The Science of TV's *The Big Bang Theory*

Explanations Even Penny Would Understand

by

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DRAFT

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coming soon from ECW Press

This mockup doesn't represent
the book's final appearance and layout.

I'm not a book designer.

It's only intended to give a sense
of the book's visual feel
by demonstrating
how the body text might flow
around the various sidebars and images.

Whaddya *Mean,* "Explanations Even Penny Would Understand"?!

(Scene: An apartment building in Pasadena, California, USA.)

Sheldon's mother: Sheldon, when is your landlord going to fix the elevator?

Sheldon: I don't know. Lately we've been talking about converting it into a missile silo.

Leonard: Your son seems to think we need to launch a preemptive strike on Burbank.

Sheldon: Get *them* before they get *us.*

—*"The Rhinitis Revelation" (Season 5, Episode 6)*

What's this? A deadly dance of mutual apocalyptic cease-and-desist, Southern California-style, city against city? The left brains of the California Institute of Technology (Pasadena) versus the right brains of Warner Bros. Entertainment (Burbank)? *Why haven't we been warned?*

In reality, the situation isn't quite that dire. Neither Pasadena nor Burbank has expressed any desire to wipe the other off the map anytime soon. It's only a scene from *The Big Bang Theory,* the situation comedy with the highbrow pedigree.

Pasadena

Where *The Big Bang Theory* is set.

Burbank

Where the *Big Bang Theory* set is.

By turns hilarious and poignant, the show explores the differences—and similarities—between book smarts and people smarts. It features four intellectually gifted social maladroits and one street-savvy ingenue (or, in co-creator Chuck Lorre's facetious turn of phrase, "four wise guys and a sexy dame"). [1] And every time the guys haul out their advanced science degrees and start talking shop, viewers know they're in for a buzzword

bath.

Except that it's not buzzwords. Nearly every bit of science mentioned on the show is entirely legitimate. It's just that not much of it gets explained.

Nor should it. This is CBS, not PBS, after all, and viewers aren't tuning in to be educated, only entertained. "Brilliant people being foolish" is a time-tested formula for comedy, and "foolish people being brilliant" for drama, but it's just not all that funny when brilliant people are brilliant. (And if the thing you most want to watch is foolish people being foolish—well, you hardly need a TV for *that.)*

Still, it's a rare viewer who doesn't occasionally long for a little more background in whatever it is the characters happen to be jabbering about. Wouldn't you like to know, for instance:

• What Leonard does in the laser lab all day?

• Why Sheldon is so fanatical about being "the scientist who confirms string theory" when, according to Leonard (on his very first date with Penny), "you can't prove string theory"? [2]

• Where Howard—who, according to the sign on his door, works in an **ASTRONAUTICAL ENGINEERING** lab in season 1 but a **MECHANICAL ENGINEERING** lab [*] in season 5—found the time to become an expert programmer as well? [3]

• When Raj—domestic divo by day, stargazer by night—sleeps?

We don't have answers to all of those questions (chalk those last two up to the magic of television, for starters), but we can take a poke at some of them and see what we find. It's not a requirement, of course. You can get a terrific laugh from the nerds on the show without having any background in science at all. But it's nice to know why the nerds in the audience are laughing, too.

Okay, "nerds" is unfair—we should probably be saying something like "gifted and highly educated persons." And you can be a scientist without being a nerd. (In a more serious moment, Lorre proposed that the show was "not about geeks or nerds [at all, but] about extraordinary people.") [4]

There's an unfortunate myth about scientists, probably fueled by the

nerd/geek stereotype. In the popular imagination, scientists are self-assured, introverted, walking encyclopedias. When you ask them how they are, they'll analyze the question in depth before giving a medically accurate response. When you comment on the weather, they'll respond with strange mumblings about global thermodynamics and ripples of causality.

But there are many things scientists know just as little about as the rest of us. Ask a scientist what energy is—or time, or space, or fields, or free will—and watch him squirm. Although the word **science** comes from a root meaning "knowing," science isn't really about *having* knowledge; it's about *searching* for it. (Until the mid-1800s, it wasn't even called science; it was called **natural philosophy**—literally, "the pursuit of knowledge about how Everything works.") [†] And it's an endless search. The smartest people know that what they know is nothing compared to what they don't know.

