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WILLIAM I. FINE THEORETICAL PHYSICS INSTITUTE

The 10th biennial presentation of Continuous Advances in QCD

May 16 - 19, 2013

University of Minnesota, Minneapolis, MN

WELCOME TO CONTINUOUS ADVANCES IN QCD 2013

In Keeping with the CAQCD workshop tradition, we intend to cover a broad range of questions reaching far beyond conventional QCD topics; supersymmetry-based methods to ideas inspired by strings or branes; the ‘t Hooft large-N limit to axion-like particles, the TeV energies to the length scales of the size of the Universe.

The foremost goal of the workshop is to gather as many enthusiastic theorists as possible and to recharge the community, directing it toward exciting advances and breakthrough developments.

The workshop is sponsored and organized by the William I. Fine Theoretical Physics Institute, part of the School of Physics and Astronomy, at the University of Minnesota.

We appreciate your contribution to this exciting event, thank you for your participation.

Scientific Organizing Committee:

Keith Olive
Mikhail Shifman
Arkady Vainshtein
Mikhail Voloshin

http://www.ftpi.umn.edu/workshops/2012-2013/qcd2013/index.html
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<tr>
<td>8:40 AM</td>
<td>Registration opens</td>
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<tr>
<td>8:55 AM</td>
<td>Mikhail Voloshin</td>
<td>University of Minnesota</td>
<td>Welcome and Opening Remarks</td>
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<tr>
<td>9:00 AM</td>
<td>Kenichi Konishi</td>
<td>University of Pisa</td>
<td>Quark Confinement Via Strongly-Interacting NonAbelian Monopoles</td>
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<td>9:45 AM</td>
<td>Amihay Hanany</td>
<td>Imperial College, London</td>
<td>Quiver Block Models, SCFTs and Diophantine Equations</td>
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<td>Alexander Gorsky</td>
<td>ITEP</td>
<td>Baryon as Dyonic Instanton</td>
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<td>11:45 AM</td>
<td>Alexei Yung</td>
<td>PNPI, St. Petersburg and University of Minnesota</td>
<td>Seiberg’s Duality and N=2 SQCD</td>
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<td>LUNCH BREAK</td>
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<td>Thomas Cohen</td>
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<td>Nucleon-Nucleon Scattering at Large $N_c$</td>
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<td>Richard Lebed</td>
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<td>Decays of Muons: Free and Bound</td>
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<td>4:45 PM</td>
<td>Ian Balitsky</td>
<td>Old Dominion University</td>
<td>NLO BFKL and Anomalous Dimensions of Light-Ray Operators</td>
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Friday, May 17th

Hubert H. Humphrey School of Public Affairs
Cowles Auditorium

9:00 AM  **Jacobus Verbaarschot**  
*Stony Brook University*  
Collective Fluctuations of Wilson Dirac Spectra and First Order Phase Transitions

9:45 AM  **Nikita Nekrasov**  
*Simons Center for Geometry and Physics*  
On BPS/CFT Correspondence

10:30 AM  **COFFEE BREAK**

11:00 AM  **Mithat Unsal**  
*San Francisco State University*  
Resurgence and Trans-series in Quantum Field Theory

11:45 AM  **Gerald Dunne**  
*University of Connecticut*  
Resurgence: Exact WKB in QM and QFT

12:30 PM  **LUNCH BREAK**  
*Lunch is on your own. Please refer to the dining guide in the back of this booklet.*

2:00 PM  **Vladimir Braun**  
*University of Regensburg*  
Operator Product Expansion in QCD in Off-Forward Kinematics
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<td>Peter Koroteev</td>
<td>Perimeter Institute for Theoretical Physics</td>
<td>3d Quiver Theories and Integrability</td>
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<td>Eric Zhitnitsky</td>
<td>University of British Columbia</td>
<td>QCD as Topologically Ordered System</td>
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Friday, May 17th

Hubert H. Humphrey School of Public Affairs
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2013
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Saturday, May 18th
Hubert H. Humphrey School of Public Affairs
Cowles Auditorium

9:00 AM  Zvi Bern
University of California, Los Angeles
UV Surprises in Supergravity and its Relation to QCD

9:45 AM  Erich Poppitz
University of Toronto
Continuity, Deconfinement, and Super-Yang-Mills Theory

10:30 AM  COFFEE BREAK

11:00 AM  Adam Ritz
University of Victoria
Chiral Conductivities and Effective Field Theory

11:45 AM  Edward Shuryak
Stony Brook University
Understanding Chiral Symmetry and Deconfinement Via the Instanton-Dyons

12:30 PM  LUNCH BREAK
Lunch is on your own. Please refer to the dining guide in the back of this booklet.

