EuroNNAC and EuPRAXIA Workshop on Pilot Applications of Electron Plasma Accelerators (PAEPA)

Report of Contributions

https://indico.cern.ch/e/569936

Contribution ID: **26** Type: **not specified**

Welcome address and workshop assignment (focus)

Tuesday 11 October 2016 13:30 (20 minutes)

The goals of the workshop will be briefly outlined.
The structure of the workshop will be presented.
Announcement on practical details will be made.

Presenter: SPECKA, Arnd (Ecole Polytechnique France - CNRS/IN2P3)

Session Classification: Session 1: Introduction

Contribution ID: **27** Type: **not specified**

EuPRAXIA electron beam parameters

Tuesday 11 October 2016 13:55 (30 minutes)

The talk will introduce the current study concept of EuPRAXIA. It presents much of the outcome of discussions and meetings over the last year, condensed into flow diagrams and technical tables. These will define the preliminary study version of EuPRAXIA. Input from the PAEPA workshop will be incorporated into these tables and diagrams at the end of the workshop, to include HEP user cases in the EuPRAXIA design study.

Presenter: WALKER, Paul Andreas (DESY)

Session Classification: Session 1: Introduction

Contribution ID: **28** Type: **not specified**

Medical imaging applications at innovative radiation sources

Tuesday 11 October 2016 14:30 (10 minutes)

X-ray imaging has been the most important and widespread diagnostic tool in medicine over the last century. Despite its success, for example in imaging bone and dense structures, X-ray diagnostics reaches its limits in the examination of soft tissues, such as small tumours in healthy tissues, or in imaging lungs, vessels, or articular cartilage. Moreover, medical diagnostic imaging requires high contrast at low radiation dose: a condition that often limits the sensitivity of the method. In this scenario, the application to biomedical imaging of innovative methods using monochromatic or quasi monochromatic X-rays can open new diagnostic opportunities. These techniques have been developed at synchrotron radiation facilities and are ready to be exported at compact radiation sources. An overview of the most recent results obtained in microscopic will be presented and discussed.

Presenter: BRAVIN, Alberto (ESRF)

Session Classification: Imaging

Contribution ID: **29** Type: **not specified**

Prospective use of laser-driven sources for X-ray phase contrast imaging

Tuesday 11 October 2016 14:45 (15 minutes)

X-ray phase contrast imaging (XPCI) methods have emerged that can potentially transform all areas where x-ray imaging is used - medical and not. XPCI is historically associated with stringent coherent requirements which means it has been mostly implemented at synchrotron facilities; however, the use of laser-based plasma sources could transform this. Although there are now totally incoherent approaches to XPCI such as the "edge illumination" method pioneered at UCL, sources with higher brilliance and coherence would still be beneficial in terms of speeding up acquisitions (allowing e.g. dynamical studies) and increasing image quality.

Presenter: OLIVO, Alessandro (University College London)

Session Classification: Imaging

Contribution ID: **30** Type: **not specified**

Discussion on requirements for imaging

Tuesday 11 October 2016 15:05 (25 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Imaging

Contribution ID: **31** Type: **not specified**

Plasma Accelerators as a source of fs X-rays for probing Matter Under Extreme Conditions

Tuesday 11 October 2016 16:00 (10 minutes)

The betatron oscillations of the electron beam inside a laser wakefield accelerator have been shown to produce bright X-rays with some unique properties: namely they are both broadband and have a femtosecond duration. In this talk I will outline future applications that will use these unique properties to perform time resolved X-ray spectroscopy of matter under extreme conditions.

Presenter: MANGLES, Stuart (Imperial College London)

Session Classification: Session 5: Applications

Contribution ID: **32** Type: **not specified**

LWFA gamma source applications

Tuesday 11 October 2016 16:20 (10 minutes)

I will briefly review the requirements for gamma ray sources generated with a LWFA for a variety of applications.

Presenter: THOMAS, Alexander (university of michigan)

Session Classification: Session 5: Applications

Contribution ID: **33** Type: **not specified**

Inverse Compton scattering from plasma wakefield acceleratedbeams

Tuesday 11 October 2016 16:35 (10 minutes)

Generation of hard photon pulses from inverse Compton scattering with plasma wakefield accelerated electron beams is presented. The high beam quality in terms of energy spread and divergence ensures low radiation bandwidth on the order of a few percent within fs-scale pulses. This scheme gets extended to decoupled and yet synchronized multicolor radiation pulses that enable unique control of temporal and spectral spacing. Properties of these beam/pulse pairs can be tuned independently and allow for a broad range of photon energies and delays while maintaining the narrow single-pulse bandwidth.

