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To whom it may concern,

This is an evaluation of the scientific work included in the mémoire d'Habilitation of **Floernt Berthelin.** The work presented consists of 15 articles which were published in leading journals including JDEs, ARMA, KRM, M3AS and SIMA. There is a body of work which can be divided into several main topics.

- *Kinetic descriptions, primarily BGK models for isentropic flows*. In this series of works, Berthelin provides a systematic study for the existence of BGK solutions [1], their relaxation limit towards one-dimensional entropy solutions, using the entropic structure of BGK models based on a family or just one entropy [2,4], and the proper passage to a limit with the boundary conditions [3]. In [5], Berthelin uses the relative entropy method to justify the relaxation limit for smooth solutions of the *mutli-dimensional* isentropic equations. The results employ clever and original approaches, using classical and modern tools of energy estimates, invariant regions, compensated compactness arguments and velocity averaging.

- *Other Kinetic descriptions and their macroscopic limit*. Here I group several works of Berthelin which deal with nonlinear PDEs through various types of their kinetic descriptions. The work in [6] proves the relaxation limit of discrete velocity Boltzmann model for *smooth* solutions of one-dimensional compressible Euler equations. This is a generalization of the Caflisch-Papanicolaou result for the Broadwell model, which is accomplished using the relative entropy method employed earlier in [5]. The work in [7] is a novel treatment of a Vlasov-type description for nonlinear conservation laws with possibly *variable coefficients.* The passage to a limit in the case of one spatial dimensional was handled here using compensated compactness. The extension to multi-dimensional transport with Vlasov-type terms is raised in [8] by improving the velocity averaging with Vlasov-type forcing terms. The recent work [13] derives a new class of different multi-water-bag-type models which are solved by discontinuous Galerkin methods.

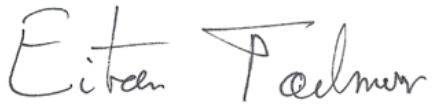
- *Models with constraints*. The works [9-12] discuss different conservative models which are augmented by pointwise constraints. In [9], Berthelin study a ``saturated" *pressureless* model where the pressure vanishes except when the volume fraction of two gases saturate at 1. Existence and are consequence of a sticky particles descriptions and entropic stability is realized in terms of a one-sided Lip condition. The extension to the case with pressure is presented in [10]. A closely related class of AR-type models for

traffic jams is investigated in [11,12]: the pressureless case [11] was later improved into a more realistic model [12] where the offset velocity now depends on the velocity itself.

- *Convergence analysis of splitting methods for nonlinear equations*. In [15], Berthelin studies the numerical flux-splitting methods for the constrained system of [10]. The work [14] presents a systematic convergence result for the popular flux-vector splitting method for approximation of one-dimensional conservation laws, scalar equations and general 2x2 p-system. The approach taken here involves weak BV estimates and estimates on the corresponding kinetic splitting.

The following is self-evident from the works above. Berthelin attacks difficult problems, obtaining novel results using a variety of modern tools from applied nonlinear PDEs. The breadth of the problems he dealt with, in analysis, modeling and numerics, is impressive. Overall, this is an *excellent* research record and accordingly, I enthusiastically support **Florent Berthelin**, based on the work he presented, for a Diploma de l'Habilitation à Diriger des Recherches.

Sincerely,



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