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Magnetic Resonance Medical Imaging (MRI)–from the inside

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There are about 36,000 magnetic resonance imaging (MRI) scanners in the world, with annual sales of ˜2500. In the USA about 34 million MRI studies are done annually, and 60-70% of all scanners operate at 1.5 Tesla (T). In 1982 there were none. How MRI got to be–and how it got to1.5T is the subject of this talk. Its an insider's view–mine–as a physics PhD student at Nottingham University when MRI (almost) began, through to the invention of the 1.5T clinical MRI scanner at GE's research center in Schenectady NY.Before 1977 all MRI was done on laboratory nuclear magnetic resonance instruments used for analyzing small specimens via chemical shift spectroscopy (MRS). It began with Lauterbur's 1973 observation that turning up the spectrometer's linear gradient magnetic field, generated a spectrum that was a 1D projection of the sample in the direction of the gradient. What followed in the 70's was the development of 3 key methods of 3D spatial localization that remain fundamental to MRI today.As the 1980's began, the once unimaginable prospect of upscaling from 2cm test-tubes to human body-sized magnets, gradient and RF transmit/receive systems, was well underway, evolving from arm-sized, to whole-body electromagnet-based systems operating at <0.2T. I moved to Johns Hopkins University to apply MRI methods to localized MRS and study cardiac metabolism, and then to GE to build a whole-body MRS machine. The largest uniform magnet possible–then, a 1.5T superconducting system–was required. Body MRI was first thought impossible above 0.35T due to RF penetration, detector coil and signal-to-noise ratio (SNR) issues. When GE finally did take on MRI, their plan was to drop the field to ˜0.3T. We opted to make MRI work at 1.5T instead. The result was a scanner that could study both anatomy and metabolism with a SNR way beyond its lower field rivals. MRI's success truly reflects the team efforts of many: from the NMR physics to the engineering of magnets, gradient and RF systems.