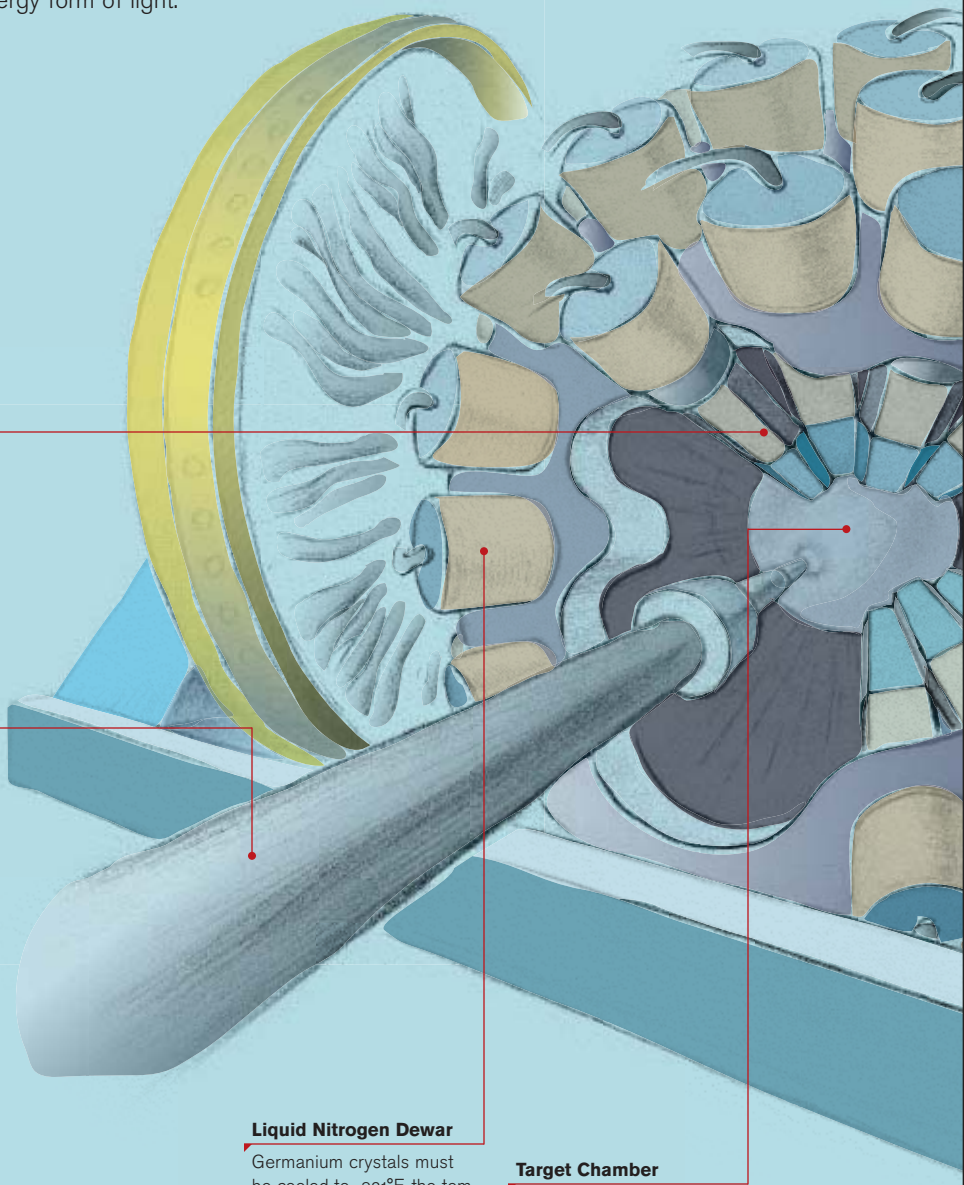
inside: gammasphere

In the 2003 summer blockbuster *The Hulk*, this nuclear physics device turns mild-mannered scientist Bruce Banner into the movie's fearsome title character. In the movie, Gammasphere zaps Banner with radiation; in reality, it detects gamma rays from rare and exotic atomic nuclei.

