Raghav Kunnawalkam Elayavalli

CONTACT INFORMATION

815 Pallister St
Detroit, Michigan. USA 48202
Cell: +1 732 532 9232
e-mail: raghavke@wayne.edu

EMPLOYMENT HISTORY

Wayne State University
Detroit, Michigan USA
Post Doctoral Research Fellow, Nov 2017 - Present
Rutgers, The State University of New Jersey
New Brunswick, New Jersey USA
Post Doctoral Research Fellow, Oct - Nov 2017

EDUCATION

Rutgers, The State University of New Jersey
New Brunswick, New Jersey USA
PhD. Relativistic Heavy Ions, Sept 2017 [3.83/4]
Stony Brook University,
Long Island, New York USA
M.A Physics, December 2012 [3.52/4]
Cornell College,
Mount Vernon, Iowa USA
B.A. Hons. Physics, May 2011 [3.82/4]

RESEARCH INTERESTS

Relativistic Heavy Ion and Fundamental QCD physics

- Hot and cold nuclear matter effects.
- Jet-medium and Quark Gluon Plasma (QGP) tomographic studies in ultra relativistic ion collisions.
- Experimental tests of Quantum Chromo Dynamics (QCD) in extreme environments.

Computing and Software

- MonteCarlo simulations of QCD interaction at high energy density/temperature.
- Neural networks and machine learning for efficient tracking, accurate particle reconstruction and identification.
- Enhanced reconstruction quality monitoring and minimizing detector energy response fluctuations.

RESEARCH EXPERIENCE

Wayne State Relativistic Heavy Ion Group, Detroit, Michigan
Post Doctoral Research Fellowship mentored by Prof. Joern Putschke

Investigations of the QGP's transport properties via jet structure tomography at the STAR experiment at RHIC, Brookhaven National Lab. Nov 2017 - Present

- Systematic studies of jet evolution and correlated medium response at RHIC utilizing the jet's angular scales and jet sub-structure observables

- Measuring the groomed jet radius and jet mass in pp collisions and its subsequent modifications Au-Au collisions
- Exploring coherent and de-coherent aspects of jet-medium interaction by measuring a time evolution of parton showers

Rutgers Relativistic Heavy Ions Group, Piscataway, New Jersey

PhD thesis titled "Jetting Through the Primordial Universe" guided by **Prof. Sevil Salur** - Jet studies with proton-proton and heavy ion collisions at the CMS detector: July 2013 - Oct 2017. arXiv:1803.03686

- Measuring double differential jet cross section and the nuclear modification factors for proton-proton, proton-lead and lead-lead collisions.
- Theoretical perturbative QCD predictions for the differential jet cross section in pp collisions including the non perturbative corrections across a variety of jet distance parameters
- Heavy Ions Jet Reconstruction co-convener taking charge of Data Quality Monitoring (DQM) resulting in novel software validation packages validating jet qualities before and after reconstruction
- Primary DQM expert during the heavy ion run period Nov-Dec 2015 as service work to the CMS collaboration
- Expertise with data-driven or MC-driven detector resolution un-smearing or "Unfolding techniques" with various methods such as SVD, Bayesian, bin-by-bin etc...
- Monte carlo event generation studies with different Heavy Ion generators such as JEWEL and Q-PYTHIA.

Machine Learning Applications for Jet Physics

- Quark Gluon identification and classification with state of the art Deep Convoluted Neural Network (DCNN) compared to current Boosted Decision Tree (BDT) models.
- First quantitative analysis of quark vs gluon flavor dependence on jet quenching in JEWEL with DCNN
- Estimating the Jet Energy Response utilizing jet images and DCNNs for minimal bias in Data

CERN Theory Group, Geneva, Switzerland

Marie Curie Early Stage researcher fellowship. JEWEL Monte Carlo event generator with **Dr. Korinna Zapp** and the CERN MCNet: April - August 2016

- Added Boson $(\gamma, Z^0, W^{\pm})$ + jet processes to JEWEL to predict observables such as the momentum asymmetry and angular correlations of the un-quenched boson with the quenched jet.
- New background subtraction methods based on the treatment of medium induced recoil partons and scattering centers.
- Keeping track of the thermal background energy significantly improves the predictive power of JEWEL for differential and sub-jet observables highlighting importance on correlations between jet and the background.

