The Kavli Institute for Cosmological Physics: the first 40 years

Some history, greatest hits (to date!), the future

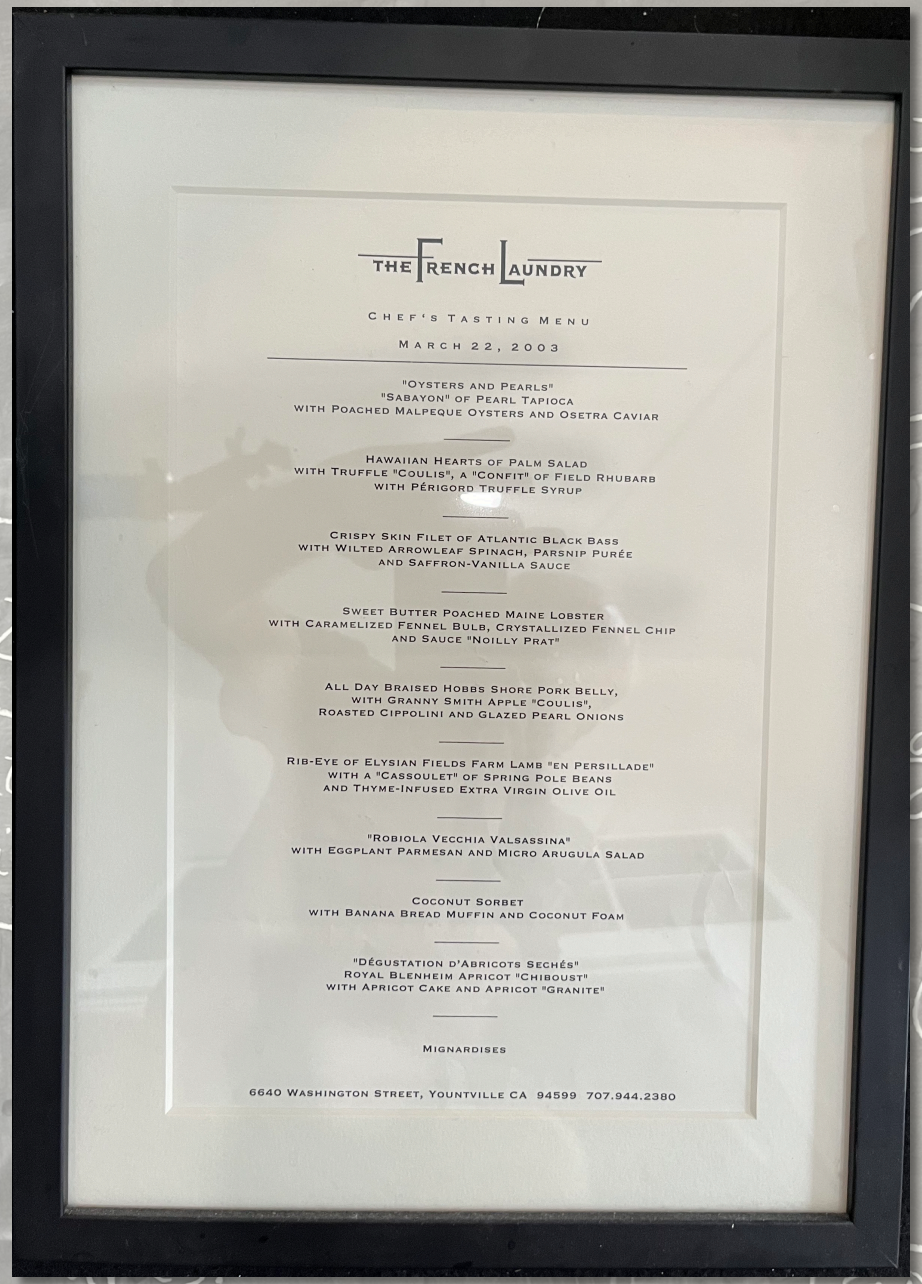
"embrace the complexity"

Michael S. Turner

Kavli Institute for Cosmological Physics (2004 –)

8 June 2024

KICP origins, part 1: 2003/04



THE FRENCH LAUNDRY

CHEF'S TASTING MENU

MARCH 22, 2003

"OYSTERS AND PEARLS"
"SABAYON" OF PEARL TAPIOCA
WITH POACHED MALPEQUE OYSTERS AND OSETRA CAVIAR

HAWAIIAN HEARTS OF PALM SALAD
WITH TRUFFLE "COULIS", A "CONFIT" OF FIELD RHUBARB
WITH PÉRIGORD TRUFFLE SYRUP

CRISPY SKIN FILET OF ATLANTIC BLACK BASS
WITH WILTED ARROWLEAF SPINACH, PARSNIP PURÉE
AND SAFFRON-VANILLA SAUCE

SWEET BUTTER POACHED MAINE LOBSTER
WITH CARAMELIZED FENNEL BULB, CRYSTALLIZED FENNEL CHIP
AND SAUCE "NOILLY PRAT"

