

寿命关联实验的重要性*

彭桓武

近年来量子理论的统计解释又为少数物理学者所质问。在极少数实验工作中，我们可以提到 Janossy 在匈牙利领导进行的实验工作。

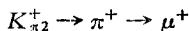
因为量子理论探索微粒子的自然规律，自然而然地引入统计概念——所谓量子系统。问题是量子系统供给微粒子原则上完全的描述呢？还是它只供给原则上不完全的描述？这种描述是代表某种更基本的完全描述的上层构造。

更多的实验工作将有助于解决这问题。考虑到近代物理实验技术的发展，我以为串级衰变过程中上一代衰变的真正寿命和下一代衰变的真正寿命两者之间有无关联的现象是可以实验研究的，而且很值得做实验研究。令 t_1 和 t_2 代表一具体事例中上一代衰变 $A \rightarrow B$ 的真正寿命和下一代衰变 $B \rightarrow C$ 的真正寿命。在测量大量事例后用统计计算算出上一代衰变的平均寿命 $\langle t_1 \rangle$ ，下一代衰变的平均寿命 $\langle t_2 \rangle$ ，和接连两代衰变间的寿命关联系数

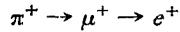
$$C = \frac{\langle (t_1 - \langle t_1 \rangle)(t_2 - \langle t_2 \rangle) \rangle}{\langle t_1 \rangle \langle t_2 \rangle}.$$

如有足够大量的事例，统计误差也可以计算出，这样就能够确定地回答究竟存在寿命关联与否。按迄今为止的看法，量子理论预言两代衰变之间寿命不关联。这确定的预言可能为上述确定的实验结果证实或者推翻。如果真有寿命关联，因此迄今为止的量子系统供给不完全的描述，它的实验发现对今后理论进展必将有重大意义。

原子核的 $\beta - \beta$ ， $\beta - \gamma$ 或 $\gamma - \gamma$ 型的串级跃迁，可能有适宜做寿命关联实验的，不必在此一一枚举。关于基本粒子的串级衰变我特别提起



及



这儿实验结果可能更可靠些，而理论推理也可能更清楚些。

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IMPORTANCE OF LIFE TIME CORRELATION EXPERIMENTS

PENG HWAN-WU

In recent years the statistical interpretation of quantum theory has again been questioned by some physicists. Among the very few experimental works done we may mention that led by Janossy in Hungary.

Because quantum theory aims at natural laws for microscopic particles, statistical concept (called quantum ensemble) is naturally involved. The question is whether the quantum ensemble affords in principle a complete description for the microscopic particles or it affords in principle only an incomplete description which represents the top structure of certain more fundamental and complete description for the microscopic particles.

It seems to me that more experimental work may help to decide this question. Thanks to modern development of experimental technique I think that experiments on the possible correlation between the actual life times of two successive decays can be made and may be well worth it. Let t_1 and t_2 denote, for a certain individual event, the actual life time of the parent decay $A \rightarrow B$ and that of the daughter decay $B \rightarrow C$. After measuring a large number of individual events we can obtain by statistical calculation the average life time $\langle t_1 \rangle$ for the parent decay, the average life time $\langle t_2 \rangle$ for the daughter decay, and also the correlation coefficient

$$C = \frac{\langle (t_1 - \langle t_1 \rangle)(t_2 - \langle t_2 \rangle) \rangle}{\langle t_1 \rangle \langle t_2 \rangle}.$$

With a sufficient large number of events statistical errors can be calculated, so that a definite answer to the question of existence or non-existence of correlation can be made. Of course, according to present view, quantum theory predicts that no correlation between the successive life times should exist. This definite prediction can be verified or disproved by the above experiment which yields also definite result. If indeed life time correlation exists and therefore the present day quantum ensemble affords an incomplete description for microscopic particles, then its experimental discovery may prove to be very important for further theoretical development.

It is unnecessary to mention the very many cascade nuclear transitions of $\beta - \beta$, $\beta - \gamma$ or $\gamma - \gamma$ types that may be used for the above purpose. Concerning the cascade decay of elementary particles we mention specially the cases of $K_{\pi 2}^+ \rightarrow \pi^+ \rightarrow \mu^+$ and $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ where experimental results may be more reliable and where theoretical reasoning may be less ambiguous.