

# **The Destruction of Antimatter In The Creation of The Universe**

**New Mexico**

**Supercomputing Challenge**

**Final Report**

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Team Members:

Kalab Lambert

Aidan Link

Zachariah Donnelly

Teachers:

Laura Larisch

Gerry Joy

Project Mentor

Laura Larisch

## Executive Summary

The Big Bang theory is a major theory for the existence of us and the universe. There are many problems with the Big Bang Theory that modern physics can't explain how it exactly happened. A major problem with the Big Bang theory is Where is the Anti-matter? For years people have wondered how could matter have destroyed all of the anti-matter if all particles had a balanced amount of anti-particles. We are modeling our project on the a few micro seconds after the Big Bang viewing the smallest particles known at the time to view their reactions in that situation.

## Statement of problem

The problem we are investigating is the how particles reacted with each other which allowed matter to rule the universe. So far in our investigation we have the main particles that started it all the Quarks. Which move around in our randomly generated universe freely and randomly ever run of the model.

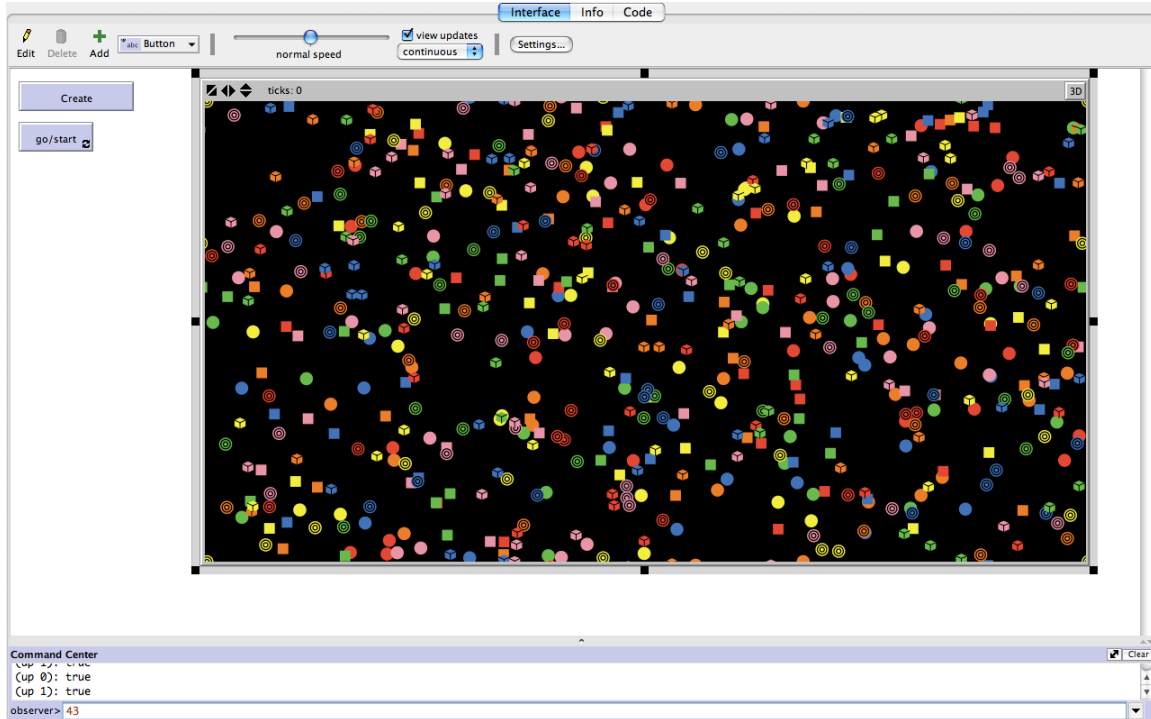
## Method of Problem

We have particles roaming and running into each other with their one paths they chose to take. We have different color, shapes, and masses to allow us to see what particles are interacting with the other particles. When the particles touch they will create a new particles such as Baryons or Mesons depending on the amount of Quarks that hit each other.

## Problem with our Project.

For our model we chose Netlogo to fastest and simplest way to get results for our question. We have discovered that to find the results we are searching for we have to use a more powerful language that allows objects to combine.