Gammasphere is a $20 million detector array that helps answer fundamental questions about the structure and behavior of atomic nuclei. The device's 110 gamma-ray detectors point to the center of the spherical array, where a beam of nuclei from a particle accelerator smashes into a thin target. The collisions create unstable nuclei that decay by emitting gamma rays, an extremely high-energy form of light. Gammasphere catches and measures as many of the gamma rays as possible, so that scientists can study what happens to nuclei under extreme physical conditions.

The 14-ton device, built at the Lawrence Berkeley National Laboratory by a group of scientists from several US national laboratories and universities, splits its time between LBNL in California and Argonne National Laboratory near Chicago. Since Gammasphere's dedication in December 1995, scientists from all over the world have conducted hundreds of experiments with the array.



Ge and BGO detectors

Nuclei created in the beam-target collisions with an abundance of extra energy may shed it by emitting gamma rays at specific energies. 110 germanium-bismuth germanate detector assemblies catch the gamma rays and measure their energies.

Beam Line

Beams of nuclei, accelerated by the Argonne Tandem Linac Accelerator System or LBNL's 88-Inch Cyclotron, travel at millions of miles per hour down the beam line to the center of Gammasphere.

Liquid Nitrogen Dewar

Germanium crystals must be cooled to -321°F, the temperature of liquid nitrogen, to produce electrical signals from gamma ray interactions. An automated system fills all 110 dewars every 12 hours.

Target Chamber

The small, square target is positioned at the center of this spherical aluminum shell. Beam nuclei smash into the target, and everything from electrons to heavy nuclei are produced.

Detector Assembly

Electronics Box

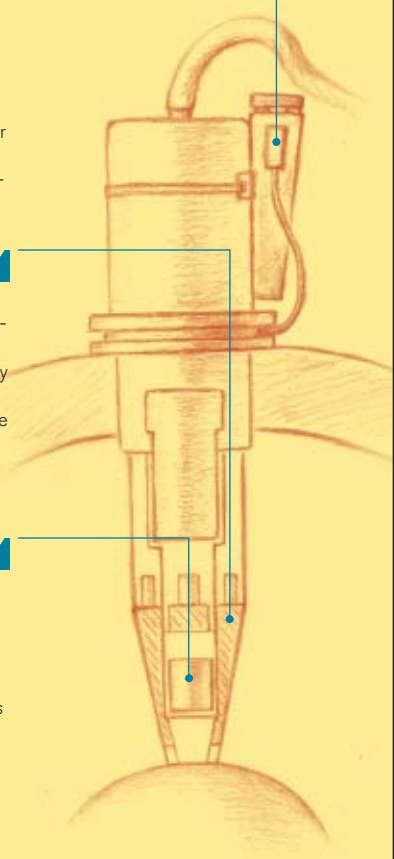
These triangular boxes are the connection between Gammasphere and researchers. They pass signals from the detectors to electronics and computers for analysis, and provide high-voltage power for the germanium and BGO detectors.

BGO Crystal

Seven bismuth germinate detectors surround each germanium crystal, and detect gamma rays that deposit only part of their energy in the germanium. Eliminating these events in analysis allows researchers to measure very rare gamma-ray decays.

Germanium Crystal

When a gamma ray stops in these coffee-cup-sized semiconductors, an applied electric field guides the tiny electric signals generated to electrodes on the crystal's surface. The electrical signal produced is proportional to the gamma-ray's energy.

