

Higher

Larger

Faster

```

<svg viewBox="0 0 800 800" xmlns="http://www.w3.org/2000/svg">
  <!-- Background -->
  <rect width="800" height="800" fill="#1a1a2e" />

  <!-- Frequency Waves Background -->
  <g opacity="0.1">
    <path d="M 0 150 Q 100 100, 200 150 T 400 150 T 600 150 T 800 150"
stroke="#4ddbff" stroke-width="10" fill="none" />
    <path d="M 0 250 Q 100 200, 200 250 T 400 250 T 600 250 T 800 250"
stroke="#e580ff" stroke-width="10" fill="none" />
    <path d="M 0 350 Q 100 300, 200 350 T 400 350 T 600 350 T 800 350"
stroke="#ffcc00" stroke-width="10" fill="none" />
    <path d="M 0 450 Q 100 400, 200 450 T 400 450 T 600 450 T 800 450"
stroke="#ff6666" stroke-width="10" fill="none" />
    <path d="M 0 550 Q 100 500, 200 550 T 400 550 T 600 550 T 800 550"
stroke="#80ffaa" stroke-width="10" fill="none" />
    <path d="M 0 650 Q 100 600, 200 650 T 400 650 T 600 650 T 800 650"
stroke="#ffd633" stroke-width="10" fill="none" />
  </g>

  <!-- Character Nodes: Heroes -->
  <g id="heroes">
    <!-- Lyra Nightsong -->
    <circle cx="400" cy="250" r="40" fill="#4ddbff" />
    <circle cx="400" cy="250" r="43" fill="none" stroke="#4ddbff"
stroke-width="1.5">
      <animate attributeName="r" values="43;47;43" dur="4s" repeatCount="indefinite"
/>
      <animate attributeName="opacity" values="1;0.5;1" dur="4s"
repeatCount="indefinite" />
    </circle>
    <text x="400" y="250" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Lyra</text>
    <text x="400" y="270" fill="ffffff" font-family="Arial" font-size="10"
text-anchor="middle">Nightsong</text>

    <!-- Master Wei -->
    <circle cx="250" cy="400" r="35" fill="#80ffaa" />
    <circle cx="250" cy="400" r="38" fill="none" stroke="#80ffaa"
stroke-width="1.5">
      <animate attributeName="r" values="38;42;38" dur="4s" repeatCount="indefinite"
/>
      <animate attributeName="opacity" values="1;0.5;1" dur="4s"
repeatCount="indefinite" />
    </circle>
    <text x="250" y="400" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Wei</text>
    <text x="250" y="420" fill="ffffff" font-family="Arial" font-size="10"
text-anchor="middle">Silentread</text>
  </g>

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<!-- Character Nodes: Antiheroes -->
<g id="antiheroes">
  <!-- Raven Discordant -->
  <circle cx="550" cy="400" r="35" fill="#ff6666" />
  <circle cx="550" cy="400" r="38" fill="none" stroke="#ff6666"
stroke-width="1.5">
    <animate attributeName="r" values="38;42;38" dur="4s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="1;0.5;1" dur="4s"
repeatCount="indefinite" />
  </circle>
  <text x="550" y="400" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Raven</text>
  <text x="550" y="420" fill="ffffff" font-family="Arial" font-size="10"
text-anchor="middle">Discordant</text>

  <!-- Khand Crystallor -->
  <circle cx="400" cy="550" r="35" fill="#ffcc00" />
  <circle cx="400" cy="550" r="38" fill="none" stroke="#ffcc00"
stroke-width="1.5">
    <animate attributeName="r" values="38;42;38" dur="4s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="1;0.5;1" dur="4s"
repeatCount="indefinite" />
  </circle>
  <text x="400" y="550" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Khand</text>
  <text x="400" y="570" fill="ffffff" font-family="Arial" font-size="10"
text-anchor="middle">Crystallor</text>
</g>

<!-- Character Nodes: Villains -->
<g id="villains">
  <!-- The Silence Weaver -->
  <circle cx="150" cy="200" r="35" fill="#33007a" />
  <circle cx="150" cy="200" r="38" fill="none" stroke="#33007a"
stroke-width="1.5">
    <animate attributeName="r" values="38;42;38" dur="4s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="1;0.5;1" dur="4s"
repeatCount="indefinite" />
  </circle>
  <text x="150" y="200" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Silence</text>
  <text x="150" y="220" fill="ffffff" font-family="Arial" font-size="10"
text-anchor="middle">Weaver</text>

  <!-- Maestra Carmina -->
  <circle cx="650" cy="200" r="35" fill="#cc00cc" />

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    <circle cx="650" cy="200" r="38" fill="none" stroke="#cc00cc"
stroke-width="1.5">
    <animate attributeName="r" values="38;42;38" dur="4s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="1;0.5;1" dur="4s"
repeatCount="indefinite" />
  </circle>
  <text x="650" y="200" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Maestra</text>
  <text x="650" y="220" fill="ffffff" font-family="Arial" font-size="10"
text-anchor="middle">Carmina</text>
</g>

<!-- Character Nodes: Supporting -->
<g id="supporting">
  <!-- Echo -->
  <circle cx="400" cy="400" r="30" fill="e580ff" />
  <text x="400" y="405" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Echo</text>

  <!-- Elder Harmonis -->
  <circle cx="400" cy="120" r="30" fill="ffd633" />
  <text x="400" y="125" fill="ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-weight="bold">Elder</text>
  <text x="400" y="145" fill="ffffff" font-family="Arial" font-size="9"
text-anchor="middle">Harmonis</text>

  <!-- The Dissonant Twins -->
  <circle cx="300" cy="650" r="25" fill="ff9999" />
  <text x="300" y="655" fill="ffffff" font-family="Arial" font-size="12"
text-anchor="middle" font-weight="bold">Mari</text>

  <circle cx="500" cy="650" r="25" fill="9999ff" />
  <text x="500" y="655" fill="ffffff" font-family="Arial" font-size="12"
text-anchor="middle" font-weight="bold">Maro</text>

  <!-- Connection between twins -->
  <path d="M 300 650 L 500 650" stroke="ffffff" stroke-width="2"
stroke-dasharray="5,5" />
  <text x="400" y="680" fill="ffffff" font-family="Arial" font-size="12"
text-anchor="middle">Dissonant Twins</text>
</g>

<!-- Relationship Lines -->
<g id="relationships" opacity="0.8">
  <!-- Main Oppositions -->
  <path d="M 400 250 L 150 200" stroke="ff0000" stroke-width="2">
    <title>Complex mentor/adversary relationship</title>
  </path>
  <text x="275" y="210" fill="ffffff" font-family="Arial" font-size="10"

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transform="rotate(-15, 275, 210)">Mentor/Adversary</text>

    <path d="M 400 250 L 650 200" stroke="#ff0000" stroke-width="2">
        <title>Opposition - Lyra suspects Carmina's involvement in her mother's
death</title>
    </path>
    <text x="525" y="210" fill="ffffff" font-family="Arial" font-size="10"
transform="rotate(15, 525, 210)">Suspicion</text>

    <path d="M 150 200 L 650 200" stroke="#996633" stroke-width="2"
stroke-dasharray="10,5">
        <title>Secret alliance between villains</title>
    </path>
    <text x="400" y="185" fill="#996633" font-family="Arial" font-size="10">Secret
Alliance</text>

    <!-- Master-Student -->
    <path d="M 250 400 L 400 550" stroke="#ffcc00" stroke-width="2"
stroke-dasharray="5,3">
        <title>Former master and student, now philosophical differences</title>
    </path>
    <text x="300" y="475" fill="#ffcc00" font-family="Arial" font-size="10"
transform="rotate(45, 300, 475)">Former Teacher</text>

    <!-- Alliances -->
    <path d="M 400 250 L 250 400" stroke="#00ff00" stroke-width="3">
        <title>Strong alliance</title>
    </path>
    <text x="325" y="325" fill="#00ff00" font-family="Arial" font-size="10"
transform="rotate(-45, 325, 325)">Alliance</text>

    <path d="M 400 250 L 400 400" stroke="#00ff00" stroke-width="3">
        <title>Mentorship and protection</title>
    </path>
    <text x="410" y="325" fill="#00ff00" font-family="Arial"
font-size="10">Mentor</text>

    <path d="M 400 250 L 550 400" stroke="#ffff00" stroke-width="2"
stroke-dasharray="5,3">
        <title>Antagonistic cooperation</title>
    </path>
    <text x="475" y="325" fill="#ffff00" font-family="Arial" font-size="10"
transform="rotate(45, 475, 325)">Uneasy Alliance</text>

    <!-- Complex Relationships -->
    <path d="M 400 400 L 300 650" stroke="#e580ff" stroke-width="2">
        <title>Echo mediates Mari's discord</title>
    </path>
    <text x="340" y="525" fill="#e580ff" font-family="Arial" font-size="10"
transform="rotate(60, 340, 525)">Mediates</text>

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    <path d="M 400 400 L 500 650" stroke="#e580ff" stroke-width="2">
      <title>Echo mediates Maro's discord</title>
    </path>
    <text x="460" y="525" fill="#e580ff" font-family="Arial" font-size="10"
transform="rotate(-60, 460, 525)">Mediates</text>

    <path d="M 550 400 L 300 650" stroke="#ff6666" stroke-width="1.5"
stroke-dasharray="5,2">
      <title>Raven protects Mari despite differences</title>
    </path>

    <path d="M 550 400 L 500 650" stroke="#ff6666" stroke-width="1.5"
stroke-dasharray="5,2">
      <title>Raven protects Maro despite differences</title>
    </path>

    <path d="M 550 400 L 400 400" stroke="#ff6666" stroke-width="2">
      <title>Raven is protective of Echo</title>
    </path>
    <text x="475" y="390" fill="#ff6666" font-family="Arial"
font-size="10">Protects</text>

    <!-- Elder's Connections -->
    <path d="M 400 120 L 400 250" stroke="#ffd633" stroke-width="2">
      <title>Mentor relationship</title>
    </path>
    <text x="410" y="185" fill="#ffd633" font-family="Arial"
font-size="10">Guides</text>

    <path d="M 400 120 L 650 200" stroke="#ffd633" stroke-width="1.5"
stroke-dasharray="3,3">
      <title>Manipulated by Carmina</title>
    </path>
    <text x="525" y="145" fill="#ffd633" font-family="Arial" font-size="10"
transform="rotate(15, 525, 145)">Manipulated</text>

    <path d="M 400 120 L 150 200" stroke="#ffd633" stroke-width="1.5"
stroke-dasharray="3,3">
      <title>Former colleague</title>
    </path>
    <text x="275" y="145" fill="#ffd633" font-family="Arial" font-size="10"
transform="rotate(-15, 275, 145)">Former Colleague</text>

    <path d="M 400 120 L 550 400" stroke="#ffd633" stroke-width="1.5"
stroke-dasharray="7,3">
      <title>Informant relationship</title>
    </path>
    <text x="475" y="260" fill="#ffd633" font-family="Arial" font-size="10"
transform="rotate(45, 475, 260)">Informant</text>

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    <!-- Other Key Relationships -->
    <path d="M 250 400 L 400 400" stroke="#80ffaa" stroke-width="2">
        <title>Wei teaches Echo</title>
    </path>
    <text x="325" y="390" fill="#80ffaa" font-family="Arial"
font-size="10">Teaches</text>

    <path d="M 550 400 L 400 550" stroke="#ff6666" stroke-width="1.5"
stroke-dasharray="5,3">
        <title>Secret communication about forbidden frequencies</title>
    </path>
    <text x="475" y="475" fill="#ff6666" font-family="Arial" font-size="10"
transform="rotate(-45, 475, 475)">Secret Comms</text>

    <!-- Carmina's Manipulation Web -->
    <path d="M 650 200 L 400 400" stroke="#cc00cc" stroke-width="1.5"
stroke-dasharray="2,2">
        <title>Carmina views Echo as a threat</title>
    </path>
    <text x="525" y="300" fill="#cc00cc" font-family="Arial" font-size="10"
transform="rotate(-45, 525, 300)">Views as Threat</text>

    <path d="M 650 200 L 300 650" stroke="#cc00cc" stroke-width="1.5"
stroke-dasharray="2,2">
        <title>Tries to recruit Mari</title>
    </path>

    <path d="M 650 200 L 500 650" stroke="#cc00cc" stroke-width="1.5"
stroke-dasharray="2,2">
        <title>Tries to recruit Maro</title>
    </path>
    <text x="575" y="425" fill="#cc00cc" font-family="Arial" font-size="10"
transform="rotate(75, 575, 425)">Tries to Recruit</text>
</g>

<!-- Legend -->
<g id="legend" transform="translate(600, 500)">
    <rect width="180" height="200" fill="#1a1a2e" stroke="ffffff" stroke-width="1"
opacity="0.8" />
    <text x="10" y="20" fill="ffffff" font-family="Arial" font-size="12"
font-weight="bold">Relationship Types</text>

    <!-- Alliance -->
    <line x1="10" y1="40" x2="35" y2="40" stroke="#00ff00" stroke-width="3" />
    <text x="40" y="45" fill="ffffff" font-family="Arial" font-size="10">Strong
Alliance</text>

    <!-- Antagonistic Cooperation -->
    <line x1="10" y1="65" x2="35" y2="65" stroke="#ffff00" stroke-width="2"

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stroke-dasharray="5,3" />
    <text x="40" y="70" fill="#ffffff" font-family="Arial" font-size="10">Uneasy
Alliance</text>

    <!-- Opposition -->
    <line x1="10" y1="90" x2="35" y2="90" stroke="#ff0000" stroke-width="2" />
    <text x="40" y="95" fill="#ffffff" font-family="Arial"
font-size="10">Opposition</text>

    <!-- Mentor/Teacher -->
    <line x1="10" y1="115" x2="35" y2="115" stroke="#80ffaa" stroke-width="2" />
    <text x="40" y="120" fill="#ffffff" font-family="Arial"
font-size="10">Teaching/Mentoring</text>

    <!-- Secret Communication -->
    <line x1="10" y1="140" x2="35" y2="140" stroke="#ff6666" stroke-width="1.5"
stroke-dasharray="5,3" />
    <text x="40" y="145" fill="#ffffff" font-family="Arial" font-size="10">Secret
Communication</text>

    <!-- Manipulation -->
    <line x1="10" y1="165" x2="35" y2="165" stroke="#cc00cc" stroke-width="1.5"
stroke-dasharray="2,2" />
    <text x="40" y="170" fill="#ffffff" font-family="Arial"
font-size="10">Manipulation</text>

    <!-- Secret Alliance -->
    <line x1="10" y1="190" x2="35" y2="190" stroke="#996633" stroke-width="2"
stroke-dasharray="10,5" />
    <text x="40" y="195" fill="#ffffff" font-family="Arial" font-size="10">Secret
Alliance</text>
</g>

<!-- Title -->
<text x="400" y="30" fill="#ffffff" font-family="Arial" font-size="24"
font-weight="bold" text-anchor="middle">Character Relationship Network</text>
<text x="400" y="60" fill="#ffffff" font-family="Arial" font-size="14"
text-anchor="middle" font-style="italic">The Harmonies of Resonara</text>
</svg>

```


Expanding consciousness across cosmic scales...

