

## Referências Bibliográficas

- [1] ANDRES, K.; GRAEBNER, J. E. ; OTT, H. R.. **4f-virtual-bound-state formation in  $ceal_3$  at low temperatures.** Physical Review Letters, 35(26):1779–1782, 1975. 1
- [2] F.STEGLICH; J.ARTS; C.D.BREDL; W.LIEKE; D.MESCHEDE; W.FRANZ ; H.SCHRAFER. **Superconductivity in the presence of strong pauli paramagnetism:  $cecu_2si_2$ .** Physical Review Letters, 43:1982, 1979. 1
- [3] BARDEEN, J.; COOPER, L. N. ; SCHRIEFFER, J. R.. **Microscopic theory of superconductivity.** Physical Review, 106:162, 1957. 1
- [4] J.BARDEEN; L.N.COOPER ; J.SCHRIEFFER. **Bcs.** Physical Review, 108(5):1175, 1957. 1
- [5] SIGRIST, M.; UEDA, K.. **Phenomenological theory of unconventional superconductivity.** Reviews of Modern Physics, 63:239, 1991. 1
- [6] STEWART, G. R.. **Heavy-fermion systems.** Rev. Mod. Phys., 56(4):755–787, Oct 1984. 1
- [7] MORIYA, T.; UEDA, K.. **Antiferromagnetic spin fluctuation and superconductivity.** Reports on Progress in Physics, 66(8):1299–1341, 2003. 1.1
- [8] FISK, Z.; PINES, D.. **The ghost of magnetism.** Nature, 394:22–23, 1998. 1.1
- [9] CHUBUKOV, A. V.; PINES, D. ; SCHMALIAN, J.. **A spin fluctuation model for d-wave superconductivity.** cond-mat/0201140, 2002. 1.1
- [10] FISK, Z.; HESS, D. W.; PETHICK, C. J.; PINES, D.; SMITH, J.; THOMPSON, J. D. ; WILLIS, J. O.. **Heavy-electron metals: New highly correlated states of matter.** Science, 239:34, 1988. 1.1
- [11] FLOUQUET, J.. **On the heavy fermion road.** preprint, 0. 1.1

- [12] L. TAILLEFER, L.; NEWBURY, R.; LONZARICH, G. G.; FISK, Z. ; SMITH, J. L.. **Direct observation of heavy quasiparticles in  $Upt_3$  via the dhva effect.** Journal of Magnetism and Magnetic Materials, 63-64:372, 1987. 1.1
- [13] OTT, H. R.; RUDIGIER, H.; FELDER, E.; FISK, Z. ; SMITH, J. L.. **Influence of impurities and magnetic fields on the normal and superconducting states of  $Ube_{13}$ .** Physical Review B, 33(1):126–131, Jan 1986. 1.1
- [14] PETHICK, C. J.; PINES, D.. **Verify title.** Proceedings of the Fourth International Conference on Recent Progress in Many-Body Theories, 1986. 1.1
- [15] KNEBEL, G.; BRAITHWAITE, D.; CANFIELD, P. C.; LAPERTOT, G. ; FLOUQUET, J.. **Electronic properties of  $cein_3$  under high pressure near the quantum critical point.** Physical Review B, 65(2):024425, Dec 2001. 1.3, 1.3
- [16] WALKER, I. R.; GROSCHE, F. M.; FREYE, D. M. ; LONZARICH, G. G.. **The normal and superconducting states of  $cein_3$  near the border of antiferromagnetic order.** Physica C, 282-287:303–306, 1997. (document), 1.3, 1.3, 1.4
- [17] BRANDT, N.; MOSHCHALKOV, V.. **Concentrated kondo systems.** Advances in Physics, 33:373, 1984. 1.3
- [18] AUERBACH, A.; LEVIN, K.. **Kondo bosons and the kondo lattice: Microscopic basis for the heavy fermi liquid.** Phys. Rev. Lett., 57:877–880, 1986. 1.3
- [19] DONIACH, S.. **The kondo lattice and weak antiferromagnetism.** Physica B+C, 91:231–234, 1977. 1.3
- [20] BITTAR, E. M.. **Estudos das propriedades magnéticas de novos compostos intermetálicos de terras raras.** PhD thesis, Instituto de Física Gleb Wataghin, Unicamp, 2006. (document), 1.5, 2.1
