PAX/CE Symposium
Closing session

Lisa Barsotti

(for the CE Symposium parallel session team)

Artists: Edward Anaya, Virginia Kitchen, and Angela Nguyen (Cal State Fullerton)

It was awesome!!!
Thank you!!!

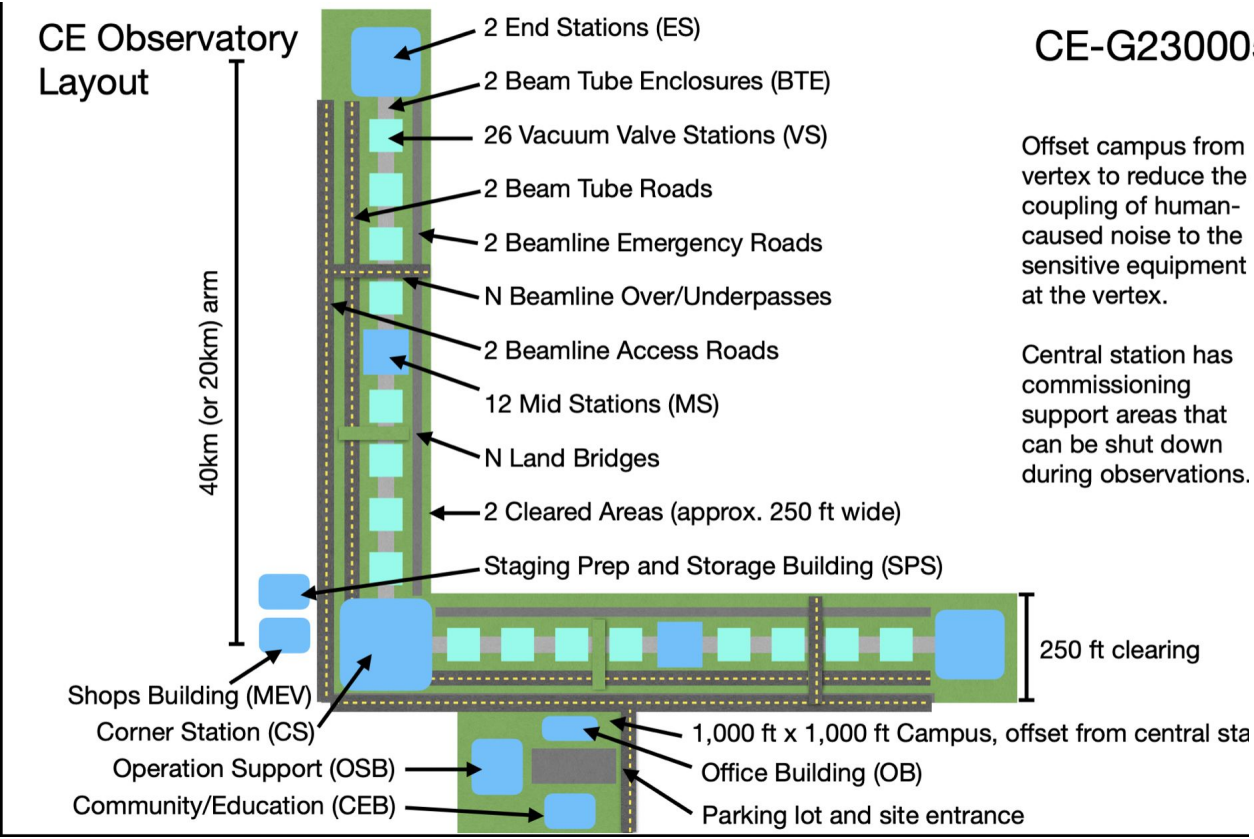
CE Symposium Parallel Sessions, Beckman Institute, Room 1005		
Round-table discussion on STM (instrument side): Barsotti	Connecting CE with hot topics in science and technology: McCuller	Real-time control: Ballmer (chair), Nitz, Rollins
Coffee Break	**Coffee Break**	**Coffee Break**
Round-table on CE instrument open questions and future-proofing CE facilities: Driggers, Smith	Modeling challenges and AI opportunities in the XG detector era: Mukund, Neubauer	Cosmic Explorer Working Groups Technical Discussions

Science Traceability Matrix

Agency Mission	Science goal	Science objective	Key Observations	Key Performance Parameters	Observatory System Requirements			Network Configuration
					Subsystem	Property	Value	

Goal is to pick a “mature” science goal, and do the exercise of filling a full row of the STM

