

BIG BANG SCIENCE FAIR @WATERFIRE PROVIDENCE

Ulrich Heintz, Meenakshi Narain – *Brown University*

Connie Potter – *CERN and the The Big Bang Collective*

Chris Thomas – *Iowa University and the The Big Bang Collective*

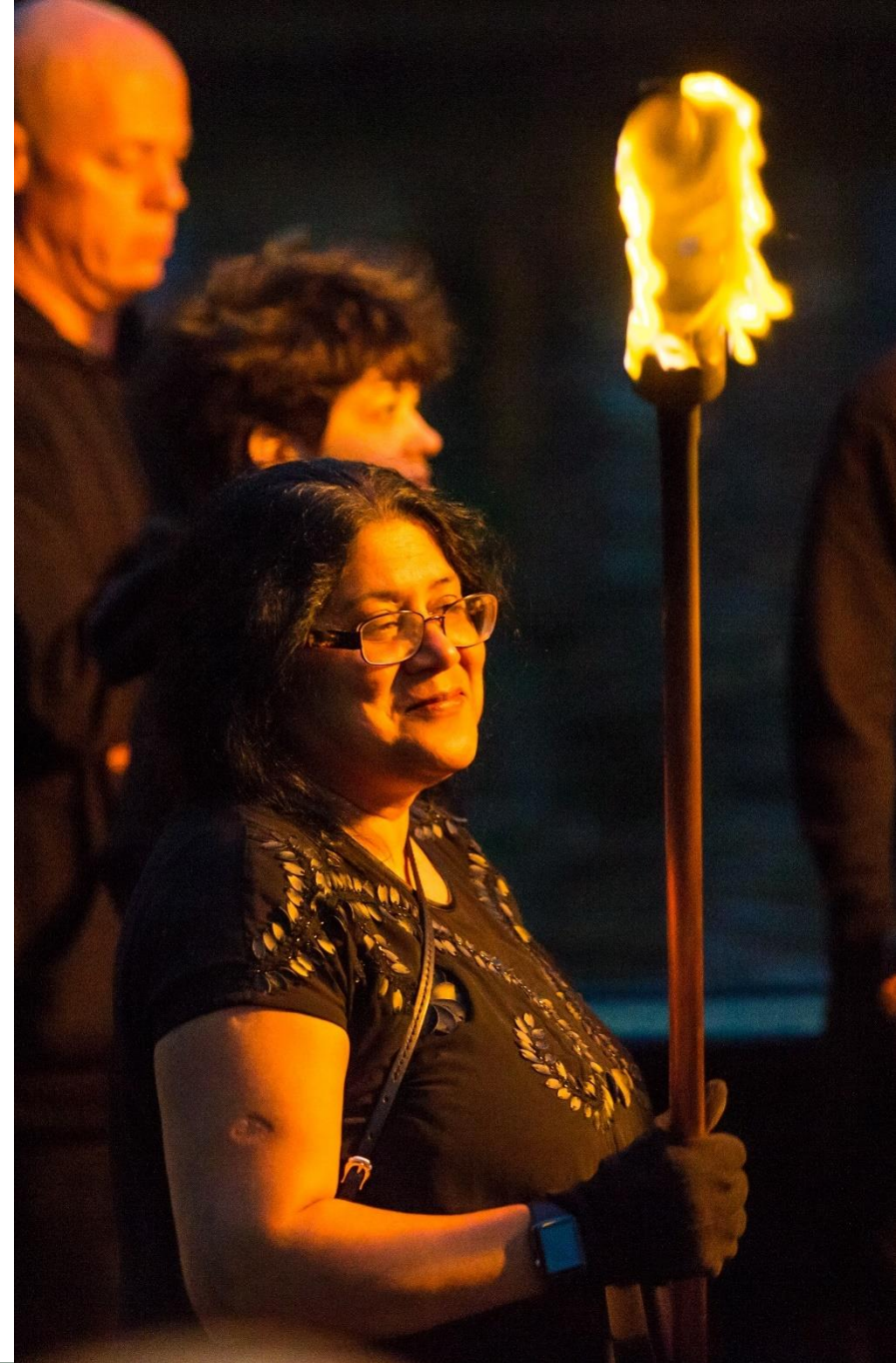
WaterFire Providence

- WaterFire Providence® is an independent, ... non-profit arts organization whose mission is to inspire Providence and its visitors by revitalizing the urban experience, fostering community engagement and creatively transforming the city by presenting WaterFire for all to enjoy (from <https://waterfire.org/>).
- WaterFire is an award-winning sculpture by Barnaby Evans installed on the three rivers of downtown Providence. About 100 braziers light about a dozen times (usually Saturday nights) and attract about 1.1 million people to Providence each season.



