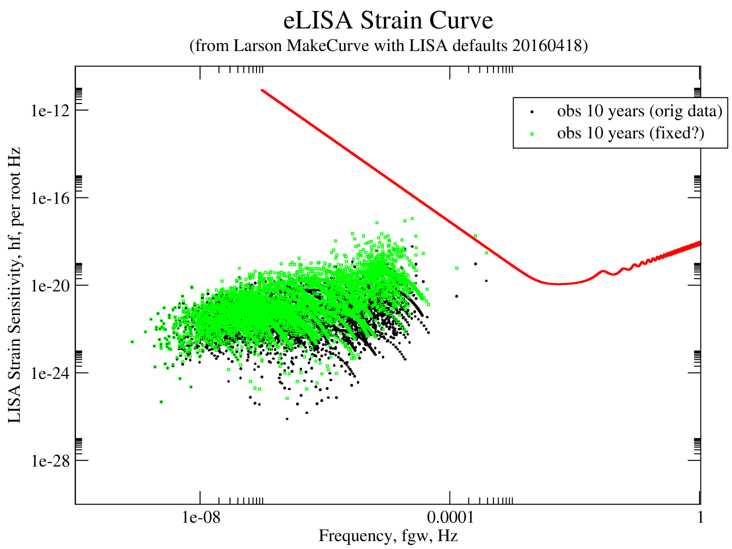
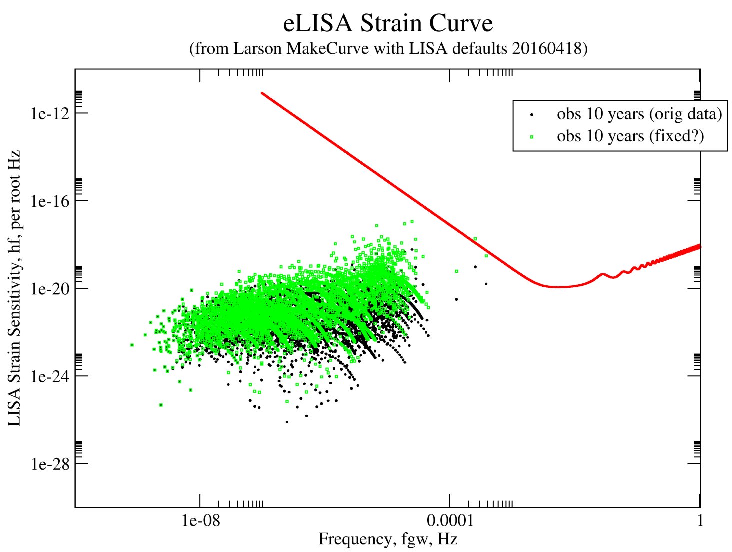
```
Clear["Global`*"]
```

Check the three high points in the hf vs freq plot.

Identify the planet and its properties. From the xmgrace hf vs freq.

```
approxFreq = {1.29 × 10^-4, 2.54 × 10^-4, 3.88 × 10^-4};
approxhf = {6.38 × 10^-20, 1.74 × 10^-18, 2.96 × 10^-19};
(* approx freq for three points touching red LISA strain
 sensitivity curve on far right, taken from plot below *)
```





The frequency ratios 1:2:3 indicate the same planet with an fr=1.29e-4 Hz.

```
perSecs = 1 / approxFreq[[1]]
perDays = perSecs / 3600.0 / 24.0
```

```
7751.94
```

```
0.0897215
```

As of 20160510.1100 the database, which is different now than the previous set that I used for my analysis indicates that the above is for Host Name PSR J1719-1438, currently rowid 1807.

```
plhostname = "PSR J1719-1438"; (* Underscores are NOT allowed! *)
plorbper = 0.090706; (* days, orbital period *)
plorbsmax = 0.0044; (* AU, orbit semi-major axis *)
plorbeccen = 0.06; (* orbital eccentricity *)
plbmassj = 1.2; (* Jupiter masses, planet mass *)
stdist = 1200; (* pc, stellar distance *)
stmass = 1.4; (* Sun masses, stellar mass *);
```

