined computations which allow a real time detuning measurements of 8 and more cavities. Moreover, the SIMCON DSP board was used for 10 ns latency computations. The new approach enables integrating the algorithm dedicated for cavity shape control with the LLRF control system using optical transmission. Furthermore the 8-channels amplifiers have been successfully added to the compensation system for driving the piezoelectric actuators. The system is tested in FLASH at DESY. The accelerating modules ACC 3, 5 and 6 with high operating gradients cavities have been taken into account. The multilayer piezostacks from PI and NOLIAC are used for the compensation purpose of cavities' deformations.
Funding Agency: We acknowledge the support of the European Community Research Infrastructure Activity under the FP6 Structuring the European Research Area program (CARE, contract number RII3-CT-2003-506395).
Sub Classif.: T25 Low Level RF

Poster Panel 75

Digital LLRF for ALBA Storage Ring, **Angela Salom**, Francisco Pérez (ALBA, Bellaterra (Cerdanyola del Vallès)) - ALBA is a 3 GeV, 400 mA, 3rd generation Synchrotron Light Source that is in the construction phase in Cerdanyola, Spain. The RF System will have to provide 3.6 MV of accelerating voltage and restore up to 540 kW of power to the electron beam. A Digital LLRF prototype has been developed for the Storage Ring RF Cavity. The prototype is based on the IQ modulation/demodulation technique and it has been implemented using a commercial FPGA cPCI board. The prototype has been installed in the high power RF lab of CELLS and tested to control up to 80 kW on the real Storage Ring Cavity. The test results of the control loops (amplitude, phase and tuning) will be presented, as well as the hardware structure (digital boards, analogue front ends, timing, etc.) and the system interface.
Sub Classif.: T25 Low Level RF

Poster Panel 76

Universal DOOCS Server Based on the Scripting Language, **Jaroslaw Szewinski** (Warsaw University of Technology, Warsaw) - This document describes the design and implementation of the universal DOOCS* server based on the script language for the FLASH accelerator in DESY (Hamburg, Germany). Server works with the DOOCS, which is used in FLASH for machine control. The typical usage of this application is to communicate with the measurement equipment and control small facilities of the accelerator. The aim of the project is to provide a tool which can make the server creation easy for non-programmer users (typically physicists). The heart of the server is the script language parser which has been done using well known UNIX tools: bison and flex. The complexity of designed language is comparable with complexity of the Matlab language. Application has additional features like possibility of attaching external dynamic libraries or possibility of defining the state machines (more sequencer like). Server has been tested at FLASH and currently is used by people who wish to control their equipment via DOOCS, with the minimal effort of software development.
* Distributed Object Oriented Control System.
Sub Classif.: T25 Low Level RF

Poster Panel 77

Hardware-software Simulation for LLRF Control System Development, **Andrea Vaccaro**, Lawrence Doolittle, Alessandro Ratti, Carlos Serrano (LBNL, Berkeley, California) - Field Programmable Gate Arrays (FPGA) have been used in accelerator controls for a long time. Stricter performance requirements in new

accelerator designs force LLRF control systems to continuously improve, and the increasing density of available FPGAs enables such progress. The increased complexity in FPGA design is not always followed by new RF systems availability for development and testing. Therefore, a hardware-software simulation tool has been developed to model RF systems by a software simulator. It simulates the interaction of HDL code that is to be synthesized with both RF systems and communication ports to external controls software, reproducing realistic working conditions of the FPGA. The hardware-software interaction for LLRF control system design is discussed here.
Sub Classif.: T25 Low Level RF

Poster Panel 78
Remote Alignment of Low Beta Quadrupoles with Micrometric Resolution, **Mikail Acar**, Julien Boerez, Andreas Herty, Helene Mainaud Durand, Antonio Marin, Jean-Pierre Quesnel (CERN, Geneva) - Considering their location in a high radiation environment and the alignment tolerances requested, the Low Beta quadrupoles of LHC will be positioned remotely (controlling 5 degrees of freedom), with a displacement resolution of few microns in horizontal and vertical. Stepping motor gearbox assemblies are plugged into the jacks which support the cryomagnets in order to move them to the desired position regarding the quality of the beam collisions in the detectors. This displacement will be monitored in real time by the sensors located on the magnets. This paper describes the positioning strategy implemented as well as the software tools used to manage it.
Sub Classif.: T28 Subsystems, Technology and Components, Other

Classification 8: Applications of Accelerators, TT and Relations with Industry

Poster Panel 79
Spiral Scaling FFAG Accelerator for Hadrontherapy, **Joris Fourrier**, Jaroslaw Pasternak (LPSC, Grenoble), Francois Meot (CEA, Gif-sur-Yvette) - A hadrontherapy accelerator assembly based on an FFAG ring and a variable energy H- cyclotron injector has been designed in the frame of the RACCAM project. The FFAG ring allows 2.1 Tm top rigidity, corresponding to 180 MeV proton top energy and 21.6 cm penetration depth and to 50 MeV per nucleon for carbon ions suitable for biological R&D). Variable energy extraction, bunch to pixel 3D scanning and multiport beam delivery are proposed in this installation. A prototype of a spiral sector scaling type of FFAG dipole is being built for proving the feasibility of the FFAG ring, subject to a second contribution in the conference. This paper will describe the accelerator assembly parameters and the beam properties.
Funding Agency: LPSC / IN2P3 / CNRS – UJF - INPG
Sub Classif.: U01 Medical Applications

Poster Panel 80
Dual Energy Material Recognition: Preliminary Results Obtained with the Radio-tomographic System Hosted in Messina, **Dario Loria**, Lucrezia Auditore, Renato Calogero Barnà, Umberto Emanuele, Emanuele Morgana, Antonio Trifirò, Marina Trimarchi (INFN - Gruppo Messina, S. Agata, Messina), Massimo Carpinelli (INFN-Cagliari, Monserrato (Cagliari)), Antonio Franconieri, Mauro Gambaccini (INFN-Ferrara, Ferrara) - Dual Energy technique is a very powerful tool for material recognition. It typically involves X-ray energy below 1 MeV, thus limiting to few mm the thickness of the inspected heavy materials. However, it would be interesting to investigate the chance to extend this technique to higher energies, to allow recognition of thick heavy samples too. Encouraging preliminary tests performed by means of the radio-tomographic system based on a 5 MeV electron linac have suggested to develop a dual energy technique for high energy x-ray beams. This can be done because first experimental tests have confirmed the chance to vary the electron beam energy in a continuous way. As a consequence, bremsstrahlung beams with different end points can be produced, thus allowing to work with different x-ray transmissions. The composition of two different energies X-ray transmission results, allows to perform material recognition. By means of the MCNP4C2 code, simulations have been performed to evaluate the theoretical x-ray transmission in different materials and thickness. These results allow us to choose two x-ray energies providing the best results in order to perform material recognition.
Sub Classif.: U04 Other Applications