*"The universe is not only stranger than we imagine, it is
stranger than we can imagine." - J.B.S. Haldane*

Our Solar System

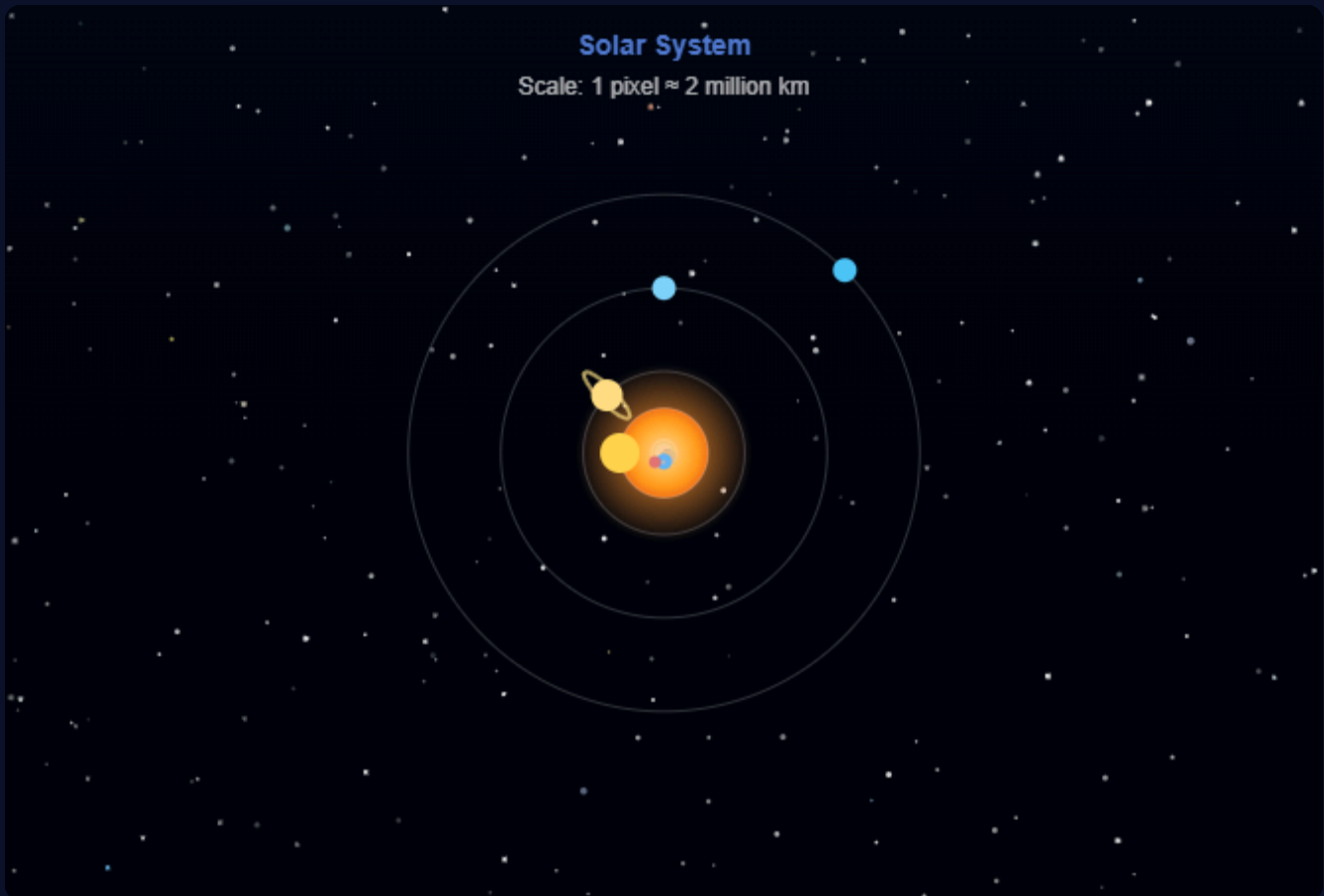
Nearby Stars

Milky Way Galaxy

Local Group

Cosmic Scale Explorer

Explore the vast differences in scale from our Solar System to the Local Group of galaxies.

[Solar System](#)[Nearby Stars](#)[Milky Way](#)[Local Group](#)

Select an object to learn more:

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Warp Drive Implications

At chemical rocket speeds ($\sim 20,000$ mph), reaching even the nearest star would take $\sim 70,000$ years. A warp drive could theoretically allow travel to nearby stars within a

human lifetime by warping the fabric of spacetime, creating a "bubble" where the starship resides in flat spacetime while space itself contracts ahead and expands behind.

The Young Explorer's Warp Drive Development Timeline

From Theoretical Breakthrough to Potential Future Reality

Historical Progress

Near Term (2025-2035)

Mid Term (2035-2060)

Long Term (2060+)

View All

```

import React, { useState, useEffect, useRef } from 'react';

const FrequencyVisualizer = () => {
  const [activeFrequency, setActiveFrequency] = useState('harmonic');
  const [amplitude, setAmplitude] = useState(50);
  const [frequency, setFrequency] = useState(2);
  const [complexity, setComplexity] = useState(1);
  const [colorScheme, setColorScheme] = useState('blue');
  const canvasRef = useRef(null);
  const animationRef = useRef(null);
  const [time, setTime] = useState(0);

  // Color schemes for different frequency types
  const colorSchemes = {
    blue: ['#0066cc', '#66ccff'],
    green: ['#006633', '#00cc66'],
    purple: ['#330066', '#9933cc'],
    gold: ['#cc9900', '#ffcc00'],
    red: ['#990000', '#ff3333'],
    void: ['#330033', '#cc33cc'],
  };

  // Map frequency types to colors
  const frequencyColors = {
    harmonic: 'blue',
    terrestrial: 'green',
    stellar: 'purple',
    planetary: 'gold',
    dissonant: 'red',
    void: 'void'
  };

  // Descriptions for each frequency type
  const frequencyDescriptions = {
    harmonic: "Harmonic frequencies stabilize and enhance existing patterns. Used for healing, protection, and amplification of natural phenomena.",
    terrestrial: "Earth-based frequencies connect with elements and life forces. Common in agriculture, healing, and weather manipulation.",
    stellar: "The highest form of frequency manipulation, drawing power from stars. Requires exceptional attunement and used for the most powerful workings.",
    planetary: "Frequencies that tap into planetary bodies, creating effects based on traditional planetary correspondences.",
    dissonant: "Disruptive frequencies that can break down existing harmonies. Potentially dangerous but powerful for defensive or offensive applications.",
    void: "The mysterious frequencies found in the Silent Deserts, representing the spaces between conventional harmonies. Few can hear or manipulate these."
  };

  useEffect(() => {
    // Update color scheme when frequency type changes

```

```

    setColorScheme(frequencyColors[activeFrequency]);
}, [activeFrequency]);

useEffect(() => {
  const canvas = canvasRef.current;
  const ctx = canvas.getContext('2d');
  const width = canvas.width;
  const height = canvas.height;

  const render = () => {
    // Clear canvas
    ctx.clearRect(0, 0, width, height);

    // Create gradient based on active color scheme
    const colors = colorSchemes[colorScheme];
    const gradient = ctx.createLinearGradient(0, 0, 0, height);
    gradient.addColorStop(0, colors[0]);
    gradient.addColorStop(1, colors[1]);

    // Draw waveform based on frequency type
    ctx.beginPath();
    ctx.moveTo(0, height / 2);

    for (let x = 0; x < width; x++) {
      let y = height / 2;

      // Base wave
      const baseWave = Math.sin((x / width) * Math.PI * 2 * frequency + time) *
amplitude;
      y += baseWave;

      // Add complexity for different frequency types
      if (activeFrequency === 'harmonic') {
        // Smooth, regular waves
        y += Math.sin((x / width) * Math.PI * 4 * frequency + time) * (amplitude *
0.2 * complexity);
      } else if (activeFrequency === 'terrestrial') {
        // More grounded, fluctuating waves
        y += Math.sin((x / width) * Math.PI * 3 * frequency + time * 0.7) *
(amplitude * 0.3 * complexity);
        y += Math.cos((x / width) * Math.PI * 1.5 * frequency + time * 0.5) *
(amplitude * 0.15 * complexity);
      } else if (activeFrequency === 'stellar') {
        // Higher frequency, more complex patterns
        y += Math.sin((x / width) * Math.PI * 6 * frequency + time * 1.2) *
(amplitude * 0.25 * complexity);
        y += Math.sin(x / width) * Math.PI * 8 * frequency + time * 0.8) *
(amplitude * 0.15 * complexity);
        y += Math.cos((x / width) * Math.PI * 10 * frequency + time * 1.5) *
(amplitude * 0.1 * complexity);
      }
    }
  };
  render();
  // Call render again after a short delay
  setTimeout(render, 1000 / 60);
}, [activeFrequency, frequency, time, colorScheme, colorSchemes, amplitude, complexity]);

```

```

    } else if (activeFrequency === 'planetary') {
        // Resonant, orbit-like patterns
        y += Math.sin((x / width) * Math.PI * 2.5 * frequency + time * 0.9) *
(amplitude * 0.3 * complexity);
        y += Math.cos((x / width) * Math.PI * 5 * frequency + time * 0.4) *
(amplitude * 0.2 * complexity);
    } else if (activeFrequency === 'dissonant') {
        // Jagged, disruptive patterns
        y += Math.tan(Math.sin((x / width) * Math.PI * 3 * frequency + time) *
0.2) * (amplitude * 0.4 * complexity);
        y += Math.sin((x / width) * Math.PI * 7 * frequency + time * 1.1) *
(amplitude * 0.25 * complexity);
        // Keep dissonant waves from going off-canvas
        y = Math.max(10, Math.min(height - 10, y));
    } else if (activeFrequency === 'void') {
        // Strange, "impossible" patterns with gaps
        if (Math.sin((x / width) * Math.PI * frequency * 2 + time * 0.5) > 0.7) {
            // Create "gaps" in the wave
            y = height / 2;
        } else {
            y += Math.sin((x / width) * Math.PI * 2 * frequency + time * 0.7) *
(amplitude * 0.3 * complexity);
            y += Math.cos((x / width) * Math.PI * 5 * frequency + time * 1.3) *
(amplitude * 0.4 * complexity);
            if (Math.cos((x / width) * Math.PI * 10 + time) > 0.8) {
                y += Math.sin((x / width) * Math.PI * 20 * frequency + time * 2) *
(amplitude * 0.5 * complexity);
            }
        }
    }
}

ctx.lineTo(x, y);
}

// Style and stroke the path
ctx.strokeStyle = gradient;
ctx.lineWidth = 3;
ctx.stroke();

// Add glow effect
ctx.save();
ctx.filter = `blur(8px)`;
ctx.strokeStyle = colors[1];
ctx.lineWidth = 5;
ctx.stroke();
ctx.restore();

// Animate
setTime(prevTime => prevTime + 0.05);
animationRef.current = requestAnimationFrame(render);

```

```

    };

    render();

    return () => {
        cancelAnimationFrame(animationRef.current);
    };
}, [activeFrequency, amplitude, frequency, complexity, colorScheme, time]);

return (
    <div className="flex flex-col items-center w-full p-4 bg-gray-900 text-white rounded-lg">
        <h2 className="text-2xl font-bold mb-4">Harmonic Frequency Visualizer</h2>

        <div className="w-full mb-6">
            <canvas
                ref={canvasRef}
                width={800}
                height={300}
                className="w-full h-64 bg-gray-800 rounded-lg border border-gray-700"
            />
        </div>

        <div className="w-full mb-4 p-4 bg-gray-800 rounded-lg">
            <h3 className="text-xl mb-2 font-semibold">{activeFrequency.charAt(0).toUpperCase() + activeFrequency.slice(1)} Frequency</h3>
            <p className="text-gray-300 mb-4">{frequencyDescriptions[activeFrequency]}</p>
        </div>

        <div className="w-full grid grid-cols-2 gap-4 mb-6">
            <div className="flex flex-col">
                <label className="mb-1 text-gray-300">Frequency Type</label>
                <div className="grid grid-cols-3 gap-2">
                    {Object.keys(frequencyColors).map(type => (
                        <button
                            key={type}
                            className={`py-2 px-3 rounded ${activeFrequency === type ? 'bg-blue-600' : 'bg-gray-700'}`}
                            onClick={() => setActiveFrequency(type)}
                        >
                            {type.charAt(0).toUpperCase() + type.slice(1)}
                        </button>
                    ))}
                </div>
            </div>

            <div className="flex flex-col">
                <label className="mb-1 text-gray-300">Controls</label>

```



```

<div className="grid grid-cols-1 gap-4">
  <div>
    <label className="block text-sm">Amplitude: {amplitude}</label>
    <input
      type="range"
      min="10"
      max="100"
      value={amplitude}
      onChange={(e) => setAmplitude(parseInt(e.target.value))}
      className="w-full"
    />
  </div>

  <div>
    <label className="block text-sm">Base Frequency: {frequency}</label>
    <input
      type="range"
      min="1"
      max="5"
      step="0.1"
      value={frequency}
      onChange={(e) => setFrequency(parseFloat(e.target.value))}
      className="w-full"
    />
  </div>

  <div>
    <label className="block text-sm">Complexity: {complexity}</label>
    <input
      type="range"
      min="0.5"
      max="3"
      step="0.1"
      value={complexity}
      onChange={(e) => setComplexity(parseFloat(e.target.value))}
      className="w-full"
    />
  </div>
</div>
</div>
</div>

```

```

<div className="w-full p-4 bg-gray-800 rounded-lg text-sm">
  <p className="text-gray-300">

```

In the world of Harmonica, practitioners learn to sense and manipulate these fundamental frequencies that underlie reality.