The vision

- Promote Science for the public in collaboration with Art, Design and Music
- Take science to a large audiences who is not necessarily science-minded
- Promote appreciation of science as a normal part of everyday life rather than something reserved for an academic elite
- Target diverse audiences (girls and under represented minorities)
- WaterFire is an ideal venue to supply the audience
- Organize an evening full of fun and excitement
 - Lecture-demos by world renowned scientists
 - Hands-on science, art, and design activities
- Goal: establish the Big Bang Science Fair as an annual event!



The people

- Main organizers: Meenakshi Narain (Brown U, CMS) & Connie Potter (CERN, ATLAS)
- Plus
 - Carlos Aizenman (Brown University)
 - Geeta Chougule (Brown University)
 - Gelonia Dent (Brown University)
 - James S. Gates (Brown University)
 - Geoffrey Gunter (Citizens Bank)
 - Ulrich Heintz (Brown University)
 - Stephanie Mott (Bryant University)
 - List of organizers: <https://www.brown.edu/academics/physics/event-organizers>
- 180 Volunteers
 - from Brown University, U Mass Amherst, local high schools, neighbors, friends and family ...



The sponsors

- Nothing happens without funding...



BROWN

Office of the President,
Office of the Provost,
The Science Center,
The Physics Department,
Office of Institutional Equity and Diversity,
Carney Institute for Brain Science,
Data Science Initiative, ICERM,
Athletics Department, Ladd Observatory
Northeast Planetary Data Center