2:00 PM  Hiromichi Nishimura
University of Bielefeld
Monopoles and Instantons in Confining Gauge Theories with Higgs
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<td>Washington University</td>
<td>Duality and Gauge Theories at Finite Density</td>
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<td><strong>DINNER</strong></td>
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<td>5:30 PM</td>
<td>Bus begins loading at the Humphrey School Conference Center for the Museum of Russian Art. Locals please see website for driving directions.</td>
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<td>6:00 PM</td>
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<td>6:45 PM</td>
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University of Minnesota, Minneapolis, MN

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Sunday, May 19th

Hubert H. Humphrey School of Public Affairs
Cowles Auditorium

9:00 AM  Igor Shovkovy  
*Arizona State University*  
Unusual Properties of Relativistic Matter in Strong Magnetic Fields

9:45 AM  Anatoly Radyushkin  
*Old Dominion University*  
Singularities of Generalized Parton Distributions

10:30 AM  **COFFEE BREAK**

11:00 AM  Maxim Pospelov  
*University of Victoria*  
Review of the “Proton Radius Puzzle”

11:45 AM  Mikhail Shifman  
*University of Minnesota*  
Counting Goldstone Modes on Abrikosov-Nielsen-Olesen String

12:30 PM  Workshop closing
Kenichi Konishi, University of Pisa
Quark Confinement Via Strongly-Interacting NonAbelian Monopoles

New kinds of confinement phase appear when singular SCFT’s appearing as infrared-fixed-point of N=2 supersymmetric QCD are deformed by an N=1 adjoint mass term. Based on some remarkable developments in the understanding of these SCFT of highest criticality by Gaiotto, Seiberg and Tachikawa, we analyze the physics of such confining systems with SU(N), USp(2N) and SO(N) gauge groups. They show features different from a straightforward dual superconductivity picture of confinement a’ la Nambu, ‘t Hooft and Mandelstam, reflecting the presence of strongly-coupled nonAbelian monopoles. This could suggest a new possible confinement picture for the standard QCD.

Amihay Hanany, Imperial College, London
Quiver Block Models, SCFTs and Diophantine Equations

A certain class of superconformal field theories arises in string theory through a quiver construction from branes which probe singular spaces. These are known as the three block models and their higher block analogs - the n block models. The talk will introduce this class of theories and will discuss the conditions for conformal invariance that result in a set of Diophantine equations with an infinite number of solutions that are nicely organized into a tree. We will find the Markov equation for 3 block models and some higher dimensional analogs for n block models with n=4, 5.

Alexander Gorsky, ITEP
Baryon as Dyonic Instanton

We suggest the new mechanism of the stabilization of the skyrmion size. It is based on the particular solution in the holographic QCD with two quantum numbers. The size turns out to be related to the quark condensate.

Alexei Yung, PNPI, St. Petersburg and University of Minnesota
Seiberg’s Duality and N=2 SQCD

We consider N=2 supersymmetric QCD with gauge group U(N) and N_f flavors of quarks deformed by the mass term \mu for the adjoint matter. At small \mu in the r-vacua, where r quarks condense the low energy theory has U(r)xU(1)^{N-r} gauge group. We consider so called zero vacua which are present at r < (N_f-N) and show that at large \mu the low energy physics in these vacua can be described in terms of weakly coupled infrared-free \mu-dual theory with U(N_f-N) gauge group. In this theory r quarks condense triggering confinement of monopoles. We compare \mu-dual theory in zero vacua with Seiberg’s dual and find a perfect match. This match
reveals the physical nature of Seiberg’s dual quarks. They turn out to be the ordinary quarks of the original theory rather than monopoles. We also review the phase structure of N=1 QCD at large \( \mu \).

**Thomas Cohen, University of Maryland**  
Nucleon-Nucleon Scattering at Large Nc

The total nucleon-nucleon cross-section for momenta much larger than the QCD is calculated in the extreme large Nc limit where Log(Nc) is much larger than the unity and a simple analytic result is obtained. The result is discussed in the context of the Froissart–Martin bound.

