On the finite energy weak solutions to a system in Quantum Fluid Dynamics

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In this paper we consider the global existence of weak solutions to a class of Quantum Hydrodynamics (QHD) systems with initial data, arbitrarily large in the energy norm. These type of models, initially proposed by Madelung [M], have been extensively used in Physics to investigate Superfluidity and Superconductivity phenomena and more recently in the modeling of semiconductor devices. Our approach is based on various tools, namely the wave functions polar decomposition, the construction of approximate solution via a fractional steps method which iterates a Schrödinger Madelung picture with a suitable wave function updating mechanism. Therefore several a priori bounds of energy, dispersive and local smoothing type allow us to prove the compactness of the approximating sequences. No uniqueness result is provided.

References

[M] Madelung E., Quantentheorie in hydrodynamischer form, Z. Physik, 40, 322 (1927).