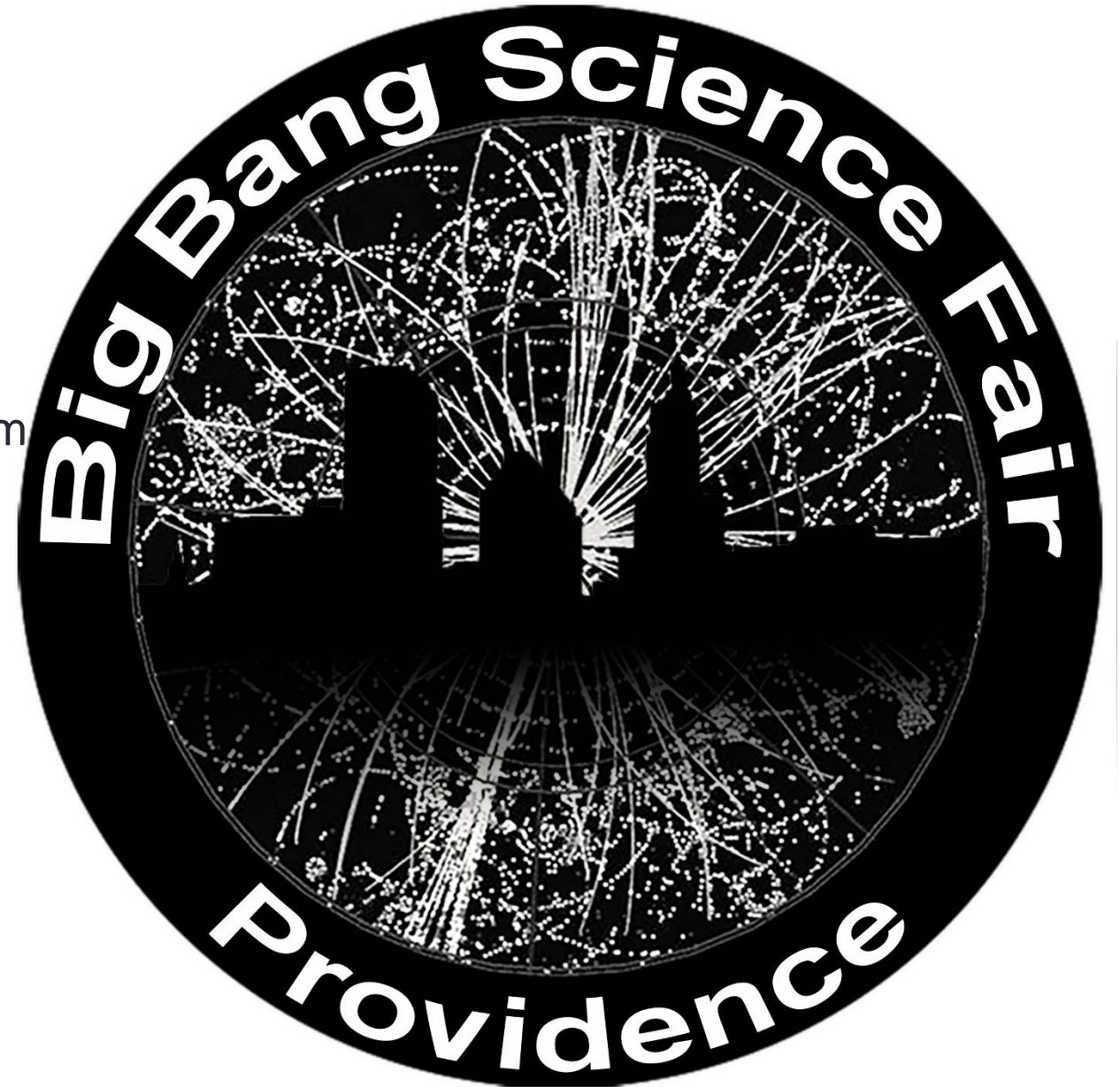
THANK YOU FOR YOUR GENEROUS SUPPORT

<https://www.brown.edu/academics/physics/sponsors>




The branding

- We needed a name
 - Science lighting?
 - The Universe at the Micro-Macro Scales?
- Then we needed a logo
 - which didn't conflict with the WaterFire trademark



The program

- September 22, 2018, from 3 – 11pm
 - <https://waterfire.org/big-bang-science-fair-at-waterfire-providence-on-september-22-2018/>
- Presentations
 - 6 lecture presentations in RISD auditorium
- Workshops in big tent on market square
 - Theremin
 - Cloud Chamber workshops
 - CS
 - bb8 droids,
 - Zombie, arduino coding
 - Game design using Scratch
- Hands-on-activities all over market square
 - Telescopes
 - Neuroscience
 - RI Museum of Science and Arts
 - Chemistry
 - CS4RI
 - Neutrinoscope
 - Science of Cooking
 - Physics demos



BIG BANG SCIENCE FAIR

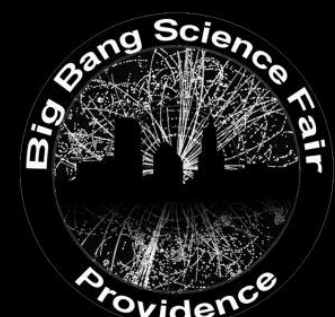
WaterFire Providence
September 22, 2018 - 3pm - 10pm

Market Square
Exciting walk-up activities (for all ages)
Star-gaze with local astronomers
Blend science and art with RIMOSA
Experience the wonders of the brain
Design your own circuitry and code robots
Take a selfie in the tunnel of the Large Hadron Collider
See the invisible neutrinos penetrate Earth
The science of cooking

Workshops at "The Lab" (space limited, come early to reserve tickets)
Play the "Theremin" without touching it
See the "cosmic rain" using a fish tank
Talk to your BB-8 droid or defeat the Zombies

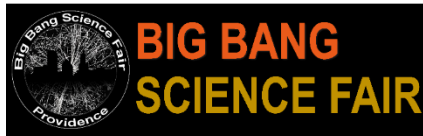
RISD Auditorium
World-renowned scientists talk about topics from "Understanding our Universe" to "How Drugs rewire your Brain"
Micky Dolenz of The Monkees lets you in on a secret: his lifelong passion for science
Discover the "Theremin" used in spy surveillance to making music
Find your way without using GPS or Google Earth
Listen to a jazz performance to the themes of "God Particle", "Black Holes" and more

And many more demonstrations illustrating the wonders of science
See website for program and ticket info: <https://waterfire.org/bigbangsciencefair>



The signage

- Every tent was named after a famous female scientist



**BIG BANG
SCIENCE FAIR**

Marie Curie Tent
Amazing Science

Host: The Science Outreach Team
U. Mass (Amherst)

Table of Optics

6:00—9:00 PM

The table of optics will amaze you with mysterious mirages, disappearing beakers and bending light! You won't want to miss out on this sight.

