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Overview of the BPM system for HIAF & CiADS projects

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Both large-scale facilities, CiADS and HIAF, have a SC linac with current range from tens μA to 20 mA demanding a big dynamic for BPM. The HIAF booster ring accelerates all ion beams from MeV/u to GeV/u, resulted an unprecedented challenge to BPM with induced voltage in range of 40 uV –40 V. Four types of pickups are designed, with the capacitive pickups inside the quadrupoles, the titanium button BPMs inside the CMs with a compact geometry, a complex structure integrated with BPM, a water-cooled niobium ring and vacuum pumps within 300 mm between the CMs. The SiO₂ cables under 2 K are developed by the joint R&D with a domestic company. For the synchrotron, a diagonal-cut BPM is designed with a good position linearity, low beam impedance, good vacuum performance up to 5.0E-12 mbar, as well as good mechanical properties with the electrode coaxiality less than 0.2 mm. To obtain precise and reliable position measurement, the dedicated electronics are developed for the position and phase measurement in linac, and the turn-by-turn trajectory and orbit measurement for synchrotrons. Moreover, the non-linearity calibration due to the approaching effect and fringe field is carried out and a high-order polynomial correction algorithm is implemented on FPGA to get the real-time accurate position for beam offsets. Furthermore, both newly developed BPM electronics have self-testing and self-calibration functions. Presently the BPM system is preparing for the installation.

Footnotes

Funding Agency

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Yes

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