WS101-12: Perspectives of laser driven particle acceleration in radiation oncology

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Fundamental advances in radiation oncology including tumor molecular assessment, volumetric imaging, technical developments, and introduction of combined approaches (ie radiosensitisation, radio-immuntherapy) have lead to substantial improvements in the therapeutic index. The implementation of precision medicine, such as genomics, radiomics, and mathematical modelling open the possibility to personalised radiotherapy adaptation and treatment. Further emerging methods under intensive preclinical research offer additional benefit such as, high dose-rate synchrotron broad-beam radiation therapy (SBBR), microbeam radiation therapy (MRT) (1) and ultra-high dose-rate radiation therapy (so called “FLASH” effect). The recent development of high power lasers allows laser driven particle acceleration (LDPA) with main characteristics of ultra-high beam intensity, small beam size and the potential of particle and energy range selection. With the laser based technique the promising results by FLASH, SBBR and MRT achieved on *in vitro* and small animal studies (mice, rats, mini pigs), furthermore on tumor bearing veterinary patients such as cats and dogs potentially transferable into human investigation could be available on wider basis for radiation oncology. The laser research facilitated as well as the exploitation of novel binary approach of boron proton capture enhanced proton radiation. Seeking for neutron free fusion the boron proton capture reaction have been proposed for densely ionizing additional dose delivery, occurring at the end of spread out Bragg peak(SOBP) at a proton energy of ca 700 KeV resulting in 3 alpha particles (2). Another promising modality is the Boron Neutron Capture Therapy (BNCT), which requires special neutron facility, which could be theoretically provided with the development of laser based thermal- epithermal neutron beams. The biomedical application group at ELI-ALPS has established and validated a vertebrate biological model with reliable quantitative endpoints for extensive preclinical investigations on very high energy electron (VHEE) / VHEE based photon/ and laser driven proton sources for MBT, SBBT and FLASH radiation development (3). The recent achievements in radiation oncology, the clinical potential of the laser based approaches will be presented and guidelines for *in vitro* radiobiology experiments using zebrafish embryo model at LDPA facilities will be proposed.

The ELI-ALPS project (GINOP-2.3.6-15-2015-00001) is supported by the European Union and co-financed by the European Regional Development Fund. The project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement no 654148 Laserlab-Europe.

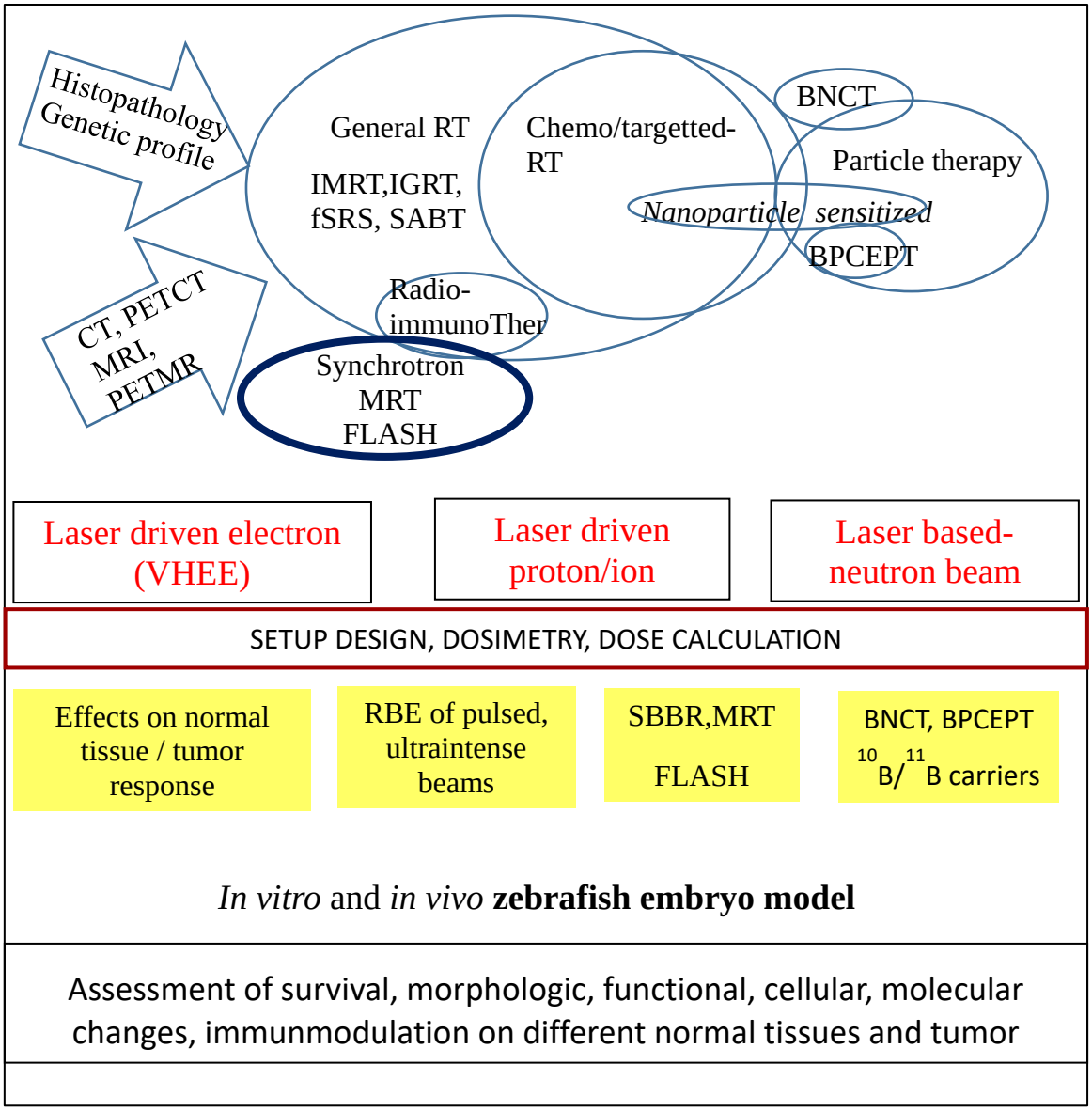

Figure 1: One figure representing the key content and message of your presentation is highly appreciated. Ideally you can use the above drawing canvas.

[1] Billena C, Khan AJ. A Current Review of Spatial Fractionation: Back to the Future Int J Radiat Oncol Biol Phys. 2019 Jan 23. pii: S0360-3016(19)30154-3.

[2] Cirrone GAP, Manti L, Margarone D, et al. First experimental proof of Proton Boron Capture Therapy (PBCT) to enhance protontherapy effectiveness. *Sci Rep*. 2018;8(1):1141.

[3] Szabó ER, Brand M, Hans S, Hideghéty K et al.Radiobiological effects and proton RBE determined by wildtype zebrafish embryos. PLoS One. 2018 Nov 8;13(11)