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Cover: A new picture—at atomic resolution—provides insight into how two molecular chaperones help proteins fold. The snapshot reveals that, upon capturing a protein, the molecules twist dramatically and completely renovate the chemical environment in which the protein resides. (Image: Zhaohui Xu)

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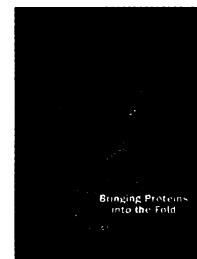
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Letters

Give Dad his due

The mitochondrial DNA study of Neandertals rules out only maternal inheritance of this DNA by modern humans ("Neandertals make big splash in gene pool," SN: 7/19/97, p. 37). Until male-linked DNA analysis is possible, some degree of Neandertal ancestry for modern humans through the male lineage cannot be ruled out.

Lynn Hawley Bootes
Redlands, Calif.

Congestion suggestions stir storms

Concerning "Internet congestion stirs up data storms" (SN: 7/26/97, p. 53) and its proposed solution to usage spikes, the assertion that equations exist to describe such phenomena does nothing to validate either the equations themselves or the assertion that data charges are the way to go. The funda-

mental assumption that everyone, or even a significant proportion of users, will suck up bandwidth all day because it's free needs some closer examination as well. Let me mention a few actual problems.

First, it is not the amount of usage that creates congestion spikes, it is the fact that the usage is random.

Next, users indeed do not differentiate between low and high data transmission requirements. For one thing, the advertisers who insist on swamping us with elaborate graphics at every turn of the page are not charged in proportion to their excesses. How will a pricing algorithm distinguish between wanted and unwanted data? For another thing, it is a mistake to suppose that the average user will base his or her demand for service on charges for use of the available bandwidth. The average adult will use as much as seems necessary—or in the case of teenagers, what they can get away with.

Finally, the article cites spikes that are fre-

quent and last a fraction of a second. They must be really, really frequent for the user to notice them without specialized electronic equipment. My impression is that the server addressed gets swamped long before the transmission lines do.

As for the answer, it is provided in the article. Users tend to avoid delays by trying later or by timing their access to periods of low usage. This is called smoothing, and it happens automatically.

We already have a somewhat regressive pricing structure for the Internet, and we don't need one that favors institutional users (who are unlikely to lose their free ride in any case). Can you imagine a grad student paying punitive charges for graphics essential to his scientific endeavors? Or the government saving any money at all?

Last, how will an equitable pricing structure be implemented? First, you have to get

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indicated that a neutron's quarks carry roughly 50 percent of its spin (SN: 9/18/93, p. 191).

Because the EMC and SLAC experiments were performed under quite different conditions, comparing the two sets of measurements directly proved difficult. A second round of experiments at SLAC and CERN was initiated to help resolve the discrepancy, even as theorists improved their methods of calculation.

At SLAC, researchers obtained high-precision results for the quark spin contribution in the proton and deuteron (composed of a proton and neutron), confirming that the constituent quarks of both the proton and the neutron carry only a fraction of the particle's overall spin. In 1995, the researchers more than doubled the energy of the electron beam to measure again the spin effects in helium-3 nuclei and in protons and deuterons.

Despite numerous technical difficulties, the SLAC team obtained enough high-quality data to pinpoint the quark contribution. "It is difficult to envision any future experiments outdoing the precision of these SLAC experiments in this energy range," Hughes comments.

At CERN, the Spin Muon Collaboration followed up the original EMC experiment, collecting data from firing muons at polarized protons until late last year. Both the SLAC and CERN data now essentially agree, indicating that only about 30 percent of the proton's and neutron's spin is found among the quarks.

The rest of the proton's spin must come from its gluons and the movements of gluons and quarks within the proton.

Complicating the picture, the number of quarks within the particle can actually fluctuate rapidly with the continuous creation and annihilation of quark-antiquark pairs. In other words, the three constituent quarks speed about within a foaming sea of virtual particles produced by short-lived quantum fluctuations, during which a gluon can momentarily split itself into a quark-antiquark pair.

It's also possible that not only up and down quarks but also the other varieties of quarks—strange, charm, bottom, and top (SN: 7/1/95, p. 10)—can take part in the fluctuations to create a mess of appearing and disappearing particles.

Recent experimental searches for evidence of strangeness in the proton imply that strange quarks carry an appreciable fraction of the particle's spin. On average, however, the spins of the strange quarks apparently point in the opposite direction to that of the proton itself.

