Spectral Effects:
Chromatic Refraction and Wavelength Interference

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All You Pink Floyd Fans Already Understand Spectral Behavior . . . 😊

Certain processes result in a different light color being seen in a different place.

Rainbows

Rainbow Strategy

1. Draw one big quadrilateral across the scene
2. Anywhere that .7400 ≤ cos(Θ) ≤ .7700, paint a color
3. Otherwise, discard.

<table>
<thead>
<tr>
<th>Color</th>
<th>λ</th>
<th>η</th>
<th>Θ</th>
<th>cos(Θ)</th>
<th>θ0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>650 nm</td>
<td>1.515</td>
<td>42°</td>
<td>0.743</td>
<td>50.0°</td>
</tr>
<tr>
<td>Green</td>
<td>500 nm</td>
<td>1.519</td>
<td>41°</td>
<td>0.735</td>
<td>51.5°</td>
</tr>
<tr>
<td>Blue</td>
<td>400 nm</td>
<td>1.528</td>
<td>40°</td>
<td>0.706</td>
<td>53.0°</td>
</tr>
</tbody>
</table>
float Pulse( float min, float max, float tol, float t )
{
    float a = min - tol;
    float b = min + tol;
    float c = max - tol;
    float d = max + tol;
    return smoothstep(a,b,t) - smoothstep(c,d,t);
}

vec3 SunDirection = vec3( 0., SunY, 10. );
vec3 PtToSun = normalize( SunDirection );
vec3 PtToEye = normalize( vec3(0,0,0) - ECposition );
float costheta = dot( PtToEye, PtToSun );
float R = Pulse(.7400, .7490, Tol, costheta);
float G = Pulse(.7490, .7605, Tol, costheta);
float B = Pulse(.7605, .7700, Tol, costheta);

float t = (λ – 400.)/(600. – 400.);
vec3 rgb = Rainbow(t);

Oil Slicks

Cancels when 2d = λ/m
Reinforces when 2d = λ/m+½

λ_n = λ/η
η ≈ 1.4

λ = 2dη
m + ½

On the way in, A travels dcos(φ_i) less than B. On the way out, A travels dcos(φ_r) more than B.

So, wavelengths reinforce when abs[dcos(φ_i) - dcos(φ_r)] is a multiple of the wavelength = mλ

λ* = d x |cos(φ_i) - cos(φ_r)| / m
Then, \( \cos(\phi_i) \) is \( \text{ToLight} \cdot \text{Tangent} \)

And, \( \cos(\phi_r) \) is \( \text{ToEye} \cdot (-\text{Tangent}) \)

So that \( \cos(\phi_i) - \cos(\phi_r) \) is: \( \text{Tangent} \cdot (\text{ToLight} + \text{ToEye}) \)

\[ \lambda^* = d \times \left| \cos(\phi_i) - \cos(\phi_r) \right| / m \]