## Our Model



Netlogo Model Code:

```
;;BARYONS  
breed [protons proton]  
  
breed [neutrons neutron]  
  
breed [lambdas lambda]  
  
breed [sigmas sigma]  
  
breed [sigma1s sigma1]  
  
breed [sigma2s sigma2]  
  
breed [deltas delta]  
  
breed [delta1s delta1]  
  
breed [delta2s delta2]  
  
breed [delta3s delta3]  
  
breed [Xicascades Xicascade]
```

breed [Xicascade1s Xicascade1]

breed [omegas omega]

breed [lambda1s lambda1]

::Mesons

breed [pions pion]

breed [pion1s pion1]

breed [kaons kaon]

breed [kaon1s kaon1]

breed [kaon2s kaon2]

breed [etas eta]

breed [etaprimes etaprime]

breed [rhos rho]

breed [rho1s rho1]

breed [omega1s omega1]

breed [phis phi]

breed [ds d]

breed [ds1 d1]

breed [ds2 d2]

breed [j/psis j/psi]

breed [bs b]

breed [b1s b1]

breed [bs1ss bs1s]

breed [upsilons upsilon]

:: Quarks

breed [ups up]

breed [charms charm]

breed [tops top]

breed [downs down]

breed [stranges strange]

breed [bottoms bottom]

:: Leptons

breed [electronns electronn]

breed [muonns muonn]

breed [tauns taun]

breed [electrons electron]

breed [muons muon]

breed [taus tau]

:: Anti-Quarks

breed [a-ups a-up]

breed [a-charms a-charm]

breed [a-tops a-top]

breed [a-downs a-down]

breed [a-stranges a-strange]

breed [a-bottoms a-bottom]

:: Anti-Leptons

breed [a-electronns a-electronn]

breed [a-muonns a-muonn]

breed [a-tauns a-taun]

breed [a-electrons a-electron]

breed [a-muons a-muon]

breed [a-taus a-tau]

globals

[  
  quarks  
  leptons

]

ups-own

[ baryons  
  mesons

]

charms-own

[ baryons  
  mesons

]

tops-own

[ baryons  
  mesons

]

downs-own

[ baryons  
  mesons

]

stranges-own

[ baryons  
  mesons

]

bottoms-own

[ baryons  
  mesons

]

:::Anti-Quarks

```
a-ups-own
[ a-baryons
  a-mesons
]
a-charms-own
[ a-baryons
  a-mesons
]
a-tops-own
[ a-baryons
  a-mesons
]
a-downs-own
[ a-baryons
  a-mesons
]
a-stranges-own
[ a-baryons
  a-mesons
]
a-bottoms-own
[ a-baryons
  a-mesons
]
```

to Create

```
clear-all
```

```
::Quarks
```

```
create-ups 24 [ set color red ]set-default-shape ups "circle"
create-charms 24 [ set color orange ]set-default-shape charms "circle"
create-tops 24 [ set color yellow ] set-default-shape tops "circle"
create-downs 24 [ set color green ] set-default-shape downs "circle"
create-stranges 24 [ set color blue ] set-default-shape stranges "circle"
create-bottoms 24 [ set color pink ] set-default-shape bottoms "circle";;143
```

```
::Leptons
```

```
create-electronns 24 [ set color red ] set-default-shape electronns
"square" ;;144
create-muonns 24 [ set color orange ] set-default-shape muonns "square"
create-tauns 24 [ set color yellow ] set-default-shape tauns "square"
create-electrons 24 [ set color green ] set-default-shape electrons "square"
create-muons 24 [ set color blue ] set-default-shape muons "square"
```

create-taus 24 [ set color pink ] set-default-shape taus "square" ;;287

;;Anti-Quarks

create-a-ups 24 [ set color red ] set-default-shape a-ups "target" ;;288

create-a-charms 24 [ set color orange ] set-default-shape a-charms "target"

create-a-tops 24 [ set color yellow ] set-default-shape a-tops "target"

create-a-downs 24 [ set color green ] set-default-shape a-downs "target"

create-a-stranges 24 [ set color blue ] set-default-shape a-stranges "target"

create-a-bottoms 24 [ set color pink ] set-default-shape a-bottoms "target" ;;431

