ICFA mini-WORKSHOP ON IMPEDANCES AND BEAM INSTABILITIES IN PARTICLE ACCELERATORS

Monday, 18 September 2017 - Friday, 22 September 2017

Benevento

Book of Abstracts

Contents

Session 1- Introductory talks (Chair: Giovanni Rumolo) / 0

Welcome and general introduction

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Session 1- Introductory talks (Chair: Giovanni Rumolo) / 1

Impedance theory and modeling

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Session 1- Introductory talks (Chair: Giovanni Rumolo) / 2

Impedance measurement techniques

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3

Impedance Effects on Beam Dynamics in the 50 MeV ThomX Storage Ring

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ThomX is a low energy Compton Backscattering Source (CBS) demonstrator which is being built at LAL, Orsay, France. As the 18 m storage ring has a design energy of 50 MeV, the electron beam is very sensible to collective effects. Furthermore the beam is extracted while a new one is injected every 20 ms, and the damping time is about 2 seconds. So the electron dynamics is not damped and the beam stability becomes a crucial matter. The impedance of all the storage ring components has been computed either by simulation, by RF measurement or by using an analytical model. The impedance effect on beam dynamics has been evaluated by tracking simulations using two different methods: the broad band resonator model and wake functions. ThomX impedance model and how the beam dynamics is affected will be shown in both cases.

Session 1- Introductory talks (Chair: Giovanni Rumolo) / 4

Electron cloud effects

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Session 1- Introductory talks (Chair: Giovanni Rumolo) / 5

Instability theory and modeling

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Session 1- Introductory talks (Chair: Giovanni Rumolo) / 6

Instability observations and cures

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 7

Wakefields/impedances for a bunch moving between two corrugated plates

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 8

Calculation of wakefields for plasma-wakefield accelerators

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 9

Multi-physics simulations of impedance effects in accelerators

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 10

Advanced method of wakefield calculations (numerical methods, parallel computing)

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 11

Analytical impedance models for very short bunches

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 12

The concept of coupling impedance in the self-consistent plasma wake field excitation

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 13

Impedance Issues in the Design, Measurements, and Beam Commissioning of a Narrow Gap Stripline Kicker For On-Axis Injection

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 14

"The Birth and the Childhood of the Coupling Impedance and the Stability Maps" Special seminar to celebrate the 50 years of the beam coupling impedance concept

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 21

Needs and solutions for machine impedance reduction

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 22

2D and 3D collimator impedance modelling and experimental measurements

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 23

Challenges and pitfalls for impedance measurements in the lab

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 24

Beam measurements of frequency characteristics of (longitudinal) impedance

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 27

Beam-based impedance measurement techniques in light sources

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 28

An improved method to measure beam impedance with rotating wire. Theoretical and simulation results

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 29

Precise impedance determination from simultaneously measured tunes of unequal charge bunches

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Session 2 - Impedance theory and modeling (Chair: Ursula Van Rienen. Scientific secretary: Mario Beck) / 30

Eigenmode Computations for Chains of Cavities

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 32

Role of space charge in coherent instabilities

Author: Mike Blaskiewicz[1]

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 33

Microbunching instability

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 34

Chromaticity effects on head-tail instabilities for broad-band impedance using two particle model, Vlasov analysis, and simulations

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 35

Modeling of fast beam ion instabilities

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 37

Circulant matrix formalism, benchmarks and beam-beam effect in coherent instabilities

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38

Coherent head-tail instability in collision with a large crossing angle

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 39

Longitudinal and transverse ions cloud dynamics in an electron ring in presence of electromagnetic fields and gaps

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 40

Mitigation of collective effects by optics optimization and the SPS experience

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 43

Transverse feedback systems for multi-bunch beam diagnostics and instabilities suppression

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 44

Codes benchmarking for the single-bunch instabilities in electron storage rings

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 45

Vlasov solvers and macroparticle simulations

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Session 7: Conclusions (Chair: Stefania Petracca) / 52

Closing remarks of Session 2: Impedance theory and modeling

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Session 7: Conclusions (Chair: Stefania Petracca) / 53

Closing remarks of Session 3: Impedance measurements and control

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Session 7: Conclusions (Chair: Stefania Petracca) / 54

Closing remarks of Session 4: Instability theory and modeling

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Session 7: Conclusions (Chair: Stefania Petracca) / 55

Closing remarks of Session 5: Instability modeling, observations and cures

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Session 7: Conclusions (Chair: Stefania Petracca) / 56

Closing remarks, acknowledgements and goodbye

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70

Conclusions

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This contribution will be the workshop closure with general conclusions from the experience, acknowledgement of participants and farewell

Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 84

Wide-band feedback systems to diagnose and suppress intra-bunch motion in accelerators

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 85

TMCI at strong space charge

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 86

Observation and active damping of longitudinal coupled bunch instabilities

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 93

Continuous-Wave HOM Load Power Computations Based on Single-Bunch Wake Simulations

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 94

Simulation of longitudinal intensity effects with LLRF system (BLonD)

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Session 5: Instability modeling, observations and cures (Chair: Mikhail Zobov. Scientific secretary: Eleonora Belli / 95