- [21] IGLESIAS, J. R.; LACROIX, C. ; COQBLIN, B.. **Revisited doniach diagram: Influence of short-range antiferromagnetic correlations in the kondo lattice.** Physical Review B (Condensed Matter), 56(18):11820–11826, 1997. (document), 1.6
- [22] FISK, Z.. **Singular behaviour.** Nature, 424:504–505, 2003. 1.3

- [23] CONTINENTINO, M. A.. Quantum critical point in heavy fermions. Braz. J. Phys., 35:197, 2005. 1.3
- [24] ROSCH, A.. Interplay of disorder and spin fluctuations in the resistivity near a quantum critical point. Physical Review Letters, 82(21):4280–4283, 1999. 1.3, 1.3
- [25] ABRIKOSOV, A. A.; KHALATNIKOV, I. M.. The theory of a fermi liquid (the properties of liquid  $^3He$  at low temperatures). Rep. Prog. Phys, 1959, p. 329, 1959. 1.3
- [26] Electrons in Metals. 1990. (document), 1.3, 1.7
- [27] A.SCHRÖDER; G.AEPPL; R.COLDEA; M.ADAMS; O.STOCKERT; H.V.LÖHNESEN; E.BUCHER; R.RAMAZASHVILI ; P.COLEMAN. Onset of antiferromagnetism in heavy-fermion metals. Nature, 407:351–355, 2000. 1.3
- [28] MATHUR, N.; GROSCHE, F. M.; JULIAN, S. R.; WALKER, I. R.; FREYE, D. M.; HASELWIMMER, R. K. W. ; LONZARICH, G. G.. Magnetically mediated superconductivity in heavy fermion compounds. Nature, 394:39, 1998. 1.3, 1.11
- [29] P.COLEMAN. Theories of non-fermi liquid behaviour in heavy fermions. Physica B, 259:353–358, 1999. 1.3
- [30] COLEMAN, P.. Magnetic glue exposed. Nature, 410:320–321, 2001. 1.3
- [31] M.JOURDAN; M.HUTH ; H.ADRIAN. Superconductivity mediated by spin fluctuations in the heavy-fermion compound  $Ud_2Al_3$ . Nature, 398:47–49, 1999. 1.3
- [32] MOSHOPOULOU, E.; FISK, Z.; HUNDLEY, M. F.; MODLER, R.; MOVSHOVICH, R.; SARRAO, J. L. ; THOMPSON, J. D.. Crystal growth, structural characterization and physical properties of the new heavy fermion compounds  $cerhin_5$  and  $ceirin_5$ . APS Meeting Abstracts, p. 3303–+, Mar. 1998. 1.4
- [33] MOSHOPOULOU, E.; FISK, Z.; SARRAO, J. L. ; THOMPSON, J. D.. Crystal growth and intergrowth structure of new heavy fermion materials  $ceirin_5$  and  $cerhin_5$ . Journal of Solid State Chemistry, 158:25, 2001. 1.4

- [34] HEGGER, H.; PETROVIC, C.; MOSHOPOULOU, E. G.; HUNDLEY, M. F.; SARRAO, J. L.; FISK, Z.; THOMPSON, J. D.. **Pressure-induced superconductivity in quasi-2d  $cerhin_5$** . Physical Review Letters, 84:4986–4989, May 2000. (document), 1.5, 1.10, 1.11, 1.12, 1.5, 1.13, 1.5
- [35] PARK, T.; RONNING, F.; YUAN, H. Q.; SALAMON, M. B.; MOVSHOVICH, R.; SARRAO, J. L.; THOMPSON, J. D.. **Hidden magnetism and quantum criticality in the heavy fermion superconductor  $cerhin_5$** . Nature, 440:65–68, Mar. 2006. (document), 1.6, 1.14, 1.15, 1.16, 1.6
- [36] LAKE, B.; RONNOW, H. M.; CHRISTENSEN, N. B.; AEPPLI, G.; LEFMANN, K.; MCMORROW, D. F.; VORDERWISCH, P.; SMEIBIDL, P.; MANGKORNTONG, N.; SASAGAWA, T.; NOHARA, M.; TAKAGI, H.; MASON, T. E.. **Antiferromagnetic order induced by an applied magnetic field in a high-temperature superconductor**. Nature, 415:299, 2002. 1.6
- [37] ZHANG, Y.; DEMLER, E.; SACHDEV, S.. **Competing orders in a magnetic field: Spin and charge order in the cuprate superconductors**. Physical Review B, 66(9):094501, Sep 2002. 1.6
- [38] DEMLER, E.; SACHDEV, S.; ZHANG, Y.. **Spin-ordering quantum transitions of superconductors in a magnetic field**. Physical Review Letters, 87(6):067202, Jul 2001. 1.6