**Richard Lebed, Arizona State University**  
Does the Lattice Pick a Unique Large Nc Expansion?

My CAQCD 2011 talk showed that understanding the experimental baryon mass spectrum requires both an SU(3) flavor-breaking expansion (with parameter e) and a \( 1/N_c \) expansion, but this conclusion is surprisingly agnostic as to whether the quarks transform in the fundamental or two-index antisymmetric color representation. Now that reliable lattice QCD simulations of the masses are available for various values of e, one can confirm the robustness of the large Nc results independent of the flavor physics. Moreover, the baryon mass relations hold even in alternate prescriptions for identifying physical baryon states with particular members of the large Nc SU(3) multiplets.

**Andrzej Czarnecki, University of Alberta**  
Decays of Muons: Free and Bound

I will describe recent progress in the theoretical description of the free and bound muon decay, including radiative corrections.

**Ian Balitsky, Old Dominion University**  
NLO BFKL and Anomalous Dimensions of Light-Ray Operators

The anomalous dimensions of light-ray operators of twist two are obtained by analytical continuation of the anomalous dimensions of corresponding local operators. I demonstrate that the asymptotics of these anomalous dimensions at the “BFKL point” \( j \to 1 \) can be obtained from the comparison of the light-cone operator expansion with the high-energy expansion in Wilson lines.

**Jacobus Verbaarschot, Stony Brook University**  
Collective Fluctuations of Wilson Dirac Spectra and First Order Phase Transitions

We analyze spectra of the Wilson Dirac operator. In the continuum limit, this operator has a gap equal to the quark mass, but at finite lattice spacing states intrude inside the gap. At the critical
point where the gap closes, a second order phase transition to a new phase with broken parity, known as the Aoki phase, takes place. However, for dynamical quarks, collective fluctuations of the Dirac spectrum may lead to a first order phase transition. In this case the gap does not close and the pseudo-Goldstone bosons remain massive at the phase transition point. This result based on chiral Lagrangians explains that such first order phase transition cannot occur in the quenched approximation in agreement with existing lattice QCD simulations.

Nikita Nekrasov, Simons Center for Geometry and Physics

On BPS/CFT Correspondence

Status report on the 2004 conjecture relating the vacuum condensates of chiral observables in supersymmetric gauge theories and the correlation functions in two(+) dimensional theories with infinite dimensional chiral symmetry, such as CFT or its q-deformation.

Mithat Unsal, San Francisco State University

Resurgence and Trans-series in Quantum Field Theory

I describe a method which may potentially provide a non-perturbative continuum definition of quantum field theory (QFT). The method is of practical utility for general QFT and relies on two recent ideas from mathematics and QFT. The ideas from mathematics are resurgence theory, the trans-series framework, and Borel-Ecalle resummation (work of Jean Ecalle from 80s), and the one from QFT employs adiabatic continuity. The method gives a physical interpretation of the elusive IR renormalon ambiguity in perturbation theory. The ambiguity is a Stokes jump/crossing and is mirrored by the topological sector of the QFT by neutral bions, leading to a cancellation thereof. We show that a new notion of graded resurgence triangle is necessary to capture the path integral approach to resurgence. I discuss these in two dimensional CP(N) and four dimensional QCD compactified on a circle. This talk is a summary of recent work with Argyres and Dunne.

Gerald Dunne, University of Connecticut

Resurgence: Exact WKB in QM and QFT

I introduce the concept of “resurgent” semiclassical analysis, a systematic approach to all-orders WKB, and explain how it can be applied to resolve problems in quantum theories with degenerate minima. Illustrations include double-well and periodic potentials in QM, and asymptotically free QFTs such as CPN and Yang-Mills, where this resurgent approach yields a new semiclassical interpretation of IR renormalons.

Vladimir Braun, University of Regensburg

Operator Product Expansion in QCD in Off-Forward Kinematics

We develop a general approach to the calculation of target mass and finite t=(p’-p)2 corrections in hard processes which involve momentum transfer from the initial to the final hadron state. Such corrections, which are usually referred to as kinematic, can be defined as contributions of operators of all twists that can be reduced to total derivatives of the leading twist operators.
As the principal result, we provide a set of projection operators that pick up the “kinematic” part of an arbitrary flavor-nonsinglet twist-four operator in QCD. A complete expression is derived for the time-ordered product of two electromagnetic currents that includes all kinematic corrections to twist-four accuracy. The results are immediately applicable to the studies of deeply-virtual Compton scattering, transition $\gamma^* \rightarrow M \gamma$ form factors and related processes.