Challenges in impedance and instabilities computation for new generation light sources

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Session 6 -Instability modeling, observations and cures (Chair: Mikhail Zobov, Scientific secretary: Andrea Passarelli) / 96

Damping of transverse instabilities

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Session 6 -Instability modeling, observations and cures (Chair: Mikhail Zobov, Scientific secretary: Andrea Passarelli) / 97

Concept and simulations of unconventional damping devices: wideband damper and RFQ

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Session 6 -Instability modeling, observations and cures (Chair: Mikhail Zobov, Scientific secretary: Andrea Passarelli) / 98

A study of longitudinal effects on transverse Landau damping

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Session 6 -Instability modeling, observations and cures (Chair: Mikhail Zobov, Scientific secretary: Andrea Passarelli) / 99

Beam Transfer Function (BTF) measurements and transverse stability in presence of beam-beam

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SPECIAL SESSION: Overview on different types of machines (Chair: Chris Prior, Scientific Secretary: Adrian Oeftiger) / 101

Impedance and instabilities in lepton colliders

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SPECIAL SESSION: Overview on different types of machines (Chair: Chris Prior, Scientific Secretary: Adrian Oeftiger) / 102

Impedance and instabilities in hadron machines

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SPECIAL SESSION: Overview on different types of machines (Chair: Chris Prior, Scientific Secretary: Adrian Oeftiger) / 103

Impedance modeling in low emittance rings

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SPECIAL SESSION: Overview on different types of machines (Chair: Chris Prior, Scientific Secretary: Adrian Oeftiger) / 104

Instabilities in hadron colliders and role of the transverse damper

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Session 3: Impedance modeling, measurements and control (Chair: Maria Rosaria Masullo. Scientific secretary: Andrea Passarelli) / 110

Comparison of machine impedance calculation with beam based measurements

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Session: 4: Instability theory and modeling (Chair: Ingo Hofmann. Scientific secretary: Adrian Oeftiger) / 111

How e-cloud in dipoles and quadrupoles can be source of transverse instabilities

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POSTER session / 113

Preliminary results from validation measurements of the longitudinal power deposition model for the LHC injection kicker magnet

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The MKIs are fast pulsed transmission line injection kicker magnets of the LHC injection system. To shield the ferrite yoke from the beam, by providing a path for the beam image current, a set of 24 conductive wires is placed in the inner part of a ceramic tube along the length of the magnet aperture. Stringent rise-time specifications require that the wires are capacitively coupled to a grounded metallic cylinder at the upstream end of the tube, while at the downstream end they can be directly grounded. The cylinder also serves to support a set of nine ferrite rings, placed there to damp low frequency modes that can be excited along the length of the tube. Due to the beam screen design, an open-ended, half-wavelength resonating cavity is formed in the region where the screen conductors overlap with the external metallic cylinder. The so-formed cavity couples to the beam spectrum at discrete frequencies, determined by the length and effective dielectric constant of the cavity. Therefore, the impedance spectrum is resonant in nature exhibiting peaks at the cavity' s resonant frequencies.
In order to ensure uninterrupted LHC operation, the MKI ferrite yokes must remain below their Curie temperature at all times. Otherwise, waiting for the yokes to cool down leads to long turnaround times and hence significant deterioration of the overall machine performance. To monitor the temperatures reached within the MKIs 4 thermal probes (PT100) are placed in each magnet: two probes at the upstream and two at the downstream end of the magnet. During Run 1 of the LHC, one of the MKIs occasionally exhibited a high ferrite temperature. An impedance mitigation campaign was launched prior to Long Shutdown 1 (LS1) that led to an effective reduction of the MKI beam coupling impedance and to the corresponding RF heating during Run 2. However, thermal measurements during operation have clearly demonstrated that the upstream end of the magnet is consistently hotter than the downstream one. Power deposition caused by beam induced electromagnetic (e/m) fields due to the coupling of the beam spectrum to the MKI real longitudinal impedance, was identified as the main cause. Nonetheless, the simplified approach of a uniformly distributed power deposition along the length of the magnet was in clear contradiction with the measured data. Therefore, a more detailed description of the power dissipation process had to be looked for and carefully modelled to allow for accurate and robust predictions of current and future kicker beam screen designs; e.g. for HL-LHC.
In the present work, the approach followed to obtain estimations for the power loss deposition distributions is presented in detail. The method utilizes sophisticated electromagnetic simulations combined with carefully designed data post-processing to minimize the required simulation data, thus leading to acceptable execution time and storage space per simulation. The method, is then applied to two beam screen designs of the MKI: the one currently in operation and a new one, to be installed as an upgraded version in YETS 17/18. A comparison of the expected power deposition distributions is then carried out and the results are discussed. To validate the predictions of the power deposition model and gain more confidence in the effectiveness of the proposed design, a novel measurement method is proposed and implemented. The method is based on a simple measurement of a transmission coefficient taking advantage of the configuration of the expected e/m modes responsible for RF-heating. Preliminary results of the power deposition measurements are then reported and compared to model predictions.