Adelaide activities

February 18th, 2019

Paul Jackson

THE UNIVERSITY of ADELAIDE

Outline

- Personnel
- Activities
- Plans

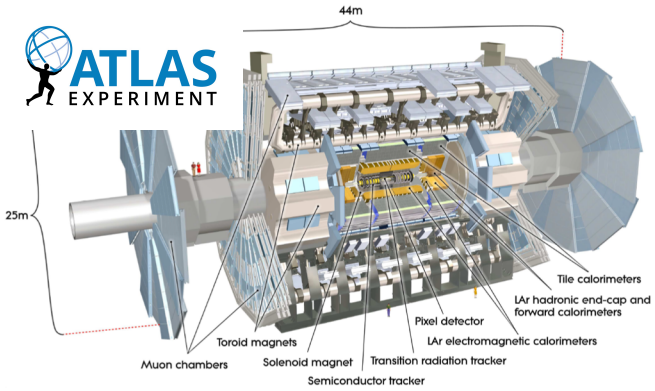
  - The 5/10 year goal has an embedded future vision in it. The LHC is funded to run through the 2030s (ATLAS will be a “50 year collaboration” by the time we wrap up analysing the data) . Similarly, the timescale for many future high-energy collider experiments is long.

HEP Personnel

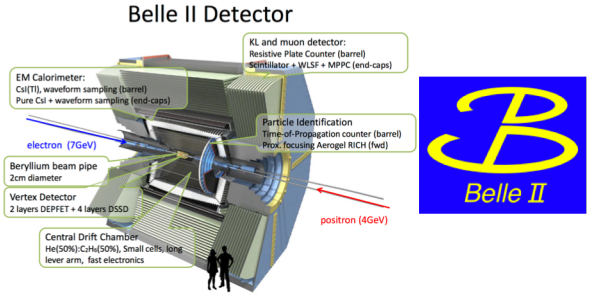
- Faculty: Anthony Thomas, Anthony Williams, Martin White, Paul Jackson, Ross Young
  - spanning theory and experiment (ATLAS, Belle-II….. + future colliders and expts)
  - We have approximately 30 HDR students working with us under the umbrellas of our CoEPP and CSSM - mostly involved in experimental work and/or pheno studies of collider physics

- Additional “HEP-related” faculty: Bruce Dawson, Derek Leinweber, Gary Hill, Gavin Rowell, James Zanotti (+LIGO/OzGrav folks)
  - The hope (dream/goal) is to grow the number of people in the department who work with the high-energy physics group - either in a direct capacity, or through synergistic efforts

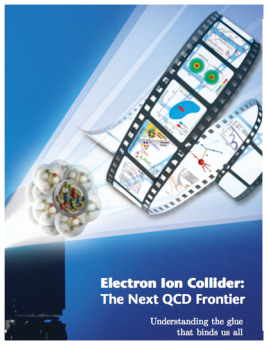
HEP Experimental Activities

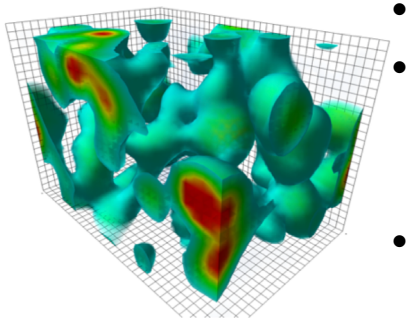


- Ongoing commitments to finish analyses in the SUSY group (EWK and strong production); longer terms efforts in top (4 top) and SM physics (triboson)
- Growing efforts in FTKSim and FTK operations
- Also growing in strip and pixel DAQ for ITK (phase II)
- Member of Executive Board for next 2 years (19-21)



- Continuing efforts on data skimming
- Building efforts on physics analysis (currently working on $D^{*}\tau\nu$, will join other analyses)





- Proposed facility to study hadron physics at HEs
- Combined efforts of EIC measurement with lattice QCD calculations to give transformational images of nucleon & nuclear structure
- Precision EWK physics

HEP Phenomenology Activities

Topics include:

- global fits of SUSY, two Higgs doublet and composite Higgs scenarios (including studies of future facilities)
- New techniques for better optimisation of LHC searches
- Global fits of models capable of explaining flavour anomalies
- “Model-independent” modelling of interference effects in LHC searches
- Jet substructure techniques for charged Higgs searches

HEP Plans

- Involvement in ATLAS is growing, with student numbers continuing to stay healthy. In this sense we are committed to activities at CERN and are strong advocates for CERN associate membership
  - Exploiting LHC physics, improving the quality of the data and growing the group is a priority
  - ATLAS upgrade involvement is a long-term commitment. Phase-II upgrade will be a commitment for the coming ~7 years prior to Run4 data-taking beginning in 2026/27
- Belle II remains a strong interest, growing student numbers, funding and person power
  - We will always be a modest sized group in Belle II, but are committed to being a part of a national effort in flavour physics
  - Flavour also becoming synergistic with our lattice group

HEP Plans, continued

- While not collider physics we have made a strong commitment to dark matter activities in the country, this will complement our collider physics activities

- Electron-Ion Collider is one of the big exciting machines under strong consideration in the US Nuclear physics community – Adelaide interest

- We have interest in a future e^+e^- collider, but any involvement we have must be aligned with our national interests and activities, we can't (and won't) "go it alone" on a new, potentially multi-decade, adventure

- Finally, we recognise that we are involved in two CoE bids in the coming round
  - The success of these bids will shape our group, as with other grant applications. We're at the mercy of the ARC in these cases.

