```
λ =.; Clear[normalgamma]; (*
     efface
PDF of getting nooe electrons out for exactly λ photons in in a given
fonction de densité de probabilité
   pixel. Includes Gamma distribution  + Normal readout noise. Model
                    fonction gamma          forme normale
   applied to all photo electrons including darks and pCIC. sCIC neglected.

    nooe = output electrons = read signal / 0.55
    g = gain = 470
      r = read noise = 109 electrons
        λ = nb of photons you are testing for
*)normalgamma[nooe_, g_, r_, λ_] :=
```

$$2^{-\lambda/2}\, e^{-\frac{nooe^2}{2\,r^2}}\, g^{-\lambda}\, r^{-2+\lambda}\left(\left(r\ \text{Hypergeometric1F1}\left[\frac{\lambda}{2},\ \frac{1}{2},\ \frac{\left(-g\ nooe + r^2\right)^2}{2\,g^2\,r^2}\right]\right)\Big/\left(\sqrt{2}\ \text{Gamma}\left[\frac{1+\lambda}{2}\right]\right) +$$

$$\left(\left(g\ nooe - r^2\right)\text{Hypergeometric1F1}\left[\frac{1+\lambda}{2},\ \frac{3}{2},\ \frac{\left(-g\ nooe + r^2\right)^2}{2\,g^2\,r^2}\right]\right)\Big/\left(g\ \text{Gamma}\left[\frac{\lambda}{2}\right]\right)$$

Examples:

In[•]:=
```
normalgamma[1000, 500, 100, 2.]
```

Out[•]=
```
0.000541231
```

In[•]:=
```
normalgamma[1000, 500, 100, 2.]
```

Poisson prior:

In[•]:=
```
PDF[PoissonDistribution[moyvalue], λ]
```

Out[•]=

$$\begin{cases} \dfrac{e^{-moyvalue}\ moyvalue^{\lambda}}{\lambda!} & \lambda \geq 0 \\ 0 & \text{True} \end{cases}$$

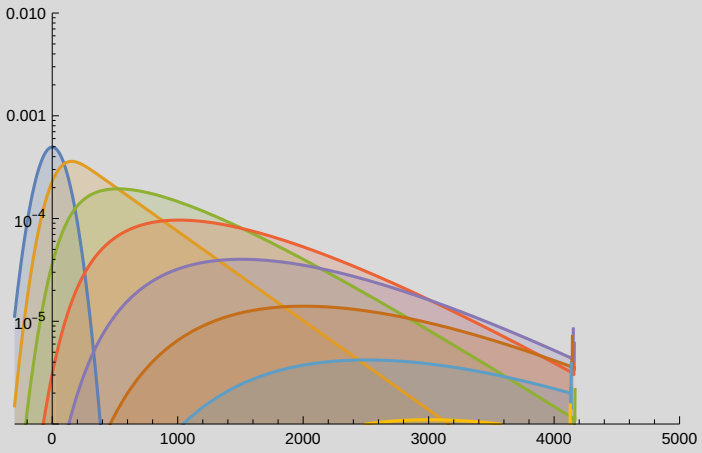
Poisson weighted distribution of λ for an observed nooe is:

```
PDF[PoissonDistribution[moyvalue], λ] * normalgamma[nooe, g, r, λ]
```

Plot for moyvalue = 2:

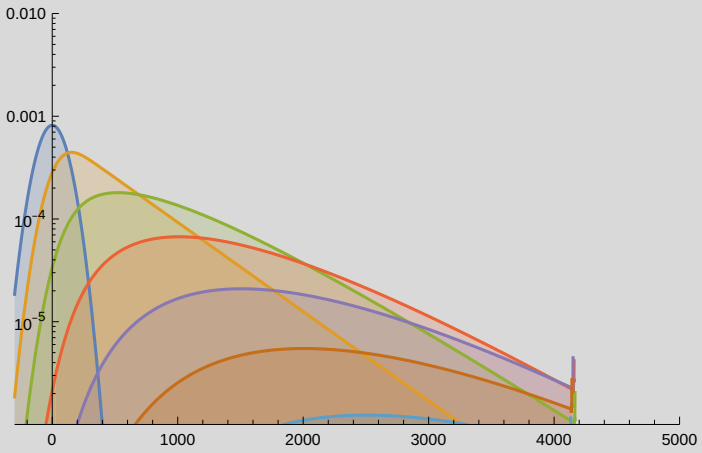
In[•]:=
```
plot1 =
 LogPlot[Table[PDF[PoissonDistribution[moyvalue], λ] × normalgamma[noe, 500, 109, λ] /.
  moyvalue → 2, {λ, {0, 1, 2, 3, 4, 5, 6, 7}}] // Evaluate,
 {noe, -300, 5000}, Filling → Axis, PlotRange → {{-300, 5000}, {.000001, .01}}]
```

Out[•]=



In[•]:=
```
plot1 =
 LogPlot[Table[PDF[PoissonDistribution[moyvalue], λ] × normalgamma[noe, 500, 109, λ] /.
  moyvalue → 1.5, {λ, {0, 1, 2, 3, 4, 5, 6, 7}}] // Evaluate,
 {noe, -300, 5000}, Filling → Axis, PlotRange → {{-300, 5000}, {.000001, .01}}]
```

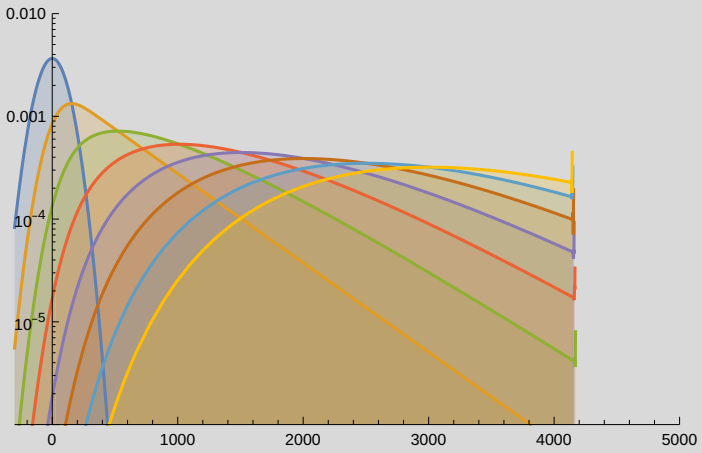
Out[•]=



Same without prior:

In[•]:=
```
plot1 =
 LogPlot[Table[normalgamma[noe, 500, 109, λ], {λ, {0, 1, 2, 3, 4, 5, 6, 7}}] // Evaluate,
 tracé log table                                                              évalue
  {noe, -300, 5000}, Filling → Axis, PlotRange → {{-300, 5000}, {.000001, .01}}]
                      rempliss··· axe   zone de tracé
```

Out[•]=



Find curves intersections for threshold calculation here a bissection method, here for moylevel = 1,10,0.1 Note the upper right corner of the matrix is not useful:

In[•]:=
```
Taballthrs = Table[
             table

  noemi0 = -300; noema0 = 60 000;
  tabstart = Table[noemi = noemi0; noema = noema0;
             table

    While[noema - noemi > .1,
    pendant que

     noech = (noemi + noema) / 2;
     If[
     si

      PDF[PoissonDistribution[moylevel], λ] × normalgamma[noech, 500, 109, λ] >
      f··· loi de Poisson

       PDF[PoissonDistribution[moylevel], λ + 1] × normalgamma[noech, 500, 109, λ + 1],
       f··· loi de Poisson

      noemi = noech, noema = noech];

    ]; noech, {λ, 0, 10}]; Join[{moylevel}, N[tabstart]],
                           joins          valeur numérique

  {moylevel, 1, 10, .1}
 ];
MatrixForm[Taballthrs]
forme matricielle
```

General: Exp[−37497.8] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−37497.8] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−9186.96] is too small to represent as a normalized machine number; precision may be lost.

