The **colorwav** package*

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The **colorwav** package defines a command to return the RGB values for a color corresponding to a given wavelength. The \LaTeX\ code is based upon the FORTRAN code found at [http://www.efg2.com/Lab/ScienceAndEngineering/Spectra.htm](http://www.efg2.com/Lab/ScienceAndEngineering/Spectra.htm) which is based upon Dan Bruton's FORTRAN code.

For more information on the mapping and the original FORTRAN code, see [http://www.midnightkite.com/color.html](http://www.midnightkite.com/color.html)

## 1 Basics

The physics of this is far too complicated to get into, but it may come about that you have a wavelength of light that you need to express as a color and this code will do that for you.

## 2 Descriptions

\texttt{\textbackslash storeRGBofWavelength\{\textbackslash R\ value\ command\}\{\textbackslash G\ value\ command\}\{\textbackslash B\ value\ command\}\{wavelength\}\} stores the RGB values of \langle wavelength \rangle in \langle R\ value\ command \rangle, \langle G\ value\ command \rangle, \langle B\ value\ command \rangle respectively

## 3 Test Cases

### 3.1 Wavelengths in Nanometers (default)

\texttt{\textbackslash storeRGBofWavelength}

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*This document corresponds to **colorwav** v1.0, dated 2007/04/12.*
<table>
<thead>
<tr>
<th>Wavelength (Angstroms)</th>
<th>RGB Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>400</td>
<td>\textcolor{rgb}{400}</td>
</tr>
<tr>
<td>430</td>
<td>\textcolor{rgb}{430}</td>
</tr>
<tr>
<td>460</td>
<td>\textcolor{rgb}{460}</td>
</tr>
<tr>
<td>490</td>
<td>\textcolor{rgb}{490}</td>
</tr>
<tr>
<td>520</td>
<td>\textcolor{rgb}{520}</td>
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<tr>
<td>550</td>
<td>\textcolor{rgb}{550}</td>
</tr>
<tr>
<td>580</td>
<td>\textcolor{rgb}{580}</td>
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<tr>
<td>600</td>
<td>\textcolor{rgb}{600}</td>
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<tr>
<td>630</td>
<td>\textcolor{rgb}{630}</td>
</tr>
<tr>
<td>660</td>
<td>\textcolor{rgb}{660}</td>
</tr>
<tr>
<td>690</td>
<td>\textcolor{rgb}{690}</td>
</tr>
</tbody>
</table>

### 3.2 Wavelengths in Angstroms

Change the units to Angstroms. \setUnitsE{-10}
4 Acknowledgments

Special Thanks to http://www.efg2.com/Lab/ScienceAndEngineering/Spectra.htm and Dan Bruton for placing their code online so that it may be translated to other languages.

5 Implementation

5.1 Constants and Parameters

\textcolor[rgb]{\Rval,\Gval,\Bval}{4000}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{4000}
\textcolor[rgb]{\Rval,\Gval,\Bval}{4300}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{4300}
\textcolor[rgb]{\Rval,\Gval,\Bval}{4600}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{4600}
\textcolor[rgb]{\Rval,\Gval,\Bval}{4900}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{4900}
\textcolor[rgb]{\Rval,\Gval,\Bval}{5200}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{5200}
\textcolor[rgb]{\Rval,\Gval,\Bval}{5500}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{5500}
\textcolor[rgb]{\Rval,\Gval,\Bval}{5800}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{5800}
\textcolor[rgb]{\Rval,\Gval,\Bval}{6000}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{6000}
\textcolor[rgb]{\Rval,\Gval,\Bval}{6300}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{6300}
\textcolor[rgb]{\Rval,\Gval,\Bval}{6600}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{6600}
\textcolor[rgb]{\Rval,\Gval,\Bval}{6900}
\storeRGBofWavelength{\Rval}{\Gval}{\Bval}{6900}

\COLORWAV@gamma\textcolor[rgb]{\Rval,\Gval,\Bval}{4000}
This is the gamma correction factor.
\begin{verbatim}
\newcommand{\COLORWAV@gamma}{0.8}\
\end{verbatim}

\setGammaCorrection\textcolor[rgb]{\Rval,\Gval,\Bval}{4000}
Allow the user to set the gamma correction
\begin{verbatim}
\newcommand{\setGammaCorrection}[1]{% 
\renewcommand{\COLORWAV@gamma}{#1}% 
}\
\end{verbatim}
\COLORWAV@powerOfTen The power of ten representing the units of the wavelength. $\lambda$ is in $10^{\COLORWAV@powerOfTen}$ meters

5 \newcommand{\COLORWAV@powerOfTen}{-9}\%

\setUnitsE Set the power of ten of the units
6 \newcommand{\setUnitsE}[1]{%
7 \renewcommand{\COLORWAV@powerOfTen}{#1}%
8 \}%

