The New Boson N

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Abstract

The elementary particles that make up the universe can distinguish in particle-matter, of a fermionic type (quark, neutrino and neutrino, mass-equipped) and force-particles, bosonic type, carrying the fundamental forces in nature (photons and gluons, , And the W and Z bosons, endowed with mass). The Standard Model contemplates several other unstable particles that exist under certain conditions for a variable time, but still very short, before decaying into other particles. Among them there is at least one Higgs boson, which plays a very special role. The bosonic N, is an elementary discovery discovery thanks to various electronic devices and sensors. All this is a physical-electronic theoretical study. This particle seen on the oscilloscope has a different shape from the other, in particular it moves by looking at the oscilloscope and has a round shape.

Keywords Boson;particles;

1. Introduction

In particle physics, an elementary particle or fundamental particle is a particle whose substructure is unknown; thus, it is unknown whether it is composed of other particles. Known elementary particles include the fundamental fermions (quarks, leptons, antiquarks, and antileptons), which generally are "matter particles" and "antimatter particles", as well as the fundamental bosons (gauge bosons and the Higgs boson), which generally are "force particles" that mediate interactions among fermions. A particle containing two or more elementary particles is a composite particle. Everyday matter is composed of atoms, once presumed to be matter's elementary particles—atom meaning "unable to cut" in Greek—although the atom's existence remained controversial until about 1910, as some leading physicists regarded molecules as mathematical illusions, and matter as ultimately composed of energy. Soon, subatomic constituents of the atom were identified. As the 1930s opened, the electron and the proton had been observed, along with the photon, the particle of electromagnetic radiation. At that time, the recent advent of quantum mechanics was radically altering the conception of particles, as a single particle could seemingly span a field as would a wave, a paradox still eluding satisfactory explanation. quantum theory, protons and neutrons were found to contain quarks—up quarks and down quarks—now considered elementary particles. And within a molecule, the electron's three degrees of freedom (charge, spin, orbital) can separate via wavefunction into three quasiparticles (holon, spinon, orbiton). Yet a free electron—which, not orbiting an atomic nucleus, lacks orbital motion—appears unsplittable and remains regarded as an elementary particle.

2. Methodology

this project I have used a various instrumentation to get to discover the N boson,

This was a great discovery in the field of physics and electronics because I used an oscilloscope and created an electronic board that made the detector a sort of hunt for a new boson with a particular sensor.

Physics and electronics are great for a search like that of the bosons, I can say that the methodology is innovative because it unveiled a new boson thanks to a circuit designed by me.

There was a chance on a billion that I could unveil a boson with a shape different from the others.

the instrumentation was:

- **Oscilloscope**
- **probes**
- **breadboard**
- **capacitor**
- **resistance,**
- **integrated operational amplifier (LM741),**
- **Particle sensor.**

3. Data Analysis

From the oscilloscope i took the boson measure the volts were exactly 5V / divison while the time was 5Time / div, with a frequency by 0.00454Khz.

In the photos I will attach to you will have all the details of the form and the data.

4.Results

The result was surprising because after repeatedly repeating the experiment to make sure it was not a mistake, we saw that the boson was really there, thanks to my circuit. The feeling of having discovered in the school didactic laboratory a boson of optimal characteristics, with different shape that was moving, is all for me, I am proud of the result obtained.

there is a new equations that called: field of Nascimbene.

5.Equations

In order to derive the necessary condition for the appearance of the generalized HOM dip for an even number of bosons, we calculate the output state (9) of the system under the condition of the collection of one particle per output port. Each term contributing to the projected conditional output state $|\phi_{\text{pro}}\rangle$ can be characterized by a certain permutation, which maps the particles in the input ports 1,2,...,*N* to the output ports 1,2,...,*N*. In the following, we denote any of the *N*! permutations by σ with σ(*i*) being the *i*th element of the list obtained, when applying the permutation σ onto the list {1,2,...,*N*}. Using this notation, $|\phi_{\text{pro}}\rangle$ equals up to normalization

$$|\phi_{\text{pro}}\rangle = \sum_{\sigma}\left[\prod_{i=1}^{N} U_{\sigma(i)i} b^{\dagger}_{\sigma(i)}\right]|0\rangle. \tag{14}$$

The norm of this state has been chosen such that

$$P_{\text{coinc}} = \| |\phi_{\text{pro}}\rangle \|^2 \tag{15}$$

is the probability to detect one particle per output port. It is therefore also the probability for observing coincidence counts in all *N* detectors.

