III. EXPECT SEVERAL 4*σ* FLUCTUATIONS PER Y EAR

Before we go on to survey far-out mass spectra where bumps have been reported in (Kππ) 3/ 2, (πρ)– –, … we should first decide what threshold of significance to demand in 1968.

I want to show you that although experi mentalists should probably note *3σ* effects, theoreticians

and phenomenologists would do better to wait till the effect reaches > 4*σ* . (Note that doubling the counts on a real *3σ* peak should increase its significance to *3√ 2σ* ~ 4.25*σ* , so I am not suggesting an impossibly long wait.)

In appendices to our January 1967 compilation of particle properties3, we presented a collection of histograms in which we tried to kill the kappa and H mesons.

We wounded both but killed neither, and ourselves learned something of the statistical problems that arise when each year bubble chamber physicists numbering nearly a thousand (if you include graduate students) hunt through ten-thousand mass distributions in search of striking features, either real or statistical fluctuations.

Then, to repeat my warning at the beginning of this

section; we are now generating at least 100,000 potential

bumps per year, and should expect several 4*σ* and hundreds of

3*σ* fluctuations. What are the implications? To the

theoretician or phenomenologist the moral is simple; wait

for nearly 5*σ* effects. For the experimental group who have

just spent a year of their time and perhaps a million dollars,

the problem is harder. I suggest that they should go ahead

and publish their tantalizing bump (or at least circulate it as

a report.) But they should realize that any bump less than

about 5*σ* constitutes only a call for a repeat of the experiment.

If they, or somebody else, can double the number of

counts, the number of standard deviations should increase by √2, and that will confirm the original effect.

http://www.science20.com/quantum\_diaries\_survivor/demystifying\_fivesigma\_criterion\_part\_iv\_and\_summary-118684

However, I am a bit disappointed in the particular case at hand, observing how an arbitrary and fixed convention has crystallized into a unmovable requirement. It looks as if the popularization of the concept has made it even harder to replace it with something smarter. The strict "five sigma" criterion is liable to cause us to claim false discoveries before we have completed our homeworks carefully -as was the case of OPERA- or to wait years before we can confirm a model, when trials factors and systematics are not a concern and when we are studying an effect that we know must exist.