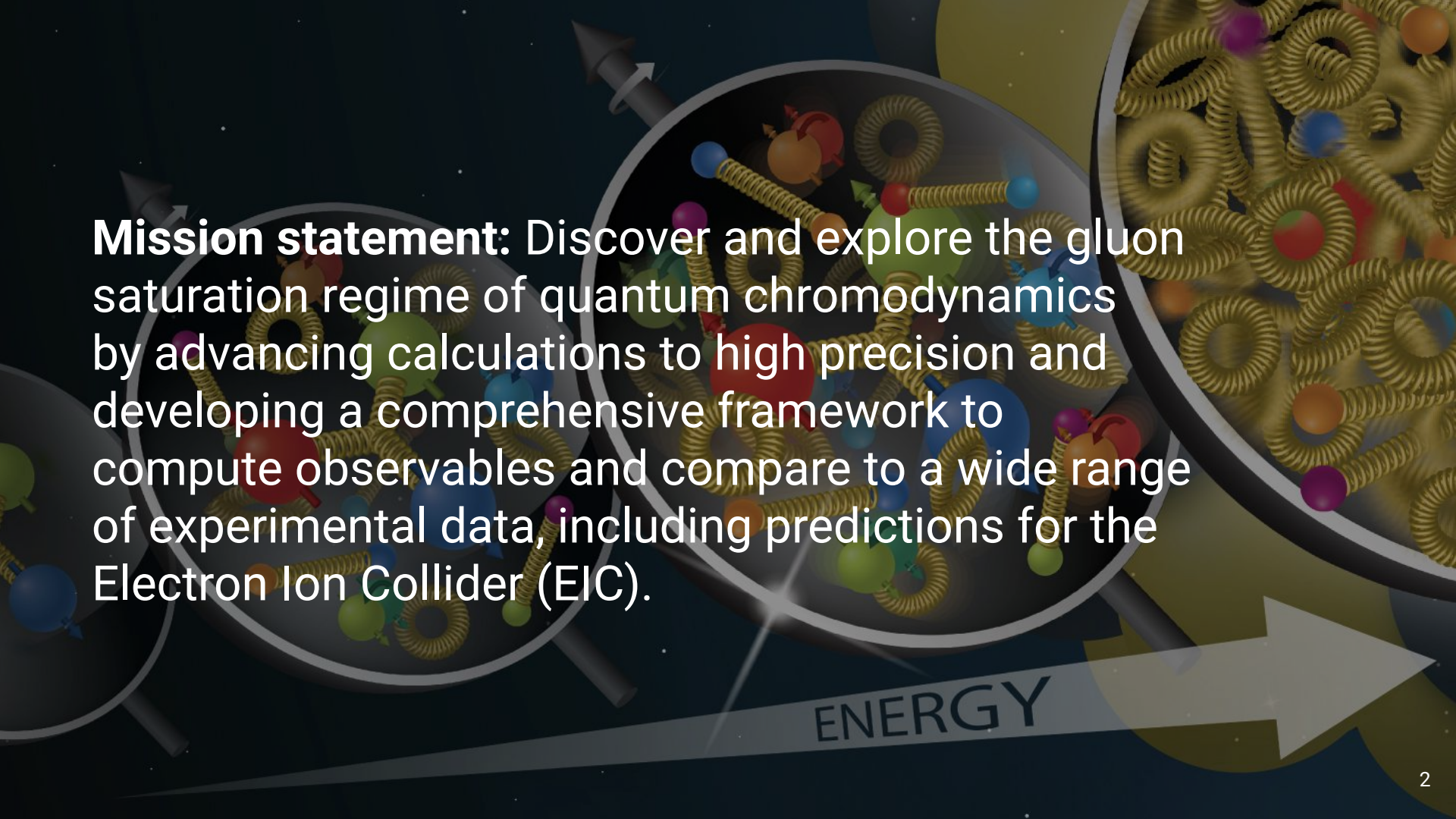
Collaboration Meeting

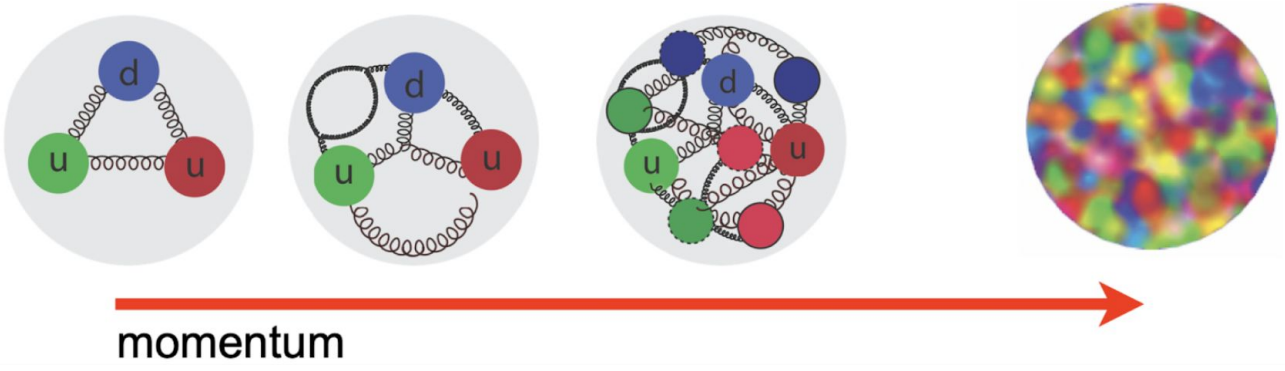
June 28 2023



Mission statement: Discover and explore the gluon saturation regime of quantum chromodynamics by advancing calculations to high precision and developing a comprehensive framework to compute observables and compare to a wide range of experimental data, including predictions for the Electron Ion Collider (EIC).

The problem

In nuclei at high energy, gluon saturation is expected on basic theoretical grounds. There are several hints in the experimental data. Yet, there has been no clear demonstration that we have saturation effects in observables at RHIC or LHC. Also, predictions for the EIC need to be made now, to maximize its impact.



The solution

A collaborative effort to identify the best observables, perform high precision calculations, and embed them in a comprehensive numerical framework that allows for direct comparison to experimental data and ultimately global analysis

Members

Brookhaven National Laboratory
Y. Hatta, D. Kharzeev, Y. Mehtar-Tani, S. Mukherjee, P. Petreczky, R. Venugopalan

