In memoriam of Chung-Chieh Cheng

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This session of the Cool Star Workshop is dedicated to the memory of Chung-Chieh Cheng, who passed away prematurely on March 10, 1995, after a long and painful illness. As all of you know, Chung-Chieh had devoted his scientific life to solar physics and to the study of solar flares, an area in which he provided many outstanding contributions. For many years he had also been connected with the Arcetri Observatory where he used to spend a few weeks almost every year, working on both solar and stellar projects. He liked Florence, and Italy in general, very much and he was planning to attend the Cool Star Workshop to present his latest results on the analysis of Yohkoh data. I regret that he could not fulfill this wish.

Dr. Cheng was born in Chungking on 1938, but he left China in 1950, when he was still in his childhood. He spent his youth in Taiwan where he studied physics and graduated from the National Taiwan University in 1960. In 1962 he went to the United States where in 1970 he earned a PhD in astronomy and astrophysics from Harvard University. His PhD thesis, carried out under the supervision of Giovanni Fazio, was on gamma-ray emission from the Sun, a research field that was still purely theoretical at that time, but whose predictions were later confirmed by observations of gamma rays from solar flares.

After some post-doctoral research work at the University of Maryland and at the NASA’s Goddard Space Flight Center, he joined in 1972 the Solar Physics group at the Naval Research Laboratory, where he remained till the end of his life. During this period, he was involved in a number of major solar physics missions, including Skylab, the Solar Maximum Mission (SMM) and most recently Yohkoh. At the time of his death he was co-investigator on the NRL coronograph on board SOHO. He was particularly intrigued by solar flares and used the spectral and imaging observations of satellites to infer the magnetic topology and plasma processes in these fascinating phenomena.

His studies of the extreme ultraviolet and X-ray emission of flares, that he carried out using Skylab and SMM data, established conclusively that solar flares occur in magnetically confined loops that connect regions of opposite magnetic polarity. He also showed the complex temperature structure of flares, as results from energy deposition and transport inside magnetic flux tubes. Using SMM data he clearly demonstrated the spatial and temporal relationship between impulsive UV and hard X-ray bursts, as well as between the impulsive phase seen in OV and the more gradual phase seen in high temperature lines like Fe XXI.

These observational studies later formed the basis of his important work on the hydrodynamics of solar flares that he carried out using the NRL code. He showed with the help of numerical simulations that the rapid dissipation of energy inside a magnetically confined loop reproduces many of the observed
features of solar flares as observed at X-ray and UV wavelengths, including line profiles and light curves. Numerical simulations therefore proved to be an extremely useful way to get insights into the flare phenomenon.

While Skylab data put the emphasis on simple loop structures, SMM observations showed a more complex picture of flares with evidence for multiple loops and loop interactions. Dr. Cheng provided evidence for this complex nature of solar flares through his careful analysis of time sequences of SMM images in different lines. More recently, he found strong evidence for magnetic reconnection in flares and active region brightenings using Yohkoh data.

What many people however often ignore is that Dr. Cheng was not only a solar physicist (the field where he gained most of his fame) but he was also deeply interested in stellar physics and in the solar-stellar connection. He soon realized that the ultraviolet and extreme ultraviolet observations carried out for spatially resolved regions on the Sun by the NRL slit spectrograph on Skylab covered the same spectral range as the spatially unresolved observations of stars carried out at much lower spectral resolution by IUE. By degrading the spatially resolved observations of the Sun to the same resolution of IUE one has a powerful means to interpret spatially unresolved observations of solar-type stars. Along the same direction, he applied solar-type numerical hydrocodes to the simulation of stellar flares with the purpose of providing a diagnostic tool to be exploited later by more sensitive higher spectral resolution observations of stellar flares.

In the course of his researches, Dr. Cheng travelled widely, seeking out and forming successful collaborations with scientists in many parts of the world, including the Institute of Theoretical Astrophysics in Oslo, Norway, the Arcetri Astrophysical Observatory in Florence, the Nanking and Beijing Universities in China, and the Institute for Astronomy and Astrophysics of the Academy of Science in Taiwan. In the last years of his life he travelled extensively across mainland China giving lectures and seminars, and spent extensive periods in Taiwan where he helped to establish the Institute of Astronomy and Astrophysics.

Besides science, he also liked all kinds of arts, and Florence was a perfect place for him under this respect. He came to Florence many times over the decade 1982-92, spending his spare time in the Uffi Gallery and in the other Florentine museums to admire the paintings of Renaissance masters. He even tried to learn Italian, although this was not an easy task for him. His Italian (and someone would say also his English!) pronunciation was not excellent, but he was good enough in reading Italian and finding his way around. He was even able to co-author with me a paper in Italian on solar observations from space, that was published in 1988 in a popular Italian astronomy magazine.

Chung-Chieh leaves his wife, Min-Hwa, and two children, Guang-Shing and Guan-Jen. He also leaves a legacy of important studies on solar and stellar phenomena, which have become part of our current knowledge of the field and which are frequently cited in the scientific literature. While we are missing him as a friend, his scientific legacy remains alive and his papers will always be inspiring to the many researchers who will follow after his steps using new and more powerful space facilities.