Presenter: SCHERKL, Paul

Session Classification: Session 5: Applications

Contribution ID: **34** Type: **not specified**

Discussion on requirements for other radiation applications

Tuesday 11 October 2016 16:50 (30 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 5: Applications

Contribution ID: **35** Type: **not specified**

Embryonic thinking of possible EuPraxia vs medical applications synergy

Tuesday 11 October 2016 17:20 (10 minutes)

Electron beams in the 1 - 5 GeV range seem hard to be used for what is regarding medical applications thought as “patient treatment”. But it can be that some of the instrumentation techniques developed in the medical may be considered for EuPraxia and, reciprocally, that this new platform may help in providing the medical field some testing and development opportunities. Under the convinced eagis of this workshop organizer, some early, incomplete and early remarks will be made.

Presenter: VERDERI, Marc (Centre National de la Recherche Scientifique (FR))

Session Classification: Session 2: Medical, Biological, Space and Material Science Applications of electron beams

Contribution ID: **36** Type: **not specified**

Microbeam Radiation Therapy

Tuesday 11 October 2016 17:35 (10 minutes)

The intense X-ray beams available at large scales facilities and, in the near future, at compact sources, are also well suited for radiation therapy. A flagship development in this field is microbeam radiation therapy (MRT), which uses very high doses of microscopic beams delivered to tissues in a fraction of a second. These microbeams are very well tolerated by normal tissues while tumoral tissues appear to be much more radiosensitive. MRT is being tested for the treatment of aggressive brain tumors and for brain function modulation.

Presenter: BRAVIN, Alberto (ESRF)

Session Classification: Session 2: Medical, Biological, Space and Material Science Applications of electron beams

Contribution ID: **37** Type: **not specified**

Terrestrial reproduction of space radiation electrons using Plasma Wakefield Accelerators

Tuesday 11 October 2016 17:50 (10 minutes)

Space radiation poses a major hazard both for astronauts and spacecraft electronics, especially during prolonged mission periods. High energy protons and electrons, originated from the sun or deep space, are trapped into the Earth's magnetic field, forming radiation belts and act as main contributors regarding astronauts'radiation dose and electronic malfunctions. In this study, the terrestrial reproduction of the 'killer'electrons component using Plasma Wakefield Accelerators (PWFA) is discussed and the total produced dose in water is investigated.

Presenter: DELINIKOLAS, Panagiotis

Session Classification: Session 2: Medical, Biological, Space and Material Science Applications of electron beams

Contribution ID: **38** Type: **not specified**

Discussion on requirements for irradiation for space, material, biological applications

Tuesday 11 October 2016 18:05 (25 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 2: Medical, Biological, Space and Material Science Applications of electron beams

Contribution ID: **39** Type: **not specified**

Presentation of the H2020 EuPRAXIA Design Study

Wednesday 12 October 2016 09:00 (25 minutes)

The Horizon2020 Design Study EUPRAXIA is introduced. Presently foreseen electron beam and laser parameters are summarised.

Presenter: ASSMANN, Ralph Wolfgang (DESY)

Session Classification: Session 1: Introduction

Contribution ID: **40** Type: **not specified**

Plasma accelerators: State of the art

Wednesday 12 October 2016 09:30 (40 minutes)

Introductory talk on (Laser) Plasma Acceleration : after a short review of the basic principles, the state-of-the-art will be presented with emphsis on the injection and staging issues. Last, the expected and achieved properties of the extracted electron beams will be discussed.

Presenter: MOSNIER, Alban

Session Classification: Session 1: Introduction

Contribution ID: **41** Type: **not specified**

Enhancing the efficiency of laser and plasma based accelerators using bichromatic driver pulses

Wednesday 12 October 2016 10:15 (10 minutes)

