Continued Operation of DESI and DESI-II

Camille Avestruz, University of Michigan

P5 Cosmic Frontier Town Hall, Virginia Tech
June 27, 2023

DARK ENERGY SPECTROSCOPIC INSTRUMENT

U.S. Department of Energy Office of Science

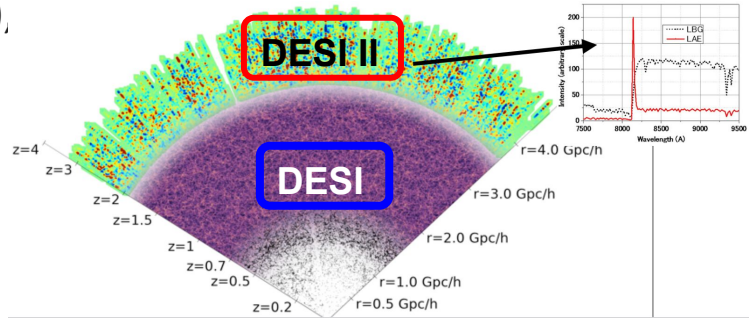
See K. Dawson's P5 LBNL slides full science case:
https://indico.physics.lbl.gov/event/2382/contributions/7561/

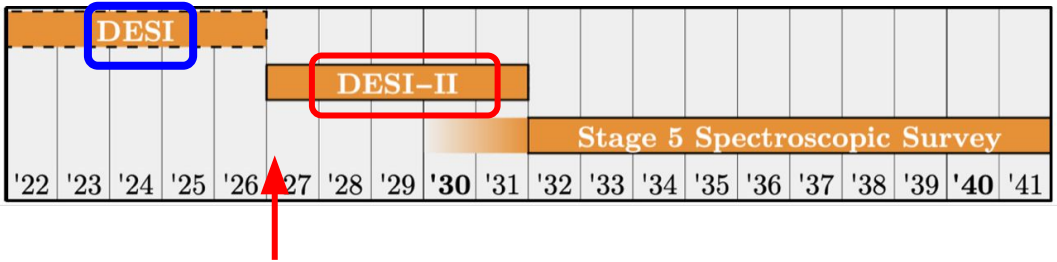
DESI Enabled Science: Beyond the Standard Model Exceeding Expectations to the Next Decade

Scientific Questions for Particle Physics and Cosmology:

- physics of the **early universe** (e.g. primordial inflation),
- measures of **dark energy** at both early and late times,
- **neutrino mass** hierarchy, and
- the physics of **dark matter**.

New regime: galaxy clustering at z>2





DESI-II spectroscopy → Early Universe physics and synergies with LSST imaging data

Snowmass: "Continue operation of DESI (via a new DESI-II program) to constrain dark energy in new domains and as a step towards a Stage V spectroscopic facility (Spec-S5)."

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Importance to the University Community

Early Career Scientists at the December 2022 DESI Meeting – our community's future

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Importance to the University Community

DESI Training and Career Development for Early Career Scientists:

- Hands-on practical experience on DESI
- Driver of instrumentation development and advanced methods in computation
- Crucial role in supporting the education and training of the **116 U.S. PhD students** involved in the project.
- Key tool for university research on dark energy and building new, robust analyses for primordial physics
- **Statement of support for the continued operation of DESI signed by 46 faculty members at US institutions.**

Please recommend to DOE to continue to support DESI-I and DESI-II operations into the 2030's, so that we can train our students, prepare for Spec-S5, maintain US leadership, and fully exploit the scientific potential of what we built for DESI. DESI-II needs a positive recommendation from P5 to be fundable.

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Importance to the University Community

Continued support requested by

46 Members at 24 Institutions

Early Career Scientists:

Prof. Paul Martini	Ohio State University
Res. Prof. Michael Lesser	University of Arizona
Prof. Jeffrey Newman	University of Pittsburgh / PITT PACC
Res. Prof. David Rabinowitz	Yale University
Prof. Rachel Bean	Cornell University
Prof. Antonella Palmese	Carnegie Mellon University
Prof. Charles Baltay	Yale University
Prof. Mustapha Ishak	University of Texas at Dallas
Prof. Uros Seljak	University of California Berkeley
Prof. Masao Sako	University of Pennsylvania
Prof. Steve Ahlen	Boston University
Prof. Zheng Zheng	University of Utah
Prof. Christopher J Miller	University of Michigan
Prof. Eric F. Bell	University of Michigan
Prof. David H. Weinberg	Ohio State University
Prof. Marcelle Soares-Santos	University of Michigan
Prof. Richard Pogge	Ohio State University
Prof. Eduardo Rozo	University of Arizona
Prof. Kyle Dawson	University of Utah
Prof. Tim Eifler	University of Arizona
Res. Scientist Michael Schubnell	University of Michigan
Prof. Regina Demina	University of Rochester
Prof. Zachary Slepian	University of Florida
Prof. Jeremy Tinker	New York University
Prof. Anthony Pullen	New York University
Prof. Peter Behroozi	University of Arizona
Prof. Douglas Finkbeiner	Harvard University

April 19, 2023

Re: Statement in favor of continued operation of DESI

Dear Particle Physics Project Prioritization Panel (P5),

As faculty members from the universities listed below, we write to you to express our strong support for the continued operations of the Dark Energy Spectroscopic Instrument (DESI) and its extension into DESI-II.