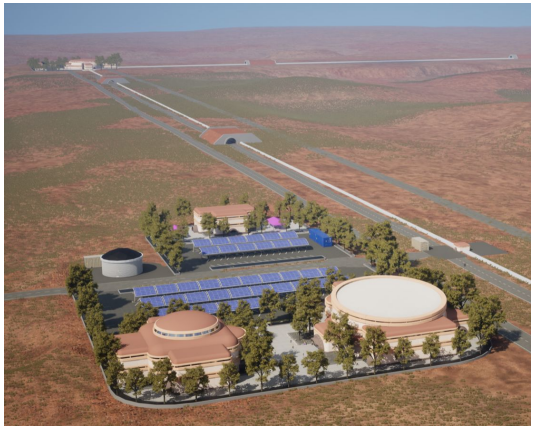
The CE Facility Components

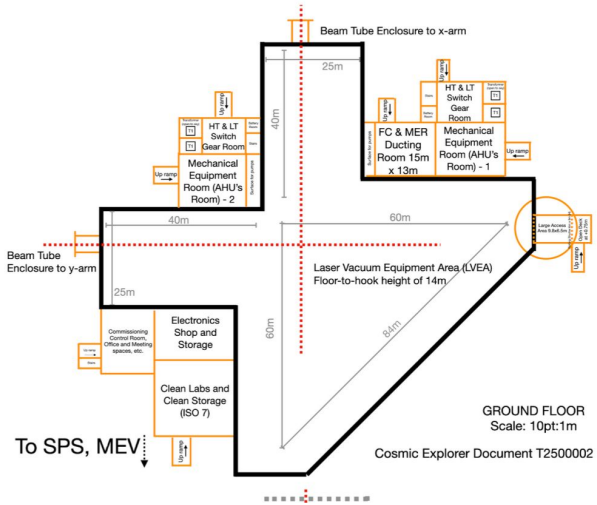


CE-G2300054

Offset campus from vertex to reduce the coupling of human-caused noise to the sensitive equipment at the vertex.

Central station has commissioning support areas that can be shut down during observations.





To do: validate the facility design by thinking about all of the phases of the project

Role of A# as CE technology pathfinder

		A♯ R&D	CE R&D	Δ
Core Optics	Substrates (§4.1.1)	production and polishing of fused silica optics 45 cm ∅, 100 kg	further scaling, toroidal mirrors for corner, polishing of strong lens in ITMs	🟡
	Coatings (§4.1.2)	amorphous coatings: materials better than A+ coatings and scaling	amorphous coatings: further scaling required	🟢
		crystalline coatings: birefringence tests and scaling	crystalline coatings for future upgrades: further size scaling required	🔴
Vibration Control	Suspensions (§4.2.1)	improved controllability, high stress fibers, test mass actuation, full scale prototype	design optimization, long high stress fibers, test mass actuation, full scale prototype	🟡
	Active Vibration Isolation (§4.2.2)	improved sensors and global control strategies	scaling up of A♯ design	🟢
Lasers & Input	Lasers (§4.3.1)	high power laser, beam quality	integration of A♯ design	🟢
	Input Optics (§4.3.2)	mitigation of laser noise couplings (intensity, frequency, beam jitter)	mitigation of laser noise couplings with double mode-cleaners	🟡
Readout & Quantum	Readout (§4.4.1)	optimization of Balanced Homodyne	adaptation of A♯ design	🟢
	Squeezing (§4.4.2)	loss, mode mismatch and phase noise reduction, robustness	adaptation of A♯ design, reduction of SEC loss, study of HOM in band	🟡

		A♯ R&D	CE R&D	Δ
Sensing & Control	Length & Angle (§4.5.1)	control noise reduction, optimal hierarchical control	adaptation of A♯ design, lock acquisition for 40 km arms	🟡
	Mode (§4.5.2)	improved sensors and actuators, evaluation of BS thermal lensing	adaptation of A♯ design elements, study of low AOI on BS	🟡
	Parametric Instab. (§4.5.3)	improved modeling and dampers	adaptation of A♯ design	🟢
Facility & Interface	Vacuum system (§5.2)	maintenance of existing infrastructure	large scale sector test of new system	🔴
	Newtonian Noise (§5.1.2)	modeling and demonstration of subtraction techniques	adaptation of A♯ design, facility design optimization	🟡
	Stray Light (§5.3)	incremental improvements, material research	beam tube baffling strategy, analysis of corner layouts, detection strategy	🔴
	Environment (§5.1.1)	incremental improvements	building isolation, beam tube isolation, HVAC redesign	🔴
	Electronics (§4.5.4)	advanced prototypes	exploration of modern low-noise electronics designs	🟡
Computing & Data	Digital I/O (§4.6.1)	incremental improvements	architecture re-design with modern technology	🟡
	Calibration (§4.6.2)	incremental improvements	fast and accurate low latency calibration techniques	🟢
	Data Analysis, Transfer and Storage (§4.6.3)	incremental improvements	integrated architecture for low-latency analysis of ~ 1000 daily events	🟡

