

TTC 2019 - Vancouver

WG1 List of abstract

Session 1: Cavity performance experience-safe limit

Title: Long Term Operation of a Large Ensemble of SRF Cavities in CEBAF

Speaker: Arne Greyberger, JLAB

Abstract: Jefferson Lab's (JLab) Continuous Electron Beam Accelerator Facility (CEBAF) has been in operation since 1994. CEBAF was upgraded to 12 GeV in 2014 and this talk will focus on the performance during the first four years of 12 GeV operation. At present there are 418 superconducting accelerating cavities with individual power and control systems, two linacs and two cryogenic plants. This talk will present the operational aspects of simultaneous operation of 418 cavities, maintenance and unplanned events.

Title: Long term experience with SRF cavities at ELBE

Speaker: Peter Michel, HZDR

Abstract: ELBE is a compact, accelerator-driven photon and particle source. The variety of secondary radiation being offered extends from high-energy gamma rays to infrared and THz radiation as well as from neutrons to positrons and electrons. ELBE commissioning and test operation was started in 2001. In 2004 ELBE was transferred to a user facility, providing more than 5500 hours of beamtime with an up-time of more than 90% each year. The electron accelerator is based on four superconducting 9-cell TESLA cavities that are driven in CW operation to accelerate an average current of 1 mA up to beam energies of 40 MeV. Although these cavities performed well in the vertical test, they were limited by field emission from the very beginning to about 10 MV/m each. The reason is still unknown, but several candidates are being discussed. The prime suspect is particle contamination during cleanroom and beamline assembly but also a mechanism that allows particles to migrate from far away towards the cavity over an extended period of time might be possible. And also outgassing EPDM gaskets that are installed in the entire accelerator are a candidate for deterioration. Nevertheless, to ensure a reliable user operation, the performance of the cavities is determined in regular intervals by Q vs. E measurements and by means of high power RF processing and complete thermal cycling the performance could be partially returned to an earlier state. With the contribution we try to summarize our experiences in operating a superconducting CW LINAC over the last 15 years in an unclassified and probably dirty environment.

Title: Summary of the Maximum SCRF voltage in XFEL

Speaker: Nick Walker, DESY

Abstract: In this presentation, we will provide an overview of the maximum obtained voltage performance of each RF station in the XFEL, quantifying the observed differences and limitations as compared to the expected performance based on single module tests at AMTF. We will also briefly discuss operations experience affecting maximum voltage and future study directions.

Title: Operational experience of SRF linacs at IMP and IHEP

(TALK CANCELLED)

Speaker: Weiming Yue, IMP

Abstract: In this presentation, we will present the background of the ADS Linac, the issues of cavity conditioning, the performance of the SRF cavities in the Linac and compare the cavities performance between different beam commissioning stages.

Title: Operation and performance limits of the LHC cryomodule

Speaker: Katarzyna Turaj, CERN

Abstract: The LHC RF system comprises two cryomodules per beam with four cavities each. Single-cell Niobium sputtered cavities are operating at a frequency of 400.789 MHz at 4.5K, and deliver 8–16 MV per beam. This talk summarizes the experience and lessons learned of the operation of the LHC RF system over the years, performance limiting factors in the machine, the successful replacement and re-commissioning of one cryomodule with a spare module, and the recent re-test of the originally installed module on the test stand. Results of the currently launched cavities production compared to those already in operation are also included.

Session 2: Cavity performance experience-safe limit

Title: Long term experience at INFN Legnaro

Speaker: Giovanni Bisoffi, INFN

Abstract: The paper will review the various types of superconducting resonators (quarter wave resonators and RFQs) developed, built and employed on the presently running heavy ion superconducting linacs ALPI and PIAVE, operational at INFN-Legnaro since 1994 and 2004 respectively. It will cover their operational accelerating fields, RFE and FE conditioning times, slow and fast tuning schemes versus phase and amplitude locking issues. Ongoing upgrades on the superconducting RFQs and the production of 2 additional cryostats, with 4 higher-beta Nb-sputtered QWRs each, will be reported too.

