

CE-G2200019 LIGO-G2200542

## Update from Cosmic Explorer LIGO-Virgo-KAGRA Meeting, Spring 2022

On zoom, March 18, 2022 Stefan Ballmer

Artist: Eddie Anaya (Cal State Fullerton)



# Cosmic Explorer

The Vision for Gravitational-Wave Astrophysics and Astronomy

- Third-Generation Gravitational-Wave Observatory
  - 40 km and 20 km L-shaped surface observatories
  - 10x sensitivity of today's observatories (Advanced LIGO+)
- Enables access to
  - Stellar to intermediate mass mergers throughout Cosmic Time
  - Dynamics of Dense Matter
  - Extreme Gravity
- Envisioned as an open-data facility





News

from last year

### Cosmic Explorer Horizon Study

- Connect science goals to design choices
  - Number of detectors and location
  - Detector length and configuration
- Delivered to the NSF in Fall 2021
- Available at
  - <u>dcc.cosmicexplorer.org/CE-P2100003/public</u>
  - arxiv.org/abs/2109.09882





A Horizon Study for

### **Cosmic Explorer**

Science, Observatories, and Community

# COSMIC EXPLORER

News

since last LVK meeting



- Astro 2020 Decadal Survey: A Resounding Endorsement for Cosmic Explorer (Nov 2021)
  - "Gravitational wave astrophysics is one of the most exciting frontiers in science."
  - "..and planning the next-generation observatory, such as Cosmic Explorer, is essential."
  - "The survey committee strongly endorses gravitational wave observations as central to many crucial science objectives."





since last LVK meeting

#### Dawn VI Meeting on Next Generation Observatories

🛗 October 5-7, 2021 🕒

#### • Virtual event

- DAWN VI workshop held Oct 5-7, 2021
  - Over 200 physicists and astronomers attended
  - Report available here: <a href="https://arxiv.org/pdf/2112.12718.pdf">https://arxiv.org/pdf/2112.12718.pdf</a>
  - A total of 205 researchers endorsed the report





since last LVK meeting

Dawn VI Meeting on Next Generation Observatories



**DAWN VI Report Quotes:** 

On Cosmic Explorer specifically:

"There was a consensus that Cosmic Explorer is a concept that can deliver the promised science. A strong endorsement of Cosmic Explorer, as described in the CE Horizon Study, is a primary outcome of DAWN VI."

 "Guided by the experience with the LIGO and Virgo detector commissioning, the CE team came to the conclusion that while making the detector longer evidently increased the cost, it appeared to be the lowest risk path to better sensitivity."

On 3G detectors in general:

• "...the observational science value to having a network node in the southern hemisphere is significant. The community should continue to explore means to realize a next-generation observatory there."



# Snowmass

DPF Community Planning Exercise



• " The Particle Physics Community Planning Exercise (a.k.a. "Snowmass") is organized by the Division of Particles and Fields (DPF) of the American Physical Society. Snowmass is a scientific study. It provides an opportunity for the entire particle physics community to come together to identify and document a scientific vision for the future of particle physics in the U.S. and its international partners. Snowmass will define the most important questions for the field of particle physics and identify promising opportunities to address them. The P5, Particle Physics Project Prioritization Panel, will take the scientific input from Snowmass and develop a strategic plan for U.S. particle physics that can be executed over a 10 year timescale, in the context of a 20-year global vision for the field."



# Snowmass

DPF Community Planning Exercise

- GW participating this time
  - Numerous GW white paper contributions
  - One white paper focused on new GW facilities:
- "Future Gravitational-Wave Detector Facilities" Snowmass 2021 white paper was submitted
  - Covers Cosmic Explorer +Voyager + MAGIS/AION Atom Interferometers + GLOC
  - Available at arxiv.org/abs/2203.08228



Submitted to the Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021)

Snowmass2021 Cosmic Frontier White Paper: Future Gravitational-Wave Detector Facilities

 Looking for endorsements - email me if you want to endorse it: sballmer@syr.edu

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NSF

Research Infrastructure Guide

- The new Research Infrastructure Guide
  - Guide for full life-cycle of all Major Facilities
  - Was published in December 2021
  - Replaces NSF Major Facilities Guide (MFG)
  - ...has GW merger on front page....
  - Outlines the next steps for Cosmic Explorer
    - Conceptual Design
    - Preliminary Design
    - Final Design
    - Construction



### **RESEARCH INFRASTRUCTURE GUIDE**

NSF guidance for full life-cycle oversight of Major Facilities and Mid-Scale Projects



NSF Large Facilities Office Office of Budget, Finance and Award Management

> NSF 21-107 December 2021

Credit: Scientific contact by Ed Seidel (eseidel@aci.mpg.de); simulations by Max Planck Institute for Gravitational Physics (Albert-Einstein-AEI); visualization by Werner Benger, Zuse Institute, Berlin (ZIB) and AEI. The computations were performed on NCSA's It.



# **NSF** Proposal

Our Plan, with Input from the NSF



- One core Conceptual Design proposal (from multiple institutions)
  - Establish a project office, write initial Project Execution Plan (PEP), address governance and organization questions, etc.
- In parallel, pursue (with CE Consortium and LSC) a variety of grants for design-focused R&D
  - CE Project to facilitate and coordinate R&D efforts, but the research will happen in the community, and will be funded through the usual NSF proposal process. We need participation!

# COSMIC COSMIC Explorer Project Formation



### **Cosmic Explorer Project**

- Initiated by PIs of Horizon Study to maintain momentum
- Highest priority: Determine path to funding Conceptual Design Phase
- Established project organizational chart
- Call to consortium for project volunteers went out earlier this Month
  - Not too late to volunteer contact Matt Evans: m3v4n5@mit.edu
- CE Consortium provides venue for interested scientists to engage
  - Sign up at <a href="https://cosmicexplorer.org/consortium.html">https://cosmicexplorer.org/consortium.html</a>



## Cosmic Explorer

Project Organization

- Intended to
  - Take Cosmic Explorer into the Conceptual Design Phase
  - Provide contact information to outside researchers and funding agencies
  - Currently staffed by volunteer effort

### Cosmic Explorer Road Map

- Lots happened for Cosmic Explorer since last LVK meeting:
  - Horizon Study delivered to NSF
  - Astro 2020-
  - DAWN VI endorsement
  - Snowmass participation
  - Project formation and organization
- More will happen this year:
  - Consortium research organization
  - Path to funding Conceptual Design

## End