high. Given the countless billions of stars known to exist, planets like our own may indeed be quite common.

Building on this accomplishment, the Lawrence Berkeley Laboratory collaborators continued their far-infrared detector work, with an eye toward even more demanding specifications. Supported by funding from many sources, including Basic Energy Sciences, which focused on much of the fundamental work concerning the interactions of radiation with matter work, the collaborators produced improved far-infrared detectors capable of sensing radiation with wavelengths in the spectral region of 100 microns for source temperatures down to −400°F.

Further developments included an invention which extended this capability to 240 microns, or to −440°F! Absolute zero, by comparison, is just shy of −460°F. This latter feat was accomplished by applying stress to the detector with a small mechanical clamp. Known as the "stressed germanium photoconductor," this device opened up a whole new spectral band for space astronomy.

The spectacular success of the Infrared Astronomical Satellite, combined with the promise of new spectral bands, stimulated the development of other approved or planned infrared space research projects. These included the Cosmic Background Explorer Satellite, the Infrared Space Observatory, and the Space Infrared Telescope Facility.

The designs for such projects all employed detectors sensitive to wavelengths in the far-infrared spectral bands. Refined versions of these detectors all build on fundamental knowledge and science concerning the nature of far-infrared radiation and its interactions with matter—a field to which Basic Energy Sciences researchers made numerous and substantive contributions.

GLASSY METALS

The iron age wasn't very old before weapons makers discovered the value of rapidly cooled metals. Although the scientific principals of how atoms in a metal arrange themselves were unknown to these prehistoric foundrymen, they learned by experience that when a white hot sword blade was doused in cold water, it was a tougher weapon than when it was allowed to cool of its own accord.

During the next thousand years or so, advancements in metallurgy came slowly—so slowly in fact that the most advanced metals of the first half of the 20th century were little different structurally from the sword King Richard the Lionhearted used when he fought his way to the Holy Land.

In 1959, all of this changed. It wasn't much of a change at first because the experimenters at the California Institute of Technology were working with very small amounts of metal, but what they were doing with this metal was very different indeed.

Professor Pol Duwez and his Basic Energy Sciences supported researchers at Caltech had an idea how to make new kinds of metal alloys, especially out of mixtures of metals that normally separated from each other as they cooled from the melted state. Their idea was that they could make a new arrangement of the atoms if they could develop a technique that chilled liquid metal faster than it had ever been chilled before.

The difficulty was in producing sufficiently rapid cooling. Such old techniques as those practiced by the ancient sword makers were not nearly fast enough—cooling rates hundreds of times faster were needed. Duwez' team saw that rapid cooling could be achieved if a way could be found to make liquid metal suddenly and instantaneously come into intimate contact with a cold surface. They recognized the practical limitations that made this a difficult problem. First, they had to rule out trying to make any thick layers of metal. Thick layers could not be cooled fast enough. Their final product would necessarily be thin foils. Second, a fresh cold surface must be provided for each droplet of the molten metal. Otherwise, the molten metal would quickly make the cold surface hot. Third, the liquid metal and the cold surface must be brought together at a high rate of speed so that the liquid would not have time to cool.

With determination and despite initial failure, Professor Duwez' team succeeded. In their successful experiment, they propelled droplets of molten copper and gold alloys at high velocity onto a cold copper substrate, a process sometimes referred to as "splat cooling." This simple but ingenious setup did indeed achieve the cooling rates required, over a million degrees per second, and totally new kinds of materials were produced.