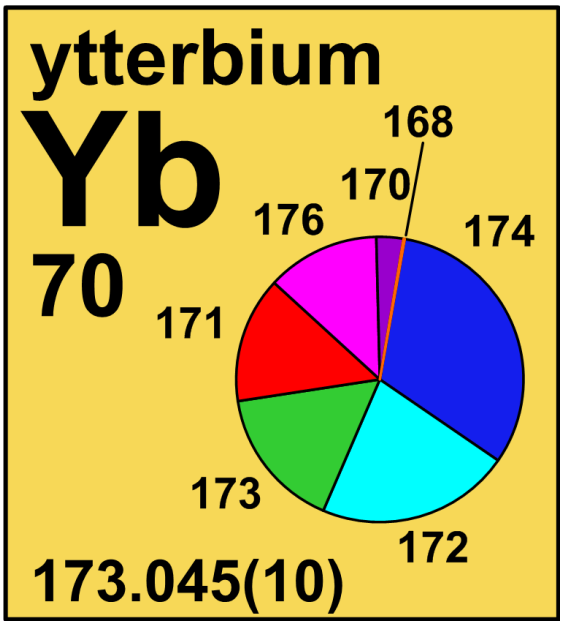
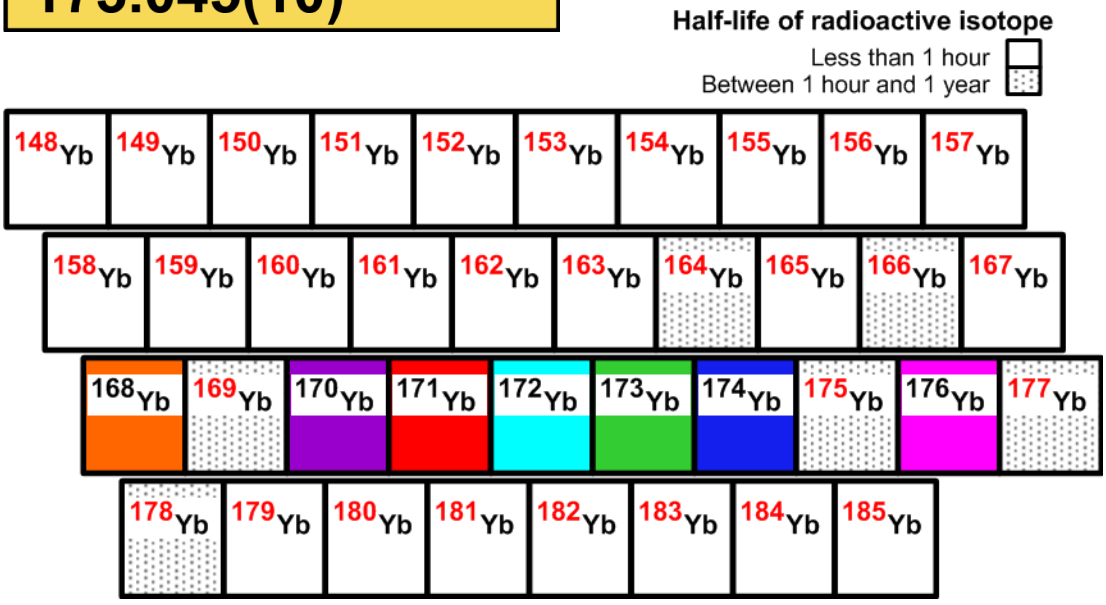
4.70 ytterbium



Stable isotope	Relative atomic mass	Mole fraction
^{168}Yb	167.933 89	0.001 26
^{170}Yb	169.934 77	0.030 23
^{171}Yb	170.936 33	0.142 16
^{172}Yb	171.936 39	0.217 54
^{173}Yb	172.938 22	0.160 98
^{174}Yb	173.938 87	0.318 96
^{176}Yb	175.942 58	0.128 87



4.70.1 Ytterbium isotopes in industry

^{169}Yb (with a **half-life** of 32 days) emits **gamma rays** and can be used to create a radiographic image of an object without the use of electricity. A capsule containing ^{169}Yb is placed on one side of the object being screened and photographic film is placed on the other. The result will indicate flaws in metal casting or welded joints [488, 489]. **Gamma cameras** use ^{169}Yb as a radiation source (Figure 4.70.1). Gamma cameras are used to locate sealed radioactive sources

and hot spots in historical waste. Images of the gamma ray intensity are made and then the 2-D distribution is superimposed on a picture or video image [490, 491].

