“Nurturing and Sustaining Nobel Science”

Food for thought: that is, some thoughts and personal impressions to stimulate discussion over lunch.

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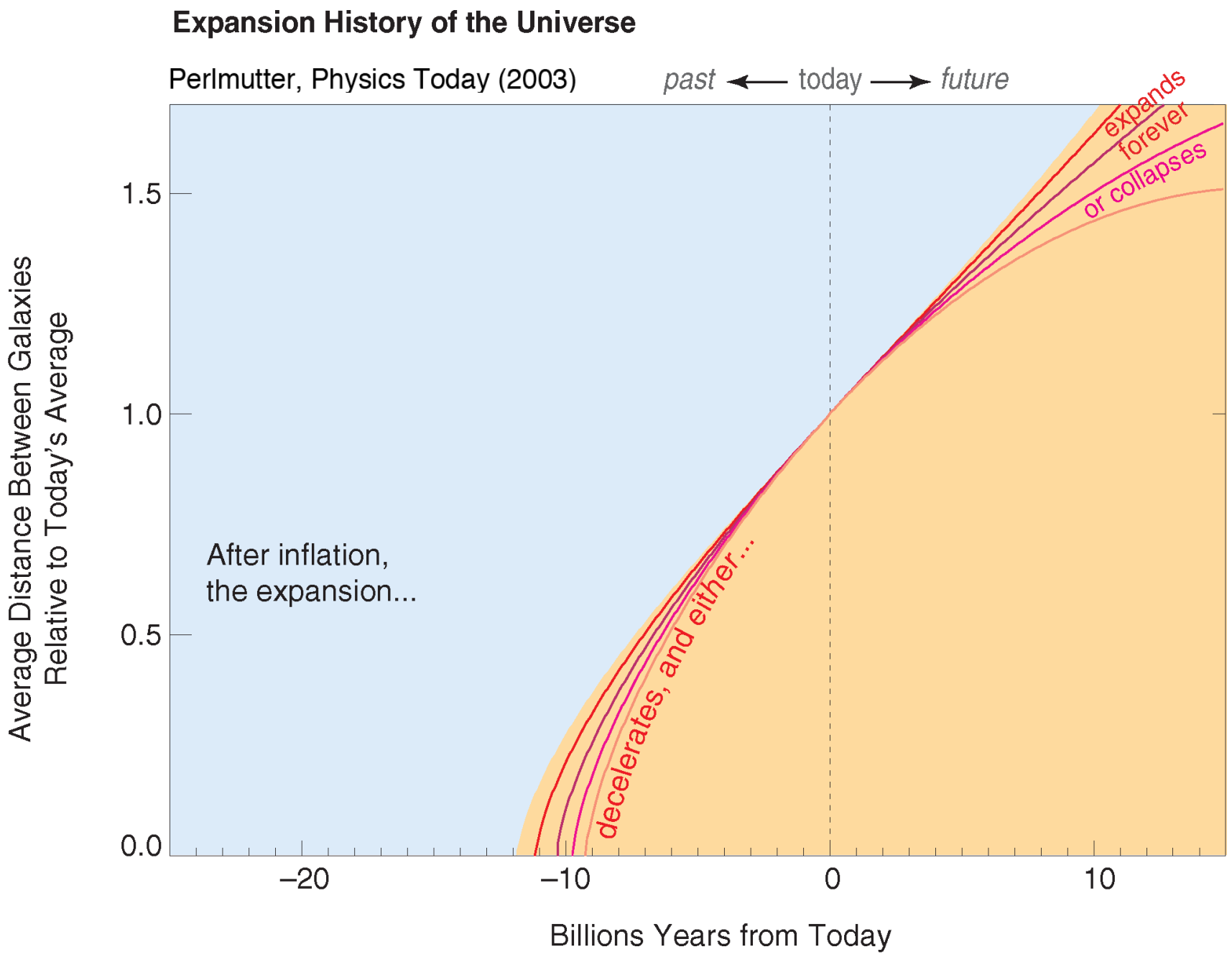
University of California, Berkeley
Lawrence Berkeley National Laboratory

In my Nobel Lecture, I walked through the challenges / problems that we faced when we set out to measure the deceleration parameter using supernovae.

I won't repeat this here, but I will just summarize a few of the main points / steps.