Fortunately, you can understand some surprisingly heady concepts even if you don't think of yourself as having any scientific aptitude whatsoever. Science is all about curiosity, and that same curiosity that drives scientific research runs deep in all of us. Have you never wondered what makes logs float but rocks sink? Why no two snowflakes are alike? Whether bears can ever be taught the rudiments of beekeeping? In the pursuit of knowledge, curiosity is the most important factor.

As for *Explanations Even Penny Would Understand:* how often have you said, "Ah yes, it's all clear to me now," when it really wasn't? We've all occasionally faked our way through a discussion that had become too convoluted, confusing, or inadequate. It's a way of keeping the conversation moving along and hiding our ignorance, though it often has the opposite effect. (When Sheldon challenges Amy to defend an extraordinary leap of logic, and she responds simply, "Isn't it obvious?" and he counters after an awkward pause, "You're right. My apologies," [5] it's not entirely clear that they aren't both completely faking it.)

The admirably unabashed Penny is more apt to say something direct, like, "Okay, sweetie, I know you think you're explaining yourself, but you're really not." [6] She knows that the responsibility for making something understandable lies not with the listener but with the speaker. It's not a question of "dumbing things down," or using short words, or glossing things over. It's a question of giving your audience the tools they need to help them draw their own mental pictures.

This book is an attempt to give you just a few of those tools. Where it

fails, the fault lies not with Penny or with the reader, but with the author.

So come along, and let's delve into what's fun—and funny—about science, engineering, and *The Big Bang Theory.*

And who knows? Along the way, maybe we'll learn just a little about how Everything works . . .

. . . starting with this book itself, and the recurring sections scattered here and there throughout it:

- [science to come]
- `science @ the.real.caltech.edu`
- Ask an Icon
- Out to Lands Beyond
  and
- In What Universe?

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* And a **"RESTICTED" AREA**, no less.

† Okay, it's not an *exact* translation.

[science to come]

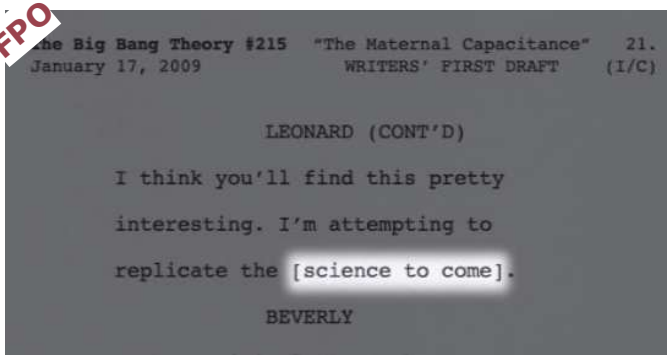
These three little words are there to draw attention to what some people would call nitpicks.

Not many television comedy writers are science experts. (Big surprise.) But so what? Sheldon's whiteboards could be covered with pure kindergarten scribble-scrabble, instead of "a little string theory doodling around the edges," and only a few highly tech-savvy bloggers would grumble. [7] If *The Big Bang Theory* were drowning in the same sort of buzzword technobabble that weighs down reruns of *CSI* and *Star Trek: Voyager,* not many viewers would care.

But it isn't. Laudably, creators Bill Prady and Chuck Lorre wanted their

show to be beyond scientific reproach. * So they brought in an expert to catch errors, filter out buzzwords, and provide authentic terminology. The startled-looking stranger Howard descends on in the cafeteria with the announcement: "This is my girlfriend, Bernadette" [8] is David Saltzberg, Ph.D., science consultant to *The Big Bang Theory.*

Saltzberg, a real-life professor of astrophysics at UCLA, is responsible for most of the show's science references, as well as at least one joke (the one about Galileo and the Pope). [9] In a sense, his work is what made this book possible. †



This is how a sitcom writer shrugs. It happens at least a couple of times per script.