\COLORWAV@minWavelength The minimum wavelength to accept
9 \newcommand{\COLORWAV@minWavelength}{380}\%

\setMinVisibleWavelength Set the min wavelength
10 \newcommand{\setMinVisibleWavelength}[1]{%
11 \renewcommand{\COLORWAV@minWavelength}{#1}%
12 \}%

\COLORWAV@maxWavelength Max visible wavelength
13 \newcommand{\COLORWAV@maxWavelength}{780}\%

\setMaxVisibleWavelength Set the maximum visible wavelength
14 \newcommand{\setMaxVisibleWavelength}[1]{%
15 \renewcommand{\COLORWAV@maxWavelength}{#1}%
16 \}%

5.2 Internal Functions
\COLORWAV@colorAdjust A function that adjust things.
17 \newcommand{\COLORWAV@colorAdjust}[3]{%
18 \FPifzero{#2}%
19 \xdef#1{0}%
20 \else%
21 \FPmul{\COLORWAV@tempA}{#2}{#3}%
22 \FPpow{\COLORWAV@tempA}{\COLORWAV@tempA}{\COLORWAV@gamma}%
23 \xdef#1{\COLORWAV@tempA}%
24 \fi%
25 \}%

5.3 Internal Parameters
26 \newboolean{COLORWAV@lessthansmallest}%
27 \newboolean{COLORWAV@greaterthanlargest}%
28 \newboolean{COLORWAV@isnearruv}%
29 \newboolean{COLORWAV@isviolet}%
30 \newboolean{COLORWAV@isindigo}%
31 \newboolean{COLORWAV@isblue}%
32 \newboolean{COLORWAV@isgreen}%
33 \newboolean{COLORWAV@isorange}%
34 \newboolean{COLORWAV@isnearir}%
5.4 The Workhorse

```latex
\storeRGBofWavelength \storeRGBofWavelength{(R value command)}{(G value command)}{(B value command)}{(wavelength)} stores the wavelength's R value number in \langle R value command \rangle, etc
```

```latex
\newcommand{\storeRGBofWavelength}[4]{%
  \initialize booleans
  \setboolean{COLORWAV@lessthansmallest}{false}%
  \setboolean{COLORWAV@greaterthanlargest}{false}%
  \setboolean{COLORWAV@isnearuv}{false}%
  \setboolean{COLORWAV@isviolet}{false}%
  \setboolean{COLORWAV@isindigo}{false}%
  \setboolean{COLORWAV@isblue}{false}%
  \setboolean{COLORWAV@isgreen}{false}%
  \setboolean{COLORWAV@isorange}{false}%
  \setboolean{COLORWAV@isnearir}{false}%
  \get the current units and convert to nanometers
  \FPsub{\COLORWAV@tempA}{\COLORWAV@powerOfTen}{-9}%
  \FPpow{\COLORWAV@tempA}{10}{\COLORWAV@tempA}%
  \FPmul{\COLORWAV@thewavelen}{#4}{\COLORWAV@tempA}%
  \Now set the booleans based upon the wavelength. One can't just use the FP conditionals since they aren't always expanded and this leads to "extra" \fi's
  \FPiflt{\COLORWAV@thewavelen}{\COLORWAV@minWavelength}%
  \setboolean{COLORWAV@lessthansmallest}{true}%
  \fi%
  \FPifgt{\COLORWAV@thewavelen}{\COLORWAV@maxWavelength}%
  \setboolean{COLORWAV@greaterthanlargest}{true}%
  \fi%
  \FPiflt{\COLORWAV@thewavelen}{440}%
  \setboolean{COLORWAV@isviolet}{true}%
  \fi%
  \FPiflt{\COLORWAV@thewavelen}{490}%
  \setboolean{COLORWAV@isindigo}{true}%
  \fi%
  \FPiflt{\COLORWAV@thewavelen}{510}%
  \setboolean{COLORWAV@isblue}{true}%
  \fi%
  \FPiflt{\COLORWAV@thewavelen}{580}%
  \setboolean{COLORWAV@isgreen}{true}%
  \fi%
  \FPiflt{\COLORWAV@thewavelen}{645}%
  \setboolean{COLORWAV@isorange}{true}%
  \fi%
  \now determine what to do
  \ifthenelse{ \boolean{COLORWAV@lessthansmallest} \OR \boolean{COLORWAV@greaterthanlargest} }%```
\% \gdef\COLORWAV@redValue{0}\%  
\gdef\COLORWAV@greenValue{0}\%  
\gdef\COLORWAV@blueValue{0}\%  
\}% \ifthenelse{ \boolean{COLORWAV@isviolet} }{  
% R  
\FPsub{\COLORWAV@tempA}{440}{\COLORWAV@minWavelength}\%  
\FPsub{\COLORWAV@tempB}{440}{\COLORWAV@thewavelen}\%  
\FPdiv{\COLORWAV@redValue}{\COLORWAV@tempB}{\COLORWAV@tempA}\%  