CHEP 2019 – International Conference on Computing in High-Energy and Nuclear Physics

4-8 November, 2019
Adelaide, Australia

Backup Slides

Electron–Ion Collider

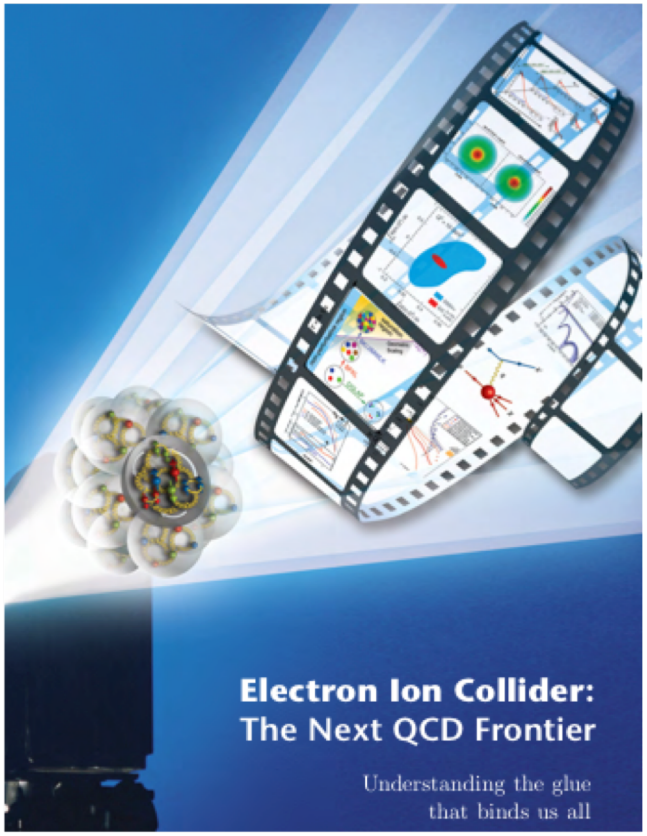
The Electron–Ion Collider (EIC) is a proposed facility to study hadron physics at high energy recommended by the **2015 Long Range Plan** for Nuclear Science by the NSAC.

Supported by **National Academies of Sciences** review 2018:

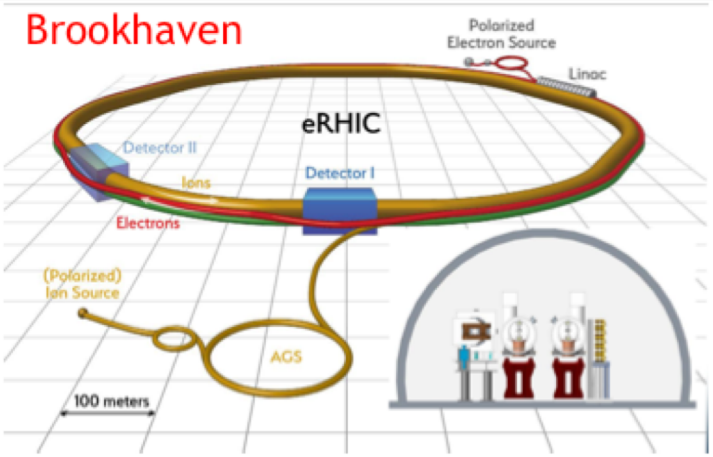
Finding 1: An EIC can uniquely address three profound questions about nucleons—neutrons and protons—and how they are assembled to form the nuclei of atoms:

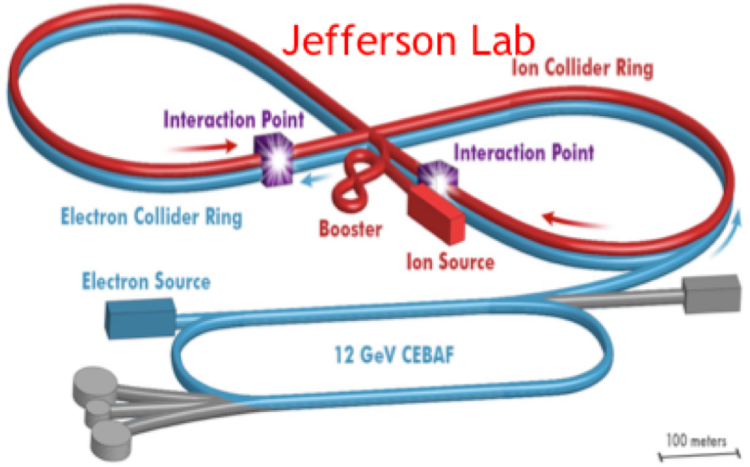
- ★ **How does the mass of the nucleon arise?**
- ★ **How does the spin of the nucleon arise?**
- ★ **What are the emergent properties of dense systems of gluons?**

EIC User Group: 800+ members from 180+ institutions



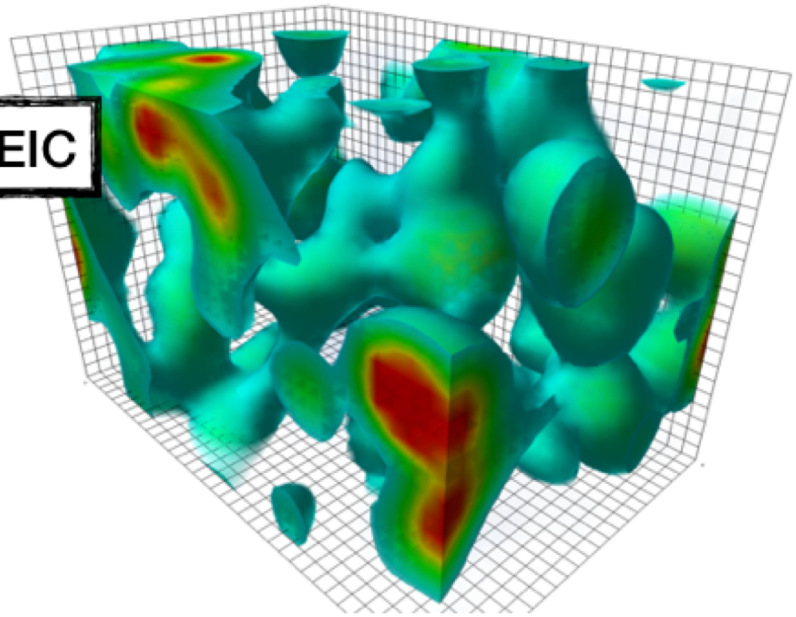
White paper: Accardi *et al*. EPJ(2016)





Two proposed configurations: Brookhaven Nat'l Lab and Jefferson Lab

Imaging quark and gluon distributions at the EIC



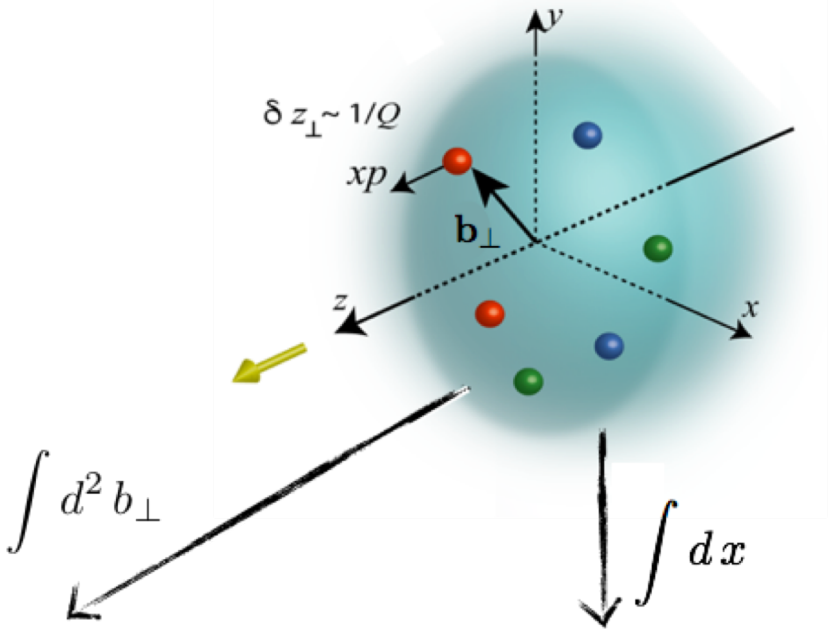
Generalised parton distributions: resolve the joint distribution of longitudinal momentum fraction and transverse position.

Can access the "gravitational form factors"

Combined efforts of EIC measurement with lattice QCD calculations to produce transformational images of nucleon & nuclear structure

Potential for precision electroweak physics

"Synergies of lattice and the EIC"
EICUG Meeting 2018



Combined analyses
Can enhance the physics reach beyond data alone

Improved predictions
Better predictions to inform experimental design

Theoretical testing
Test theoretical foundations to permit data-driven analyses