

$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega z} d\omega + \sum_{n=2} \beta_n \frac{d^n}{dz^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(\tau) |A(T-\tau)|^2 d\tau \right)$$

## Tutorial

### Step-by-step Origin maps

#### In this tutorial

Learn how to display the matrix obtained in Tutorial 2, after step 3.

$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega z} d\omega + \sum_{n=2} \beta_n \frac{r^{n-1}}{n} \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(r) |A(T-r)|^2 dr \right)$$

## Paste as matrix

Once you pasted the clipboard data into a matrix format, your Origin™ sheet should look like this.

*Important: Choose the right separator format (Tools->Options->Numeric format)*

The screenshot shows the Microcal Origin software interface. A window titled 'Matrix1' is open, displaying a table of numerical data. The table has 27 rows and 11 columns. The values are in scientific notation, ranging from approximately 1.812E-20 to 4.38014E-20. The software interface includes a menu bar (File, Edit, View, Plot3D, Matrix, Tools, Format, Window, Help) and a toolbar with various icons for file operations and data manipulation.

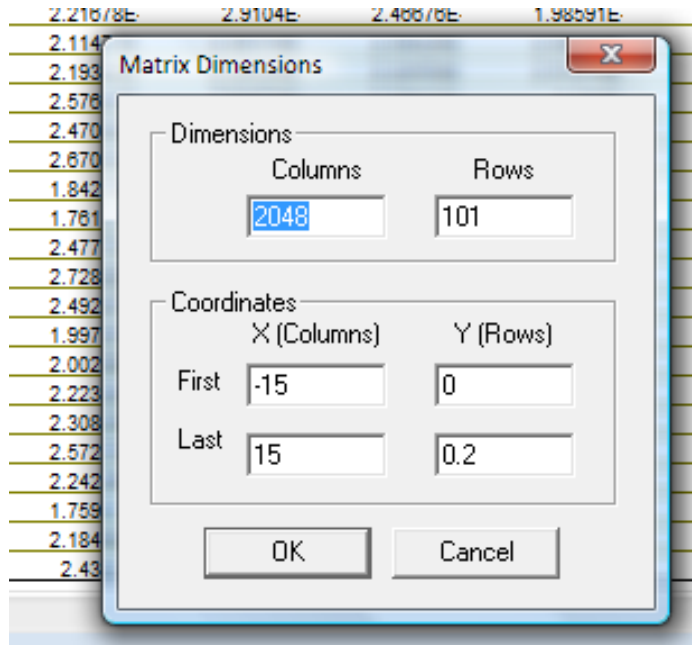
|    | 1           | 2        | 3        | 4        | 5        | 6        | 7        | 8        | 9         | 10       | 11       |
|----|-------------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|
| 1  | 1.812E-20   | 1.82871E | 1.84543E | 1.86215E | 1.87886E | 1.89558E | 1.91230E | 1.92901E | 1.94573E  | 1.96244E | 1.97916E |
| 2  | 8.20232E-20 | 8.84803E | 9.55533E | 1.03119E | 1.11194E | 1.19828E | 1.29088E | 1.39044E | 1.49788E  | 1.61411E | 1.73916E |
| 3  | 2.84155E-20 | 2.78849E | 2.74482E | 2.70252E | 2.66158E | 2.62200E | 2.58379E | 2.54695E | 2.51148E  | 2.47739E | 2.44466E |
| 4  | 7.53494E-20 | 6.69197E | 4.58014E | 3.34102E | 2.37585E | 1.79002E | 1.36954E | 1.08095E | 0.86424E  | 0.69444E | 0.55844E |
| 5  | 4.44183E-20 | 3.35004E | 2.33211E | 1.60242E | 1.09372E | 0.69144E | 0.43174E | 0.26744E | 0.16444E  | 0.10444E | 0.06444E |
| 6  | 5.62374E-20 | 4.95532E | 4.35459E | 3.81544E | 3.33111E | 2.90282E | 2.53044E | 2.21444E | 1.94444E  | 1.71444E | 1.51444E |
| 7  | 6.08937E-20 | 4.50105E | 3.77685E | 3.55098E | 3.30885E | 3.00244E | 2.62884E | 2.19121E | 1.71444E  | 1.19444E | 0.63444E |
| 8  | 4.78437E-20 | 3.73449E | 3.16722E | 3.13727E | 3.0198E  | 2.82837E | 2.57187E | 2.26104E | 1.90444E  | 1.50444E | 1.07444E |
| 9  | 6.81183E-20 | 5.38849E | 4.86379E | 4.35921E | 3.87444E | 3.41884E | 2.99174E | 2.60174E | 2.24444E  | 1.91444E | 1.60444E |