That leaves a number of theoretical puzzles concerning the role played by strange quarks, says Robert L. Jaffe of the Massachusetts Institute of Technology.

At the moment, most physicists suspect that much of the proton's spin

comes from its gluons. Somehow, these particles move or orient themselves in such a way that they produce a net spin.

In the Aug. 18 *PHYSICAL REVIEW LETTERS*, Ian Balitsky of Old Dominion University in Norfolk, Va., and Xiangdong Ji of the University of Maryland at College Park calculate that gluons contribute at least half of the proton spin. Hence, gluons are at least as important in determining proton spin as quarks, they argue.

However, there is scant experimental evidence concerning the gluon's effect on the proton's spin. So the gluon hunt is on.

At the Deutsches Elektronen-Synchrotron (DESY) facility in Hamburg, Germany, physicists participating in the HERMES experiment are now studying collisions between high-energy, spin-polarized positrons (the antimatter counterpart of electrons) and a gas of spin-polarized helium-3 nuclei. As reported earlier this year, preliminary data from HERMES confirmed the results of the SLAC neutron experiments, which were done with a solid target. By upgrading the instrumentation to detect particles dislodged from the gas, the researchers hope to obtain evidence of the presence of strange quarks.

At CERN, physicists are looking forward to a new experiment called COMPASS, which stands for Common Muon and Proton Apparatus for Structure and

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all the current service providers to agree on a new—and marketable—scheme that does not violate restraint-of-trade laws. What will be done about overseas providers?

Any change in pricing will most likely evolve as a result of environmental pressures, not as a result of anyone's concept of what would be nice.

*John Hannah
Silver Spring, Md.*

The issues involved in flat-rate pricing are certainly not new (consider buffet lunches, unmetered phone calls, freeway use), and the occurrence of congestion should surprise no one.

The future of routing is probably a pay-for-priority scheme. Though billing per byte sounds satisfyingly simple, the nature of the World Wide Web in particular makes this problematic. It is easy to estimate costs for sending N bytes of E-mail, but the cost of connecting to many of today's graphics-heavy sites is impossible for the end user to estimate.

While there may eventually need to be a surcharge for multimedia transfers, a show of restraint on the part of Web designers should reduce much of the day-to-day congestion. Perhaps a picture is worth only 10 words on the Internet.

*John M. Vinopal
Berkeley, Calif.*

It's easy for the researchers to suggest that users are to blame for Internet congestion

Spectroscopy. They expect to probe the gluon content of the proton by firing high-energy muons at polarized targets and looking for ejected mesons containing the charm quark.

Perhaps the most promising effort is slated to start in 1999 at the new Relativistic Heavy Ion Collider at the Brookhaven National Laboratory in Upton, N.Y. (SN: 9/21/96, p. 190). High-energy collisions between polarized protons should make it possible to detect clear evidence of gluon spin.

When these and several related experiments are completed, physicists should have the data they need to tell their story of how the proton's constituents give it its spin.

Studies of the proton furnish insights into the strong force, which governs how quarks bind together and how protons and neutrons form atomic nuclei, Hughes says. Moreover, to understand what happens when one proton collides with another in the sorts of cataclysmic crashes that create the top quark and other particles, it helps to know as much as possible about the proton itself.

There's also a deeper question that underlies investigations of proton spin. In general, why do quantum particles exhibit the quality of spin at all?

"Spin is a quantum number and a property of matter," Hughes notes. Yet in a fundamental sense, "we do not understand where it comes from or why it is there." □

and should be charged according to the data they use. The researchers' own usage is paid for by the grants given them by Xerox and the University of Michigan.

I can understand Xerox's interest in the study. As for public university studies which suggest the public should pay more and more fees for using a public resource, maybe tax-paying users should conduct a study that investigates such research studies.

Maybe a scalable grant scheme is in order. I think a wise and sound approach would be to measure those studies that suggest "improvements" which increase (worsen) users' quality of life while saving (costing) money and then grant the studies more or less research money accordingly.

As it stands now, because researchers do not personally pay costs linked to their performance, they seem unable or unwilling to differentiate between activities that may require users to spend more money and irresponsibly thinking that their actions have little effect on the users.

*Nancy Jane Mathews
Davis, Calif.*

I have had many years' experience managing large segments of the Internet. I agree that the short-lived storms observed are normal, but I take issue with the conclusion that somehow charging for access (or altering the current charging scheme in some undefined way) will make the storms go away. The article presents no evidence linking the conclusions to the data.

*Craig A. Finseth
Saint Paul, Minn.*