Old Dominion University / Thomas Jefferson Laboratory I. Balitsky

McGill University
S. Caron-Huot

CUNY, Baruch College
A. Dumitru, J. Jalilian-Marian

University of California, Los Angeles
Z. Kang

The Ohio State University
Y. Kovchegov

University of Connecticut
A. Kovner

University of Illinois at Urbana Champaign
J. Noronha-Hostler

Southern Methodist University
F. Olness

Lebanon Valley College
D. Pitonyak

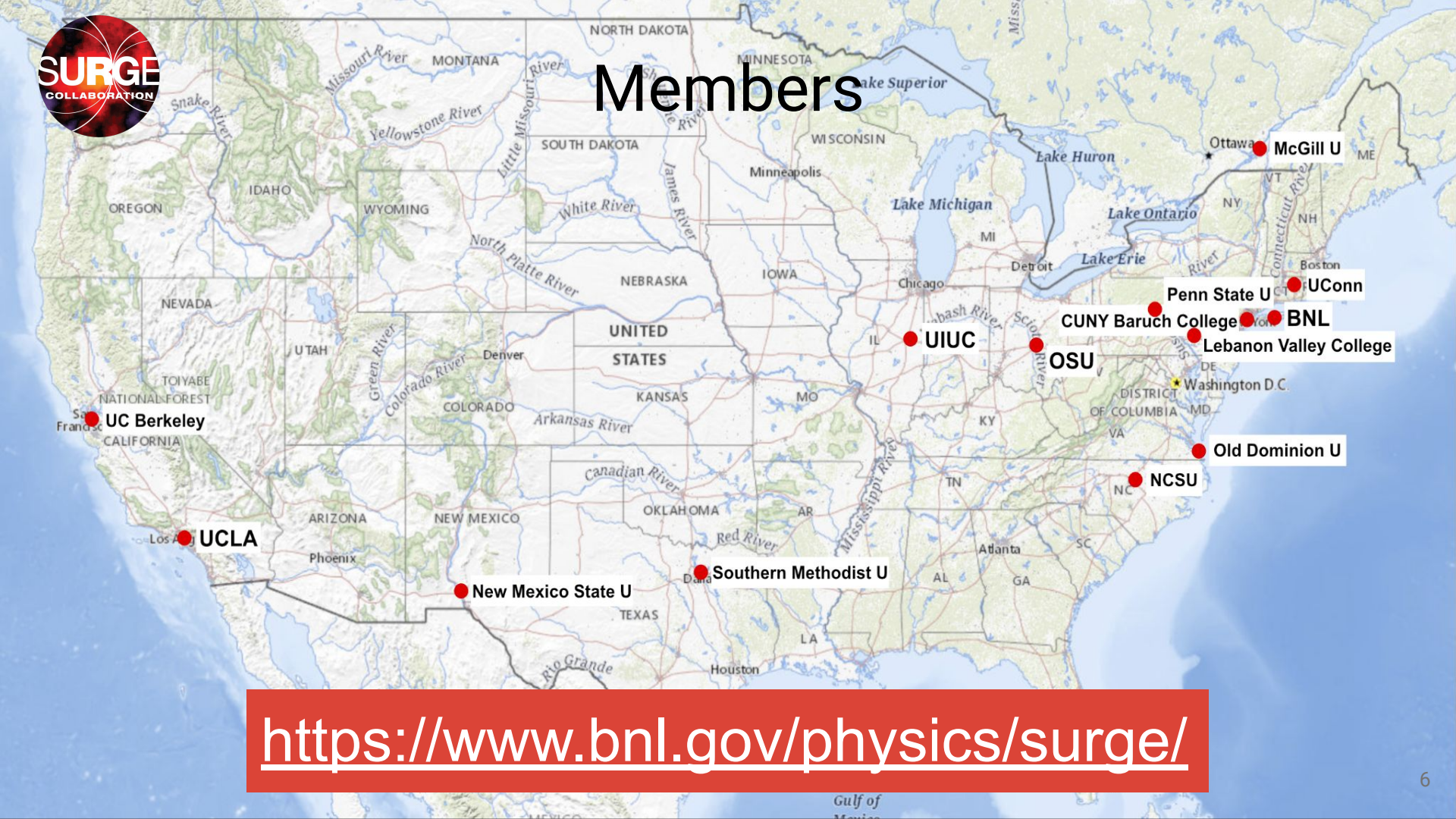
New Mexico State University
M. Sievert

North Carolina State University
V. Skokov

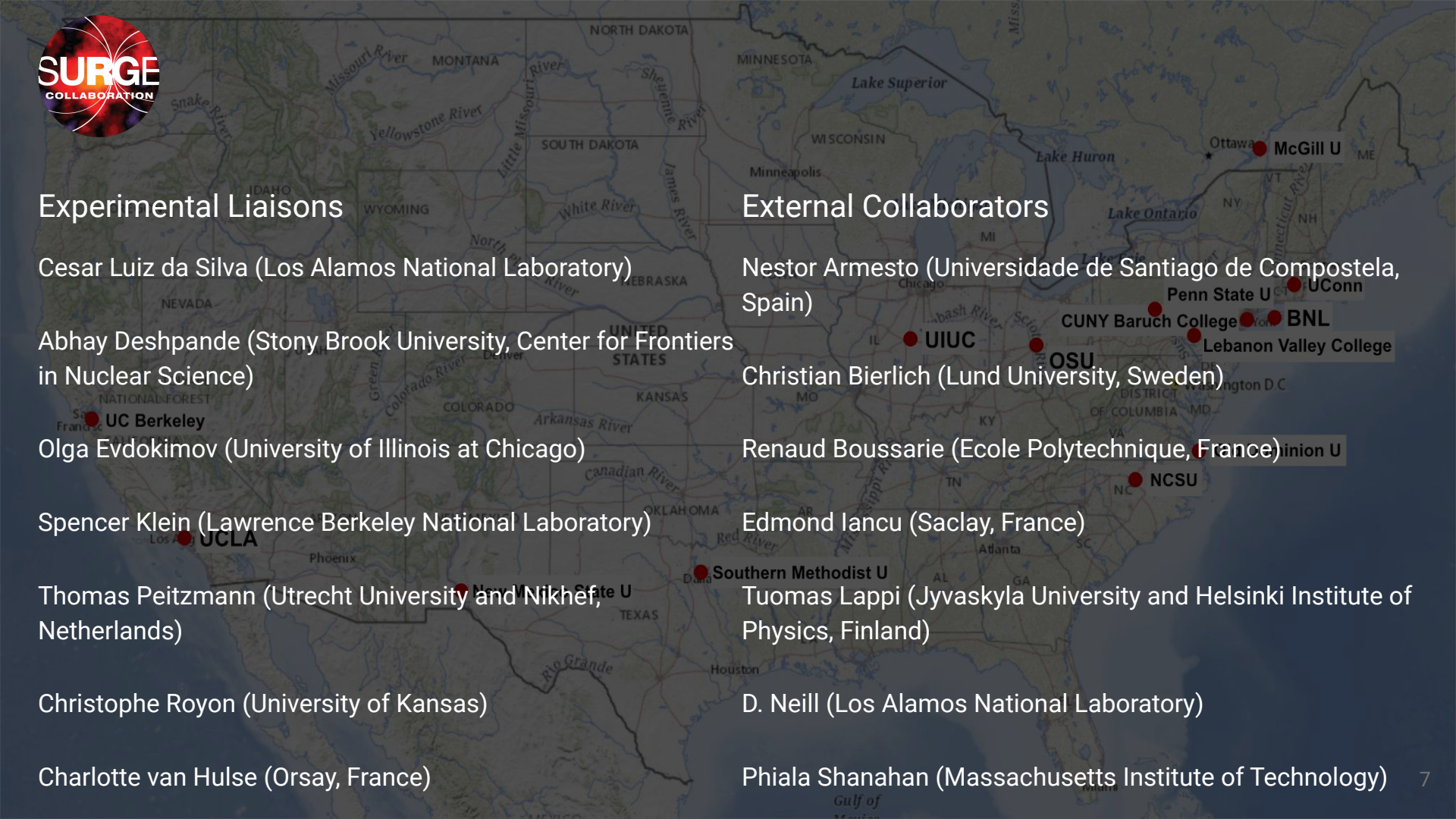
Penn State University
A. Stasto

University of California Berkeley / Lawrence Berkeley National Laboratory
X.-N. Wang

Members



https://www.bnl.gov/physics/surge/



Experimental Liaisons

Cesar Luiz da Silva (Los Alamos National Laboratory)

Abhay Deshpande (Stony Brook University, Center for Frontiers in Nuclear Science)

Olga Evdokimov (University of Illinois at Chicago)

Spencer Klein (Lawrence Berkeley National Laboratory)

Thomas Peitzmann (Utrecht University and Nikhef, Netherlands)

Christophe Royon (University of Kansas)

Charlotte van Hulse (Orsay, France)

External Collaborators

Nestor Armesto (Universidade de Santiago de Compostela, Spain)

Christian Bierlich (Lund University, Sweden)

Renaud Boussarie (Ecole Polytechnique, France)

Edmond Iancu (Saclay, France)

Tuomas Lappi (Jyvaskyla University and Helsinki Institute of Physics, Finland)

D. Neill (Los Alamos National Laboratory)

Phiala Shanahan (Massachusetts Institute of Technology)

Steering Committee

The steering committee is in charge of coordinating the activities of the collaboration. This includes prioritization and coordination of research activities, overseeing progress, and organization of workshops and collaboration meetings.

Björn Schenke

Brookhaven National Laboratory

PI and co-spokesperson

Anna Stasto

Penn State University

co-spokesperson

Zhongbo Kang

University of California Los Angeles

Jaki Noronha-Hostler

University of Illinois Urbana-Champaign

Matt Sievert

New Mexico State University

Working groups

We have formed 5 working groups to focus on the different components of the proposed research.