| 10 | 4.33114E-20 | 3.80389E | 3.24402E | 2.87865E | 2.58444E | 2.33779E | 2.13044E | 1.95420E | 1.80444E  | 1.67444E | 1.55444E |
| 11 | 6.35179E-20 | 4.52327E | 3.83599E | 3.28902E | 2.89187E | 2.54459E | 2.24744E | 1.99444E | 1.77444E  | 1.58444E | 1.41444E |
| 12 | 5.15027E-20 | 4.49079E | 3.65702E | 2.54922E | 2.40373E | 2.26191E | 2.13082E | 2.00396E | 1.88149E  | 1.7638E  | 1.6538E  |
| 13 | 5.54199E-20 | 4.91009E | 4.28048E | 3.25331E | 2.32887E | 1.52412E | 0.87009E | 0.48459E | 0.26884E  | 0.14598E | 0.07998E |
| 14 | 5.35988E-20 | 4.84191E | 4.18935E | 3.43033E | 2.70189E | 2.12737E | 1.64273E | 1.23771E | 0.89444E  | 0.60444E | 0.39444E |
| 15 | 4.74688E-20 | 4.52018E | 2.88939E | 3.62881E | 2.50588E | 1.65744E | 1.08111E | 0.63222E | 0.35359E  | 0.23788E | 0.15788E |
| 16 | 5.815E-20   | 4.5028E  | 3.48895E | 3.48135E | 2.72282E | 2.58596E | 2.47771E | 1.80077E | 1.56387E  | 1.42004E | 1.28004E |
| 17 | 4.97005E-20 | 4.48528E | 3.77412E | 2.59215E | 2.13268E | 1.42149E | 0.72809E | 0.34965E | 0.17488E  | 0.0922E  | 0.0482E  |
| 18 | 5.43848E-20 | 3.90447E | 3.72483E | 2.81483E | 2.8332E  | 2.87012E | 2.48247E | 2.14459E | 1.84021E  | 1.57181E | 1.33181E |
| 19 | 4.38898E-20 | 4.10289E | 3.58742E | 2.88738E | 2.8324E  | 2.53347E | 1.98797E | 1.53449E | 1.18073E  | 0.88073E | 0.62805E |
| 20 | 5.21887E-20 | 4.10389E | 3.65244E | 2.88185E | 2.80284E | 2.51711E | 2.00204E | 1.51818E | 1.12298E  | 0.82298E | 0.59298E |
| 21 | 4.88891E-20 | 4.21748E | 4.159E   | 3.46053E | 2.5587E  | 2.17941E | 1.22334E | 0.50844E | 0.247001E | 0.12484E | 0.06484E |
| 22 | 5.19334E-20 | 4.01984E | 3.23738E | 3.56339E | 2.8788E  | 2.00912E | 1.30818E | 0.61722E | 0.20061E  | 0.08482E | 0.04282E |
| 23 | 4.38121E-20 | 4.40519E | 3.25121E | 3.33511E | 2.93144E | 2.18911E | 1.57273E | 1.17814E | 0.86339E  | 0.63905E | 0.48905E |
| 24 | 6.18114E-20 | 4.53249E | 4.1739E  | 3.28848E | 2.81425E | 2.27388E | 1.74244E | 1.38925E | 1.07238E  | 0.8238E  | 0.6238E  |
| 25 | 4.14088E-20 | 4.61105E | 3.84089E | 3.24585E | 2.84935E | 2.19733E | 1.75901E | 1.38935E | 1.02744E  | 0.78474E | 0.58474E |
| 26 | 5.98241E-20 | 5.38462E | 3.78805E | 3.081E   | 2.89892E | 2.30444E | 1.84899E | 1.42928E | 1.0533E   | 0.78184E | 0.58184E |
| 27 | 4.38014E-20 | 4.0752E  | 3.20584E | 2.96111E | 3.09931E | 2.89929E | 2.4391E  | 1.85888E | 1.48231E  | 1.1397E  | 0.8397E  |

$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega t} d\omega + \sum_{n=2}^{\infty} \beta_n \frac{r^{n-1}}{n!} \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(\tau) A(T-\tau) d\tau \right)$$

## Set up matrix

Now set up your matrix dimensions by Matrix->Dimensions and type in the data according to your problem.

