



# Artificial Intelligence as a Core Component of the Cosmology Research

P5 Town Hall @ LBNL  
February, 2023

Aleksandra Ćiprijanović  
(she/her/hers)

Fermilab, DSSL  
aleksand@fnal.gov

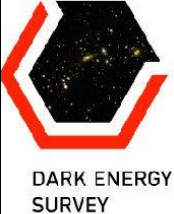
# Vision of the Future - Cosmology with Big Data

- Major Cosmic Frontier dark energy experiment for the next decade (~\$70M operations per year for 10 years, split between DOE & NSF).
- Fermilab - major role in project operations and data management; transfers expertise from DES and SDSS, LSST Dark Energy Science Collaboration (DESC).



# Vision of the Future - Cosmology with Big Data

- Synergies with other surveys: DESI, DES, Roman, JWST, CMB-S4 etc.



# Vision of the Future - Cosmology with Big Data

- Synergies with other surveys: DESI, DES, Roman, JWST, CMB-S4 etc.



U.S. Department of Energy Office of Science

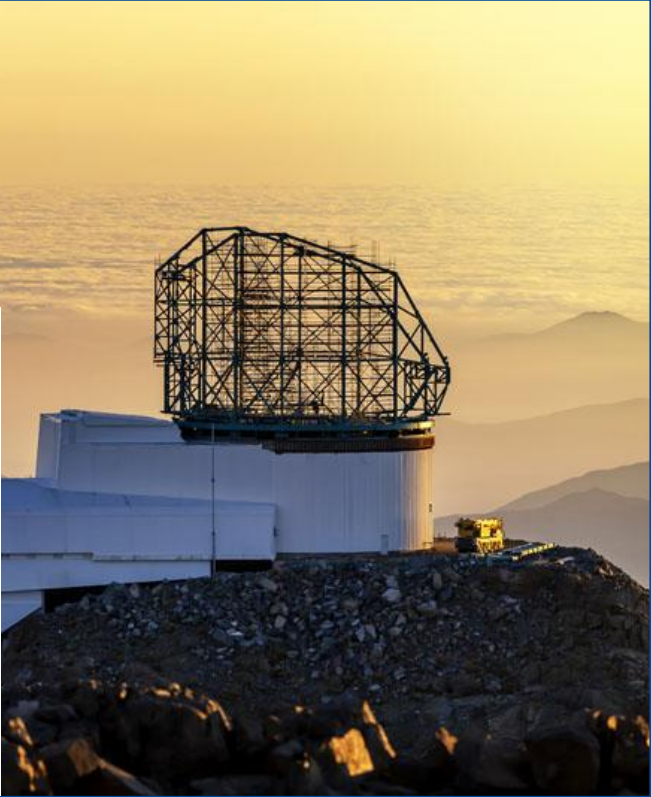


DARK ENERGY SURVEY



## Rubin LSST

- ~ 20 TB / day
- ~ 114x4 TB / month (raw)
- ~ 650 PB / year



# Vision of the Future - Cosmology with Big Data

- Synergies with other surveys: DESI, DES, Roman, JWST, CMB-S4 etc.



**DARK ENERGY  
SPECTROSCOPIC  
INSTRUMENT**

U.S. Department of Energy Office of Science



**DARK ENERGY  
SURVEY**



**CMB-S4**

Next Generation CMB Experiment

**THE NANCY GRACE  
ROMAN SPACE TELESCOPE**



## Rubin LSST

- ~ 20 TB / day
- ~ 114x4 TB / month (raw)
- ~ 650 PB / year

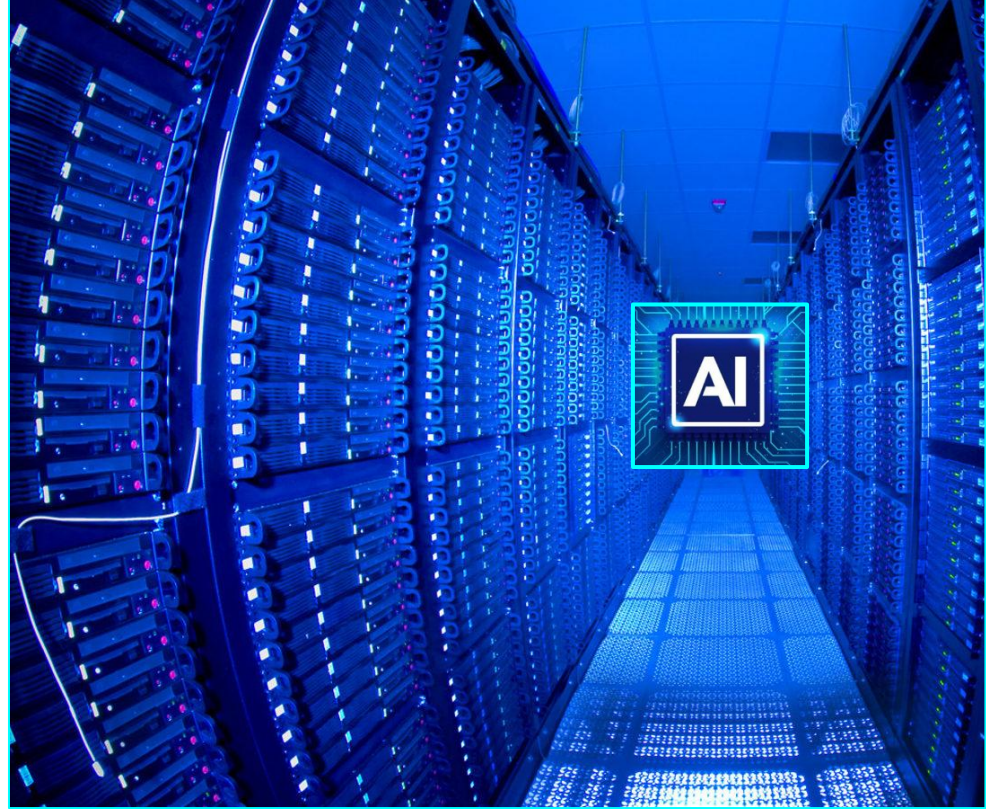


## Challenges:

- **Real-time:**
  - data handling,
  - decision making
  - detection of interesting events
  - inference
- **Automated experiments**
- **Working with big data** later in the process -> cosmology

# Artificial Intelligence for Precision Cosmology

- **AI will increase our capabilities** for real-time data handling, decision making, anomaly detections, and enable cross-dataset learning.
- Easier and faster work with big datasets, no approximations and data-driven models, no MCMC and other slow and limiting methods, **going beyond summary statistics for cosmology** etc.
- Recognising the need for the development of science-specific AI methods. AI should be **recognized as a core component of cosmology research**.



# Artificial Intelligence for Precision Cosmology

---

AI for Physics, Physics for AI

---

- Fermilab has established **Computational Science and Artificial Intelligence Directorate** and **AI Office**.
- Build a community around our cross-cutting problems and guide the development of much needed physics-driven AI methods.