Alexander Khodjamirian, University of Siegen
Photoleptonic Decay of $B$-meson Beyond QCD Factorization

The photoleptonic $B \rightarrow \gamma \ell \nu$, decay at large energies of the photon receives an important nonfactorizable soft contribution which is formally of the next-to-leading order in the expansion in the inverse photon energy. We calculate this contribution in the framework of heavy-quark expansion and soft-collinear effective theory, making use of dispersion relation and quarkâ€“hadron duality, in a full analogy with a similar contribution to the pion-photon transition form factor. This result strengthens the case of using the photoleptonic $B$ decay to extract the $B$-meson distribution amplitude and its inverse moment.

Peter Koroteev, Perimeter Institute for Theoretical Physics
3d Quiver Theories and Integrability

We compare different descriptions of the space of vacua of certain three dimensional $N=4$ superconformal field theories, compactified on a circle and mass-deformed to $N=2$ in a canonical way. The original $N=4$ theories are known to admit two distinct mirror descriptions as linear quiver gauge theories, and many more descriptions which involve the compactification on a segment of four-dimensional $N=4$ super Yang-Mills theory. Each description gives a distinct presentation of the moduli space of vacua. Our main result is to establish the precise dictionary between these presentations. We also study the relationship between this gauge theory problem and integrable systems. The space of vacua in the linear quiver gauge theory description is related by Nekrasov-Shatashvili duality to the eigenvalues of quantum integrable spin chain Hamiltonians. The space of vacua in the four-dimensional gauge theory description is related to the solution of certain integrable classical many-body problems. Thus we obtain numerous dualities between these integrable models.

Eric Zhitnitsky, University of British Columbia
QCD as Topologically Ordered System

We argue that QCD belongs to a topologically ordered phase similar to many well-known condensed matter systems with a gap such as topological insulators or superconductors. Our arguments are based on analysis of the so-called “deformed QCD” which is a weakly coupled gauge theory, but nevertheless preserves all crucial elements of strongly interacting QCD, including confinement, nontrivial theta dependence, degeneracy of the topological sectors, etc. Furthermore, we interpret the well-known resolution of the celebrated $U(1)_A$ problem when would be $U(1)$ Goldstone boson generates its mass as a result of mixing of the Goldstone field with a topological auxiliary field characterizing the system. We identify the non-propagating auxiliary topological field in BF formulation in deformed QCD with the Veneziano ghost. Finally, we elaborate on relation between “string-net” condensation in topologically ordered condensed matter systems and long range coherent
configurations, the “skeletons,” studied in QCD lattice simulations.

10th

Zvi Bern, University of California, Los Angeles
UV Surprises in Supergravity and its Relation to QCD

New calculations in N=8 and N=4 supergravity display a surprisingly good ultraviolet behavior. The recently discovered duality between color and kinematics not only helps us carry out the calculations but it offers a link between the UV behavior of gravity and gauge theories.

Erich Poppitz, University of Toronto

We argue that a quantum phase transition in super-Yang-Mills theory with soft-breaking terms, which can be studied in a theoretically controlled way, is continuously connected to the deconfinement phase transition in pure Yang-Mills theory for all simple gauge groups. We use the twisted partition function on \( R^3 \times S^1 \) and consider gauge theories with a center symmetry, such as SU\( (N_c) \) gauge theory, as well as theories without a center symmetry, such as \( G_2 \) gauge theory. The mechanism governing the phase transition is universal and valid for all simple groups. The perturbative one-loop potential as well as monopole-instantons generate attraction among the eigenvalues of the Wilson line. This is counter-acted by neutral bions --- topological excitations which generate eigenvalue repulsion for all simple groups. The transition is driven by the competition between these three effects. We study the transition in more detail for the gauge groups SU\( (N_c) \) and \( G_2 \). In the case of \( G_2 \), there is no change of symmetry, but the expectation value of the Wilson line exhibits a discontinuity. We also examine the effect of the theta-angle on the phase transition and critical temperature \( T_c(\Theta) \). The critical temperature is a multi-branched function, which has a minimum at \( \Theta=\pi \) as a result of topological interference. We compare our results with recent lattice studies and discuss future directions.

