In[1034]:=

```
"vincenti new - all units in mm"
"divergence (half angle) of fundamental at out parameters"
ThetaL = 60 / 1500;
N[ThetaL]
numerischer Wert
"beamwaist of fundamental"
w0 = 0.012
lambdaL = 0.0008;
"harmonic beamwaist at point of emission"
wN = w0
"denting depth"
D0 = 0.00010
alpha = 45 °;
"diffraction limit"
Theta0 = (lambdaL) / (π * wN * n)
```

$$phi = \frac{2 * \pi}{0.72} * (wN / w0)^2 * D0 / lambdaL$$

$$ThetaN = \left(\sqrt{1 + (n * phi)^2}\right) * Theta0;$$

```
Plot[{ThetaN, Theta0}, {n, 1, 30},
stelle Funktion graphisch dar
 PlotLegends → {"vincinti HHG div over N", "HHG div diffraction limit"}]
 Legenden der Graphik                    numerischer Wert
"note: in this case HHG div reaches 60% of fundamental
  for almost all  harmonic numbers.. which is quite huge..."

Plot[ThetaN / ThetaL, {n, 1, 30},
stelle Funktion graphisch dar
 PlotLegends → {"ThetaDenting/ThetaL"}, PlotRange → All]
 Lege···                                Koordinatenb··· alle
```

$$Plot\left[\sqrt{1 + (n * phi)^2}, \{n, 15, 30\}, PlotLegends \to \{\text{"Denting contribution x"}\}\right];$$

```
                                        Legenden der Graphik
Clear[n, Theta0, D0]
lösche
"now as a function of D0 - denting depth"

Theta0 = (lambdaL) / (π * wN * n)
```

$$phi = \frac{2 * \pi}{0.72} * (wN / w0)^2 * Dx / lambdaL$$

$$ThetaN = \left(\sqrt{1 + (n * phi)^2}\right) * Theta0;$$

```
n = 1
"here we see find evidence that the
  equation is NOT valid for smaller harmonic numbers,
especially NOT for the fundamental ! - in case of Denting = 0, we should reach
  1, or in other words, for small denting the divergences vor n=1 should always
  be larger 1, in the sense, that the PM denting acts as a focusing mirror on
```

```
   the fundamental (and on the harmonics) - which only sets in for D0>150nm"
Plot[{ThetaN / ThetaL}, {Dx, 0.00001, 0.0002},
stelle Funktion graphisch dar
 PlotLegends → {"ThetaDenting/Theta0 for n: 1" }]
 Legenden der Graphik

Clear[n, Theta0, Dx]
lösche
```

