

DESPEC in the landscape of large spectrographic surveys

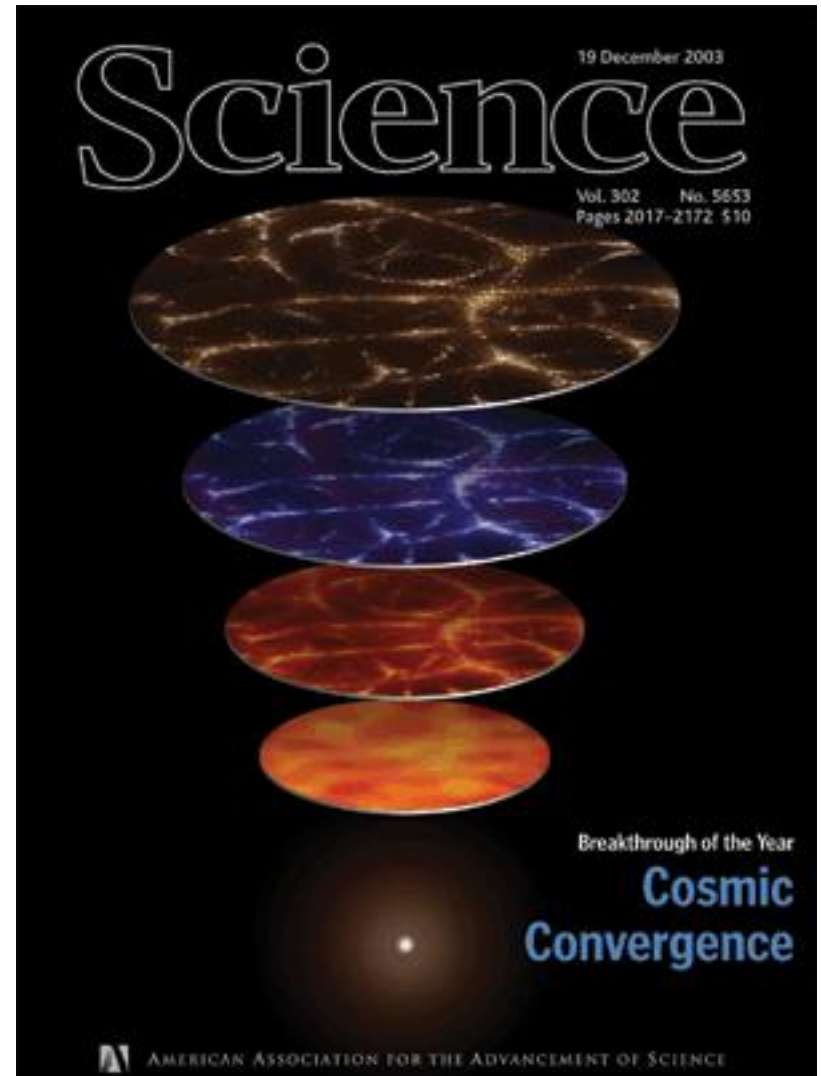
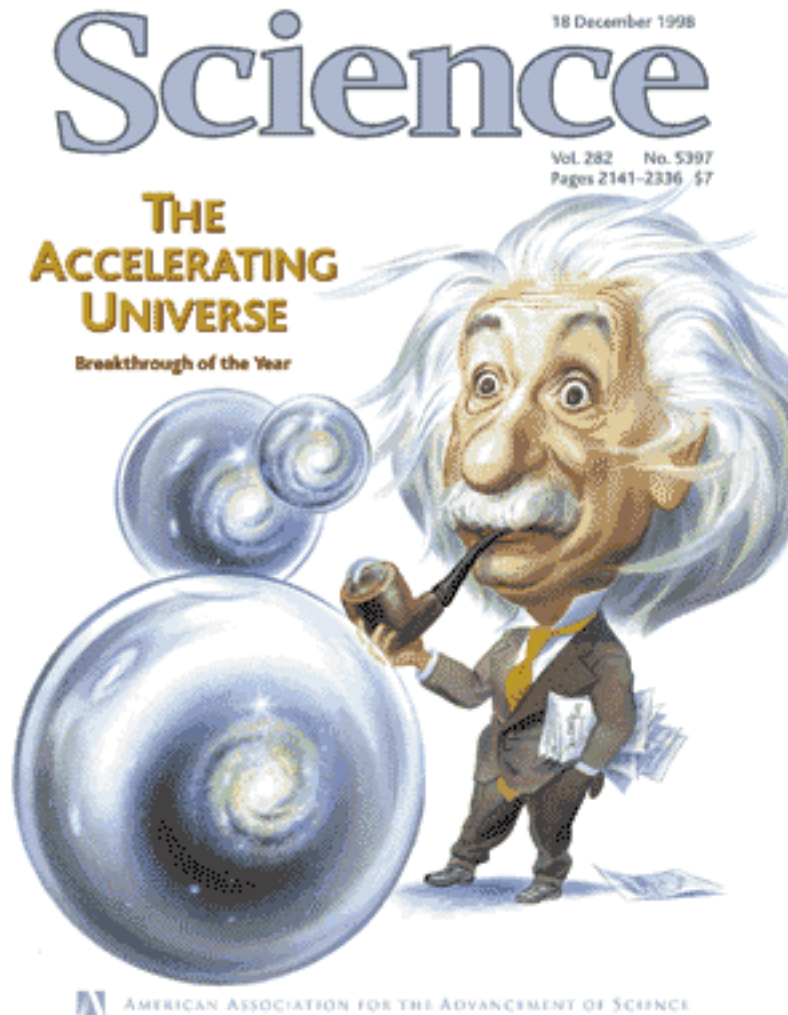
Craig Hogan

