

Recent advances and developments in IBA cyclotrons

Jean-Michel Geets, Benoit Nactergal, Michel Abs, Claudy Fostier, Eric Kral

IBA Molecular, IBA Technology group, www.iba-group.com

Various development and enhancement to the existing IBA cyclotron range were accomplished last year including the launch of new cyclotrons and the revival of the oxygen machine.

To reply to the strong demand of F-18 radiopharmaceuticals in PET nuclear medicine, IBA has achieved a development program on the Cyclone® 18/9 PET cyclotron with the aim of increasing beam current and reliability. The strippers were replaced by a 'drop-in-place' designed to ease the maintenance. The uncritical internal ion source system was doubled so as to provide redundancy and lower maintenance schedule in the Cyclone® 18 TWIN with two proton sources. Since almost all of the PET tracers are today produced by protons, the same concepts were reused to develop the Cyclone 11 TWIN compact self-shielded machine for hospital-scale production of PET tracers.

The well-know Oxygen generator, a positive deuteron machine known as Cyclone® 3d, is under redesign for installation in Japan in early 2011. The aim is to provide a continuous flow of $^{15}\text{O}_2$ without disrupting the PET production schedule of the main hospital cyclotron. The production is carried out on natural nitrogen as target with 3.6 MeV deuteron.

In the high energy range, following the Cyclone® 70 XP multiparticules machine installation in Nantes (France), a small brother was designed in the 30 MeV proton-alpha range, the Cyclone® 30 XP for Jülich (Germany). While proton (15-30 MeV) and deuteron (8-15 MeV) are produced and extracted in the well-known negative ion mode with stripping extraction in the Cyclone® 30, the positive alpha beam (nucleus of helium atom He^+) is accelerated and extracted in positive ion mode using an electrostatic deflector. The He^{2+} acceleration needs specific external source and adjustments to the cyclotron magnetic field and acceleration frequency (RF). The energy of the alpha beam will be fixed in the 29-30 MeV range to maximize At-211 production. Redesign of the magnet system was needed in order to leave free space for the alpha deflector and to reuse magnetic 'flaps' for field correction as it is done on the IBA-Cyclone® 18/9. Some technical challenges were solved to fit the two RF acceleration modes in the same machine with external ion sources platform for the different ions species. The innovative new RF design was patented by IBA.

The well-know Cyclone® 30 used by most of the SPECT producers worldwide was upgraded to higher current mainly to deal with the TI-201 needs. A new external powerful H^- ion source was used, a redesigned injection line and central region was installed onto a standard 30 MeV cyclotron. The acceleration power (RF) was upgraded to 100 kW using the IBA in-house expertise giving the power extra supply for acceleration of 2mA of proton beam. Auxiliaries systems were upgraded (extraction, collimators,..) to handle the new beam power. Consequently, the high power solid target system is proposed with an optimized full process (plating, separation and recovery of isotope).