Radio-Frequency Technology

Radio Frequency Technology for Accelerators and Spin-offs

One of the Amritkaal targets is indigenous development of GeV range, high current proton accelerator. Globally, such accelerators employ high power RF sources, along with associated RF control and instrumentation systems, to set-up and stabilize oscillating electromagnetic fields in resonant cavities used for acceleration. Accelerator Control Division (ACnD) is developing Radio Frequency (RF) Systems for different types of accelerators.

Meeting the challenges in RF power systems catering to high power demands, both peak and average, necessitates focus on high efficiency. Development of indigenous, robust, reliable, and high efficiency solid-state amplifiers (SSA) by ACnD is an important milestone achieved, which will play a major role in self-reliance in this area. Significant efforts are being made by the division to meet future requirements using the latest technology.

Development of an integrated RF control solution (IRFCS), comprising of low-level RF control system, resonance control System, RF phase distribution system, and RF protection & interlock system is necessary for successful, smooth and reliable operation of high intensity proton accelerator. ACnD has developed and deployed IRFCS for a variety of accelerators associated with the Indian accelerator program. Starting from primarily analog based systems, the present day RF control and instrumentation systems take advantages of the advancement in digital technology. This has enabled achieving better speed of response with the flexibility of implementing the sophisticated algorithms and features with better accuracy and precision.

Apart from developing RF systems for variety of accelerators associated with the Indian accelerator program, ACnD has also been developing and delivering RF systems to Fermi National Accelerator Laboratory, USA.

Application of machine learning for optimal and adaptive control of accelerator for efficient operation is also becoming feasible. Use of a real time emulator of high-power RF system, incorporating a cavity, for the development of RF control system, is also becoming a reality.

Spin-off of this work on accelerator RF has been very useful in applications like RF-plasma based disinfection and quantum computing initiative.

This thematic issue of BARC Newsletter is a collection of articles on RF systems for accelerators and other applications. I sincerely hope that this newsletter will provide an insight into the expertise and experience available within ACnD for utilizing it for future accelerator development plans.

As the thematic issue of BARC Newsletter on Radio Frequency Technology for Accelerators and Spin-offs is being published for the first time, I take this opportunity to thank all the authors and associate editors for their time and efforts in preparing this issue.

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