the supernova explosion because its present orbit would then have been inside the blue giant progenitor star. Even a planet orbiting just above the surface of the star would have been expelled from the system by the explosion because this abruptly reduced the central mass by a factor of 20. The planet must therefore be composed of matter that came from deep inside the star and went into orbit after the supernova explosion.

When SN1987A exploded, about 18 $M_{\odot}$ of matter on the outside was expelled, but the matter in the interior collapsed inwards to form the neutron star. A model[3] suggests that the radial velocity of matter fell below 500 km s^{-1} close to the centre of the envelope. It is conceivable that 1.5×10^{-3} $M_{\odot}$ of this inner envelope may have gone into orbit around the central core assisted by rotation of the core and a slight departure from spherical symmetry in the explosion.

The matter deep inside SN1987A will consist almost entirely of heavy metals which, within a year of the outburst, will have condensed into grains. Computer simulations of the formation of planets in our Solar System from coalescence of grains[4] show that the process is very rapid, taking only 100–1,000 orbital periods. For the putative SN1987A planet this corresponds to less than a year. The simulations also show that the most likely result of such coalescence (especially for more eccentric initial orbits of the dust cloud) is a single large planet, as may be the case around SN1987A.

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1. Middledicth, J. *et al. IAU Circ. No.* 4735 (1989).
2. Hansen, C. J., Winget, D. E. & Kawaler, S. D. *Astrophys. J.* **297,** 544–547 (1985).
3. Woosley, S. E. in *Supernova 1987A in the Large Magellanic Cloud* (eds Kafatos, M. & Michalitsianos, A.) 289–299 (Cambridge Univ. Press, 1988).
4. Isaacman, R. & Sagan, C. *Icarus* **31,** 510–533 (1977).

New ways with gravitational waves

SIR—John Maddox (*Nature* **336**, 513: 1988) makes the statement that "solidly informed opinion has moved away from the instrument designs of a decade ago" and implies that researchers have shifted their effort to laser interferometer detectors. This is incorrect. Four US groups and others in Italy, Australia and China are actively engaged in research to operate and develop improved resonant bar gravitational-wave detectors.

Resonant bars remain the most sensitive gravitational-wave detectors yet developed and are the only instruments so far used to mount a serious search for gravitational radiation. There has been tremendous development and refinement of the basic design used by Joe Weber two decades ago and the potential remains for vast improvements.

Maddox's statement that resonant detectors are "out of fashion" for mechanical reasons is also completely off the mark. Although larger detectors would give proportionally larger signals, the potential sensitivity of a particular detector also depends on the methods available for motion detection. Maddox states that interferometry is the preferred method for detecting the vibrations of a bar detector but electromechanical transducer schemes, which function by the modulation of an impedance in a superconducting circuit, have been found to be superior. There is no reason to attempt to construct larger bar detectors until the full potential of existing bars has been exhausted by pushing the transducer sensitivity to the maximum. Thus the argument that the larger bars which are needed will be difficult to suspend in a vibration-free manner is specious.

Nor is the issue of the quantum limt of bar detectors an immediate concern. There is a factor of about 1,000 to go from the present bar-detector strain sensitivity level of 3×10^{-18} to the 'quantum limit'. It should even be possible to surpass this limit by using a specially designed transducer to force the bar into a 'squeezed state', analogous to an optical squeezed state, and integrating the existing technologies for low acoustic loss materials and low electrical loss superconducting circuits. In this way, a sensitivity level of 10^{-22} could be reached with bar detectors.

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SIR—We fully share the concern (*Nature* **336**, 513; 1988) that the US National Science Foundation may turn down the proposal for a new gravity-wave detector based on laser interferometer and we are equally concerned about the financing of the equivalent European projects. We are convinced, however, that resonant bar detectors have a much greater future than is suggested, and wish to correct some statements about them.

First, bar detectors are not, of course, "suspended so as to pick up mechanical movements from the surroundings" but are substantially isolated by stacks of mechanical filters. In present detectors the external container can be hit with no effect on the output data, so it is difficult to believe that "passing traffic is a nuisance". In an interferometer at least three mirrors are suspended and protected by mechanical filters.

Second, the measurement of the displacement of the free surface of the suspended object is not "usually done by cementing a mirror on the surface and setting up an interferometer". This technique has been tested without much success, but the transducers used in all the antennas that have been operating and taking data have nothing to do with interferometers.

Finally, the uncertainty principle and the corresponding quantum noise limit the performances of all measuring devices, not only of some of them, and the frequency spectrum of a bar detector is not "a complicated function of its geometry": the longitudinal mode, which is what matters because it is best coupled to the gravitational radiation field, is separated from the other resonances by several hundred hertz.

Most probably, both types of detectors, bars and interferometers, will be pushed to the sensitivity necessary for providing useful astrophysical data. Only their use in observational work will allow an adequate comparison, because computations on paper can be misleading. We tend to believe that both will find favour, but for different classes of events.

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Fear of flying

SIR—Robert Parker (*Nature* **336**, 719; 1988) purports to demonstrate that a Boeing 747 crash could put 250,000 people at risk from the combustion of the depleted uranium counterweight in the tail.

His figures show that on the worst-case assumptions, 8.5 kg of uranium would reach the atmosphere in respirable form, and that if 250,000 people inhale exactly equal shares of a total of 8 kg which then concentrates on one kidney in each individual, that kidney reaches its maximum permissible uranium oxide concentration.

May one enquire how all the contaminated air gets uniformly inhaled, why the absorbed material seeks out one kidney, and why the maximum permissible concentration puts people at risk?

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Scientific Correspondence

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