Experiment with different frequency types, amplitudes, and complexities to visualize how various forms of harmonic magic might appear.

```

  </p>
</div>

```

```
    </div>
  );
};

export default FrequencyVisualizer;
```

```

<svg viewBox="0 0 800 600" xmlns="http://www.w3.org/2000/svg">
  <!-- Background -->
  <rect width="800" height="600" fill="#1a1a2e" />

  <!-- Star field -->
  <g id="stars">
    <!-- Small stars -->
    <g fill="ffffff" opacity="0.7">
      <circle cx="50" cy="40" r="1" />
      <circle cx="120" cy="70" r="1" />
      <circle cx="200" cy="30" r="1" />
      <circle cx="280" cy="50" r="1" />
      <circle cx="350" cy="20" r="1" />
      <circle cx="420" cy="60" r="1" />
      <circle cx="500" cy="40" r="1" />
      <circle cx="580" cy="30" r="1" />
      <circle cx="650" cy="50" r="1" />
      <circle cx="720" cy="20" r="1" />
      <circle cx="780" cy="70" r="1" />
      <!-- More stars scattered throughout -->
      <circle cx="80" cy="120" r="1" />
      <circle cx="150" cy="150" r="1" />
      <circle cx="230" cy="110" r="1" />
      <circle cx="310" cy="130" r="1" />
      <circle cx="380" cy="100" r="1" />
      <circle cx="450" cy="140" r="1" />
      <circle cx="530" cy="120" r="1" />
      <circle cx="610" cy="110" r="1" />
      <circle cx="680" cy="130" r="1" />
      <circle cx="750" cy="100" r="1" />
      <!-- And many more stars across the upper part of the image -->
    </g>

    <!-- Medium stars -->
    <g fill="ffffff" opacity="0.8">
      <circle cx="100" cy="50" r="1.5" />
      <circle cx="250" cy="40" r="1.5" />
      <circle cx="400" cy="30" r="1.5" />
      <circle cx="550" cy="50" r="1.5" />
      <circle cx="700" cy="40" r="1.5" />
      <!-- More medium stars scattered -->
      <circle cx="180" cy="80" r="1.5" />
      <circle cx="330" cy="70" r="1.5" />
      <circle cx="480" cy="60" r="1.5" />
      <circle cx="630" cy="80" r="1.5" />
    </g>

    <!-- Large stars -->
    <g fill="ffffff">
      <circle cx="75" cy="25" r="2" />
    </g>
  </g>

```

```

        <circle cx="225" cy="15" r="2" />
        <circle cx="375" cy="25" r="2" />
        <circle cx="525" cy="15" r="2" />
        <circle cx="675" cy="25" r="2" />
    </g>
</g>

<!-- Major Celestial Bodies -->
<!-- Sun -->
<circle cx="400" cy="100" r="30" fill="url(#sunGradient)" />
<defs>
    <radialGradient id="sunGradient">
        <stop offset="0%" stop-color="#fff7d6" />
        <stop offset="40%" stop-color="#ffdb4d" />
        <stop offset="100%" stop-color="#ff8c00" />
    </radialGradient>
</defs>

<!-- Planets with their orbits and frequency lines -->
<!-- Inner Planet (Venus-like) -->
<circle cx="400" cy="100" r="60" fill="none" stroke="#a335ee" stroke-width="0.5"
opacity="0.6" />
<circle cx="450" cy="130" r="10" fill="#e580ff" />
<path d="M 400 100 L 450 130" stroke="#e580ff" stroke-width="1.5" opacity="0.7" />

<!-- Earth-like Planet -->
<circle cx="400" cy="100" r="100" fill="none" stroke="#33ccff" stroke-width="0.5"
opacity="0.6" />
<circle cx="350" cy="180" r="15" fill="#4ddbff" />
<path d="M 400 100 L 350 180" stroke="#4ddbff" stroke-width="1.5" opacity="0.7" />

<!-- Mars-like Planet -->
<circle cx="400" cy="100" r="140" fill="none" stroke="#ff3333" stroke-width="0.5"
opacity="0.6" />
<circle cx="500" cy="200" r="12" fill="#ff6666" />
<path d="M 400 100 L 500 200" stroke="#ff6666" stroke-width="1.5" opacity="0.7" />

<!-- Jupiter-like Planet -->
<circle cx="400" cy="100" r="200" fill="none" stroke="#e6b800" stroke-width="0.5"
opacity="0.6" />
<circle cx="300" cy="270" r="25" fill="#ffd633" />
<path d="M 400 100 L 300 270" stroke="#ffd633" stroke-width="1.5" opacity="0.7" />

<!-- Saturn-like Planet -->
<circle cx="400" cy="100" r="250" fill="none" stroke="#cc9900" stroke-width="0.5"
opacity="0.6" />
<circle cx="500" cy="330" r="20" fill="#ffcc00" />
<path d="M 400 100 L 500 330" stroke="#ffcc00" stroke-width="1.5" opacity="0.7" />

<!-- Lunar Body -->

```

```

<circle cx="350" cy="180" r="30" fill="none" stroke="#b3b3cc" stroke-width="0.5"
opacity="0.6" />
<circle cx="350" cy="150" r="5" fill="#e6e6ff" />
<path d="M 350 180 L 350 150" stroke="#e6e6ff" stroke-width="1" opacity="0.7" />

<!-- Resonance Points on Earth -->
<g id="resonancePoints">
  <!-- Northern Resonance Point -->
  <circle cx="300" cy="270" r="8" fill="#00ff00" opacity="0.8" />
  <circle cx="300" cy="270" r="15" fill="none" stroke="#00ff00" stroke-width="2"
opacity="0.5">
    <animate attributeName="r" values="15;20;15" dur="4s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="0.5;0.8;0.5" dur="4s"
repeatCount="indefinite" />
  </circle>
  <!-- Second pulse wave -->
  <circle cx="300" cy="270" r="25" fill="none" stroke="#00ff00" stroke-width="1.5"
opacity="0.3">
    <animate attributeName="r" values="25;40;25" dur="4s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="0.3;0.1;0.3" dur="4s"
repeatCount="indefinite" />
  </circle>

  <!-- Southern Resonance Point (weakening) -->
  <circle cx="410" cy="330" r="6" fill="#00ccff" opacity="0.5" />
  <circle cx="410" cy="330" r="12" fill="none" stroke="#00ccff" stroke-width="1.5"
opacity="0.3">
    <animate attributeName="r" values="12;15;12" dur="6s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="0.3;0.1;0.3" dur="6s"
repeatCount="indefinite" />
  </circle>

  <!-- Eastern Resonance Point -->
  <circle cx="520" cy="290" r="7" fill="#ff9900" opacity="0.7" />
  <circle cx="520" cy="290" r="14" fill="none" stroke="#ff9900" stroke-width="1.8"
opacity="0.4">
    <animate attributeName="r" values="14;18;14" dur="4.5s"
repeatCount="indefinite" />
    <animate attributeName="opacity" values="0.4;0.2;0.4" dur="4.5s"
repeatCount="indefinite" />
  </circle>

  <!-- Western Resonance Point -->
  <circle cx="220" cy="320" r="7" fill="#cc33ff" opacity="0.7" />
  <circle cx="220" cy="320" r="14" fill="none" stroke="#cc33ff" stroke-width="1.8"
opacity="0.4">
    <animate attributeName="r" values="14;18;14" dur="5s" repeatCount="indefinite"

```

```

/>
    <animate attributeName="opacity" values="0.4;0.2;0.4" dur="5s"
repeatCount="indefinite" />
</circle>

<!-- Central Resonance Point (Resonara) -->
<circle cx="380" cy="300" r="10" fill="#ffff00" opacity="0.9" />
<circle cx="380" cy="300" r="18" fill="none" stroke="#ffff00" stroke-width="2.2"
opacity="0.6">
    <animate attributeName="r" values="18;25;18" dur="3s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="0.6;0.3;0.6" dur="3s"
repeatCount="indefinite" />
</circle>
<!-- Second pulse wave -->
<circle cx="380" cy="300" r="30" fill="none" stroke="#ffff00" stroke-width="1.5"
opacity="0.3">
    <animate attributeName="r" values="30;50;30" dur="3s" repeatCount="indefinite"
/>
    <animate attributeName="opacity" values="0.3;0.1;0.3" dur="3s"
repeatCount="indefinite" />
</circle>
</g>

<!-- Harmonic Ley Lines connecting resonance points -->
<g id="leyLines" opacity="0.6">
    <path d="M 300 270 L 380 300" stroke="#80ffaa" stroke-width="2">
        <animate attributeName="stroke-width" values="2;3;2" dur="4s"
repeatCount="indefinite" />
    </path>
    <path d="M 380 300 L 410 330" stroke="#80d4ff" stroke-width="1.5">
        <animate attributeName="stroke-width" values="1.5;2;1.5" dur="6s"
repeatCount="indefinite" />
    </path>
    <path d="M 380 300 L 520 290" stroke="#ffcc80" stroke-width="2">
        <animate attributeName="stroke-width" values="2;3;2" dur="4.5s"
repeatCount="indefinite" />
    </path>
    <path d="M 380 300 L 220 320" stroke="#e680ff" stroke-width="2">
        <animate attributeName="stroke-width" values="2;3;2" dur="5s"
repeatCount="indefinite" />
    </path>
    <!-- Hidden connection between Northern and Southern shown by Twins -->
    <path d="M 300 270 L 410 330" stroke="ffffff" stroke-width="1"
stroke-dasharray="5,5" opacity="0.4" />
    <!-- Hidden connection between Eastern and Western shown by Twins -->
    <path d="M 520 290 L 220 320" stroke="ffffff" stroke-width="1"
stroke-dasharray="5,5" opacity="0.4" />
</g>

```

```

<!-- Silent Deserts -->
<g id="silentDeserts">
  <path d="M 160 380 Q 200 350, 240 380 T 320 380 T 400 380 T 480 380 T 560 380 T
640 380"
    fill="none" stroke="#330033" stroke-width="30" opacity="0.7" />
  <!-- Void frequency emanations (subtle) -->
  <path d="M 160 380 Q 200 350, 240 380 T 320 380 T 400 380 T 480 380 T 560 380 T
640 380"
    fill="none" stroke="#9900cc" stroke-width="2" opacity="0.3">
    <animate attributeName="opacity" values="0.3;0.7;0.3" dur="10s"
repeatCount="indefinite" />
  </path>
</g>

<!-- Crystal City of Resonara -->
<g id="resonaraCity">
  <polygon points="380,300 370,310 390,310" fill="#ffffcc" opacity="0.9" />
  <line x1="380" y1="300" x2="380" y2="280" stroke="#ffffcc" stroke-width="2" />
  <circle cx="380" cy="280" r="2" fill="#ffffcc" />
  <text x="393" y="310" fill="black" font-family="Arial"
font-size="10">Resonara</text>
</g>

<!-- Nightsong Academy -->
<g id="nightsongAcademy">
  <polygon points="300,270 290,280 310,280" fill="#ccffff" opacity="0.8" />
  <text x="313" y="275" fill="black" font-family="Arial" font-size="8">Nightsong
Academy</text>
</g>

<!-- Legend -->
<g id="legend" transform="translate(20, 430)">
  <rect width="180" height="150" fill="#1a1a2e" stroke="black" stroke-width="1"
opacity="0.7" />
  <text x="10" y="20" fill="black" font-family="Arial" font-size="12"
font-weight="bold">The Harmony Map</text>

  <!-- Resonance Points -->
  <circle cx="20" cy="40" r="5" fill="red" />
  <text x="30" y="43" fill="black" font-family="Arial" font-size="10">Resonance
Point</text>

  <!-- Ley Lines -->
  <line x1="10" y1="60" x2="25" y2="60" stroke="red" stroke-width="2" />
  <text x="30" y="63" fill="black" font-family="Arial" font-size="10">Harmonic
Ley Line</text>

  <!-- Silent Desert -->
  <rect x="10" y="75" width="15" height="5" fill="#330033" opacity="0.7" />
  <text x="30" y="83" fill="black" font-family="Arial" font-size="10">Silent

```

Desert</text>

```
<!-- Void Frequency -->
<line x1="10" y1="100" x2="25" y2="100" stroke="#9900cc" stroke-width="2"
opacity="0.7" />
<text x="30" y="103" fill="ffffff" font-family="Arial" font-size="10">Void
Frequency</text>
```

```
<!-- Cities -->
<polygon points="17,115 13,120 21,120" fill="ffffcc" opacity="0.9" />
<text x="30" y="123" fill="ffffff" font-family="Arial"
font-size="10">City/Academy</text>
```

```
<!-- Hidden Connections -->
<line x1="10" y1="140" x2="25" y2="140" stroke="ffffff" stroke-width="1"
stroke-dasharray="3,3" />
<text x="30" y="143" fill="ffffff" font-family="Arial" font-size="10">Hidden
Connection</text>
</g>
```

```
<!-- Title -->
<text x="400" y="30" fill="ffffff" font-family="Arial" font-size="20"
font-weight="bold" text-anchor="middle">The Harmony Map of Resonara</text>
</svg>
```


Higher



Dense

Pause

This visualization represents the quantum foam theorized to exist at the Planck scale (10^{-35} meters) - the quantum fluctuations of spacetime itself.

