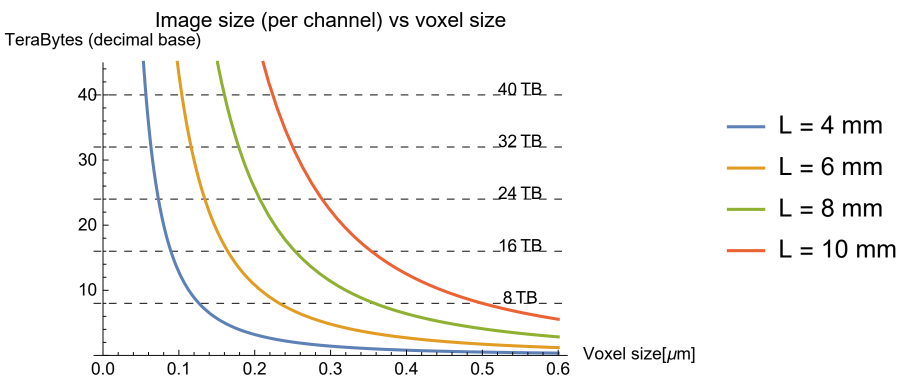
Calculate the data size of an entire image and the scanning time
TB: binary vs decimal basis, http://knowledge.seagate.com/articles/en_US/FAQ/194563en

```
μm = 10^-6;
μs = 10^-6;
ms = 10^-3;
ns = 10^-9;
mm = 10^-3;
Tera = 10^12; (*Decimal base*)
kHz = 10^3;
Mega = 10^6;
Giga = 10^9;
byte = 8;

bpp = 8; (*Bits per pixel*)
Δx = 0.5 μm; (*Spatial sampling rate in x and y. Optical resolution is twice this*)
Δz = 0.5 μm; (*Spatial sampling in z. The pptical resolution is twice this*)
Lz = 0.5 mm; (*Section thickness*)
FFOV = 0.25 mm; (*Full field of view (tile size)*)
Zmax = 150 μm; (*Thickness of each z-section*)
γ = 0.8; (*Prefactor that accounts for the dead time at the turning points*)
tshiftXY = 1 ms;
tshiftZ = 0.1 ms; (*The z-stage can do 20mm/s = 20μm/ms = 1μm in 0.05ms*)
Tcutting = 60;
Tline = 1/(2 * 8 kHz);
(*Scanning time per line. The resonant scanner does a round trip in 8kHz*)
Npix = FFOV/Δx; (*A tile has a total of Npix^2 pixels*)
dwellTime = γ Tline/Npix; (*Dwell time [s/pix]*)

Ttile[n_] := Npix * Tline / n (*Scanning time per tile. n is the number of
 beamlets. Note that the dead time at the turning points must be considered*)

Ntiles[L_] := (L/FFOV)^2 (*Number of tiles in a plane*)
Npixz[L_] := L/Δz (*Total number of pixels in the z direction*)
Npixtotal[L_] := (L/Δx)^2 L/Δz (*Total number of pixels in the sample*)
Nsecz[L_] := L / Zmax (*Number of z-sections in the sample*)

time[L_, n_] :=
 Ntiles[L] Npixz[L] (Ttile[n] + tshiftZ) + Nsecz[L] Ntiles[L] tshiftXY + Nsecz[L] Tcutting
 (*Toal scanning time per sample (per channel)*)
time[10 mm, 16] / 3600
Plot[Npix^2 * t ns / ms, {t, 0, 100}, PlotRange → {0, 0.03 / ms},
  AxesLabel → {"pixel dwell time [ns]", "Runtime per tile, single beam [ms]"}];
19.3907
```

