

The Eternal Evolution of Quantum Theory (A Brief Note on Quantum Optics)

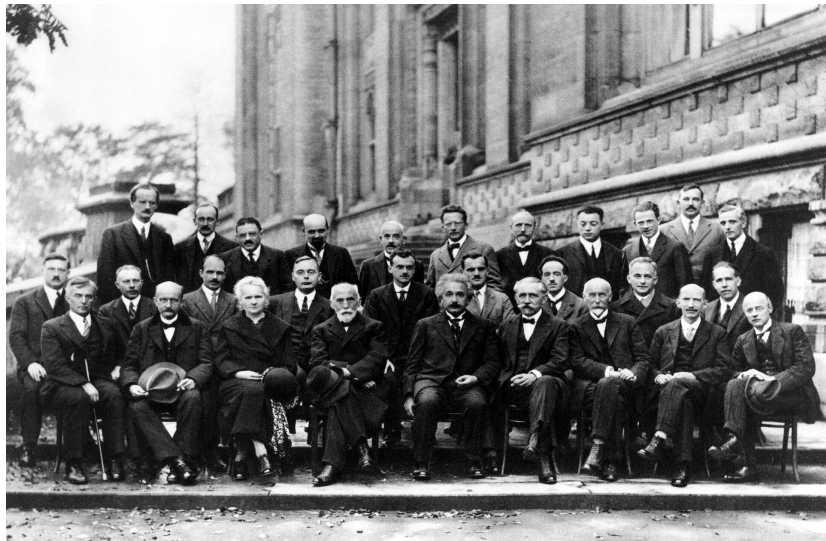
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Let's begin!! A quite famous photograph...



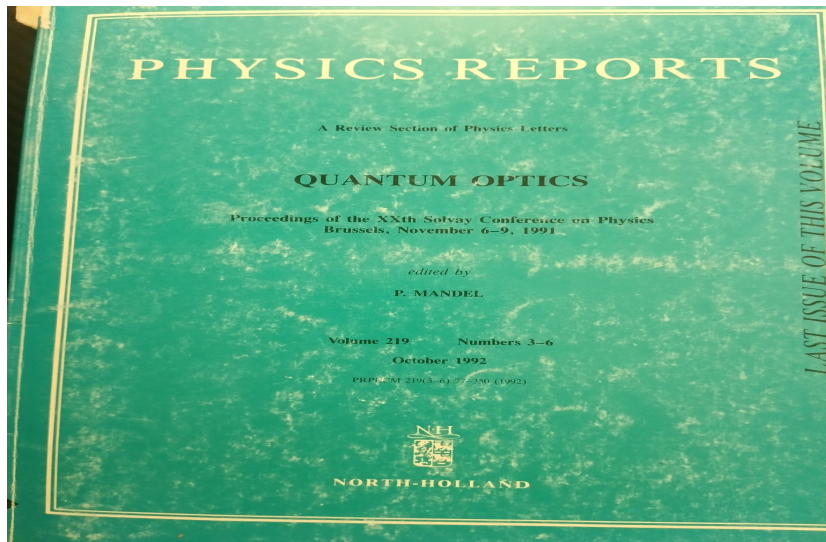
5th (1927) Solvay Conference - "Radiation Theory and the Quanta"

A. Piccard, E. Henriot, P. Ehrenfest, E. Herzen, Th. De Donder, E. Schrödinger, J.E. Verschaffelt, W. Pauli, W. Heisenberg, R.H. Fowler, L. Brillouin; P. Debye, M. Knudsen, W.L. Bragg, H.A. Kramers, P.A.M. Dirac, A.H. Compton, L. de Broglie, M. Born, N. Bohr; I. Langmuir, M. Planck, M. Skłodowska-Curie, H.A. Lorentz, A. Einstein, P. Langevin, Ch. E. Guye, C.T.R. Wilson, O.W. Richardson

Quantum Optics Books

- **Rodney Loudon: The Quantum Theory of Light**
- **Marlan O. Scully - M. Suhail Zubairy: Quantum Optics**
- **Mark Fox: Quantum Optics An Introduction**

Physics Reports



Another photo not so famous, but quite important and relevant to our meeting!!!