Table of Fluids

6:00—9:00 PM

The water you wash in and the juice you drink are everyday liquids...but have you ever interacted with *abnormal* liquids? Come find out how a "liquid" called "oblek" is different than any other liquid you've ever seen. Also, discover some interesting features of the liquids you know and love!

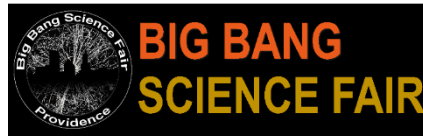
Table of Materials

3:00—11:00 PM

How many different types of materials can you name? Now, how many of those can you identify by touch? Try out your hand at these games centered around granular materials and get a feel for what they can do!

About Marie Curie

Born in 1867, Marie Curie was not only the first woman to win a Nobel Prize (1903), but also the first scientist to win the award twice (1911)! Marie's pioneering work as a chemist and physicist laid the foundation of modern day atomic physics, as well as for x-rays. Her impact has yet to cease as many honors and awards are dedicated in her name to this day.



**BIG BANG
SCIENCE FAIR**

Maria Goepfert Mayer Tent
Innovate by Merging Art with Science

Host: Rhode Island Museum of Science and Arts

Flight Tube

3:00—11:00 PM

Experiment with turbulent air flow! Toss objects into the air tube and watch as they spin, float, sink or fly in the wind.

Shadow and Light

3:00—11:00 PM

Make giant shadow plays! Use an overhead projector, colored flashlights, and found objects, to explore shadow, transparency, and illusion.

Light Pendulum Exhibit

3:00—11:00 PM

Play with glowing light! See the pendulum – an ultra-violet flashlight in motion – describe its path in glowing green light on the table below it.

STEAM Table Top Activities

3:00—11:00 PM

Doodlebots! Adjust drawing robots to alter the designs they make! Spirograph! Convert circular motion into geometric designs! Thaumotopes! Make optical illusions to take home!

About Maria G. Mayer

Born in 1906, Maria Mayer was a theoretical physicist who won the 1963 Nobel Prize for developing a mathematical model for nuclear structure. Despite physics being a male-dominated field, Maria persevered through obstacles in her career to become a full professor at UC San Diego where the Physics Department building is named in her honor.



**BIG BANG
SCIENCE FAIR**

Rita Levi Montalcini Tent
Neuroscience in Action

Hosts: The Carney Institute of Brain Science
Department of Neuroscience, Brown University
Brown Neuroscience Graduate Program

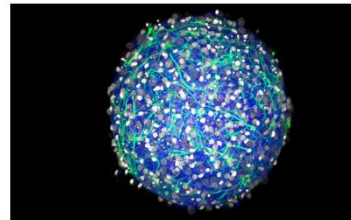
Mysteries of the Brain & Nervous System

3:00—10:00 PM

Experience the mysteries of the brain and nervous system through a series of hands-on activities and demonstrations including:

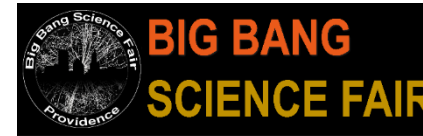
- Building your own neuron
- Measuring electrical responses from the nervous system
- Understanding the mysteries behind optical illusions
- Seeing a human-machine interface in action
- Exploring the anatomy of the human brain

...and more!



About Rita Montalcini

Born in 1909, Rita Montalcini grew up in Italy, living through World War II practicing medicine. Not one to let a war stop her passion, she acted as a doctor for soldiers on the field before returning to academia. She won a Nobel Prize in 1986 for her work on nerve growth of cancerous tissue. Her groundbreaking work provided insight into modern day cancer research.



**BIG BANG
SCIENCE FAIR**

Ada Yonath Tent
Cool Chemistry

Host: Chemistry Department, Brown University

Interactive Chemistry

3:00—10:00 PM

Get your hands busy with various chemistry tricks that are sure to keep you wanting more! We've got frozen bubbles, "PH painting," cabbage juice indicators, a floating bowling ball, levitating balloons and a wind tube!

Demonstrating Chemistry

3:00—10:00 PM

Sit back and relax as we amaze you with the quirks of chemistry! We're bringing to you a magic show inspired purely by chemistry. This will include—but is not limited to—dry ice clouds, magnesium rainbows, inflammable dollar bills, elephant's toothpaste, and more. Come to find out!

