

## Why Multiple Events / Bunch Crossing Is Not A Problem

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WHY MULTIPLE EVENTS  
PER BUNCH CROSSING  
IS NOT A PROBLEM

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March 1, 1984

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3/1/84

## Multiple Events per Crossing ?

Say we have  $L = 1.0 \times 10^{27} / \text{cm}^2 / \text{sec}$  for gold and  $L = 1.1 \times 10^{30} / \text{cm}^2 / \text{sec}$  for carbon (gold-gold and carbon-carbon). The total reaction cross sections (geometric) are  $\frac{\pi}{100} 1.25^2 (A_1^{1/3} + A_2^{1/3})^2$  barns. This gives 1.03 barns for  $^{12}\text{C} + ^{12}\text{C}$  and 6.65 barns for  $^{197}\text{Au} + ^{197}\text{Au}$ . The beam makes 78197 orbits/second. Thus on the average, there are

$$N/\text{crossing} = \frac{L \cdot \sigma}{(\# \text{ orbits/second}) (\# \text{ crossings/orbit})} \quad \text{events per crossing.}$$

We always have 57 crossings/orbit i.e. bunches. Then for carbon-carbon, there are 0.254 events/crossing and for gold-gold there are 0.00149 events/crossing, on the average.

A <sup>normalized</sup> Poisson distribution has the form  $P_{\bar{n}}(n) = \frac{e^{-\bar{n}} (\bar{n})^n}{n!}$   $n = 0, 1, 2, \dots$  where  $n$  is the number of events and  $\bar{n}$  is the mean, given above. The variance equals the mean. The following table results for our two cases.

	C-C $L = 1.1 \times 10^{30}$	Au-Au $L = 1.0 \times 10^{27}$
$n$	$P_{\bar{n}}(n) = P_{0.254}(n)$	$P_{\bar{n}}(n) = P_{0.00149}(n)$
0	.776	.9985
1	.197	.001488
2	.0250	$1.11 \times 10^{-6}$
3	.00212	$5.51 \times 10^{-10}$
4	.000135	$2.05 \times 10^{-13}$
5	.00000683	$6.11 \times 10^{-17}$
6	$2.89 \times 10^{-7}$	$1.52 \times 10^{-20}$
7	$1.05 \times 10^{-8}$	$3.23 \times 10^{-24}$
8	$3.33 \times 10^{-10}$	$6.02 \times 10^{-28}$

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The gold numbers are just fine.

