Spectral Effects:
Chromatic Refraction and Wavelength Interference

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Rainbows

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

Rainbow Strategy

1. Draw one big quadrilateral across the scene.
2. Anywhere that \( 0.740 \leq \cos(\theta) \leq 0.770 \), paint a color.
3. Otherwise, discard.

Or anything else, really. You just need a large “fragment-generator.”

Spectral Colors

Floats:
- 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( 0.7400, 0.7490, Tol, costheta );
float G = Pulse( 0.7490, 0.7605, Tol, costheta );
float B = Pulse( 0.7605, 0.7700, Tol, costheta );

vec3 RGB = vec3( R, G, B );
vec3 YC = vec3( 0.0, 1.0, 0.0 );
vec3 RBG = vec3( 1.0, 1.0, 0.0 );
vec3 RGB = Rainbow( t );

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vec3 PtToEye = normalize( vec3(0.,0.,0.) - ECposition );
float costheta = dot( PtToEye, PtToSun );
float R = Pulse( 0.66, 0.66, Tol, costheta );
float G = Pulse( 0.66, 0.66, Tol, costheta );
float B = Pulse( 0.66, 0.66, Tol, costheta );
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Oil Slicks

- No phase change when $d = \frac{\lambda}{\eta}$
- Reinforces when $2d = \frac{\lambda}{\eta}$ (m/2)

$$\lambda_1 = 450, 525, 600$$

$\lambda$ - RBG
$\eta$ - Y
$C$ - 1.0

Phase Change

On the way in, A travels $d\cos(\phi_i)$ less than B. On the way out, A travels $d\cos(\phi_r)$ more than B.

So, wavelengths reinforce when $\text{abs} [d\cos(\phi_i) - d\cos(\phi_r)]$ is a multiple of the wavelength = $\lambda_1$

$$\lambda_1 = d \times |\cos(\phi_i) - \cos(\phi_r)| \div m$$

For a CD, $d = 1600$ nm
For a DVD, $d = 740$ nm

Diffraction Gratings

Call the unit vector from the point to the light $\text{ToLight}$.
Call the unit vector from the point to the eye $\text{ToEye}$.
Call the transformed tangential unit vector $\text{Tangent}$.

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: $\text{Tangent} \cdot (\text{ToLight} + \text{ToEye})$