Work in SI units.

```
massSun = 1.99 × 10^30; (*kg *)
massJ = 1.90 × 10^27; (* kg *)
massE = 5.97 × 10^24; (* kg *)
massJe = 317.9; (* earth masses *)
massJs = massJ / massSun; (* relative to the sun's mass *)
pc = 30.86 × 10^15; (* meters, parsec *)
au = 149.6 × 10^9; (* meters, astron unit *)
cee = 299 792 458.0; (* meters/s, speed of light *)
secsYear = 365.24 * 24.0 * 3600.0; (* s, number of seconds in a year *)
secsDay = 24.0 * 3600.0; (* s, number of seconds in a day *)
rscon = 2955.43; (* meters per solar mass, Schwarzschild radius *)
rscon = 2 * 6.67388 × 10^-11 * massSun / cee^2 (* solar mass Scharzschild radius *)
lunits = 6.67388 × 10^-11 * massSun / cee^2
(* meters per solar mass, units of G=c=1 *)
bigG = 6.67384 × 10^-11; (* Gravitational constant, m^3/kg/s^2 *)
```

```
2955.43
```

```
1477.71
```

```
{cee, secsYear, rscon, lunits}
```

$\{2.99792 \times 10^{8}, 3.15567 \times 10^{7}, 2955.43, 1477.71\}$

Use the full eccentricity formulae because we are checking the hv vs freq plot!

Max n from my formula, for the Peters & Mathews curve to come back down to 1/20 of the peak. Used Nmax=3 if it was smaller.

```
nmaxFcn = E^# (0.589993 - 1.41201 # + 0.892102 #^2) &
```

$e^{\#1} \left(0.589993 - 1.41201\, \#1 + 0.892102\, \#1^{2}\right)$ &

```
nmax = nmaxFcn[plorbeccen]
```

```
0.539927
```

```
nmax = 3
```

```
3
```

Work in SI.

```
m1 = stmass * massSun
m2  = plbmassj * massJ
totMass  = m1 + m2
redMass  = m1 * m2 / totMass
chirpMass  = redMass^(3/5) totMass^(2/5)
dist  = stdist * pc  (* m *)
period  = plorbper * secsDay (* s *)
freq  = 1/period (* Hz *)
```

2.786×10^{30}

2.28×10^{27}

2.78828×10^{30}

2.27814×10^{27}

3.91455×10^{28}

3.7032×10^{19}

7837.

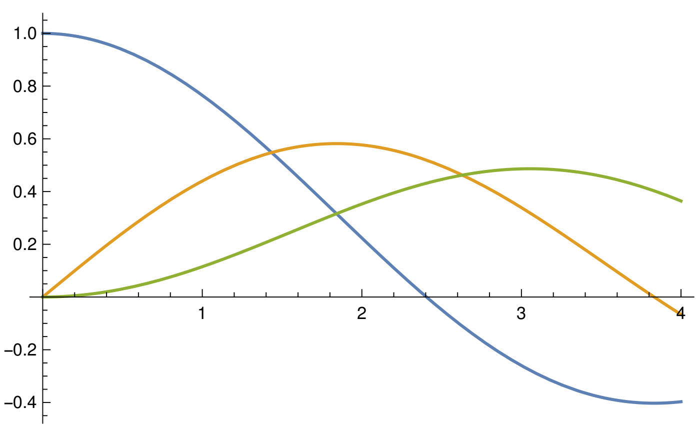
0.0001276

Egads the A, B, and g(n,e) functions. Put them in again! Amaro-Seoane et al.'s form Eqns(4-6).

```
jj = BesselJ[#1, #2] & (* Bessel function of integer order,
 this is a function definition *)
```

```
BesselJ[#1, #2] &
```

```
Plot[{jj[0, u], jj[1, u], jj[2, u]}, {u, 0, 4}]
```

