

The Physics of NASCAR

How to Make Steel + Gas + Rubber = Speed

Diandra Leslie-Pelecky
Dutton, New York, 2008. \$25.95
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Reviewed by Giovanni G. Fazio

As a physicist and an avid fan of IndyCar racing, I read with considerable interest Diandra Leslie-Pelecky's *The Physics of NASCAR: How to Make Steel + Gas + Rubber = Speed*. NASCAR stands for National Association for Stock Car Auto Racing, and auto racing is the number one spectator sport in the US, as measured by attendance.

IndyCar racing involves open-wheel cars, in which the wheels are outside the body of the car. In contrast, NASCAR racecars may look like ordinary cars to the casual observer, but they are far from ordinary. They have engines with 850 horsepower at 9000 revolutions per minute and reach speeds of 200 mph, fast enough to cover

the length of a football field in 1.02 seconds. The physics of what makes a car go that fast and still stay on an oval racetrack is fascinating. Even more interesting is that many of the car's properties, such as chassis size and

shape, engine size, car weight, and so forth, are fixed and tightly regulated. Because of the small permissible differences between cars, a thorough understanding of the physics becomes even more critical if a racing team is to achieve the highest speeds possible. After traveling hundreds of miles, a car may win by only seconds, or even

hundredths of a second.

Leslie-Pelecky is a professor of physics at the University of Texas at Dallas and has worked extensively with K–12 teachers and schools. In her book, she describes the many applications of physics in racing, and as I was reading it, I realized that using examples from auto racing would be a good and interesting way to introduce physics to high-school students or even students in an introductory college physics course. The author discusses the mechanical structure of the frame and sheet-metal “skin” (usually made of low-carbon steel); the solid-state properties of the materials; optics of the paint; thermodynamics of engine combustion; fluid mechanics; engine dynamics such as power, torque, and horsepower; aerodynamics; force and motion; acoustics; and electromagnetic radiation. A major factor in winning a race is the car's aerodynamics and the wind-induced downforces applied to the vehicle. Wind-tunnel tests and computational fluid dynamics become quite important. One interesting phenomenon is so-called drafting, in which two cars, one behind the other and separated by inches, can travel 3–5 mph faster on a superspeedway than a single car can. The physics of drafting makes for some interesting driving tactics during a race.

Because the major car parameters are fixed, it is the small variables that race teams must fine-tune to make their cars go faster. Those variables—there are about 25 of them—are correlated. To “setup” a car means to adjust the spring tension, shock absorbers, sway bars, tire pressure, weight distribution, the angles of the splitter in front and the wing in the rear, and more. To make matters even more challenging, the setup can change with track temperature, with conditions, and, indeed, from track to track. Rather than take an ad hoc approach, car crews use computers to analyze data from multiple variables to reach the winning combination.

Leslie-Pelecky's book is easy and enjoyable to read; it has no equations, and anyone with a high-school education can handle the science. I did find a few discrepancies between diagrams and ac-

companying text, and I thought the section on tire friction during a turn could have benefited from inclusion of the coefficient of friction and vector diagrams analogous to those the author used in her discussion of an impact with a wall. Likewise, the chapter on the car's suspension system could have used diagrams to help readers understand the system's structure and operation.

Interspersed with the treatment of the physics are Leslie-Pelecky's observations of the car owners, drivers, pit crew, and mechanics. Some readers might say such narrative distracts from the physics, but the people she encounters are fascinating. They come from interesting and varied backgrounds and are an inherent part of what makes racing exciting. Mention of them makes the book more enjoyable.

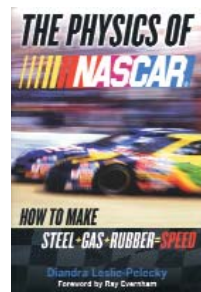
Normally, I am not a NASCAR fan: I find IndyCar racing, in which cars reach 235 mph, more fascinating. However, after reading Leslie-Pelecky's book, I caught myself one weekend watching a NASCAR race on ESPN and paying particular attention to all the physics that I learned from her book. Even if you are not a NASCAR fan, read *The Physics of NASCAR*. It may change your mind.

Applications of Synchrotron Radiation

Micro Beams in Cell Microbiology and Medicine

Ari Ide-Ektessabi
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In the past few years, developments in hard x-ray microprobe instrumentation and methods have improved our understanding of the role trace metals play in life and in causing disease. The results have led to considerable interest from researchers in the life sciences who want to use microprobe instruments with high spatial resolution and trace-level sensitivity. Nonetheless, the literature is missing a comprehensive book that focuses on the biological and



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