ASTRO 330 - GALAXIES / Fall 2010
University of Wisconsin Madison
Professor Matthew Bershady

==========

COURSE OUTLINE

I. Intro (Ch. 1, 2.4) - 5 lectures
II. Milky Way As Galaxy (Ch. 2) - 2 lectures
III. Gravity & Orbits (Ch. 3) - 3 lectures
IV. Disk-dominated systems (Ch. 5) - 4 lectures
V. Spheroidal-dominated systems (Ch. 6) - 3 lectures
VI. Dwarfs (Ch.4) - 3 lectures
VII. Structure on the largest scales (Ch. 7,8) - 3
VIII. AGN & Evolution (Ch. 9) - 3
IX. Future and Summary

I. Intro (Ch. 1) - 5 lectures

1. Galaxy overview

History
Definitions
Content, types, statistical properties
Large scale structure
Surveys

2. Brief history of universe

Cosmological expansion (H0, q0)
Big Bang -> inflation -> particle genesis -> BBNS
Recombination to Reionization
Structure formation / galaxy formation
Contents: dark matter, dark energy (lambda)

3. Content of galaxies-1: Stellar populations

Photometry
Stellar classification & types
Stellar evolution: HR diagrams
The importance of iron
Optical-NIR telescopes

4. Content of galaxies-2: ISM (see also Ch. 2.4)

Phases & detection
Feedback
Panchromatic spectral energy distribution
FIR, radio and X-ray telescopes

5. Chemical Evolution

Stellar fusion vs BBNS
Stellar dispersal into the ISM (feedback again)
Abundances: definition and measurements
QSO absorbers
Evolution models and the G-dwarf problem

II. Milky Way As Galaxy (Ch. 2) - 2 lectures

6. Stellar distribution

Distances and 3D structure
Star counts
Metallicity vs age
Malmquist bias
Solar neighborhood
IMF

7. Rotation and halo

Solar motion
Galactic rotation
Clusters
Galactic center

III. Gravity & Orbits (Ch. 3) - 3 lectures

8. Galactic Dynamics

Fundamentals
Spherical and flattened potentials
Virial theorem
Angular momentum

9. Orbits

Epicycles
Collisionless Bolztman equation
Velocity ellipsoid

10. Kinematics

- Moments & maps
- Stars vs gas
- Rotation and asymmetric drift
- Mass decomposition

IV. Disk-dominated Systems: Spirals (Ch. 5) - 4 lectures

11. Basic properties

- Structural properties
- Classification
- Stellar and gaseous content

12. Spiral structure

- Density waves, winding
- Star formation

13. Scaling relations

- Apparent correlations
- Tully-Fisher: mass and luminosity ?
  - Measures of rotation, inclination, and luminosity
  - Sources of dispersion
  - Distance indicator & cosmology
  - Tracers of star-formation and evolution

14. Rotatation curve decomposition and disk kinematics

V. Spheroidal-dominated systems: Bulges & Ellipticals (Ch. 6) - 3 lectures

15. Bulges vs Ellipticals

- Properties of spheroidals: dwarf to cD
- Bulges and pseudo-bulges
- Stellar pops:
- ISM and X-rays in ellipticals: hot gas, dark matter

16. Internal structure

- Shapes
- Fundamental plane
- Stellar kinematics of ellipticals
- Mass modelling of ellipticals
- Central structure: cusp or core ?
- Black holes: spheroidal mass correlation

17. Formation

- Red sequence, green valley and blue cloud
- Scenarios: mergers, cannibalism
- Wet vs dry mergers
- Bulges in disk systems: early or late?

VI. Dwarfs (Ch.4) - 3 lectures

18. Dwarfs in the Local Group

- Types
- Gas Content
- Stellar content
- Abundances
- Kinematics

19. Dwarfs in the field and clusters

- Luminosity functions
- Environment

20. Processes

- Tidal streams
- Stripping
- Feedback and blow-out
- Truncated star-formation and bursts

VII. Structure on the largest scales (Ch. 7,8) - 3 lectures

21. Groups and Clusters

- Mergers & interactions

22. Clusters

- Population gradients

Morphology-density relationship
Intracluster medium:
Hot gas
Stars
Dark matter

23. Large scale structure

Phenomenology
Physics: early universe and gravity
BAO ("wiggles")

VIII. AGN & Evolution (Ch. 9) - 3 lectures

24. Evolution

SF history
AGN activity

25. Where are the baryons?

An accounting of stars and gas in the universe
Malmquist bias in a cosmological context:
k-corrections
morphological k-corrections

26. The first galaxies and reionization

IX. Future and Summary - 2 lectures

27. Future surveys & facilities

28. Outstanding problems