CCAPP: The Next 20 Years

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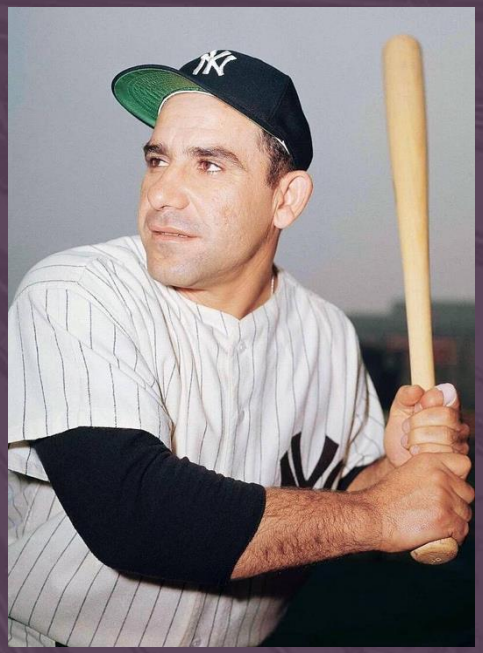
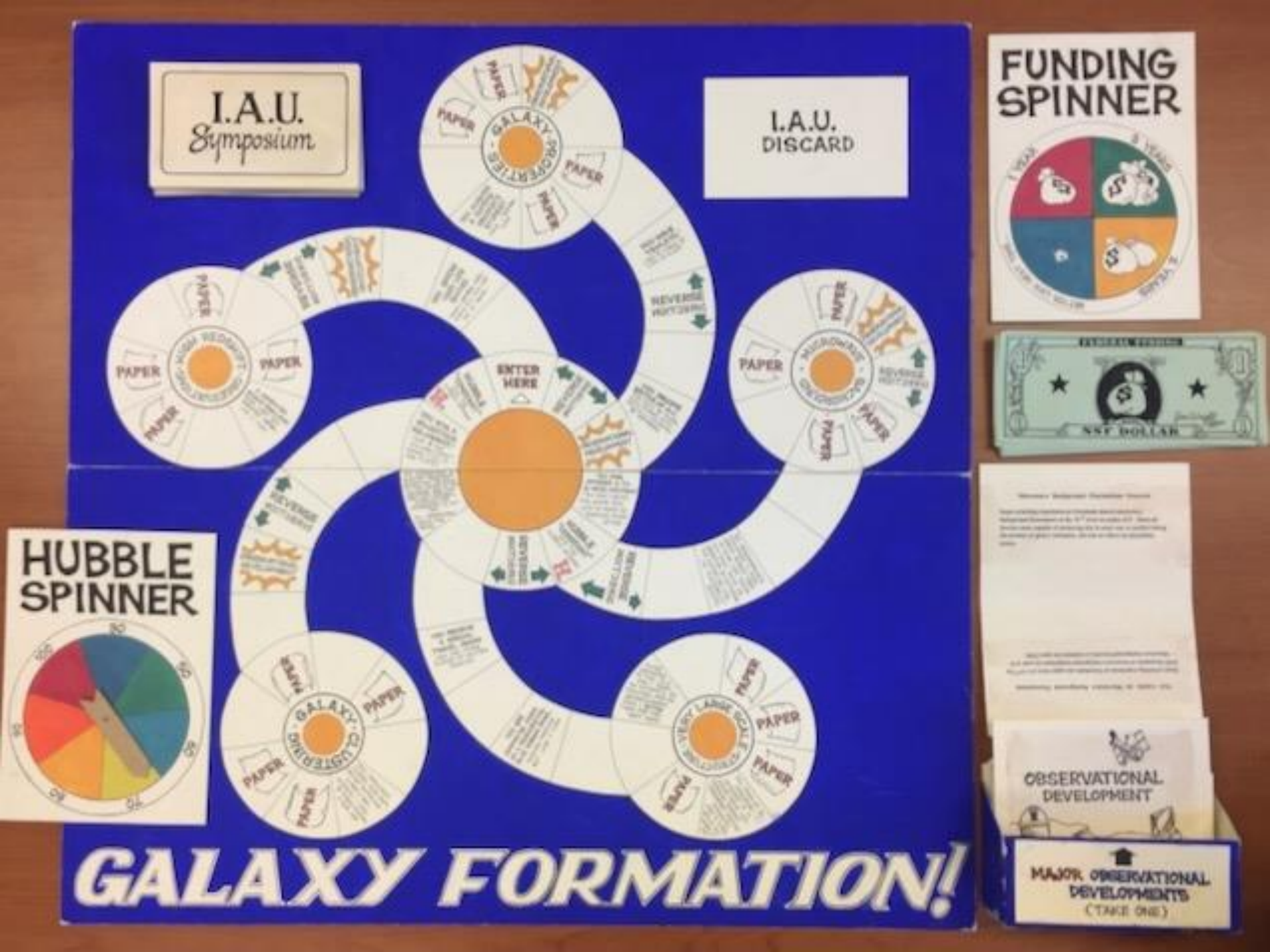
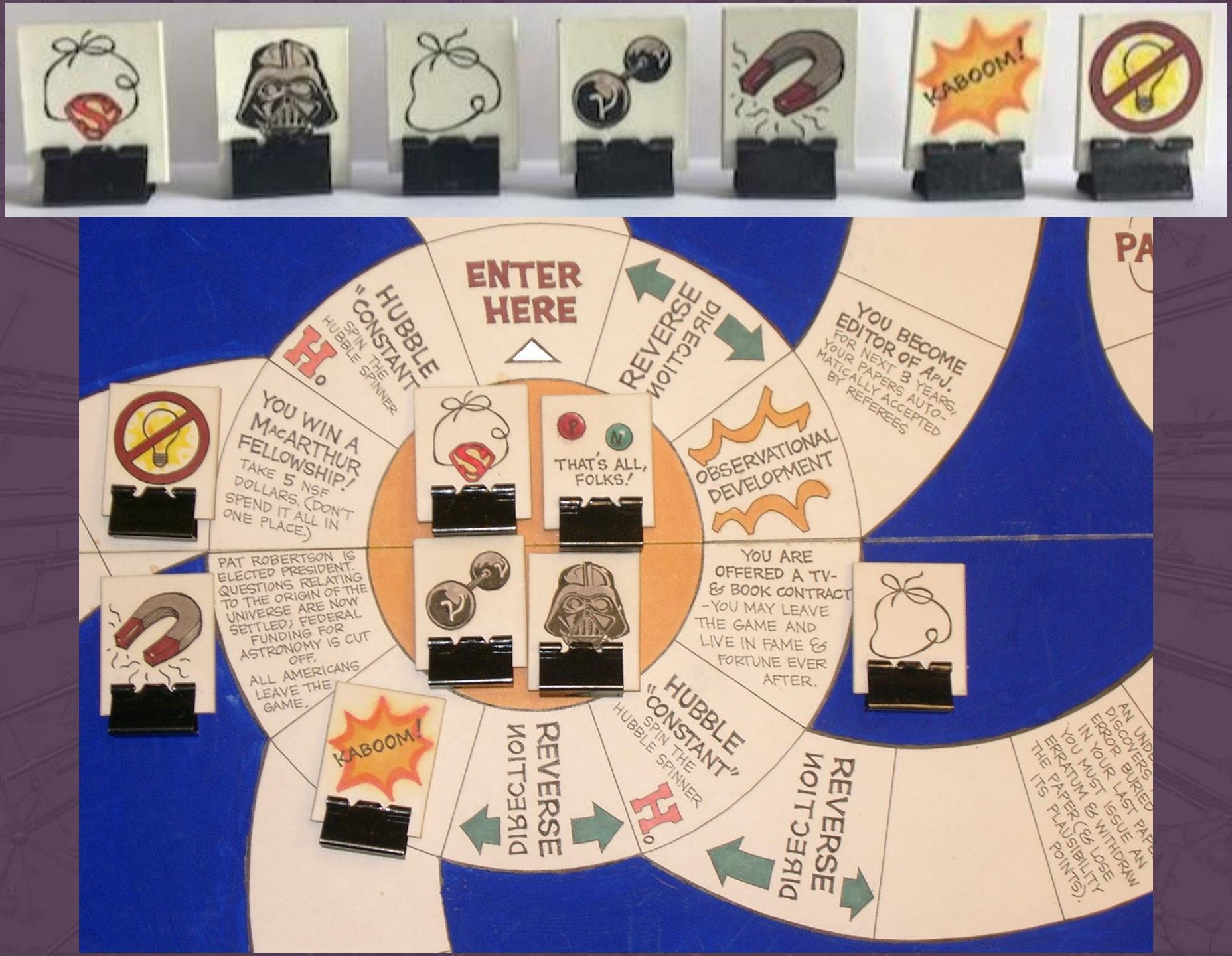
Prediction is hard,
especially about the future.