- **Quantum Foam:** Virtual particles continuously popping in and out of existence
- **Quantum Bubbles:** Fluctuations in spacetime geometry
- **Negative Energy:** Exotic matter with negative energy density, required for the Alcubierre warp drive

The central energy field represents a region where quantum effects are being manipulated to create the conditions needed for a warp bubble to form.

The Young Explorer's Warp Drive Development Timeline

This interactive Gantt timeline illustrates the theoretical and experimental pathways toward warp drive technology, from past achievements to projected future milestones.

- Historical Progress
- Near Term (2025-2035)
- Mid Term (2035-2060)
- Long Term (2060+)
- View All

Full Timeline View (1994-2080)

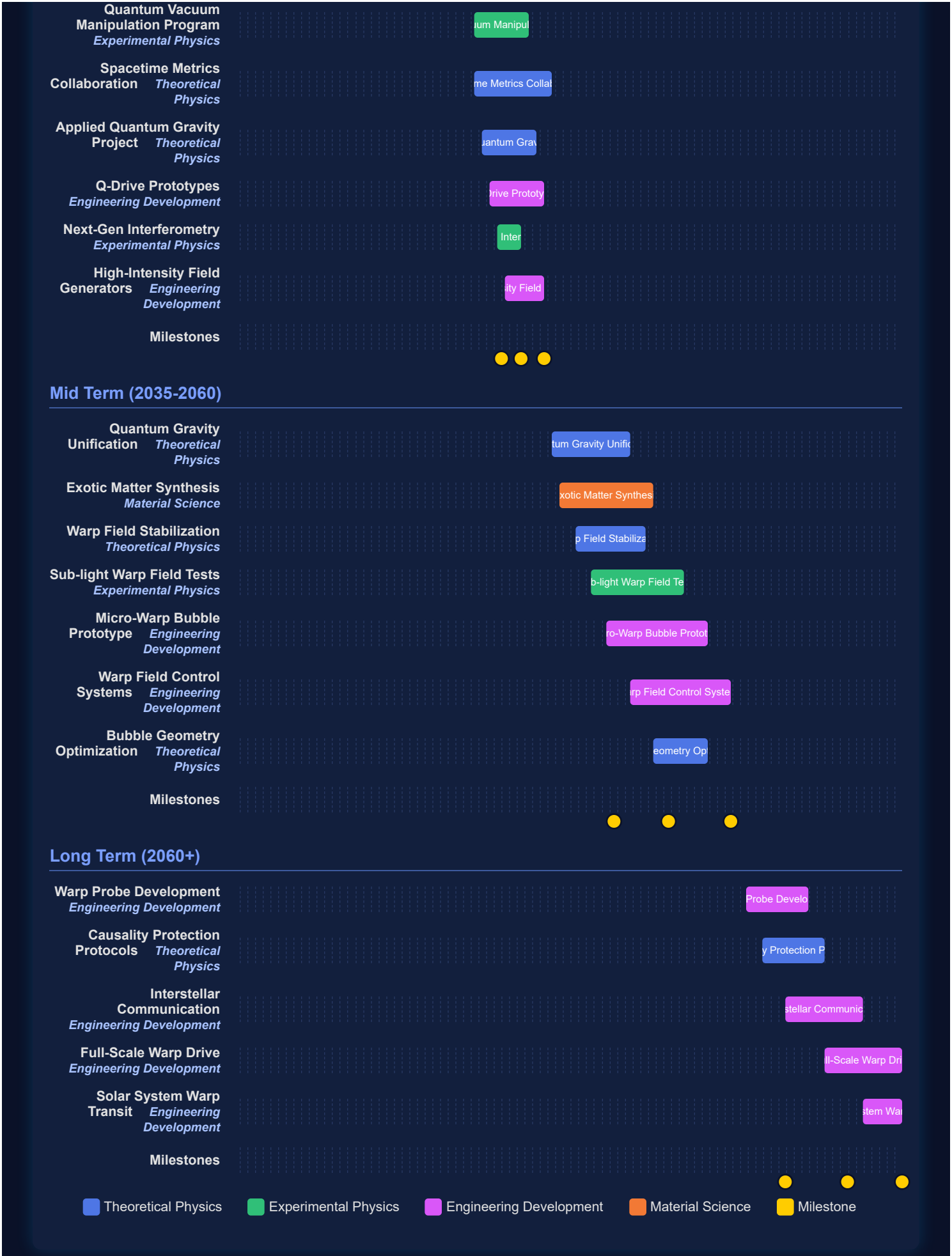
199419951996199719981999200020012002200320042005200620072008200920102011201220132014201520162017

Historical Progress



Near Term (2025-2035)







```

import { useState, useEffect, useRef } from 'react';

// Timeline data structure - Historical progress from 1994-2025
const timelineData = {
  historical: [
    {
      phase: "Historical Progress",
      items: [
        {
          label: "Alcubierre Metric",
          category: "Theoretical Physics",
          start: 1994,
          end: 1994,
          color: "#4e76e5",
          description: "Miguel Alcubierre publishes his groundbreaking paper describing a spacetime metric that would allow for faster-than-light travel without violating special relativity."
        },
        {
          label: "Van Den Broeck Refinement",
          category: "Theoretical Physics",
          start: 1999,
          end: 2000,
          color: "#4e76e5",
          description: "Chris Van Den Broeck proposes modifications to the Alcubierre metric that reduced energy requirements from greater than the mass of the universe to approximately solar mass."
        },
        {
          label: "Early NASA BPP Program",
          category: "Experimental Physics",
          start: 1996,
          end: 2002,
          color: "#30bf78",
          description: "NASA's Breakthrough Propulsion Physics program investigates speculative physics concepts including warp drive theories."
        },
        {
          label: "Natário Contribution",
          category: "Theoretical Physics",
          start: 2002,
          end: 2002,
          color: "#4e76e5",
          description: "José Natário demonstrates that the Alcubierre drive could be modified to avoid the frontal horizon expansion that would capture high-energy particles."
        },
        {
          label: "Thin-Shell Optimization",
          category: "Theoretical Physics",

```

```

    start: 2011,
    end: 2012,
    color: "#4e76e5",
    description: "Theoretical work showing that making the bubble walls
'thinner' could dramatically reduce negative energy requirements."
  },
  {
    label: "White's Energy Calculations",
    category: "Theoretical Physics",
    start: 2012,
    end: 2013,
    color: "#4e76e5",
    description: "Harold White at NASA recalculates energy requirements using
oscillating bubble geometries, suggesting dramatic reductions in negative energy
needs."
  },
  {
    label: "Early Interferometer Tests",
    category: "Experimental Physics",
    start: 2013,
    end: 2018,
    color: "#30bf78",
    description: "White-Juday Warp Field Interferometer experiments at NASA
attempt to detect microscopic spacetime distortions created in laboratory
conditions."
  },
  {
    label: "Casimir Effect Experiments",
    category: "Experimental Physics",
    start: 2014,
    end: 2020,
    color: "#30bf78",
    description: "Advanced Casimir effect experiments demonstrate sustained
negative energy density in increasingly larger regions of space."
  },
  {
    label: "White-Bohrick Framework",
    category: "Theoretical Physics",
    start: 2021,
    end: 2021,
    color: "#4e76e5",
    description: "Alexey Bohrick and Gianni Martire publish a comprehensive
classification of all possible warp drives, showing that some sub-light variants
might be possible with positive energy."
  },
  {
    label: "DARPA 'Accidental Bubble'",
    category: "Experimental Physics",
    start: 2021,
    end: 2021,

```

```

        color: "#30bf78",
        description: "Researchers at Limitless Space Institute accidentally detect
what appears to be a microscopic spacetime distortion consistent with a tiny warp
bubble during Casimir effect experiments."
    },
    {
        label: "Soliton Warp Shell Theory",
        category: "Theoretical Physics",
        start: 2022,
        end: 2022,
        color: "#4e76e5",
        description: "Development of the soliton-based warp field theory,
suggesting self-reinforcing solitary waves could maintain stable warp bubbles with
less energy input."
    },
    {
        label: "Bobrick-Lentz Reconfiguration",
        category: "Theoretical Physics",
        start: 2023,
        end: 2023,
        color: "#4e76e5",
        description: "Breakthrough paper proposing modified warp metrics using
'solitonic wave configurations' of positive energy to create effective spacetime
distortion without negative energy."
    },
    {
        label: "Quantum Foam Leverage Hypothesis",
        category: "Theoretical Physics",
        start: 2023,
        end: 2023,
        color: "#4e76e5",
        description: "Dr. Viola Chen's team publishes findings suggesting quantum
foam might be temporarily 'borrowed against' to create macroscopic negative energy
regions."
    },
    {
        label: "NASA BPP Program Revival",
        category: "Experimental Physics",
        start: 2023,
        end: 2024.5,
        color: "#30bf78",
        description: "NASA reestablishes funding for speculative propulsion
physics research, including warp drive concepts and experimental tests."
    },
    {
        label: "Quantum Field Anchoring",
        category: "Theoretical Physics",
        start: 2024,
        end: 2024.5,
        color: "#4e76e5",

```



```

        description: "Development of quantum field anchoring theory suggesting
methods to stabilize warp bubbles using quantum entanglement between the bubble's
outer edge and reference frames."
    },
    {
        label: "Casimir Cavity Array Experiment",
        category: "Experimental Physics",
        start: 2024,
        end: 2024.5,
        color: "#30bf78",
        description: "Successful generation of measurable spacetime curvature
using an array of nanoscale Casimir cavities combined with electromagnetic fields.
The distortion was approximately one billionth of required warp effect."
    }
]
},
// Near Term timeline data (2025-2035)
near: [
    {
        phase: "Near Term (2025-2035)",
        items: [
            {
                label: "Advanced Metamaterials",
                category: "Material Science",
                start: 2025,
                end: 2030,
                color: "#f27935",
                description: "Development of metamaterials with negative refractive index
to simulate properties of exotic matter for experimental warp field tests."
            },
            {
                label: "Quantum Vacuum Manipulation Program",
                category: "Experimental Physics",
                start: 2025,
                end: 2032,
                color: "#30bf78",
                description: "Consortium research using advanced Casimir cavity
geometries, squeezed quantum states of light, and superconducting metamaterials to
create and sustain regions of negative energy density.",
                milestones: [
                    {
                        position: 2028.5,
                        label: "First Sustained Negative Energy",
                        description: "First laboratory demonstration of sustained negative
energy density for more than 1 second in a region larger than molecular scale."
                    }
                ]
            }
        ]
    },
    {

```

```

    label: "Spacetime Metrics Collaboration",
    category: "Theoretical Physics",
    start: 2025,
    end: 2035,
    color: "#4e76e5",
    description: "International initiative to find 'loopholes' in general
relativity permitting viable warp solutions with reduced exotic matter
requirements."
  },
  {
    label: "Applied Quantum Gravity Project",
    category: "Theoretical Physics",
    start: 2026,
    end: 2033,
    color: "#4e76e5",
    description: "Research exploring how quantum gravity theories might enable
warp effects through manipulation of microscopic spacetime structure."
  },
  {
    label: "Q-Drive Prototypes",
    category: "Engineering Development",
    start: 2027,
    end: 2034,
    color: "#d957f8",
    description: "Development of Quantum Vacuum Plasma Thrusters attempting to
leverage quantum vacuum effects for propulsion, generating small but measurable
forces.",
    milestones: [
      {
        position: 2034,
        label: "Quantum Vacuum Engineering",
        description: "Development of reliable methods to engineer quantum
vacuum states with specific properties, a fundamental prerequisite for warp field
generation."
      }
    ]
  },
  {
    label: "Next-Gen Interferometry",
    category: "Experimental Physics",
    start: 2028,
    end: 2031,
    color: "#30bf78",
    description: "Advanced versions of the White-Juday Interferometer with
sensitivity to detect spacetime distortions smaller than a proton's width.",
    milestones: [
      {
        position: 2031,
        label: "Macro Spacetime Distortion",
        description: "First reproducible macroscopic spacetime distortion