The importance of the laser and plasma based accelerators is well known. The tuning of the laser and plasma parameters is the crucial point of this technology. Earlier we already have done numerical simulations to determine the beam parameters of a laser driven plasma based electron accelerator, i.e. the parameters of both the laser beam and the victim electron bunch [1]. In a latter study, we improved our simulations such that it is capable to deal with bichromatic driver pulses [2]. We simulated the effects of mixing the second harmonic to the original driver pulse with 800 nm wavelength and got promising results. The most important one is, that by properly tuned laser parameters, it is possible to transfer 30% more energy to the victim bunch by the same intensity than that is achievable by applying a monochromatic, infra red driver pulse. It is also possible to realise this idea in practice with a moderate additional effort. Our studies suggest that laserplasma electron accelerators may be relevant tools in material science, e.g. radiography, or in medical sciences, e.g. radiotherapy. For the latter applications, mostly electrons with a few tens of MeV energy are needed [3]. For higher penetration depth, electrons with a few hundred MeV kinetic energy may be needed. Both energy ranges can be achieved using laserplasma electron accelerators. According to our studies, using an 800nm wavelength laser these energies can be achieved if the laser intensity lies between 10ˆ17 - 10ˆ21 W/cm2 and the pulse duration lies between 5 and 75 fs. In our calculations the maximum of the beam waist was 80 um and they suggest that larger beam waists result in higher energy gain, i.e. larger beam waists may reduce the required laser intensity to achieve the same energy gain, even by one or two orders of magnitudes.
[1] M. A. Pocsai, S. Varró, I. F. Barna, Laser and Particle Beams (2015), 33, 307-313. [2] M. A. Pocsai, S. Varró, I. F. Barna, Nucl. Instr. Meth. Phys. Res. B (2016) 369, 50-54. [3] K. S. Clifford Chao and Carlos A. Perez, Radiation Oncology: Management Decision 2n. Edition, chap. 3. p. 29. (ISBN: 978-0781732222)

Presenter: POSCAY, Mihaly Andras

Session Classification: Session 1: Introduction

Contribution ID: **42** Type: **not specified**

EuPRAXIA Q&A and the workshop assignment (focus)

Wednesday 12 October 2016 11:00 (15 minutes)

Presenter: SPECKA, Arnd (Ecole Polytechnique France - CNRS/IN2P3)

Session Classification: Session 3: HEP applications

Contribution ID: **43** Type: **not specified**

Particle Flow Analysis and Ultra-high Granularity Calorimetry

Wednesday 12 October 2016 11:20 (15 minutes)

Presenter: POESCHL, Roman (Laboratoire de l'Accelerateur Lineaire (FR))

Session Classification: Session 3: HEP applications

Contribution ID: **44** Type: **not specified**

Potential of EuPRAXIA test beam for Ultra-high Granularity Calorimetry

Wednesday 12 October 2016 11:40 (15 minutes)

Picosecond multiparticle bunches offers novel tool to test and calibrate calorimeters. This might be a tool especially suited or PFA oriented detecteors such as the CALICE SiW-ECAL or SDHCAL, CMS HGCAL or ATLAS HGTD.

Presenter: BOUDRY, Vincent (LLR - Ecole Polytechnique/CNRS-IN2P3)

Session Classification: Session 3: HEP applications

Contribution ID: **45** Type: **not specified**

Discussion on requirements for HEP (test beams)

Wednesday 12 October 2016 12:00 (30 minutes)

Presenter: SPECKA, Arnd (Ecole Polytechnique France - CNRS/IN2P3)

Session Classification: Session 3: HEP applications

Contribution ID: **46** Type: **not specified**

Search for dark photons using high energy e beams and other applic's

Wednesday 12 October 2016 13:30 (20 minutes)

Given a clean high energy electron beam, new and improved fixed-target or beam-dump experiments are possible. An example is the NA64 experiment which is searching for hidden sector physics such as dark photons using the secondary SPS electron beam at an intensity of ˜10ˆ6 e-/s. With the expectation of being able to increase this rate by at least a factor of 100 to 1000, sensitivity to new physics is correspondingly extended. This work was originally presented at the Physics Beyond Colliders Workshop at CERN based on the use of a beam from AWAKE. The idea has still applicability at lower electron beam energies. A review of other HEP applications for plasma wakefield acceleration will also be briefly given. Having about 15 minutes would be good.

Presenter: WING, Matthew (UCL)

Session Classification: Session 3: HEP applications

Contribution ID: **47** Type: **not specified**

Discussion on requirements for HEP (fundamental physics)

Wednesday 12 October 2016 13:55 (15 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 3: HEP applications

Contribution ID: **48** Type: **not specified**

Positron source overview

Wednesday 12 October 2016 14:25 (15 minutes)

The aim of this talk is to give an overview of current and planned positron source technologies. Such sources include electron beams incident on amorphous conversion targets or crystalline targets, as well as gamma-ray positron sources using either Compton back-scattering or undulators to produce gamma-rays which are then incident on thin targets. Currently achievable fluxes and emittances are reviewed.