General: Further output of General::munfl will be suppressed during this calculation.

Out[•]//MatrixForm=

1.	155.049	1023.74	3019.8	4157.28	4147.96	4138.07	4127.49	4116.45	4105.06	409
1.1	147.689	932.883	2746.64	4157.85	4148.77	4139.1	4128.87	4118.17	4107.02	409
1.2	140.673	857.09	2519.03	4158.31	4149.57	4140.02	4130.02	4119.55	4108.74	409
1.3	134.002	793.027	2326.27	4158.66	4150.15	4140.94	4131.17	4120.93	4110.24	409
1.4	127.676	738.051	2161.11	4142.21	4150.72	4141.75	4132.2	4122.08	4111.73	410
1.5	121.581	690.436	2017.8	4017.77	4151.18	4142.44	4133.01	4123.23	4113.	410
1.6	115.83	648.801	1892.44	3767.38	4151.64	4143.01	4133.93	4124.27	4114.26	410
1.7	110.194	611.997	1781.68	3546.44	4152.1	4143.59	4134.62	4125.19	4115.3	410
1.8	104.789	579.333	1683.23	3350.	4152.45	4144.16	4135.31	4126.11	4116.33	410
1.9	99.4981	550.119	1595.13	3174.14	4152.79	4144.62	4136.	4126.8	4117.37	410
2.	94.4375	523.781	1515.77	3015.89	4153.02	4145.08	4136.57	4127.6	4118.17	410
2.1	89.4919	499.974	1444.	2872.58	4153.37	4145.54	4137.15	4128.29	4119.09	410
2.2	84.6614	478.351	1378.67	2742.27	4153.6	4145.89	4137.61	4128.98	4119.78	411
2.3	79.9459	458.569	1318.98	2623.35	4144.39	4146.23	4138.07	4129.56	4120.59	411
2.4	75.3453	440.397	1264.24	2514.2	4144.62	4146.58	4138.53	4130.13	4121.28	411
2.5	70.7448	423.72	1213.75	2413.79	4014.89	4146.81	4138.99	4130.71	4121.97	411
2.6	66.3743	408.308	1167.16	2321.09	3860.66	4147.15	4139.33	4131.17	4122.54	411
2.7	62.0038	394.047	1124.03	2235.29	3717.81	4147.38	4139.79	4131.63	4123.12	411
2.8	57.7483	380.705	1084.01	2155.47	3585.2	4147.61	4140.02	4132.09	4123.69	411
2.9	53.6078	368.284	1046.63	2081.17	3461.68	4147.84	4140.37	4132.55	4124.15	411
3.	49.4674	356.667	1011.78	2011.82	3346.43	4148.08	4140.71	4132.89	4124.73	411
3.1	45.4419	345.741	979.118	1946.95	3238.55	4148.19	4140.94	4133.24	4125.19	411
3.2	41.4165	335.505	948.41	1886.	3137.34	4148.42	4141.17	4133.58	4125.65	411
3.3	37.506	325.844	919.542	1828.84	3042.34	4148.54	4141.52	4133.93	4125.99	411
3.4	33.5956	316.758	892.399	1774.89	2952.86	4148.65	4141.75	4134.27	4126.45	411
3.5	29.8001	308.017	866.866	1724.17	2868.44	4148.77	4141.86	4134.5	4126.8	411
3.6	26.0047	299.736	842.598	1676.1	2788.73	4148.88	4142.09	4134.85	4127.14	411
3.7	22.3243	291.915	819.595	1630.67	2713.29	4066.07	4142.32	4135.08	4127.49	411
3.8	18.5288	284.439	797.858	1587.54	2641.75	3959.11	4142.44	4135.31	4127.83	412
3.9	14.9634	277.193	777.27	1546.71	2573.89	3857.55	4142.67	4135.54	4128.18	412
4.	11.283	270.408	757.603	1507.83	2509.48	3761.06	4142.78	4135.77	4128.41	412
4.1	7.71761	263.737	738.856	1470.8	2448.18	3669.28	4142.9	4136.	4128.75	412
4.2	4.1522	257.411	721.029	1435.61	2389.75	3581.87	4143.01	4136.23	4128.98	412
4.3	0.701809	251.315	704.007	1402.02	2333.97	3498.48	4143.13	4136.34	4129.21	412
4.4	-2.74858	245.45	687.675	1369.82	2280.72	3418.89	4143.24	4136.57	4129.44	412
4.5	-6.19898	239.699	672.148	1339.11	2229.89	3342.87	4143.36	4136.69	4129.67	412
4.6	-9.64937	234.178	657.197	1309.78	2181.24	3270.06	4131.17	4136.92	4129.9	412
4.7	-13.0998	228.888	642.82	1281.6	2134.66	3200.37	4143.59	4137.03	4130.13	412
4.8	-16.4351	223.712	629.134	1254.57	2089.92	3133.54	4143.59	4137.15	4130.36	412
4.9	-19.7705	218.767	615.907	1228.7	2047.02	3069.48	4143.7	4137.26	4130.48	412
5.	-23.1059	213.821	603.256	1203.74	2005.84	3007.95	4143.7	4137.38	4130.71	412
5.1	-26.3263	209.106	591.064	1179.82	1966.28	2948.72	4143.82	4137.49	4130.82	412
5.2	-29.6617	204.505	579.333	1156.81	1928.21	2891.9	4047.55	4137.61	4123.58	412
5.3	-32.882	200.02	567.947	1134.62	1891.63	2837.16	3971.07	4137.72	4123.81	412
5.4	-36.1024	195.649	557.02	1113.22	1856.32	2784.36	3897.35	4130.02	4131.28	412
5.5	-39.3228	191.394	546.439	1092.64	1822.28	2733.53	3826.38	4130.13	4131.4	412