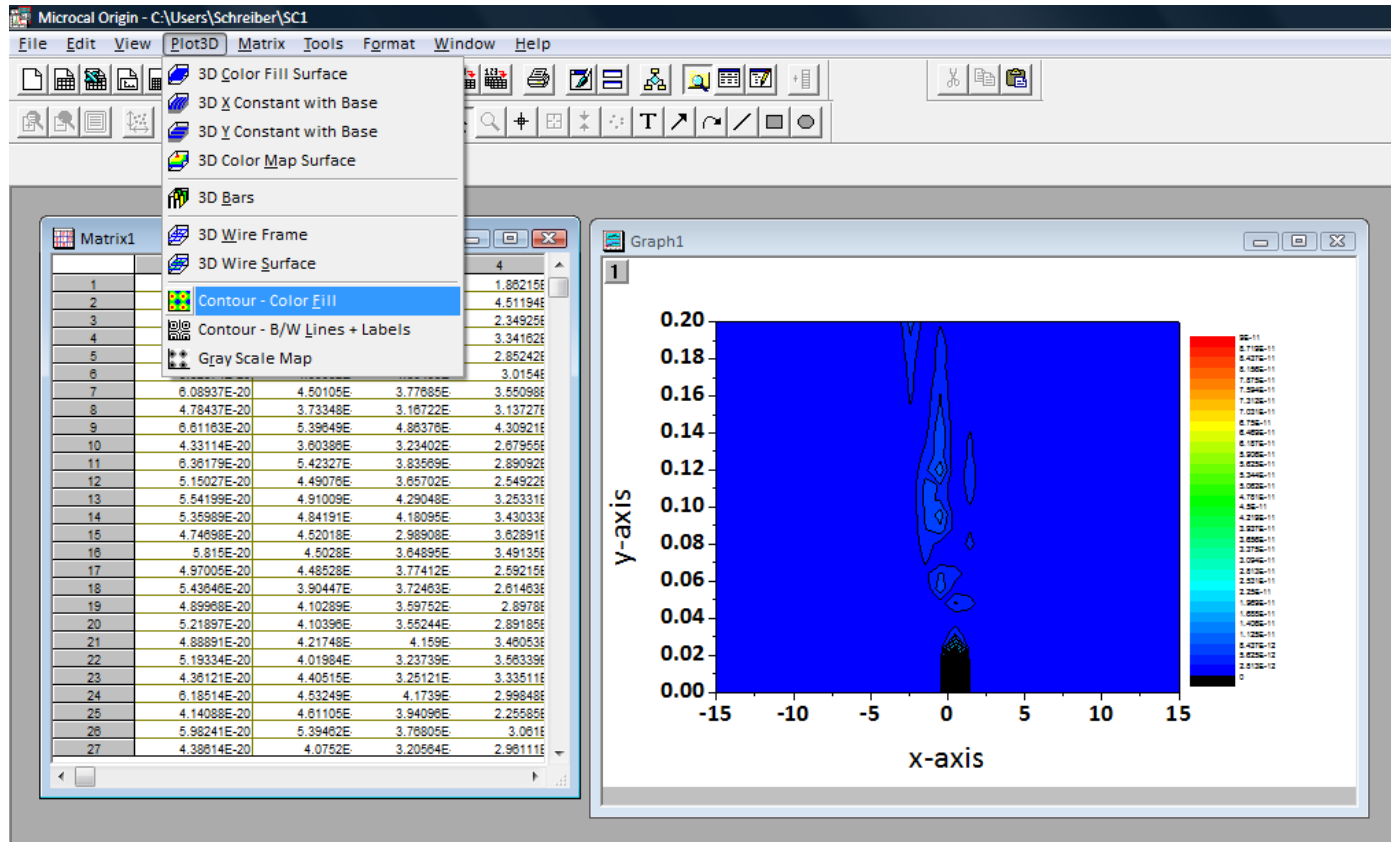
(in this case, the x-axis is the normalized frequency axis from -15 THz to 15 THz, because it is linear in the data copied to the matrix. The y-axis is the distance from 0 m to 0.2 m, see Tutorial 2 for more details.)



