PHYSICS CHALLENGES FOR FEEDBACK PROCESSES IN GALAXY FORMATION

PHYSICS CHALLENGES

Methodology: predict or fit observations ? physic confronts a theory to an experiment. Are we really doing this ?

Theory: solve ab-initio equation numerically. Does it make sense to model physics we can't compute/simulate ? (see next session)

Dark matter: wimps are dead, exotic dark matter, new physics

Gravity: is all done ? modified gravity. two-body effects in star cluster dynamics or SMBH pairing and merging, need to couple NBODY6 with GADGET, runaway/ walkaway stars and exact location for supernovae explosions

Fluid dynamics: radiative shocks, cooling length, sonic length, fields length, precipitation in the CGM, Large Eddy Simulations coupled to star formation models, coupled to microscopic physics, general problem of a multi-phase/multi-fluid gas

AGN feedback: resolve nuclear region (host star cluster, nuclear ISM physics), resolve accretion disk, resolve jet/outflow, model multi-wavelength radiation field, if not: subgrid models: energy/momentum injection

PHYSICS CHALLENGES

Feedback: resolving the cooling radius for supernovae, the Strömgren sphere for HII region, the photosphere (tau=1) for IR dominated regions. If not then subgrid models: decoupled wind, direct momentum injection: is it enough ? aren't we missing the multi-phase nature (temperature, density, velocity and mixing) of the gas, impact of core formation ?

MHD: small scale dynamos versus large scale field amplifications, LES generalised to MHD, star formation subgrid models with MHD

Cosmic rays: beyond a single average energy, multiple energy groups with multiple diffusion coefficients, results sensitive to parameters, predictability ?

Radiation (cooling and force) and chemistry: models for radiation transfer (beyond M1 and reduced speed of light), multiple energy band and multiple angular domains, self-shielding, reduction of cooling through soft X-rays, radiation force in UV and in IR, molecular and dust physics: from subgrid to background radiation to fully radiative molecular networks. BPT diagrams