

Nathalie Palanque-Delabrouille

Physics Division Director Berkeley Lab

Quarknet, June 2022

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Brief curriculum

Engineering school in Paris, France (in telecommunications)

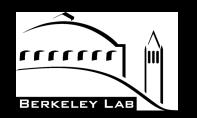
PhD in physics jointly between University of Chicago, USA University Paris, France

Researcher in cosmology for over 25 years at CEA (Agency for atomic energy and alternative energies, France)





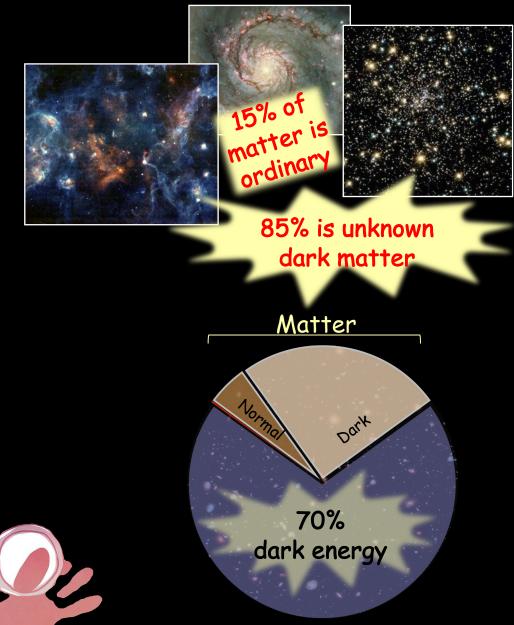
Physics Division Director at Lawrence Berkeley National Laboratory



Why research ?

- I love puzzles; the cosmos is a mystery What is it made of? How does it evolve?
- Leading investigations and solving mysteries is exciting Finding clues, testing hypotheses

This is exactly what research is !





Research in cosmology

Using the Canada-France-Hawaii telescope in Hawaii (4200m elevation)

Studying stellar explosions (supernovae) to investigate dark energy



- their distance
- age of the Universe at explosion

 \rightarrow allow us to measure expansion rate of the Universe at different epochs (dictated by dark energy)





Research in cosmology

Using the Sloan Digital Sky Survey telescope (SDSS) in New Mexico (2800m elevation)

To probe the distribution of galaxies (\rightarrow expansion rate of the universe \rightarrow dark energy)



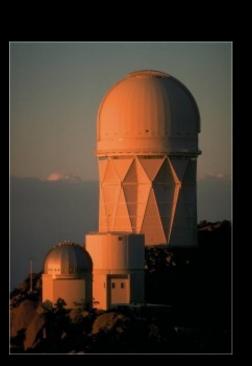


Research in cosmology

And now the Dark Energy Spectroscopic Instrument (DESI) in Arizona (2200m elevation)

To probe the distribution of galaxies (\rightarrow expansion rate of the universe \rightarrow dark energy)

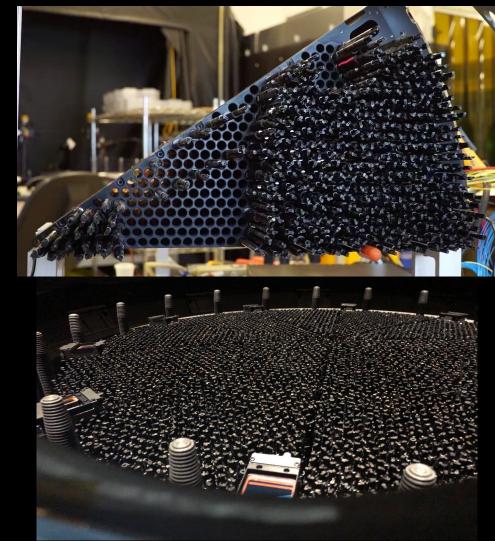
Led by Berkeley Lab

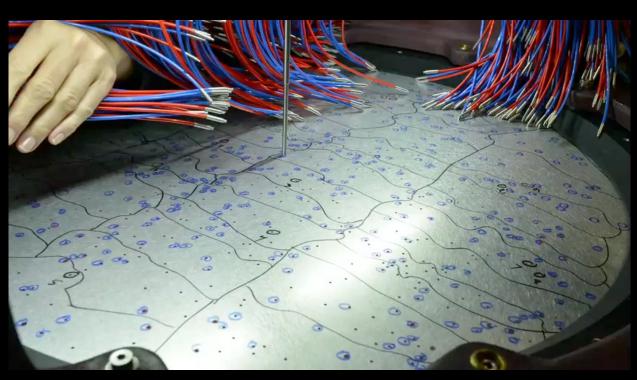




New technologies

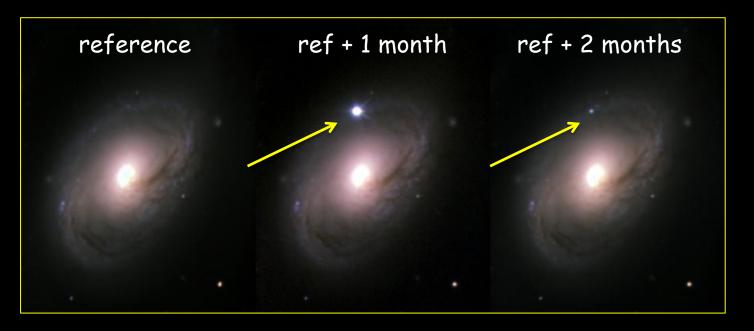
2020 (DESI): Robotic positioners positioned to micron-precision in 1 minute