Expansion History of the Universe
Perlmutter, Physics Today (2003)
past
today
future
expands
forever
or collapses
decelerates, and either...
After inflation,
the expansion...
Average Distance Between Galaxies
Relative to Today's Average
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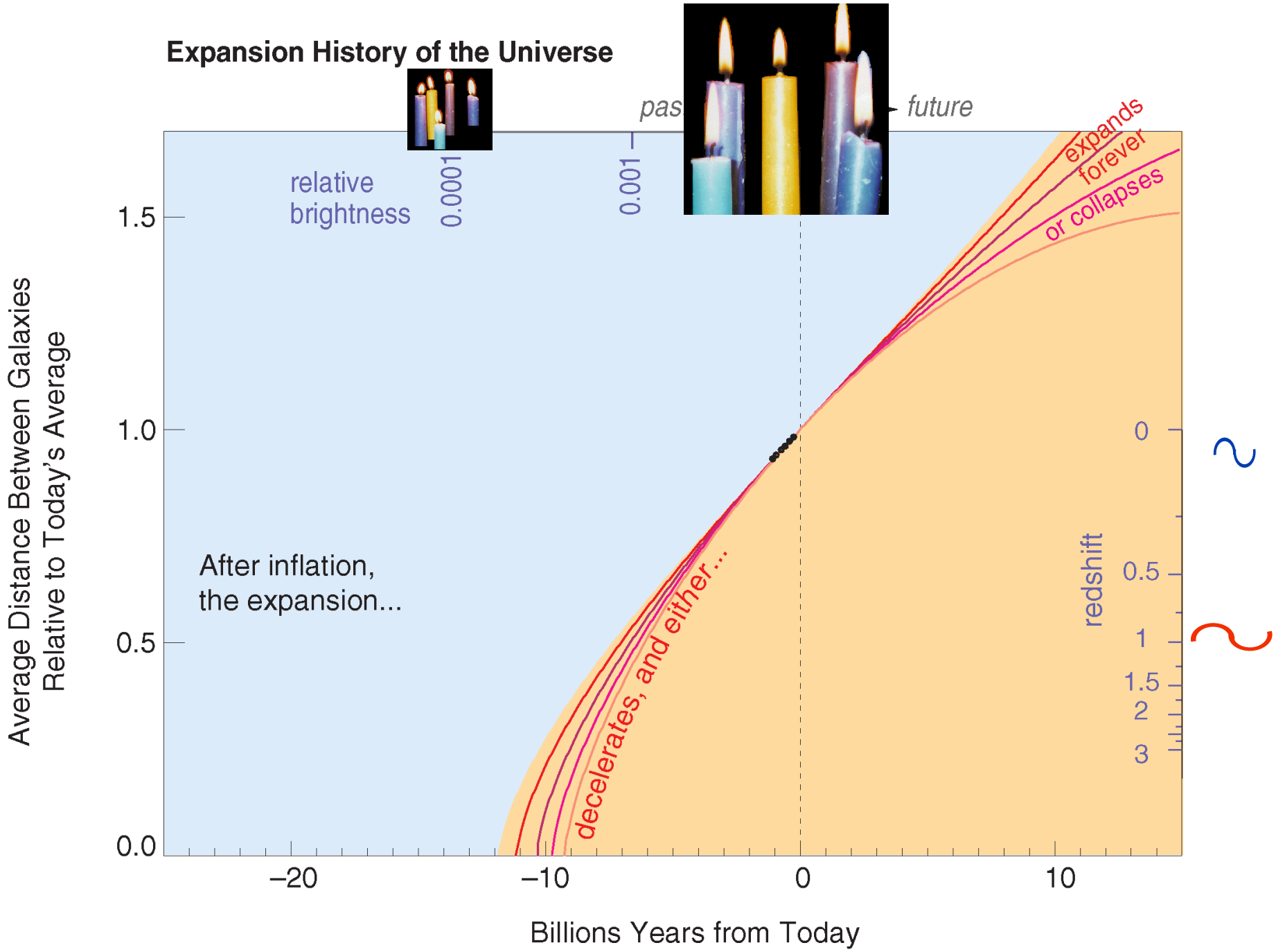