$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega z} d\omega + \sum_{n=2}^{\infty} \beta_n \frac{r^{n-1}}{n!} \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(r) |A(T-r)|^2 dr \right)$$

## Display matrix

Display the matrix as a contour plot by using Plot3D->Contour-Color Fill. (The result might look slightly different).

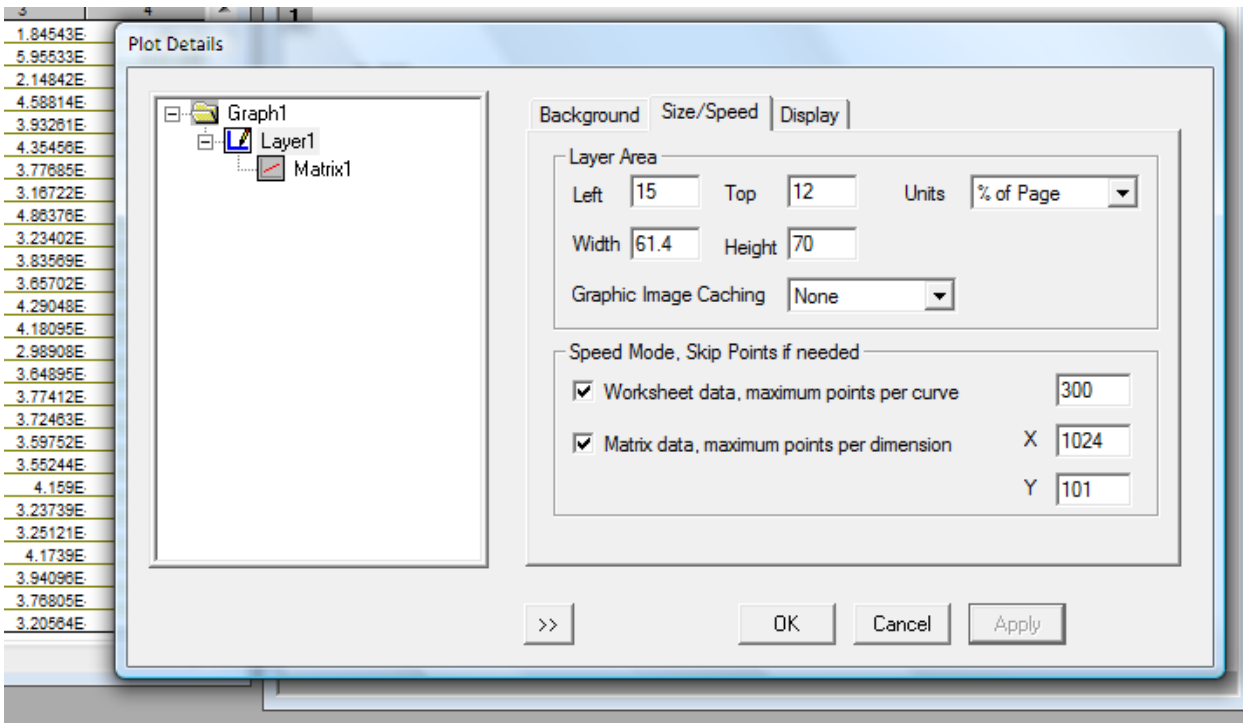


$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega z} d\omega + \sum_{n=2}^{\infty} \beta_n \frac{\partial^n A}{\partial T^n} + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) A(T) \int R(\tau) A(T-\tau)^2 d\tau$$

## Change Layout

Change the Layout.

Especially, use the Layer->Properties and disable “maximum points per dimension in the Size/Speed option or increase it to a reasonable value.

