Private/Public Partnerships: Simons Foundation and Astronomy

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SIMONS FOUNDATION

Simons Foundation's mission is to advance the frontiers of research in mathematics and basic science

Simons Foundation and Simons Foundation International exists to support discovery-driven scientific research in pursuit of understanding the phenomena of the world. The combined annual budgets of the two foundations is ~700M$ with over 2750 gifts and grants per year.

I serve as President of both SF and SFI. SF staff include six members of the NAS

Our support of science takes two forms: We support research grants to individual investigators and their projects through academic institutions, and with the launch of the Flatiron Institute in 2015, we now conduct scientific research in-house with teams of computational scientists.

Jim and Marilyn Simons,
SF co-founders

The primary areas of scientific support for Simons Foundation are mathematics, physics, neuroscience and autism, and ecology and evolutionary biology. Simons Foundation also supports Quanta magazine, Transmitter magazine, Sandbox films, and programs support education. Education programs are focused in NY.

SF and SFI have an international reach

While the bulk of the SF scientific grants support researchers in the US, over 20% of SF and SFI funds support international scientists and institutions.

SF and SFI are major supporters of IHES in Paris, ICTP in Trieste, as well as institutes in Bulgaria, UK, Ireland, Canada, India and Australia.

SF and SFI are currently in discussion with ICTP about a major gift to enable the purchase of housing for scientific visitors.

SF and SFI support anthropology research in Kenya, telescopes in Chile and South Africa, autism research in Denmark and Israel, refugee physicists from Gaza, Afghanistan, and Ukraineand research on solar radiation management in Switzerland and South Africa.

SF and SFI support scientists in Ukraine and have been active in efforts to rebuild its academic institutions. We are supporters of scientific refugees from many countries.

Role of philanthropy

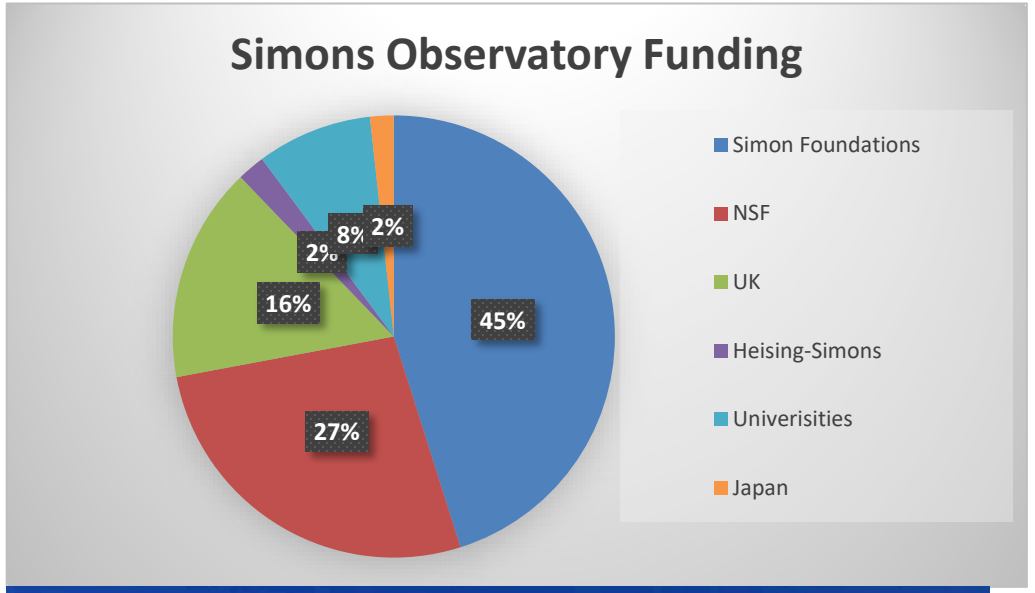
- Philanthropy can fund projects that are difficult for Federal agencies to fund
  - Too risky
  - Controversial
  - Crosses boundaries (typical, international)
  - Early funding (SDSS, Rubin, Simons Observatory)
  - Respond fast (Ukraine, IAU GA, ICTP in Trieste)
- Philanthropy can partner with Federal Agencies to enable them to launch new programs
  - Often enable agencies to access new funds
  - Partner by funding international aspects of projects (Ukraine)
- Some projects are started by NSF ([k]ITP); Other projects are started by foundation funding (Rubin); and others are started by joint efforts

