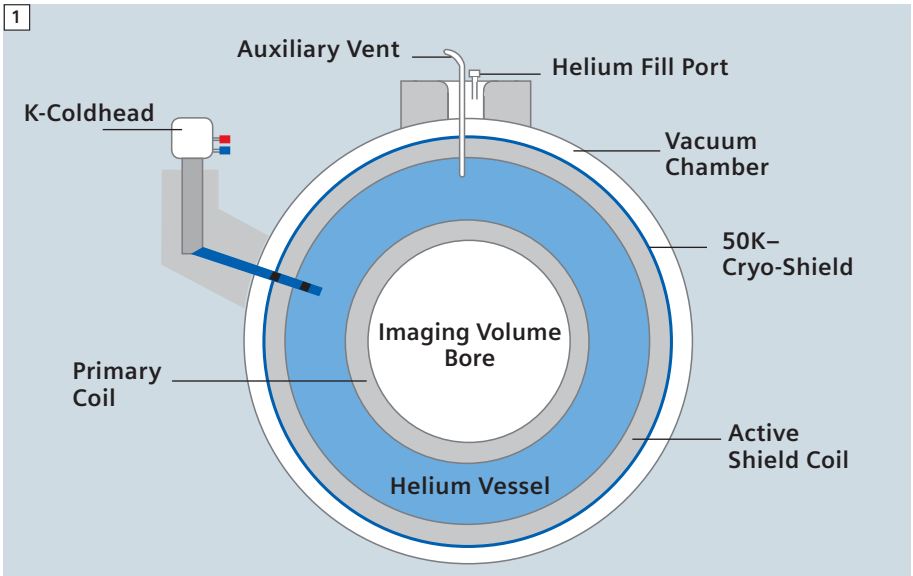
Questions & Answers on Hardware Topics

Jörg Stapf; Rolf Heinrichs; Matthias Nittka, Ph.D.

Siemens Healthcare, Erlangen, Germany

Q: What is the principle of "Zero-Helium Boil Off"?

A: Super-conducting magnets require built-in overdimensional thermos flasks for maintaining super-conductivity in cryostats (Fig. 1).
To ensure that the liquid helium used as coolant does not boil off too quickly, the helium dewar has to be very well insulated to reduce, for example, heat conduction and radiation. For this purpose, the helium vessel is suspended by materials that are poor heat conductors, such as GFK or reinforced carbon fiber materials. Furthermore, heat bridges are reduced as much as possible. The housing is evacuated to prevent convection currents. Irradiation on the helium vessel is reduced by Kelvin shields and super-insulating foils.
If the helium boiling off re-condenses via a 4K cold head, at least statically the magnet no longer boils off or consumes helium. The second stage extends into a volume connected to the helium vessel where it cools and re-liquifies the gas. Since it is not easy to regulate the performance of the cold head, the excess refrigeration capacity is compensated for by a heater so that the working pressure in the helium vessel remains constant.
Eddy currents caused by gradient activity lead to additional heat transfer into the helium vessel.
If the sum of heat transferred is less than that of the refrigeration capacity of the cold head, a "zero boil off" system is obtained.
To maintain this state, the cold head has to be in continuous operation, and the line voltage as well as the chilled water supply should not fail, at all, or at worst, only briefly.
Normally, liquid helium is lost only within the framework of service activities, such as ramping or replacing cold heads. Unfortunately, liquid helium will also boil off when both the line voltage and chilled water supply fail for more than 3 hours.



1 MR system.

Q: What is the difference between the different RF pulse types?

A: The RF pulse types are pure sequence parameters. This means they are not allocated to a hardware feature. By comparison, the Matrix Mode, for example, actually affects the surface coils (modes: CP, Dual, Triple depending on the coil).
The RF pulse types allow flexible control of the RF pulses (radio frequency pulses) of the sequences, for exciting or refocusing the MR signals and for various other applications:

- The "Normal" mode is optimized to cover a broad sequence application range providing for a well-defined slice profile.
- The "Fast" mode is implemented for time-critical protocols when rather short echo times are required. For this reason, it uses very short RF pulses.

A disadvantage of the "Fast" mode is that shorter RF pulses are normally accompanied by increased RF exposure for the patient (increase in the specific absorption rate).

- The "Low SAR" mode addresses high-performance protocols that may exceed the allowed SAR threshold. Usually, longer RF pulses are used, i.e., the RF-power output decreases.

One of the resulting disadvantages is that longer RF pulses increase the minimal timing of fast sequences. However, this is not required for all applications. It is important that every sequence defines the actual pulses that stand behind the RF pulse types and is able to change them at any time depending on other parameters.