RHIC group at Stony Brook, Long Island, New York.

Masters thesis titled "Searches for Beyond the Standard Model τ-jet at the proposed EIC detector" guided by **Prof. Abhay Deshpande** - Simulating the proposed eRHIC detector at the EIC (Electron Ion Collider) : Jan 2012 - Jan 2013

- Created a new physics framework called EICROOT for the eRHIC detector based on the existing FAIRROOT framework, integrating PYTHIA, GEANT and ROOT.
- Integrated EICROOT with montecarlo generators (PYTHIA) and jet analysis software (FastJet).
- Modeled and studied eRHIC detector response comparing the jet widths of a Lepton Flavor Violating process to a standard Deep inelastic scattering process.

Cornell College, Mt. Vernon, Iowa

Senior Year September 2010 - Feb 2011

- Honor Thesis on Riemann Surface calculations in String theory under **Prof. Derin Sherman**
- Designed, fabricated and built a muon detector to calculate the muon flux at various altitudes and hence infer time dilation in the Special theory of Relativity.

Institute of Mathematical Sciences, Chennai, India

Summer Internship Program, June to August 2010

- Reading course: Non-commutative Quantum field theory under **Prof. A.P.Balachandran** and **Prof. T.R.Govindarajan**
- Cross section calculation for simple one loop process in thermal quantum field theory and analyzed its UV-IR divergences.

University of Iowa, Experimental High Energy Physics, Iowa City, Iowa

Summer Internship Program, June to August 2009

- Worked with **Prof. Yasar Onel** and **Prof. Jane Nachtman** on the US-CMS group on testing new Photo Multiplier Tubes (PMT) for test beam readiness.
- Simulated the decays of exotic particles at their respective LHC production cross sections and studied their detector response.

COMPETITIVE HONORS/AWARDS

Awards

- Marie Curie Early Stage researcher fellowship, part of the MCNetITN with funding from the European Union. 2016 April-August (12000 CHF for work at CERN)
- Claud Lovelace Experimental Research fellowship, Department of Physics and Astronomy, Rutgers University 2015 Sept - 2016 May

- Certificate of Training in Physics Mentorship, Department of Physics and Astronomy, Rutgers University 2017 May
- Certificate of Training in Physics Education, Department of Physics and Astronomy, Rutgers University 2013 Dec
- Graduate research fellowship, Department of Physics and Astronomy, Rutgers University 2013 July - 2015 July, August 2016 - present
- Distinguished Performance, ACM (Associated Colleges of Midwest) Intercollegiate Programming Contest 2010, Iowa, USA
- Outstanding Physics Major of the academic year 2009-2010, Cornell College, USA
- Ed Hill Math Scholar of the academic year 2008-2009, Cornell College, USA
- Physics Department Scholarship awarded, Loyola College, Spring 2008, India
- Global Young Leadership Award 2007, awarded by the Congressional Youth Leadership Council, Washington DC, USA
- Ranked First, Ramanujam State wide Mathematics talent search contest 2006, India

Travel Grants

- Hard Probes, titled "Medium Recoils in JEWEL" at Wuhan China, Sept 2016
- Hot Quarks 2016, South Padre Island, Texas USA, Sept 2016
- 4th Heavy Ion Jet workshop, titled "Latest results with the JEWEL Heavy Ion event generator" at Paris, France, July 2016
- The CTEQ - MCnet School 2016, at DESY, Hamburg Germany. July 2016
- MCNet meeting, Goettingen Germany, April 2016
- Tropical Groups in Hadronic Physics APS 2015, Baltimore MD USA, April 2015
- Hot Quarks 2014, Las Negras, Spain, Sept 2014
- Gordon Research Conference. Photonuclear Reactions, From Quarks to Nuclei 2014. Holderness, NH USA August 2014
- Frontiers and Careers in Photonuclear Physics 2014, MIT, Cambridge, MA USA, August 2014
- Quark Matter XXIV 2014, Darmstadt, Germany, May 2014
- Boston Jet Physics Workshop 2014, Harvard University, Cambridge, MA USA, Jan 2014