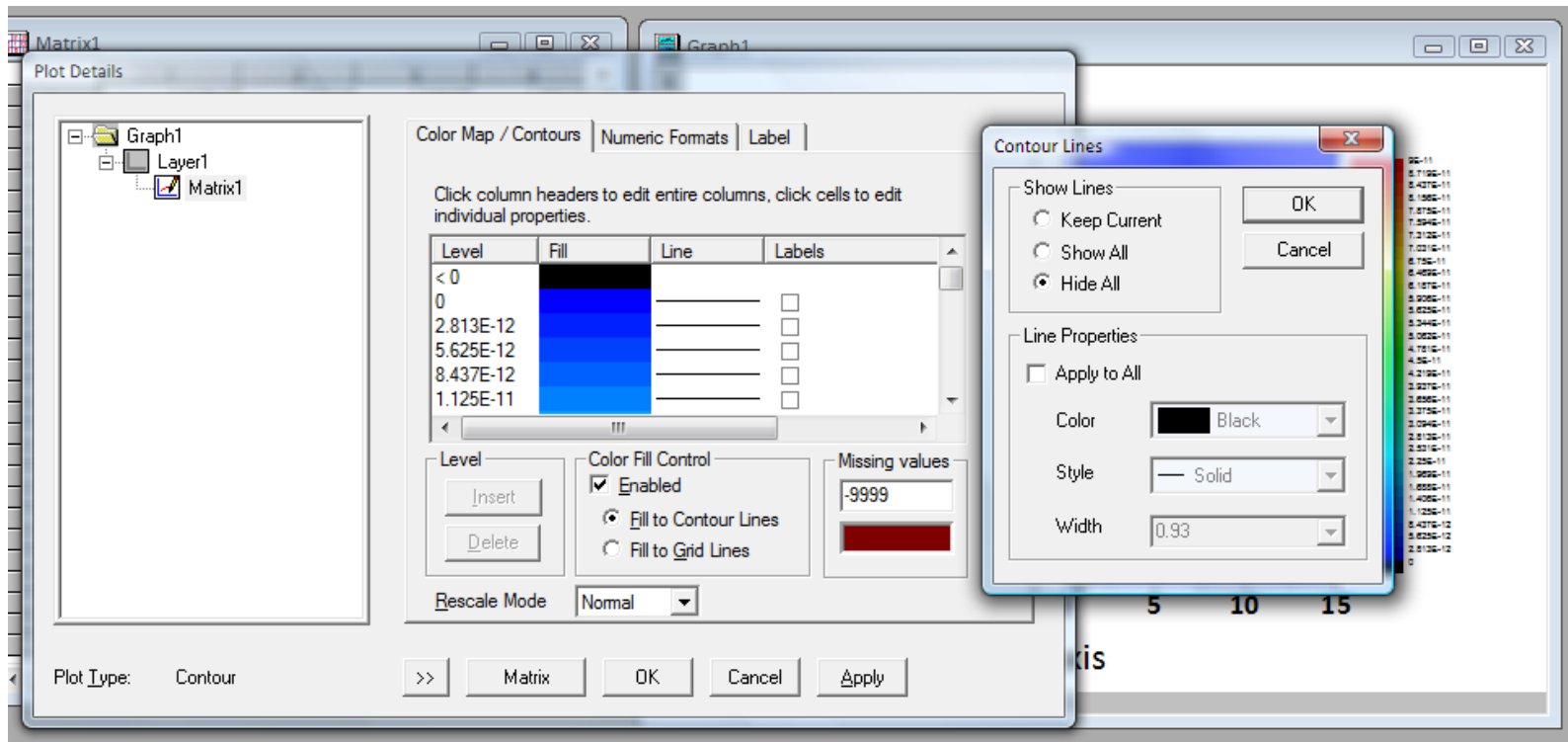


$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega z} d\omega + \sum_{n=2}^{\infty} \beta_n \frac{r^{n-1}}{n!} \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(r) A(T-r)^2 dr \right)$$

## Change Layout

Change the Layout.

Usually, you do not want Contour lines, so switch it off in the layer plot details.

