Interview: Dr. Giuliano Preparata

Coherent self-organization in cold fusion

The following interview with Dr. Preparata, a physicist at the University of Milan, was conducted in Italy by Evanthia Frangou in June 1990. It appeared in the Winter 1990 issue of 21st Century Science & Technology *magazine.*

Q: Can you explain in more detail the notion of superradiance and how it is a possible explanation for the phenomenon of cold fusion?

Preparata: Superradiance is the self-organization of matter in interaction with electromagnetic radiation. This occurs in a situation where the matter is highly condensed, as in a liquid or in a solid. This behavior does not hold, at least spontaneously, in a dilute system like a gas.

A gas is a phenomenon that is easy to describe physically: All the single molecules of the system, like balls, go on their own randomly. But if you take this gas and compress it, and lower the temperature until it makes the transition into a liquid or a solid phase, then something different happens. As soon as you put all these "balls" or systems together they lose their individuality. They become part of a big family, and it does not look anymore like balls, but like plasma fluids throughout the crystal. The whole entity is endowed with completely different properties. The whole is really much more than the sum of its parts.

I have shown that under certain conditions the laws of quantum mechanics that everyone loves and cherishes, in fact, *do* allow for the kind of system of self-organization that occurs in condensed matter. When you simply look at it from the outside, nothing in particular seems to be happening. However, if you really look deep inside the system, you see all the elementary systems—the atoms, molecules, and so on—just oscillating in phase, at the same pace, and with a peculiar configuration of the electromagnetic field.

This radiation gets trapped inside and cannot get out; it is imprisoned in the matter. It is this order that makes possible the strange phenomena that we begin to see in cold fusion, for example.

Q: How exactly does this radiation help the deuterons to fuse?

Preparata: This fusion is really due to the fact that the various electrons are traveling; they are not static; they move at a peculiar pace, which creates the situation where it is much easier for the deuterons to get in touch and fuse. It is a very subtle and completely new way of behaving.

At first this somehow looks strange and ridiculous. You think, "There is a molecule here and another there; how do they know each other?" But they do, because essentially through radiation they are able to exchange long-range messages.

Q: Is this the way that the electrons are able to overcome the Coulomb barrier?

Preparata: Yes, they are helped by these very strange plasma waves. Of course, this could not happen if matter is what everyone believes it is. But this is the point.

Q: You have also related this behavior of condensed matter to what may be happening in room temperature superconductivity. What can you tell us about that?

Preparata: I hope that by the end of this year I will have a theory on room temperature superconductivity. The idea of having an ordered structure that remains so at high temperatures, or room temperature, is not trivial. Low-temperature order in superconductors is order by default, because you can't have anything else. Room temperature order is order by choice, because there are so many other choices, all of them disordered to fight against, yet you choose the most unlikely possibility. This goes also for cold fusion at room temperature.

The basic mechanism that makes superradiance work is that there must be a system that can communicate electromagnetically only on a well-defined, sharp frequency. If you have a lot of frequencies, this radiation simply disperses itself. If electrons emit always at one peculiar frequency, then you have a tremendous amplification effect. So the real question for high-temperature superconductors is to find out which are the discrete, peculiar frequencies on which the interaction works out among electrons—the fluid that carries current into this type of material.

I think there is a very interesting hint in the anti-ferromagnetic structure of this material. You know that all the materials used in achieving room temperature superconductivity have this property. The copper spins tend to be aligned one opposite to the other. Now this looks very much like an undulator, a complicated magnetic structure like the one used in the FEL or free electron laser. So I got the very simple idea of using the single frequency that you have in the FEL to do that, and I believe that idea works out.

Of course, I have not been able to work out all the specifics yet. A superconductor, even from a conceptual point of view, is a very complicated system. There's the question of pair condensation and so forth, but these are just technicalities. Again, the concept is that when a particle moves on a magnetic structure that undulates, then it works with a single frequency. That is the frequency in which the electrons can talk to each other, get ordered, and condense.

This is a dynamic order, not a static order. These are relationships not in space but in time. This is because you want to have at the same time order and plasticity. You don't want this order to be frozen; you want this order to move like water and yet keep its formation even though it moves.

Superradiance is an ordering that comes from the fact that the matter systems—say, electrons, atoms, molecules, nuclei, whatever—communicate with each other in particular frequencies of the electromagnetic field. It is a superradiating process because the radiation is enormously amplified by the fact that there are many systems that radiate precisely, the same way it happens in a laser.

Q: You have also proposed that this behavior of condensed matter can explain some peculiar properties of water that may play a part in the observed water with "memory" of the Benveniste experiment?

Preparata: Here a similar thing could be happening, only with different actors in the play, shall we say. But these actors tend to play always in the same way (see box).

Q: How did you arrive at the notion of superradiance?

Preparata: Throughout my life I concentrated on quarks, on the behavior of matter at very deep layers where there are still frontiers. It is not an area where the laws are yet established, so you still struggle to understand what the forces are, what the fields are, and how they behave. It is not like ordinary matter, where scientists know precisely what the forces and the actors of the collective drama of matter are. For some reason, because of certain steps I took in my life, I was able to transfer to this area the things I had understood for quarks. About three years ago, by chance I got interested in this area. Putting two and two together, a picture of matter emerged that made a tremendous amount of sense.

How H_2O molecules can 'communicate'

Giuliano Preparata discusses a potential explanation for the Benveniste experiment in Paris in 1988, in which water seemed to have a "memory." His remarks are condensed from an article he wrote for the Italian daily La Stampa, *in August 1988.*

I would like to present a few recent theoretical developments on the structure of water that, far from explaining the results of the Benveniste group, do, however, shed light on the capacity of water, up to now unknown, to organize itself around biological molecules in dynamic structures of considerable complexity. It allows for phenomena that imply that water assumes an active role in biological reactions. . . .

Some months ago, my colleagues, E. Del Giudice and G. Vitiello, and I decided to apply some ideas that I had developed in the area of laser physics, to the fundamental substrate of living material: water. We decided to concentrate on the most simple aspects of water. We described it as a collection of a large number of molecules in the shape of a wide "V," with oxygen at the vertex and the two hydrogen atoms at the ends. These rotate without stop, trailing behind them a sort of radio antenna because of asymmetry of the electric charges of the atoms of hydrogen (positive) and of the oxygen atoms (negative).

Soon it became clear to me that this rotating antenna created a communication of the molecules via "radio" within a distance of some tens of microns, the typical dimension of the cell. This radio contact informs the molecules to combine together at precise cadences, transforming the initial chaos into a dynamic order, very similar to what happens to the photons in a laser.

Water, in fact, behaves like a laser! In the "preordered" system of this myriad of walky-talkies that are constantly exchanging information, we attempt now to place a biological molecule also equipped with a walky-talky (which is usually the case). This new molecule will be able to "give orders" to the water around it at a distance equal to that of the cell's dimensions, generating in this way around itself a state of water that is very "personalized," that depends on the type of "orders" that were given.

That molecules of water could communicate electromagnetically on particular frequencies has been known for a long time. It used to be thought, though, that the signals were too weak to have appreciable consequences. What has been understood recently is that, due to a mechanism that occurs also in lasers, the mechanics of quanta enormously amplifies these signals.