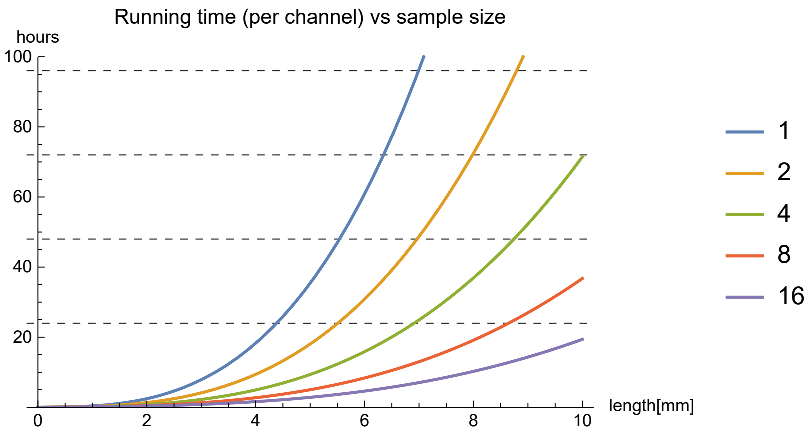
```
L = 10 mm;
Ntiles[L] Npixz[L] Ttile[16] / 3600(*total scanning time*)
Ntiles[L] Npixz[L] tshiftZ / 3600
(*total z-shifting time. Covering larger tiles decreases the shifting in z*)
Nsecz[L] Ntiles[L] tshiftXY / 3600
(*total xy-shifting time. Covering larger tiles decreases the shifting in xy*)
Nsecz[L] Tcutting / 3600.(*total cutting time. This term is basically fixed*)
```

```
17.3611

0.888889

0.0296296

1.11111
```

```
DataSize[L_, Δx_] := (L / Δx)^2 (L / Δz) * bpp (*Data size in bits PER CHANNEL*)
Show[Plot[Evaluate[Table[DataSize[dummy mm, dummy2 μm], {dummy, 4, 10, 2}] / (Tera * byte)],
   {dummy2, 0.05, 0.6}, AxesOrigin → {0, 0}, PlotRange → {0, 45},
   PlotLegends → {"L = 4 mm", "L = 6 mm", "L = 8 mm", "L = 10 mm"},
   AxesLabel → {"Voxel size[μm]", "TeraBytes (decimal base)"},
   GridLines → {{}, {8, 16, 24, 32, 40}}, GridLinesStyle → Directive[Black, Dashed],
   PlotLabel → "Image size (per channel) vs voxel size"],
 Graphics[Table[Text[ToString[i] "TB", {0.55, i + .8}], {i, 8, 40, 8}]]]
```



```
(*Running time PER CHANNEL*)
Plot[Evaluate[Table[time[dummy mm, 2^i] / 3600, {i, 0, 4}]],
 {dummy, 0, 10}, PlotRange → {0, 100}, AxesLabel → {"length[mm]", "hours"},
 PlotLegends → Table[2^i, {i, 0, 6}], GridLines → {{}, {24, 48, 72, 96}},
 GridLinesStyle → Directive[Black, Dashed],
 PlotLabel → "Running time (per channel) vs sample size"]
```




```
L = 10 mm; (*Sample size*)
Npixtotal[L]
1 / Ttile[1] (*frames (tiles) per second*)
```

$8. \times 10^{12}$

32.

How much time does it take to fully transfer a 8TB (decimal base) HDD

```
HDD = 8 * Tera * byte; (*Max HDD capacity in bits*)
busrate = 10 × 10^9; (*Transfer rate in bps*)
1. * HDD / busrate / 3600 (*Time to transfer a 8TB HDD [in hours]*)
```

1.77778

```
(*Data-saving speed required [MB/s]
  for 16 beamlets. A commercial HDD writes at 150 MB/s*)
```

$$16 \frac{\mathrm{FFOV}}{\Delta x} \frac{\mathrm{bpp}}{\mathrm{Tline} * \mathrm{Mega} * \mathrm{byte}}$$

128.

```
(*Quick estimations*)
L = 10 mm; (*sample size*)
Δx = 0.5 μm;
bpp = 8; (*bits per pixel*)
```

$$3 \left(\frac{L}{\Delta x}\right)^3 \mathrm{bpp} \frac{1}{\mathrm{Tera} * \mathrm{byte}} \text{(*Data size for 3 channels*)}$$

24.

```
(*Runtime for 3 channel [hours]*)
```

$$3 \frac{L^3}{\Delta x^2} \frac{\text{Tline}}{\text{FFOV} * 16} \Big/ 3600$$

52.0833