Project 1: Constraining modified gravity with large scale structure

Project Lead: Eva Mueller

Program per session (2 hours each , total 8 hours):
1 Intro to CosmoMC, modified gravity and growth rate measurements
2 Implementation of a new growth rate likelihood
3 Intro to MGCAMB, implementation of new model
4 Constrain modified gravity model, make plots etc.

Requirements (software, bibliography):
CosmoMC, getdist (comes with CosmoMC, needs Python 2.7+ or 3.4+), MGCAMB (CosmoMC comes with CAMB and I want the students to implement the MG files so this doesn't need to be 'installed' only downloaded)

Are there any concepts (cosmology/statistics) that you would like the students review previous to your sessions?
Basic MCMC concepts, basic large scale structure

1. Gabriela Bárcenas
2. Bryan Sagredo
3. Cristhian García
4. Juan Carlos Ruelas Vázquez
5. Juan Flores
6. César Hernández Aguayo
7. Francisco Linares
8. Rebeca Martínez Carrillo

Project 2: Learning Galaxy Formation from Large-scale Structure and Weak Lensing
Project Lead: Ying Zu
Github page: https://github.com/nye17/macss2017_quenching
Program per session (2 hours each , total 8 hours):
1. Fitting Halo Mass to Weak Lensing Profiles.
i. Introduce the weak lensing measurement of Mandelbaum+2016 on the average halo mass of galaxies at fixed
stellar mass split by colors, <M_h|M_*r>_red vs. <M_h|M_*>_blue. (~20 mins)
ii. Build a model for NFW profiles at fixed M_h and concentration. (~30 mins)
iii. Vary parameters in the NFW profile on a grid and overplot the results against the measurements from i. (~20 mins)
iv. Fit individual weak lensing profiles using simple curve fitting. (~20 mins)
v. Fit individual weak lensing profiles using MCMC sampling, and compare the results to iv. (~20 mins)
2. Predicting Halo Mass from Theory.
i. Interpret the results from session 1 and describe the steps for predicting them from theory. (~20 mins)
ii. Measure halo mass function (HMF) and stellar-to-halo mass relation (SHMR) from simulated halos and mock galaxies (provided by me) (~30 mins)
iii. Predict HMF and SHMR from theory (plenty of HMF code online!). (~30 mins)
iv. Convolve HMF and SMHR to compute <M_h|M_*>. (~30 mins)
3. Constructing Galaxy Quenching Models.
i. Introduce the halo quenching model of Zu & Mandelbaum (2016). (~20 mins)
ii. Implement a quenching model into the <M_h|M_*> code from session #2, and predict <M_h|M_*r>_red vs.
<M_h|M_*>_blue. (~30 mins)
iii. Measure <M_h|M_*r>_red vs. <M_h|M_*>_blue from the mock catalog. (~20 mins)
iv. Vary parameters in the quenching model on a grid and overplot the results against the measurements
from iii. (~30 mins)
4. Model inference.
i. Write the likelihood functions and run MCMC inferences (~ 30 mins).
ii. Try different quenching models and repeat the analysis. (~ 30 mins)
iii. Comment on model selection, quenching of satellite population, extra constraints from correlation functions, etc.
Requirements (software, bibliography):
software:Python, numpy, scipy, h5py, your favorite HMF and cosmology code (type "halo mass function" into github).
biblio:
Mandelbaum et al. 2016 (http://adsabs.harvard.edu/abs/2016MNRAS.457.3200M)
Zu and Mandelbaum 2015 (http://adsabs.harvard.edu/abs/2015MNRAS.454.1161Z)
Zu and Mandelbaum 2016 (http://adsabs.harvard.edu/abs/2016MNRAS.457.4360Z)

Are there any concepts (cosmology/statistics) that you would like the students review previous to your sessions?

None. Just ask questions during the sessions.

1. José CarlosCarvajal García
2. Hiram Kalid Herrera Alcantar
3. Osvaldo Rosales Pérez
4. Gabriel Karim Miranda Carrion
5. Mariana Jaber
6. Oleg Burgueño Gerardo
7. Fidel Sosa Nuñez
8. Brenda Izamar Tapia Benavies
9. Cynthia Cotto Parraguirre

Project 3: 21-cm Cosmology

Project Lead: Jordan Mirocha

Program per session (2 hours):
1. Background theory of 21-cm background and galactic foreground, development of simple phenomenological models for each.
2. The likelihood function for signal, foreground, and (perhaps) instrument in multiple sky regions.
3. Uncertainties in 21-cm measurements and priors on fitting parameters, leading to running of first MCMC fits of synthetic data.
4. Analysis of MCMC data. Parameter inference, relationship with independent measurements (e.g., tau, luminosity functions, 21-cm power spectrum, etc.)