5.6	-42.4281	187.138	536.318	1072.74	1789.39	2684.53	3757.95	4130.13	4131.63	412
5.7	-45.6485	183.113	526.427	1053.53	1757.76	2637.26	3691.82	4130.25	4131.74	412
5.8	-48.7538	179.087	516.881	1035.01	1727.16	2591.6	3627.99	4130.36	4131.86	412
5.9	-51.9742	175.177	507.68	1017.07	1697.61	2547.44	3566.34	4130.36	4131.86	412
6.	-55.0796	171.381	498.709	999.706	1668.97	2504.77	3506.76	4130.48	4131.97	412
6.1	-58.1849	167.586	490.083	982.914	1641.25	2463.36	3449.14	4130.48	4132.09	412
6.2	-61.1753	163.905	481.687	966.582	1614.45	2423.45	3393.36	4127.37	4132.2	412
6.3	-64.2806	160.34	473.521	950.825	1588.46	2384.69	3339.3	4126.45	4132.32	412
6.4	-67.386	156.775	465.585	935.528	1563.39	2347.2	3286.86	4126.57	4132.32	412
6.5	-70.3763	153.324	457.994	920.692	1538.89	2310.86	3236.14	4126.57	4132.43	412
6.6	-73.3666	149.874	450.518	906.315	1515.31	2275.55	3186.91	4126.57	4132.43	412
6.7	-76.357	146.538	443.157	892.399	1492.31	2241.27	3139.06	4125.88	4132.55	412
6.8	-79.3473	143.203	436.141	878.712	1469.99	2208.03	3092.71	4125.99	4132.55	412
6.9	-82.3377	139.868	429.241	865.6	1448.26	2175.71	3047.74	4064.12	4132.66	412
7.	-85.328	136.762	422.57	852.719	1427.21	2144.43	3003.92	4005.92	4132.66	412
7.1	-88.3183	133.542	416.014	840.183	1406.74	2113.84	2961.37	3949.33	4132.66	412
7.2	-91.3087	130.437	409.688	828.106	1386.84	2084.16	2920.08	3894.36	4132.78	412
7.3	-94.184	127.331	403.478	816.26	1367.4	2055.41	2879.83	3840.76	4132.78	412
7.4	-97.1744	124.341	397.382	804.759	1348.54	2027.23	2840.61	3788.66	4132.78	412
7.5	-100.05	121.351	391.516	793.487	1330.14	1999.97	2802.54	3737.94	4132.78	412
7.6	-102.925	118.36	385.651	782.561	1312.31	1973.29	2765.39	3688.6	4132.89	412
7.7	-105.8	115.485	380.015	771.865	1294.83	1947.3	2729.27	3640.52	4132.89	412
7.8	-108.791	112.61	374.494	761.514	1277.81	1922.	2693.96	3593.6	4132.89	412
7.9	-111.666	109.734	369.089	751.277	1261.25	1897.38	2659.58	3547.94	4132.89	412
8.	-114.541	106.974	363.913	741.386	1245.03	1873.35	2626.11	3503.43	4132.89	412
8.1	-117.302	104.214	358.738	731.725	1229.27	1849.88	2593.44	3459.95	4132.89	412