Selected Peer Reviewed Publications

Journals

- Probing heavy ion collisions using quark and gluon jet substructure
  Yang-Ting Chien and Raghav Kunnawalkam Elayavalli
  In Preparation for Submission to JHEP https://arxiv.org/abs/1803.03589
- Medium response in JEWEL and its impact on jet shape observables in heavy ion collisions
  Raghav Kunnawalkam Elayavalli and Korinna Christine Zapp
  JHEP 1707 (2017) 141 arXiv:1707.01539
  10 citations counted in INSPIRE as of 23rd March 2018
- Measurement of inclusive jet cross-sections in pp and PbPb collisions at

$\sqrt{s_{\mathrm{NN}}}$=2.76 TeV
Primary analysis contact, CMS Collaboration
Phys. Rev. C Phys. Rev. C 96, 015202 arXiv:1609.05383
34 citations counted in INSPIRE as of 23rd March 2018

- Simulating V+jet processes in heavy ion collisions with JEWEL
Raghav Kunnawalkam Elayavalli and Korinna Christine Zapp
Eur. Phys. J. C. (2016) 76: 695 arXiv:1608.03099
11 citations counted in INSPIRE as of 23rd March 2018
- Measurement of inclusive jet production and nuclear modifications in pPb collisions at $\sqrt{s_{\mathrm{NN}}}$=5.02 TeV
Analysis workforce, CMS Collaboration
Eur. Phys. J. C (2016) 76: 372 arXiv:1601.02001
18 citations counted in INSPIRE as of 23rd March 2018
- Transverse momentum spectra of inclusive b jets in pPb collisions at $\sqrt{s_{\mathrm{NN}}}$=5.02 TeV
Analysis workforce and cross checks, CMS Collaboration
Phys.Lett. B754 (2016) 59 arXiv:1510.03373
35 citations counted in INSPIRE as of 23rd March 2018

Conference Proceedings

- Medium Recoils and background subtraction in JEWEL (HP'16)
Raghav Kunnawalkam Elayavalli, Korinna Christine Zapp
Nuclear and Particle Physics Proceedings 289, 368-371 (2017) arXiv:1612.05116
- Jet structure modifications in heavy-ion collisions with JEWEL (HQ'16)
Raghav Kunnawalkam Elayavalli
Journal of Physics: Conference Series (2017) 832. 1 arXiv:1610.09364
- Jet Measurements in Heavy-ion Collisions with CMS (HQ'14)
Raghav Kunnawalkam Elayavalli (on behalf of the CMS collaboration)
Journal of Physics: Conference Series (2015) 612. 1 arXiv:1607.03281

Invited Talks and Posters

Conferences/Workshops

- Machine Learning for Jet Physics, titled "Probing Heavy Ion Collisions using Classification of Quark and Gluon Jets", at LBNL Dec 2017
- Machine Learning for Jet Physics, titled "Jet Response Prediction Using Jet Images ", at LBNL Dec 2017
- First Annual Yale-LeHeigh-Rutgers Jet Workshop, titled "Machine Learning for JETS", at Yale University, Aug 2017
- Jet SubStructure Planning for the future workshop, titled "Jet (Sub)Structure in Heavy Ions", LPC at Fermi National Laboratory, Nov 2016
- Hard Probes, titled "Medium Recoils in JEWEL" at Wuhan China, Sept 2016
- Hard Probes, titled "Inclusive jet spectra in pp and PbPb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 2.76 TeV" at Wuhan China, Sept 2016 (Poster)
- Hot Quarks, titled "Jet Structure modifications in HIN collisions with JEWEL" at South Padre Island, Texas Sept 2016
- 4th Heavy Ion Jet workshop, titled "Latest results with the JEWEL Heavy Ion event generator" at Paris, France, July 2016