Billions Years from Today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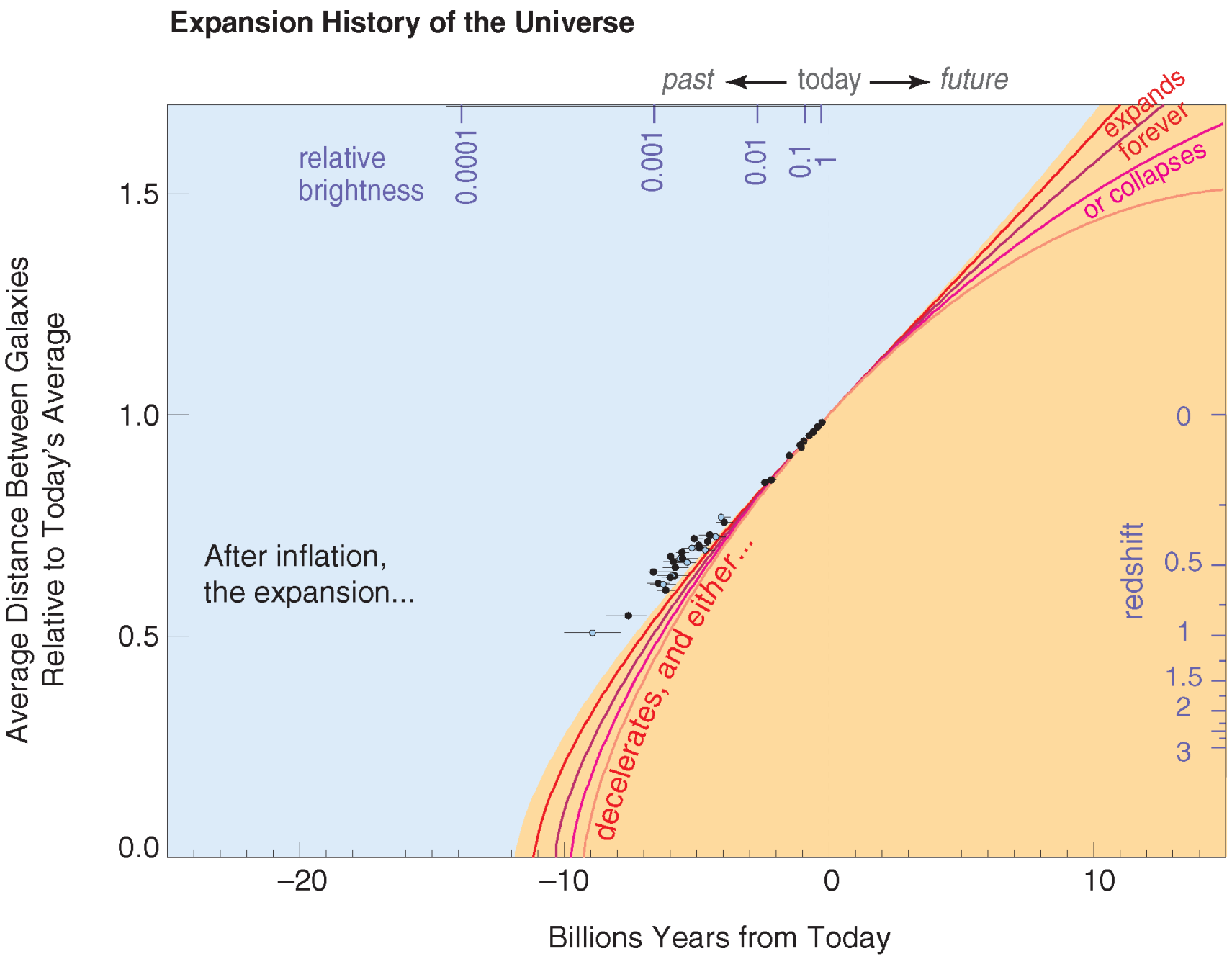
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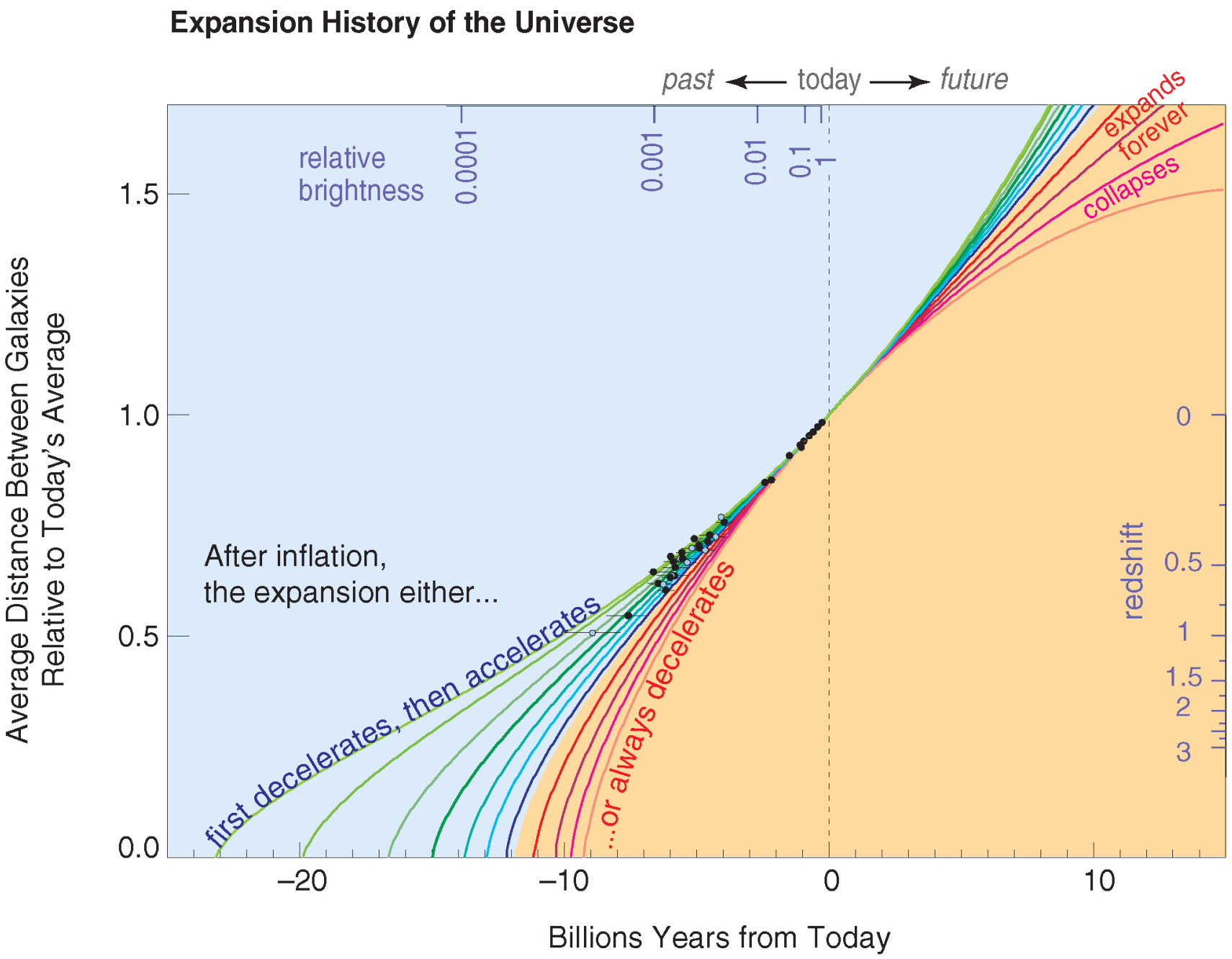
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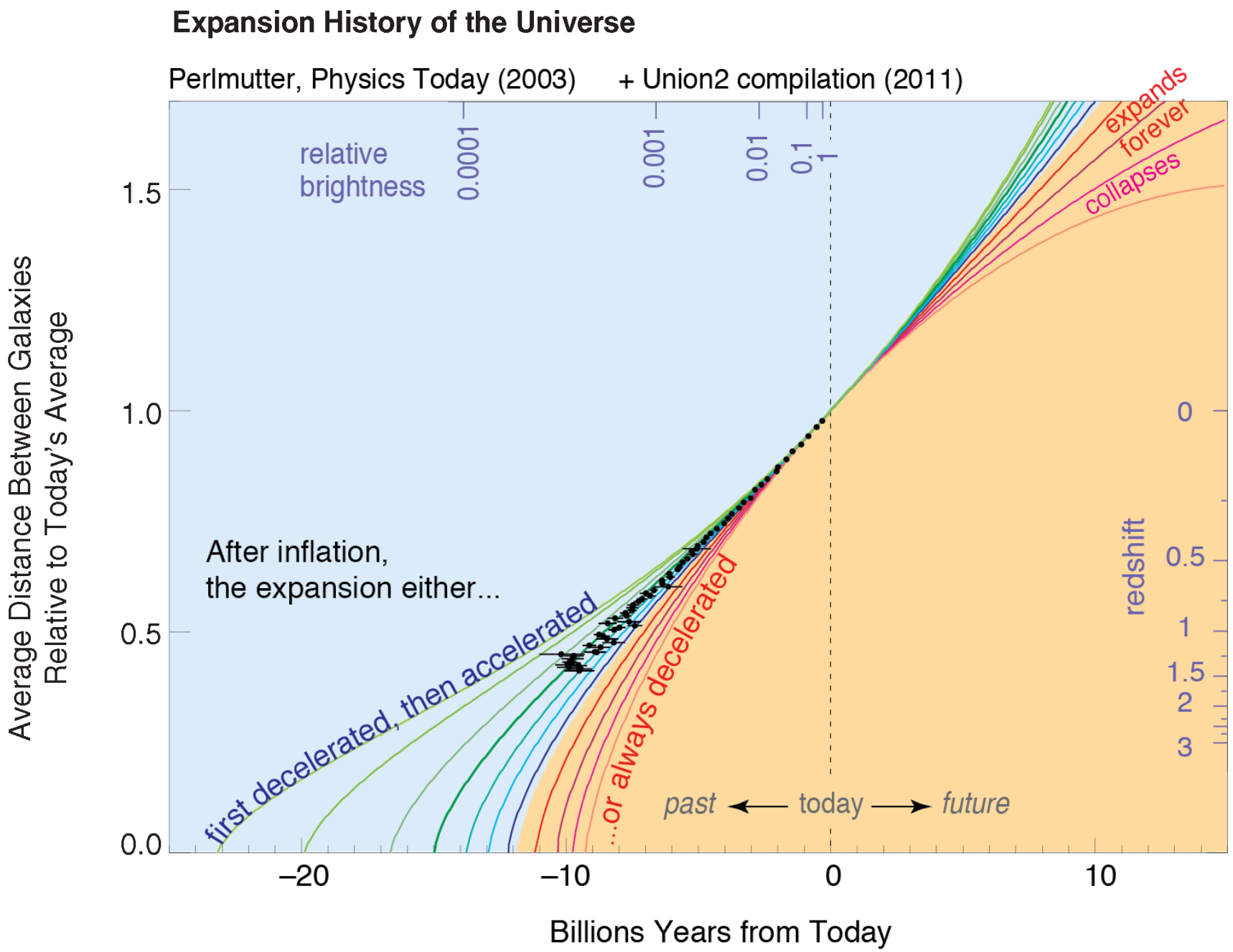
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First steps:

- Design, then build, novel wide-field imager, with first-generation 1K x 1K CCD chip.
- Get network resources to bring data to the computers at home.
- Novel image analysis software (challenging data set at the time), to get near-real-time results.

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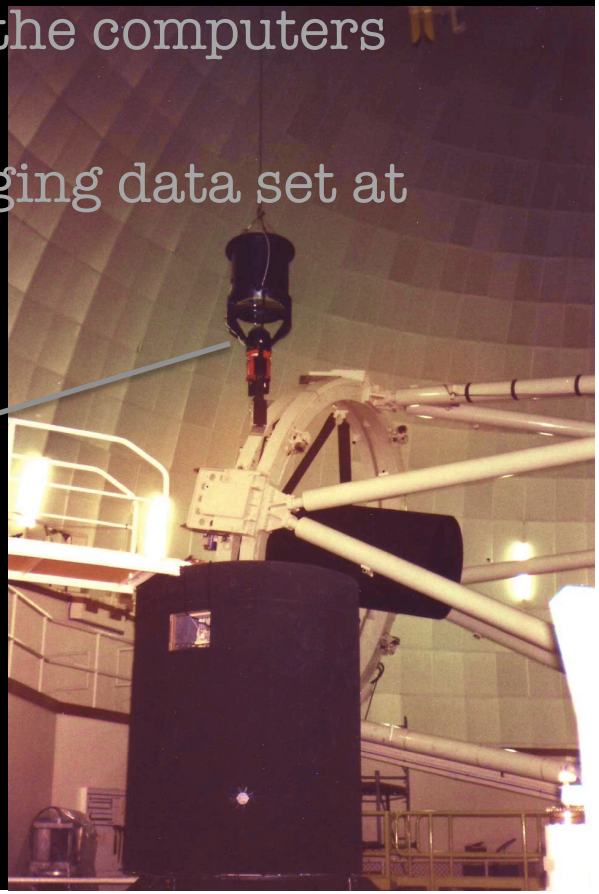

