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Dr. Miriam Brosi / Young Investigator Group "Beam Dynamics and Collective Effects in the Generation and Propagation of Structured Beams for Advanced Accelerator-based Radiotherapy."

Dear KIT Executive Board, dear members of CRYS,

The Institute for Beam Physics and Technology (IBPT) of the Karlsruhe Institute of Technology develops innovative accelerator technologies at its accelerator test facilities KARA and FLUTE. Examples are diagnostics for ultra-fast measurement and control of electron beams and new magnet technologies. Machine learning methods are used to optimize and stabilize operation. Among other things, this enables basic research into the non-linear dynamics of electron beams at a level which is scarcely achieved elsewhere. Together with our partners from science and industry, we put our developments to use in German and international high-performance accelerators.

Recent additions to our research portfolio of high strategic importance for IBPT and the Helmholtz program Matter and Technologies as a whole are the research on energy solutions for large-scale research infrastructures and the development and generation of efficient new beams for application in radiotherapy. To this ends, IBPT expressly supports the application of Dr. Miriam Katharina Brosi for a Helmholtz Investigator Group "Beam Dynamics and Collective Effects in the Generation and Propagation of Structured Beams for Advanced Accelerator-based Radiotherapy."

It has to be stressed that the research to be addressed in the framework of the young investigator group ideally complements and enhances the present research portfolio of accelerator research at IBPT and in the Accelerator Technology Platform at KIT (ATP). In addition, Miriam Brosi is an outstanding scientist with a proven talent for transdisciplinary work and a knack for teaching, and undoubtedly has a stellar career ahead of her. Already, she received two awards for her doctoral research on storage ring beam dynamics. After a short stay at the University of Lille, France, she now works at the accelerator complex of MAXLab (Lund, Sweden). Very quickly she has become an internationally known accelerator specialist, introducing top-notch data science approaches to complex beam dynamics questions.

This allows very new and exciting insight into relativistic particle behavior and, finally, will enable to novel and resource-efficient operation modes of accelerators. When applied to linear accelerators for medical purpose, this approach has the potential to resolve a fundamental limitation inherent to all applications of high-intensity, short-duration particle pulses by improved understanding, predictability and potential control of these challenging beams.

The proposal intends to make a very timely contribution to novel radiotherapy methods based on temporally and spatially structured accelerator-generated beams. By investigating the influence of

Karlsruhe Institute of Technology

collective effects on the dynamics for these complex beam properties and, furthermore, extending the consideration of collective effects into the beam-matter interaction outside of the accelerator, the project aims for a greatly improved predictability of the beam properties. This, combined with a systematic study of applicable diagnostic methods, will form the basis for research into the possibilities and physical limits of accelerator-based pulse shaping and modulation, with the aim of generating predefined beam shapes on the target.

This research into the dynamics, detection and control of customized short-pulsed accelerator beams fits very well with the PoF V application focus in the Helmholtz program Matter and Technology (MT). Cross-topical approaches between detector and accelerator research, already a trademark of MT at KIT, will be further strengthened. Furthermore, the project aligns perfectly with the new KIT-center Health Technologies and future Cooperation with the German Center for Cancer Research DKFZ in Heidelberg and with Heidelberg University.

The thorough control of the demanding beam properties and beam stability is crucial input to new layouts for energy-efficient accelerators in the medical sector. The overall power consumption and operability of accelerators will be one of the deciding factors for the availability of accelerator-based medical treatment in countries around the world in years to come. Here, the IBPT cooperates with Energy Lab 2.0 within the KITTEN joint research infrastructure. Miriam Brosi's Young Investigator Group would play an central role as a showcase project for medical systems and hence advance the impact of KITTEN as well as on transdisciplinary teaching approaches.

The desired scientific contributions of the Young Investigator Group cannot be directly compensated by the existing expertise of IBPT in particular or the KIT in general.

In my function as head of institute, I hereby confirm that IBPT will provide the required 25% of the total funding to co-finance the group in case of the approval of the proposed Helmholtz Young Investigator Group for the duration of the funding. Also, IBPT will provide appropriate infrastructure (workplaces incl. computers, communication services) as well as access to the accelerator test facilities and infrastructure.

Following a positive evaluation, the Young Investigator Group will be made permanent by the permanent appointment of Miram Brosi as project leader. The management of the IBPT and Miram Brosi will meet regularly to discuss her development and career prospects.

The establishment of the junior research group would not only support efforts to attract a brilliant woman scientist to the IBPT. Rather, the HGF as a whole would also benefit from strengthening the competences for the generation of new particle beams for sustainable, application-oriented and efficient accelerators in the person of Miriam Brosi.

I would be delighted if you would support the project proposal of Miriam Katharina Brosi to set up a Helmholtz Young Investigator Group.

Yours sincerely,

Prof. Dr. Anke-Susanne Müller