```

measurable with standard equipment, though far too small for propulsion applications."

```
    }
  ]
},
{
  label: "High-Intensity Field Generators",
  category: "Engineering Development",
  start: 2029,
  end: 2034,
  color: "#d957f8",
  description: "Development of ultra-high electromagnetic field generators
to test spacetime manipulation theories in laboratory settings."
}
]
},
// Mid Term timeline data (2035-2060)
mid: [
  {
    phase: "Mid Term (2035-2060)",
    items: [
      {
        label: "Quantum Gravity Unification",
        category: "Theoretical Physics",
        start: 2035,
        end: 2045,
        color: "#4e76e5",
        description: "Theoretical work toward a unified theory of quantum gravity
with specific focus on implications for spacetime engineering and warp physics."
      },
      {
        label: "Exotic Matter Synthesis",
        category: "Material Science",
        start: 2036,
        end: 2048,
        color: "#f27935",
        description: "Research into creating stable materials with exotic
properties like negative mass-energy density through advanced quantum vacuum
manipulation techniques."
      },
      {
        label: "Warp Field Stabilization",
        category: "Theoretical Physics",
        start: 2038,
        end: 2047,
        color: "#4e76e5",
        description: "Development of mathematical frameworks to ensure stable warp
bubbles that don't collapse catastrophically once formed."
      }
    ]
  }
]
```

```

{
  label: "Sub-light Warp Field Tests",
  category: "Experimental Physics",
  start: 2040,
  end: 2052,
  color: "#30bf78",
  description: "Laboratory experiments testing limited 'sub-light' warp
field technologies that distort spacetime without achieving FTL capabilities.",
  milestones: [
    {
      position: 2043,
      label: "Laboratory Warp Effect",
      description: "First demonstration of a proper 'warp effect' where
spacetime itself is manipulated to move an object, even if only at microscopic
scales."
    }
  ]
},
{
  label: "Micro-Warp Bubble Prototype",
  category: "Engineering Development",
  start: 2042,
  end: 2055,
  color: "#d957f8",
  description: "Engineering work to create the first microscopic but stable
warp bubble capable of moving test particles with measurable spacetime distortion
effects.",
  milestones: [
    {
      position: 2050,
      label: "Warp Field Propagation",
      description: "First controlled propagation of a stable warp field
moving at measurable velocity through laboratory apparatus."
    }
  ]
},
{
  label: "Warp Field Control Systems",
  category: "Engineering Development",
  start: 2045,
  end: 2058,
  color: "#d957f8",
  description: "Development of precise control systems capable of
initiating, maintaining, and safely collapsing experimental warp fields.",
  milestones: [
    {
      position: 2058,
      label: "Macroscopic Transport",
      description: "First macroscopic object (>1cm) transported using
limited warp field technology, potentially enabling revolutionary sub-light

```

```

propulsion systems."
    }
  ]
},
{
  label: "Bubble Geometry Optimization",
  category: "Theoretical Physics",
  start: 2048,
  end: 2055,
  color: "#4e76e5",
  description: "Refinement of warp bubble geometry to minimize exotic matter
requirements and maximize stability across varying energy conditions."
}
]
}
],
// Long Term timeline data (2060+)
far: [
  {
    phase: "Long Term (2060+)",
    items: [
      {
        label: "Warp Probe Development",
        category: "Engineering Development",
        start: 2060,
        end: 2068,
        color: "#d957f8",
        description: "Engineering program to develop the first instrumented probe
capable of surviving inside a warp bubble for scientific measurements.",
        milestones: [
          {
            position: 2065,
            label: "First Warp Bubble Transport",
            description: "First experimental transport of a probe within a true
warp bubble, potentially achieving speeds exceeding conventional limits."
          }
        ]
      },
      {
        label: "Causality Protection Protocols",
        category: "Theoretical Physics",
        start: 2062,
        end: 2070,
        color: "#4e76e5",
        description: "Theoretical and practical work to ensure FTL warp technology
cannot create causality paradoxes that violate physical laws."
      },
      {
        label: "Interstellar Communication",
        category: "Engineering Development",

```

```

        start: 2065,
        end: 2075,
        color: "#d957f8",
        description: "Application of limited warp field technology to enable
near-instantaneous communication with distant spacecraft through quantum
entanglement enhanced by spacetime manipulation."
    },
    {
        label: "Full-Scale Warp Drive",
        category: "Engineering Development",
        start: 2070,
        end: 2080,
        color: "#d957f8",
        description: "Development of the first full-scale warp drive capable of
transporting significant mass (>1 ton) through a stable warp bubble.",
        milestones: [
            {
                position: 2073,
                label: "FTL Milestone",
                description: "First potential demonstration of apparent
faster-than-light effect through spacetime manipulation rather than conventional
motion."
            }
        ]
    },
    {
        label: "Solar System Warp Transit",
        category: "Engineering Development",
        start: 2075,
        end: 2080,
        color: "#d957f8",
        description: "Development of first practical warp transit system for rapid
transport between distant points in the solar system, reducing travel times from
years to days.",
        milestones: [
            {
                position: 2080,
                label: "Interstellar Capability",
                description: "Development of theoretical capability to reach nearby
stars within human timescales, pending resolution of remaining engineering
challenges."
            }
        ]
    }
]
}
];
};

```

// Literary quotes to enhance the timeline

```
const literaryQuotes = {
  alcubierre: "Remember Alcubierre? 1994—mathematics dancing on the edge of reality,
equations carving tunnels through the fabric we call Now.",
  warpBubble: "Contract the space ahead, expand what lies behind, create a bubble of
flat spacetime—a surfboard on the quantum ocean.",
  negativeEnergy: "Negative energy, exotic matter, the universe's forbidden
ingredients hidden in the Casimir effect, quantum foam bubbling beneath reality.",
  timeline: "The timeline stretches before us: 1994-2024: Theory and whispered
possibilities, 2025-2035: Microscopic bubbles, negative energy sustained, 2035-2060:
First warp effects in laboratory conditions, Beyond 2060: The stars no longer out of
reach",
  possibility: "And though the stars still seem distant, their light taking years to
reach us, the quantum whispers grow louder: The impossible is merely difficult; the
difficult merely takes time.",
  conclusion: "So when you look up at the night sky, remember—there's a folded path
between here and there, waiting for us to learn its secrets."
};
```

```
function WarpDriveTimeline() {
  const [focus, setFocus] = useState('all');
  const [tooltipData, setTooltipData] = useState(null);
  const [timelineConfig, setTimelineConfig] = useState({
    startYear: 1994,
    endYear: 2080,
    phases: [...timelineData.historical, ...timelineData.near, ...timelineData.mid,
...timelineData.far]
  });
  const [isInitialRender, setIsInitialRender] = useState(true);
  const containerRef = useRef(null);
```

```
// Current year for highlighting
const currentYear = 2025;
```

```
// Update timeline configuration when focus changes
useEffect(() => {
  let startYear, endYear, phases;
```

```
  switch(focus) {
    case 'past':
      startYear = 1994;
      endYear = 2025;
      phases = timelineData.historical;
      break;
    case 'near':
      startYear = 2025;
      endYear = 2035;
      phases = timelineData.near;
      break;
    case 'mid':
      startYear = 2035;
```

```

        endYear = 2060;
        phases = timelineData.mid;
        break;
    case 'far':
        startYear = 2060;
        endYear = 2080;
        phases = timelineData.far;
        break;
    case 'all':
    default:
        startYear = 1994;
        endYear = 2080;
        phases = [...timelineData.historical, ...timelineData.near,
...timelineData.mid, ...timelineData.far];
        break;
    }

    if (isInitialRender) {
        setTimelineConfig({ startYear, endYear, phases });
        setIsInitialRender(false);
    } else {
        // Animate the transition between different timeline views
        const container = containerRef.current;
        if (container) {
            container.style.opacity = 0;
            container.style.transform = 'translateY(20px)';

            setTimeout(() => {
                setTimelineConfig({ startYear, endYear, phases });
                container.style.opacity = 1;
                container.style.transform = 'translateY(0)';
            }, 300);
        } else {
            setTimelineConfig({ startYear, endYear, phases });
        }
    }
}, [focus, isInitialRender]);

// Show tooltip with item information
const showTooltip = (event, item) => {
    const rect = event.target.getBoundingClientRect();

    setTooltipData({
        title: item.label,
        category: item.category,
        description: item.description,
        quote: getRelevantQuote(item),
        position: {
            top: rect.top - 10,
            left: rect.left + (rect.width / 2)
        }
    });
};

```



```

    }
  });
};

// Hide tooltip
const hideTooltip = () => {
  setTooltipData(null);
};

// Get a relevant literary quote based on the item's characteristics
const getRelevantQuote = (item) => {
  const label = item.label.toLowerCase();
  const description = item.description.toLowerCase();

  if (label.includes('alcubierre') || description.includes('alcubierre')) {
    return literaryQuotes.alcubierre;
  } else if (label.includes('bubble') || description.includes('bubble')) {
    return literaryQuotes.warpBubble;
  } else if (label.includes('energy') || description.includes('energy') ||
    label.includes('exotic') || description.includes('exotic')) {
    return literaryQuotes.negativeEnergy;
  } else if (label.includes('star') || description.includes('star') ||
    label.includes('ftl') || description.includes('ftl')) {
    return literaryQuotes.possibility;
  }

  // Default quote for items that don't match specific criteria
  return "";
};

// Generate year markers for the timeline header
const renderYearMarkers = () => {
  const { startYear, endYear } = timelineConfig;
  const years = [];

  for (let year = startYear; year <= endYear; year++) {
    years.push(
      <div
        key={year}
        className={`year-marker ${year === currentYear ? 'current-year' : ''}`}
      >
        {year}
      </div>
    );
  }

  return years;
};

// Calculate position and width of timeline items

```

```

const calculateTimelineItemStyle = (item) => {
  const { startYear, endYear } = timelineConfig;
  const yearRange = endYear - startYear;

  const startPosition = ((item.start - startYear) / yearRange) * 100;
  const endPosition = ((item.end - startYear) / yearRange) * 100;
  const width = endPosition - startPosition;

  return {
    left: `${startPosition}%`,
    width: `${width}%`,
    backgroundColor: item.color,
  };
};

// Calculate position of milestones on their parent bar
const calculateMilestonePositionOnBar = (milestone, parentItem) => {
  const { startYear, endYear } = timelineConfig;
  const yearRange = endYear - startYear;

  // Calculate relative position within the parent bar
  const parentStartPos = ((parentItem.start - startYear) / yearRange) * 100;
  const parentEndPos = ((parentItem.end - startYear) / yearRange) * 100;
  const parentWidth = parentEndPos - parentStartPos;

  const milestonePos = ((milestone.position - startYear) / yearRange) * 100;
  // Calculate position relative to parent bar's left edge
  const relativePos = ((milestonePos - parentStartPos) / parentWidth) * 100;

  return {
    left: `${relativePos}%`,
  };
};

// Render timeline items for a phase
const renderTimelineItems = (phase) => {
  return phase.items.map((item, index) => {
    const itemStyle = calculateTimelineItemStyle(item);
    const isHistorical = item.end < currentYear;
    const isCurrent = item.start <= currentYear && item.end >= currentYear;
    const isProjected = item.start > currentYear;

    // Calculate animation delay based on item index
    const delay = index * 100;

    return (
      <div key={`-${phase.phase}-${index}`} className="timeline-item">
        <div className="timeline-label">
          {item.label}
          <span className="category-label">{item.category}</span>
        </div>
      </div>
    );
  });
};

```

```

    </div>
    <div className="timeline-bar-container">
      <div className="timeline-grid">
        {Array(timelineConfig.endYear - timelineConfig.startYear +
1).fill().map((_, i) => (
          <div key={i} className="grid-line"></div>
        ))}
      </div>
      {isCurrent && <div className="present-line"></div>}
      <div
        className={`timeline-bar ${isHistorical ? 'historical' : ''}
${isProjected ? 'projected' : ''}}
        style={{
          ...itemStyle,
          animationDelay: `${delay}ms`
        }}
        onMouseEnter={(e) => showTooltip(e, item)}
        onMouseLeave={hideTooltip}
      >
        {item.label}

        /* Render milestones directly on the timeline bar if they exist */
        {item.milestones && item.milestones.map((milestone, milestoneIndex) =>
{
  const milestonePos = calculateMilestonePositionOnBar(milestone,
item);

  const milestoneDelay = (index * 100) + (milestoneIndex * 100) + 500;

  return (
    <div
      key={`milestone-${item.label}-${milestoneIndex}`}
      className="milestone milestone-on-bar"
      style={{
        left: milestonePos.left,
        animationDelay: `${milestoneDelay}ms`
      }}
      onMouseEnter={(e) => showTooltip(e, {
        label: milestone.label,
        category: "Milestone",
        description: milestone.description
      })}
      onMouseLeave={hideTooltip}
    ></div>
    );
  )}}
    </div>
  </div>
  </div>
);
});

```

```

};

// Render milestones for a phase - this is now only used for historical milestones
const renderMilestones = (phase) => {
  // Skip rendering if no milestones at phase level (they're now embedded in
  timeline items)
  if (!phase.milestones || phase.milestones.length === 0) return null;

  return (
    <div className="timeline-item">
      <div className="timeline-label">Milestones</div>
      <div className="timeline-bar-container">
        <div className="timeline-grid">
          {Array(timelineConfig.endYear - timelineConfig.startYear +
1).fill().map((_, i) => (
            <div key={i} className="grid-line"></div>
          ))}
        </div>

        {phase.milestones.map((milestone, index) => {
          // Use the regular milestone position calculation for standalone
milestones
          const { startYear, endYear } = timelineConfig;
          const yearRange = endYear - startYear;
          const position = ((milestone.position - startYear) / yearRange) * 100;
          const milestoneStyle = { left: `${position}%` };
          const delay = (phase.items.length + index) * 100 + 300;

          return (
            <div
              key={`milestone-${index}`}
              className="milestone"
              style={{
                ...milestoneStyle,
                animationDelay: `${delay}ms`
              }}
              onMouseEnter={(e) => showTooltip(e, {
                label: milestone.label,
                category: "Milestone",
                description: milestone.description
              })}
              onMouseLeave={hideTooltip}
            ></div>
          );
        })}
      </div>
    </div>
  );
};