Simons Foundation and Astronomy

- ArXiv
- Center for Computational Astrophysics
- Support of African scientists at IAU General Assembly
- Support of Ukrainian astronomers in Kyiv and Lviv
- NSF/Simons Astronomy & AI Centers:
  - Cosmic Origins (UT Austin)
  - AI Institute for the Sky (Northwestern)
- Collaborations:
  - Learning the Universe
  - Extreme Electrodynamics of Compact Sources
- HIRAX: South African led 21 cm experiment
- CCA partner in Terra Hunting Experiment
- 24 Simons Investigators in Astrophysics
- Simons Observatory

Simons Observatory

- Started as SF-funded project with Heising-Simons and institutional support
- Large Aperture Telescope + 3 Small Aperture Telescopes in initial design (Now, 4).
- Grew with UK + Japanese support. Now, 6 SATs
- NSF Support enables Advanced Simons Observatory. Green telescope with longer operations and increased sensitivities
- LAT optimized for smaller angular scale; SATs for large angular scales (gravitational wave signature in CMB polarization)
- Initial private investment grew to multinational collaboration
  - 350 scientists (6 UK institutions with 72; 7 Japanese institutions with 27 scientists)
  - ~$200M project with multiple contributors

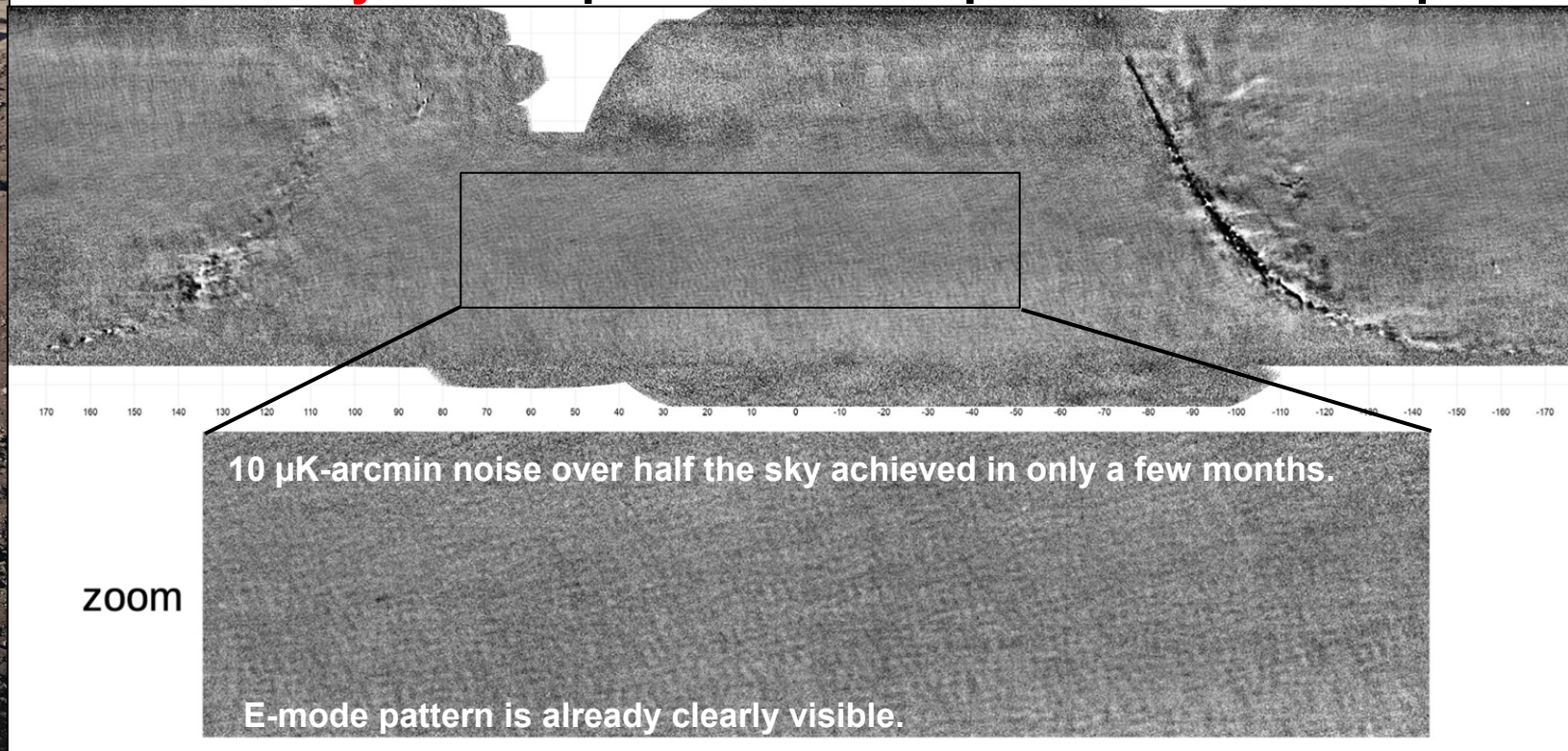


Small Aperture Telescopes Operating and Exceeding Requirements

- The SO SATs represent **the most sensitive CMB observatory in existence**.
- Measured Noise and Observations show **SO is on track to deliver its promised science with high signal to noise maps of CMB polarization.**
- **Beam systematic effects are approaching 10x smaller** than what is seen in the competing experiments. This will greatly simplify its analysis.

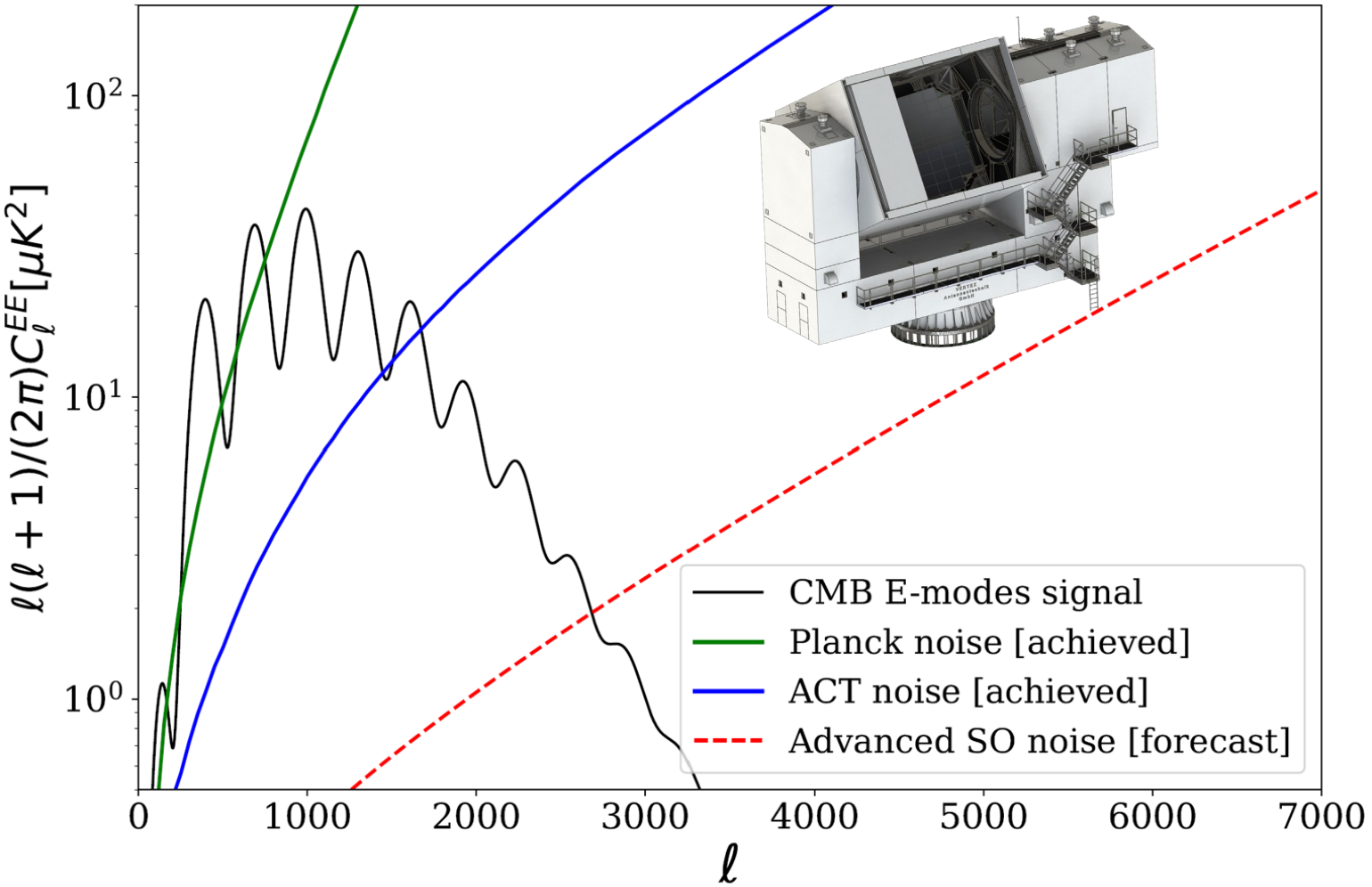
SO is projected to be Fully Operational mid-2025