DESI has been an incredibly important tool for each of our universities' research on dark energy, and will be instrumental in advancing our understanding of this fundamental component of the universe. The data collected by DESI has already helped us to make significant progress in our efforts to better understand the large-scale structure of the universe, and to uncover new insights into the nature of dark energy. DESI has exceeded our expectations both in performance and in scientific reach. We expect DESI with its proposed extension, DESI-II, with operations into the next decade, to address important scientific questions including the neutrino mass hierarchy, measures of dark energy at both early and late times, the physics of the early universe including primordial inflation, and the physics of dark matter. DESI-II spectroscopy will also provide important synergies with LSST imaging data.

Furthermore, DESI has played a crucial role in supporting the education and training of the 116 U.S. PhD students involved in the project. The hands-on experience provided by working on DESI has been invaluable for these students, allowing them to gain practical skills and experience that will serve them well in their future careers. These are unique experiences that can be provided by a nimble experiment such as DESI.

In addition to supporting our research and training efforts, DESI has also been an important driver of instrumentation development and advanced methods in computation at several of our universities. The project has brought together a diverse array of experts and researchers, leading to numerous breakthroughs in the development of cutting-edge instrumentation and software tools that can be applied in future experiments.

Finally, we would like to emphasize that DESI in just its first year has already been a scientific goldmine, producing a wealth of valuable data that will continue to be analyzed and explored for many years to come. We strongly support extending the DESI program as presented at the P5 Town Hall on February 22. Given the immense potential of this project, we urge you to recommend to DOE to continue to support its operations into the 2030's, so that we can continue to build on the tremendous progress that has already been made, upgrade the instrument as needed to maintain US leadership, and fully exploit the potential of this exciting new facility.

Sincerely,

The undersigned signatories:

Title/Name	University
Prof. Daniel Eisenstein	Harvard University
Prof. Gregory Tarlé	University of Michigan
Prof. Lado Samushia	Kansas State University
Prof. Risa Wechsler	Stanford University
Prof. Hee-Jong Seo	Ohio University
Prof. Klaus Honscheid	Ohio State University
Prof. Adam Myers	University of Wyoming
Prof. Camille Avestruz	University of Michigan
Prof. David Kirkby	University of California Irvine
Prof. Robert Kehoe	Southern Methodist University
Prof. Constance Rockosi	UC Santa Cruz, SCIPP
Prof. Segev BenZvi	University of Rochester
Prof. Martin White	University of California, Berkeley
Res.Prof. Monica Valluri	University of Michigan
Prof. Nikhil Padmanabhan	Yale University
Prof. Xiaohui Fan	University of Arizona
Prof. Alexie Leauthaud	University of California Santa Cruz
Prof. Dragan Huterer	University of Michigan
Prof. John Moustakas	Siena College

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Please recommend to DOE … 30's, so that we can train our students, prepare for Spec-S5, maintain US leadership, and fully exploit the scientific potential of what we built for DESI. DESI-II needs a positive recommendation from P5 to be fundable.

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A Success Story: Undergraduate to Scientist Role (Kevin Fanning)

Undergrad: UMich 2014-2018

Tested control electronics for the DESI focal plane (***Instrumentation)***

Grad school: OSU 2018-present

Integrated fiber positioners and helped lead efforts in focal plane work ***(Commissioning)***

Developed imputation methodology for missing galaxies for survey homogenization ***(Data Analysis)***

Next: Observing Scientist at SLAC

Commissioning+Science Validation: Rubin Observatory's Legacy Survey of Space and Time

UNIVERSITY OF MICHIGAN

THE OHIO STATE UNIVERSITY

SLAC NATIONAL ACCELERATOR LABORATORY

"[Financial support for undergraduate research] is especially important for students coming from low-income backgrounds like myself."

"DESI gave me the opportunity to learn valuable technical skills to apply to future jobs collaborate with wonderful people, and to be proud of the ongoing survey that I helped make happen."

– K. Fanning

DoE Support to DESI provided opportunities and an environment for a junior scientist to grow

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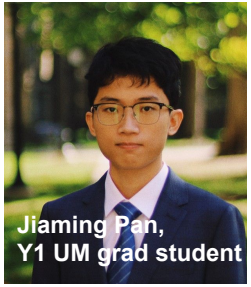
What DESI means to an ECS faculty member: Ingredients & Community for a new group

Opportunities within my 2 years of being faculty at a DESI institution (UMich):

- DESI provides **motivating applications for an interdisciplinary collaborative effort** with a UMich Statistics group in *probabilistic cataloging for cosmology*,
- Opportunity for my first postdoc to **apply her expertise in systematics to real data** (from LSST-DESC studies to DESI),
- **Science to co-advise** a first year grad student with a senior colleague who is one of my senior faculty mentors, and
- **Common ground to interact with ECS** in other cosmology groups at UMich and other DESI researchers.




Thank you!