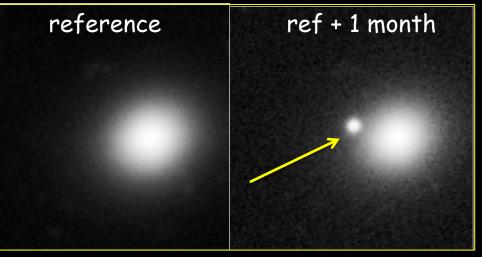


2010 (SDSS): Several hours of daytime work To prepare for Night observations

New analysis methods

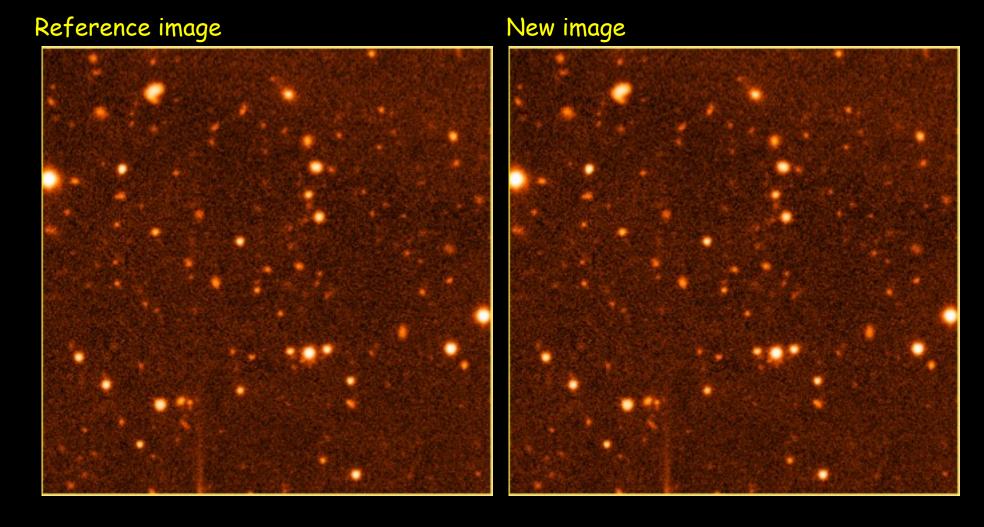


Where are the supernovae?



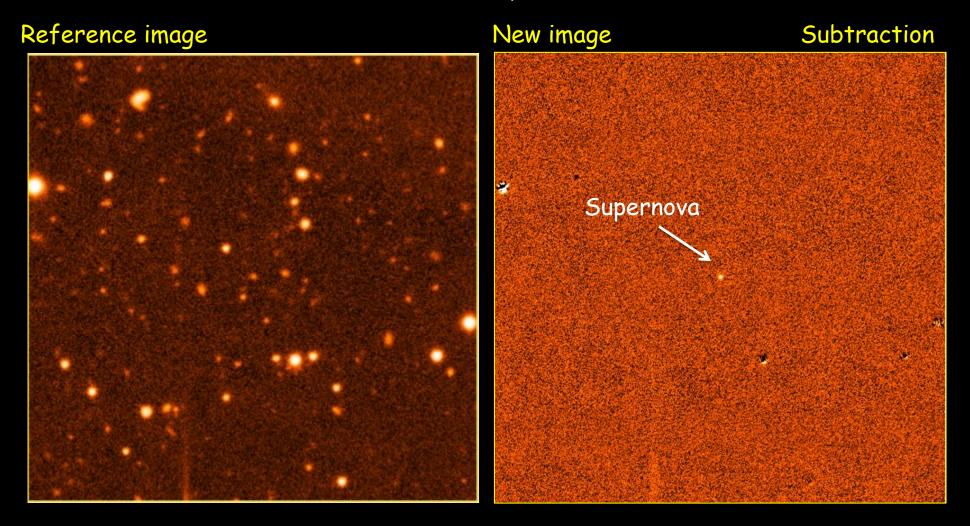
New analysis methods

Where are the supernovae?



New analysis methods

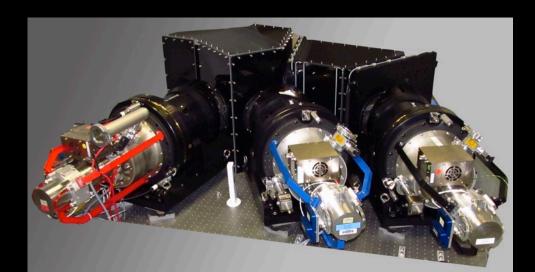
Where are the supernovae?

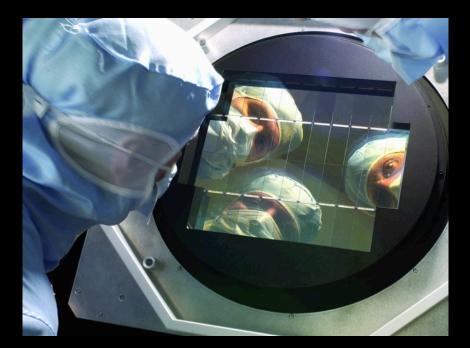


Cutting-edge detectors

CCD cameras

- In the public: millions of pixels 0.5 inch on a side
- In research: billions of pixels 1 ccd up to 2.5 inches on a side mosaics ~16 inches on a side







High performance computing to model the the Universe

Reproducing the evolution of the Universe over 13.7 billion years requires millions of hours (100 years!) on a single-core computer!

Run on over 2000-8000 processors simultaneously (supercomputers) \rightarrow ~ 2 weeks



Use of High Performance Computing

To compare observations of the Universe to models

The Universe contains 100 to 200 billion galaxies





Science is a place for men and women as well

Research is exciting

Research is both a scientific and a human adventure

There is room for you