```

```

return (
  <div className="warp-drive-timeline" style={{ animation: 'fadeIn 1s ease-out'
  }}>
    <h1 className="animate-title">The Young Explorer's Warp Drive Development
Timeline</h1>
    <p className="intro-text animate-text">
      <em>This interactive timeline illustrates the theoretical and experimental
pathways toward warp drive technology, from past achievements to projected future
milestones.</em>
    </p>

    <div className="controls animate-controls">
      <button className={`control-btn ${focus === 'past' ? 'active' : ''}`}
onClick={() => setFocus('past')}>Historical Progress</button>
      <button className={`control-btn ${focus === 'near' ? 'active' : ''}`}
onClick={() => setFocus('near')}>Near Term (2025-2035)</button>
      <button className={`control-btn ${focus === 'mid' ? 'active' : ''}`}
onClick={() => setFocus('mid')}>Mid Term (2035-2060)</button>
      <button className={`control-btn ${focus === 'far' ? 'active' : ''}`}
onClick={() => setFocus('far')}>Long Term (2060+)</button>
      <button className={`control-btn ${focus === 'all' ? 'active' : ''}`}
onClick={() => setFocus('all')}>View All</button>
    </div>

    <div className="time-focus animate-focus">
      {focus === 'past' && 'Historical Progress (1994-2025)'}
      {focus === 'near' && 'Near Term (2025-2035)'}
      {focus === 'mid' && 'Mid Term (2035-2060)'}
      {focus === 'far' && 'Long Term (2060+)'}
      {focus === 'all' && 'Full Timeline View (1994-2080)'}
    </div>

    <div className="timeline-container" ref={containerRef}>
      <div className="timeline-header animate-header">
        {renderYearMarkers()}
      </div>

      {timelineConfig.phases.map((phase, phaseIndex) => (
        <div key={`phase-${phaseIndex}`} className="phase-section">
          <h2 className="phase-header" style={{ animationDelay: `${phaseIndex *
200}ms` }}>
            {phase.phase}
          </h2>
          {renderTimelineItems(phase)}
          {renderMilestones(phase)}
        </div>
      ))}
    </div>

    {tooltipData && (

```

```

<div
  className="tooltip"
  style={{
    position: 'absolute',
    top: `${tooltipData.position.top}px`,
    left: `${tooltipData.position.left}px`,
    transform: 'translate(-50%, -100%)',
    animation: 'tooltipFadeIn 0.2s ease forwards'
  }}
>
  <div className="tooltip-title">{tooltipData.title}</div>
  <div className="tooltip-category">{tooltipData.category}</div>
  <div className="tooltip-description">{tooltipData.description}</div>
  {tooltipData.quote && (
    <div className="tooltip-quote">{tooltipData.quote}</div>
  )}
</div>
)}

<div className="legend animate-legend">
  <div className="legend-item">
    <div className="legend-color" style={{ backgroundColor: '#4e76e5'
}}></div>
    <span>Theoretical Physics</span>
  </div>
  <div className="legend-item">
    <div className="legend-color" style={{ backgroundColor: '#30bf78'
}}></div>
    <span>Experimental Physics</span>
  </div>
  <div className="legend-item">
    <div className="legend-color" style={{ backgroundColor: '#d957f8'
}}></div>
    <span>Engineering Development</span>
  </div>
  <div className="legend-item">
    <div className="legend-color" style={{ backgroundColor: '#f27935'
}}></div>
    <span>Material Science</span>
  </div>
  <div className="legend-item">
    <div className="legend-color" style={{ backgroundColor: '#ffcc00'
}}></div>
    <span>Milestone</span>
  </div>
</div>

<style jsx>{`
.warp-drive-timeline {
  font-family: 'Arial', sans-serif;

```

```
background-color: #0a1128;
color: #e2e2e2;
padding: 20px;
border-radius: 10px;
max-width: 100%;
overflow-x: hidden;
position: relative;
background-image:
  radial-gradient(circle at 10% 20%, rgba(50, 100, 255, 0.05) 0%,
transparent 40%),
  radial-gradient(circle at 90% 60%, rgba(50, 100, 255, 0.05) 0%,
transparent 40%);
}
```

```
@keyframes fadeIn {
  from { opacity: 0; }
  to { opacity: 1; }
}
```

```
h1 {
  text-align: center;
  color: #7b9fff;
  margin-bottom: 30px;
  font-size: 28px;
  text-shadow: 0 0 10px rgba(100, 150, 255, 0.3);
  animation: fadeInDown 1s forwards;
}
```

```
@keyframes fadeInDown {
  from {
    opacity: 0;
    transform: translateY(-20px);
  }
  to {
    opacity: 1;
    transform: translateY(0);
  }
}
```

```
.intro-text {
  margin-bottom: 25px;
  line-height: 1.5;
  text-align: center;
  color: #aac4ff;
  animation: fadeIn 1s forwards;
  animation-delay: 0.3s;
  opacity: 0;
}
```

```
.controls {
```

```

display: flex;
justify-content: center;
margin-bottom: 20px;
flex-wrap: wrap;
gap: 10px;
animation: fadeIn 1s forwards;
animation-delay: 0.5s;
opacity: 0;
}

.control-btn {
background-color: #1a2649;
color: #aac4ff;
border: 1px solid #3d5a9d;
padding: 10px 20px;
border-radius: 4px;
cursor: pointer;
transition: all 0.3s;
position: relative;
overflow: hidden;
}

.control-btn::after {
content: '';
position: absolute;
top: 0;
left: -100%;
width: 100%;
height: 100%;
background: linear-gradient(90deg, transparent, rgba(255, 255, 255, 0.1),
transparent);
transition: left 0.5s;
}

.control-btn:hover {
background-color: #263563;
color: white;
transform: translateY(-2px);
box-shadow: 0 5px 15px rgba(0, 0, 0, 0.2);
}

.control-btn:hover::after {
left: 100%;
}

.control-btn.active {
background-color: #3d5a9d;
color: white;
box-shadow: 0 0 15px rgba(123, 159, 255, 0.3);
}

```



```
.time-focus {
  text-align: center;
  margin-bottom: 20px;
  font-weight: bold;
  color: #7b9fff;
  font-size: 18px;
  animation: fadeIn 1s forwards;
  animation-delay: 0.7s;
  opacity: 0;
}

.timeline-container {
  position: relative;
  margin-bottom: 40px;
  transition: opacity 0.3s, transform 0.3s;
}

.timeline-header {
  display: flex;
  margin-bottom: 10px;
  padding-left: 200px;
  position: sticky;
  top: 0;
  background-color: rgba(10, 17, 40, 0.95);
  z-index: 10;
  padding-top: 10px;
  padding-bottom: 10px;
  backdrop-filter: blur(5px);
  animation: fadeIn 1s forwards;
  animation-delay: 0.9s;
  opacity: 0;
}

.year-marker {
  flex: 1;
  text-align: center;
  font-weight: bold;
  color: #7b9fff;
  font-size: 12px;
  transition: color 0.3s;
}

.current-year {
  color: #ffcc00;
  position: relative;
}

.current-year::after {
  content: '';
```

```
position: absolute;
left: 50%;
top: 100%;
transform: translateX(-50%);
width: 1px;
height: 0;
background-color: rgba(255, 204, 0, 0.2);
animation: currentYearLine 2s forwards;
z-index: 1;
}
```

```
@keyframes currentYearLine {
  0% { height: 0; }
  100% { height: 500px; }
}
```

```
.phase-header {
  margin-top: 40px;
  margin-bottom: 15px;
  color: #7b9fff;
  font-size: 20px;
  border-bottom: 1px solid #3d5a9d;
  padding-bottom: 5px;
  opacity: 0;
  transform: translateY(20px);
  animation: fadeIn 0.8s forwards;
}
```

```
.timeline-item {
  display: flex;
  margin-bottom: 15px;
  align-items: center;
}
```

```
.timeline-label {
  width: 200px;
  padding-right: 15px;
  text-align: right;
  font-weight: bold;
  color: #e2e2e2;
}
```

```
.category-label {
  font-style: italic;
  color: #aac4ff;
  margin-left: 5px;
  font-size: 0.8em;
}
```

```
.timeline-bar-container {
```

```

    flex: 1;
    display: flex;
    height: 30px;
    position: relative;
}

.timeline-grid {
    display: flex;
    position: absolute;
    width: 100%;
    height: 100%;
    pointer-events: none;
}

.grid-line {
    flex: 1;
    border-right: 1px dashed rgba(123, 159, 255, 0.2);
    height: 100%;
}

.timeline-bar {
    height: 100%;
    border-radius: 4px;
    transition: all 0.3s ease;
    position: absolute;
    display: flex;
    align-items: center;
    justify-content: center;
    color: white;
    font-size: 12px;
    cursor: pointer;
    overflow: hidden;
    white-space: nowrap;
    text-overflow: ellipsis;
    padding: 0 10px;
    box-shadow: 0 2px 5px rgba(0, 0, 0, 0.3);
    opacity: 0;
    transform: translateY(20px);
    animation: fadeInUp 0.5s ease forwards;
}

@keyframes fadeInUp {
    from {
        opacity: 0;
        transform: translateY(20px);
    }
    to {
        opacity: 1;
        transform: translateY(0);
    }
}

```

```

}

.timeline-bar:hover {
  transform: translateY(-2px);
  box-shadow: 0 4px 8px rgba(0, 0, 0, 0.5);
  z-index: 10;
}

.historical {
  border: none;
}

.projected {
  background-image: linear-gradient(45deg,
    rgba(255, 255, 255, 0.1) 25%,
    transparent 25%,
    transparent 50%,
    rgba(255, 255, 255, 0.1) 50%,
    rgba(255, 255, 255, 0.1) 75%,
    transparent 75%,
    transparent);
  background-size: 15px 15px;
  border: 1px dashed rgba(255, 255, 255, 0.3);
  animation: moveStripes 30s linear infinite;
}

@keyframes moveStripes {
  from { background-position: 0 0; }
  to { background-position: 100px 0; }
}

.present-line {
  position: absolute;
  left: 0;
  width: 100%;
  height: 1px;
  background-color: #ffcc00;
  top: 50%;
  transform: translateY(-50%);
  z-index: 1;
  pointer-events: none;
}

.milestone {
  position: absolute;
  width: 15px;
  height: 15px;
  background-color: #ffcc00;
  border-radius: 50%;
  bottom: -20px;
}

```

```

    transform: translateX(-50%) scale(0);
    cursor: pointer;
    z-index: 5;
    box-shadow: 0 0 10px rgba(255, 204, 0, 0.5);
    animation: pulseIn 0.5s forwards;
}

/* Milestone positioned directly on timeline bar */
.milestone-on-bar {
    bottom: auto;
    top: 50%;
    transform: translate(-50%, -50%) scale(0);
    animation: pulseInCentered 0.5s forwards;
}

@keyframes pulseInCentered {
    0% {
        transform: translate(-50%, -50%) scale(0);
        opacity: 0;
    }
    50% {
        transform: translate(-50%, -50%) scale(1.2);
        opacity: 1;
    }
    100% {
        transform: translate(-50%, -50%) scale(1);
        opacity: 1;
    }
}

@keyframes pulseIn {
    0% {
        transform: translateX(-50%) scale(0);
        opacity: 0;
    }
    50% {
        transform: translateX(-50%) scale(1.2);
        opacity: 1;
    }
    100% {
        transform: translateX(-50%) scale(1);
        opacity: 1;
    }
}

.milestone::after {
    content: '';
    position: absolute;
    width: 100%;
    height: 100%;

```

```
border-radius: 50%;
background-color: rgba(255, 204, 0, 0.4);
animation: pulse 2s infinite;
left: 0;
top: 0;
}
```

```
@keyframes pulse {
  0% {
    transform: scale(1);
    opacity: 0.7;
  }
  50% {
    transform: scale(1.5);
    opacity: 0;
  }
  100% {
    transform: scale(1);
    opacity: 0;
  }
}
```

```
.milestone:hover {
  transform: translateX(-50%) scale(1.2);
}
```

```
.tooltip {
  background-color: rgba(10, 17, 40, 0.95);
  color: #fff;
  padding: 15px;
  border-radius: 5px;
  box-shadow: 0 0 15px rgba(0, 0, 0, 0.5);
  z-index: 100;
  width: 250px;
  font-size: 14px;
  border: 1px solid #3d5a9d;
  pointer-events: none;
  opacity: 0;
  backdrop-filter: blur(5px);
}
```

```
@keyframes tooltipFadeIn {
  from {
    opacity: 0;
    transform: translate(-50%, -90%);
  }
  to {
    opacity: 1;
    transform: translate(-50%, -100%);
  }
}
```

```
}

.tooltip-title {
  color: #7b9fff;
  font-weight: bold;
  margin-bottom: 5px;
  font-size: 16px;
  border-bottom: 1px solid rgba(123, 159, 255, 0.3);
  padding-bottom: 5px;
}

.tooltip-category {
  color: #aac4ff;
  font-style: italic;
  margin-bottom: 5px;
  font-size: 12px;
}

.tooltip-description {
  margin-bottom: 10px;
  line-height: 1.4;
}

.tooltip-quote {
  font-style: italic;
  border-left: 3px solid #7b9fff;
  padding-left: 10px;
  margin-top: 10px;
  color: #aac4ff;
}

.legend {
  display: flex;
  justify-content: center;
  flex-wrap: wrap;
  margin-top: 30px;
  gap: 15px;
  opacity: 0;
  animation: fadeIn 1s forwards;
  animation-delay: 1s;
}

.legend-item {
  display: flex;
  align-items: center;
  margin-right: 15px;
  transition: transform 0.3s;
}

.legend-item:hover {
```

```

    transform: translateY(-2px);
}

.legend-color {
    width: 20px;
    height: 20px;
    border-radius: 4px;
    margin-right: 5px;
    box-shadow: 0 2px 5px rgba(0, 0, 0, 0.2);
}

.animate-title {
    opacity: 0;
    animation: fadeInDown 1s forwards;
}

.animate-text {
    opacity: 0;
    animation: fadeIn 1s forwards;
    animation-delay: 0.3s;
}

.animate-controls {
    opacity: 0;
    animation: fadeIn 1s forwards;
    animation-delay: 0.5s;
}

.animate-focus {
    opacity: 0;
    animation: fadeIn 1s forwards;
    animation-delay: 0.7s;
}

.animate-header {
    opacity: 0;
    animation: fadeIn 1s forwards;
    animation-delay: 0.9s;
}

@media (max-width: 768px) {
    .timeline-label {
        width: 150px;
        font-size: 12px;
    }

    .control-btn {
        font-size: 12px;
        padding: 6px 10px;
    }
}

