



Figure 1 | State surveillance. **a**, As a stream of rubidium atoms passes through a mirror-walled cavity filled by a coherent light field in Guerlin and colleagues' experiment², the atomic 'clocks' are disturbed according to the number of photons present in the light field. The probability for different photon numbers is initially evenly distributed between the possible outcomes (none to seven photons), but 'collapses' to a definite value as more and more atoms pass through — to five, in this case. **b**, A different measurement of the same state collapses to a different photon number — seven. **c**, By repeating the same measurement over and over again, an overall (poissonian) probability distribution for the number of photons in the initial coherent light field can be gathered. (Figure modified from ref. 2.)

interaction of the atom with the electromagnetic field is complete. Second, the interaction with the classical part must not contribute significantly to the total error of the measurement. Finally, there should be no fundamental constraint on the precision of a measurement: in quantum-mechanical terms, the phase of the electromagnetic field (which according to the uncertainty principle is the 'canonical conjugate' of the number of photons) should be maximally perturbed by the measurement in order to measure the photon number accurately.

Each individual measurement in this process gives only one answer about the number of photons in the coherent state. As the measurement process is started, these answers are uniformly (randomly) distributed among the possible values, but as the measurement progresses and more and more atoms are sent through the light field, the answer converges (collapses) to a particular value. Starting the process all over again with a freshly trapped, but identically prepared, light field, the measurement converges again to a different number. By repeating the measurement process again and again, the distribution of the number of photons in the initial

coherent state can be reconstructed (Fig. 1).

The ability to follow a quantum measurement stage by stage as the wavefunction collapses opens up broad avenues of approach to fundamental questions that were previously accessible only in simulations. The process of measurement might now be manipulated to steer a system to a particular final state using quantum feedback or to explore conditional quantum dynamics — using the outcome of a measurement to determine a system's evolution. The Parisian team is uniquely placed to advance farther into the quantum jungle, a largely unexplored area where new species of Schrödinger's cat rub shoulders with exotic 'quantum butterflies' — flighty states that flutter between values when disturbed by measurement, only to settle down to rest again. ■

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1. Gleyzes, S. et al. *Nature* **446**, 297–300 (2007).
2. Guerlin, C. et al. *Nature* **448**, 889–893 (2007).
3. Raimond, J. M., Brune, M. & Haroche, S. *Rev. Mod. Phys.* **73**, 565–582 (2001).
4. Braginsky, V. B. & Khalili, F. Y. *Quantum Measurement* (Cambridge Univ. Press, 1995).



50 YEARS AGO

On the Beach by N. Shute —

THE theme of "On the Beach" is the extinction of the human race resulting from an atomic war. Everybody dies. Just that. When the novel opens in Melbourne, 1962, nobody is alive in the northern hemisphere. Movements of the atmosphere are steadily carrying lethal particles southwards. Mr Shute has deployed his remarkable imagination as engineer, naval officer and storyteller... On his immense popular following this book can only inflict a haunting distress: one takes off one's hat to him. Mr Shute has limited his canvas: he has taken only five main characters—five very ordinary people at that; and he has pitched the emotional and dramatic tone invariably low. Until the moment when the radiation sickness comes on, everybody sticks to the tamest of domestic preoccupations; and then quietly takes a suicide pill. The effect is hypnotic and also odd. Mr Shute's world ends not, as the epigraph warns, with a whimper, but with a stoical silence, movingly impressive... The moral in so far as Mr Shute states it explicitly, comes via his characters thus: "Maybe we've been too silly to deserve a world like this"...

From *Nature*, 24 August 1957.

100 YEARS AGO

According to *Engineering*, an Australian record in wireless telegraphy has been achieved by the successful transmission of messages from H.M.S. *Challenger*, one of the Australian squadron at present stationed in Hobson's Bay, to the flagship *Powerful*, which at the time was moored in Farm Cove, Port Jackson. The *Challenger* was in communication with the flagship by means of wireless telegraphy the whole of her voyage. The longest message was one flashed over a distance of 410 miles in a direct line, and this constitutes an Australian record, as previously never more than 240 miles had been achieved by warships on the Australian station. From *Nature*, 22 August 1907.

50 & 100 YEARS AGO