

TALENT School on Nuclear Quantum Monte Carlo

July 11 – 29, 2016

Department of Physics, NC State University

Course Lecturers: Joseph Carlson (LANL), Joaquín Drut (UNC-CH),
Stefano Gandolfi (LANL), Dean Lee (NC State)



Special Lecturers: Shailesh Chandrasekharan (Duke), David Dean (ORNL),
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Quantum Monte Carlo

J. Carlson
S. Gandolfi

QMC in the continuum

J. Drut
D. Lee

QMC on the lattice

- Goals for Week I:
 - Why QMC?
 - Types of QMC
 - Introduction to MC methods: sampling, statistics
 - Introduction to parallel computation
 - Variational Monte Carlo (VMC): Bosons, Fermions
 - Diffusion Monte Carlo (DMC): Bosons, Fermions
 - GFMC with spins/isospins introduction
 - AFMC with spins/isospins introduction

Small Projects, Sample Codes, up to more complicated projects...

Why QMC?

Allows for accurate studies of non-perturbative quantum systems with many degrees of freedom:

Nuclear Physics
Atoms/Molecules
Cold Atoms
Condensed Matter
Lattice QCD

Search for “Quantum Monte Carlo” on Google Scholar from 2010:
13,600 hits

Examples: 1st two pages of Google Scholar Search

- Measuring Renyi [entanglement entropy](#) in quantum Monte Carlo simulations
- [Correlation effects](#) in quantum spin-Hall insulators: a quantum Monte Carlo study
- Quantum Monte Carlo Methods in [Equilibrium and Nonequilibrium](#) Systems
- Communications: Survival of the fittest: Accelerating convergence in full [configuration-interaction quantum Monte Carlo](#)
- Continuous-time Monte Carlo methods for [quantum impurity](#) models
- Applications of quantum Monte Carlo methods in [condensed systems](#)
- Quantum Monte Carlo calculations with [chiral effective field theory](#) interactions
- Itinerant ferromagnetism of a repulsive [atomic Fermi gas](#): A quantum Monte Carlo study
- Weak-coupling QMC calculations on the Keldysh contour: Theory and application to the [current-voltage characteristics](#) of the Anderson model
- [Quantum ice](#): a quantum Monte Carlo study
- [Loop updates](#) for variational and projector quantum Monte Carlo simulations in the valence-bond basis
- Photoisomerization of model [retinal chromophores](#): insight from quantum monte carlo and multiconfigurational perturbation theory
- Magnetism of finite [graphene](#) samples: Mean-field theory compared with exact diagonalization and quantum Monte Carlo simulations

Many important/current topics in physics and QMC