;;Anti-Leptons

create-a-electronns 24 [ set color red ] set-default-shape a-electronns  
"box" ;;432

create-a-muonns 24 [ set color orange ] set-default-shape a-muonns "box"

create-a-tauns 24 [ set color yellow ] set-default-shape a-tauns "box"

create-a-electrons 24 [ set color green ] set-default-shape a-electrons "box"

create-a-muons 24 [ set color blue ] set-default-shape a-muons "box"

create-a-taus 24 [ set color pink ] set-default-shape a-taus "box" ;;575

ask ups [ setxy random-xcor random-ycor ]

ask charms [ setxy random-xcor random-ycor ]

ask tops [ setxy random-xcor random-ycor ]

ask downs [ setxy random-xcor random-ycor ]

ask stranges [ setxy random-xcor random-ycor ]

ask bottoms [ setxy random-xcor random-ycor ]

ask electronns [ setxy random-xcor random-ycor ]

ask muonns [ setxy random-xcor random-ycor ]

ask tauns [ setxy random-xcor random-ycor ]

ask electrons [ setxy random-xcor random-ycor ]

ask muons [ setxy random-xcor random-ycor ]

ask taus [ setxy random-xcor random-ycor ]

ask a-ups [ setxy random-xcor random-ycor ]

```
ask a-charms [ setxy random-xcor random-ycor ]
ask a-tops [ setxy random-xcor random-ycor ]
ask a-downs [ setxy random-xcor random-ycor ]
ask a-stranges [ setxy random-xcor random-ycor ]
ask a-bottoms [ setxy random-xcor random-ycor ]
ask a-electronns [ setxy random-xcor random-ycor]
ask a-muonns [ setxy random-xcor random-ycor ]
ask a-tauns [ setxy random-xcor random-ycor ]
ask a-electrons [ setxy random-xcor random-ycor ]
ask a-muons [ setxy random-xcor random-ycor ]
ask a-taus [ setxy random-xcor random-ycor ]

reset-ticks

end

to go/start

ask turtle 0
[
  create-link-with turtle 1
  show link-neighbor? turtle 1 ;; prints true
]
ask turtle 1
[
  show link-neighbor? turtle 0 ;; prints true
]

ask ups [ move ]
ask charms [ move ]
ask tops [ move ]
ask downs [ move ]
ask stranges [ move ]
ask bottoms [ move ]
```

```
ask electronns [ move ]
ask muonns [ move ]
ask tauns [ move ]
ask electrons [ move ]
ask muons [ move ]
ask taus [ move ]
ask a-ups [ move ]
ask a-charms [ move ]
ask a-tops [ move ]
ask a-downs [ move ]
ask a-stranges [ move ]
ask a-bottoms [ move ]
ask a-electronns [ move ]
ask a-muonns [ move ]
ask a-tauns [ move ]
ask a-electrons [ move ]
ask a-muons [ move ]
ask a-taus [ move ]
```

