EBCT

The overall goal of the EBCT scanner is to produce high-resolution images of moving organs (e.g., the heart) that are free of artifacts caused by motion. In this respect, the scanner can be used for imaging the heart and other body parts in both adults and children. The scanner performs this task well because its design enables it to acquire CT data 10 times faster than conventional CT scanners.

The design configuration of the EBCT scanner is different from that of conventional CT systems in the following respects:

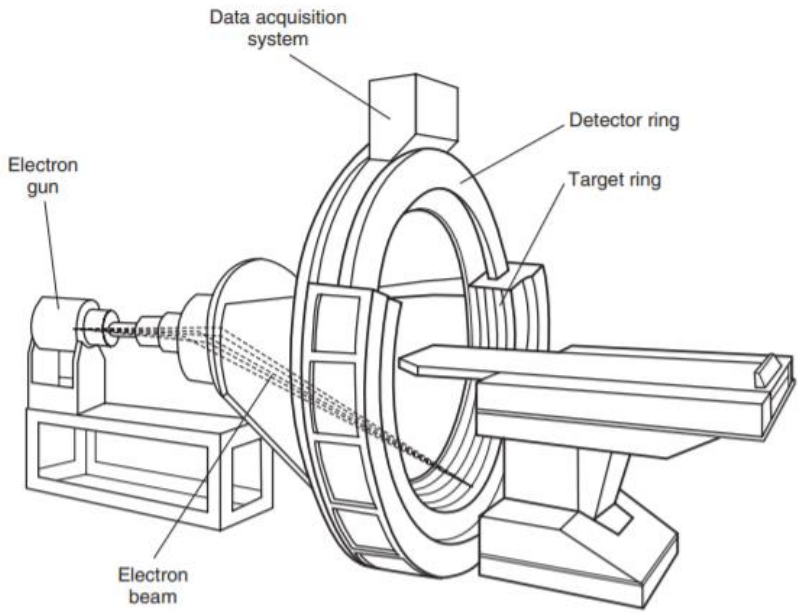
1. The EBCT scanner is based on electron-beam technology and no x-ray tube is used.

2. There is no mechanical motion of the components.

3. The acquisition geometry of the EBCT scanner is fundamentally different compared with those of conventional systems.

The basic configuration of an EBCT scanner is shown in Figure. At one end of the scanner is an electron gun that generates a 130-kilovolt (kV) electron beam. This beam is accelerated, focused, and deflected at a prescribed angle by electromagnetic coils to strike one of the four adjacent tungsten target rings. These stationary rings span an arc of 210 degrees. The electron beam is steered along the rings, which can be used individually or in any sequence. As a result, heat dissipation does not pose a problem as it does in conventional CT systems

When the electron beam collides with the tungsten target, x rays are produced. Collimators shape the x rays into a fan beam that passes through the patient, who



is positioned in a 47-cm scan field, to strike a curved, stationary array of detectors positioned opposite the target rings

The detector array consists of two separate rings holding a 216-degree arc of detectors. The first ring holds 864 detectors, each half the size of those in the second ring, which holds 432 detectors (McCollough, 1995). This arrangement allows for the acquisition of either two image slices when one target ring is used or eight image slices when all four target rings are used in sequence

Each solid-state detector consists of a luminescent crystal and cadmium tungstate (which converts x rays to light) coupled optically with silicon photodiodes (which convert light into current) connected to a preamplifier. The output from the detectors is sent to the data acquisition system

The DAS consists of ADCs, or digitizers, that sample and digitize the output signals from the detectors. In addition, the digitized data are stored in bulk in random access memory, which can hold data for hundreds of scans in the multislice and single-slice modes. This information is subsequently sent to the computer for processing.

The computer for the EBCT scanner is capable of very fast reconstruction speeds, and image reconstruction is based on the filtered back-projection algorithm used in conventional CT systems.

The EBCT scanner does not have any moving physical parts and, as noted by Flohr et al. (2005), “the EBCT principle is currently not considered adequate for state-of-the-art cardiac imaging or for general radiology applications.