Adam Ritz, University of Victoria
Chiral Conductivities and Effective Field Theory

A 3D spatial effective field theory, capturing the low-momentum static correlation functions of a wide class of 4D field theories at finite temperature and chemical potential, is used to describe and constrain P-violating chiral conductivities in hydrodynamic constitutive relations. This setup can incorporate anomalous global currents in the presence of dynamical gauge fields, and allows the computation of infrared-sensitive perturbative corrections to e.g. the chiral vortical conductivity.

Edward Shuryak, Stony Brook University
Understanding Chiral Symmetry and Deconfinement Via the Instanton-Dyons

The talk is a summary of three works on ensemble of gauge topology (instanton-dyons) at finite temperatures. Analytic models and numerical statistical simulations are applied. We study
fermion mode collectivization and chiral symmetry breaking, as well as confinement (via back reaction on the holonomy potential).

Hiromichi Nishimura, University of Bielefeld
Monopoles and Instantons in Confining Gauge Theories with Higgs

We extend recent work on QCD-like gauge theories with high-temperature confinement on $\mathbb{R}^3 \times S^1$ with scalar fields. The model shows a rich phase structure with a new confined phase where the Polyakov loop mixes with the scalar field. Each phase can be categorized by topological objects that generalize the instanton constituents of BPS and KK monopoles in Euclidean space, and they give rise to the Wilson loop string tension in portions of all phases. I will discuss the relationship between the monopoles in the model and Julia-Zee dyons in Minkowski space using Poisson duality.

Michael Ogilvie, Washington University
Duality and Gauge Theories at Finite Density

The occurrence of complex weights in the path integral is a major obstacle in the study of finite-density QCD using lattice methods. For corresponding Abelian lattice models, an analytic duality transformation turns complex actions into theories with real actions, solving the sign problem for these models. However, many of the dual forms are known to have a complicated phase structure with many spatially-modulated phases. There are several indications that similar behavior is present in finite-density QCD.

Leonid Glozman, University of Graz
Chiral Symmetry Breaking, Confinement and the Mass Generation of Hadrons

Hadrons (except for a pion) survive the artificial restoration of chiral symmetry upon removal of the low-lying modes of the Dirac operator and their mass is surprisingly large. Hadrons reveal in this regime some higher symmetry that includes the chiral group as a subgroup. The $U(1)_A$ symmetry is not restored. We also discuss the effect of the low-lying modes on hadrons.

Thomas Mannel, Siegen University
The Electric Dipole Moment of the Neutron as a Probe of New Physics

I will discuss the calculation of the electric dipole moment of the neutron in the standard model, identifying contributions which have not been discussed yet. Depending on the size of the unknown hadronic matrix elements these contributions could significantly enlarge the electric dipole moment compared to the previous estimates. The impact on the search for effects beyond the standard model is discussed.
Relativistic models in strong magnetic fields are of interest in basic and applied physics (i.e., astrophysics, neutron stars, graphene, etc.). Some properties of such models are well known. For example, the vacuum state is a strong magnetic field is governed by the magnetic catalysis. In this talk, I will argue that the regime of finite density also has interesting and unusual properties. In particular, the ground state is characterized by the so-called chiral shift, which is defined as a relative shift of the longitudinal momenta in the dispersion relations of opposite chirality fermions. The chiral shift is expected to modify the axial current density and affect transport and emission properties of magnetized matter.

Anatoly Radyushkin, Old Dominion University
Singularities of Generalized Parton Distributions

We discuss recent developments in building models for GPDs that are based on the formalism of double distributions (DDs). The DD formalism is applied to construction of a model GPDs with a singular Regge behavior. This approach is compared with an alternative prescription based on analytic regularization.

Maxim Pospelov, University of Victoria
Review of the “Proton Radius Puzzle”

The measurement of the proton radius using the Lamb shift of the muonic hydrogen is 7σ discrepant with the determinations of the same quantity from the e-p scattering and regular hydrogen Lamb shift. I will review possible resolutions of this discrepancy, and outline new theoretical and experimental ideas that could help resolve the issue.