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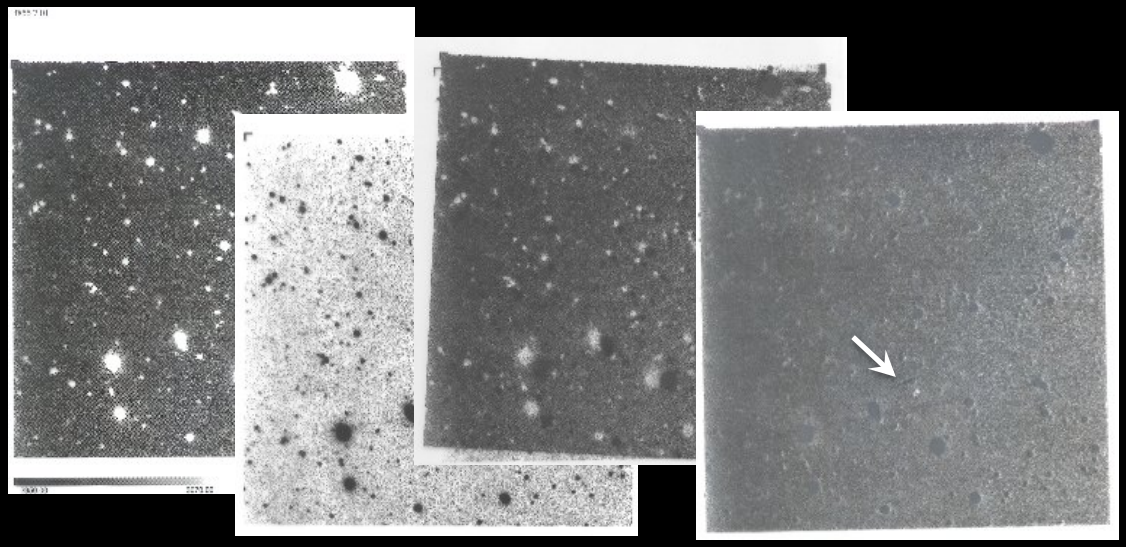

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Result: several years of work, nice camera,
nice software, but no confirmed SNe.

Next steps:

On strength of first results, now get telescope time at better sites (with proposals, and with trades for a new wide-field camera).

Develop new observing timing strategies to guarantee all SNe are discovered while brightening, in batches.

