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Preliminary evaluation of a brightness enhancement system of the KUR slow positron beamline

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At present, a reactor-based slow positron beamline, as a part of joint usage research facilities, is under development at the Kyoto University Research Reactor (KUR) [1–4] in order to promote the research on nuclear and other advanced materials using energy-variable slow positron beams. To date, slow positron production tentatively measured was 1.4×10^6 s^{-1} under 1 MW reactor operation [2] (Maximum 5 MW). The KUR beamline mainly consists of a positron source [2], a brightness enhancement system [3], a pulsing system [4] and an experiment chamber.

A brightness enhancement technique for positron beams has been studied at several facilities for getting high-brightness and low-emittance beams [5, 6]. We use this technique to reduce the beam size from around 30 mm to several mm while keeping the beam intensity as high as possible. Our brightness enhancement system was designed based on the positron microprobe developed at AIST [5] and has been already installed at the beamline. Brightness-enhanced beams are obtained by focusing the accelerated positron beams (5 keV) at the transmission-type remoderator (single-crystal Ni thin film). In our design, the remoderator can be easily retracted from the center of the beamline to adjust the beam transport.

As the KUR has not been in operation for approximately three years (from June, 2014) to comply with new safety regulations, we performed preliminary operation tests by electron beams with respect to the beam extraction from a transport magnetic field and focusing using a magnetic lens. For comparison, we also performed the trajectory analysis of positron beams in the several types of configurations by using GPT [7] and Poisson Superfish [8] codes.
In this presentation, we will report the above experimental and calculation results together with the introduction of the recent developments of our slow positron beamline.

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