Preliminary Small Aperture Telescope Polarization map



Large Aperture Telescope Science

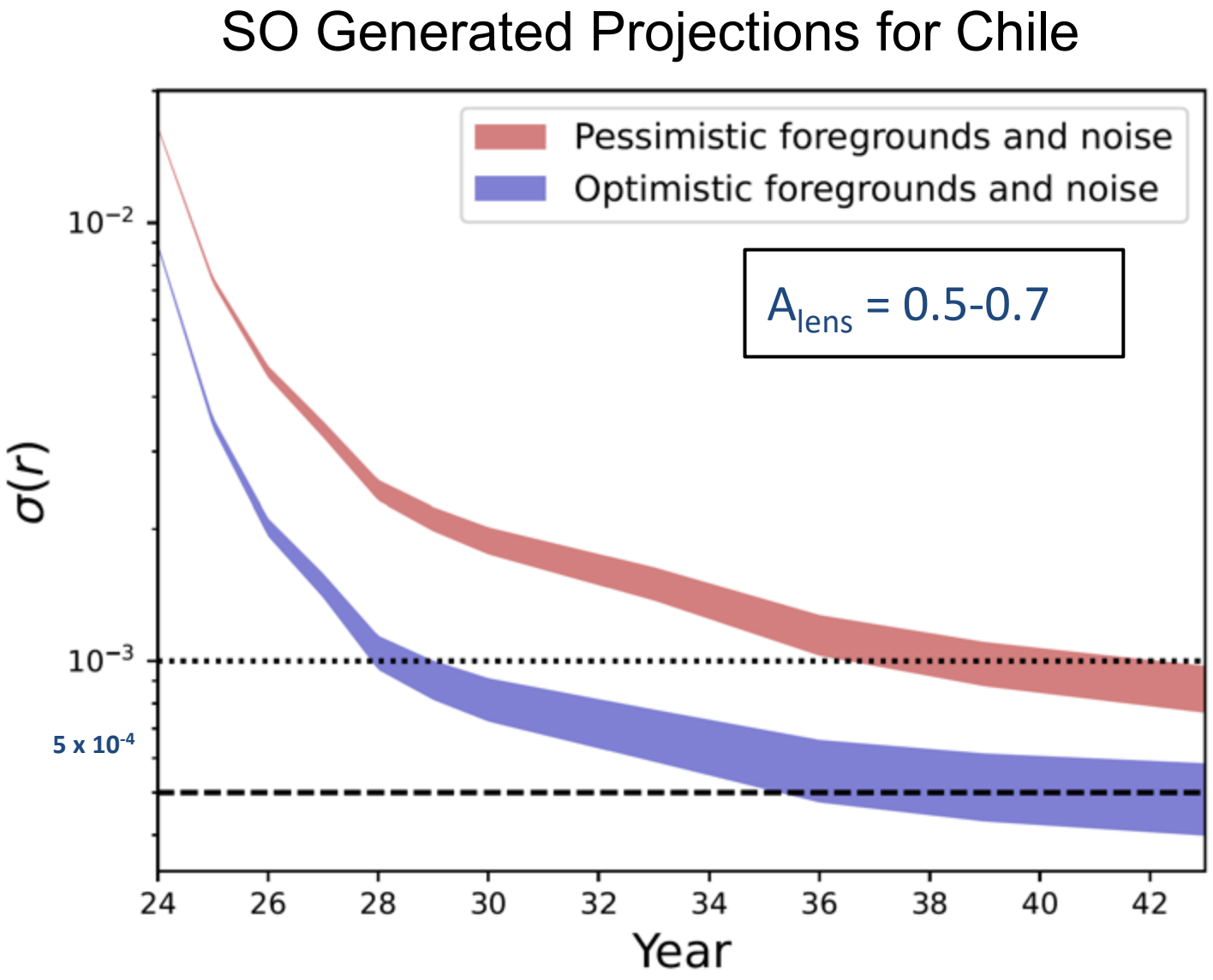
High-resolution, 20,000 deg^2 Legacy Maps of the Millimeter-wave Sky to 2.5 μK-arcmin