ALL DAY BRAISED HOBBS SHORE PORK BELLY,
WITH GRANNY SMITH APPLE "COULIS",
ROASTED CIPPOLINI AND GLAZED PEARL ONIONS

RIB-EYE OF ELYSIAN FIELDS FARM LAMB "EN PERSILLADE"
WITH A "CASSOULET" OF SPRING POLE BEANS
AND THYME-INFUSED EXTRA VIRGIN OLIVE OIL

"ROBIOLA VECCHIA VALSASSINA"
WITH EGGPLANT PARMESAN AND MICRO ARUGULA SALAD

COCONUT SORBET
WITH BANANA BREAD MUFFIN AND COCONUT FOAM

"DÉGUSTATION D'ABRICOTS SECHÉS"
ROYAL BLENHEIM APRICOT "CHIBOUST"
WITH APRICOT CAKE AND APRICOT "GRANITE"

MIGNARDISES

6640 WASHINGTON STREET, YOUNTVILLE CA 94599 707.944.2380

PLEDGE AND GRANT AGREEMENT

The Kavli Institute for Cosmological Physics at the University of Chicago

In consideration of Mr. Fred Kavli making a pledge and the Kavli Foundation ("the Foundation") making a grant in the aggregate sum of $7,500,000, to the undersigned, The Board of Trustees of The University of Chicago ("The University"), and as an inducement to the consummation of such pledge and grant, the Foundation, Fred Kavli and The University agree to the following terms and conditions:

1. Use of Pledge and Grant Proceeds.

The amount transferred in payment of this pledge and grant commitment may, for investment purposes, be merged with any of the investment assets of The University, but they shall be entered in The University's books and records initially as THE FRED KAVLI FUND ("the Fund"). The purpose of the Fund is to establish, name and endow The Kavli Institute for Cosmological Physics at the University of Chicago (the "Institute"). One million dollars of the Fund shall be used as seed funding for an ultra-sensitive polarimeter to enable cosmic microwave background radiation measurements with the South Pole Telescope. The remainder of The Fund will be used to establish an endowment, proceeds of which will be distributed on an annual basis in support of the programs of the Institute according to University policy.

The mission of the Kavli Institute for Cosmological Physics is to deepen our understanding of the origin and evolution of the Universe and the laws that govern it by bringing together astronomers and physicists within a unique interdisciplinary culture. The Institute is envisaged to be an inclusive program, broadly supporting cosmological physics University-wide; it will nurture the intellectual range of activities at the University and promote scholarly communication and research activities engaging a cross-disciplinary group of scientists pursuing forefront research on fundamental problems in cosmology. In pursuit of its research goals, it will develop collaborations with other institutions, world-wide. Where appropriate, the Kavli Institute for Cosmological Physics will also foster interactions with other Kavli Institutes.

The creation of the Kavli Institute will bring together cosmological physics at the University of Chicago and will make permanent and expand the existing Center for Cosmological Physics, under the new name of the Kavli Institute for Cosmological Physics. The current name of the Center for Cosmological Physics and its acronym (CfCP) will no longer be used. It is understood that the Kavli endowment will be used to enrich and strengthen the Institute and will not be used as a substitute for federal funding, which will continue to be sought to support the research programs of the Institute.

The research thrusts of The Kavli Institute for Cosmological Physics will encompass the full breadth of the interface between particle physics and astrophysics,

The research thrusts of The Kavli Institute for Cosmological Physics will encompass the full breadth of the interface between particle physics and astrophysics,
from string cosmology to ultra-high energy cosmic rays, from inflationary cosmology to dark energy, from cosmic microwave background anisotropy to dark matter detection, and new fields in the future. Some of the initial topics that will be pursued are: elucidating the nature of dark energy and dark matter; testing the inflationary cosmology hypothesis; resolving the mystery of the origin of the highest energy cosmic rays; understanding the role of neutrinos in cosmology; and connecting cosmology with string theory.

11. Grant Acceptance

The pledge and grant are hereby accepted by the University of Chicago, upon and subject to the terms and conditions hereinabove stated.