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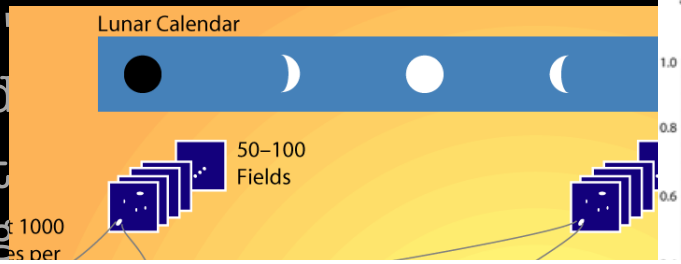
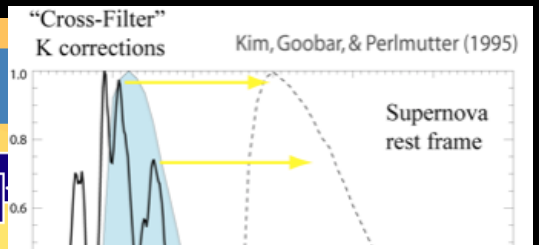
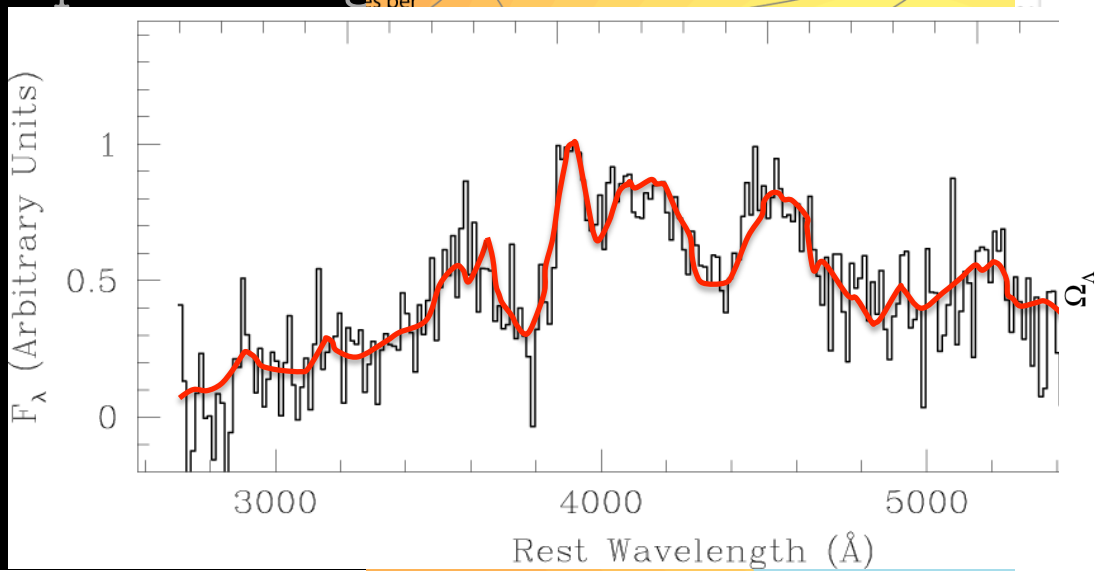
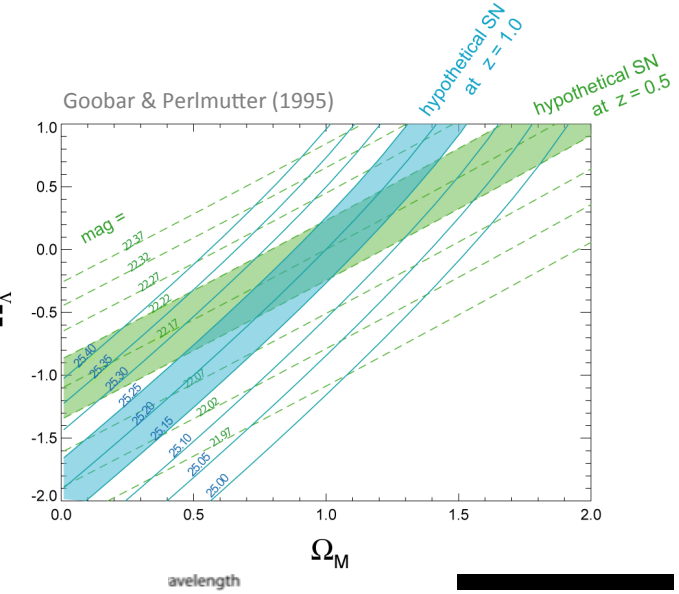








Next steps:

- On strength of first results, now get telescope time at better sites (with proposals, and with trades for a new wide-field camera).
- Develop new observing timing strategies to guarantee all SNe are discovered while brightening, in batches.
- Develop new "cross-filter K-correction" approach, and approach to dust and reddened SNe.
- Develop solution to problem of identifying Type Ia spectra at high redshift.
- Develop method to separate Ω_M from Ω_Λ.

Result: several more years of work, first SN discovery and first discovery of batch of SNe, first points on Hubble diagram, but no statistically significant deceleration parameter measurement.

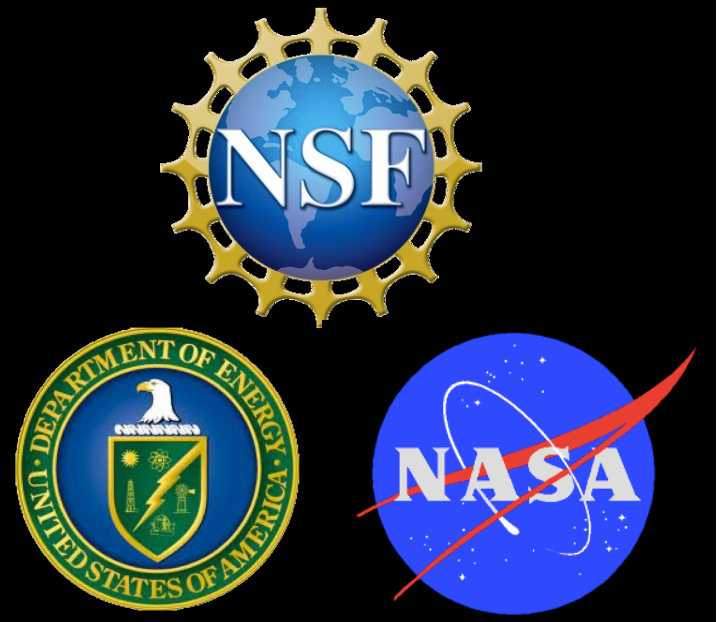
What was particularly helpful for this work?