Title: Overview of 12-year operation of the SCL at SNS

Speaker: Sang-Ho Kim and John Mammosser, ORNL

Abstract: The Spallation Neutron Source (SNS) has acquired extensive operational experience of a pulsed proton superconducting linear accelerator (SCL) as a user facility. Numerous lessons have been learned to achieve a stable and reliable operation of the SCL. The various improvements that contributed to the increase of the output beam energy and reliability are LLRF/control system improvement, high voltage converter modulator system improvement, high-power RF system improvement, cryomodule repairs, spare cryomodule development and accelerating gradient improvement through in-situ plasma processing. In this presentation, a brief overview of the operational experiences and the history of the SNS SCL output beam energy are reported.

Session 2: Field emission and multipacting: experience and mitigation

Title: Field Emission and Mitigation in the CEBAF Linacs

Speaker: Bob Legg and Rongli Geng, JLAB

Abstract: We describe the problem of field emission in CEBAF. We then discuss the effects of field emission caused by the C100 cryomodules on CEBAF. We show statistics relating field emission to cavity trip rates and damage to materials in adjacent areas and the overall increase in field emission over time. We discuss several techniques attempted to mitigate the effects of the radiation, including modelling to allow maximization of the dose vs Eacc, local shielding and cavity post processing and then summarize our CEBAF experiences to date.

Title: Exceptional events during the operation of the European XFEL

Speaker: Mathieu Omet, DESY

Abstract: In this talk we present our experience with exceptional events, which occurred during the operation of the European XFEL. This covers phenomena such as e.g. sudden and complete cavity discharge, stable quench conditions and cavity heating from the cryogenic system point of view. Furthermore the implications of these events on the operation are discussed.

Title: Operational Experience of Cavity/CMs in ISAC-II QWR linac

Speaker: Zhongyuan Yao, TRIUMF

Abstract: TRIUMF has operated the ISAC-II linac (heavy ion, 40 QWRs, 4K, common vacuum, 9T solenoid on board) since 2010. There is now substantial experience in tracking cavity performance, impact of High B solenoid, FE, MP.

Session 3: Voltage and phase stability

Title: LLRF systems performance limiting factors during CW operation of high QI cavities cryomodule

Speaker: Wojciech Cichalewski, TUL

Abstract: Since 2011 CMTB is hosting LLRF related studies dedicated to continuous wave and long pulse mode operation. During this period various 8-cavities cryomodules and various LLRF systems configurations have been tested. Current contribution summarizes main limiting factors encountered during high gradient CW operation of narrow bandwidth resonators. Issues with asymmetric cavity behavior due to Lorentz Force Detuning, microphonics, fundamental power couplers heating, nonlinear behavior of high power RF source and others will be addressed. Additionally, their influence on the multicavity system field regulation will be discussed.

Title: The measurement of microphonics and ponderomotive at the ADS demo

(TALK CANCELLED)

Speaker: Jinying Ma, IMP

Abstract: Microphonics and ponderomotive effects were one of major challenges to the stabilization of the fields. This talk will describe the measurement of microphonics and the ponderomotive instabilities and the conditions under which they can occur.

Title: LLRF compensation and mitigation of two cavity instability

Speaker: Ramona Leewe, TRIUMF

Abstract: Within TRIUMF's e LINAC two TESLA type cavities are operated with a single klystron in CW. Vector sum control is applied for field stabilization and the resonance frequencies are individually tuned with a proportional feedback controller. First operational experiences showed that amplitude oscillations can start in both cavities, while the vector sum is perfectly stable. These instabilities occur at high operating fields and are driven by Lorentz force changes. Within this talk the effect of Lorentz force on a single cavity is analyzed (no tuning system). A stability analysis of the linearized system reveals stable and unstable operational areas. A deeper analysis shows the existence of a limit cycle within the system. Simulation results confirm the analytical results and the operational experiences.

Title: CEBAF C100 Fault Classification Based on Time Domain RF Signals

Speaker: Tom Powers, JLAB

Abstract: In a CEBAF C100 cryomodule, when one cavity has a fault and the gradient is reduced quickly it will mechanically deform due to the Lorentz force effects. This deformation will cause perturbations in the adjacent cavities which, in turn, will cause a cascade of cavity faults that are difficult to understand without time domain data. In 2018 the software and hardware in the digital low level RF systems that are used with the C100

cryomodules, were configured such that a fault would trigger an acquisition process where waveform records of 17 of the RF signals for each of the 8 cavities within the cryomodule are recorded for further analysis. This talk will describe the types of faults that we have been able to identify as well as some of the remedial actions taken to mitigate them.

