believed to originate from the He-burning zone of massive stars at the end of their evolution, just before their explosion as supernovae (*13*). The former are produced by explosive reactions, the latter by He burning of ^{14}N during the hydrostatic evolution of the star. The large variations in Si isotopic compositions and specifically excesses in ^{28}Si are interpreted as a result of the mixing of interior stellar layers, where O burning took place, with the C-rich outer He zone during the supernova explosion (*14*). Violent mixing has indeed been observed during supernova explosions (*15*).

Additional evidence for a supernova origin was recently presented at the 58th Meteoritical Society Meeting in Washington, D.C. Nittler and co-workers from Washington University in St. Louis and Strebel and co-workers from the University of Berne found large ^{44}Ca excesses, apparently from the decay of short-lived ^{44}Ti (half-life = 58 years) in graphite and SiC grains. This radioisotope is produced only deep inside of supernovae and, together with ^{28}Si, has to be mixed into C-rich zones during the supernova explosion in order to be present in carbonaceous grains.

At the same meeting, Amari and co-workers presented evidence for ^{41}Ca in graphite grains of supernova origin in the form of ^{41}K excesses (^{41}Ca decays to ^{41}K with a half-life of 105,000 years). Finding ^{41}Ca in these grains, which also have large amounts of extinct ^{26}Al (half-life = 720,000 years), has potentially important implications for the source of these two radioisotopes, which are also found in early solar system objects (*16*). Whereas Wasserburg *et al.* (*17*) implicate an AGB star as the source of these two isotopes in the early solar system, Cameron *et al.* (*18*) revived the supernova trigger hypothesis for solar system formation and postulate that both ^{26}Al and ^{41}Ca originated in this explosive event.

At present, the isotopic data on presolar grains so far identified provide important constraints on nucleosynthesis and stellar evolution. However, it is likely that additional types of presolar grains are present in primitive meteorites and that only our lack of ingenuity to locate them keeps us from gaining even more information about our celestial ancestors.

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Optical Rockets

A very intense laser pulse can modify the index of refraction of the medium through which it travels, even to the point of producing a lens effect that focuses the beam to smaller diameters, a phenomenon known as self-focusing (*1*). If the laser travels through a gas with an intensity high enough to cause ionization, the plasma thus created can also modify the propagation of the light, although in this case, the effect is one of defocusing (in addition to the usual effects of diffraction). For a range of laser intensities, it is therefore conceivable that the effects of self-focusing and defocusing might balance each other, leading to a stable transport of laser light through a narrow channel. Recent work by the group of Mourou and co-workers at the University of Michigan shows this to be the case 2), and the results demonstrate self-channeling of laser light over a distance of 20 m (see figure).

Long light. Optical channel formed as an intense laser pulse propagates down a laboratory hallway. [Photo courtesy of G. Mourou, University of Michigan.]

A fancy bit of laser technology makes this possible. Mourou's group have used a titanium-sapphire laser system with chirped pulse amplification (*3*) to produce 100-fs pulses having an energy of 50 mJ at a wavelength of 775 nm. In chirped pulse amplification, the spectral components of the laser pulse are stretched out in space with a pair of diffraction gratings, making the peak power lower and enabling the high-gain amplifier stages to boost the energy efficiently. Once amplified, the spread spectrum is compressed into a short-duration, high-intensity laser pulse by another pair of gratings. With this technique, laser pulses approaching 100 TW (terawatts) have been produced (*4*).

Braun et al. found that the critical power for self-focusing in air was around 10 GW for a pulse energy of 2 mJ. At 15 mJ with a clean, spatially homogeneous laser beam profile, a narrow filamentary channel formed with a diameter of 80 mm. The researchers reported generation of white light along the channel and conical off-axis emission of colored light, which show up in the image as rings (see figure). Instead of being an "optical bullet," the Michigan group refers to the pulse propagation as an "optical rocket" because they believe that the pulse energy is continually resupplied by the background optical energy propagating outside of the filamentary channel.

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