1. Breathing room.

2. Expertise all in one place, including: theory, optics, mechanical, computing, electronics, data analysis

Tripod of Natural Sciences Funding

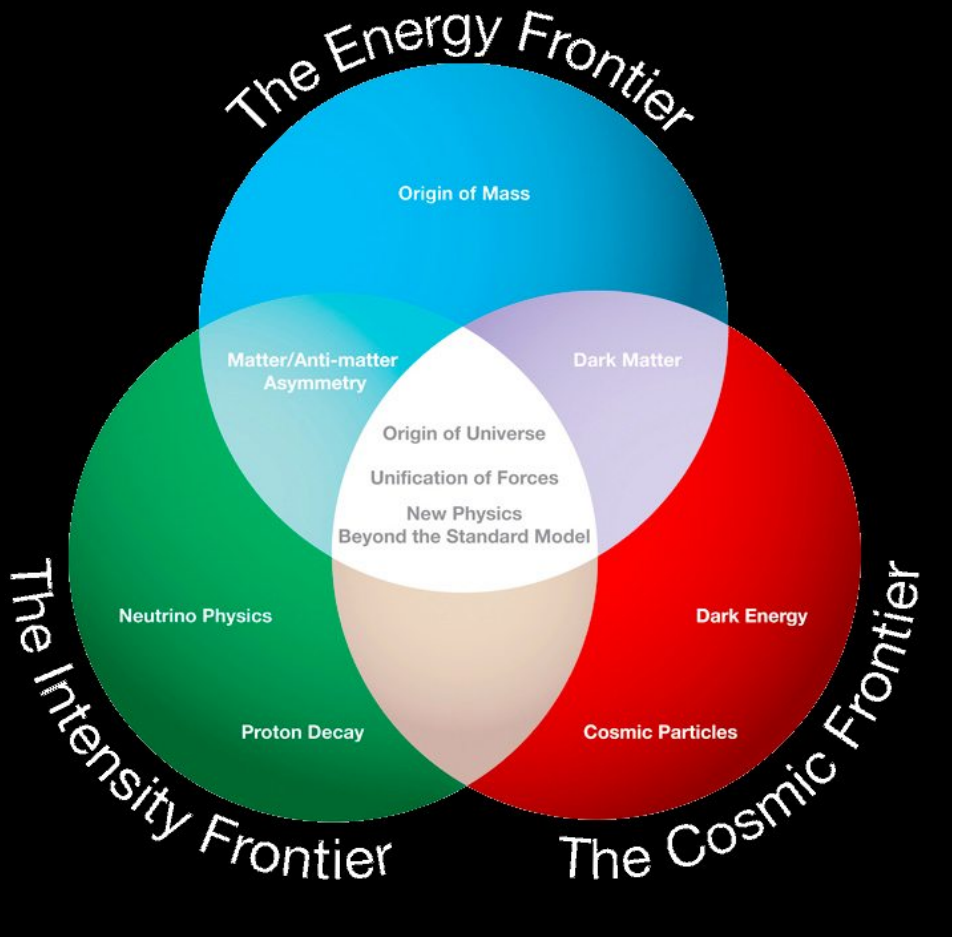
NSF, DOE, NASA



What does D.O.E. offer to the U.S. science portfolio?

A different science focus: Fundamental particle physics asks somewhat different questions of astrophysics.

The mission of the High Energy Physics program is to understand how our universe works at its most fundamental level. We do this by discovering the most elementary constituents of matter and energy, exploring the basic nature of space and time itself, and probing the interactions between them….



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A particular approach to "large science" projects. The scientists are deeply embedded in all aspects of the project, down to the "choice of screws." The projects are led by scientists.

What does D.O.E. offer to the U.S. science portfolio?

A different route (and congressional subcommittee budget) for funding science.

My sense is that this is not currently a zero-sum game:
More science funding in one domain is probably positively correlated with more science funding in another domain.

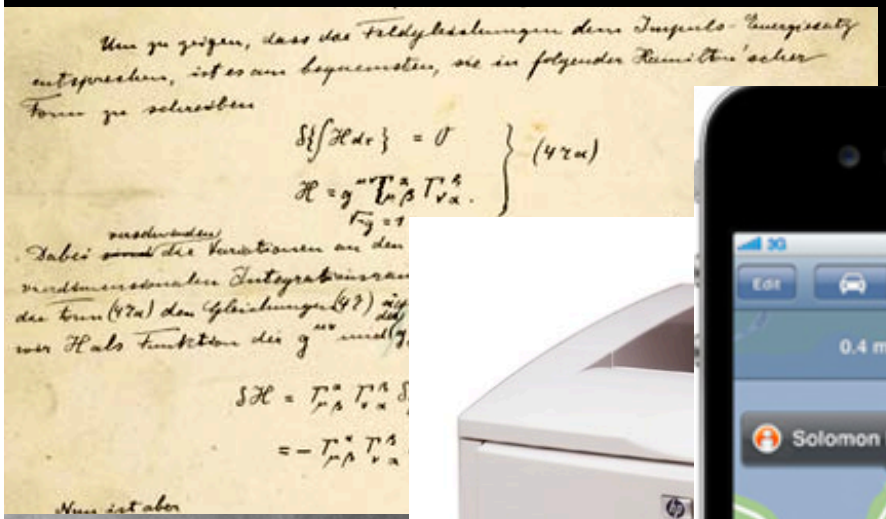
This is (I believe) still good for society

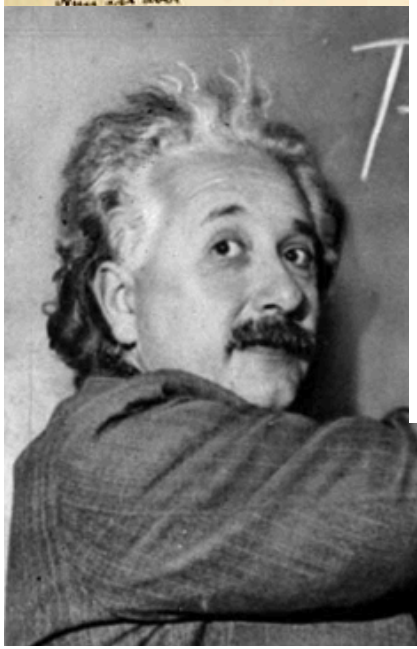
A recent study from Dept. of Commerce argues that the return on investment in basic science is 2 to 4 times more for society as a whole (for the economy) than for a private company.