- [39] BORTH, R.; LENGYEL, E.; PAGLIUSO, P. G.; SARRAO, J. L.; SPARN, G.; STEGLICH, F.; THOMPSON, J. D.. **Heat capacity of the heavy fermion superconductor  $ceirin_5$  under hydrostatic pressure**. Physica B (Condensed Matter), 312:136–137, Mar. 2002. (document), 1.7, 1.17, 1.18, 3.4
- [40] MONTHOUX, P.; LONZARICH, G. G.. **Magnetically mediated superconductivity in quasi-two and three dimensions**. Physical Review B, 63(5):054529, Jan 2001. 1.7, 1.11
- [41] NICKLAS, M.; SIDOROV, V. A.; BORGES, H. A.; PAGLIUSO, P. G.; SARRAO, J. L.; THOMPSON, J. D.. **Two superconducting phases in  $cerh_{1-x}ir_xin_5$** . Physical Review B, 70(2):020505–+, July 2004. (document), 1.8, 1.19, 1.20, 1.9, 1.9, 1.21
- [42] THOMPSON, J. D.; MOVSHOVICH, R.; FISK, Z.; BOUQUET, F.; CURRO, N. J.; FISHER, R. A.; HAMMEL, P. C.; HEGGER, H.; HUNDLEY, M. F.;

- JAIME, M. ; ET AL.. not defined yet. to be published - private communication, 2006. 1.9
- [43] YUAN, H.; GROSCHE, F.; DEPPE, M.; GEIBEL, C.; SPARN, G. ; STEGLICH., F.. **Observation of two distinct superconducting phases in  $cecu_2si_2$** . Science, 302:2104, 2003. 1.9
- [44] YUAN, H. Q.; GROSCHE, F. M.; DEPPE, M.; GEIBEL, C.; SPARN, G. ; STEGLICH, F.. **Effect of impurity scattering on the superconductivity of  $cecu_2si_2$** . New Journal of Physics, 6:132, 2004. 1.9
- [45] HOLMES, A. T.; JACCARD, D. ; MIYAKE, K.. **Signatures of valence fluctuations in  $cecu_2si_2$  under high pressure**. Physical Review B (Condensed Matter and Materials Physics), 69(2):024508, 2004. 1.9
- [46] PAGLIUSO, P. G.; MOVSHOVICH, R.; BIANCHI, A. D.; NICKLAS, M.; MORENO, N. O.; THOMPSON, J. D.; HUNDLEY, M. F.; SARRAO, J. L. ; FISK, Z.. **Multiple phase transitions in  $ce(rh,ir,co)in_5$** . Physica B, 312-313:129, 2002. 1.9, 1.14
- [47] KUMAR, R. S.; KOHLMANN, H.; LIGHT, B. E.; CORNELIUS, A. L.; RAGHAVAN, V.; DARLING, T. W. ; SARRAO, J. L.. **Anisotropic elastic properties of  $cerhin_5$** . Physical Review B (Condensed Matter and Materials Physics), 69(1):014515, 2004. 1.9
- [48] BAO, W.; P.G.PAGLIUSO; J.L.SARRAO; J.D.THOMPSON; Z.FISK ; J.W.LYNN. **Magnetic structure of heavy-fermion  $ce_2rhin_8$** . Physical Review B, 64:020401, 2001. (document), 1.9.1, 1.22
- [49] CHRISTIANSON, A. D.; LLOBET, A.; BAO, W.; GARDNER, J. S.; SWAINSON, I. P.; LYNN, J. W.; MIGNOT, J.-M.; PROKES, K.; PAGLIUSO, P. G.; MORENO, N. O.; SARRAO, J. L.; THOMPSON, J. D. ; LACERDA, A. H.. **Novel coexistence of superconductivity with two distinct magnetic orders**. Physical Review Letters, 95(21):217002, 2005. (document), 1.10, 1.23
- [50] NICKLAS, M.; SIDOROV, V. A.; BORGES, H. A.; PAGLIUSO, P. G.; PETROVIC, C.; FISK, Z.; SARRAO, J. L. ; THOMPSON, J. D.. **Magnetism and superconductivity in  $ce_2rhin_8$** . Physical Review B, 67(2):020506+, Jan. 2003. (document), 1.11, 1.26, 1.27, 1.11, 1.28, 1.29
- [51] MONTHOUX, P.; LONZARICH, G. G..  **$p$ -wave and  $d$ -wave superconductivity in quasi-two-dimensional metals**. Physical Review B, 59(22):14598–14605, Jun 1999. 1.11

- [52] MONTHOUX, P.; LONZARICH, G. G.. Magnetically mediated superconductivity: Crossover from cubic to tetragonal lattice. *Physical Review B*, 66(22):224504, Dec 2002. 1.11
- [53] MILLIS, A. J.. Effect of a nonzero temperature on quantum critical points in itinerant fermion systems. *Physical Review B*, 48(10):7183–7196, Sep 1993. 1.11