	Current[b]	SO 2025–2034
Primordial perturbations		
n_s	0.004	0.002
$e^{-2\tau}\mathcal{P}(k = 0.2\,\mathrm{Mpc}^{-1})$	3%	0.4%
$f_{\mathrm{NL}}^{\mathrm{local}}$	5	1
Relativistic species		
N_{eff}	0.2	0.045
Neutrino mass		
Σm_ν (eV, $\sigma(\tau) = 0.01$)	0.1	0.03
Σm_ν (eV, $\sigma(\tau) = 0.002$)		0.015
Accelerated expansion		
$\sigma_8(z = 1 - 2)$	7%	1%
Galaxy evolution		
η_{feedback}	50–100%	2%
p_{nt}	50–100%	4%
Reionization		
Δz	1.4	0.3
τ	0.007	0.0035
Cluster catalog	4000	33,000
AGN catalog	2000	100,000

+ **Galactic Science**
+ **Transients**
+ **Planet 9 and Our Solar System**

A Path for B-Mode Measurements from Chile

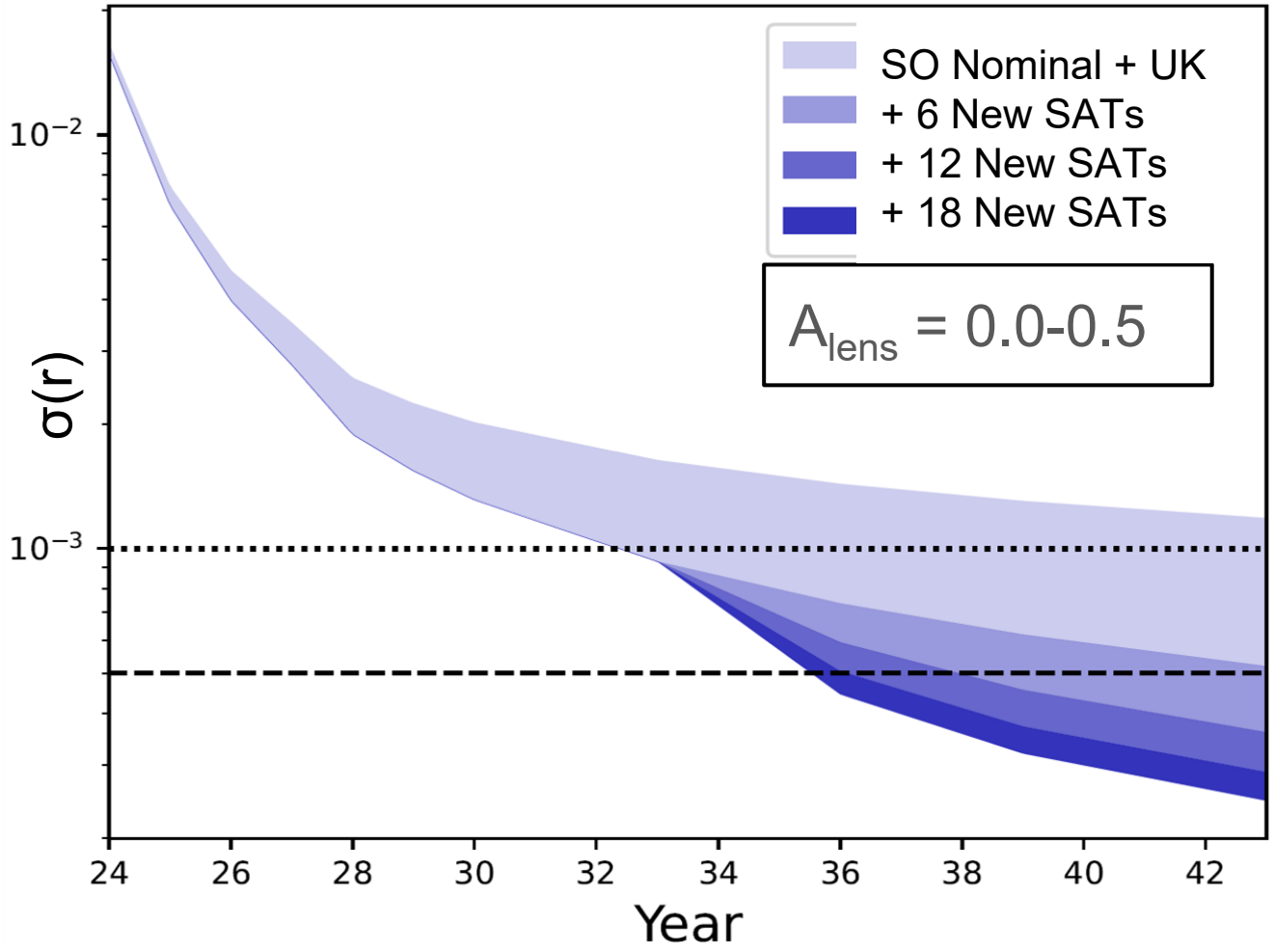


The **CMB S4** Analysis of Alternatives estimated **27 SO-like SATs**. A new analysis is underway which takes advantage of the actual SO design.

Here we show **σ(r) projections** for the planned **six SO SATs** (including SO:UK and SO:Japan).

Six additional SATs (12 total) observing for **10 years starting in 2033** would increase the probability of achieving **σ(r) = 0.0005.** This assumes an additional LAT-like telescope(s) for delensing.

SO Generated Projections for Chile Assuming Pessimistic Foregrounds and Noise Models



The **CMB S4** Analysis of Alternatives estimated **27 SO-like SATs**. A new analysis is underway which takes advantage of the actual SO design.

PRELIMINARY **SO σ(r) projections** for the planned **six SO SATs** (including SO:UK and SO:Japan) are shown.

PRELIMINARY **SO σ(r) projections for 6, 12 and 18 additional SATs** observing for **10 years starting in 2033** are shown for reference. Achieving this assumes an additional LAT-like telescope(s) for delensing.

The lower limit for σ(r) in all cases is the case of perfect delensing.

SO and a Staged Approach to CMB-S4

- Chile seems to be a promising site for search for gravitational wave signatures and small scale CMB (including delensing)
- Potential to achieve CMB-S4 goals cheaper and faster
- Need to bring teams together and encourage DOE cooperation
- Staged approach of Chile first followed by SP later.
- Deploying the new instruments at the SO site would advance the timeline and dramatically save on costs.
    - The SO team has decades of experience at the site which would reduce cost and risk.
- Simons Foundation is eager to be supportive of collaboration with Federal and international funding agencies. Merge projects on 2028-2032 timeframe

Thank you.

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