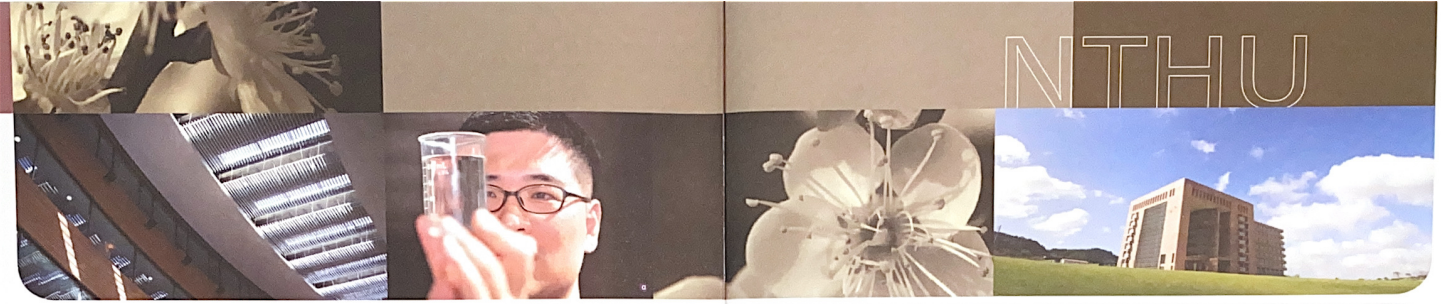
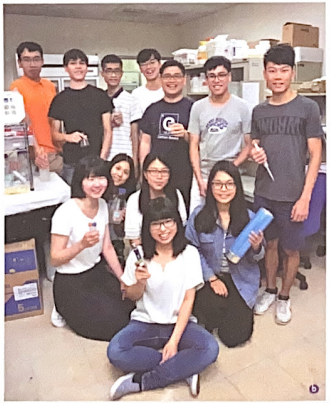


NTHU RESEARCH TEAM EXPLORES THE WORLD OF WATER AT LOW TEMPERATURES

a Chiang specializes in the study of water molecules.
b Prof. Chiang Yun-wei of the Department of Chemistry and his research team.

If intergalactic travel by a manned spacecraft ever becomes possible, it will take hundreds of years to reach another galaxy. In light of the average human life span at present, such an undertaking will thus require the use of cryonics—freezing a living body and later reviving it. One of the major hurdles facing the development of cryonics is that frozen cells can't fully recover their original functions. However, Prof. Chiang Yun-wei of the Department of Chemistry has used a technique known as saturation-transfer electron spin resonance (ST-ESR) to verify that there are two different liquid phases at a temperature of -93°C, constituting a major advance in the field of cryonics.

Together with his doctoral student Kuo Yun-hsuan, Chiang has presented his findings in a paper titled, "*Slow Dynamics around a Protein and Its Coupling to Solvent*," in which they unveil the mystery surrounding the interaction between water and protein. It was previously believed that water invariably controls the movement of proteins, but their study demonstrates that this is not always the case. Their paper recently appeared in the American journal *ACS Central Science*, and is the first full-length paper by Taiwanese researchers ever published by the journal. Their breakthrough was featured on the journal's website under the headline "*Water 'Slaves' Protein Motions?*"

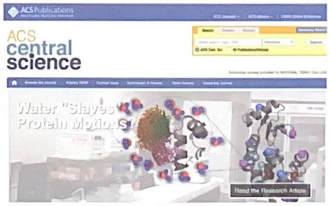


The Highly Complex Behavior of Simple Water Molecules

Water is the most important element of living organisms. All who has a grade school education knows that water exists in three different states, and most people know the boiling point and freezing point of water. But for Prof. Chiang water is anything but simple. As he puts it, "water molecules are extremely simple, but their behavior is highly complex!" For example, most people believe that there is only one kind of ice, when in fact researcher has so far identified 21 different kinds of ice crystals, and its derived thermodynamic phase diagram is unexpectedly rich and brilliant. There are still many unknowns, and the behavior of water is an important field of contemporary physical chemistry research.

There is only one ST-ESR system in Taiwan, costing more than NT$40 million, and by using it to measure the movement of water molecules at low temperatures Chiang's research team has observed that a "liquid-liquid critical phenomenon" occurs at temperatures between -33°C to -93°C.

They also found that at temperatures below -13°C, an aqueous solution containing trace amounts of glycerin enters "liquid state one," and that at -83°C it enters "liquid state two," both of which are quite stable. However, their densities and forms of movement are different, which seems counterintuitive, since both states are liquids consisting of the same elements, yet at low temperatures these elements separate from each other and remain on the surface of the protein.



Chiang's breakthrough research was featured on the

Chiang explains that as soon as fruit is frozen at a low temperature the cells swell, making freezing a rather ineffective means of preservation, since it tends to cause protein damage. If one day it becomes possible for spacecraft to travel to distant galaxies over the course of many light years, any humans on board will have to be placed in a state of suspended animation using cryonic technology, which currently exists only in sci-fi novels, but Chiang's research team has made a big step towards making it a reality.

Emancipated Protein Dynamics

Chiang's research helps to unlock the mystery of the interaction between water and protein. It is well known that proteins must have water to function properly, but is water just a foil to protein? Or does it act more like a guide? This topic has been hotly debated in the scientific community for more than 20 years.

Chiang says that because the interaction between protein and water molecules is highly persistent and dense, it is quite