Connecting CE to hot topics in science and technology

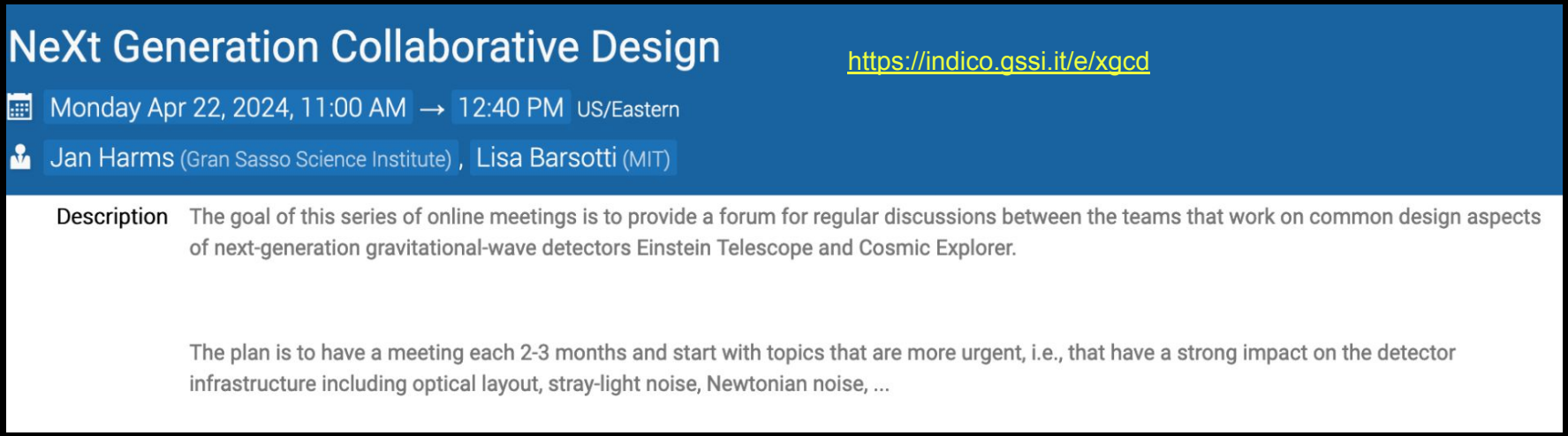
- “Quantum” connection
  - Squeezing..then what?
  - Lee’s vision: switch readout topology depending on astrophysical sources

- AI: What are the *right* problems to solve with AI?
  - Mark – LHC perspective
  - Nikhil – AI for control and operations

⇒ Lisa’s take away-message: we need to do more of this

neXt-Generation Collaborative Design (XGCD)

- ET-CE technical discussion on topics of common interest
- Several topics discussed so far: Optical Design, Straylight mitigation discussed, Lasers and Laser Noise couplings, Seismic Isolation and Sensors, Suspension design, …
- Next topic to be decided soon – talk to Lisa Barsotti ⇒ DECIDED!!
- **Jamie et al on control architecture (stay tuned for when)**



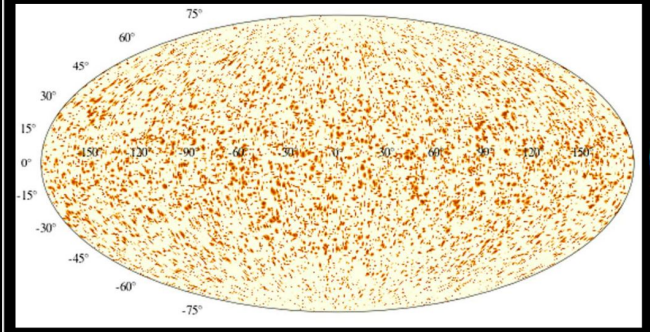
Dave Ottaway (from 2G+XG panel)

How much would a 10 km A# detector in Australia improve the XG network? What new exciting science would it enable?

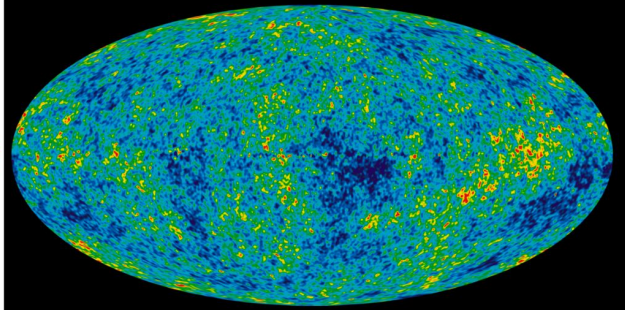
Main outcomes from discussion

- Why not a CE20? Design is almost “free”, very compelling argument
- Need a robust science case for a third XG detector, to be framed carefully

Detecting Baryon Acoustic Oscillations



Combined posterior field 1year 3G detector network



CMB - WMAP

$$\theta \sim \frac{r_s}{(1+z)D_A(z)}$$

Sumit Kumar

https://iopscience.iop.org/article/10.3847/1538-4357/ac5e34 1

How can you get involved?

- Join the CE Consortium!
  https://cosmicexplorer.org/consortium.html

- Participate in the CE Science Calls (~monthly)
  https://cosmicexplorer.org/sciencecalls.html

- Join the CE Project… the next round of proposals is in the works!