LETTERS *(continued from page 15)*

if one uses the tools of statistical physics, which have been applied to a gamut of subfields ranging from magnetism to earthquakes, one can formulate a theory of options that is clearer and uses a simpler mathematical formalism that allows for large deviations and crashes in particular.

We have attempted such an approach.[1] We think it could lead to a better understanding of the nature of the problems by both players in the market and managers of financial institutions. One critical aspect of our approach is that it calculates the risks associated with derivatives. As the record over the past 20 years shows, actual risks can be significant.

It is also evident that the lack of regulation has played a key role in the present turmoil surrounding derivatives. We believe that effective regulation will appear spontaneously when reliable quantitative estimates of the degree of risk of each market position can be developed. On this issue, we rely on the optimistic concept that the availability of useful information will lead to a natural limitation on exposure to risk. Recent work on complex systems has shown that feedback provided by the learning process is sufficient to create self-organized and self-regulated dynamical functioning, at least in biological systems (as discussed in PHYSICS TODAY, March 1991, page 9 and July 1991, page 9).

Much work remains to be done, both theoretically and practically, to bring about the efficient use of such risk estimators in the field of derivatives, as well as their application to other financial products.[2] Meanwhile, it is important to recognize that the financial world continues somehow to avoid the systematic use of risk assessments, even though they have long been applied to various industrial and natural hazards, such as the siting of nuclear plants and the occurrence of earthquakes.

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JEAN-PHILIPPE BOUCHAUD
Atomic Energy Commission–Saclay
Gif-sur-Yvette, France
DIDIER SORNETTE
University of Nice
Nice, France
University of California at Los Angeles
Los Angeles, California

Celestial Rays Raise Hopes of Finding Their Sources

Ultrahigh-energy cosmic rays, above 10^{19} electron volts, have been reported coming from the supergalactic plane (PHYSICS TODAY, December 1995, page 9). This result may be even more important than it first seems because it is supported by recent gamma-ray and x-ray observations. The gamma-ray observations up to about 1000 MeV from EGRET show extensions of this high-energy radiation down through the spine of the Virgo cluster of galaxies, and through the southern extension of that cluster and beyond.[1] The ROSAT x-ray observations show > 0.4-keV x rays coming from the Virgo cluster along this line.[2] They also show higher-energy (>1.0 keV) x rays extending farther south along the supergalactic equator for a total of over 11 degrees.[3]

The investigators who have made the cosmic-ray observations suggest that the rays are powered by active extragalactic objects situated in the Local Supercluster. This seems to be the only reasonable site for their origin and agrees with the suggestions that have been made for a similar origin for the observed gamma rays and x rays.

The possibility for making further important progress, of course, lies in the identification of the specific objects that are generating this huge energy and the elucidation of the basic physical mechanisms responsible.

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HALTON ARP
Max Planck Institute for Astrophysics
Garching, Germany

Lowest Notes on Violin Require Skill and Guts

The report (September 1995, page 20) of anomalously low frequency sound from the violin deals with what should really be called a rediscovery of a technique that has long been used by great violinists.

Despite the credibility of independent discoveries by Frederick Halgedahl and Mari Kimura, the credit for achieving low, nonharmonic tonalization through increased bow pressure has already been assigned to Niccolò Paganini. According to my source, virtuoso violinist Ruggiero Ricci, Paganini made use of this "secret" method to enhance his bow control—a practice later emulated by generations of virtuosos. Yet Paganini historian Joseph Gold believes that the actual discovery goes back to the great 18th-century violin master Giuseppe Tartini.

Although it is hard to discover anything new about the violin, the interpretations of Roger Hanson *et al.* and their mathematical underpinning by Knut Guettler are convincing and meritorious. They break welcome new ground in a field that tends to ignore how violins are actually played.

The forced subfundamental emissions are occasionally used to produce cellolike tones below the fundamental of the G string. But their musical significance lies primarily in their ubiquitous presence in sounds produced on the violin's other three strings under the dynamics of forte and fortissimo. The low musical third is an essential transient in each attack of the bow, and is especially audible in the staccato mode.

The technique of forced bowing required to produce low emissions is artistically acceptable only if old-fashioned gut-based strings are used. Metal and synthetic strings have frictional characteristics and stiffness that result in too much noise.

One amusing aspect of the recent interpretations is that they could have occurred 30 years ago if the members of the acoustics societies had been more inclined to generate sound from the violin as it is supposed to be done, by using the bow rather than mechanical transducers. Now, though, perhaps more acoustics scholars will rededicate themselves to the study of the real violin sound and will then be able to narrow the gap that exists between what they know and what performers feel.

JOSEPH NAGYVARY
Texas A&M University
College Station, Texas

Cartoon Assessment

The cartoon reproduced on page 85 of the January issue is in exceedingly poor taste. Regardless of what view one takes in the current debate about the effects of electro-