```



```
        .timeline-bar {
          font-size: 10px;
        }
      `}</style>
    </div>
  );
}

export default WarpDriveTimeline;
```

```

// Warp Drive Timeline JavaScript Code
// This code defines the timeline data structure and functions to generate and
interact with the timeline

// Timeline data structure - Historical progress from 1994-2025
const timelineData = {
  historical: [
    {
      phase: "Historical Progress",
      items: [
        {
          label: "Alcubierre Metric",
          category: "Theoretical Physics",
          start: 1994,
          end: 1994,
          color: "#4e76e5",
          description: "Miguel Alcubierre publishes his groundbreaking
paper describing a spacetime metric that would allow for faster-than-light travel
without violating special relativity."
        },
        {
          label: "Van Den Broeck Refinement",
          category: "Theoretical Physics",
          start: 1999,
          end: 2000,
          color: "#4e76e5",
          description: "Chris Van Den Broeck proposes modifications to the
Alcubierre metric that reduced energy requirements from greater than the mass of the
universe to approximately solar mass."
        },
        {
          label: "Early NASA BPP Program",
          category: "Experimental Physics",
          start: 1996,
          end: 2002,
          color: "#30bf78",
          description: "NASA's Breakthrough Propulsion Physics program
investigates speculative physics concepts including warp drive theories."
        },
        {
          label: "Natário Contribution",
          category: "Theoretical Physics",
          start: 2002,
          end: 2002,
          color: "#4e76e5",
          description: "José Natário demonstrates that the Alcubierre
drive could be modified to avoid the frontal horizon expansion that would capture
high-energy particles."
        }
      ]
    }
  ]
}

```

```

        label: "Thin-Shell Optimization",
        category: "Theoretical Physics",
        start: 2011,
        end: 2012,
        color: "#4e76e5",
        description: "Theoretical work showing that making the bubble
walls 'thinner' could dramatically reduce negative energy requirements."
    },
    {
        label: "White's Energy Calculations",
        category: "Theoretical Physics",
        start: 2012,
        end: 2013,
        color: "#4e76e5",
        description: "Harold White at NASA recalculates energy
requirements using oscillating bubble geometries, suggesting dramatic reductions in
negative energy needs."
    },
    {
        label: "Early Interferometer Tests",
        category: "Experimental Physics",
        start: 2013,
        end: 2018,
        color: "#30bf78",
        description: "White-Juday Warp Field Interferometer experiments
at NASA attempt to detect microscopic spacetime distortions created in laboratory
conditions."
    },
    {
        label: "Casimir Effect Experiments",
        category: "Experimental Physics",
        start: 2014,
        end: 2020,
        color: "#30bf78",
        description: "Advanced Casimir effect experiments demonstrate
sustained negative energy density in increasingly larger regions of space."
    },
    {
        label: "White-Bohrick Framework",
        category: "Theoretical Physics",
        start: 2021,
        end: 2021,
        color: "#4e76e5",
        description: "Alexey Bohrick and Gianni Martire publish a
comprehensive classification of all possible warp drives, showing that some
sub-light variants might be possible with positive energy."
    },
    {
        label: "DARPA 'Accidental Bubble'",
        category: "Experimental Physics",

```

```

        start: 2021,
        end: 2021,
        color: "#30bf78",
        description: "Researchers at Limitless Space Institute
accidentally detect what appears to be a microscopic spacetime distortion consistent
with a tiny warp bubble during Casimir effect experiments."
    },
    {
        label: "Soliton Warp Shell Theory",
        category: "Theoretical Physics",
        start: 2022,
        end: 2022,
        color: "#4e76e5",
        description: "Development of the soliton-based warp field
theory, suggesting self-reinforcing solitary waves could maintain stable warp
bubbles with less energy input."
    },
    {
        label: "Bobrick-Lentz Reconfiguration",
        category: "Theoretical Physics",
        start: 2023,
        end: 2023,
        color: "#4e76e5",
        description: "Breakthrough paper proposing modified warp metrics
using 'solitonic wave configurations' of positive energy to create effective
spacetime distortion without negative energy."
    },
    {
        label: "Quantum Foam Leverage Hypothesis",
        category: "Theoretical Physics",
        start: 2023,
        end: 2023,
        color: "#4e76e5",
        description: "Dr. Viola Chen's team publishes findings
suggesting quantum foam might be temporarily 'borrowed against' to create
macroscopic negative energy regions."
    },
    {
        label: "NASA BPP Program Revival",
        category: "Experimental Physics",
        start: 2023,
        end: 2024.5,
        color: "#30bf78",
        description: "NASA reestablishes funding for speculative
propulsion physics research, including warp drive concepts and experimental tests."
    },
    {
        label: "Quantum Field Anchoring",
        category: "Theoretical Physics",
        start: 2024,

```

```

        end: 2024.5,
        color: "#4e76e5",
        description: "Development of quantum field anchoring theory
suggesting methods to stabilize warp bubbles using quantum entanglement between the
bubble's outer edge and reference frames."
    },
    {
        label: "Casimir Cavity Array Experiment",
        category: "Experimental Physics",
        start: 2024,
        end: 2024.5,
        color: "#30bf78",
        description: "Successful generation of measurable spacetime
curvature using an array of nanoscale Casimir cavities combined with electromagnetic
fields. The distortion was approximately one billionth of required warp effect."
    }
]
},
// Near Term timeline data (2025-2035)
near: [
    {
        phase: "Near Term (2025-2035)",
        items: [
            {
                label: "Advanced Metamaterials",
                category: "Material Science",
                start: 2025,
                end: 2030,
                color: "#f27935",
                description: "Development of metamaterials with negative
refractive index to simulate properties of exotic matter for experimental warp field
tests."
            },
            {
                label: "Quantum Vacuum Manipulation Program",
                category: "Experimental Physics",
                start: 2025,
                end: 2032,
                color: "#30bf78",
                description: "Consortium research using advanced Casimir cavity
geometries, squeezed quantum states of light, and superconducting metamaterials to
create and sustain regions of negative energy density."
            },
            {
                label: "Spacetime Metrics Collaboration",
                category: "Theoretical Physics",
                start: 2025,
                end: 2035,
                color: "#4e76e5",

```

```

        description: "International initiative to find 'loopholes' in
general relativity permitting viable warp solutions with reduced exotic matter
requirements."
    },
    {
        label: "Applied Quantum Gravity Project",
        category: "Theoretical Physics",
        start: 2026,
        end: 2033,
        color: "#4e76e5",
        description: "Research exploring how quantum gravity theories
might enable warp effects through manipulation of microscopic spacetime structure."
    },
    {
        label: "Q-Drive Prototypes",
        category: "Engineering Development",
        start: 2027,
        end: 2034,
        color: "#d957f8",
        description: "Development of Quantum Vacuum Plasma Thrusters
attempting to leverage quantum vacuum effects for propulsion, generating small but
measurable forces."
    },
    {
        label: "Next-Gen Interferometry",
        category: "Experimental Physics",
        start: 2028,
        end: 2031,
        color: "#30bf78",
        description: "Advanced versions of the White-Juday
Interferometer with sensitivity to detect spacetime distortions smaller than a
proton's width."
    },
    {
        label: "High-Intensity Field Generators",
        category: "Engineering Development",
        start: 2029,
        end: 2034,
        color: "#d957f8",
        description: "Development of ultra-high electromagnetic field
generators to test spacetime manipulation theories in laboratory settings."
    }
],
milestones: [
    {
        position: 2028.5,
        label: "First Sustained Negative Energy",
        description: "First laboratory demonstration of sustained
negative energy density for more than 1 second in a region larger than molecular
scale."
    }
]

```

```

    },
    {
        position: 2031,
        label: "Macro Spacetime Distortion",
        description: "First reproducible macroscopic spacetime
distortion measurable with standard equipment, though far too small for propulsion
applications."
    },
    {
        position: 2034,
        label: "Quantum Vacuum Engineering",
        description: "Development of reliable methods to engineer
quantum vacuum states with specific properties, a fundamental prerequisite for warp
field generation."
    }
]
},
// Mid Term timeline data (2035-2060)
mid: [
    {
        phase: "Mid Term (2035-2060)",
        items: [
            {
                label: "Quantum Gravity Unification",
                category: "Theoretical Physics",
                start: 2035,
                end: 2045,
                color: "#4e76e5",
                description: "Theoretical work toward a unified theory of
quantum gravity with specific focus on implications for spacetime engineering and
warp physics."
            },
            {
                label: "Exotic Matter Synthesis",
                category: "Material Science",
                start: 2036,
                end: 2048,
                color: "#f27935",
                description: "Research into creating stable materials with
exotic properties like negative mass-energy density through advanced quantum vacuum
manipulation techniques."
            },
            {
                label: "Warp Field Stabilization",
                category: "Theoretical Physics",
                start: 2038,
                end: 2047,
                color: "#4e76e5",
                description: "Development of mathematical frameworks to ensure

```

```

stable warp bubbles that don't collapse catastrophically once formed."
    },
    {
        label: "Sub-light Warp Field Tests",
        category: "Experimental Physics",
        start: 2040,
        end: 2052,
        color: "#30bf78",
        description: "Laboratory experiments testing limited 'sub-light'
warp field technologies that distort spacetime without achieving FTL capabilities."
    },
    {
        label: "Micro-Warp Bubble Prototype",
        category: "Engineering Development",
        start: 2042,
        end: 2055,
        color: "#d957f8",
        description: "Engineering work to create the first microscopic
but stable warp bubble capable of moving test particles with measurable spacetime
distortion effects."
    },
    {
        label: "Warp Field Control Systems",
        category: "Engineering Development",
        start: 2045,
        end: 2058,
        color: "#d957f8",
        description: "Development of precise control systems capable of
initiating, maintaining, and safely collapsing experimental warp fields."
    },
    {
        label: "Bubble Geometry Optimization",
        category: "Theoretical Physics",
        start: 2048,
        end: 2055,
        color: "#4e76e5",
        description: "Refinement of warp bubble geometry to minimize
exotic matter requirements and maximize stability across varying energy conditions."
    }
],
milestones: [
    {
        position: 2043,
        label: "Laboratory Warp Effect",
        description: "First demonstration of a proper 'warp effect'
where spacetime itself is manipulated to move an object, even if only at microscopic
scales."
    },
    {
        position: 2050,

```



```

        label: "Warp Field Propagation",
        description: "First controlled propagation of a stable warp
field moving at measurable velocity through laboratory apparatus."
    },
    {
        position: 2058,
        label: "Macroscopic Transport",
        description: "First macroscopic object (>1cm) transported using
limited warp field technology, potentially enabling revolutionary sub-light
propulsion systems."
    }
]
},
// Long Term timeline data (2060+)
far: [
    {
        phase: "Long Term (2060+)",
        items: [
            {
                label: "Warp Probe Development",
                category: "Engineering Development",
                start: 2060,
                end: 2068,
                color: "#d957f8",
                description: "Engineering program to develop the first
instrumented probe capable of surviving inside a warp bubble for scientific
measurements."
            },
            {
                label: "Causality Protection Protocols",
                category: "Theoretical Physics",
                start: 2062,
                end: 2070,
                color: "#4e76e5",
                description: "Theoretical and practical work to ensure FTL warp
technology cannot create causality paradoxes that violate physical laws."
            },
            {
                label: "Interstellar Communication",
                category: "Engineering Development",
                start: 2065,
                end: 2075,
                color: "#d957f8",
                description: "Application of limited warp field technology to
enable near-instantaneous communication with distant spacecraft through quantum
entanglement enhanced by spacetime manipulation."
            },
            {
                label: "Full-Scale Warp Drive",

```

```

        category: "Engineering Development",
        start: 2070,
        end: 2080,
        color: "#d957f8",
        description: "Development of the first full-scale warp drive
capable of transporting significant mass (>1 ton) through a stable warp bubble."
    },
    {
        label: "Solar System Warp Transit",
        category: "Engineering Development",
        start: 2075,
        end: 2080,
        color: "#d957f8",
        description: "Development of first practical warp transit system
for rapid transport between distant points in the solar system, reducing travel
times from years to days."
    }
],
    milestones: [
        {
            position: 2065,
            label: "First Warp Bubble Transport",
            description: "First experimental transport of a probe within a
true warp bubble, potentially achieving speeds exceeding conventional limits."
        },
        {
            position: 2073,
            label: "FTL Milestone",
            description: "First potential demonstration of apparent
faster-than-light effect through spacetime manipulation rather than conventional
motion."
        },
        {
            position: 2080,
            label: "Interstellar Capability",
            description: "Development of theoretical capability to reach
nearby stars within human timescales, pending resolution of remaining engineering
challenges."
        }
    ]
}
]
};

