UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Physics of Galaxy Clusters

86R-XXXV-PGC

Obiettivi

Corso introduttivo alla fisica degli ammassi di galassie.
L'obiettivo principale è quello di fornire una panoramica delle proprietà generali degli ammassi di galassie e dare una base di partenza per eventuali studi più approfonditi sui singoli argomenti.

Contenuti sintetici

Vedi programma esteso

Programma esteso

Title: PHYSICS OF GALAXY CLUSTERS

SETTING THE CONTEXT

- The observed Universe:
- Redshift definition and Hubble-Lemaitre law
- Redshift surveys
- Local Large Scale Structure (LSS): from the Milky-Way to Laniakea
- Definition of Group of Galaxies, Cluster of Galaxies, Supercluster, Void
- The primordial Universe and brief Universe’s history
- The simulated Universe: simulations of the LSS
- Motivation for the study of galaxy clusters

A MULTI-WAVELENGTH VIEW

- Hubble Diagram and the galactic content in clusters
- Morphology - density relation of galaxies
- Optical Cluster Catalogues and morphological classification from galactic content
- Total mass of clusters from the dynamics of the galaxies (virial theorem)
- Mass-to-light ratio
- Rotation curves in Sp galaxies
- Gravitational lenses: strong and weak lensing effect
- Introduction to the X-Ray Astronomy for galaxy clusters
- Properties of the Intra-Cluster Medium (ICM; cooling, heating)
- X-ray spectra of clusters
- Total mass from the ICM temperature and density profiles
- Matter composition of galaxy clusters
- Baryonic mass fraction
- Clusters mass function
- ICM entropy
- Metal content in the ICM and enrichment mechanisms

COOL-CORE CLUSTERS

- The core properties of dynamically relaxed clusters:
- Cooling time, density, temperature profiles
- Brightest Clusters Galaxies (BCG)
- Cooling flow and gas flow suppression (AGN feedback)
- Spitzer thermal conduction and turbulence
- Fate of the cooling gas

MERGERS IN CLUSTERS

- Properties of the dynamically un-relaxed clusters
- Mergers shocks: the Bullet cluster
- Shock kinematic, Rankine-Hugoniot jump conditions
- Energetic of clusters mergers
- Cold Fronts in un-relaxed clusters: merger cold fronts
- Cold fronts in relaxed clusters: gas sloshing
- Diffuse radio emission in clusters: halos, relics, mini-halos
- Group scale accretion in clusters outskirts
- Missing baryon problem and cluster outskirts

Prerequisiti

Modalità didattica

Video lezioni pre-registrate

Materiale didattico

Sarazin C. 1988,

Boehringer & Werner 2009

Biviano. A. 2000,

Borgani & Kravtsov 2009,

Hoekstra et al. 2013, “Masses of galaxy clusters from gravitational lensing”,

Mernier et al. 2018,

Peterson & Fabian 2006,

McNamara & Nulsen 2012,

Sarazin 2001,

Markevitch & Vikhlinin 2007, "Shocks and cold fronts in Galaxy Clusters",

Markevitch et al. 2002,

Clowe et al. 2006,

ZuHone & Roediger 2016,

Feretti et al. 2012,

Periodo di erogazione dell'insegnamento

Marzo-Aprile 2020

Modalità di verifica del profitto e valutazione

Esame orale

Orario di ricevimento

Per ogni informazione o domanda relativa al corso e/o agli argomenti svolti, contattare la docente direttamente all'indirizzo e-mail sabrina.degrandi@inaf.it