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History

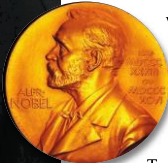
- Projects: CfA, Las Campanas, 2dF, SDSS, BOSS
- “Discoveries”: “Stick man”, “Great Wall”, “Great Attractor”, “Large Scale Flows”
- Cosmic Web in 3D/HD
- Precision Cosmology (BAO, ISW, etc)
- Cosmic Acceleration: multiple modalities
- SDSS: highest impact observatory

Science Breakthroughs of the Year: 1998 and 2003





Trifecta. Saul Perlmutter (left), Brian Schmidt (center), and Adam Riess shared the 2011 Nobel Prize in physics.



would win a Nobel Prize had come to be matched by a growing certainty about who the individual winners might be. The Shaw Prize, awarded in 2006, had already singled them out: Brian Schmidt and Adam Riess from the High-*z* Supernova Search Team—which Garnavich was a part of—and Saul Perlmutter, leader of the competing Supernova Cosmology Project (SCP). Yet, when his wife named the winners, all he could say was, “Shit.” The disappointment of being left out was far more intense than Garnavich had imagined.

“I had thought this was really going to happen a long time from now, and I didn’t have to deal with it, but now I did have to deal with it,” says Garnavich, a genial 53-year-old with a perpetual smile. At the same time, he felt relieved that the Nobel committee had not given the prize to Perlmutter alone. “The jockeying for which team was first in making the discovery had gone on for a long time, and there was a worry that maybe the Nobel committee wouldn’t have seen that.”

Garnavich wasn’t alone in feeling a mix of pride and pain. “I was disappointed,” he would recall, “but I was also proud.” Garnavich, a balding astronomer at the University of Texas at Austin, had been at the College Station, where he had worked in 1994 along with others, and he had taken a deep breath when he heard the news.

Public Radio that morning. “I was disappointed,” he would recall, “but I was also proud.” Garnavich, a balding astronomer at the University of Texas at Austin, had been at the College Station, where he had worked in 1994 along with others, and he had taken a deep breath when he heard the news. Explaining the rules of the Nobel, which allow for more than three individuals, did not care about any of that stuff, she wanted to say. Later, when colleagues e-mailed with condolence, Kirshner responded that he’s known to direct at others and him that you don’t win a Nobel Prize,” he wrote.

The winners knew what the others were thinking. Riess dug out from an avalanche of e-mails to e-mail his gratitude to the High-*z* team. Riess, a professor at Johns Hopkins University, wrote:

“We accept this prize on behalf of the team. We are lucky to be part of this adventure.” Schmidt, an Italian National University professor, wrote with a message of gratitude. The prize has been awarded to all of us, and we all know it is in our work.” Perlmutter, a physicist at Lawrence Berkeley National Laboratory (LBNL) in California and a professor at the University of California, Berkeley, conveyed similar sentiments. SCP. Later that day, a comment in the *New York Times* by Martin Rees acted as a salve for those who felt the prize had been fairer, and would send a less

Online

sciencemag.org

Podcast interview with author Yudhijit Bhattacharjee.