- Sante Fe Jet and Heavy Flavor workshop titled "Jets in pPb collisions at CMS" at Santa Fe, NM, Jan 2016
- Tropical Groups in Hadronic Physics titled "Latest CMS Jet results from HI collisions" at Baltimore MD, April 2015
- Hot Quarks, titled "Jet Measurements in Heavy Ion Collisions with CMS" at Las Negras, Spain September 2014
- Frontiers and Careers in Photonuclear Physics, titled '"Recent Results in Fully Reconstructed Jets in Heavy Ion Collisions at CMS" at MIT, August 2014
- Quark Matter XXIV, titled '"Inclusive jet measurements in Heavy Ion collisions at CMS" at GSI Darmstadt, May 2014 (Poster)
- EIC Detector R&D Simulation Agenda. titled "Graduate Student's experience in learning, exploring and using FAIRROOT" at Brookhaven National Lab, Fall 2012

Seminars

- (Upcoming) Rutgers Nuclear Seminar, titled "Exploiting Quark vs Gluon Jet Discrimination in Heavy Ions", Rutgers University, Piscataway NJ, March 2018
- P-25 Seminar, titled "Jetting Through the Primordial Universe", Los Alamos National Laboratory, (via video) Sept 2017
- Nuclear Seminar, titled "Jetting Through the Primordial Universe", Wayne State University, (via video) August 2017
- Nuclear Seminar, titled "Jetting Through the Primordial Universe", NSCL, Michigan State University, East Lansing, August 2017
- Heavy Ion Tea Seminars, titled "Jets in the QGP; What we know and how do we go forward", LBNL, Berkeley California, March 2017
- Science Interest Seminar, titled "Whats new at the LHC? Heavy Ions!", Cornell College, Mt Vernon Iowa, Dec 2016
- Rutgers Nuclear Seminar, titled "Learning about the QGP using Jets", Rutgers University, Piscataway NJ, Oct 2016
- Student Seminars in Physics and Astronomy at Rutgers (SSPAR), titled "Jetting through the QGP", Rutgers University, Piscataway NJ, Oct 2016
- Student Seminars in Physics and Astronomy at Rutgers (SSPAR), titled "Physics of the Beam. Scotty, beam us up!", Rutgers University, Piscataway NJ, March 2016
- Student Seminars in Physics and Astronomy at Rutgers (SSPAR), titled "Heavy Ions at the LHC: When protons aren't big enough", Rutgers University, Piscataway NJ, Oct 2015
- Rutgers Nuclear Seminar, titled "Recent Jet Results from the CMS experiment", Rutgers University, Piscataway NJ, Feb 2015
- Student Seminars in Physics and Astronomy at Rutgers (SSPAR), titled "A First look at Heavy Ion Collisions: Initial State Physics", Rutgers University, Piscataway NJ, Dec 2014

Mentoring experience

Undergraduate Students

- Jennifer Coulter (Summer 2015 - Spring 2016) Jet-Event shape study with

the thrust variable comparing PP and PbPb.
- Aditya Parikh (Summer 2014 - Spring 2016) Dijet corrections between Data and MC and Heavy Ion MC generation studies

Summer Students
- Aditya Verma (Summer 2017 - present) Jet sub-structure measurements at RHIC with the JEWEL heavy ion MC.
- Ian Hunt-Issac (Summer 2015) JEWEL and qPYTHIA Heavy Ion generator studies and comparisons with Data

Teaching Experience

Teaching Assistant PHY 121(Mechanics Lab), Summer 2012. (Stony Brook University)
Tutored at the **Quantitative Reasoning Studio**(Cornell College)

Membership

STAR Collaboration at RHIC (Nov 2017 - Present) American Physical Society (APS), Division of Particle and Fields (DPF) and Division of Nuclear Physics (DNP)
CERN Theory Department (April-August 2016)
sPHENIX Collaboration at RHIC (July 2017 - Present)
CMS Collaboration at LHC (July 2013 - October 2017)
EIC/ePhenix task force at RHIC (2012 - 2013)

Technical Skills-Set

Programming: C++, python, fortran, ROOT, FAIRRoot Package, GEANT4, Java, JavaScript, HTML5 and Labview
Computer Applications: TEX (LATEX, BIBTEX), Mathematica, most common productivity packages (for Windows, OS X, and Linux platforms)
Operating Systems: Apple OS X, Linux, Microsoft Windows family (for general purposes)