FOR THE TRUSTEES OF THE UNIVERSITY OF CHICAGO

By: Don M. Randel — November 11, 2003
Don M. Randel — Date
President

FOR THE KAVLI FOUNDATION

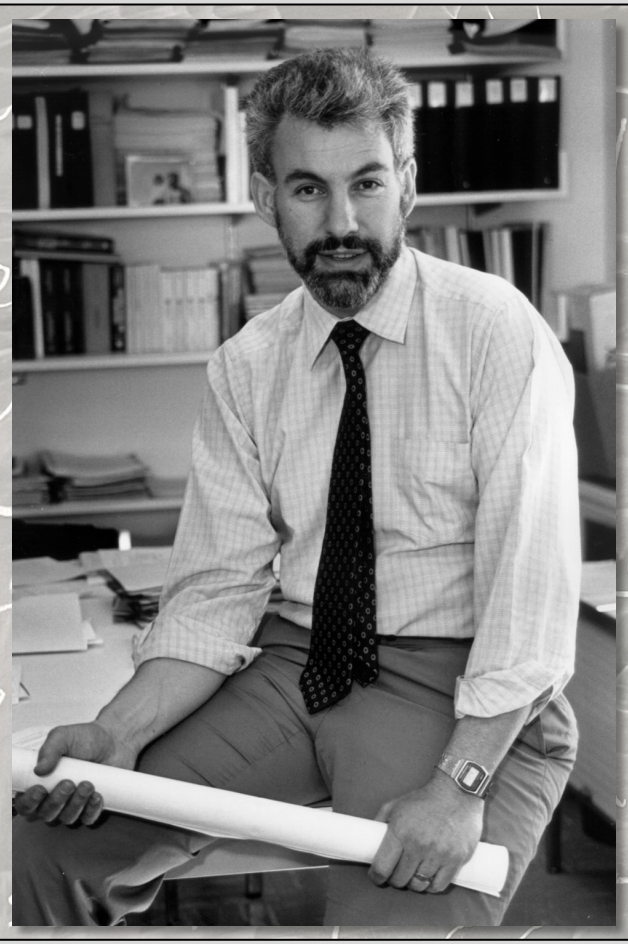
By: David Auston — 11/07/03
David Auston — Date
President

FOR FRED KAVLI

By: Fred Kavli — 11/7/03
Fred Kavli — Date

KICP origin, part 2. NSF Physics Frontier Center: Center for Cosmological Physics (2001 – 2019)

CCCP or CCP confusion?



Adult-onset astrophysics, circa 1999

- Dark Energy
- Inflation
- Ultra-high energy particles
- Co-I's
  - John Carlstrom, Sean Carroll, Jim Cronin, Josh Frieman, Wayne Hu, Stephan Meyer, Angela Olinto, Simon Swordy, and Michael Turner
- In 2004, became PFC@KICP
- Bruce Winstein, first KICP Director

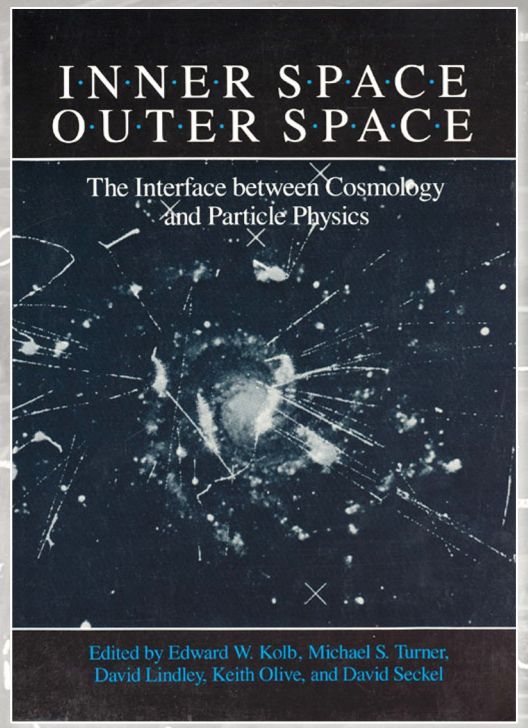

KAVLI INSTITUTE FOR COSMOLOGICAL PHYSICS
933

Guiding principle for ERC design: Cadillac labs, Yugo offices, and great interaction spaces (2010 -2015)

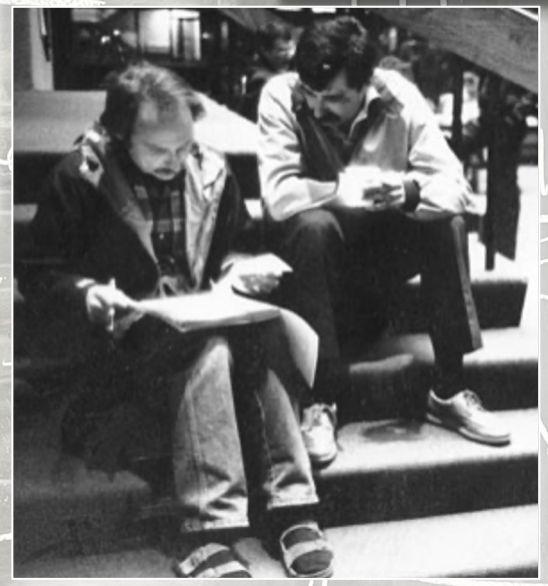
ERC 2014

TAAC June 2012

KICP origins, part 3. Fermilab (NASA) Astrophysics (1983 – today)



