Linear stability analysis of Israel-Stewart theory with shear, net charge, and non-zero background charge

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Based on: **J.S.**, M.Mayer, D.H.Rischke Phys.Rev. D107 (2022)

60th edition of the International Winter Meeting on Nuclear Physics
Bormio 22.01.2024

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CRC-TR 211 Strong-interaction matter under extreme conditions

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Motivation

- Why a stability analysis?
  - Stability analysis is needed to check if a theory is useful and applicable at all
  - First-order theory (Navier-Stokes) is acausal and unstable $\rightarrow$ inspired the development of second-order theories
  - IS theory is a stable and causal second-order theory for viscous fluid dynamics

Theory: stability and causality conditions

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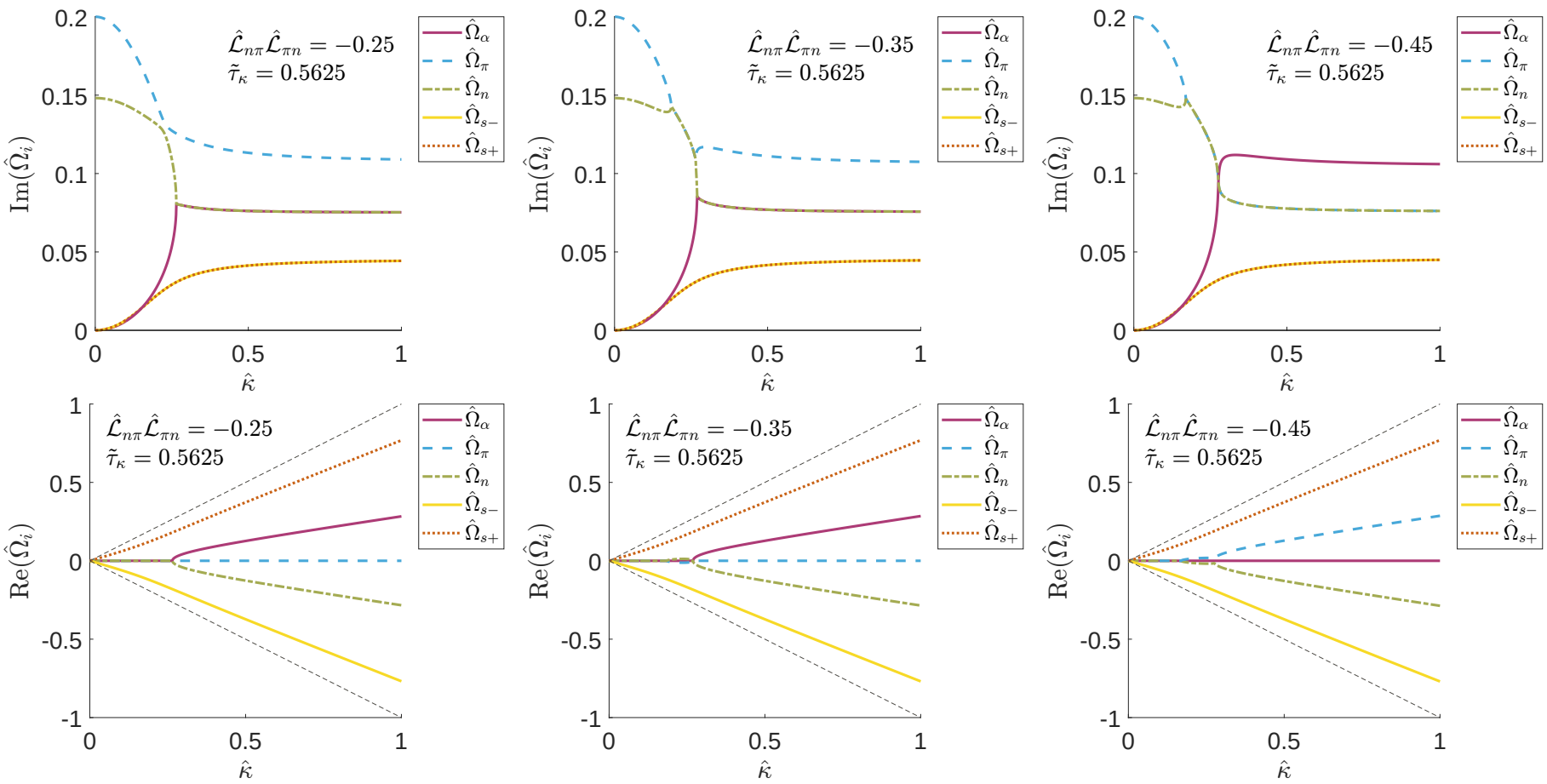
- Perturbation Ansatz $\sim \exp[i\omega t - ikx]$
  - Stable: the perturbation must not increase in time: $\mathcal{I}(\omega) > 0$
  - Causal: the asymptotic group velocity must be less than the speed of light: $\lim_{k\to\infty} \left|\frac{\partial \mathcal{R}(\omega)}{\partial k}\right| \leqslant 1$
  - Systematic investigation of parameters: details are on my Poster.
- How to do a stability analysis in detail: **J.S.**, M. Mayer, D. H. Rischke, Phys. Rev. D107 (2022)
- Theory: IS-Theory applied for massless partials with shear, net charge is done in C. Brito, G.S. Denicol, Phys. Rev. D102 (2020) **we extended this work to the case of non-zero background charge.**

Results:



- What the sound modes/hydrodynamics modes, charge modes and shear mode are doing there?????? → POSTER!

Results: systematically investigation of parameter