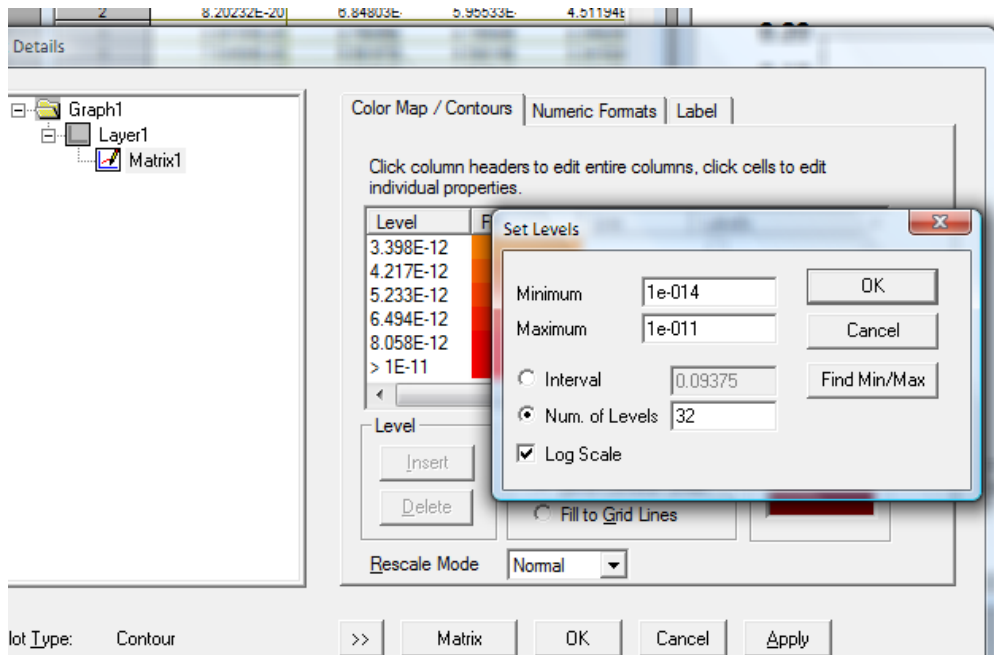


$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega t} d\omega + \sum_{n=2} \beta_n \frac{r^{n-1}}{n!} \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(r) |A(T-r)|^2 dr \right)$$

## Change Layout

Change the Layout.

For this example, it is best view if the levels are given in logarithmic scale. Also, set the color of the value below and above the maximum to a color to fit the scale.



$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega t} d\omega + \sum_{n=2} \beta_n \frac{r^{n-1}}{n!} \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) \left( A(T) \int R(r) |A(T-r)|^2 dr \right)$$

## Change Layout

Change the Layout.

For this example, it is best view if the levels are given in logarithmic scale. Also, set the color of the value below and above the maximum to a color to fit the scale. Finally, rename axis.

Color Map / Contours | Numeric Formats | Label

Click column headers to edit entire columns, click cells to edit individual properties.

| Level     | Fill |
|-----------|------|
| 3.398E-12 |      |
| 4.217E-12 |      |
| 5.233E-12 |      |
| 6.494E-12 |      |
| 8.058E-12 |      |
| > 1E-11   |      |

Level: [Insert] [Delete]

Rescale Mode: Normal

lot Type: Contour >> Matrix OK Cancel Apply

Color Map / Contours | Numeric Formats | Label

Click column headers to edit entire columns, click cells to edit individual properties.

| Level     | Fill | Line | Labels |
|-----------|------|------|--------|
| < 1E-14   |      |      |        |
| 1E-14     |      |      |        |
| 1.241E-14 |      |      |        |
| 1.54E-14  |      |      |        |
| 1.911E-14 |      |      |        |
| 2.371E-14 |      |      |        |

Level: [Insert] [Delete]

Rescale Mode: Normal

lot Type: Contour >> Matrix OK Cancel Apply

$$\frac{\partial A}{\partial z} = -\frac{\alpha}{2} A + \int \frac{g(\omega)}{2} \tilde{A}(\omega) e^{-i\omega z} d\omega + \sum_{n=2}^{\infty} \beta_n \frac{\partial^n}{\partial T^n} A + i\gamma \left( 1 + i\tau_{\text{nonl}} \frac{\partial}{\partial T} \right) A(T) \int R(r) A(T-r)^2 dr$$