- [54] HERTZ, J. A.. Quantum critical phenomena. *Physical Review B*, 14(3):1165–1184, Aug 1976. 1.11
- [55] FISHER, R. A.; BOUQUET, F.; PHILLIPS, N. E.; HUNDLEY, M. F.; PAGLIUSO, P. G.; SARRAO, J. L.; FISK, Z. ; THOMPSON, J. D.. Specific heat of  $cerhin_5$  :pressure-driven evolution of the ground state from antiferromagnetism to superconductivity. *Physical Review B*, 65(22):224509, May 2002. 1.11
- [56] HALL, D.; PALM, E. C.; MURPHY, T. P.; TOZER, S. W.; PETROVIC, C.; MILLER-RICCI, E.; PEABODY, L.; LI, C. Q. H.; ALVER, U.; GOODRICH, R. G.; SARRAO, J. L.; PAGLIUSO, P. G.; WILLS, J. M. ; FISK, Z.. Electronic structure of  $cerhin_5$ : de haas-van alphen and energy band calculations. *Physical Review B*, 64(6):064506–+, Aug. 2001. 1.11
- [57] J.S.KIM; N.O.MORENO; J.L.SARRAO; J.D.THOMPSON ; G.R.STEWART. Field-induced non-fermi-liquid behaviour in  $ce_2irin_8$ . *Physical Review B*, 69:024402, 2004. (document), 1.12, 1.30
- [58] MORENO, N.; HUNDLEY, M.; PAGLIUSO, P.; MOVSHOVICHA, R.; NICKLAS, M.; THOMPSON, J.; SARRAO, J. ; FISK, Z.. Physical properties of  $ce_2(rh, ir)_{1-x}co_xin_8$ . *Physica B*, 312-313:274, 2002. 1.13
- [59] G.D.MORRIS; R.H.HEFFNER; N.O.MORENO; P.G.PAGLIUSO; J.L.SARRAO; S.R.DUNSIGERN; G.J.NIEUWENHUYS; D.E.MACLAUGHLIN ; O.O.BERNAL. Random spin freezing in  $ce_2min_8$  (m=co,rh,ir) heavy-fermion materials. *Physical Review B*, 69:21445, 2004. (document), 1.13, 1.31, 4.7
- [60] THOMPSON, J. D.; MOVSHOVICH, R.; FISK, Z.; BOUQUET, F.; CURRO, N. J.; FISHER, R. A.; HAMMEL, P. C.; HEGGER, H.; HUNDLEY, M. F.; JAIME, M. ; ET AL.. Superconductivity and magnetism in a new class of heavy-fermion materials. *Journal of Magnetism and Magnetic Materials*, 226-230:5–10, 2001. (document), 1.14, 1.3

- [61] J.D.THOMPSON; M.NICKLAS; SIDOROV, V.; BAUER, E.; MOVSHOVICH, R.; CURRO, N. ; SARRAO, J.. **Interplay of magnetism, structure and superconductivity in heavy-fermion systems  $cemn_5$  and  $pumga_5$** . Journal of Alloys and Compounds, 408-412:16–20, 2006. 1.14
- [62] HERING, E.; BORGES, H.; RAMOS, S.; FONTES, M.; SAITOVITCH, E. B.; BITTAR, E.; PAGLIUSO, P.; MORENO, N.; THOMPSON, J. ; SARRAO, J.. **Pressure-temperature-composition phase diagram of  $ce_2min_8$** . Physica B: Condensed Matter, in press, 2006. 1.15
- [63] NICKLAS, M.; SIDOROV, V. A.; BORGES, H. A.; MORENO, N. O.; PAGLIUSO, P. G.; SARRAO, J. L. ; THOMPSON, J. D.. **Relationship of magnetism and superconductivity in heavy-fermion systems: Pressure studies on  $cemn_5$  and  $ce_2min_8$  ( $m = co, rh, ir$ )**. Acta Physica Polonica B, 34:907–+, Feb. 2003. (document), 4.2(b), 4.8

## A

### Programa de ajuste dos expoentes

```
#!/usr/bin/perl
use strict;

use Statistics::LineFit;

my $datafile = @ARGV[0];

my (@xvalues, @yvalues);
my $y0;
my $found0 = 0;
my $total = -1;
my $windowsize = 10;
my $expmax = 0;
my $expmin = 10;

print "Abrindo arquivo de dados: $datafile...";
open (DATAFILE, "<$datafile") or
    die "Error opening data file $datafile: $!";
print "Ok.\n";

print "Lendo dados do arquivo...";
while (<DATAFILE>) {
    my $line = $_;

    chomp($line);
    #print "Lido: $line\n";
    $line =~ s/\s^//;
    $line =~ s/$\s//;