- Initial state **(Vladi Skokov)**

- Small x evolution + NLO calculations **(Zhongbo Kang)**

- Spin **(Yuri Kovchegov)**

- Framework and global analysis **(Fred Olness)**

- Final state **(Xin-Nian Wang)**

*()=conveners

Support for post-docs and students

Training and mentorship is an important component of the SURGE Collaboration

Two post-docs hired (starting in the summer/fall of 2023):

- UC Berkeley: Wenbin Zhao 
- UCLA: Jani Penttala 

Supporting two students in year 1:

- NCSU: Shaswat Tiwari
- NMSU: Nicholas Baldonado

SURGE will provide partial funding for:

- 5 postdocs
- 7 graduate students
- 1 undergraduate student

at 13 institutions

SURGE plans to establish a bridge faculty position at the University of Illinois at Urbana Champaign

Meetings and Schools

- Collaboration-wide online meetings every other month (the first one was held 1/9/2023)
- Regular working group meetings
- Larger in-person workshops/meetings in years 1, 3 and 5, as well as a summer school in year 2
- As planned, here we are for our first in-person Collaboration Meeting
- We acknowledge support from the EIC Theory Institute at BNL for travel, per-diems, and accommodation

This meeting

https://www.bnl.gov/surgemeeting

Brookhaven Lab Anti-Harassment Policy

At Brookhaven National Laboratory (BNL) or BNL-sponsored events, discriminatory behavior or harassment of conference participants or presenters will not be tolerated. Please refer to the BNL Anti-Harassment Policy.

This meeting

https://www.bnl.gov/surgemeeting

Agenda takes you to the indico. Please upload your talks a day in advance so we can download them to the computer here. Please only pdf (preferred) or power point files.

Lunches

Lunches will be delivered based on your orders. **If you have not yet, please pay Dorothy for your lunches.** There is also an option to buy food at the food truck, and on Thursday inside Berkner as well.

JUN 28 Wednesday
Food Truck
Vincent's NYWF Pizza
11 a.m., Berkner Hall Cafeteria

JUN 29 Thursday
Food Truck
Rollin' Ghost
11 a.m., Berkner Hall Cafeteria

JUN 29 Thursday
Berkner Café Pop-up
Broadway Market
11 a.m., Berkner Hall Cafeteria

JUN 30 Friday
Food Truck
Maui Chop House
11 a.m., Berkner Hall Cafeteria

For more information and off-site food options see
https://www.bnl.gov/staffservices/foodservices.php

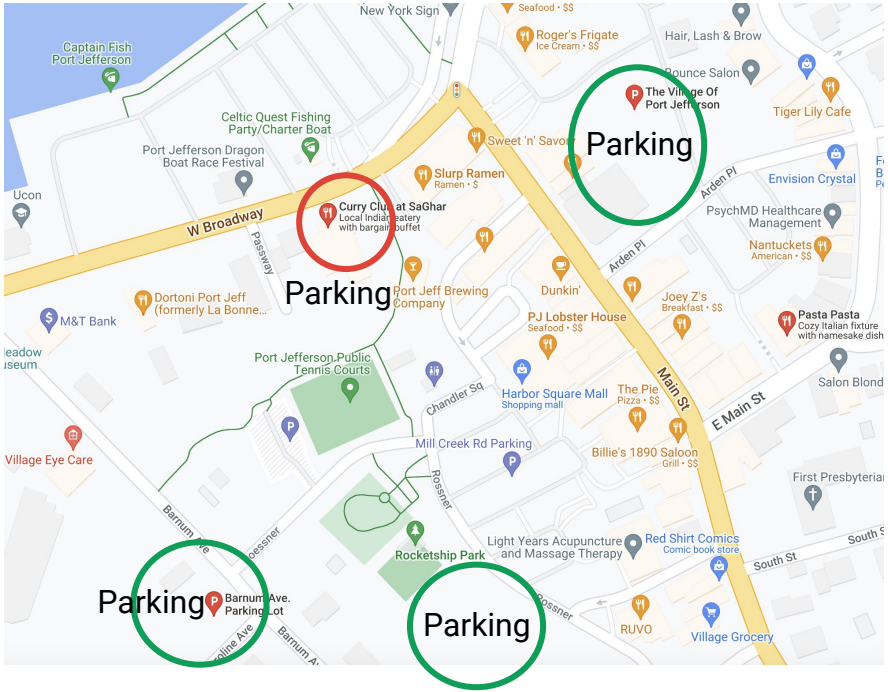
Dinner

The workshop dinner will be held on Thursday evening, 7pm, at

Curry Club at Saghar
111 W Broadway Port Jefferson, NY 11777
Thursday, June 29, 2023, 7:00 p.m
(631) 751-4845