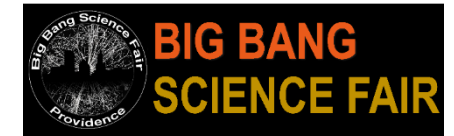
Observational Chemistry

3:00—10:00 PM

We've got several exhibits for those of you who simply want to view the beauty of chemistry in passing. Come admire the intricate workings of these chemical reactions—and feel free to ask us what exactly is going on!

About Ada Yonath

Born in 1939, Ada Yonath had to persevere through a tumultuous childhood while nurturing a growing scientific curiosity. Through hard work and determination, she eventually went on to graduate with degrees in chemistry, biochemistry and biophysics. She won the Nobel Prize (2009) in chemistry for shedding light on the structure and function of ribosomes, a key part of living cells.



**BIG BANG
SCIENCE FAIR**

Frances E. Allen Tent
Computer Science Activities

Hosts: CS4RI, RIDE and Citizens Bank

Pixel Art

3:00—11:00 PM

Turn the way images are represented into a series of numbers representing pixels. Each representation needs its own algorithm to get the image. Use your computational thinking skills to reveal a piece of art.

Paper Circuitry

3:00—11:00 PM

Build a functioning electronic circuit on a paper surface. Art techniques, such as origami, painting, or paper airplanes can fuse with circuitry to combine aesthetics and functionality.

Towers of Hanoi

3:00—11:00 PM

A mathematical game and puzzle that requires a little alternative thinking and some basic problem-solving skills. Give yourself the opportunity to see if you can solve the recursive problem.

About Frances E. Allen

Born in 1932, Frances earned an impressive series of titles throughout her career as a computer scientist. She became the first female IBM fellow, and, in 2005, she was the first female to win the most prestigious title in computer science, the Turing Award. She is noted for her work on compilers, program optimization and parallelization.

Will people sit in an auditorium for 30 min lectures?

Presentations and Performances

Location: RISD Auditorium



Making Music from Real-Time Scientific Data

3:00—3:50 PM

Juliana Cherston, MIT Media Lab

Finding Our Way

4:00—4:50 PM

Prof. John Huth, Harvard University

***Science-Fiction Soundtracks & Espionage:
The Theremini's Odyssey***

5:00—5:50 PM

Dorit Chrysler, NY Theremin Society

How Drugs Rewire Your Brain

6:00—6:50 PM

Prof. Karla R. Kaun, Brown University

My Life in Science

7:00—7:50 PM

Micky Dolenz, Actor & Musician from *the Monkees* with
Dr. Don Lincoln, Author & Physicist, Fermilab

Understanding Our Universe

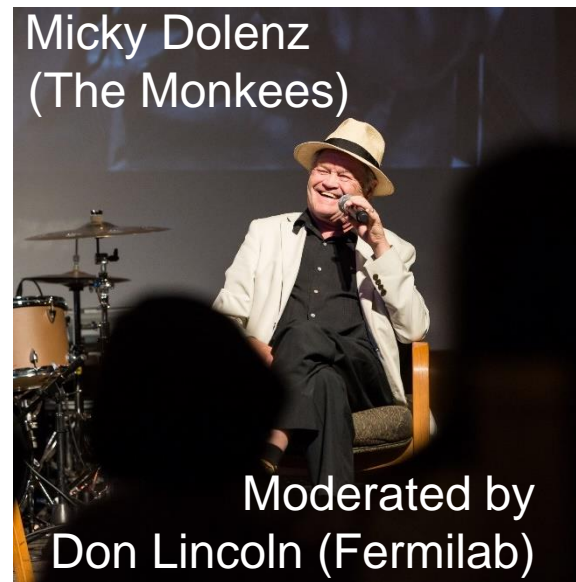
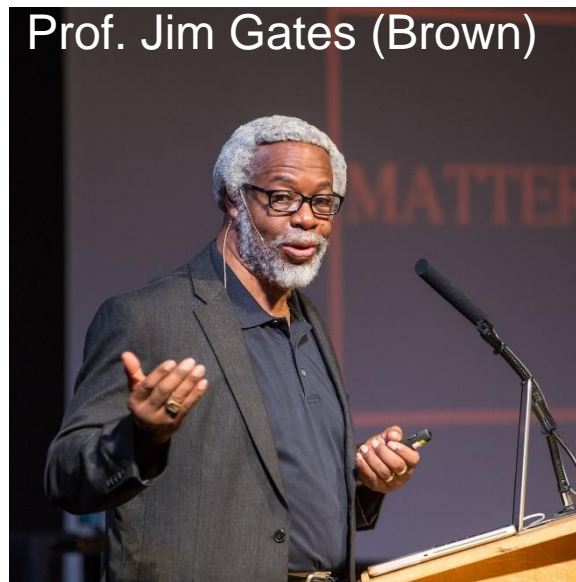
8:00—8:50 PM