Microcal Origin - C:\Users\Schreiber\SC1

File Edit View Graph Data Analysis Tools Format Window Help

**Matrix1**

|    | 1           | 2        | 3        | 4        | 5        | 6        | 7        | 8        | 9        | 10       | 11       | 12       |
|----|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 1  | 1.812E-20   | 1.82871E | 1.84543E | 1.86215E | 1.87888E | 1.89560E | 1.91232E | 1.92904E | 1.94576E | 1.96248E | 1.97920E | 1.99592E |
| 2  | 8.20232E-20 | 8.84803E | 5.95533E | 4.51194E | 3.73125E | 2.982    |          |          |          |          |          |          |
| 3  | 2.84155E-20 | 2.78848E | 2.14842E | 2.34925E | 2.25438E | 2.283    |          |          |          |          |          |          |
| 4  | 7.53494E-20 | 6.69167E | 4.58814E | 3.34162E | 3.27585E | 2.908    |          |          |          |          |          |          |
| 5  | 4.44163E-20 | 3.35204E | 3.93261E | 2.85242E | 2.95372E | 2.661    |          |          |          |          |          |          |
| 6  | 5.62374E-20 | 4.95532E | 4.35456E | 3.0154E  | 2.73811E | 2.172    |          |          |          |          |          |          |
| 7  | 6.08937E-20 | 4.50105E | 3.77885E | 3.56098E | 3.30885E | 2.306    |          |          |          |          |          |          |
| 8  | 4.78437E-20 | 3.73348E | 3.16722E | 3.13727E | 2.0198E  | 2.028    |          |          |          |          |          |          |
| 9  | 6.61163E-20 | 5.39649E | 4.86376E | 4.30921E | 3.41484E | 2.355    |          |          |          |          |          |          |
| 10 | 4.33114E-20 | 3.60386E | 3.23402E | 2.67955E | 2.2464E  | 2.301    |          |          |          |          |          |          |
| 11 | 6.36179E-20 | 5.42327E | 3.83589E | 2.89092E | 2.89167E | 2.294    |          |          |          |          |          |          |
| 12 | 5.15027E-20 | 4.49076E | 3.65702E | 2.54922E | 2.40373E | 2.281    |          |          |          |          |          |          |
| 13 | 5.54199E-20 | 4.91009E | 4.29048E | 3.25331E | 2.32887E | 2.324    |          |          |          |          |          |          |
| 14 | 5.35989E-20 | 4.84191E | 4.18095E | 3.43033E | 2.76189E | 2.727    |          |          |          |          |          |          |
| 15 | 4.74698E-20 | 4.52018E | 2.98908E | 3.62891E | 2.20508E | 2.667    |          |          |          |          |          |          |
| 16 | 5.815E-20   | 4.5028E  | 3.64895E | 3.49135E | 2.72282E | 2.584    |          |          |          |          |          |          |
| 17 | 4.97005E-20 | 4.48528E | 3.77412E | 2.59215E | 2.13288E | 2.421    |          |          |          |          |          |          |
| 18 | 5.43646E-20 | 3.90447E | 3.72463E | 2.61463E | 2.6332E  | 2.670    |          |          |          |          |          |          |
| 19 | 4.89988E-20 | 4.10289E | 3.59752E | 2.8978E  | 2.8324E  | 2.533    |          |          |          |          |          |          |
| 20 | 5.21897E-20 | 4.10396E | 3.55244E | 2.89185E | 2.56295E | 2.517    |          |          |          |          |          |          |
| 21 | 4.88891E-20 | 4.21748E | 4.159E   | 3.46053E | 2.5557E  | 2.179    |          |          |          |          |          |          |
| 22 | 5.19334E-20 | 4.01984E | 3.23739E | 3.58339E | 2.6788E  | 2.009    |          |          |          |          |          |          |
| 23 | 4.36121E-20 | 4.40515E | 3.25121E | 3.33511E | 2.9314E  | 2.188    |          |          |          |          |          |          |
| 24 | 6.18514E-20 | 4.53249E | 4.1739E  | 2.99848E | 2.91425E | 2.277    |          |          |          |          |          |          |
| 25 | 4.14088E-20 | 4.61105E | 3.94096E | 2.25585E | 2.84935E | 2.197    |          |          |          |          |          |          |
| 26 | 5.96241E-20 | 5.39462E | 3.78805E | 3.061E   | 2.89692E | 2.304    |          |          |          |          |          |          |
| 27 | 4.38614E-20 | 4.0752E  | 3.20564E | 2.96111E | 3.09931E | 2.699    |          |          |          |          |          |          |

**Graph1**

distance / m

Normalized Frequency

SC1

| Name    | Type   | View   | Size | Modified         | Created          | Dependents | Label |
|---------|--------|--------|------|------------------|------------------|------------|-------|
| Graph1  | Graph  | Normal | 2MB  | 02.01.2010 14:13 | 02.01.2010 14:13 | 0          |       |
| Matrix1 | Matrix | Normal | 2MB  | 06.12.2009 23:55 | 06.12.2009 23:52 | 1          |       |