Title: Experience with LCLS-II cavity and cryomodule tests at Fermilab

Speaker: Elvin Harms, FNAL

Abstract: Fourteen Fermilab-built cryomodules for LCLS-II have now been tested cold at Fermilab's cryomodule test stand, CMTS1. A summary of test results to date compared against performance criteria, operational experience, and upcoming plans will be shared.

Session 4: 2K versus 4K operations, He induced microphonics

Title: 8T solenoid and the local magnetic shielding in the FRIB cryomodules

Speaker: Kenji Saito, MSU

Abstract: FRIB cryomodules are design to have one-three 8-T solenoids in the cryomodule nearby SRF cavities, depending cavity families. Local magnetic shield configuration was developed to protect the cavities from the strong fringe field exposure by the solenoid package. Cryomodule bunker test and the cryomodule commission is going on the FRIB now. We have confirmed this shielding configuration is greatly working: no Q-drop from the vertical test. This talk presents the local magnetic shield design and the measured cavity performance from the flux-trapping point of view.

Title: Comparison between 4K and 2K operation performance of CEBAF injector cryomodules

Speaker: Grigory Ereemeev, JLAB

Abstract: At the Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab there are regularly scheduled maintenance periods during which cryogenic plant often increases the liquid helium temperature from 2 K to 4 K. During recent maintenance periods, we accelerated a continuous-wave electron beam at the CEBAF photo-injector to a total energy of 6.3 MeV at currents up to 80 μ A using two 5-cell niobium cavities in the quarter-cryomodule at 4 K. I will discuss the differences between 4 K and 2 K operation in beam quality, cavity limitations, and microphonics.

Title: Experience with the CeC PoP 4K 1/4 Wave Photocathode Gun and 2K 5-Cell Cavity at RHIC

Speaker: Kevin Smith, BNL

Abstract: The Coherent electron Cooling Proof of Principle (CeC PoP) experiment was developed as a demonstration project for a novel, high energy bunched beam cooling technique. First beam was generated in March, 2016 with commissioning and beam experiments continuing since that time. The experiment utilizes a 112 MHz 1/4 Wave Photocathode Gun operating at 4K to generate high charge, low emittance electron bunches, and an 704 MHz 5-Cell elliptical cavity operating at 2K as the main accelerator. A variety of SRF system operational challenges were encountered and overcome in both systems, and this presentation will present several examples along with solutions, work arounds and lessons learned.

Title: Experience with cryogenics-induced microphonics on LCLS-II cryomodules

Speaker: Tom Peterson, SLAC

Abstract: An LCLS-II cryomodule on the test stand at Fermilab at 2.0 Kelvin had a microphonics problem. This problem went away when closing a manual valve to the cool-down valve supply. The first interpretation is that the cool-down valve was sending vapor bubbles into the bottom of the helium vessel via the capillary tubes, which created a source of microphonics.

Title: Commissioning of 704 MHz SRF booster cavity for LERec

Speaker: Wencan Xu, BNL

Abstract: 704 MHz SRF booster cavity and cryomodule for LERec was originally a SRF gun for R&D ERL. Tremendous effort was put in for this conversion, as to meet the critical requirement for LERec : maximum 2.2 MV in a 8.2 cm gap, excellent HOM damping, demanded stability of field and limitation of RF power. The cavity has been successfully commissioned for LERec operation since Jan. 2018. This talk will present the commissioning experience of 704 MHz SRF booster cavity for LERec, including a brief introduction of cavity and cryomodule conversion, multipacting condition of FPC and HOM damper components to minimize the conditioning work at 2K, and stability of RF field (feedback loop for circulator and reduction of cryogenics surging, and other tricks). During operation, a field emitter lit up at 1.2 MV, and we managed to condition it out (no field emission up to 2.0 MV). This talk will present this experience as well.