Presenter: BAILEY, Ian (University of Liverpool)

Session Classification: Session 4: positron sources and applications

Contribution ID: **49** Type: **not specified**

Laser-driven generation of high-quality positron beams

Wednesday 12 October 2016 14:45 (15 minutes)

The generation of high-quality relativistic positron beams is a central area of research in experimental physics, due to their applications in a wide range of scientifi
c and engineering areas, ranging from fundamental science to practical applications. There is now growing interest in developing hybrid machines that will combine plasma- based acceleration techniques with more conventional radio-frequency accelerators, in order to minimise the size and cost of these machines. Here we report on recent experiments on laser-driven generation of high-quality positron beams using a relatively low energy, potentially table-top laser system and show how current technology allows to create, in a compact setup, positron beams suitable for injection in conventional accelerators.

Presenter: SARRI, Gianluca

Session Classification: Session 4: positron sources and applications

Contribution ID: **50** Type: **not specified**

Discussion on requirements for positron beams

Wednesday 12 October 2016 15:05 (15 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 4: positron sources and applications

Contribution ID: **51** Type: **not specified**

Positron-electron plasma

Wednesday 12 October 2016 15:20 (15 minutes)

Presenter: SARRI, Gianluca

Session Classification: Session 4: positron sources and applications

Contribution ID: **52** Type: **not specified**

Discussion on requirements for positrons electron plasma experiments

Wednesday 12 October 2016 15:40 (15 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 4: positron sources and applications

Contribution ID: **53** Type: **not specified**

Test of new longitudinal diagnostics as beam test facilities

Wednesday 12 October 2016 14:10 (15 minutes)

Coherent Smith-Purcell Radiation encodes information about the longitudinal profile of a relativistic beam. We had a succesful measurement campaign at FACET in the US recently and we are now working on accurately mapping the emission in the SOLEIL linac. I will present recent results obtained recently, current work and Research that could be performed with a new versatile test beam facility.

Presenter: DELERUE, Nicolas (LAL, CNRS & Université Paris-Sud)

Session Classification: Session 3: HEP applications

Contribution ID: **54** Type: **not specified**

Discussion on requirements for beam diagnostics

Thursday 13 October 2016 09:30 (30 minutes)

Presenter: SPECKA, Arnd (Ecole Polytechnique France - CNRS/IN2P3)

Session Classification: Session 7: Diagnostics, configurations, infrastructure

Contribution ID: **55** Type: **not specified**

Beam transport and environment simulation, a biased view.

Thursday 13 October 2016 10:00 (10 minutes)

The novel acceleration technique of EuPraxia does not seem to induce new problems for what is regarding the simulation. Once the electrons are accelerated, their energy is typical of the "high energy physics" field, and simulation tools used there can be a priori be applied to EuPraxia. Invitation to discuss the first statement of this abstract will be made ; and beam transport tools as well as environment simulation techniques for radioprotection problems will be mentioned ; this presentation will be biased toward the generalist simulation toolkit Geant4.

Presenter: VERDERI, Marc (Centre National de la Recherche Scientifique (FR))

Session Classification: Session 7: Diagnostics, configurations, infrastructure

Contribution ID: **56** Type: **not specified**

Discussion on requirements for environment simulation

Thursday 13 October 2016 10:15 (20 minutes)

Presenter: SPECKA, Arnd (Ecole Polytechnique France - CNRS/IN2P3)

Session Classification: Session 7: Diagnostics, configurations, infrastructure

Contribution ID: **57** Type: **not specified**

Discussion on EuPRAXIA facility configurations

Thursday 13 October 2016 10:35 (30 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 7: Diagnostics, configurations, infrastructure

Contribution ID: **58** Type: **not specified**

Round table discussion; Future steps

Thursday 13 October 2016 11:05 (30 minutes)

Session Classification: Session 8: Conclusions and further steps

Contribution ID: **59** Type: **not specified**

Workshop Summary

Thursday 13 October 2016 11:35 (20 minutes)

Presenter: WALCZAK, Roman (University of Oxford)

Session Classification: Session 8: Conclusions and further steps