Yogi Berra




I.A.U.
Symposium
I.A.U.
DISCARD
FUNDING
SPINNER
HUBBLE
SPINNER
GALAXY FORMATION!
OBSERVATIONAL
DEVELOPMENT
MAJOR OBSERVATIONAL
DEVELOPMENTS
(TAKE ONE)


KABOOM!
ENTER HERE
REVERSE DIRECTION
YOU BECOME EDITOR OF ApJ. FOR NEXT 3 YEARS, YOUR PAPERS AUTOMATICALLY ACCEPTED BY REFEREES
OBSERVATIONAL DEVELOPMENT
YOU ARE OFFERED A TV- & BOOK CONTRACT -YOU MAY LEAVE THE GAME AND LIVE IN FAME & FORTUNE EVER AFTER.
HUBBLE "CONSTANT" SPIN THE HUBBLE SPINNER
H0
REVERSE DIRECTION
AN UNDI... DISCOVERS ERROR BURIED IN YOUR LAST PAP... YOU MUST ISSUE AN ERRATUM & WITHDRAW THE PAPER (& LOSE ITS PLAUSIBILITY POINTS).
KABOOM!
REVERSE DIRECTION
PAT ROBERTSON IS ELECTED PRESIDENT. QUESTIONS RELATING TO THE ORIGIN OF THE UNIVERSE ARE NOW SETTLED; FEDERAL FUNDING FOR ASTRONOMY IS CUT OFF. ALL AMERICANS LEAVE THE GAME.
YOU WIN A MacARTHUR FELLOWSHIP! TAKE 5 NSF DOLLARS. (DON'T SPEND IT ALL IN ONE PLACE.)
HUBBLE "CONSTANT" SPIN THE HUBBLE SPINNER
H0
THAT'S ALL, FOLKS!

Takeaways

In the 1980s (and 1990s), a theory of galaxy formation was also a theory of cosmology.

On a timescale of decades, we really can make progress in answering fundamental questions.

You don't know in advance which experiments will be decisive.

You don't know whether you're considering the right range of possible answers.

Some basic principles

People matter most. The individuals and the culture.

Great instruments lead to great data sets.
Great data lead to great science.

In many projects, CCAPP and OSU Astro/Physics have had central roles from instrumentation and design through observation, analysis, and interpretation: DES, BOSS/SDSS-III, DESI, SDSS-V, MODS/Y_P, ASAS-SN, ANITA, PUEO, ARA, RNO-G, Roman

Some basic principles

People matter most. The individuals and the culture.

Great instruments lead to great data sets.
Great data lead to great science.

It always takes longer than you expect.
The delays don't look as bad in retrospect.

We should get the most we can from these great data sets.

You can't do everything. But you can be interested in everything.

Things I'm trying to keep up with …

- Abundance distributions of stars, with Tawny Sit, Jennifer Johnson, ++
- Chemical evolution of helium, with Miqaela Weller
- Origin of manganese, with Haniyeh Tajer, Nicole Gountanis
- Elliptical galaxy evolution with Nicole, Aliza Beverage, James Johnson

- Cluster-galaxy redshift-space correlations with Nicole, Andres Salcedo
- Cluster weak lensing with Andres, Heidi Wu, Eduardo Rozo, Chun-Hao To
- Occasional input on DESI Lyman-alpha forest
- Roman weak lensing forecasts with Kaili Cao, Tim Eifler, team CPIP
- Other HLIS PIT stuff, especially survey design

- Organizing the Roman Science Collaboration
  (Co-Spokesperson, with Jessica Lu)

CCAPP: The Next 20 Years

You can't do everything. But you can be interested in everything.

Guaranteed advances:

- Physics of galaxies, and stars, and star formation
- Physics of supernovae, explosive transients, black holes
- Physics of cosmic rays
- New exotic phenomena

Hoping for surprises:

- Novel dark matter physics
- Novel dark energy or gravitational physics
- Things we haven't thought of yet

Critical questions

What support will we get from OSU, federal govt., other?
Will the U.S. remain hospitable for international students and scientists?

Who will we hire?
What projects will we have a major role in?

The “near” term is exciting!
DES, ASAS-SN, SDSS-V, DESI++,
Roman, IceCube, PUEO, ARA, RNO-G

Critical questions

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What projects will we have a major role in?

How will AI change the field?

INTERDISCIPLINARY WORKSHOP

Philosophy Sees the Algorithm: Reconsidering Knowledge and Community in AI-Based Science

An interdisciplinary dialogue on the transformation of scientific practice.