```

```

// Function to generate the timeline HTML based on selected date range and phases
function generateTimelineHTML(startYear, endYear, phases) {
    // Calculate date ranges and grid
    const yearRange = endYear - startYear;
    const yearWidth = 100 / yearRange; // percentage width for each year

```

```

let timelineHTML = '';

// Generate year markers
timelineHTML += '<div class="timeline-header">';
for (let year = startYear; year <= endYear; year++) {
    timelineHTML += `<div class="year-marker">${year}</div>`;
}
timelineHTML += '</div>';

// Generate timeline content for each phase
phases.forEach(phase => {
    timelineHTML += `<h2 class="phase-header">${phase.phase}</h2>`;

    // Generate timeline items
    phase.items.forEach(item => {
        const startPosition = ((item.start - startYear) / yearRange) * 100;
        const endPosition = ((item.end - startYear) / yearRange) * 100;
        const width = endPosition - startPosition;

        timelineHTML += `
            <div class="timeline-item">
                <div class="timeline-label">${item.label} <span
class="category-label">${item.category}</span></div>
                <div class="timeline-bar-container">
                    <div class="timeline-grid">
                        ${Array(yearRange + 1).fill().map(() => '<div
class="grid-line"></div>').join('')}
                    </div>
                    <div class="timeline-bar"
                        style="left: ${startPosition}%; width: ${width}%;
background-color: ${item.color};"
                        onmouseover="showTooltip(event, '${item.label}',
'${item.description}')"
                        onmouseout="hideTooltip()">
                        ${item.label}
                    </div>
                </div>
            </div>
        `;
    });

    // Generate milestones if they exist
    if (phase.milestones) {
        timelineHTML += '<div class="timeline-item">';
        timelineHTML += '<div class="timeline-label">Milestones</div>';
        timelineHTML += '<div class="timeline-bar-container">';
        timelineHTML += '<div class="timeline-grid">';
        for (let i = 0; i <= yearRange; i++) {
            timelineHTML += '<div class="grid-line"></div>';
        }
    }
}

```

```

        timelineHTML += '</div>';

        // Add milestone markers
        phase.milestones.forEach(milestone => {
            const position = ((milestone.position - startYear) / yearRange) *
100;
            timelineHTML += `
                <div class="milestone"
                    style="left: ${position}%;"
                    onmouseover="showTooltip(event, '${milestone.label}',
'${milestone.description}')"
                    onmouseout="hideTooltip()">
                </div>
            `;
        });

        timelineHTML += '</div></div>';
    }
    });

    return timelineHTML;
}

```

```

// Function to create and show tooltip when hovering over timeline elements
function showTooltip(event, title, description) {
    // Remove any existing tooltips
    const existingTooltip = document.querySelector('.tooltip');
    if (existingTooltip) {
        existingTooltip.remove();
    }

    const tooltip = document.createElement('div');
    tooltip.className = 'tooltip';
    tooltip.innerHTML = `<strong>${title}</strong><br>${description}`;
    document.body.appendChild(tooltip);

    // Position the tooltip
    const rect = event.target.getBoundingClientRect();
    tooltip.style.top = `${rect.top - tooltip.offsetHeight - 10}px`;
    tooltip.style.left = `${rect.left + (rect.width / 2) - (tooltip.offsetWidth /
2)}px`;

    // Make it visible
    setTimeout(() => {
        tooltip.style.visibility = 'visible';
        tooltip.style.opacity = '1';
    }, 10);
}

```

```

// Function to hide tooltip when no longer hovering

```

```

function hideTooltip() {
    const tooltip = document.querySelector('.tooltip');
    if (tooltip) {
        tooltip.style.opacity = '0';
        setTimeout(() => {
            tooltip.remove();
        }, 300);
    }
}

// Function to change timeline focus based on button selection
function focusTimeline(focus) {
    const container = document.getElementById('timeline-container');
    const timeFocus = document.getElementById('time-focus');

    let timelineHTML = '';
    let startYear, endYear, phases;

    switch(focus) {
        case 'past':
            startYear = 1994;
            endYear = 2025;
            phases = timelineData.historical;
            timeFocus.textContent = 'Historical Progress (1994-2025)';
            break;
        case 'near':
            startYear = 2025;
            endYear = 2035;
            phases = timelineData.near;
            timeFocus.textContent = 'Near Term (2025-2035)';
            break;
        case 'mid':
            startYear = 2035;
            endYear = 2060;
            phases = timelineData.mid;
            timeFocus.textContent = 'Mid Term (2035-2060)';
            break;
        case 'far':
            startYear = 2060;
            endYear = 2080;
            phases = timelineData.far;
            timeFocus.textContent = 'Long Term (2060+)';
            break;
        case 'all':
        default:
            startYear = 1994;
            endYear = 2080;
            phases = [...timelineData.historical, ...timelineData.near,
            ...timelineData.mid, ...timelineData.far];
            timeFocus.textContent = 'Full Timeline View (1994-2080)';
    }
}

```

```
        break;
    }

    timelineHTML = generateTimelineHTML(startYear, endYear, phases);
    container.innerHTML = timelineHTML;
}

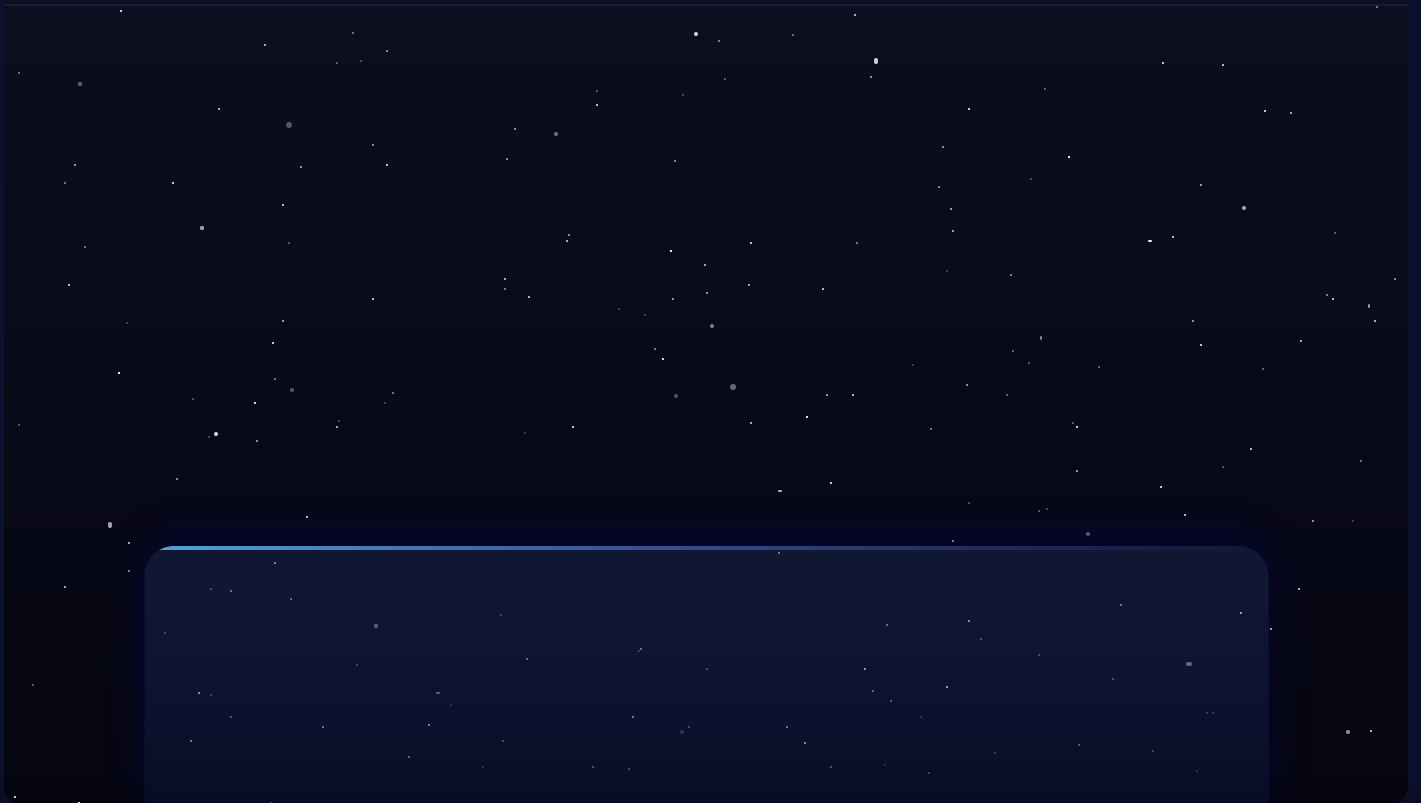
// Initialize the timeline with all phases on load
document.addEventListener('DOMContentLoaded', () => {
    focusTimeline('all');
});
```



The Young Explorer's Illustrated Primer: Visual Elements

CHAPTER I: The Dream of Stars

"The primer's pages shimmer slightly, as if alive with possibility. As you open it, a small animated starfield appears to float above the page."



CHAPTER II: The Problem of Distance

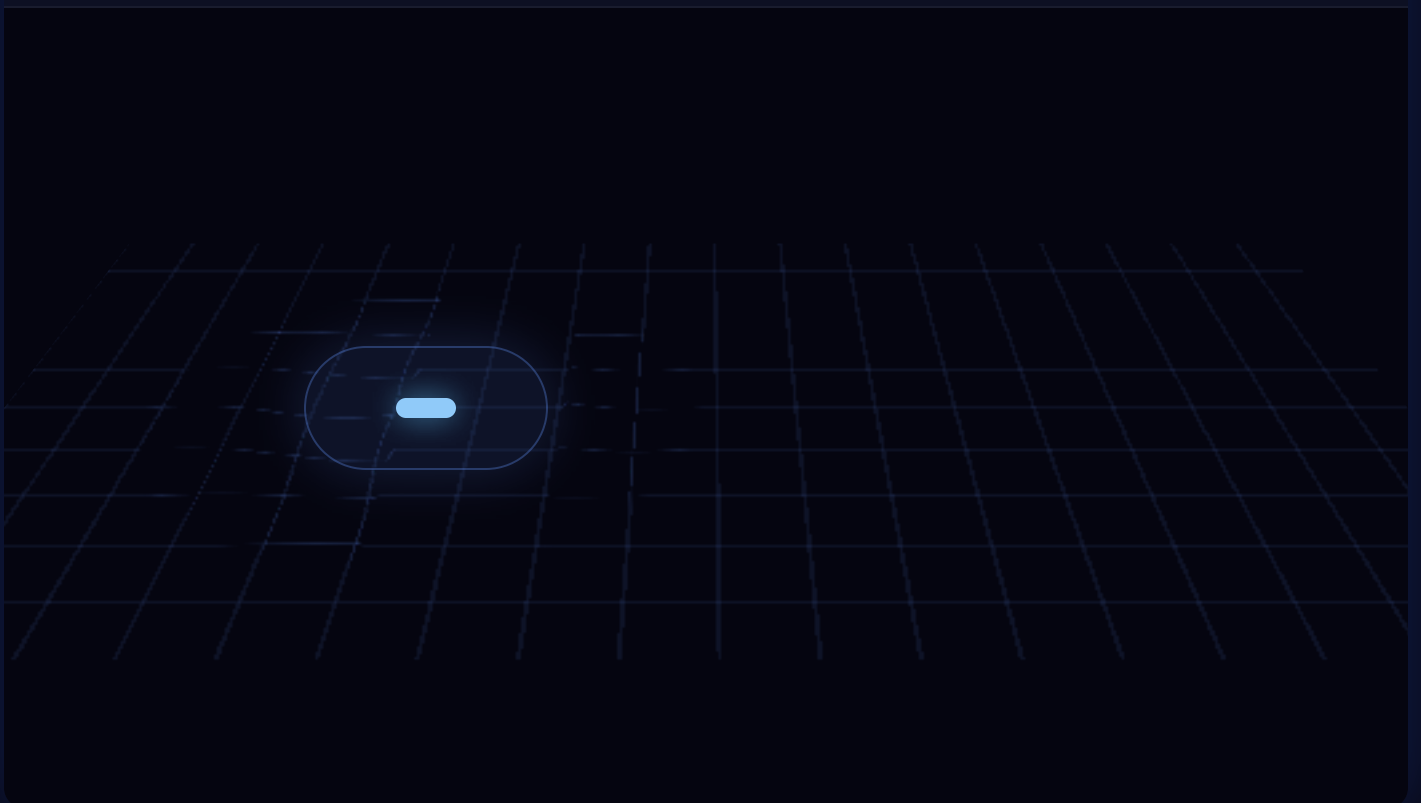
"A diagram appears showing the Solar System, then zooming out to show nearby stars, then our galaxy, then the local group of galaxies."

Our Solar System

[Solar System](#)[Nearby Stars](#)[Milky Way](#)[Local Group](#)

CHAPTER III: The Alcubierre Solution

"The pages transform to show complex equations that gradually simplify into an elegant diagram of curved spacetime."



CHAPTER V: Exotic Matter and Quantum Fields

"The page displays what looks like smoke that behaves in impossible ways, flowing upward against gravity and passing through solid objects."