    $line =~ s/,/./g;

    my ($x, $y) = split(/\t/, $line);
```



```
# Guarda o valor de rho0
if ($x == 0) {
  if ($found0 == 0) {
    $y0 = $y;
    $found0 = 1;
    next;
  }
  else {
    next;
  }
}

# elimina pontos com y negativos e nulos
next if ($y <= 0);

# elimina pontos com y-y0 negativos e nulos
next if (($y-$y0) <= 0);

#print "x: $x, y: $y\n";
@xvalues = (@xvalues, $x);
@yvalues = (@yvalues, $y);

  system "echo \"with g0; s0 point $x, $y; \" > gracepipe";

$total++;
}
system "echo \"with g0; autoscale yaxes; autoscale xaxes;
  redraw;\" > gracepipe";

print "Ok. $total pontos encontrados.\n";

if ($found0 == 0) {
  print "Aten\u{c}\u{a}o: valor de R(0) n\u{a}o encontrado. Prosseguindo
    assim mesmo.\n";
  $y0 = 0;
}

print "Ordenando os pontos em ordem crescente...";
my %data;
for (my $index = 0; $index <= $total; $index++) {
  $data{"$xvalues[$index]"} = $yvalues[$index];
}
```

```
@xvalues = sort {$a <=> $b} @xvalues;

@yvalues = ();
foreach my $value (@xvalues) {
    @yvalues = (@yvalues, $data{$value});
    #print "x: $value    y: $data{$value}\n";
}
print "Ok. \nVetor x possui $#xvalues pontos e vetor
      logy possui $#yvalues pontos.\n";

print "Calculando o logaritmo de x para cada ponto...";
my (@logx, @logy);
foreach my $x (@xvalues) {
    @logx = (@logx, &log10($x));
}
print "Ok.\n";

print "Calculando o logaritmo de y-y0 para cada ponto...";
foreach my $y (@yvalues) {
    @logy = (@logy, &log10($y-$y0));
}
print "Ok.\n";

print "Desenhando o gráfico log(R-R0) x log(T)...";
for (my $index = 0; $index <= $total; $index++) {
    system "echo \"with g1; s0 point $logx[$index],
          $logy[$index]; \" > gracepipe";
}
system "echo \"with g1; autoscale yaxes; autoscale
      xaxes; redraw;\" > gracepipe";
print "Ok.\n";

print "Realizando a regressão linear em janelas de
      $windowsize pontos:\n";

my $lineFit = Statistics::LineFit->new();

my $windowstart = 0;
my $windowend = $windowsize;
my @b_data = ();
my @r2_data = ();
```

```
while ($windowend <= $total) {

    last if ($windowstart > ($windowend-3));

    my @windowxdata = ();
    my @windowydata = ();

    #L\^{e} os dados da janela e os grava nos vetores da janela
    for (my $index = $windowstart; $index <= $windowend; $index++) {
        @windowxdata = (@windowxdata, $logx[$index]);
        @windowydata = (@windowydata, $logy[$index]);
    }

    $lineFit->setData (\@windowxdata, \@windowydata) or die "Invalid data";

    my ($intercept, $slope) = $lineFit->coefficients();
    defined $intercept or die "Can't fit line if x values are all equal";
    my $rSquared = $lineFit->rSquared();

    # Finds maximum exponent
    if ($slope > $expmax) {
        $expmax = $slope;
    }

    # Finds minimum exponent
    if ($slope < $expmin) {
        $expmin = $slope;\begin{program}
    }

    #Grava os dados encontrados em vetores apropriados
    for (my $index = $windowstart; $index <= $windowend; $index++) {
        $b_data[$index] = $slope;
        $r2_data[$index] = $rSquared;

        # plota o expoente no gr\ '{a}fico 2
        system "echo \"with g2; s0 point $xvalues[$index],
            $slope; \" > gracepipe";

        # plota a fun\ {c}\ ^{a}o fitada de volta no gr\ '{a}fico 1