Mikhail Shifman, University of Minnesota
Counting Goldstone Modes on Abrikosov-Nielsen-Olesen String

It is generally believed that the spontaneous breaking of the Poincare group by flux tubes (strings) generate only two zero modes localized on the string and associated with the spontaneous breaking of translational invariance (the so-called Low-Manohar argument). Being perfectly true in many instances it is nevertheless nonuniversal, and has to be amended in the case of order parameters carrying spatial indices. We show that under certain circumstances additional zero (or quasizero) modes can appear due to spin symmetry.
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WILLIAM I. FINE THEORETICAL PHYSICS INSTITUTE

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University of Minnesota, Minneapolis, MN

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University of Minnesota
WILLIAM I. FINE THEORETICAL PHYSICS INSTITUTE

The 10th biennial presentation of Continuous Advances in QCD

May 16 - 19, 2013
University of Minnesota, Minneapolis, MN

WORKSHOP DINNER AT
THE MUSEUM OF RUSSIAN ART
SATURDAY, MAY 18TH

Out of town guests of the CAQCD 2013 Workshop will be transported to the dinner via chartered bus. Guests should meet the bus in front of the Hubert H. Humphrey Center immediately following the last talk on Saturday at 5:30 PM. The bus will leave promptly at 5:40 PM.

Local dinner participants are responsible for finding their own transportation to and from dinner. Local participants who wish to take the chartered bus MUST talk to workshop staff in advance to check for space.

Driving directions for local participants to:
The Museum of Russian Art
5500 Stevens Ave S
Minneapolis, MN 55419

From The Hotel Minneapolis Metrodome:
Head west of Washington Ave South toward Cedar Ave
Take the 1st right to stay on Washington Ave South
Turn left to merge onto I-35W S
Take Exit 12 toward Diamond Lake
Merge onto Stevens Ave
Destination will be on the right
ADDITIONAL INFORMATION

1) **Hotel:** Hotel Minneapolis Metrodome
2) **Workshop Location:** Hubert H. Humphrey School of Public Affairs
3) **FTPI:** 116 Church Street SE
4) **Dinkytown**
5) **Stadium Village**
The 10th biennial presentation of Continuous Advances in QCD
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WALKING DIRECTIONS TO EAST BANK/COFFMAN MEMORIAL UNION
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WEST BANK DINING GUIDE

1. Maxwell's American Pub
   1201 Washington Avenue

2. Jewel of India
   1427 Washington Avenue

3. Town Hall Brewery
   1430 Washington Avenue

4. Preston's Urban Pub
   221 Cedar Avenue

5. Chipotle Mexican Grill
   229 Cedar Avenue

6. Corner Bar
   1501 Washington Avenue

7. Noodles & Co
   233 Cedar Avenue

8. Acadia Café
   329 Cedar Avenue

9. The Wienery
   414 Cedar Avenue

10. Hard Times Café
    1821 Riverside Avenue

Delivery Options:

Jimmy John’s Sandwiches
   jimmyjohns.com
   2037 Riverside Avenue
   612-344-4444

Kindee Thai Restaurant
   kindeethairestaurant.com
   719 2nd Street South
   612-465-8303

Pizza Luce - pizzaluce.com
   2200 Franklin Avenue
   612-332-2535
INSTRUCTIONS FOR UPLOADING TALKS TO THE CONFERENCE WEBSITE

Please submit a PDF (preferred format) of your talk slides by Friday, June 14, 2013 to be included in the conference web archive. Please include your name in the file name.

1. Use the following link to access the folder: 2013 QCD Workshop
   https://netfiles.umn.edu/xythoswfs/webview/_xy-15218493_1

2. Click on the “Upload” icon at the top right of the page.

3. Select your file and click “Start Upload”. The screen should display this message: “The document was successfully uploaded to the folder, 2013 QCD Workshop” It may also tell you that the directory is empty, but this just means that you may not have permission to see the files.

All submitted talks will be archived online for general access at the University of Minnesota’s Digital Conservancy. By submitting your talk slides you are agreeing to the Digital Conservancy’s Copyright policy. For policy details see the website at: http://conservancy.umn.edu/pol-copyright.jsp

Please note that there will be a delay between your upload and final posting on the workshop website. Once all talks have been submitted, participants will be notified by email. As always, any questions may be addressed to qcd2013@physics.umn.edu

These instructions are also available online at:

http://www.ftpi.umn.edu/workshops/2012-2013/qcd2013/program.html
Wireless Internet

Workshop guests may access the University of Minnesota wireless network ‘UMNGuest’ without the need of any special login information or passwords. This unsecured network requires that you provide an email address on the homepage (which you will be redirected to upon opening your browser). If you require a secure internet connection, please inquire with staff.