Out[1034]= vincenti new - all units in mm

Out[1035]= divergence (half angle) of fundamental at out parameters

Out[1037]= 0.04

Out[1038]= beamwaist of fundamental

Out[1039]= 0.012

Out[1041]= harmonic beamwaist at point of emission

Out[1042]= 0.012

Out[1043]= denting depth

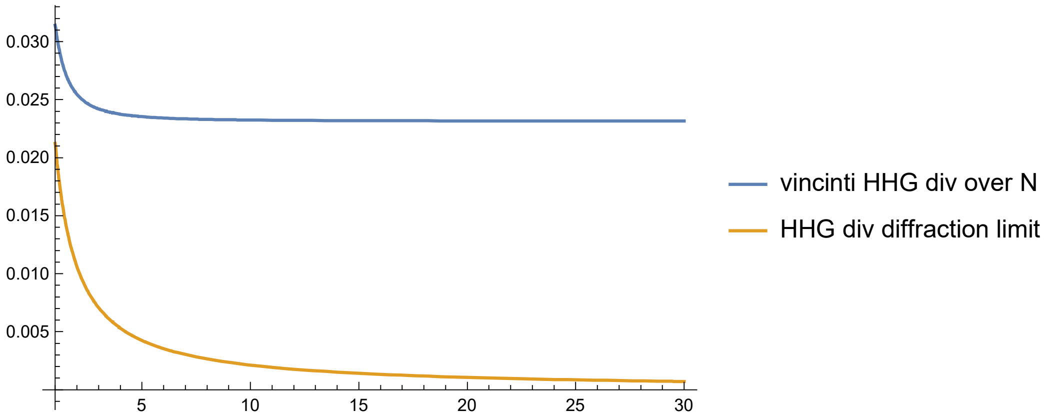
Out[1044]= 0.0001

Out[1046]= diffraction limit

Out[1047]= $\frac{0.0212207}{n}$

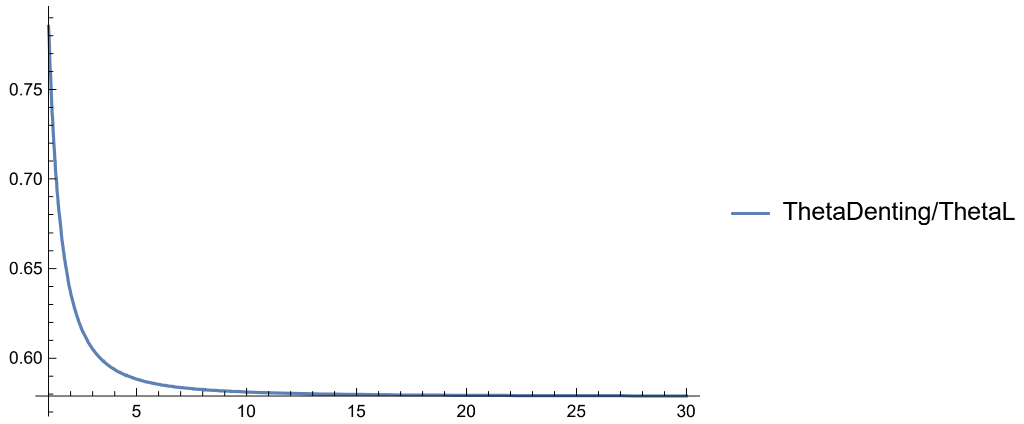
Out[1048]= 1.09083

Out[1050]=



Out[1051]= note: in this case HHG div reaches 60% of fundamental
  for almost all harmonic numbers.. which is quite huge...

Out[1052]=



Out[1055]= now as a function of D0 - denting depth

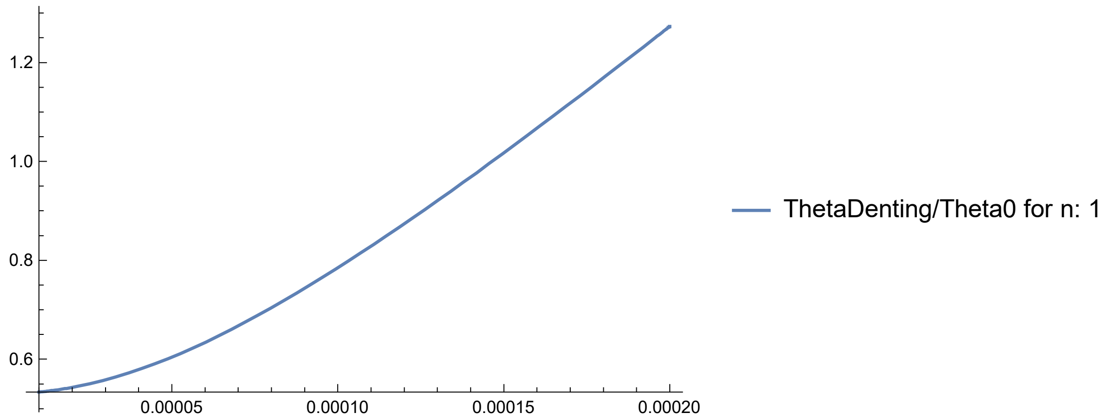
Out[1056]= $\frac{0.0212207}{n}$

Out[1057]= 10 908.3 Dx

Out[1059]= 1

Out[1060]= here we see find evidence that the equation is NOT valid for smaller harmonic numbers, especially NOT for the fundamental ! - in case of Denting = 0, we should reach 1, or in other words, for small denting the divergences vor n=1 should always be larger 1, in the sense, that the PM denting acts as a focusing mirror on the fundamental (and on the harmonics) - which only sets in for D0>150nm

Out[1061]=



In[1063]:= **"now best focus condition for Delta z<0 - focus before target - this corresponds in my coordinate system to absoute z>0 numbers"**

Out[1063]= now best focus condition for Delta z<0 - focus before target - this corresponds in my coordinate system to absoute z>0 numbers

In[1064]:=

```
n = 20;
ThetaL = 60 / 1500;
D0 = 0.0001;
Theta0 = (lambdaL) / (π * wN * n)
zr = 0.6;
"assumes radius of curvature is independent of harmonic number"
RzL = z * (1 + (zr / z)^2);
wz = w0 * Sqrt[1 + (z / zr)^2];
"assuming wNz (beamwaist HHG) = w(z) fundamental"
psi = (2 * π / 0.72) * (wz / wz)^2 * D0 / lambdaL;
fz = wz^2 / (D0 / 0.72)
ThetaZ = Theta0 * Sqrt[1 + (n * psi^2) * (1 + fz * 0.72 / RzL)]
ThetaZL = ThetaL * Sqrt[1 + (1 * psi^2) * (1 + fz * 0.72 / RzL)]

Plot[{ThetaZ, ThetaZL}, {z, -5, 3},
 PlotLegends → {"Theta HHG n = 20, D0 = 100nm", "Theta fundamental"}, PlotRange → All]
"here we find a problem with the definition of negative Rz or fz function, assuming
  Vincenti relies to negative means in front of means negative z-values is
a bit unconventionel... definitely the curvertaure should compensate, so
  be it that negative values relate to focus in front of target.... "

Plot[ThetaZ / ThetaZL, {z, -2, 2}, PlotLegends → "ThetaHHG/ThetaL"]
"the function is not STETIG for the
  optimum range .... as it becomes complex i guess,
but the optimum range decreases divHHG to < 5% of the origianl fundamental, which
suggests somehting like <2mrad for N>7"
Clear[D0, n, Theta0, zr, wz, fz, ThetaL]
```

stelle Funktion graphisch dar · Legenden der Graphik · Koordinatenb··· · alle · stelle Funktion graphisch dar · Legenden der Graphik · numerischer Wert · lösche

