## An introduction to the theory of waves in plasmas. (Ravello, September 1914)

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The goal is to propose an elementary introduction to the theory of waves in plasmas. Even with the most careful selection of the topics covered, of course, it is impossible to give in a few lectures an overview in any way complete of this theory. This introduction, therefore, is conceived instead as "guideline" to a subsequent deeper study. We will try, therefore, to illustrate the structure and physical content of the models on which the theory is based, and to clarify as much as possible the limits of their applicability, rather than giving details of the derivations and/or the solution of the equations used. Although by necessity only uniform infinite plasmas will be considered, the point of view appropriate to applications to real, finite plasmas will be adopted when important.

As far as the available time will allow, the lectures will be articulated as follows:

1) Elementary kinetic theory.

Microscopic and macroscopic descrition of a plasma: From th BBGK hierarchy to the Vlasov and Fokker-Planck equations. The moment hyerarchy: the fluid and MHD models. Alfv\'en waves (for later comparison with the hot-plasma theory)

- 2) Formulation of the electrodynamics in plasmas. The material equations in hot plasmas; Time and space dispersion; The dispersion relation and its meaning for real plasmas; Analytic properties of the conductivity tensor: The Kramers-Kroenig relations and the interconnection between dipersion, causality, and dissipation.
- 3) Plane waves in a uniform hot plasma. Schematic derivation of the conductivity tensor The cold and the small Larmor radius approximations Electrostatic waves in plasmas.
- 4) Power balance for hf waves in plasmas. Landau (and cyclotron) damping Elementary introduction to the Quasilinear theory Selfconsistency and validity range of the linear theory of waves in plasmas
- 5) A (very) rapid overview of plasma waves General form of the Dispersion Relation; Cutoffs and resonances, mode conversion; The different frequency ranges: Electron cyclotron Lower Hybrid Ion cyclotron Drift and MHD