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bility by recalling his role in an earlier episode involving radiohalos. I apologize if my remarks exceeded this objective.

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2/85

Stellar companions

I would like to make a few comments on David Helfand's report (April, page 19) "Stellar companion appears to be giant planet":

► The basic theory of the structure and evolution of stars of very low mass (M below $0.1 M_{\odot}$) that is applicable to brown dwarfs and black dwarfs was presented in two papers that I published¹ in 1963.

► As I discussed in 1963 and in subsequent² papers, the end product of the evolution of a star of very low mass is a completely degenerate object of zero luminosity. I referred to such an object as a (low-mass) black dwarf in my papers. Before reaching the black-dwarf stage, the star goes through a self-luminous phase for approximately one billion years, and the terminology "brown dwarf" is appropriate for this pre-black-dwarf phase in the evolution of such a star. During the self-luminous phase the star is sufficiently hot at its surface to be detectable by optical, infrared and radio telescopes.

► Whether we are talking about the self-luminous phase or the final, nonluminous state, it should be kept in mind that brown dwarfs and black dwarfs are quite different from giant planets in the solar system. The masses of the brown and black dwarfs lie in the range $0.07-0.01 M_{\odot}$, or $70-10 M_{J}$, where M_{J} is the mass of Jupiter (24). (The

upper limit of this range gives the approximate value of the minimum mass on the hydrogen-burning main sequence, as discussed in my 1963 papers.) On the other hand, the masses of the planets in the solar system, including the giant planets, do not exceed $0.001 M_{\odot}$, or $1 M_{J}$. Not only are the masses of these degenerate stars much greater than those of giant planets, but the basic processes of star formation also appear to be different from those of planet formation. Stars are generally formed by instabilities in interstellar gas-dust clouds, while planets are formed by collisional-accretion processes in the material surrounding a star.³

► As far as VB8B is concerned, from the observational data⁴ it appears to be a degenerate star of very low mass and not a planet.

► In a paper published² in 1972, I pointed out the significance of low-mass degenerate stars (brown dwarfs and black dwarfs) for the missing-mass problem. I tentatively concluded in that paper that luminous and nonluminous stars of very low mass contribute significantly to the total mass in the galactic disk and the rest of the galaxy. I am happy to note that this suggestion is now being looked at⁵ seriously by some astronomers. Since 1962, I have argued for the existence of a large number of brown and black dwarfs in the real universe, and I am delighted with the recent announcement concerning VB8B. However, I am not too happy with the statement that VB8B and other, similar objects are planets beyond the solar system.

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4/85

Physics and the military

Charles Schwartz preaches clear thinking, sensibility and logic in his reply to Jocelyn Tomkin (May, page 15). He claims that they should lead the US scientists and engineers to "withdraw from the nuclear arms race," which he sees as one of the first steps to disarmament. Employing the same three above-mentioned principles, I would

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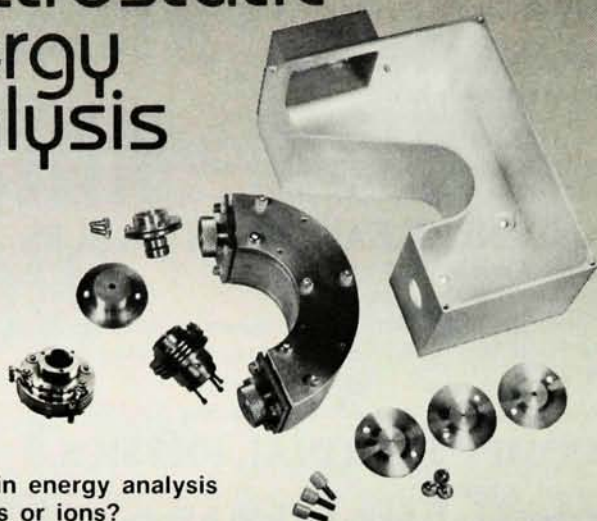
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like to make an inference regarding the next steps:

► The following second step would take place in the USSR: Under an inch-tall headline "AMERICAN SCIENTISTS FOR PEACE," *Pravda* would applaud the action and announce that the Soviet people enthusiastically join the US scientists in their condemnation of American militarism. To express its solidarity and strengthen the united peace front, the Soviet Union would reinforce its nuclear defenses along its western borders and the authorities would increase their firmness in dealing with any hooligans who might attempt to sabotage this peace initiative.

► In the third step, a Charles Schwartz would try to exonerate the Soviets by pointing out that in the US undesirable things are happening as well—for example, the deficit rose again by \$2 billion—which naturally makes the USSR feel more insecure and justifies their build-up, which must be countered by fresh grass-root initiatives for arms reductions.

► In the fourth step, *Izvestia* would add full support, and so on.

There is nothing like logic and clear thinking.

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Rotation spectra

In 1972 Tony Dorney and I published¹ a paper in which we drew attention to the near-degenerate sets of states (now called clusters) of spherical top molecules at high angular momentum, and we gave a semiclassical explanation of this behavior. Subsequently, thanks mainly to developments in laser techniques, these clusters have been observed in a number of molecules, and your July 1984 story "High-spin molecular rotation spectra are surprisingly simple" (page 17) is devoted to this subject. Unfortunately your article contains a number of historical inaccuracies, including:

► claims that the clusters were discovered in Los Alamos in the mid-1970s and that the standard theoretical approaches of the day offered no explanation

► a quotation from William Harter that there were fewer lines "than anyone had ever dreamed" in the mid-1970s

► a claim that the explanation "finally emerged from the Los Alamos computer diagonalization" in 1976

► a claim that "neither the clustering nor its orderly division by the separatrix had been anticipated"

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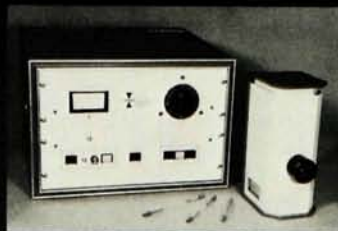
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