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Perlmutter, Riess, Schmidt: 2011 Nobel Prize in Physics, for discovery of Cosmic Acceleration

sciencemag.org on April 5, 2012

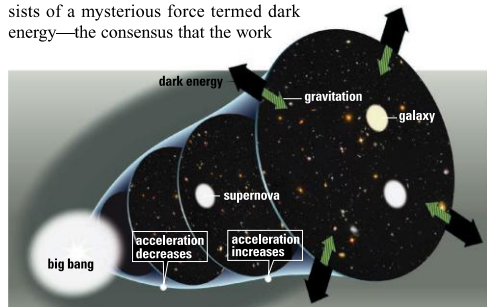
*High-*z* team in Stockholm, Dec 2011*

A Week in Stockholm

For the rival teams whose discovery of dark energy had transformed scientists’ picture of the universe, the 2011 Nobel festivities were a flurry of jubilation, disappointment, and one-upmanship

EARLY MORNING ON 4 OCTOBER 2011, THE DAY THE PHYSICS Nobel was announced, astrophysicist Peter Garnavich was woken up by a phone call that came not from Stockholm but from his wife, Lara Arielle Phillips. Garnavich was asleep in a Chicago hotel room, preparing for a long day of travel. Arielle was calling from the couple’s home in Indiana, where both are professors at the University of Notre Dame. “Is everything all right?” Garnavich asked groggily. “Yes, everything’s fine,” Arielle said, mildly apologetic. “The Nobel in physics has been awarded for the accelerating universe. It’s going to Brian, Adam, and Saul.”

Garnavich had known all along that this day would come. In the 13 years since two rival teams discovered the accelerating expansion of the universe—suggesting that three-quarters of the cosmos consists of a mysterious force termed dark energy—the consensus that the work



Bigger still. The universe is not only expanding but speeding up.



*Blanco Telescope at CTIO: critical instrument for
discovery of cosmic acceleration*



Future

- DES and LSST now almost assured
- Broad agreement that it is time to organize a massive spectroscopic survey
 - Deeper than SDSS: back to $z > 1$
 - Volume for statistics, depth for expansion history
- Serious projects underway (BigBOSS, PFS)
- Little serious competition for DESpec in the southern hemisphere

“Dark Energy”

- Need for precision drives survey design
- Some needs are clear (e.g. BAO)
- Others are more subtle
- Some are not yet dreamt of
- Argues for SDSS-style comprehensive approach
- Spectra synergize with photometry
 - Sample selection is important

Figure of merit: survey speed

- For imaging, collecting area times solid angle
- For spectroscopy, collecting area times number of fibers (if target density is high enough for field size).... times telescope time
- DESpec sweet spot for cosmic web: two 30 minute exposures \rightarrow 8000 spectra \rightarrow critically samples cosmic web to $z \sim 1.5$ over 3.8sq deg
- Reasonable goal: *a comprehensive map of large-scale cosmic structure on our past light cone, since galaxies formed, within a decade*

Strong points of DESpec

- High performance, low cost, low risk
 - CTIO Site, DECam components, other heritage
- Synergy in southern hemisphere
 - DES, LSST: quality targets
 - 3D southern 3D map near start of LSST survey
 - Gemini, ESO/VLT, LCO, etc: followup
 - SPT, ACT, SKA: CMB lensing/correlation, 21cm
- Strong team

Weak point of DESpec

- Access to the telescope is not yet arranged

This is the main obstacle to progress

- Reason for optimism: almost everyone *should* want this to happen
 - Strengthens what everyone is doing (like SDSS)

Agencies

- DOE Office of High Energy Physics
 - Dark Energy central to science program
 - DES, later LSST are flagship surveys
 - This year: Strategic DE panel (“Rocky III”) will consider other projects, eg massive spectroscopic surveys
 - BigBOSS and DESpec could both happen
 - DOE-funded Telescope operations are contemplated
- NSF Division of Astronomical Sciences
 - Portfolio Review underway, reports this summer
 - Future of facilities uncertain
 - CTIO will be sustained through DES main survey
 - LSST construction to be approved this year by NSB, Congress for start in late 2014 (survey starts >2020)

Other Agencies

- NASA
 - Whatever
- ESA
 - Euclid
- ESO
 - 4MOST
- AAO
 - DESpec part of overall strategy?
- NAOJ, IPMU et al.
 - PFS, SUMIRE@Subaru: complementarity (smaller field, bigger aperture, northern hemisphere)

Positioning

- DOE builds experiments to study Dark Energy
- NOAO serves astronomical community with broader science interests
- Blanco telescope will be used to enhance LSST
- Flexible telescope use is important
- Public data and public instrument access both strong selling points

Next Steps

- Science case(s)
- Survey design, operations model
- Instrument design
- Build partnership, community
 - Example of LSST: institutional subscriptions instead of institutional capital investments
- These are iterative and parallel processes
- Today's meeting is an important step for all of them!