Prof. S. James Gates, Brown University

"Comix Zones" Jazz Performance

3:00—3:50 PM

God Particle, band featuring Prof. Stephon Alexander
(Brown University) and Melvin Gibbs (Grammy
nominated bassist)



Will people sit in an auditorium for 30 min lectures?



Yes, they will!

Presentations and Performances

Location: RISD Auditorium

Making Music from Real-Time Scientific Data

3:00—3:50 PM

Julianna Cherston, MIT Media Lab

Finding Our Way

4:00—4:50 PM

Prof. John Huth, Harvard University

***Science-Fiction Soundtracks & Espionage:
The Theremini's Odyssey***

5:00—5:50 PM

DoriL Chrysler, NY Theremin Society

How Drugs Rewire Your Brain

6:00—6:50 PM

Prof. Karla R. Kaun, Brown University

My Life in Science

7:00—7:50 PM

Micky Dolenz, Actor & Musician from *the Monkees* with
Dr. Don Lincoln, Author & Physicist, Fermilab

Understanding Our Universe

8:00—8:50 PM

Prof. S. James Gates, Brown University

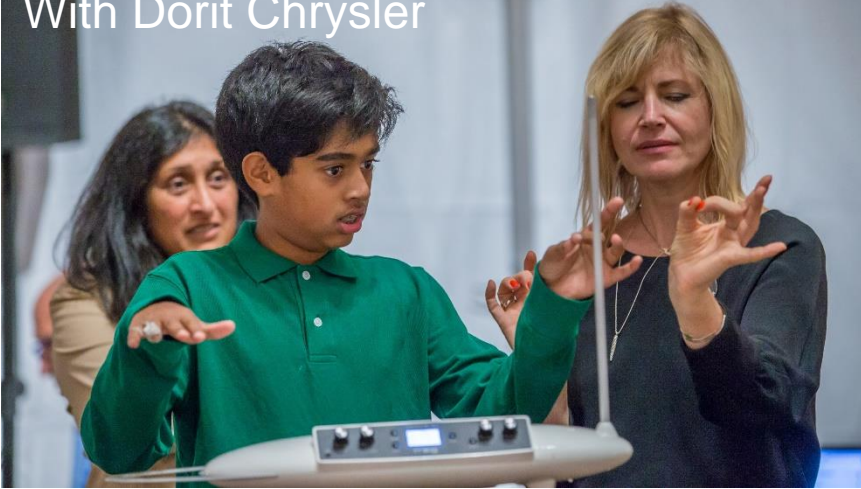
"Comix Zones" Jazz Performance

3:00—3:50 PM

God Particle, band featuring Prof. Stephon Alexander
(Brown University) and Melvin Gibbs (Grammy
nominated bassist)

The workshops – 1 hour-ling in depth activities

Hands off! How to play the Theremin
With Dorit Chrysler

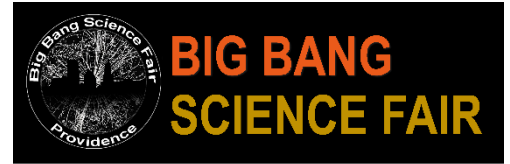


Talk to your BB8 droid



Defeat Zombies/Java and Raspberry Pi

See cosmic rain with cloud chambers



WORKSHOPS@THE LAB in Market Square

Tickets available at the door 30 minutes prior to each event.

Game Design with Scratch

3:00 - 3:50 PM
Hosts: Devovx4Kids USA and CS4RI
(Ages 6 to 12 to be accompanied by a parent)
Scratch (scratch.mit.edu) makes it easy to create interactive stories, animations, games, music, and art, and share these creations on the web. You will create fun and interesting Scratch programs. No programming experience required.

Talk to your BB-8 Droid

4:00 - 4:50 PM
Hosts: Devovx4Kids USA and CS4RI
(Ages 6 to 12 to be accompanied by a parent)
Star Wars may be science fiction, but it's getting closer to real life in this workshop. Sphero has made a real life version of the BB 8 droid. We will use block-based programming on a mobile app to program the droid.