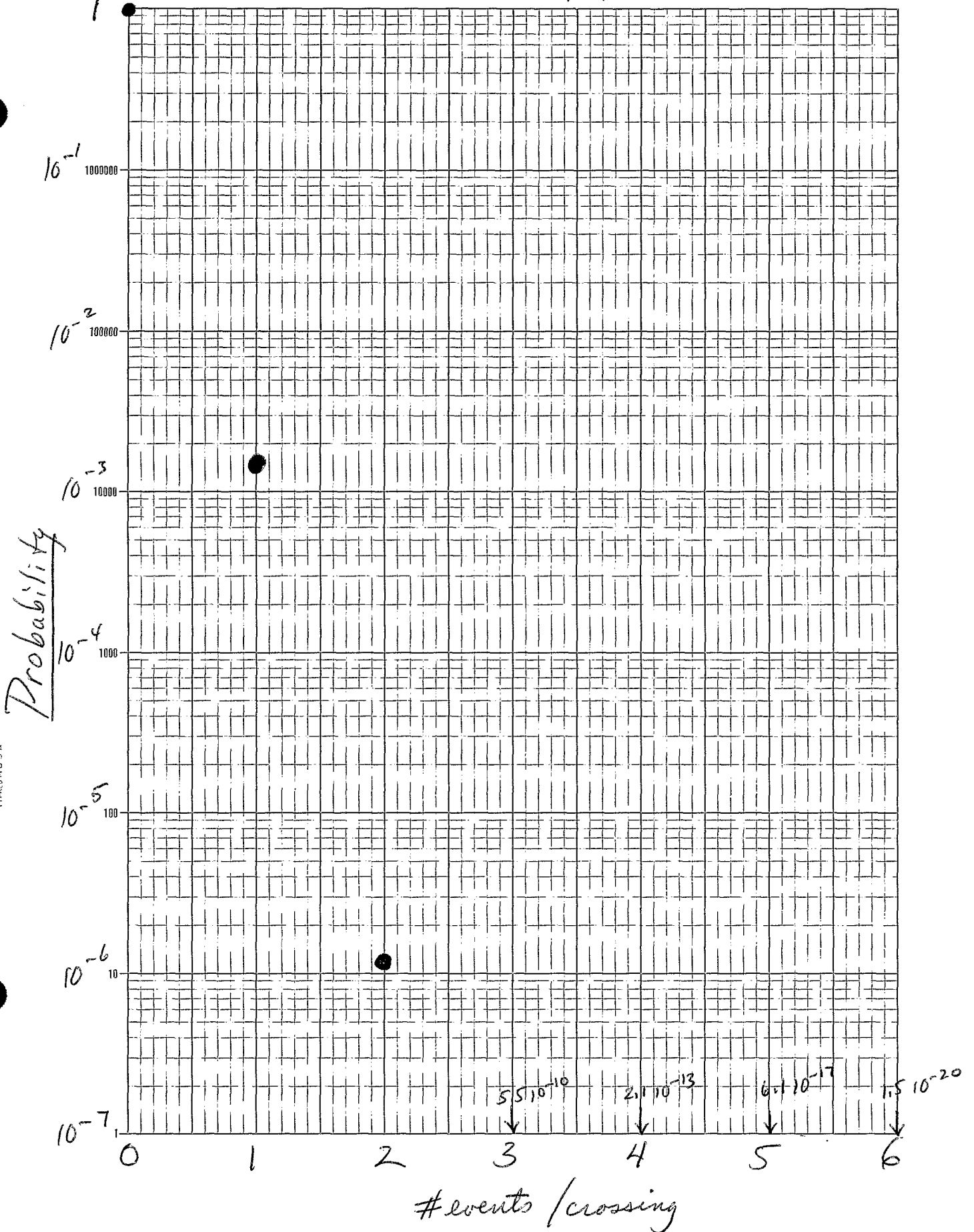
The carbon numbers for 2-4 events <sup>per</sup> crossing are perhaps unacceptable. If we lower the luminosity by a factor of ten, we get 0.0254 events/crossing, and the table becomes

n	C-C $P_{0.0254}(n)$	low L = $1.1 \cdot 10^{29} / \text{cm}^2 / \text{sec}$
0	.9749	
1	.02476	
2	.000314	
3	$2.66 \cdot 10^{-6}$	
4	$1.69 \cdot 10^{-8}$	
5	$8.59 \cdot 10^{-11}$	
6	$3.64 \cdot 10^{-13}$	
7	$1.32 \cdot 10^{-15}$	
8	$4.19 \cdot 10^{-18}$	