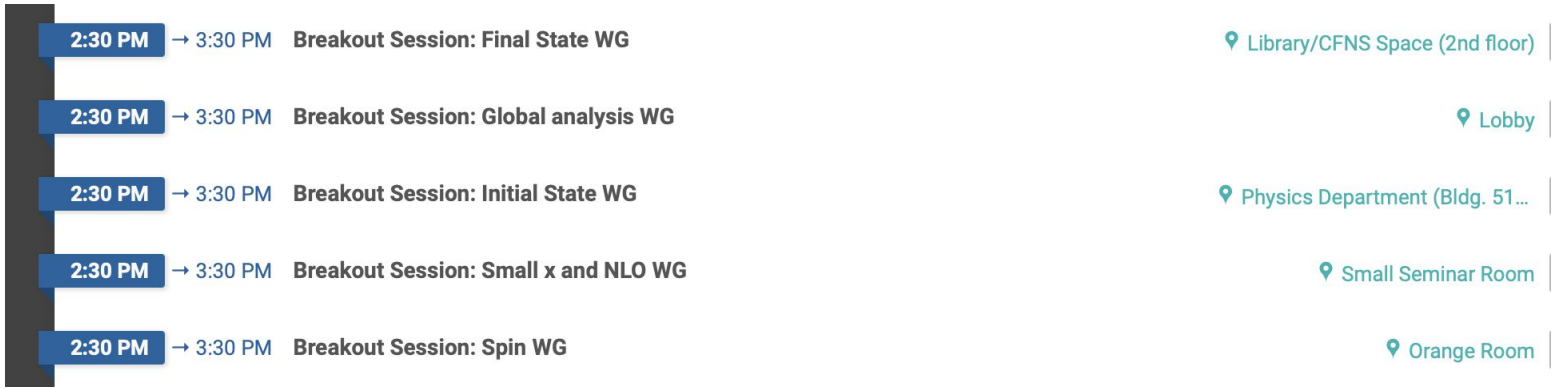
https://www.curryclubatsaghar.com/

You will need to pay yourself
(as there was no registration fee)



Breakout session and discussion

Thursday afternoon, working groups have a chance for an in-person meeting.



After that will be the discussion session

Physics questions

- **Initial conditions:** How to parametrize and/or compute initial conditions for the evolution ?
- **Small x evolution:** LO evolution is not sufficient for accuracy. Need the NLO and beyond. How to consistently implement resummation in non-linear evolution and match small with large x, relevant for EIC kinematic regime ?
- **Impact factors:** Need impact factors at NLO for accuracy. For many observables analytical and numerical implementations are missing.
- **Spin:** How proton spin emerges from spins and angular orbital momenta of quarks and gluons? What is the contribution of the small x region to the proton spin ?
- **Hadronization:** How hadronization is affected by the presence of saturated gluons ?
- **Global analysis:** Much progress made in increasing accuracy of cross sections in the collinear approach. Need to increase accuracy of predictions based on high energy factorization.

Topics and working groups

Initial state WG
Improve the initial conditions for evolution for unpolarized and polarized observables.

Small x evolution + NLO calculations WG
Non-linear evolution at NLO and beyond, computation and implementation of impact factors

Spin WG
Analyze role saturation in the polarized observables. Elucidate the role of chiral anomaly in small x helicity evolution.

Final states WG
Construct a framework for hadronization in a saturated environment, including development of MC generator based on CGC calculations

Global analysis WG
To establish saturation, perform comprehensive global analysis quantifying and minimizing uncertainties, extracting universal building blocks of high energy factorization.

Have a good meeting!