

# THE PROBLEM WITH INFLATION

The inflationary universe is a theory of the “bang” of the Big Bang.

Alan Guth (1997)

There is now a bewildering variety of different versions of inflation  
to choose from.

John Gribbin (2006)

Taken all together, the problems with the Big Bang plus inflation  
theory are not tiny negligible gaps between observation and theory;  
they are huge chasms you could drive a cosmological coach and  
horses through.

Brian Clegg (2009)

Inflation has a lot going for it, but it makes the need for a theory of  
initial conditions even more pressing.

Sean Carroll (2010)

He speaks. Or more often he is silent. He is unpredictable. What can I say? He’s already doing the detecting in a way Frank never will. It’s what I was urging all along, although he’s not exactly who I had in mind.

Now that he is here, I feel responsible. I second-guess myself. How could I suggest that he could solve the case? How could I forget that it’s impossible? I’ve set him up for failure and I can’t tell him to stop. This job’s the only reason he exists.

He seems to get the bit about the bang that’s missing. But there’s simple stuff he doesn’t seem to know. It’s like he lives in an apartment with no windows, just a peephole to a hallway in my head. He seems to know a bit about Inflation. But today his first words show he doesn’t quite know what it is.

“Is it how the universe began?”

Well, not exactly. Inflation is a freshly minted process of expansion. It comes before GR takes over with Big Bang expansion. And it comes a split-split second *after* everything begins. This sequence is not easy to explain.

The Inflation story opens in the ’70s. Separately Guth and Starobinski invent the inflationary model. Well, two models.

“This sounds familiar.”

Indeed, though how come it’s familiar to him? But, yes, Inflation isn’t really

a theory. Peebles calls it a scenario; it's a general idea. The idea is the very early universe must stretch itself in a big hurry. A faster-than-light hurry a gazikosecond after it begins. Inflation is a fancy way the cosmos could get rid of Monopoles and even out the lumps a random quantum process would have made. This fixes the horizon problem—how the universe's temperature becomes more uniform than it has time to make it so. And, it turns out too, Inflation math could generate a cosmos with exactly the right density.

Slowly the scenario attracts adherents who invent so many models they are classified in *kinds*. My list is long and growing:

- assisted inflation
- brane inflation
- chaotic inflation
- cold inflation
- eternal inflation
- extended inflation
- hot inflation
- hybrid inflation
- hypernatural inflation
- large-field inflation
- new inflation
- non-eternal inflation
- old inflation
- open inflation
- small-field inflation
- warm inflation
- warped-throat inflation

Inflationary models can predict a pattern in the Big Bang pictures. The predicted pattern shows up nicely. Inflation—whatever it may be—becomes the darling of cosmology. What's not clear is whether other concepts, less outrageously unlikely than Inflation, might lead to the same prediction. Will we ever know? Money follows success; physicists, like others, follow money. Cynical? Not so. Feldman says, 'Increasingly science is about money.'

As the list of kinds of models tells, physics has no clear idea what happened, how it happened, why it happened, or if any of it happened. Inflation's not the name of a solution. It's the name of yet another problem. It takes me days of reading to discern that it is fudge. It tweaks Big Bang theory to fit new facts.

Then there's Penrose—a voice in the wilderness—telling anyone who'll listen that Inflation has an even bigger problem. Carroll says:

Penrose has been consistently skeptical, primarily on the basis of inflation's failure to explain the low entropy of the early universe. I remember reading one of his papers as a student, and appreciating that Penrose was saying something important but feeling that he had missed the point. It took two decades of thinking about entropy before I became convinced that he has mostly been right all along.

Entropy's disorder. It's an odd idea and fundamental physics; and it too is on my Problem list. With Inflation, Penrose says, the infant cosmos cannot be so tidy. Disorder of the universe cannot decrease, not ever, even for Inflation. Indeed, an *increase* in disorder is the way Inflation is supposed to smooth things out. Even I can understand. It's that teenager's room. There was no mom to tidy up, no closet where the mess could hide.

So Inflation is the cover story for a messy problem. It's high fashion in the physics world these days. But it isn't clear what 'it' is and the latest word is that it doesn't work.

This, I think, is what the Problem with Inflation tells him: What comes *after* the Beginning, no matter how soon after, doesn't help him. The only way to get to the Beginning is to go there. Then begin.