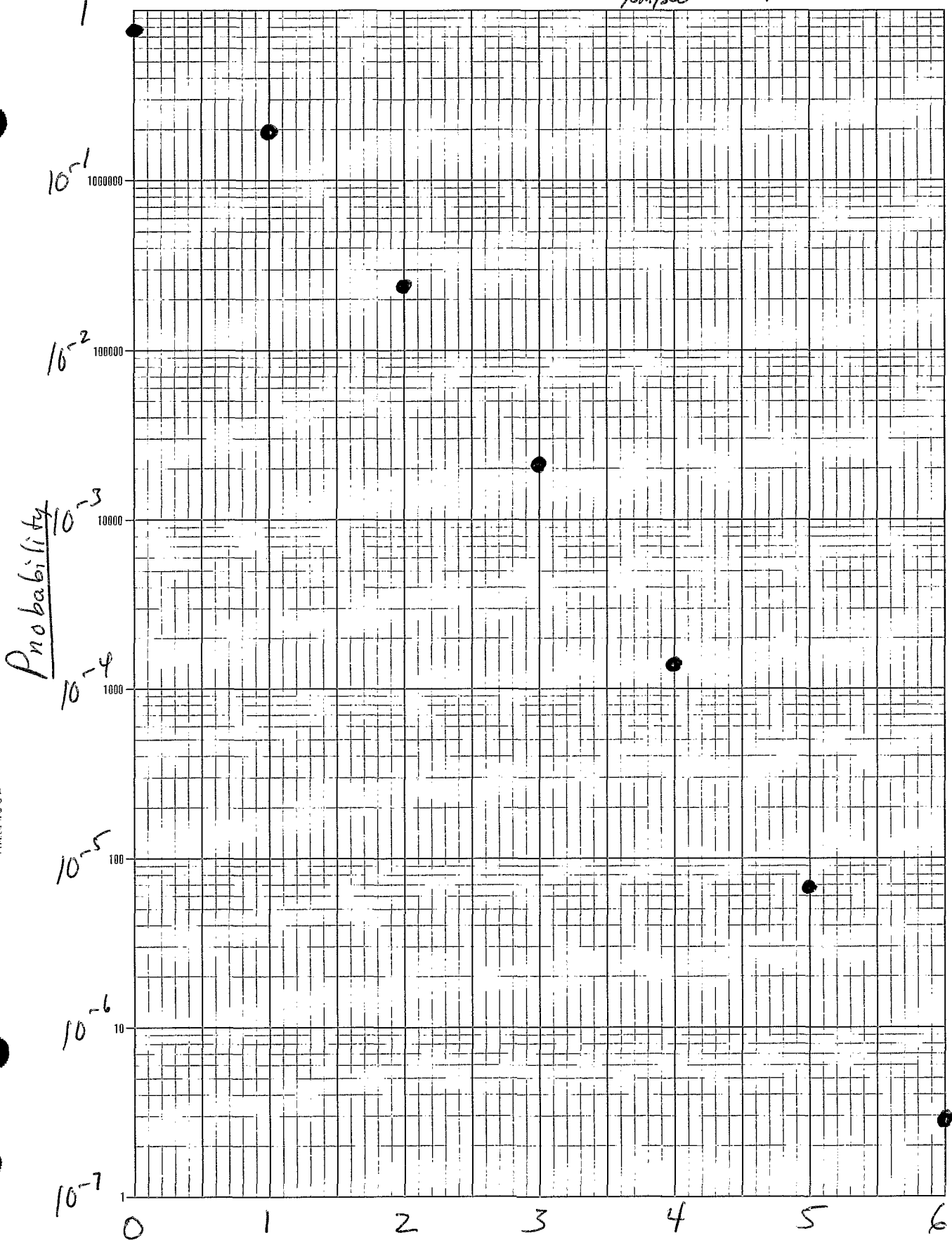
Arguing even half the cross section goes to fragmentation and thus events with little or no central rapidity activity, these values should be quite acceptable.

**BOTTOM LINE : THIS AIN'T NO PROBLEM!**

MODEL Gold-Gold  $L = 1 \times 10^{27} \text{ km}^2/\text{sec}$  DATE 3/1/84



MODEL Carbon-Carbon at  $L = 1.1 \times 10^{30} / \text{cm}^2 / \text{sec}$  DATE 3/1/84