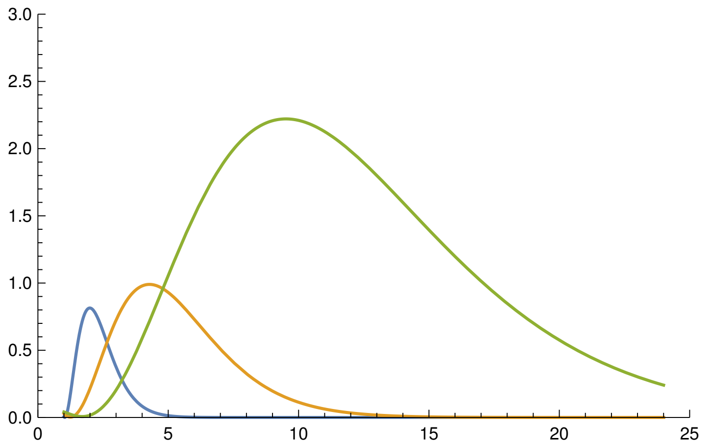



```
bigA[n_, e_] := jj[n - 2, n e] - 2 jj[n, n e] + jj[n + 2, n e]
bigB[n_, e_] :=
 jj[n - 2, n e] - 2 e jj[n - 1, n e] + 2/n jj[n, n e] + 2 e jj[n + 1, n e] - jj[n + 2, n e]
```

$$\text{gg[n\_, e\_]} := \frac{n^4}{32}\left(\text{bigB[n, e]}^2 + \left(1 - e^2\right)\text{bigA[n, e]}^2 + \frac{4}{3\,n^2}\,\text{jj[n, n e]}^2\right)$$

Check versus the Peters&Mathews Fig. 3, also Maggiore page XX.

```
Plot[{gg[u, 0.2], gg[u, 0.5], gg[u, 0.7]}, {u, 1, 24},
 PlotRange → {{0, 25}, {0, 3}}]
```



For this planet, AS eqn (9) gives h_n.

$$\texttt{hh[n\_] := } 2\sqrt{\frac{32}{5}}\ \frac{\texttt{chirpMass}^{5/3}}{\texttt{n dist}}\ (2\,\pi\,\texttt{freq})^{2/3}\ \sqrt{\texttt{gg[n, plorbeccen]}}$$

$$\texttt{Table}\left[\left\{\texttt{n, hh[n], } \frac{\texttt{bigG}^{5/3}}{\texttt{cee}^4}\ \texttt{hh[n]}\right\}\texttt{, \{n, 1, 3\}}\right]\ \texttt{// TableForm}$$

1	1.2386×10^{25}	1.68374×10^{-26}
2	2.63685×10^{26}	3.5845×10^{-25}
3	3.56137×10^{25}	4.84129×10^{-26}

AS eqn(10), the observed strain, not strain sensitivity!

$h_{obs,n} = h_n \sqrt{T\, f_{r,n}}$ where $T = \max(T_{orb},\ T_{obs})$.

I plotted the 10 year observation for the strain sensitvity.

T_{obs} for LISA is either 3, 5, 10 years.

Factor is

$$\texttt{afac[n\_] := }\sqrt{\texttt{n freq 10.0 secsYear}}$$

```
afac[{1, 2, 3}]
```

```
{200.665, 283.783, 347.562}
```

$$\texttt{bfac = }\sqrt{\texttt{10.0 secsYear}}$$

```
17 764.2
```

```
{{"PSR J1719-1438", "", "", "", ""}}~Join~
  {{"harmonic, n", "h_n(geom units)", "h_n(unitless)", "h_obs,n(SI)", "hf"}}~
  Join~Table[
    {n, hh[n], aa = bigG^(5/3)/cee^4 hh[n], bb = aa*afac[n], bb*bfac}, {n, 1, 3}
  ] // TableForm
```

PSR J1719-1438

harmonic, n	h_n(geom units)	h_n(unitless)	$h_{obs,n}$(SI)	hf
1	1.2386×10^{25}	1.68374×10^{-26}	3.37866×10^{-24}	6.00193×10^{-20}
2	2.63685×10^{26}	3.5845×10^{-25}	1.01722×10^{-22}	1.80701×10^{-18}
3	3.56137×10^{25}	4.84129×10^{-26}	1.68265×10^{-23}	2.98909×10^{-19}

For the strain senstivity plot, (freq, hf).

```
atab = Table[
  {n freq, bigG^(5/3)/cee^4 hh[n] afac[n] bfac}, {n, 1, 3}
 ]
```

$\{\{0.0001276, 6.00193\times10^{-20}\}, \{0.0002552, 1.80701\times10^{-18}\}, \{0.0003828, 2.98909\times10^{-19}\}\}$

```
(* Export["/scratch/gabella/Documents/astro/exop/PSRJ1719_1438.dat",atab] *)
```

/scratch/gabella/Documents/astro/exop/PSRJ1719_1438.dat