Contribution ID: **7** Type: **oral**

The quantum first detection problem: from the energy spectrum to the detection probabilities

Wednesday, 6 September 2017 12:00 (15 minutes)

We consider the question of when a quantum system initially prepared in state A first "arrives" in state B, i.e. the first arrival problem in quantum physics.
To determine the arrival, the observer attempts to detect the system stroboscopically with fixed period via a projective measurement.
The time of the first successful detection attempt is the first detection time.
The corresponding probability of the event is the first detection probability.
For systems with a continuous energy spectrum, this quantity can be expressed in terms of the spectral measure of the evolution operator (which is related to the density of energy states).
This allows us to present an exact formula for the total probability of detection and to derive the long-time asymptotic behavior of the first detection probabilities.
It is shown that the latter decays like a power law with superimposed oscillations.
The exponent of the power law is determined by the spectral (or fracton) dimension of the spectral measures.
The total probability of detection is always less than unity.

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Session Classification: Session 9