20th (1991) Solvay Conference - "Quantum Optics"



1. P. Meystre, 2. A. Aspect, 3. M.O. Scully, 4. C. Cohen-Tannoudji, 5. J.A. Kimble, 6. I. Prigogine, 7. H. Walther, 8. A. Abragam, 9. S.C. Tsouvar, 10. C. Fabre, 11. R. Grangier, 12. C.O. Weiss, 13. D. Vergara, 14. C. Etrich, 15. C. Demol, 16. M. Georgiou, 17. P. Knight, 18. L. Mandel, 19. T. Erneux, 20. S. Tasaki, 21. M. San Miguel, 22. T. Petrosky, 23. R.D. Li, 24. J. Mlynek, 25. Y. Yamamoto, 26. N.B. Abraham, 27. M. Thidi, 28. H.P. Yuen, 29. K. Ikeda, 30. A.N. Oraevsky, 31. H.J. Carmichael, 32. R. Loudon, 33. A. Imamoglu, 34. E. Sudarshan, 35. R. Roy, 36. E. Arimondo, 37. R. Passante, 38. R. Harrison, 39. L.A. Lugiato, 40. Ya.I. Khanin, 41. H. Winful, 42. O. Kocharovskaya, 43. P. Grégoire, 44. C. Joachain, 45. W. Firth, 46. A. Vlassenbroeck, 47. P. Kumar, 48. P.W. Milonni, 49. F.T. Arecchi, 50. J. Jeener, 51. K. Otsuka, 52. J. Dalibard, 53. R. Glauber, 54. H. Reichenberg, 55. P. Glorieux, 56. P. Mandel, 57. S. Haroche, 58. W. Hebel, 59. W. Lange, 60. S. Stenholm, 61. M. Finck, 62. W.C. Schieve, 63. L. Frommhold, 64. W. Schleich, 65. M. Henneaux, 66. N. Pettaux, 67. M.J. Collett, 68. I. Antoniou, 69. P. Coulet, 70. D. Carati, 71. P. Mussche.

Some recent Nobel Laureates in the list of participants

- 1 Nobel 1977: Ilya Prigogine
- 2 Nobel 1997: Claude Cohen-Tannoudji
- 3 Nobel 2005: Roy J. Glauber
- 4 Nobel 2022: Alain Aspect

Nobel 1977: Ilya Prigogine

Ilya Prigogine - 1977

Prize motivation: “for his contributions to non-equilibrium thermodynamics, particularly the theory of dissipative structures”

Nobel 1997: Claude Cohen-Tannoudji

Claude Cohen-Tannoudji - 1997

Prize motivation: “for development of methods to cool and trap atoms with laser light”

Nobel 2005: Roy J. Glauber

Roy J. Glauber - 2005

Prize motivation: “for his contribution to the quantum theory of optical coherence”

Nobel 2022: Alain Aspect

Alain Aspect - 2022

Prize motivation: “for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science”

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Welcome address

This is a special occasion as it is the 80th anniversary of the Solvay conferences.

The first Solvay conference on Physics took place on the 30th of October 1911. Its theme was "Radiation Theory and the Quanta". It is an interesting coincidence that the subject of the 20th Solvay conference "Quantum Optics" is the natural continuation of the first one!

Quantum theory has played quite a special role in the history of the Solvay Institutes. As you know, at the beginning of the century, there appeared fundamental discrepancies between classical theory and experimental data.

It was this problem which led Ernest Solvay to the creation of the Solvay Institutes of Physics and Chemistry. He hoped that international meetings on the highest level would, through reports and discussions, foster progress. Looking back to the past, I believe that his hopes were largely fulfilled. Everybody has seen photographs of the first Solvay meeting showing Marie Curie, Planck, Poincaré, Einstein among many others.

Today, it may be difficult to bring such a constellation together but the problems remain as fascinating as ever. Quantum theory is more than ever at the core of the description of nature. In fact, it would be difficult to quote a single Solvay conference in which quantum theory would not have played an essential role.

Still this conference has some unique features. Experimentation on quantum optics has made spectacular progress. It is possible to isolate single atoms and to study their behavior. Moreover, quantum optics is both of fundamental importance in terms of application and as a tool to reach out for a better understanding of the basic laws of nature.

From this point of view, it is quite interesting that quantum optics deals with nonequilibrium processes. How to include dissipation into the basic laws of nature still remains a subject of continued interest.

In a recent book edited by Paul Davies: *The New Physics* (Cambridge University Press, 1989), I read: "... At rock bottom, quantum mechanics provides a highly successful procedure for predicting the results of observations on microsystems, but when we ask what actually happens when an observation takes place we get nonsense! Attempts to break out of this paradox range from the bizarre, such as the many universe interpretation of Hugh Everett, to the mystical ideas of John von Neumann and Eugene Wigner, who invoke the observer's consciousness. After half a century of argument, the quantum observation debate remains as lively as ever." It may be amusing to recall that the quantum observation debate started at the fifth Solvay conference in 1927. This was the moment of the famous Einstein-Bohr debate to which many participants, including Heisenberg and Dirac contributed. I would

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Welcome address

like to express the hope that the discussions at the 20th Solvay meeting will shed a little more light on this problem.

My wife and I are looking forward to having most of you for a buffet dinner at home Friday night. You will be able to tell me if this conference had indeed fulfilled the expectations of Ernest Solvay.

J. Solvay
Bruxelles, November 6, 1991

Therefore our photo ready for comments!!!



EYXAPICHTΩ ΠΟΛΥ!!

Thank you very much!!

Obrigado Muito!!

Muchas Gracias!!