Up to now, the nature of the particles has not yet been taken into account. Using the commutation relation (1) for bosons, the conditional output state (14) becomes

$$|\phi_{\text{pro}}\rangle = \text{perm}U \cdot \prod_{i=1}^{N} b_i^{\dagger}|0\rangle, \tag{16}$$

with the permanent of the matrix *U* defined as [37, 38]

$$\text{perm}U \equiv \sum_{\sigma}\prod_{i=1}^{N} U_{\sigma(i)i}. \tag{17}$$

The permanent of a matrix is superficially similar to the determinant. However, there exist hardly any mathematical theorems that can simplify the calculation of the permanent of an arbitrary matrix.

To derive a condition for the impossibility of coincidence detections, we have to see when the probability (15) equals zero. Using equation (16), we find

$$P_{\text{coinc}} = |\text{perm}\, U|^2. \tag{18}$$

The key to the following proof is to show that the transition matrix U of the Bell multiport possesses a certain symmetry such that its permanent vanishes in certain cases. Suppose the matrix U is multiplied by a diagonal matrix Λ with matrix elements

$$\Lambda_{jk} \equiv \omega_N^{j-1} \delta_{jk}. \tag{19}$$

This generates a matrix ΛU with

$$(\Lambda U)_{ji} = \sum_{k=1}^{N} \Lambda_{jk} U_{ki} = \Lambda_{jj} U_{ji} = \frac{1}{\sqrt{N}} \omega_N^{(j-1)i}. \tag{20}$$

We now introduce the modulus function defined as $\text{mod}_N(x) = j$, if $x - j$ is dividable by N and $0 \le j < N$. Since $\omega_N^N = \omega_N^0 = 1$, the matrix elements (20) can be expressed as

$$(\Lambda U)_{ji} = \frac{1}{\sqrt{N}} \omega_N^{(j-1)(\text{mod}_N(i)+1-1)}. \tag{21}$$

Note that the function $\tilde{\sigma}(i) = \text{mod}_N(i) + 1$ maps each element of the list $\{1,2,\ldots, N-1,N\}$ respectively to the list $\{2,3,\ldots, N,1\}$. A comparison with equation (6) therefore, shows that

$$(\Lambda U)_{ji} = U_{j\tilde{\sigma}(i)}. \tag{22}$$

In other words, multiplication with Λ amounts to nothing more than a cyclic permutation of the columns of the matrix U. Taking the cyclic permutation symmetry of the permanent of a matrix (see definition (17)) into account, we obtain

$$\text{perm} U = \text{perm}\, (\Lambda U). \tag{23}$$

However, we also have the relation

$$\text{perm}(\Lambda U) = \text{perm}\, \Lambda \cdot \text{perm} U. \tag{24}$$

with the permanent of the diagonal matrix Λ given by

$$\text{perm}\, \Lambda = \prod_{k=1}^{N} \omega_N^{k-1} = \omega_N^{\sum_{k=1}^{N} k} = \omega_N^{N(N+1)/2} = e^{i\pi(N+1)} = \begin{cases} 1, & \text{if } N \text{ is odd}, \\ -1, & \text{if } N \text{ is even}. \end{cases} \tag{25}$$

For N being even, a comparison of equations (23)–(25) reveals that

$$\text{perm} U = -\text{perm} U = 0. \tag{26}$$

As a consequence, equation ([18](#)) implies that $P_{\text{coinc}} = 0$. Coincidence detection in all output ports of the setup is impossible for an even number of bosons. This is not necessarily so if the number of particles is odd. For example, for $N = 3$, one can check that there is no HOM dip by calculating perm U explicitly. Campos showed that observing a HOM dip for $N = 3$ is nevertheless possible, with the help of a specially designed asymmetric multiport beam splitter [17].