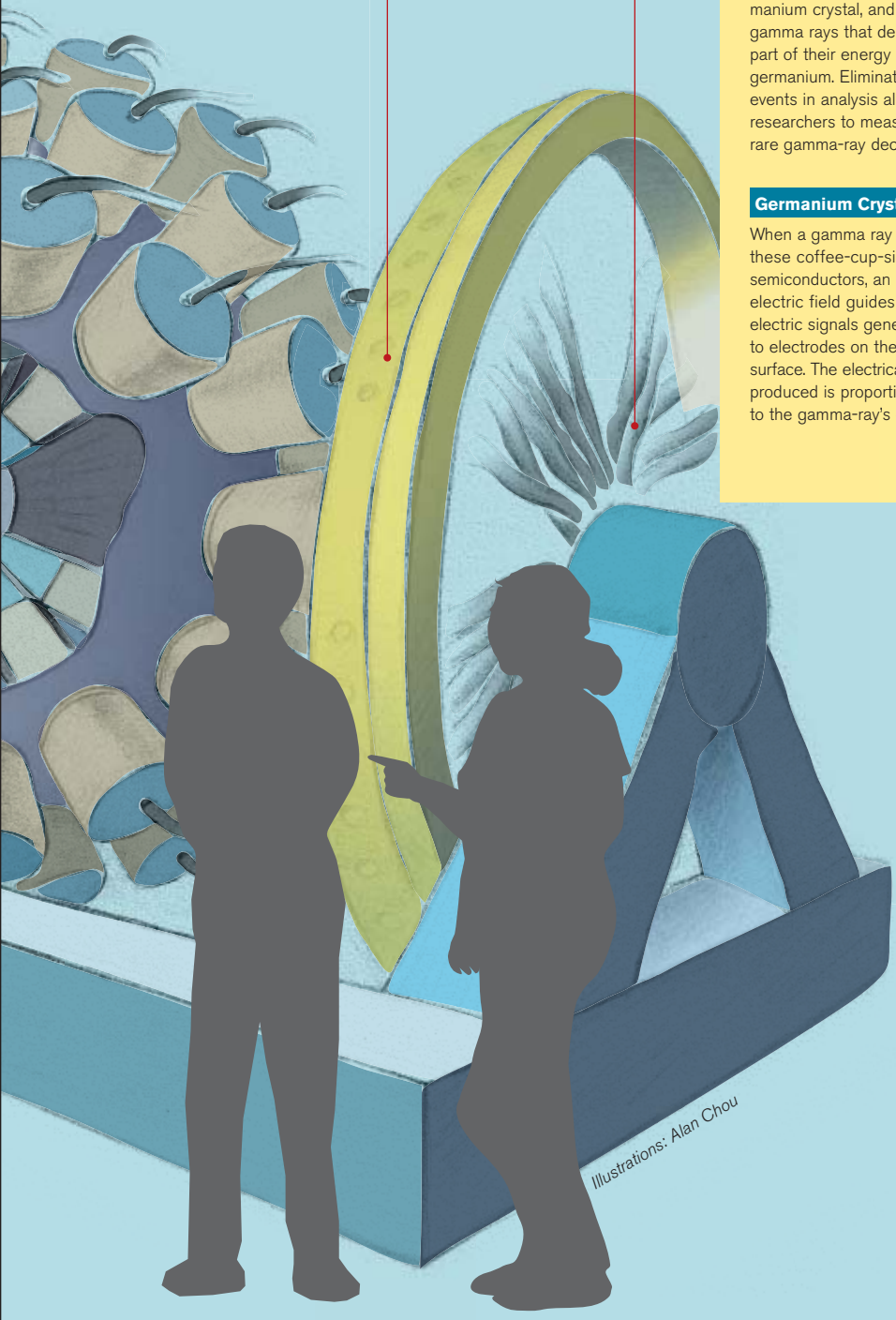


Support Structure

The two halves of the support structure, which stays intact when Gammasphere is trucked across the country, move back and forth and rotate independently to facilitate detector installation.

Hoses

Flexible hoses supply 30,000 gallons of liquid nitrogen every year to the germanium detectors.



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