Saltzberg clearly enjoys the challenge and especially likes adding highly technical jargon "that you think is Hollywood science but find out not only is it real, it's topical." [10] He's responsible for several mouthfuls of dialogue, including the show's *honorificabilitudinitatibus:* ** Sheldon's declaration that he once spent a year "examining perturbative amplitudes in n=4 supersymmetric theories, leading to a re-examination of the ultraviolet properties of multi-loop n=8 supergravity using modern twistor theory." [11] This techno-litany sounds almost as over-the-top as if he were reciting the digits of pi (or a list of videogame titles), [12] but it's entirely as legitimate as his hilarious ‡ "spoof of the Born-Oppenheimer approximation" in the pilot. ***

With the greatest of respect, this section points out some of those exceedingly rare moments when the science on the show doesn't quite ring true.

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* And for that, we thank them.

† And for that, we thank *him.*

** The longest word in Shakespeare.

‡ Trust us.

*** And outdone only by the title of IRS Form 5213: *Election To Postpone Determination as To Whether the Presumption Applies That an Activity Is Engaged in for Profit.*

science @ the.real.caltech.edu

I go for The intensity of Calculation

Leonard, Sheldon, Howard, and Raj may all be fictional (or at best composites), but their employer is very real, and the research going on there (in the real world) eclipses anything on Sheldon's whiteboards.

Caltech (one word, one capital) * is the California Institute of Technology. Together with the Jet Propulsion Laboratory, which it founded and operates, it's the largest employer in Pasadena.

Notwithstanding an undergraduate population of less than a thousand, and a graduate population not much larger, eighteen of the school's former students have gone on to win Nobel prizes, while almost as many additional Nobel laureates have been faculty members.

Since its founding in 1891 as Throop University (with a silent *h),* Caltech

has undergone a few name changes, but it is not now, nor has it ever been, Cal Tech, Cal-Tech, Cal Poly[tech], or the Southern California Institute of Technology. (Nor, fortunately, Throop Institute of Technology.) It's not a Milpitas auto body shop, a San Antonio software firm, or a calibration company in Quebec. † And though they're both based on it, it's not CalSci (that's *NUMB3RS)* and it's not Pacific Tech (that's *Real Genius).* It's generally called "the Institute," not "the University"—and it's *never* called "Caltech University" . . . is it, *Amy?* [13]

From watching *The Big Bang Theory,* you might suppose that the researchers at Caltech spend all their time playing pranks on one other, whining about their love lives, and grumbling at the administration. But that's not the whole picture. They're also solving some of the most intricate and complex problems mankind has ever confronted—just a few of which we'll look at in these pages.

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* Ignore the all-too-common two-words-two-caps misspelling, as seen in the season 4 DVD booklet. *Please.*

† And you probably didn't need to be told that it's not a construction company in East Timor.

Ask an Icon

As any fan of *The Big Bang Theory* will tell you, you don't have to be an expert in science, comedy, or visual entertainment to enjoy its unique blend of all three.

Then again, wouldn't it be interesting to know what some world-famous celebrities—folks who *are* recognized experts in science, comedy, and/or visual entertainment—think about the show?

Couldn't hurt to ask. So we did.

And several of them answered.

Out to Lands Beyond

Each year, Caltech awards bachelor's or advanced degrees to barely five hundred people. But not all of those five hundred will go on to become programmers, or professors, or physicists.

Believe it or not, many Caltech graduates choose to spend their lives doing something other than designing interplanetary spacecraft, discovering transuranic elements, disproving centuries-old theorems—or memorizing all the dialogue from all the *Star Wars* movies.

Included among the Institute's 30,000 alumni and alumnae are opera singers, Oscar winners, science-fiction authors, professional rock-and-rollers, farmers, venture capitalists, and CEOs. The last man to set foot on the Moon is an alumnus, as are a former Prime Minister of Iceland, an International Motorsports Hall of Famer, and one of the authors of *Shakespeare for Dummies.* *

Throughout the book, we'll occasionally take a glance at some of the stereotype-busting ways a Caltech degree can be put to good use.

This section's title harks back to Caltech's alma mater, written in 1919 by Manton M. Barnes '21 during his junior year. It begins in typically grandiose fashion:

In Southern California with grace and splendor bound
Where the lofty mountain peaks look out to lands beyond. . . .