5.1. Fermionic particles

Fermions scattering through a Bell multiport beam splitter show another extreme behaviour. Independent of the number N of particles involved, they always leave the setup via different output ports, thereby guaranteeing perfect coincidence detection. As expected, particles obeying the quantum statistics of fermions cannot populate the same mode.

Again, we assume that each input port is simultaneously entered by one particle and denote the creation operator of a fermion in output port i by $b_i^\dagger$. Proceeding as in section one finds again that the output state of the system under the condition of the collection of one particle per output port is given by equation . To simplify this equation, we now introduce the sign function of a permutation with sgn(σ) = ±1, depending on whether the permutation σ is even or odd. An even (odd) permutation is one that can be decomposed into an even (odd) number of integer interchanges. Using this notation and taking the anticommutator relation for fermions ([2](#)) into account, we find

$$|\phi_{\text{pro}}\rangle = \sum_{\sigma} \text{sgn}(\sigma) \left(\prod_{i=1}^{N} U_{\sigma(i)i} b_i^\dagger \right) |0\rangle. \qquad (27)$$

A closer look at this equation shows that the amplitude of this state relates to the determinant of the transformation matrix given by

$$\det U = \sum_{\sigma} \text{sgn}(\sigma) \prod_{i=1}^{N} U_{\sigma(i)i}. \qquad (28)$$

Since U is unitary, one has $|\det U| = 1$ and therefore also, as equation shows,

$$P_{\text{coinc}} = |\det U|^2 = 1. \qquad (29)$$

This means that fermions always leave the system separately, i.e. with one particle per output port. In the above, we only used the unitarity of the transition matrix U, but not its concrete form. Perfect coincidence detection therefore applies to any situation where fermions pass through an $N \times N$ multiport, i.e. independent of its realization.

We analysed a situation where N particles enter the N different input ports of a symmetric Bell multiport beam splitter simultaneously. If these particles obey a fermionic quantum statistics, they always leave the setup independently with one particle per output port. This results in perfect coincidence detection, if detectors are placed in the output ports of the setup. In contrast to this, an even number N of bosons have been shown to never leave the setup with one particle per output port. This constitutes a generalization of the two-photon HOM dip to the case of an arbitrary even number N of bosons. The generalized HOM dip is in general not observable, when N is odd.

The proof exploits the cyclic symmetry of the setup. We related the coincidence detection in the output ports to the permanent or the determinant of the transition matrix U describing the multiport, depending on the bosonic or fermionic nature of the scattered particles. Although the definition of the permanent of a matrix resembles that of the determinant, there exist almost no theorems to simplify their calculation In fact, the computation of the permanent is an NP-complete problem and much harder than the calculation of a determinant, which is only a P problem in complexity. Experimental setups involving the scattering of bosons through a multiport therefore have important applications in quantum information processing.

For example, part of the linear optics quantum computing scheme by Knill *et al* is based on photon scattering through a Bell multiport beam splitter. In contrast to this, the scattering of non-interacting fermions through the same corresponding circuit can be efficiently simulated on a classical computer Moreover, the quantum statistics of particles has been used for a variety of quantum information processing tasks such as entanglement concentration and entanglement transfer . Completely new perspectives might open when using setups that can change the quantum behaviour of particles and convert, for example, photons into fermions .

Finally, we remark that observing HOM interference of many particles is experimentally very robust. Our results can therefore also be used to verify the quantum statistics of particles experimentally as well as to characterize or align an experimental setup. Testing the predicted results does not require phase stability in the input or output ports nor detectors with maximum efficiency. The reason is that any phase factor that a particle accumulates in any of the input or output ports contributes at most to an overall phase factor of the output state $|\phi_{out}\rangle$. However, the coincidence statistics is sensitive to the phase factors accumulated inside the multiport beam splitter, as they affect the form of the transition matrix (6). The case where the input ports of the setup are not entered by perfect one-particle states but by mixtures containing also a vacuum component can be analysed, in principle, using the methods introduced by Berry

6. Conclusion

The boson was discover with success and I would like to thank the maserati institute for giving this opportunity and thanks to all my teachers (team).

6. References

Author's information's

My name is Luca Nascimbene, i am a student and research in physics and electronics in the high school for institute technology A.Maserati of Voghera province Pavia in Italy.

7.Photos