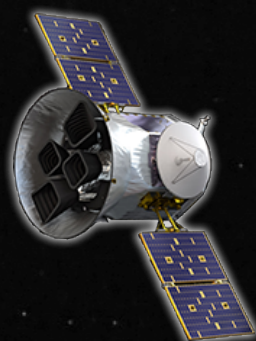


# Songs from Extrasolar Spaces

An Evening of Music  
Inspired by **TESS**, the  
**T**ransiting **E**xoplanet  
**S**urvey **S**atellite, an  
MIT-led NASA mission  
to discover new planets



Featuring  
**Lorelei Ensemble**

**July 30 | 8:00 PM**  
**MIT Kresge Auditorium**



**NORTHROP GRUMMAN**

ARTS  
CENTER FOR  
ART, SCIENCE &  
TECHNOLOGY  
AT MIT

**MIT** MUSIC &  
**MTA** THEATER  
ARTS

**Lorelei**  
ensemble



# ABOUT THE PRODUCTION

Thank you for taking part in tonight's concert, *Songs from Extrasolar Spaces*. This concert is part of a larger exploration of extrasolar spaces, the *TESS* Science Conference, presenting results from the *TESS* data in its first year of observing the night sky. Tonight's talks and music program reframe the myriad *TESS* discoveries in their wider human context along a familiar axis of inquiry, song and the human voice.

I first had the idea for this concert when *TESS* "opened its eyes" to the stars last summer. I wanted to create a space where we could all revel in the discoveries *TESS* has made, and begin to dream of what we hope to learn next from the nearby worlds *TESS* has found.

To put together this program of music, I partnered with MIT composer Elena Ruehr who distilled the abundant marvels *TESS* has found into two new vocal works premiering tonight, and established our collaboration with the Lorelei Ensemble. For the concert visualizations, I collaborated with Zach Berta-Thompson and Maria Guerrero to collect different kinds of measurements of changes in light and arrange them into a visual backdrop for the music.

I would like to thank Elena, for her partnership in creating this concert; Jonathan Lang and the Music and Theater Arts department staff; the *TESS* team and the MIT Kavli Institute for Astrophysics and Space Research; and especially our sponsors, Lockheed Martin and the Fay Chandler Faculty Creativity Grant from the Center for Art, Science & Technology at MIT.

— Natalia Guerrero

## What Is *TESS*?

*TESS* is a NASA Astrophysics Explorer mission led and operated by MIT in Cambridge, Massachusetts, and managed by NASA's Goddard Space Flight Center in Greenbelt, Maryland. Dr. George Ricker of MIT's Kavli Institute for Astrophysics and Space Research serves as principal investigator for the mission.

Additional partners include Northrop Grumman, based in Falls Church, Virginia; NASA's Ames Research Center in California's Silicon Valley; the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts; MIT's Lincoln Laboratory in Lexington, Massachusetts; and the Space Telescope Science Institute in Baltimore. More than a dozen universities, research institutes and observatories worldwide are participants in the mission.

# ABOUT THE PRESENTERS

**Dr. George Ricker** is the Principal Investigator for the Transiting Exoplanet Sky Survey (*TESS*) Explorer mission. He is currently the Director of the Detector Laboratory and Senior Research Scientist at the MIT Kavli Institute for Astrophysics and Space Research. *TESS* is the 5th scientific satellite for which he has served as an instrument or mission PI. Dr. Ricker received his undergraduate degree from MIT in physics, an M.S. in astronomy from Yale University, and a Ph.D. in physics from MIT.

**Sara Seager**, *TESS* Deputy Director of Science is a planetary scientist and astrophysicist at MIT where she is a Professor of Planetary Science, Professor of Physics, Professor of Aerospace Engineering, and holds the Class of 1941 Professor Chair. She has pioneered many research areas of characterizing exoplanets with concepts and methods that now form the foundation of the field of exoplanet atmospheres. Her present research focus is on the search for life by way of exoplanet atmospheric “biosignature” gases.

**Natalia Guerrero** graduated from MIT in 2014 with a degree in physics and a minor in writing. She started on *TESS* doing flight testing of the four *TESS* cameras. She now manages the team identifying *TESS* Objects of Interest (TOIs) from the millions of stars *TESS* observes. She also coordinates and participates in *TESS* panels, talks, and interviews for a diverse range of media outlets and educational programs. Natalia is committed to creating interdisciplinary works of art and science centered around the human relationship with the night sky, and the different ways in which we question it in order to gain understanding of ourselves.