Twentieth-century automation and automotion soon clouded the skies and rivers of greater Los Angeles until they rivaled those of Pittsburgh, and the words began to carry an unintended irony. By the time stricter environmental standards were adopted, alternate lyrics had already been circulating for some time, opening with:

In Southern California with smog and sewage bound
Where the lofty mountain peaks are seldom ever found. . . .

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* Shakespeare and Caltech are old pals. The third person to win the grand prize on the American edition of TV's *Who Wants to Be a Millionaire?,* Joe Trela '97, paused on a question from *Henry VI, Part 2,* to give a shout-out to his Shakespeare professor at Caltech, Dr. Jeniioy LaBelle. Queen Latifah later used Trela as her Phone-a-Friend on the celebrity version of the show.

In What Universe?

"I already, um, have your address," murmur Dr. Cooper super-groupies Ramona Nowitzki and Kathy O'Brien. Both claim to know where Sheldon lives. [14]

In fact, *everybody* knows where he lives. The street address of the apartment building where most of the action of the show takes place is announced in several episodes. It's located just to the northeast of downtown Los Angeles, at:

2311 North Los Robles Avenue
Pasadena
California
USA

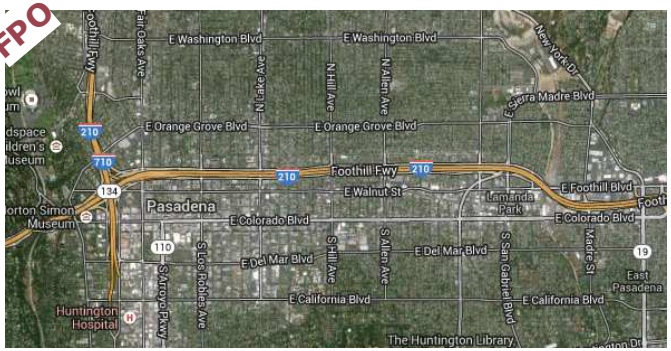
There's only one problem: That address doesn't appear on any map.

That's intentional. The show's creators deliberately avoided positioning the apartment at any recognizable place. You won't be able to loiter outside in hopes of offering Sheldon a lift to the model train store.

Sorry.

Nevertheless, a whole online subculture has grown up around pinpointing the building's location by (playfully) assimilating information gleaned from the show. A pointless exercise, admittedly, but an engaging one.

In this section, we'll take a stab at it ourselves every so often. It'll require a little sleuthing, a little logic, and every "clue" we can lay our hands on: not just the occasional tantalizing glimpse out the window or sidewalk dolly shot, but considerably more.



Kind of a big place to search for one building. (Nice day for aerial photography, though.)

But don't feel cheated if we don't take it all too seriously. After all, this is the same show that once featured [15] a hotel room in Geneva with a commanding view of the Matterhorn—nearly 80 miles away.

In what universe would *that* be possible?

ENDNOTES

[1] "The Luminous Fish Effect" (Season 1, Episode 4)—during the final 0:00:01 of screen time.

[2] "The Monopolar Expedition" (Season 2, Episode 23) and "The Fuzzy Boots Corollary" (Season 1, Episode 3).

[3] "The Jerusalem Duality" (Season 1, Episode 12), "The Transporter Malfunction" (Season 5, Episode 20), and "The Bus Pants Utilization" (Season 4, Episode 12)., respectively

[4] "The Convention Conundrum" (Season 7, Episode 14), at the very end.

[5] "The Zazzy Substitution" (Season 4, Episode 3).

[6] "The Hamburger Postulate" (Season 1, Episode 5).

[7] "Pilot" (Season 1, Episode 1).

[8] "The Gorilla Experiment" (Season 3, Episode 10).

[9] "The Cooper-Hofstadter Polarization" (Season 1, Episode 9).

[10] Heyman, K, *Talk nerdy to me,* **Science 320**, 740–741 (2008).

[11] "The Euclid Alternative" (Season 2, Episode 5).

[12] "The Bozeman Reaction" (Season 3, Episode 13).

[13] "The Tangible Affection Proof" (Season 6, Episode 16).

[14] "The Cooper-Nowitzki Theorem" (Season 2, Episode 6).

[15] "The Large Hadron Collision" (Season 3, Episode 15).