Defeat the Zombies with Java and Raspberry Pi

5:00 - 5:50 PM
Hosts: Devovx4Kids USA and CS4RI
(Ages 6 to 12 to be accompanied by a parent)
Evil zombies have taken over the planet! You are one of the last survivors and need to retake the planet. Work with the other zombie exterminators in the lab to push back the undead with a Raspberry Pi, touchscreen, and Java.

"HANDS OFF!"—How to Play a Theremin

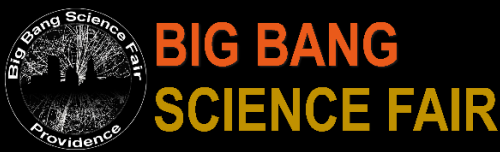
6:30 PM and 7:30 PM (two sessions)
Host: Dorit Chrysler, musicologist and composer
(Ages 10 and up)
The Theremin, an instrument played without touch, is considered mysterious and is known from science fiction soundtracks. Invented in 1919 by Russian physicist Lev Termen, the theremin transforms motion to sound.

Use Cloud Chambers to See the "Cosmic Rain"

8:30 PM and 9:30 PM (two sessions)
Hosts: U.S. CMS & U.S. ATLAS Experiments at CERN, Switzerland
(Ages 8 to 12 to be accompanied by a parent)
Our Universe is made of tiny particles that are invisible to us, but imagine if we could see them! We will build cloud chambers that make these tiny particles visible and we will discover that empty space is not as empty as we might think!



Take a selfie with the Large Hadron Collider



**BIG BANG
SCIENCE FAIR**

LHC Tunnel Picture

Snap a Selfie!

Hosts: U.S. CMS & U.S. ATLAS Experiment, CERN
CMS Experiment Team at Brown University

What is the LHC?

"LHC" stands for *Large Hadron Collider*. Let's break down these three words so you can understand what's going on:

1. The LHC is an underground tunnel 27 km (16.8 mi) around
2. "Hadron" is a term for a class of particles that includes the proton
3. The LHC collides protons from counterrotating beams in the tunnel

The Large Hadron Collider is the largest experimental apparatus in the world. It is located deep underground on the border of France and Switzerland.

How was the LHC built?

The LHC resides in the tunnel of a former particle collider known as the Large Electron-Positron Collider. Construction of the LHC began in 1995 and it had its first collisions in 2008. The construction of this project required thousands of scientists, engineers, and technicians, and a \$9 billion budget.

How are the protons made to collide?

The main component of the Large Hadron Collider is its magnet system which is contained inside the tunnel. The magnets direct and focus the beams. However, the particles are accelerated by a fluctuating electric field. This system requires precise alignment to ensure that the particles actually collide and not just fly by one another!

Who works at the Large Hadron Collider?

Scientists from all over the world work at the Large Hadron Collider, and many more work remotely from their home institutions—like the physicists at Brown University! In fact, it takes thousands of scientists to operate the collider and the four different detectors located around the ring. In total, over 11,000 scientists are involved with projects at CERN, representing over 100 different countries...one day it could be you!

Want to know more?

Please feel free to ask one of us scientists wearing an "Ask a Scientist" button about the Large Hadron Collider. We will do our best to answer all your questions!



**BIG BANG
SCIENCE FAIR**

The CMS Experiment

A Detector at the Large Hadron Collider

Hosts: U.S. CMS Experiment CERN
CMS Experiment Team at Brown University

What does CMS stand for?

CMS stands for Compact Muon Solenoid. CMS is a particle detector situated at the Large Hadron Collider in Geneva, Switzerland. In spite of the name, it is rather large, 70 feet long, 50 feet wide, 50 feet high, and it weighs 14,000 tons! So, why do we call it 'compact'? We tightly packed hundreds of thousands of electronics components into it that allow us to take detailed pictures of the particles that emanate from the powerful collisions in the center of the detector.

What are the components of CMS?

CMS consists of four nested layers of detectors, each specializing in measuring different types of particles. The innermost layer is called the silicon tracker and it tracks charged particles; the next layer is the electromagnetic calorimeter which specializes in detecting electrons and photons (light); the third layer is the hadron calorimeter which detects heavier particles such as protons or neutrons; the outermost layer is the muon detection system, which detects muons, a type of particle which penetrates all the other layers. By utilizing images from all four layers, CMS scientists can reconstruct what happens in a particle collision!