^{171}Yb has been used for making an atomic clock by making use of a ytterbium optical lattice (formed by the interference of counter-propagating laser beams) (Figure 4.70.2) [492-494].

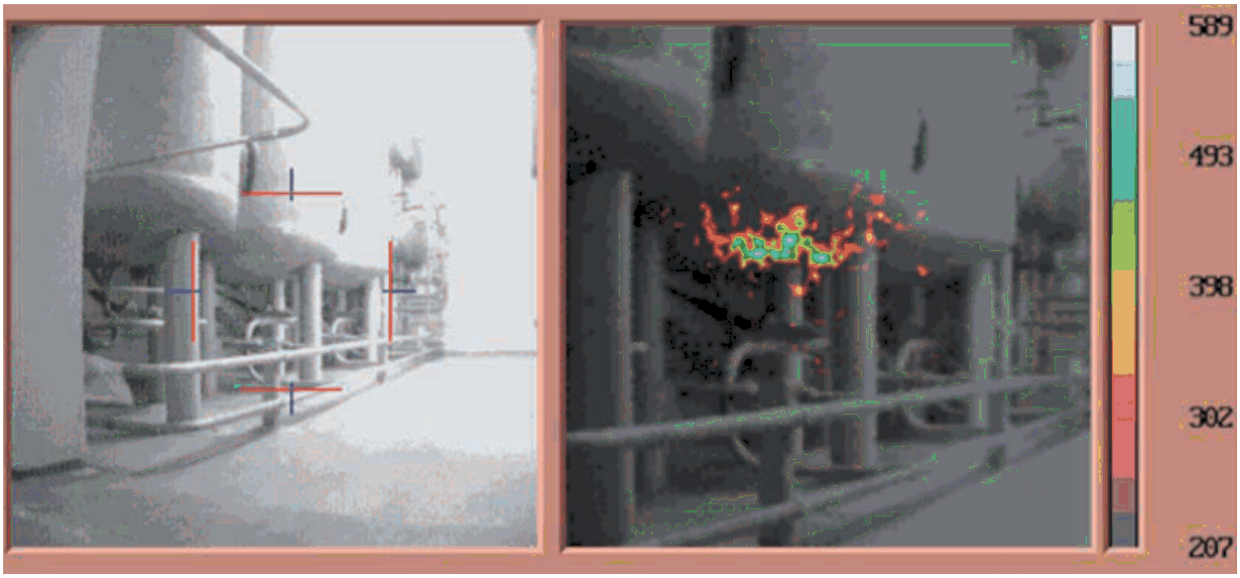


Fig. 4.70.1: Gamma cameras are typically used to identify radioactive holdup (material that does not come out of a process as product or waste). The picture to the left is of a tank and the picture to the right shows the radioactivity in the tank. (Photo Source: International Atomic Energy Agency, 2008) [490].

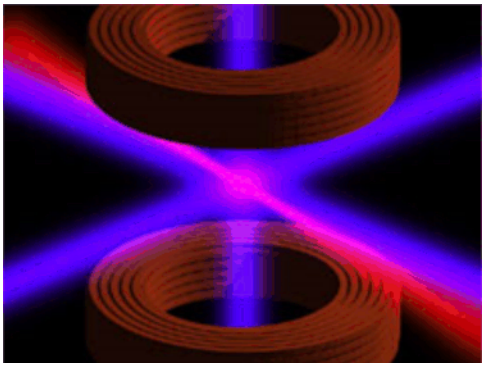


Fig. 4.70.2: The insides of the National Institute of Standards and Technology's (NIST) optical atomic clock. The red rings are magnetic coils and the red laser beam is an optical lattice. The intersecting violet lasers cool the ytterbium atoms. (Image Source: National Institute of Standards and Technology, 2006) [494].

4.70.2 Ytterbium isotopes in medicine

In the treatment of prostate cancer with **brachytherapy** seed implants, ^{169}Yb has been suggested as an alternative to using ^{125}I and ^{103}Pd [495, 496].

4.70.3 Ytterbium isotopes used as a source of radioactive isotope(s)

The **radioisotope** ^{169}Yb is manufactured using ^{168}Yb via the reaction ^{168}Yb (n, γ) ^{169}Yb.