The Study of
The Very large (Cosmology)
and
The Very Small (Elementary Particles)
IS
COMING TOGETHER

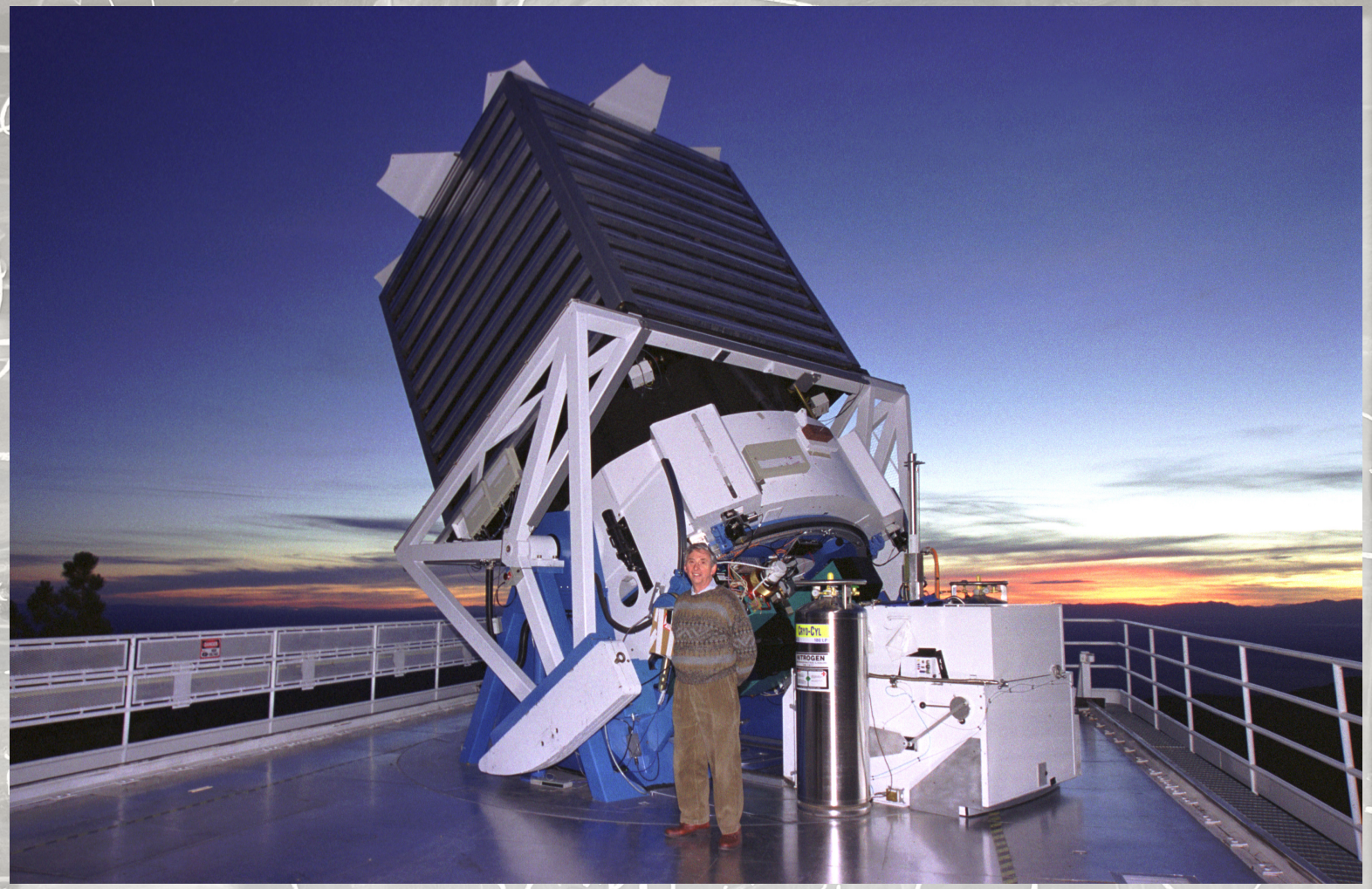


1981 hike in the Dolomites

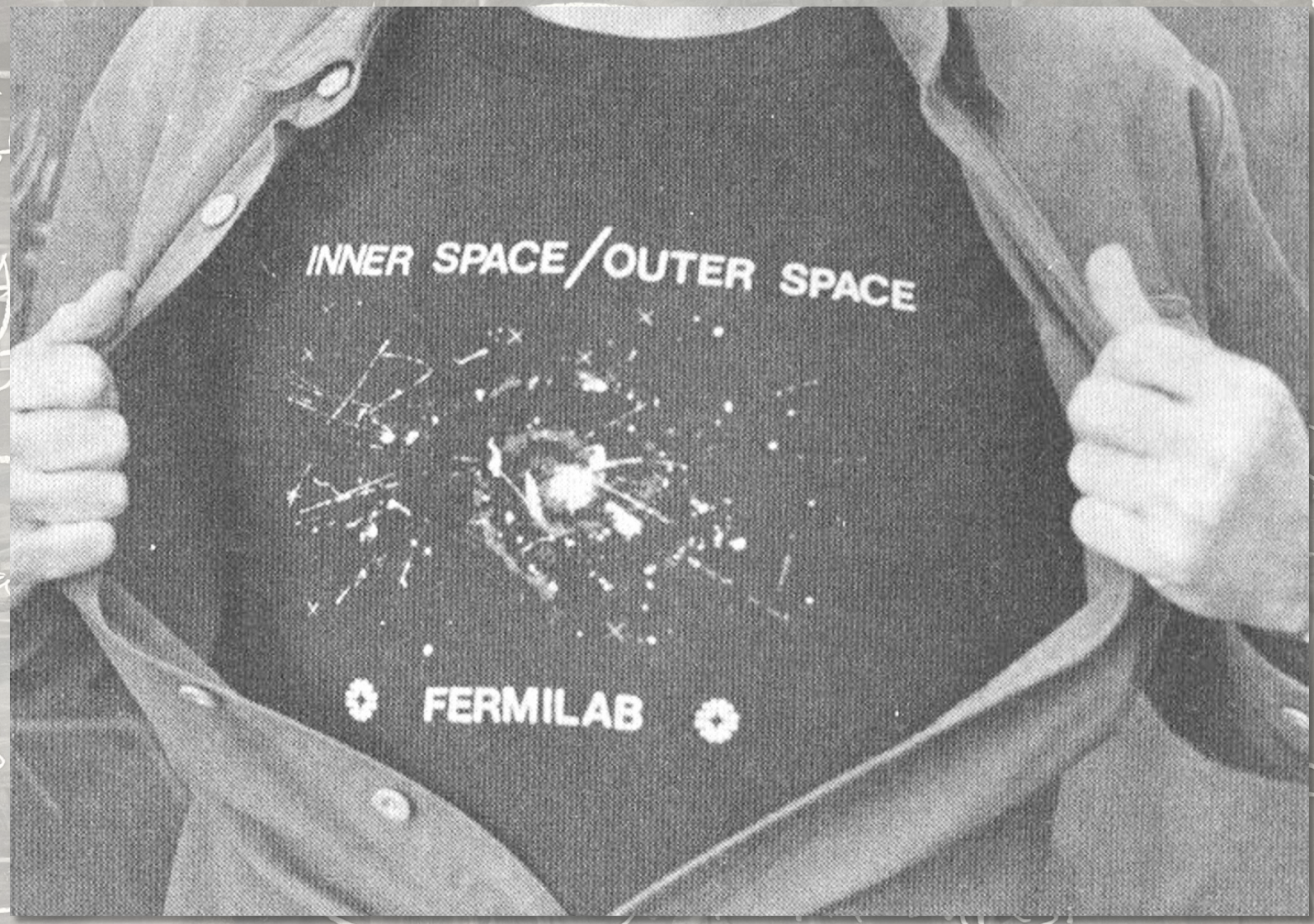

MICHAEL TURNER
CO-CHAIRMAN
INNER SPACE/OUTER SPACE
THE OFFICIAL CONFERENCE OF
THE 1984 SUMMER OLYMPICS

Contents

The SDSS and the birth of survey science



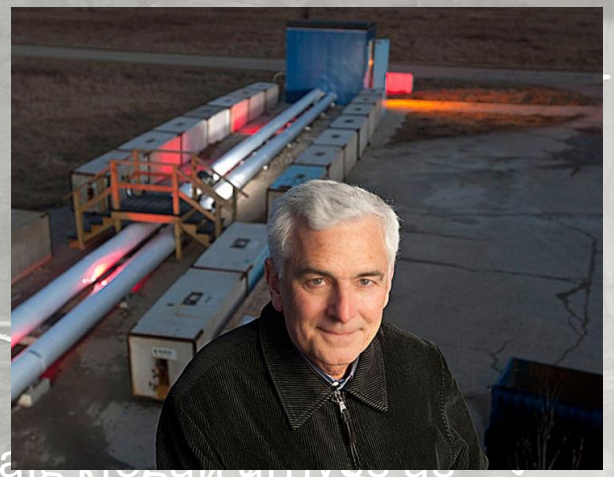
The birth of the conference T shirt



Workshops: The wormshop, ...

