

28 Jun 2018

First workshop on Pulse Power for Kicker Systems held at CERN

by Mike Barnes (CERN)

[pulse power electrical circuits](#)

The PULPOKS 2018 workshop brought more than 40 participants to discuss the latest developments in the field of pulsed power for particle accelerators



The first workshop on Pulse Power for Kicker Systems (PULPOKS) was held on 12 and 13 March, 2018, at CERN and brought together both new and experienced engineers in the field of pulsed power for particle accelerators. The PULPOKS 2018 workshop was kindly supported by both ARIES (the successor of EuCARD2) and FCC.

There were 40 participants in the workshop, including five women, from fourteen laboratories/institutes based in nine countries. One participant travelled from Fermilab, USA, to attend the workshop. ARIES sponsored a participant from the Institute of Electrophysics, Russia.

Since an accelerator stage has limited dynamic range, a chain of accelerator stages is required to reach high energy. Thus beam transfer into (injection) and out of (extraction) an accelerator is required. A combination of septa and kickers is frequently used for injection and extraction. Septa can be electrostatic or magnetic. They provide slower field rise and fall times, but a stronger field, compared to kicker magnets. Kicker magnets provide fast field rise and fall times, but relatively weak fields. When a kicker magnet is installed in a circular accelerator the circulating beam is typically in the aperture of the magnet. Thus the kicker field must rise from zero to full field in the time interval between the circulating beam and the start of the injected beam, and fall from full field to zero field in the time interval between the end of the injected beam and the subsequent circulating beam. In addition, the magnetic field must not significantly deviate from the flat top of the pulse or from zero between pulses (i.e., very small ripple/excursions). Typical field rise/fall times range from tens to hundreds of nanoseconds and pulse widths range from tens of nanoseconds to tens of microseconds. If a kicker exhibits a time-varying structure in the field pulse shape, this can translate into small offsets with respect to the closed orbit (betatron oscillations). Thus a fast, low-ripple kicker system is generally required. In order to achieve fast field rise and fall times high voltage and high current pulses are required, together with special magnets. These so called transmission line type magnets are typically used at CERN.

Many particle accelerators laboratories use pulsed power systems. Some of these systems are ageing, and spare components are no longer commercially available. Therefore R&D is being carried out into new technologies and electrical circuit topologies which can be used to replace obsolete components. Furthermore there is R&D being carried out on high performance and high reliability pulsed power systems for possible future accelerators, such as the International Linear Collider (ILC), the Compact Linear Collider (CLIC) and Future Circular Collider (FCC).

Thus the objectives of the PULPOKS workshop were to address these challenges by:

- Improving communication between both new and experienced engineers in the field of pulsed power for particle accelerators;
- Sharing knowledge, experience and approaches;
-

Sharing information about projects etc. which we are working on, including: obsolescence programs, upgrades, large procurements, new designs, R&D projects, etc.

- Discussing future requirements of the pulsed power community.

There were eight sessions, at the workshop, each covering a major topic area: these ranged from thyratrons (which have historically been used for fast, high power, switching for kicker systems), solid state switches and modulators, high voltage coaxial cables, measurements and online analysis, magnetic materials, computer simulation, to coatings and beam impedance shielding for kicker magnets. Various laboratories are carrying out studies in the aforementioned subjects, however, solid state switches and modulators is a particular active area of R&D. All the presentations stimulated interesting discussions. The presentations are publicly available on INDICO, at <https://indico.cern.ch/event/682148/>

Feedback on the workshop was very positive. Participants from two labs have offered to host a PULPOKS workshop in 2 years time. It is proposed that the next workshop will include an additional topic of strip lines for kicker systems. This is a very important subject area for Low Emittance Rings. In order to further promote communication and the exchange of ideas an e-group mailing list has also been setup.

After the workshop, participants had the opportunity to visit both LEIR and the AD.