Requirements (software, bibliography):
emcee

Are there any concepts (cosmology/statistics) that you would like the students review previous to your sessions?

Basic MCMC http://dan.iel.fm/emcee/current/

1. José Abraham Arvizu Valenzuela
2. David Florencia Cruz
3. Pablo Andrés Lizardo Romo
4. Hector Rios Hernandez
5. ALEJANDRA GUTIÉRREZ AGUIRRE
6. Josué Ely Molina Becerra
7. Elizabeth Moreno Hilario
8. Iliana Mairen Fernández-Roldán

Plenary Project: MCMC from scratch

Project Lead: Josue De Santiago and Juan Carlos Hidalgo

Program per session (2 hours):

1 Cosmology basics

a) Type Ia supernovae as standard candles.
b) SNIa datasets.
c) Luminosity distance.
d) Definition and computation of $\chi 2$

2 Sampling algorithm

a) Complementary theory
b) Steps for the Metropolis method
c) Implementation of the method
d) Execution of a single walk

3 Extras

a) Convergence criteria
b) Other sampling methods
c) Extra data
d) Extra models

Requirements (software, bibliography):

- Python
- Python libraries: Scipy, numpy and corner
- SNIa data from the following links:
  - http://supernova.lbl.gov/Union/figures/SCPUnion2_mu_vs_z.txt
  - http://supernova.lbl.gov/Union/figures/SCPUnion2_covmat_sys.txt

José Abraham	Arvizu Valenzuela	3	
José Carlos	Carvajal García	2	1
Hiram Kalid	Herrera Alcantar	2	1
Osvaldo	Rosales Pérez	2	1
Gabriela	Bárcenas	1	3
Francisco	Cervantes		
Josué Ely	Molina Becerra	2	3
Gabriel Karim	Miranda Carrion	2	1
David	Florencia Cruz	3	
Bryan	Sagredo	1	3

Cristhian	García	1	2
Pablo Andrés	Lizardo Romo	3	
Hector	Rios Hernandez	3	
Juan Carlos	Ruelas Vázquez	1	2
Brenda Izamar	Tapia Benavies	1	2
Mariana	Jaber	2	1

Oleg	Burgueño Gerardo	2	1
Juan	Flores	1	2
César	Hernández Aguayo	1	2
Francisco	Linares	1	2
Rebeca	Martínez Carrillo	1	2
ALEJANDRA	GUTIÉRREZ AGUIRRE	3	2
Irvin	Martínez	-	-
Elizabeth	Moreno Hilario	3	2

Fidel	Sosa Nuñez	2	1

Cynthia	Cotto Parraguirre	1	2
Iliana Mairen	Fernández-Roldán	3	2
Ma. Rafaela	Gonzalez Grana		

Proyecto 3

José Abraham	Arvizu Valenzuela

David	Florencia Cruz

Pablo Andrés	Lizardo Romo
Hector	Rios Hernandez

ALEJANDRA	GUTIÉRREZ AGUIRRE

Josué Ely	Molina Becerra	

Elizabeth	Moreno Hilario

Iliana Mairen	Fernández-Roldán

Proyecto 2

José Carlos	Carvajal García	2
Hiram Kalid	Herrera Alcantar	2
Osvaldo	Rosales Pérez	2

Gabriel Karim	Miranda Carrion	2

Mariana	Jaber	2

Oleg	Burgueño Gerardo	2

Fidel	Sosa Nuñez	2

Pádel	Sosa Núñez	2

Brenda Izamar	Tapia Benavies	2

Proyecto 1

Gabriela	Bárcenas	1

Bryan	Sagredo	1

Cristhian	García	1
Juan Carlos	Ruelas Vázquez	1

Juan	Flores	1
César	Hernández Aguayo	1
Francisco	Linares	1
Rebeca	Martínez Carrillo	1

Cynthia	Cotto Parraguirre	1