May day, 1985

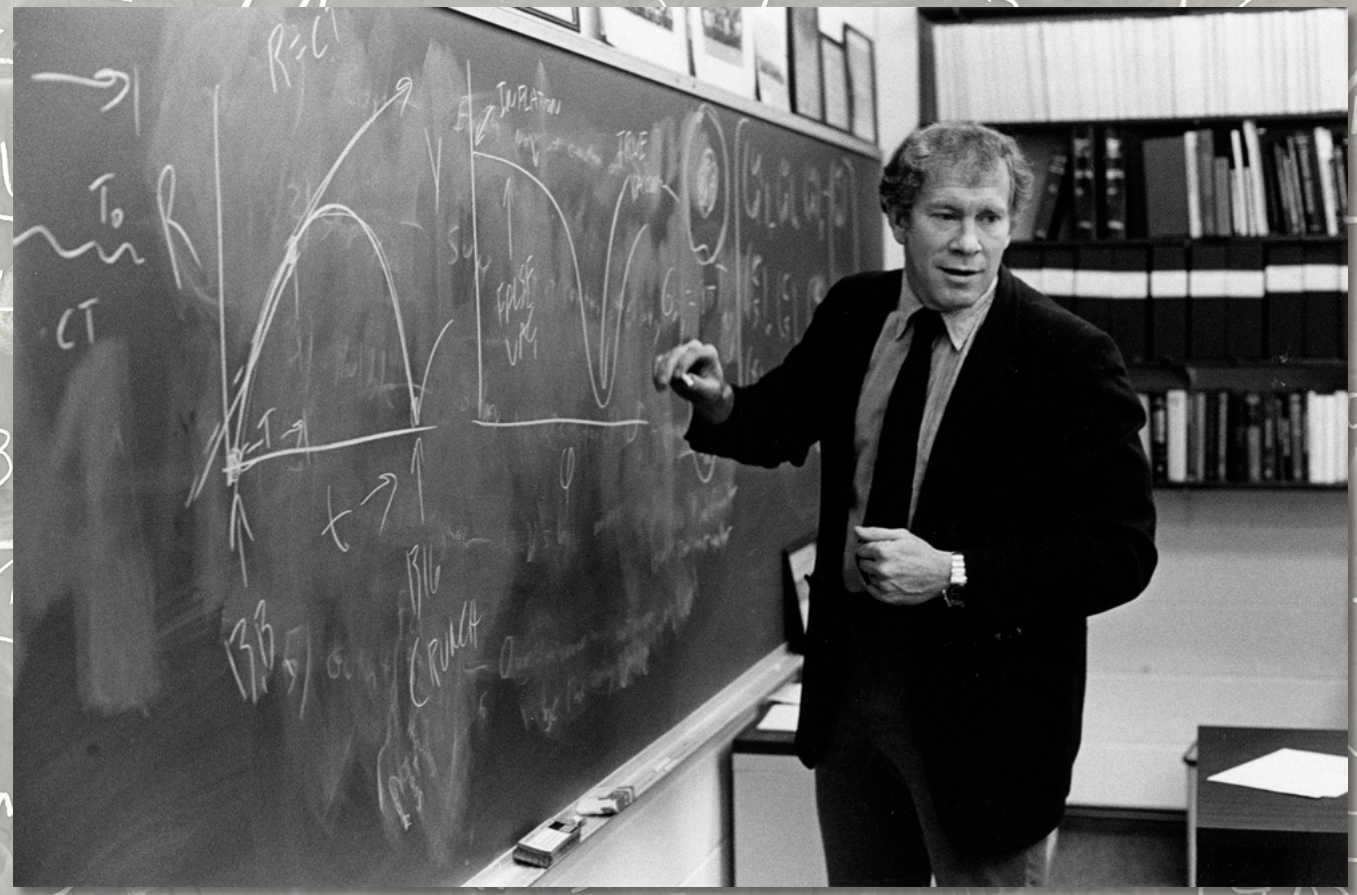
The Fermilab Particle Astrophysics Center



Craig [illegible] arrives as
1st Director 2008

KICP origins, part 4. David Schramm revitalizes Department of Astronomy & Astrophysics and brings cosmology to UChicago, 1978 – 1984

- 1978: Richard Kron
- 1980: Michael Turner
  - 2022 Josh Frieman
- 1986: Rocky Kolb
- 1993: Stephan Meyer
- 1996: Angela Olinto
- 1997: John Carlstrom
- [1999: Sean Carroll
- 2000: Wayne Hu
- 2001: Andrey Kravtsov]



Origins, part 4: UChicago invents interdisciplinary research: Fermi and Franck Institutes (1946 –)

Called the "finest example of neo-Stalinist architecture”

The greatest hits (that I can remember)