# THE LORELEI ENSEMBLE

BETH WILLER, Artistic Director

Sarah Brailey, soprano

Sonja Tengblad, soprano

Meg Dudley, soprano

Carrie Cheron, mezzo-soprano

Christina English, mezzo-soprano

Clare McNamara, mezzo-soprano

Clara Osowski, alto

Emily Marvosh, alto

**Lorelei Ensemble creates and champions bold artistic work that points toward a new normal for women in music.** We are deeply committed to crafting musical experiences that are transformative — for us, our audience, and our art form. Through commissioning, performance, and education, Lorelei is carving out a boundless new space for women to be among, and become, our most powerful and important creators.

Heralded for its “warm, lithe, and beautifully blended” sound (*New York Times*), “impeccable musicality” (*Boston Globe*) and unfailing display of the “elegance, power, grace and beauty of the human voice” (*Boston Music Intelligencer*), Boston’s Lorelei Ensemble is recognized nationally for its bold and inventive programs that champion the extraordinary flexibility and virtuosic capability of the human voice.

Lorelei is an all-professional vocal ensemble, comprising nine women whose expertise ranges from early to contemporary repertoire, and whose independent careers as soloists and ensemble singers across the globe lend to the rich and diverse vocal palette that defines the ensemble’s thrilling delivery of “exact, smooth, and stylish” programming (*Boston Globe*). Under the direction of founder and artistic director Beth Willer, Lorelei has established a remarkable and inspiring artistic vision, curating culturally-relevant and artistically audacious programs that stretch and challenge the expectations of artists and audiences alike.

Lorelei has commissioned and premiered more than fifty new works since its founding in 2007, while also exposing and reinventing early works of the Medieval, Renaissance, and Baroque repertoires.

Driven by their mission to advance and elevate women's vocal ensembles and to enrich the repertoire through forward-thinking and co-creative collaboration, Lorelei partners with established and emerging composers to create new works that point toward a "new normal" for vocal artists, and women in music.

Based in Boston, Lorelei frequently joins forces with local artistic organizations to enrich the city's vibrant music scene. Collaborating ensembles include the Boston Symphony Orchestra, Tanglewood Music Center, A Far Cry, Boston Modern Orchestra Project, Odyssey Opera, Grand Harmonie, Boston Percussion Group, and Juventas New Music. In addition to its work in and around Boston, Lorelei maintains a national touring schedule, enjoying performances on numerous concert series, venues, and institutions across the country. Appearances include Carnegie Hall, the Metropolitan Art Museum, Isabella Stewart Gardner Museum, Tanglewood Festival of Contemporary Music, Trinity Wall Street, Five Boroughs Music Festival, Rockport Chamber Music, Chamber Music Columbus, Duke Performances, Schubert Club of St. Paul, Louisville Chamber Music Series, Monadnock Music Festival, Kent Hall Masters Series, and guest appearances at state and national conferences.

Educational residencies have included work with young artists at Harvard University, Bucknell University, Yale University, Duke University, Macalester College, Pittsburg State University, Mount Holyoke College, Hillsdale College, Keene State College, Pennsylvania Girlchoir, Connecticut Children's Chorus, and Providence Children's Chorus.

# PROGRAM

**From *Atlas: an opera in three parts***

Meredith MONK (b. 1942)

*Other Worlds Revealed*

*Earth Seen from Above*

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*Exoplanets* (World Premiere)

Elena RUEHR (b. 1963)

Text: based on titles of *TESS* papers  
compiled by Natalia Guerrero

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*Stellar Atmospheres* (World Premiere, SSSSAAAA version)

Molly HERRON (b. 19???)

Text: after Cecilia Payne

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*Home Again* (World Premiere)

John HARBISON (b. 1938)

Text: John Harbison

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*Not from the Stars* (World Premiere)

Elena RUEHR (b. 1963)

Text: Shakespeare

# FROM THE COMPOSERS

## MONK | Selections from *ATLAS' PART III: Invisible Light*

This suite of a cappella pieces was originally composed by Meredith Monk in 1987 as part of a work entitled, *The Ringing Place*. Later, she included sections of *The Ringing Place* in *Part III: Invisible Light* of her opera *ATLAS: an opera in three parts*. *The Ringing Place* dealt with sound in space; how one could activate a space by singing so that the space itself would reverberate. Each piece was performed in a different configuration relating to the space and its sonic aspects.

