

Double Stars

In 1767 Reverend John Michell (Philosophical Transactions **57** pp234-265) presented a statistical analysis of the probability of find optical doubles as distinct from physical doubles. Optical double stars occur because two stars just happen to be on nearly the same line of sight. Against the backdrop of the sky they appear to be close together but actually they can be quite far apart and not physically connected.

Physical double stars are really in close proximity to each other and are orbitting each other. It is believed that many stars form with one or more companions. The exact percentage of multiple stars systems is not known, however. Our sun is an exception in that it is solitary. The propensity for stars to form double or multiple systems is an important clue on stellar formation. Modern techniques have greater analysis power than was available to John Michell.

In the figures below we have 100 stars distributed through a volume of 100x100x100 units. We see them projected against the two dimensional celestial sphere. Figure 1 has these stars distributed at random. Figure 2 has the first star distributed at random but the second star has a 20 percent chance of being anywhere within a sphere of radius 20 units of the first. In figure 3 each star has a 50 percent chance of being within a sphere of 20 units radius of another star.

From these three figures can you devise a statistical procedure by which to distinguish which field represents optical doubles and which represent physical doubles?

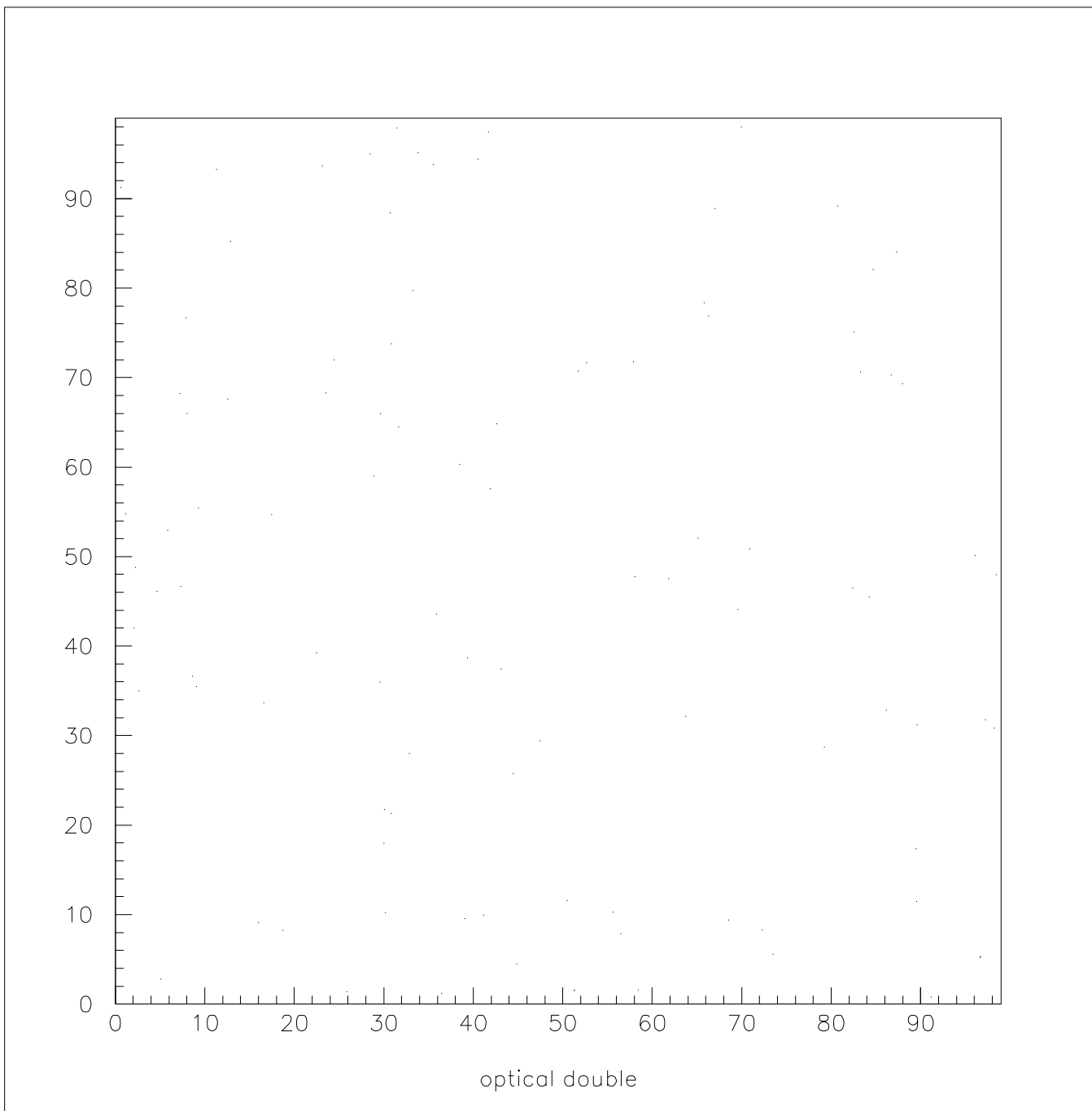


Figure 1: Optical doubles: 100 stars in a 100x100x100 volume.

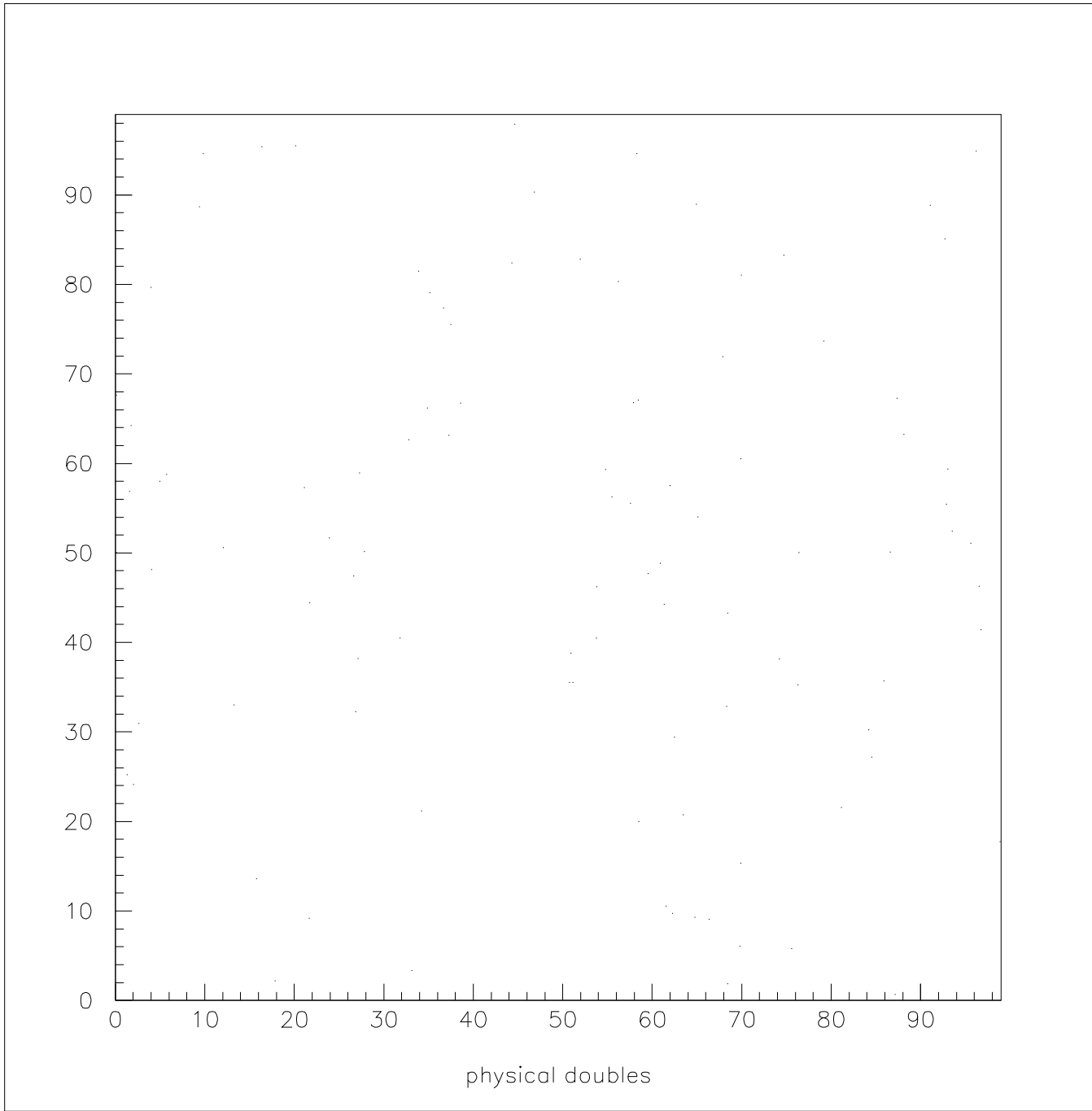


Figure 2: Optical + 0.2 fraction of physical doubles separated by 20 units.
Volume = 100x100x100

