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Chapter 1

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Date: Wed, 9 Jul 97 15:43:44 EDTFrom: physnews@aip.org (AIP listserver)To: physnews-mailing@aip.orgSubject: update.329PHYSIC NEWS UPDATE The American Institute of Physics Bulletin of Physics NewsNumber 329 July 9, 1997 by Phillip F. Schewe and Ben SteinVERY LARGE BASELINE INTERFEROMETRY (VLBI) has nowspread its arms out into space. In general, if radio astronomerswant to resolve fine structure in a distant object they would have tobuild either a large antenna or a number of smaller but widelyspaced antennas and let the signals from these interfere to form acomposite radio map of the object. The Very Large Array (VLA--27 dishes spread out over 20 miles) and the Very Long BaselineArray (VLBA--10 dishes spread across 5000 miles of the Earth'ssurface) have produced very sharp radio pictures of distant targets. Now, by coordinating the joint efforts (and signals) of the VLA,VLBA, and the orbiting Japanese satellite HALCA (the first space-based radio telescope), even sharper images have been captured. Sofar (in some test imaging) the angular resolution has exceeded onemilliarcsecond; at other bands of the radio spectrum, the resolutioncould be as good as 60 microarcseconds. (NRAO website:www.nrao.edu)M THEORY considers that all the matter in the universe consists ofcombinations of tiny membranes which come in variousdimensionalities. M theory has largely subsumed an earlier theory(circa 1984/85) in which elementary particles were thought of asminuscule vibrating strings (1D membranes, or "1-branes"). Because string theory was able to tame the "infinities" inherent incalculations involving the gravitational interaction, it inspiredoptimism that the two great pillars of 20th century physics, quantummechanics and general relativity, could at last be united. Thenmathematical difficulties intruded and enthusiasm cooled. But nowin what Edward Witten (Institute for Advanced Study) calls the"second string revolution," M theory has shown that the variousalternative string models are actually equivalent forms of the sameunderlying theory. Furthermore, progress has been made inassimilating that most severe of all gravitational systems, the blackhole, into a quantum framework. For example, by treating a blackhole as a combination of branes, physicists have shown thatquantum calculations of a black hole's entropy are equivalent to theentropy calculated using a general relativity approach. Another testof quantum/gravity compatibility is the question of information.Quantum mechanics says that, in the absence of a physicalmeasurement, information in a system cannot be lost. But whenmatter (an information-rich encyclopedia, say) is swallowed by ablack hole, energy is returned to the rest of the universe, if at all,in the degraded form of "Hawking radiation," particles producedpairwise at the very edge of the black hole. Some have argued thateven in this case information is not totally lost since it might beimprinted into the Hawking radiation in some way. Wittenbelieves that out of this struggle with gravity a new theory, just asoriginal and powerful as quantum mechanics, might emerge. (Background: Physics Today, April 1996, March and May 1997; asummary of a recent meeting can be found in Science, 27 June.)HEAVY-ELEMENT CHEMISTRY. Scientists at the GSI lab inDarmstadt, Germany not only have made most of the heavyelements (up to element 112) in recent years, but have alsoperformed some nimble chemical tests on the short-lived atoms. For instance, with only seven atoms of seaborgium (element 106,living for mere seconds) GSI researchers have established that Sgbehaves chemically much like the elements lying directly above itin the periodic table, tungsten and molybdenum. This is not thecase for the seaborgium's horizontal neighbors, hahnium (element105) and rutherfordium (104). (Nature, 3 July.) ?