DATES

December 11-12, 2025

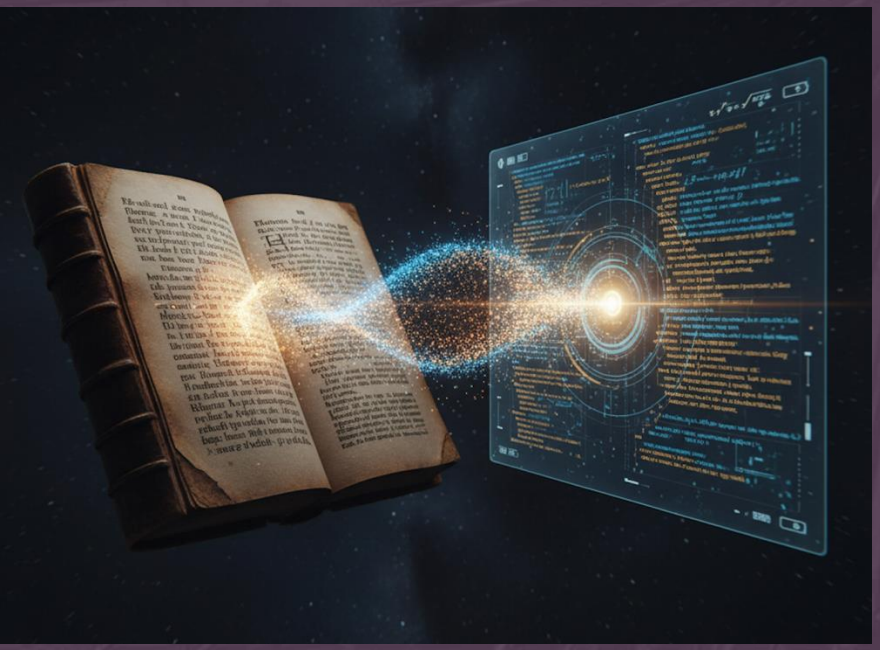
LOCATION

The Ohio State University

Caldwell 0120 / PRB 4138

FORMAT

In-Person Workshop



Can AI revolutionize scientific discovery?

David Weinberg, OSU Astronomy

Compared to what?

The Fast Fourier Transform?

Computers?

The Newtonian revolution?

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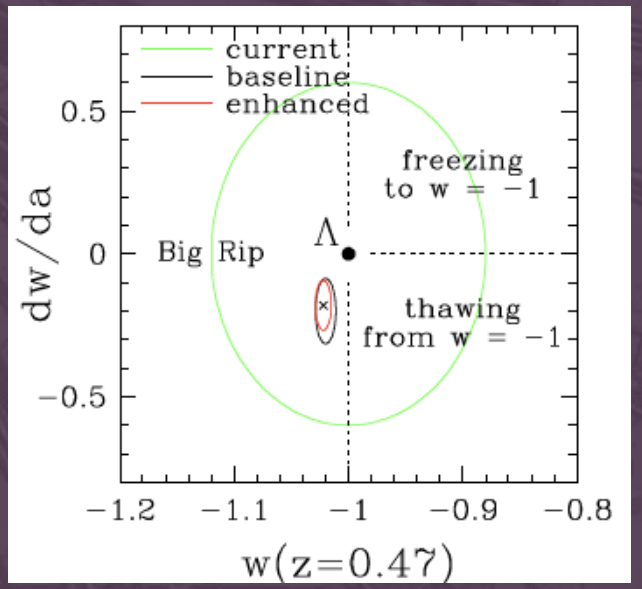
How will AI change the field?

What does the universe have in store?

WFIRST-AFTA SDT reports, 2013, 2015



The Biggest Cosmological Breakthroughs (last 200 years)

1859: Precession of Mercury

Newtonian gravity is incomplete.

1923: Distance to the Andromeda Nebula

The universe is big! Galaxies are basic unit.

1929: Hubble's law

The universe is expanding, as General Relativity naturally predicts.

1930s – 1970s: Dark matter

The dominant form of matter in the universe is invisible.

1960s: Cosmic microwave background and big bang nucleosynthesis

The universe began with a hot big bang.

1980s – 2000s: Large scale structure and CMB anisotropies

Cosmic structure formed by gravitational instability.

Dark matter is non-baryonic. Space is Euclidean.

Late 1990s: Cosmic acceleration

Gravity is repulsive over cosmological distances.

Critical questions

What support will we get from OSU, federal govt., other?
Will the U.S. remain hospitable for international students and scientists?

Who will we hire?
What projects will we have a major role in?

How will AI change the field?

What does the universe have in store?

Something remarkable, and discoverable, about dark matter, neutrinos, dark energy, gravity, inflation, other physics beyond our current understanding?