end

to move

```
left random 360
```

```
forward .6
```

end

# Reference Tables for particles

## Mesons

Particle	Symbol	Anti-particle	Makeup	Rest mass MeV/c <sup>2</sup>	S	C	B	Lifetime	Decay Modes
<a href="#">Pion</a>	$\pi^+$	$\pi^-$	$u\bar{d}$	139.6	0	0	0	$2.60 \times 10^{-8}$	$\mu^+\nu_\mu$
<a href="#">Pion</a>	$\pi^0$	Self	$\frac{u\bar{u} - d\bar{d}}{\sqrt{2}}$	135.0	0	0	0	$0.83 \times 10^{-16}$	$2\gamma$
<a href="#">Kaon</a>	$K^+$	$K^-$	$u\bar{s}$	493.7	+1	0	0	$1.24 \times 10^{-8}$	$\mu^+\nu_\mu, \pi^+\pi^0$
<a href="#">Kaon</a>	$K^0_s$	$K^0_s$	$1^*$	497.7	+1	0	0	$0.89 \times 10^{-10}$	$\pi^+\pi^-, 2\pi^0$
<a href="#">Kaon</a>	$K^0_L$	$K^0_L$	$1^*$	497.7	+1	0	0	$5.2 \times 10^{-8}$	$\pi^+e^-\nu_e$
<a href="#">Eta</a>	$\eta^0$	Self	$2^*$	548.8	0	0	0	$<10^{-18}$	$2\gamma, 3\mu$
<a href="#">Eta prime</a>	$\eta'$	Self	$2^*$	958	0	0	0	...	$\pi^+\pi^-\eta$
<a href="#">Rho</a>	$\rho^+$	$\rho^-$	$u\bar{d}$	770	0	0	0	$0.4 \times 10^{-23}$	$\pi^+\pi^0$
<a href="#">Rho</a>	$\rho^0$	Self	$u\bar{u}, d\bar{d}$	770	0	0	0	$0.4 \times 10^{-23}$	$\pi^+\pi^-$
<a href="#">Omega</a>	$\omega^0$	Self	$u\bar{u}, d\bar{d}$	782	0	0	0	$0.8 \times 10^{-22}$	$\pi^+\pi^-\pi^0$
<a href="#">Phi</a>	$\phi$	Self	$s\bar{s}$	1020	0	0	0	$20 \times 10^{-23}$	$K^+K^-, K^0\bar{K}^0$
<a href="#">D</a>	$D^+$	$D^-$	$c\bar{d}$	1869.4	0	+1	0	$10.6 \times 10^{-13}$	$K + \_ , e + \_$
<a href="#">D</a>	$D^0$	$\bar{D}^0$	$c\bar{u}$	1864.6	0	+1	0	$4.2 \times 10^{-13}$	$[K, \mu, e] + \_$
<a href="#">D</a>	$D^+_s$	$D^-_s$	$c\bar{s}$	1969	+1	+1	0	$4.7 \times 10^{-13}$	$K + \_$
<a href="#">J/Psi</a>	$J/\psi$	Self	$c\bar{c}$	3096.9	0	0	0	$0.8 \times 10^{-20}$	$e^+e^-, \mu^+\mu^- \dots$
<a href="#">B</a>	$B^-$	$B^+$	$b\bar{u}$	5279	0	0	-1	$1.5 \times 10^{-12}$	$D^0 + \_$

<a href="#">B</a>	<b>B<sup>0</sup></b>	<b><u>B</u><sup>0</sup></b>	db	5279	0	0	-1	1.5 x10 <sup>-12</sup>	D <sup>0</sup> + _
<a href="#">B<sub>s</sub></a>	<b>B<sub>s</sub><sup>0</sup></b>	<b><u>B</u><sub>s</sub><sup>0</sup></b>	sb	5370	0	0	-1	...	B <sub>s</sub> <sup>-</sup> + _
<a href="#">Upsilon</a>	<b>Υ</b>	Self	bb	9460.4	0	0	0	1.3 x10 <sup>-20</sup>	e <sup>+</sup> e <sup>-</sup> , μ <sup>+</sup> μ <sup>-</sup> ..

## Table of Baryons

Particle	Symbol	Makeup	Rest mass MeV/c <sup>2</sup>	Spin	B	S	Lifetime (seconds>	Decay Modes
<a href="#">Proton</a>	<b>p</b>	uud	938.3	1/2	+1	0	Stable	...
<a href="#">Neutron</a>	<b>n</b>	ddu	939.6	1/2	+1	0	920	pe <sup>-</sup> ν <sub>e</sub>
<a href="#">Lambda</a>	<b>Λ<sup>0</sup></b>	uds	1115.6	1/2	+1	-1	2.6 x10 <sup>-10</sup>	pπ <sup>-</sup> , nπ <sup>0</sup>
<a href="#">Sigma</a>	<b>Σ<sup>+</sup></b>	uus	1189.4	1/2	+1	-1	0.8 x10 <sup>-10</sup>	pπ <sup>0</sup> , nπ <sup>+</sup>
<a href="#">Sigma</a>	<b>Σ<sup>0</sup></b>	uds	1192.5	1/2	+1	-1	6x10 <sup>-20</sup>	Λ <sup>0</sup> γ
<a href="#">Sigma</a>	<b>Σ<sup>-</sup></b>	dds	1197.3	1/2	+1	-1	1.5 x10 <sup>-10</sup>	nπ <sup>-</sup>
<a href="#">Delta</a>	<b>Δ<sup>++</sup></b>	uuu	1232	3/2	+1	0	0.6 x10 <sup>-23</sup>	pπ <sup>+</sup>
<a href="#">Delta</a>	<b>Δ<sup>+</sup></b>	uud	1232	3/2	+1	0	0.6 x10 <sup>-23</sup>	pπ <sup>0</sup>
<a href="#">Delta</a>	<b>Δ<sup>0</sup></b>	udd	1232	3/2	+1	0	0.6 x10 <sup>-23</sup>	nπ <sup>0</sup>
<a href="#">Delta</a>	<b>Δ<sup>-</sup></b>	ddd	1232	3/2	+1	0	0.6 x10 <sup>-23</sup>	nπ <sup>-</sup>
<a href="#">Xi Cascade</a>	<b>Ξ<sup>0</sup></b>	uss	1315	1/2	+1	-2	2.9 x10 <sup>-10</sup>	Λ <sup>0</sup> π <sup>0</sup>
<a href="#">Xi Cascade</a>	<b>Ξ<sup>-</sup></b>	dss	1321	1/2	+1	-2	1.64 x10 <sup>-10</sup>	Λ <sup>0</sup> π <sup>-</sup>
<a href="#">Omega</a>	<b>Ω<sup>-</sup></b>	sss	1672	3/2	+1	-3	0.82 x10 <sup>-10</sup>	Ξ <sup>0</sup> π <sup>-</sup> , Λ <sup>0</sup> K <sup>-</sup>
<a href="#">Lambda</a>	<b>Λ<sup>+</sup><sub>c</sub></b>	udc	2281	1/2	+1	0	2x10 <sup>-13</sup>	...