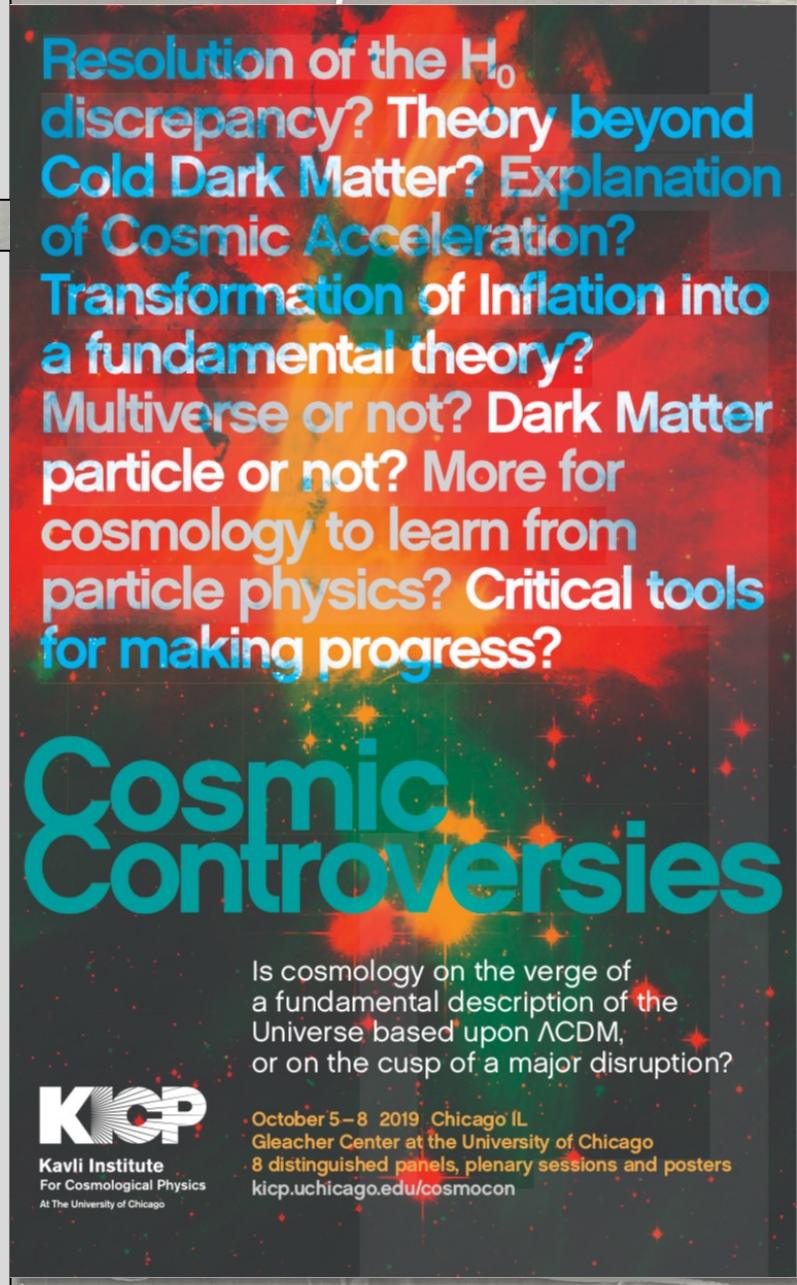
- Our alums: students and postdocs (on the program and many, many more)
- The diverse (early/late career; physicist/astronomer; theorist/experimentalist/observer), interdisciplinary, and supportive research community
- Cosmic microwave background
  - DASI, SPTxx, WMAP, QUIET, CAPMAP, CMB-S4, … , Simons Observatory
  - Discovery of CMB polarization, lensed B-modes, SZ and SZ discovered clusters
  - BICEP/KECK
- Dark Energy Survey
  - New dwarf galaxies and all the science!
- Dark Matter detectors
  - PICO, DAMIC, Xenon, …
- Pierre Auger Observatory
- Coherent neutrino scattering
- Gravitational waves and gravitational-wave astrophysics
- RNO-G (phased-array neutrino detection)
- Innovative and impactful Education and Outreach, including Alan Alda training
- Theory that inspires, guides the design of experiments and gets the most out of the data


UCHICAGO
US OPEN

The greatest hits (the first 10 years)