Want to know more?

Please ask a scientist wearing an "Ask a Scientist" button about the CMS Experiment. We will do our best to answer your questions!



Sidewalk astronomers



Fun and Excitement for all ages

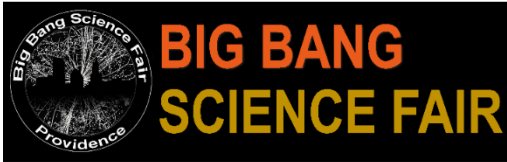


The audience

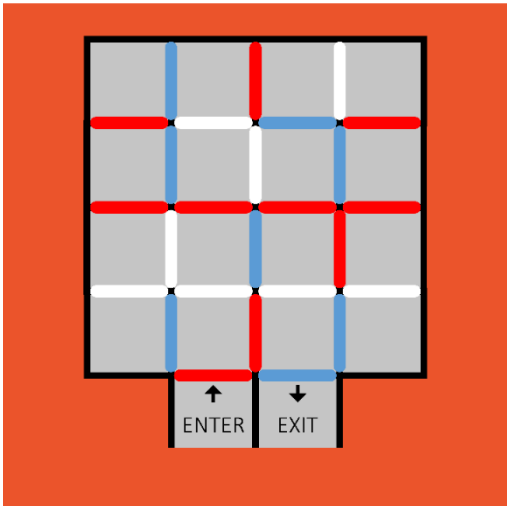
- Attended by 4000+ people.
 - We counted attendance by giving out stickers and stopped counting after 4000
 - Time lapse video <https://youtu.be/Tdqe5oCwLPM>



The maze



Red-White-Blue Maze



We saw this at the National Museum of Math in New York City and we loved it. Step over the balloons in the order red, white, blue, red, white, blue,
Can you find the exit?



Feedback collection

- We gave out feedback forms at the workshops and at the RISD auditorium
- Almost all forms checked
 - Yes – enjoyed the presentations
 - Level just right
- Only a few forms had comments
 - Mostly from RISD lectures
 - All comments were positive
- Is there a better way to do this?

Feedback Form Presentations @RISD Auditorium
BIG BANG SCIENCE FAIR at WaterFire Providence, Sep 22, 2018

We want to hear your thoughts about your experience; good or bad. Thanks!

Title of Presentation

- Did you enjoy the presentations? YES NO
- Was the duration and level of the talk/activity?
Just right Too complicated/too long [] I didn't understand anything []
- Could you please indicate your age range (in years)?
5-10 11 - 15 16 -18 19 – 24 25 – 39 40 – 64 65 +
- E-mail (optional)
- Any comments or suggestions you'd like to give us please include here...



Outlook

- The First Big Bang Science Fair at WaterFire Providence on Sept 22, 2018 was a success
- Our goal is to make this an annual event
- Funding for 2019 is already in place and planning is advanced
 - Saturday Sep 28th
 - On Market Square
 - Neuro/Brain Science, Chemistry, RIMOSA, Science of Cooking, Physics, CS, Virtual Reality (Zspace.com)/RIVR, SkillsForRI partnership
 - In RISD Auditorium
 - Women's Leadership panel discussion
 - Prof. John Donoghue: "***Merging Man and Machine to help people with Paralysis***"
 - Prof. Stephon Alexander, Melvin Gibbs et al. "**Cosmic Zones**" A jazz performance
 - And many more to be confirmed
- Planning for 2020 will start in fall...



More information on Website and Facebook

- **Facebook**

- <https://www.facebook.com/Big-Bang-Science-Fair-Providence-793571531043146>

- **Website**

- **2018** <https://waterfire.org/big-bang-science-fair-at-waterfire-providence-on-september-22-2018/>
- **2019 website will be launched soon**

- **Providence Journal Article:**

- https://www.providencejournal.com/news/20180922/by-light-of-waterfire-beauty-of-science-shines?fbclid=IwAR3o2st38W2ot0X2G_S1hcBDAl8MTgU4_oBdxUcdyxpp2QnkJN9j0pYgZOI

- **YouTube**

- https://youtu.be/iOIEr3_bzaY
- <https://vimeo.com/293561594>
- <https://www.youtube.com/watch?v=Tdqe5oCwLPM>

- **Blog**

- <https://waterfire.org/big-bang-science-fair-at-waterfire-providence-on-september-22-2018/>