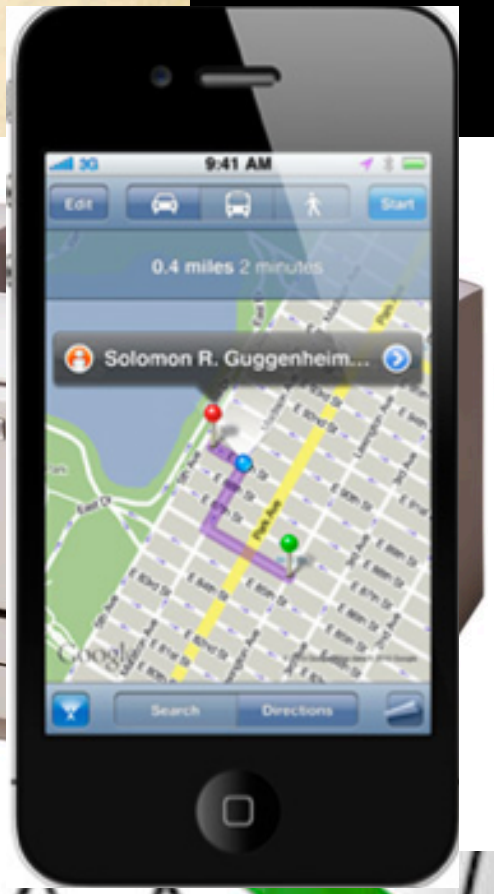
searcher	Private	Social
	25	56
31)	7–25	50
984)	29–43	64–147
1991)	15–28	20–110

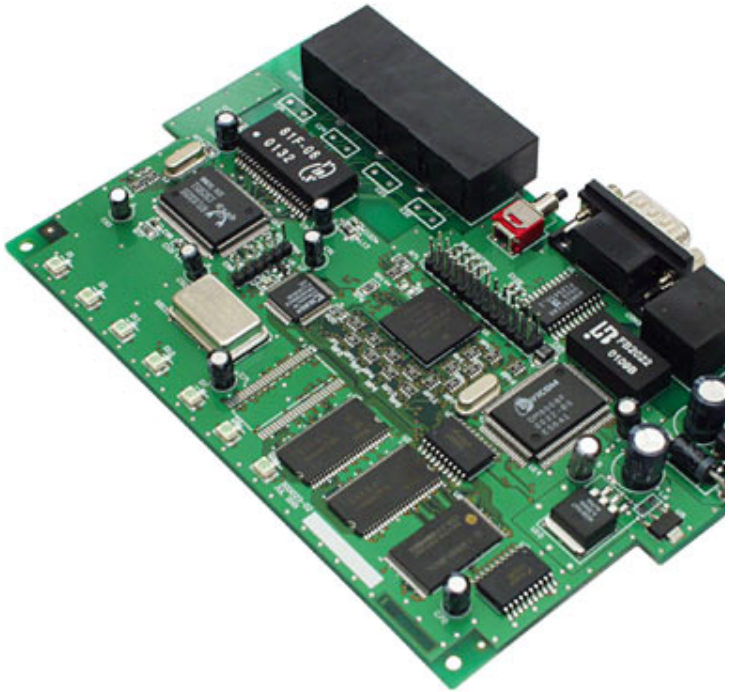
Strategic and International Studies. Global Innovation/National Competitiveness. S, 1996.

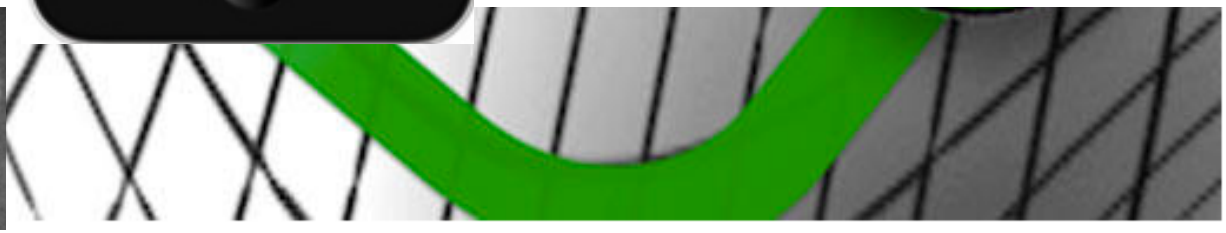
The “magic” of fundamental science.











To leapfrog forward requires

Support for basic science.

Funding that takes risks and nurtures ambitious/difficult projects.

The alternative is a world that is just an extrapolation from what we now know.

AAAC...