Quark	Symbol	Spin	Charge	Baryon Number	S	C	B	T	Mass*
<a href="#">Up</a>	U	1/2	+2/3	1/3	0	0	0	0	1.7-3.3 MeV
<a href="#">Down</a>	D	1/2	-1/3	1/3	0	0	0	0	4.1-5.8 MeV
<a href="#">Charm</a>	C	1/2	+2/3	1/3	0	+1	0	0	1270 MeV
<a href="#">Strange</a>	S	1/2	-1/3	1/3	-1	0	0	0	101 MeV
<a href="#">Top</a>	T	1/2	+2/3	1/3	0	0	0	+1	172 GeV
<a href="#">Bottom</a>	B	1/2	-1/3	1/3	0	0	-1	0	4.19 GeV(MS) 4.67 GeV(1S)

## Leptons

Particle	Symbol	Anti-particle	Rest mass MeV/c <sup>2</sup>	L(e)	L(muon)	L(tau)	Lifetime (seconds)
Electron	e <sup>-</sup>	e <sup>+</sup>	0.511	+1	0	0	Stable
Neutrino (Electron)	$\nu_e$	$\bar{\nu}_e$	0(<7 x 10 <sup>-6</sup> )	+1	0	0	Stable
Muon	$\mu^-$	$\mu^+$	105.7	0	+1	0	2.20x10 <sup>-6</sup>
Neutrino (Muon)	$\nu_\mu$	$\bar{\nu}_\mu$	0(<0.27)	0	+1	0	Stable
Tau	$\tau^-$	$\tau^+$	1777	0	0	+1	2.96x10 <sup>-13</sup>
Neutrino (Tau)	$\nu_\tau$	$\bar{\nu}_\tau$	0(<31)	0	0	+1	Stable

## Work Cited

### Websites:

Hadrons, baryons, mesons-

<file:///E:/SCC/INFORMATION%20FOR%20SCC/Hadrons,%20baryons,%20mesons.html>

Leptons- <file:///E:/SCC/INFORMATION%20FOR%20SCC/Leptons.html>

Quarks- <file:///E:/SCC/INFORMATION%20FOR%20SCC/Quarks.html>

Timeline of the Big Bang - The Big Bang and the Big Crunch - The Physics of the Universe-

<file:///E:/SCC/INFORMATION%20FOR%20SCC/Timeline%20of%20the%20Big%20Bang%20-%20The%20Big%20Bang%20and%20the%20Big%20Crunch%20-%20The%20Physics%20of%20the%20Universe.htm>

Physics of the Universe - Expanded Image-

<file:///E:/SCC/INFORMATION%20FOR%20SCC/Physics%20of%20the%20Universe%20-%20Expanded%20Image.htm>

### Software:

Netlogo- <https://ccl.northwestern.edu/netlogo/>

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