Does Heisenbergs Uncertainty Relation really limit the precision of Quantum Measurements?

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In his famous paper[1] of 1927 Heisenberg discussed the simultaneous measurement of position and momentum of a single particle and comes to the conclusion that only one observable (e.g. position) can be measured with ultimate precision $\langle\Delta x\rangle$ while the precision of it's conjugated observable (e.g. momentum) $\langle\Delta p\rangle$ becomes increasingly uncertain according to Heisenberg's famous formula $\langle\Delta p\rangle \bullet \langle\Delta x\rangle > \hbar$. Later on in his long publication it becomes evident that his Uncertainty Relation (UR) describes only the expectation values of an ensemble of identical particles and is never applicable to the measurement of the position of a single particle at a given time.

A quantum measurement is always generated by a huge number of single event measurements (event after event) where the experimentally achievable uncertainties Δx and Δp in a single event measurement are practically not affected by Heisenberg's uncertainty relation but only by the properties of the experimental apparatus. Furthermore in a single scattering event only dynamical parameters (like momenta) can be measured with sub-atomic resolution but never the position of a particle at a given time. Since the observable information must be transported from the reaction process to the classical detection device it is crucial that during this time of flight the information is conserved, which is in our example only true for the momentum of the particle. Position and also time are not conserved thus the precision of position and time measurement is strongly limited. The conservation of momentum is the principal premise for a high resolution quantum measurement.

The momentum measurement is performed e.g. by detecting the impact position of the freely moving scattered particle (e.g. electron) where the detector device can be mounted at any distance from the location of the scattering process. The experimenter determines on the basis of a classical trajectory, justified by the imaging theorem, the scattering angle and time-of-flight (TOF) of the particle thus its momentum. The position resolution Δx of the advanced detector can be made better than 10 a.u. and the momentum resolution Δp in all three dimensions even smaller than 10^{-4} a.u. thus the product $\Delta x \bullet \Delta p$ can be made smaller than 10^{-3} $\hbar$. The momentum history of this particle looking backward into the past can be reconstructed as in classical physics with sub-atomic resolution.

Heisenbergs UR limits in a scattering experiment only the preparation of the initial states of projectile beam and target. Their expectation values of momentum and position obey the UR. The preparation of the momentum distribution in the initial state, however, can be made much better than 1 a.u., whereas the position of the projectiles is limited by diffraction in slits and can never be smaller than some a.u..

Finally Heisenberg proposed several "Gedankenexperimente" (γ-microscope, α-particle microscope and methods for velocity measurements) to achieve ultimate position resolution. All these proposed approaches violate physical principles and are thus not performable.

[1)] W. Heisenberg, Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik, Zeit. f. Phys., 43, Nr. 3, S. 172–198, (1927)