8.2	-120.177	101.453	353.677	722.294	1213.86	1827.	2561.47	3417.51	4132.89	412
8.3	-123.052	98.693	348.732	712.978	1198.79	1804.57	2530.42	3376.11	4132.89	412
8.4	-125.928	96.0477	343.901	704.007	1184.07	1782.72	2499.94	3335.74	4132.89	412
8.5	-128.688	93.4024	339.07	695.151	1169.7	1761.44	2470.26	3296.17	4132.78	412
8.6	-131.563	90.7571	334.47	686.525	1155.66	1740.62	2441.28	3257.64	4132.78	412
8.7	-134.324	88.2268	329.869	678.129	1141.86	1720.26	2412.87	3220.03	4132.78	412
8.8	-137.084	85.5815	325.384	669.848	1128.52	1700.37	2385.15	3183.11	4132.78	412
8.9	-139.959	83.0512	321.013	661.682	1115.29	1680.81	2358.13	3147.12	4048.13	412
9.	-142.72	80.5209	316.643	653.861	1102.53	1661.84	2331.56	3111.92	4002.93	412
9.1	-145.48	77.9906	312.502	646.04	1089.88	1643.2	2305.68	3077.53	3958.76	412
9.2	-148.24	75.5754	308.362	638.45	1077.57	1624.92	2280.26	3043.83	3915.52	412
9.3	-151.	73.1601	304.221	630.974	1065.49	1607.09	2255.42	3010.83	3873.19	412
9.4	-153.761	70.6298	300.196	623.728	1053.76	1589.61	2231.15	2978.51	3831.79	412
9.5	-156.521	68.2145	296.286	616.597	1042.15	1572.47	2207.34	2946.88	3791.3	412
9.6	-159.281	65.9142	292.375	609.581	1030.87	1555.68	2184.	2915.94	3751.51	412
9.7	-162.042	63.499	288.58	602.68	1019.72	1539.23	2161.22	2885.58	3712.64	412
9.8	-164.802	61.1987	284.784	595.895	1008.79	1523.13	2138.8	2855.9	3674.57	412
9.9	-167.562	58.7834	281.104	589.339	998.211	1507.37	2116.94	2826.8	3637.19	412
10.	-170.323	56.4832	277.423	582.783	987.744	1491.96	2095.44	2798.28	3600.61	412

Create the thresholding function (here for another threshold table having 7 as the max calculated):

```
fthrs[x_] := Which[x < tabthrs[[1]], 0, x < tabthrs[[2]], 1, x < tabthrs[[3]], 2, x < tabthrs[[4]], 3,
                   quel
  x < tabthrs[[5]], 4, x < tabthrs[[6]], 5, x < tabthrs[[7]], 6, x < tabthrs[[8]], 7, True, 8]
                                                                                      vrai
```

and finally apply it to the image or table:

```
datapgnmt = Map[fthrs, datapgn / .55]
            applique à travers
```