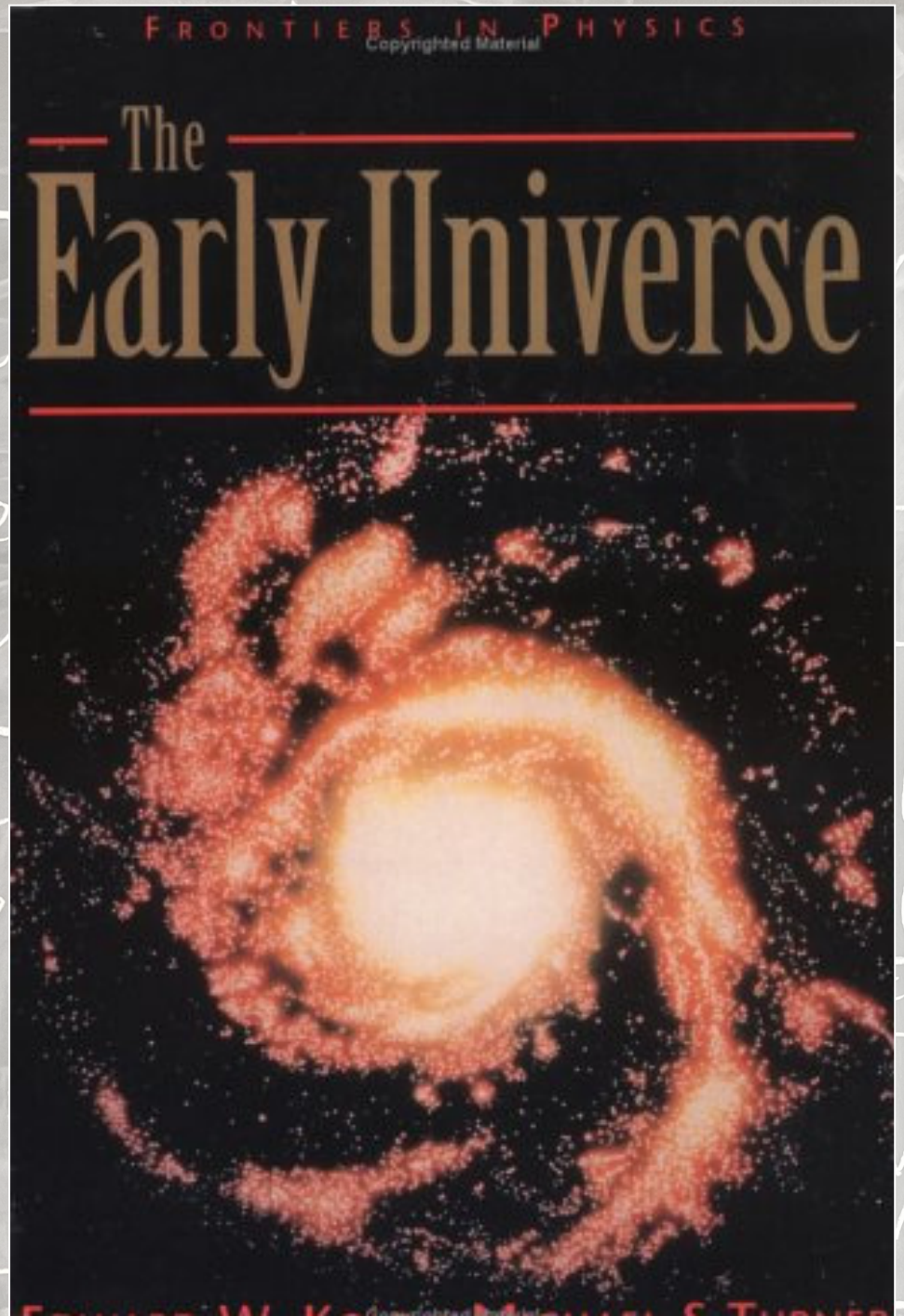
The best is still ahead: predictions for the next 20 years

- Answer one of LCDM's questions
  - Dark Matter particle, Inflation B-modes, or clue about dark energy
- Significant modification of LCDM
  - Early dark energy, quintessence, primordial black holes
- GZK neutrinos detected
- Powerful new cosmological probe invented
- Theoretical advance as important as BAO, B-modes, …
  - Worthy alternative to inflation
  - Testable, fundamental inflation model
  - Compelling dark matter candidate
- Big surprise at the boundaries of particle physics and cosmology



Final thoughts

- First twenty fantastic years exceeded all expectations!
- Precision cosmology is hard; accurate cosmology is even harder!
- World-leading institutions must change; change can be chaotic, difficult and risky
  - Be fearless and bold with eye on the North Star
  - Important and timely often attracts the best and the brightest young scientists
- It is all about the people and the interactions! Get that right and the rest will follow.
- KICP has two wonderful partners: Kavli Foundation and UChicago
- Cosmology has changed (now industrial class science)
  - Idea driven → data-driven (not forever)
  - Be careful what you wish for: theorists who begged for more data and are now survey scientists and data scientists
- The very best research involves taking risks, commitment, making mistakes, and being confused. You need a supportive community and environment and KICP@UChicago is just that.



MOOSE DIAGRAM of DARK MATTER CANDIDATES

MBT '90