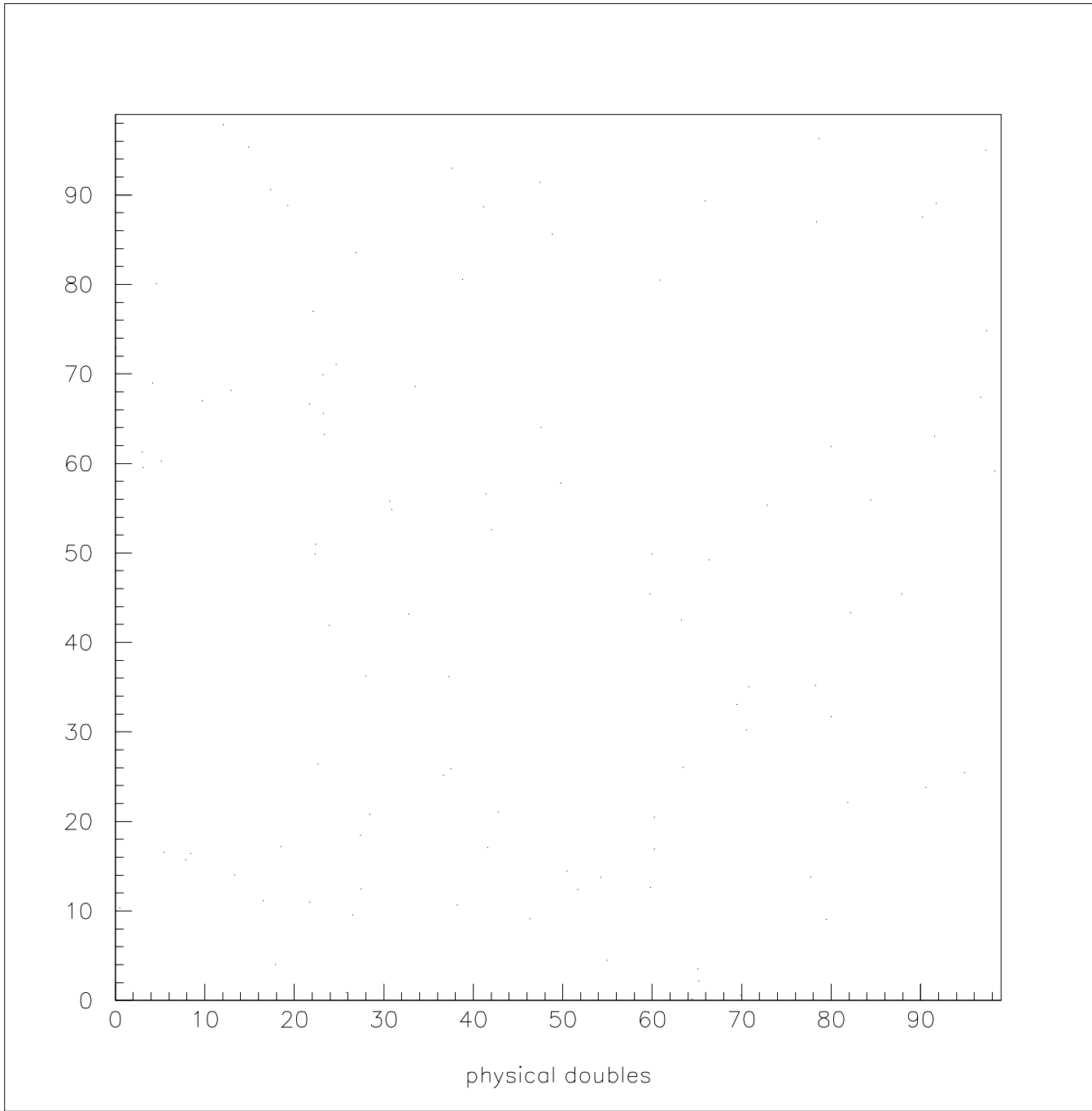


Figure 3: Optical + 0.5 fraction of physical doubles separated by 20 units.
Volume = 100x100x100.