From Meredith Monk: "I thought of *Other Worlds Revealed* as the anthem of this resonant world of sound. In a sense *Other Worlds Revealed* was meant to reveal the expanse and transparency of a unique sonic realm that would later be extended in the rest of the composition. The principle of *Other Worlds Revealed* is that the notes of the melody are passed from one person to the next in canon creating a shimmering effect. Each singer holds her note until the next note is passed to her by the previous person in line."

Today, Lorelei Ensemble performs two of the pieces from this Suite.

## RUEHR | EXOPLANETS

*Text compiled by Natalia Guerrero, based on titles of TESS papers*

the first  
smallest  
longest-period  
transiting  
massive  
eccentric  
inflated  
puffy  
**exoplanet**  
a hot Jupiter  
super Earth  
sub-Neptune  
Saturn  
mini-Neptune  
hot Earth  
**exoplanet**



A hot  
rocky  
large  
giant planet  
Orbiting  
sub-giant  
star

A hot Saturn

Oscillating

**exoplanet**

*Text for this song was taken from scientific documents describing exoplanets, using some artistic license to create a poetic story. This is not a description of one specific exoplanet but rather a broader, holistic impression. The inspiration for the music came from images from space.*

— Elena Ruehr

## **HERRON | STELLAR ATMOSPHERES**

*Text by Molly Herron, after Cecilia Payne*

*Cecilia Payne (later Payne-Gaposchkin) was one of the first students to enroll in Harvard's graduate astrophysics program in 1923. In 1925, she published one of the most transformative dissertations in the history of astrophysics Stellar Atmospheres, A Contribution to the Observational Study of High Temperature in the Reversing Layers of Stars. The work made inferences about the stars based on their spectra which upended contemporary knowledge about the universe's chemical composition. The text for Stellar Atmospheres is taken from Payne's thesis; largely from the exhaustive data sets she presents.*

*Both scientists and artists often find themselves in places of confusion and obscurity where a hunch is the only thing directing their steps. Abstract processes, mental leaps, and new paths are called for to find the way forward. Payne-Gaposchkin's brilliant work is exemplary for its course, not only its conclusions, and her thesis is an inspiration to me in my own, very different work.*

— Molly Herron, 2019

## HARBISON | HOME AGAIN

*Text by John Harbison*

Home again, we're home again,  
we have been so long away.  
We can see the clouds by day,  
and see the stars  
as we search the night  
for light we lost for years  
in a city far too bright.  
Now we need to let go of the past  
and know we're home at last.

*I was just finishing the brief pop-song Home Again when my friend Elena Ruehr asked me if I had any vocal music in which home-nature-the stars had any role. On the chance that it might be suitable for the Lorelei performance in which Elena was involved I made a three voice arrangement.*

**— John Harbison**

## RUEHR | NOT FROM THE STARS

*Text by William Shakespeare, Sonnet 14*

Not from the stars do I my judgement pluck;  
And yet methinks I have Astronomy,  
But not to tell of good or evil luck,  
Of plagues, of dearths, or seasons' quality;  
Nor can I fortune to brief minutes tell,  
Pointing to each his thunder, rain and wind,  
Or say with princes if it shall go well  
By oft predict that I in heaven find:  
But from thine eyes my knowledge I derive,  
And, constant stars, in them I read such art  
As truth and beauty shall together thrive,  
If from thyself, to store thou wouldst convert;  
Or else of thee this I prognosticate:  
Thy end is truth's and beauty's doom and date.

*This poem, in my interpretation, asks us to put aside astrological determinism and to see the reality of our universe for what it is. "Not from the stars do I my judgment pluck...But from thine eyes my knowledge I derive." While we may look at the stars to try to see our fates, we are better off understanding them scientifically.*

**— Elena Ruehr**

# ACKNOWLEDGMENTS

*Coming from Natalia by 7/24...*



[www.mta.mit.edu](http://www.mta.mit.edu)