        my $yfit = $intercept + $slope * $logx[$index];
        system "echo \"with g1; s1 point $logx[$index],
```

```
    $yfit; \" > gracepipe";

}

system "echo \"with g2; autoscale yaxes;
        autoscale xaxes; redraw;\" > gracepipe";
system "echo \"with g1; autoscale yaxes;
        autoscale xaxes; redraw;\" > gracepipe";

$intercept = sprintf("%6.3f", $intercept);
$rSquared = sprintf("%6.3f", $rSquared);
$slope = sprintf("%6.3f", $slope);

print "inicio: ($windowstart) $xvalues[$windowstart] fim: ($windowend)
        $xvalues[$windowend] a: $intercept   b: $slope   r2: $rSquared \n";

#$windowsize = 20 if ($xvalues[$windowend] <= 4);
#$windowsize = 5 if (($xvalues[$windowend] > 4)
    and (($xvalues[$windowend] <= 50)));
#$windowsize = 9 if ($xvalues[$windowend] > 4);

$windowstart = $windowend +1;
$windowend = $windowstart + $windowsize;
if ($windowend > $total) {
    $windowend = $total;
}

last if ($windowstart == $total);
}

print "Fim da regressão~{a}o.\n";

my $worldstart = 0;
my $worldend = 20;
my $logworldstart = 0; #log10($worldstart);
my $logworldend = &log10($worldend);
my $major = ($worldend-$worldstart) / 10;
my $minor = ($worldend-$worldstart) / 20;
my $logmajor = ($logworldend - $logworldstart) / 10;
my $logminor = ($logworldend - $logworldstart) / 20;

system "echo \"with g0; world $worldstart,0,
        $worldend,0.007; xaxis tick major $major;
        xaxis tick minor $minor; autoscale yaxes;
```

```
        redraw;\n" > gracepipe";
system "echo \"with g1; world $logworldstart,0,
        $logworldend,2; xaxis tick major $logmajor;
        xaxis tick minor $logminor; autoscale yaxes;
        redraw;\n" > gracepipe";
system "echo \"with g2; world $worldstart,0,$worldend,2;
        xaxis tick major $major; xaxis tick minor $minor;
        redraw;\n" > gracepipe";

close (DATAFILE);

$datafile = $datafile . '.out';
print "Abrindo arquivo sa\{i}da de dados: $datafile...";
open (OUTDATAFILE, ">$datafile") or
    die "Error opening data file $datafile: $!";
print "Ok.\n";

for (my $index = 0; $index <= $total; $index++) {

    $expmax = 2;
    $expmin = 0;
    my $colorcode = 0; # black for everything

    if (($b_data[$index] < $expmax)
        and ($b_data[$index] > $expmin)) {
        #my $expnorm = ($b_data[$index] - $expmin) / ($expmax-$expmin);

        #my $r = int($expnorm * 256);
        my $k = &gauss(2, 0.08, $b_data[$index]);
        my $r = int($k*255);

        my $l = &gauss(1.5, 0.08, $b_data[$index]);
        my $g = int($l*255);

        my $m = &gauss(1, 0.08, $b_data[$index]);
        my $b = int($m*255);

        #print "b: $b_data[$index] k: $k r $r l: $l g: $g m: $m b: $b \n";

        $colorcode = $r + int($g*256) + int($b*65536);
    }
}
```

```
my $a = sprintf("%.3f", $xvalues[$index]);
my $b = sprintf("%.6f", $yvalues[$index]);
my $c = sprintf("%.6f", $logx[$index]);
my $d = sprintf("%.6f", $logy[$index]);
my $e = sprintf("%.3f", $b_data[$index]);
my $f = sprintf("%.3f", $r2_data[$index]);
my $g = $colorcode;
print OUTDATAFILE "$a\t$b\t$c\t$d\t$e\t$f\t$g\n"
}

close OUTDATAFILE;

sub log10 {
    my $n = shift;
    return log($n)/log(10);
}

sub gauss {
    my ($center, $width, $x) = @_;

    return exp((-1*($x-$center)**2) / (2*$width));
}
```