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POWER WITH SMOKE AND LASERS
Rethinking the internal combustion engine.

In a quantum afterburner, a laser relaxes molecules from the medium energy level. Energy from the laser can be converted into electricity.

Team locomotives, aircraft carriers, and even steam whackers have one thing in common: They are powered by engines that convert heat into motion. Unfortunately, such engines are not terribly efficient. But physicist Mark Scully of Texas A&M University in College Station has a radical idea that could substantially improve them. By adding a laser and a maser (a microwave laser) to an engine, he hopes to squeeze extra energy out of the hot engine exhaust—a quantum afterburner, as he calls it.

In a typical laser, flashes of light or electricity excite the molecules inside a laser medium (which can be a gas, liquid, or solid) to high energy levels. This creates a "population inversion"—a situation in which more molecules are in a high energy state than in a low one. Then, as the high energy particles relax (drop to a lower energy level), they emit photons and, consequently, laser light.

In Scully's design, engine exhaust would be the lasing medium. Some of the molecules, heated in the combustion process, would already be in an excited state. Others are in medium and low energy states. When they arrive at the afterburner, the maser relaxes molecules from the mid level, creating a population inversion between the high and medium levels (see graphic). This triggers the laser. The laser light could then be converted into electricity.

Such a device could be built into any type of engine that emits hot exhaust gas. A quantum afterburner in a hybrid-gas electric car, for instance, could boost the auto's battery power. But Scully cautions "This is really still theoretical. We are not doing engineering yet." When researchers are able to put the theory into practice, applications are likely to be on a very small scale. For instance, nanomachines with picotons of turbines could use the technology to pump out electricity. Scully says, and "make it a kind of inoperative"—a very tiny locomotive. —Harold Hansen
In the following pages, we offer a first peek at the roof designs it makes possible.

By
Michelle Krebs
HE AUTOMOBILE HAS BEEN ON THE VERGE OF BEING reinvented practically since it was invented. Cars that would fold and fly; cars that would walk; cars that would cruise like bubbles in the sky—these visions have been talked about for decades if not centuries. But now, the technological breakthroughs have brought these concepts closer to reality. GM's concept car, the 'Autonomy,' is a step in this direction.

The 'Autonomy' is a car that can be steered, braked, and accelerated by a computer-based system. It can navigate through traffic without a human driver, and it can even park itself. The car is powered by fuel cells, which generate electricity from the chemical reaction of hydrogen and oxygen. This technology is not only environmentally friendly but also promises to be more efficient than traditional gasoline engines.

GM's 'Autonomy' is not just a car; it is a platform for future developments in autonomous vehicles. The company envisions a future where cars can be used as delivery vehicles, ride-sharing vehicles, and even as mobile offices. The possibilities are endless, and GM is leading the way in this new automotive revolution.

The 'Autonomy' is a testament to the power of technology and innovation. It is a glimpse into the future of transportation, where cars will be safer, more efficient, and more convenient. As we continue to push the boundaries of technology, we can look forward to a future where the 'Autonomy' is just the beginning.
How the Autonomy Works

Electronic precision triumphs over mechanical power to create the first car with no moving parts, save for motors mounted in the wheels.

Control Center
The vehicle's computerized brain, coordinating the by-wire functions, telematics, and suspension.

Body Attachment
Mechanical locks secure the body to the skateboard.

Wheel Motors
Four electric motors, one within each wheel, drive the vehicle.

Front Crush Zone
Protects passengers by absorbing impact energy.

Universal Docking Connection
Communications port that connects the driver-controlled system—steering, braking, power, and climate—with the skateboard.

Rear Crush Zone
Protects passengers by absorbing impact energy.

Cooling Fins
A new kind of radiator and air vents dispense heat generated by the fuel cell and electronics.

Fuel Cell
Fuel cell propulsion system, including fuel cell stack and hydrogen storage tank.

Detachable Body
Various bodies could snap on to the chassis, like Lego pieces.

Designers retire, they quite possibly could see the last of the internal combustion engine," says Ed Golden, executive director of Ford's North American design operations. "They will probably create vehicles that are more significant and different than anything current designers like me will do in our careers."

What makes the Autonomy approach so intriguing is that it would allow drivers to own several car bodies for just one skateboard, then alter the layout and look of their vehicles according to the dictates of lifestyle or mood. (A reality that would also transform the marketplace. Would a GM skateboard accept only GM bodies, or also third-party hardware? GM envisions the skateboard forming the platform not just for a few car models, but for dozens of models globally, changing the economics of production.) Each body would snap on to the Autonomy base, and its interior technology—controls, power, heating, and cooling—would connect to the chassis through a docking port on the platform. A family might own a commuter sedan body and a sport or SUV body for weekends or vacations, then buy a specially configured body so that, for example, a newly disabled family member could roll a wheelchair directly into the driving position. A notion like this has implications for another great American institution, the two-car garage—perhaps the bodies would be stored at depots for quick installation. Within a given car body, there would also be flexibility: Passenger and even driver seat positions could be moved. A car could be turned into a mobile office, even a mobile bedroom. Some of this seems familiar, but when you think of the decks above the skateboard, the possibilities are astonishing.

Before unveiling the Autonomy, GM held an internal contest to see what kinds of attachable auto bodies its designers could come up with. We decided to take a similar route, asking two independent design firms to brainstorm new configurations for the car of the future, based on the Autonomy concept. We encouraged the firms not only to play with interior configurations, but to fundamentally alter the architecture of the automobile, creating vehicles that are not only innovative but functional. Prisma Design International of Tustin, California, responded with a novel SUV and adjustable-bed pickup; Artic Group of Irvine, California, conceived a snapping sports car and a sedan.

Designers are buzzing about the potential versatility of the Autonomy—especially when it comes to interiors. "The task of driving is different at different points in the day or in one's life," says Jon Rothkop, a senior industrial designer at Lexan Corp., an automotive interiors supplier. The Autonomy yields a car that can evolve to a much more profound degree than aftermarket add-ons have ever made possible.

Drive-by-wire technology, meanwhile, would enable the steering wheel to become an aircraft-type control yoke or a
The SUV has evolved into the most functional automobiles around, a minivan with seat belts. Without the constraints of a bulky engine compartment or a transmission that creates a hump in the floor, designers at Tesla, Californian-based Prisma Design increased the size of the passenger compartment and used the Autonomy's 42-volt power supply to run a bar of onboard electronic equipment.

Joysticks, if that were desired by some drivers. Whatever the device, it would not have to be attached to a conventional steering column and could, potentially, be rocked in several places about the car. A British tourist who drove frequently to France on business could shift his position from right to left and back again. The absence of an engine compartment, meanwhile, could make cars safer, with new room for crash absorbing material in front of the driver.

There is work to be done, of course, before the skateboard is ready for prime time. That work starts with the fuel cells. Fuel cells have come a long way since 1994, when Daimler-Benz unveiled a van whose fuel cell stacks and hydrogen tanks were so large that they consumed the majority of the space inside. Ford, BMW, Volkswagen, Honda, and most of the other big automakers either have experimental fuel cell vehicles on the road, or will have them there soon. But no fuel storage system as compact as that required by the skateboard is in view; if the skateboard is 6...