Out[1067]= 0.00106103

Out[1069]= assumes radius of curvature is independent of harmonic number

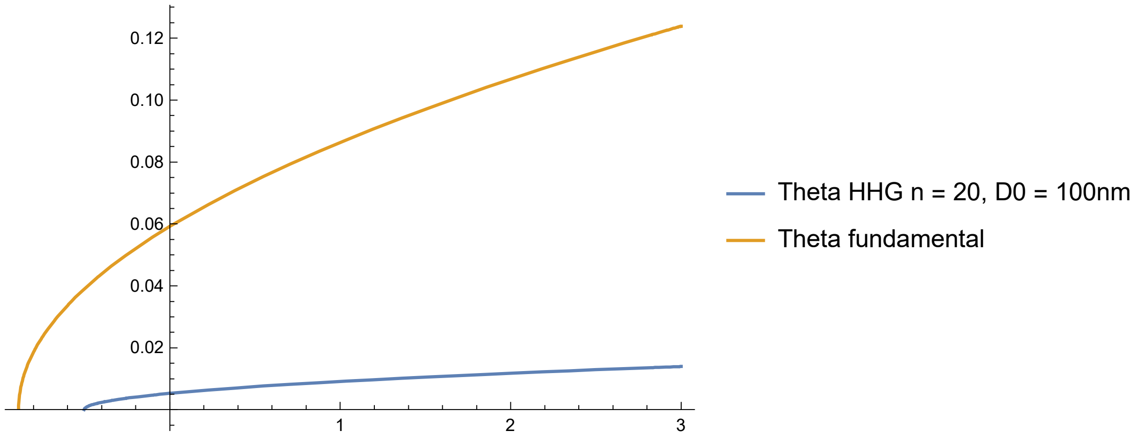
Out[1072]= assuming wNz (beamwaist HHG) = w(z) fundamental

Out[1074]= $1.0368\left(1+2.77778\,z^2\right)$

Out[1075]= $0.00106103\sqrt{1+23.7982\left(1+\frac{0.746496\left(1+2.77778\,z^2\right)}{\left(1+\frac{0.36}{z^2}\right)z}\right)}$

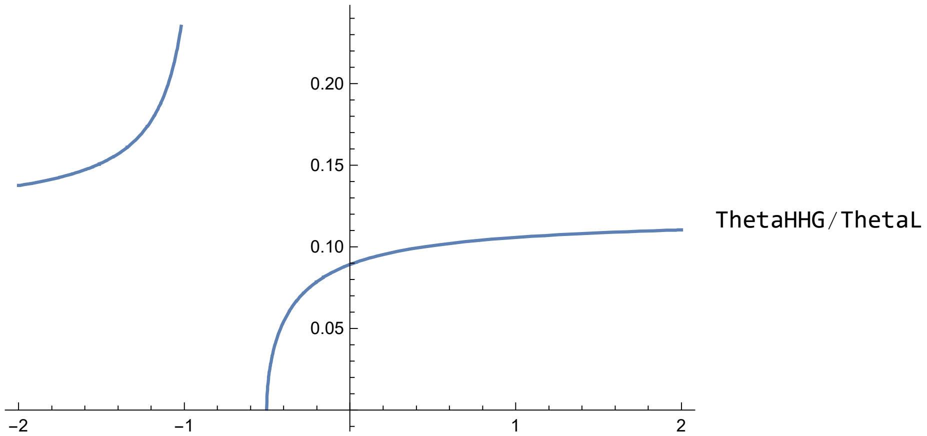
Out[1076]= $$\frac{1}{25}\sqrt{1+1.18991\left(1+\frac{0.746496\left(1+2.77778\,z^{2}\right)}{\left(1+\frac{0.36}{z^{2}}\right)z}\right)}$$

Out[1077]=



Out[1078]= here we find a problem with the definition of negative Rz or fz function, assuming Vincenti relies to negative means in front of means negative z-values is a bit unconventionel... definitely the curvertaure should compensate, so be it that negative values relate to focus in front of target....

Out[1079]=



Out[1080]= the function is not STETIG for the optimum range .... as it becomes complex i guess, but the optimum range decreases divHHG to < 5% of the origianl fundamental, which suggests somehting like <2mrad for N>7