% G  
\gdef\COLORWAV@greenValue{0.0}\%  
% B  
\gdef\COLORWAV@blueValue{1.0}\%  
\}% \ifthenelse{ \boolean{COLORWAV@isindigo} }{  
% R  
\gdef\COLORWAV@redValue{0.0}\%  
% G  
\FPsub{\COLORWAV@tempA}{490}{440}\%  
\FPsub{\COLORWAV@tempB}{\COLORWAV@thewavelen}{440}\%  
\FPdiv{\COLORWAV@greenValue}{\COLORWAV@tempB}{\COLORWAV@tempA}\%  
% B  
\gdef\COLORWAV@blueValue{1.0}\%  
\}% \ifthenelse{ \boolean{COLORWAV@isblue} }{  
% R  
\gdef\COLORWAV@redValue{0.0}\%  
% G  
\gdef\COLORWAV@greenValue{1.0}\%  
% B  
\FPsub{\COLORWAV@tempA}{510}{490}\%  
\FPsub{\COLORWAV@tempB}{510}{\COLORWAV@thewavelen}\%  
\FPdiv{\COLORWAV@blueValue}{\COLORWAV@tempB}{\COLORWAV@tempA}\%  
\}% \ifthenelse{ \boolean{COLORWAV@isorange} }{  
% R  
\gdef\COLORWAV@redValue{1.0}\%  
% G  
\FPsub{\COLORWAV@tempA}{580}{510}\%  
\FPsub{\COLORWAV@tempB}{\COLORWAV@thewavelen}{510}\%  
\FPdiv{\COLORWAV@redValue}{\COLORWAV@tempB}{\COLORWAV@tempA}\%  
% G  
\gdef\COLORWAV@greenValue{1.0}\%  
% B  
\gdef\COLORWAV@blueValue{0.0}\%  
\}% \ifthenelse{ \boolean{COLORWAV@isorange} }{  
% R  
\gdef\COLORWAV@redValue{1.0}\%  
% G  
\gdef\COLORWAV@greenValue{1.0}\%  
% B  
\gdef\COLORWAV@blueValue{0.0}\%  
\}%
now adjust intensity to fall off near vision limits
\FPiflt{\COLORWAV@thewavelen}{420}\setboolean{COLORWAV@isnearuv}{true}\fi%
\FPifgt{\COLORWAV@thewavelen}{700}\setboolean{COLORWAV@isnearir}{true}\fi%
\ifthenelse{ \boolean{COLORWAV@lessthansmallest} \OR \boolean{COLORWAV@greaterthanlargest} }{%
\gdef\COLORWAV@multFactor{0}%
\FPsub{\COLORWAV@tempA}{420}{\COLORWAV@minWavelength}%
\FPsub{\COLORWAV@tempB}{\COLORWAV@thewavelen}{\COLORWAV@minWavelength}%
\FPdiv{\COLORWAV@multFactor}{\COLORWAV@tempB}{\COLORWAV@tempA}%
\FPmul{\COLORWAV@multFactor}{0.7}{\COLORWAV@multFactor}%
\FPadd{\COLORWAV@multFactor}{0.3}{\COLORWAV@multFactor}%
}{\ifthenelse{ \boolean{COLORWAV@isnearir} }{%
\FPsub{\COLORWAV@tempA}{\COLORWAV@maxWavelength}{700}%
\FPsub{\COLORWAV@tempB}{\COLORWAV@maxWavelength}{\COLORWAV@thewavelen}%
\FPdiv{\COLORWAV@multFactor}{\COLORWAV@tempB}{\COLORWAV@tempA}%
\FPmul{\COLORWAV@multFactor}{0.7}{\COLORWAV@multFactor}%
\FPadd{\COLORWAV@multFactor}{0.3}{\COLORWAV@multFactor}%
}{\gdef\COLORWAV@multFactor{1.0}%}}}

finally, adjust and return the colors
\COLORWAV@colorAdjust{#1}{\COLORWAV@redValue}{\COLORWAV@multFactor}%
\COLORWAV@colorAdjust{#2}{\COLORWAV@greenValue}{\COLORWAV@multFactor}%
\COLORWAV@colorAdjust{#3}{\COLORWAV@blueValue}{\COLORWAV@multFactor}%
Change History

v1.0
General: Initial Release ........... 1

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<th>\COLORWAV@redValue</th>
</tr>
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<td>\COLORWAV@redValue</td>
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<td>\COLORWAV@thewavelen</td>
<td>47,</td>
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<tr>
<td>\COLORWAV@greenValue</td>
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</tr>
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<td>\COLORWAV@multFactor</td>
<td>\setMinVisibleWavelength</td>
<td>10</td>
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<td>6</td>
</tr>
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<td>\storeRGBofWavelength</td>
<td>\setUnitsE</td>
<td>6</td>
</tr>
</tbody>
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