

letters

and music, presumably be very capable of managing scientific concepts, and yet be very immune to the transcendent beauty and philosophical depth of our evolving world view? Does Roy believe that theoretical thought, guided by social utility, should have stopped with classical physics? the atom? the nucleus? Where, Professor Roy, does science cease to be useful to society? At 10 eV? 100 MeV? 40 TeV? Which committee should, in solemn conclave, set the limit?

If science—pure, applied, large, small, but above all good science—is to thrive in the next decade, it will be by our standing together in mutual respect for quality and for our common heritage. The vast majority of physicists, whatever their disciplines, operate with a complete awareness of the symbiotic nature of basic research, applied science and technology. The SSC, costly as it is, but representing the need of one discipline to make progress beyond the mid 1990s, deserves more rational debate.

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8/85

Quasar redshifts

The call to "recant" from those who question the validity of the Big Bang hypothesis, in light of recent data claimed to support this cosmology (PHYSICS TODAY, December 1984, page 17), deserves closer scrutiny.

The advent of three-dimensional, relativistic and fully electromagnetic particle-in-cell simulations on large computers have only recently been applied to astrophysical problems (PHYSICS TODAY, June 1984, page 90). The importance of the simulational approach in astrophysics derives from the fact that it offers a third, and largely independent, method to understand the behavior of plasma phenomena in the universe, in addition to theory and observation.

It is therefore of interest that the first such simulations replicate much of the observed data but do not support the cosmological interpretation of quasar redshifts and microwave background radiation.

Following a suggestion that cosmic plasmas are generally filamentary for all scale lengths from kilometers to megaparsecs,¹ simulations of galactic-dimensional current-conducting plasma filaments (Birkeland currents²) have been carried out to study what physical processes occur³ in the course of their evolution. The following sequence of events is observable in a single simulation:

► A burst of synchrotron radiation having an approximate magnitude of

10³⁷ watts lasting 10⁷–10⁸ years, with the isophotal contours of double radio galaxies

► A compression of intergalactic plasma into a central elliptical separatrix, followed by an alternating ejection of quasar-like plasmoids and "jets" (actually, relativistic electron beams accelerating toward the observer)

► Formation of peculiar, Seyfert and spiral plasma morphologies⁴ that, using observed masses, have the characteristic rotational velocity of galaxies⁵

► A total radiated energy of 2.07×10^{51} J within a 1.73×10^{65} -m³ volume, or an equivalent blackbody temperature of 2 K; the microwave radiation produced⁶ will have a high degree of isotropy in a metagalaxy of Birkeland currents

► A Marklund convection of plasma into the radiatively cooled filaments⁷ with a redshift

$$z = d\lambda/\lambda_0 \\ = (1 + \beta)^{1/2} (1 - \beta)^{-1/2} - 1 \\ \beta \approx E_x/B_{\theta c}$$

decreasing nearly linearly from the initial convection cutoff value 3.4 to essentially zero during simulation time (as $B_{\theta} \sim I_{\text{Birk}}$ increases).

The correspondence between simulation and many of the interpretations of those suggesting noncosmological redshifts is striking. In conclusion, the statement "Apostles of the noncosmological origin of quasar redshifts must now... recant, or else maintain that the unknown laws of physics which fix [these] redshifts... extend [over] appreciable distances to apparently normal galaxies..." can be taken in good humor, but it does preclude the possibility that we live in a plasma universe.

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6/85 Los Alamos National Laboratory

Colliding-beam physics

In the March issue (page 29), I read: "The development of colliding-beam physics began at Stanford University, which operated an electron-electron



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letters

collider in 1963. Electron-positron colliders followed at Frascati, Orsay and Novosibirsk." The role of the Princeton-Stanford team in the colliding-beam machine development has indeed been crucial. Nevertheless, it is not fair to say that electron-positron colliders followed at Frascati, Orsay and Novosibirsk. The work done in the latter institutions and the one done at Stanford were simultaneous—in fact, the first beam-beam collisions ever observed were e^+e^- collisions and not e^-e^- collisions, and this observation was done by the French-Italian collaboration working on the ring ADA, which was then operated at Orsay. (*Nuovo Cimento* 34, 1473, 1964).

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4/85

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THE AUTHOR REPLIES: J. Haissinski is technically correct. Indeed ADA did observe the first e^+e^- collisions, although at extremely low intensity. My error stems from recalling that the Princeton-Stanford e^-e^- machine was started earlier, in 1958, first stored beam and had the full complement of injection, storage and collision devices designed to do physics experiments. I apologize for the error.

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SDI non-nuclear?

In November 1983, *PHYSICS TODAY* published a letter (page 116) I had written in support of President Reagan's "Directed Energy Weapon" project; it emphasized the following three principles:

- Only scientists are capable of discovering methods to technically nullify nuclear weapons; hence it is their responsibility to search for such a method

- Beam weapons have practically zero inertial time; hence they can, in principle, defend against nuclear weapons, which require a large inertial time to be transported to a target country
- Beam weapons are nonexplosive and are the most benign weapons; they are useful only for defensive purposes.

In the year and a half since this letter was published, there has been a dramatic expansion of effort in the Strategic Defense Initiative. One approach that is being taken in SDI research, and the one that most concerns me, is the development of an x-ray laser driven by nuclear explosives. This approach, although possibly powerful when achieved, not only contradicts President Reagan's repeated claim of "non-nuclear defense," but also could lead to a dangerously unstable situation by making the SDI concept itself ineffec-

tive. Space deployment of nuclear weapons, even for a defensive purpose, would unavoidably lead to space deployment of offensive nuclear weapons, which would nullify the SDI concept. For SDI to succeed, political agreement to keep space free from any nuclear weapon are essential. Scientists should stick to a non-nuclear means of SDI.

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6/84

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Math anxiety and physics

The article "Math anxiety and physics: Some thoughts on learning 'difficult' subjects" (June, page 60), clearly outlines some major reasons why education in the US is at present in such a difficult situation. I found "The Learning Bill of Rights" to be particularly distressing with its implication that the less competent and responsible students have "rights" that can lead to dictation of policies for the nation's educational system.

It is all well and good to offer assistance to those who need help in acquiring an education, and in the US this has been common practice since at least 1630. But it is quite another matter to spoon-feed those who are unable or unwilling to fulfill legitimate requirements for learning at the college level. We make a big mistake in assuming that higher education is suitable for all and that it must be provided, at public expense, for everyone—regardless of their intellectual abilities or their willingness to reject responsibilities for their own actions. We need to recognize that each person educates himself or herself, and that in a very real sense, there are no teachers but only learners. When we reach the point, as we have in the US, where remedial courses in colleges are commonplace necessities because the educational foundations at lower levels have been inadequate and ineffective, and where significant numbers of former college students intentionally default on repayment of public loans to enable them to acquire higher education, then we have lost our sense of perspective.

Our emphasis on personal "rights" has been greatly overdone in recent years. It has passed the point of rationality and has given our vocal and radical elements an unjust hold on society at large. We need to recognize that freedom and license are fundamentally different and that for every right we claim, we must accept a concomitant obligation or responsibility. Yet, in all the civil-rights demonstrations since the 1950s, and in all the feminist agitations since the 1960s, I have yet to hear any exponent of

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