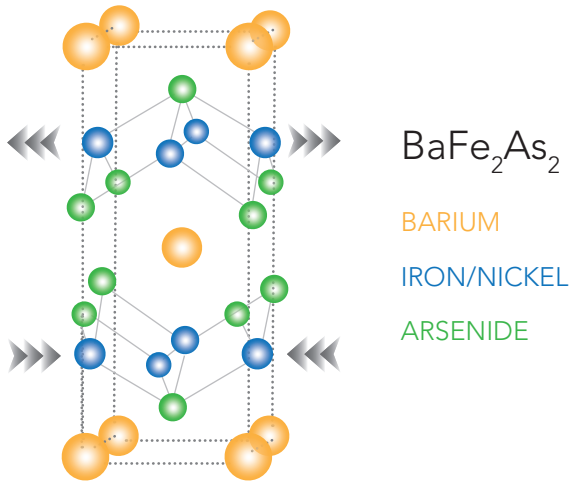


Anisotropy in High Temperature Superconductors

At certain temperatures, barium iron nickel arsenide becomes a better conductor of electricity in some directions but not others. Neutron measurements reveal the directionally dependent phenomenon is inherent in the magnetic properties of the material.

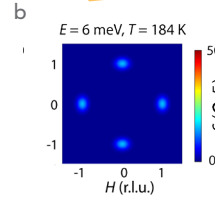
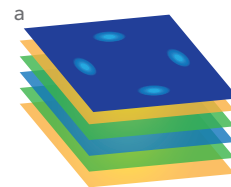


BARIUM IRON NICKEL ARSENIDE High-temperature superconductor

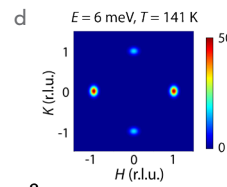
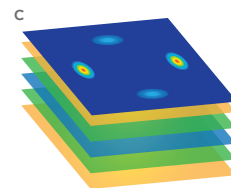
The molecular structure consists of layers of arsenic and barium atoms that are sandwiched between checkerboard planes of iron atoms. (Nickel atoms are occasionally substituted for iron.)

The atoms in the crystals form an ordered pattern that looks identical in both the right-left (X axis) and forward-back (Y axis) directions, but not in the up-down (Z axis).

ROOM TEMPERATURE



PRE-CRITICAL



DIRECTIONAL DEPENDANCE Anisotropy

"Anisotropy" refers to an object with directionally dependent properties.

At room temperature, barium iron nickel arsenide conducts electricity equally well along both its X and Y axes, and is said to exhibit four-fold symmetry -- identical properties in both the left-right (X-axis) and forward-back (y-axis) directions.

At cooler temperatures, this four-fold arrangement gives way to a two-fold state, with different properties in the forward-back and left-right directions. In this "anisotropic" state, the material conducts electricity better along one axis than the other.

Images a) and c) are artists renditions based upon actual data from (b) and (d).

For more information, see: "Nematic spin correlations in the tetragonal state of uniaxial-strained $\text{BaFe}_{2-x}\text{Ni}_x\text{As}_2$ " at <http://www.sciencemag.org/content/early/recent>

ROOM TEMPERATURE



ROOM TEMP.
1-HOUR BEFORE KICK-OFF

The disorder we see at room temperature corresponds to the crowd one hour before the game begins, when people are turning from side to side and occasionally glancing at the field.

CRITICAL TEMPERATURE



CRITICAL TEMP.
GAME TIME

During the game, all eyes are on the field. This state corresponds to the collective arrangement we see in superconductivity.

PRE-CRITICAL TEMPERATURE



PRE-GAME EXCITEMENT
1-MINUTE BEFORE KICK-OFF



WHISTLE
REVEALS HIDDEN ORDER



CONTINUE WAITING
1-MINUTE BEFORE KICK-OFF

The anisotropic state corresponds to a moment just before the game starts, when the individuals are still looking in random directions but are aware that the game is about to start. The incoming neutron pulse is the equivalent of someone blowing a whistle on the field. For a split second, the crowd reacts as one to the whistle, and every head turns to see if the game has begun. The individuals in the crowd quickly return to their random behavior, but the whistle revealed an order that wasn't present an hour before.