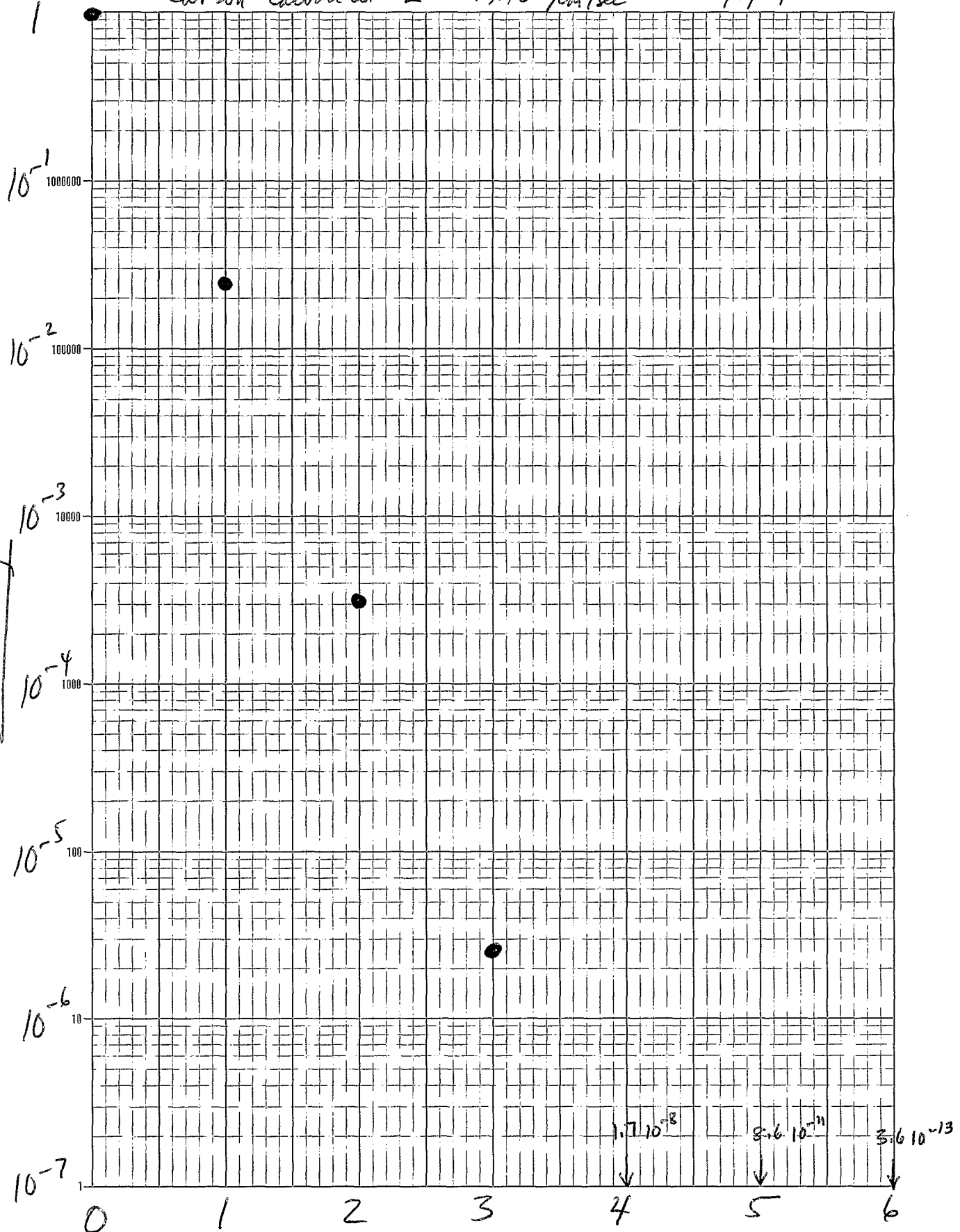
# events / crossing

MODEL Carbon-Carbon at  $L = 1.1 \times 10^{29} \text{ cm}^2/\text{sec}$  DATE 3/1/84

SEMI-LOGARITHMIC 7 CYCLES X 60 DIVISIONS AD-2346 -C0

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Probability



# events / crossing