

The Life and Legacy of Robert L. Sugar

Steven Gottlieb
Indiana University
Carleton DeTar
University of Utah
Aida El-Khadra
University of Illinois

Lattice 2026
University of Maryland
July 28, 2026

Outline

- ◆ Background
- ◆ Early research
- ◆ Institute for Theoretical Physics
- ◆ MILC
- ◆ USQCD
- ◆ Additional Collaborations
- ◆ Stories (if time)

In the beginning...

- ◆ Robert Louis Sugar was born in August, 1938 in Chicago, Illinois
 - Grew up in New Jersey; New Rochelle, New York; Shaker Heights, Ohio
- ◆ Harvard University, A.B., *summa cum laude*, 1960
- ◆ Princeton University, Ph.D., 1964
- ◆ Columbia University, postdoc, 1964-1966
- ◆ University of California, Santa Barbara
 - Assistant Professor, 1966-1969
 - Associate Professor, 1969-1973
 - Professor, 1973-2003
 - Institute for Theoretical Physics, Deputy Director, 1979-1981, 1985-1985
 - Department Chair, 1994-1997
 - Professor Emeritus, 2003-2026

Thesis and Early Work



Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.
- ◆ Subsequently worked on π - π scattering.

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.
- ◆ Subsequently worked on π - π scattering.
- ◆ Many years later, Bob's chemist nephew asked him, "Are you the Sugar of the Blankenbecler-Sugar equation?"

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.
- ◆ Subsequently worked on π - π scattering.
- ◆ Many years later, Bob's chemist nephew asked him, "Are you the Sugar of the Blankenbecler-Sugar equation?"
- ◆ Bob responded, "What is that? Uh, must be, because both Blankenbecler and Sugar are very unusual names. So it must be."

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.
- ◆ Subsequently worked on π - π scattering.
- ◆ Many years later, Bob's chemist nephew asked him, "Are you the Sugar of the Blankenbecler-Sugar equation?"
- ◆ Bob responded, "What is that? Uh, must be, because both Blankenbecler and Sugar are very unusual names. So it must be."
- ◆ His nephew said, "Oh, this is very, very widely used to study scattering in atomic physics. You have hundreds and hundreds of citations for this paper!"

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.
- ◆ Subsequently worked on π - π scattering.
- ◆ Many years later, Bob's chemist nephew asked him, "Are you the Sugar of the Blankenbecler-Sugar equation?"
- ◆ Bob responded, "What is that? Uh, must be, because both Blankenbecler and Sugar are very unusual names. So it must be."
- ◆ His nephew said, "Oh, this is very, very widely used to study scattering in atomic physics. You have hundreds and hundreds of citations for this paper!"
- ◆ Bob had no idea. [Phys.Rev. 142 (1966) 1051; 705 citations]

Thesis and Early Work

- ◆ Bob worked with Dick Blankenbecler who became a life long friend.
- ◆ His thesis was on bounding phase shifts for positron scattering from a hydrogen atom.
- ◆ Subsequently worked on π - π scattering.
- ◆ Many years later, Bob's chemist nephew asked him, "Are you the Sugar of the Blankenbecler-Sugar equation?"
- ◆ Bob responded, "What is that? Uh, must be, because both Blankenbecler and Sugar are very unusual names. So it must be."
- ◆ His nephew said, "Oh, this is very, very widely used to study scattering in atomic physics. You have hundreds and hundreds of citations for this paper!"
- ◆ Bob had no idea. [Phys.Rev. 142 (1966) 1051; 705 citations]

Romance



Romance



- Bob started to date Joan (the roommate of his cousin Louise) while in grad school

Romance



- Bob started to date Joan (the roommate of his cousin Louise) while in grad school
- On an early date, Bob surprised Joan when a special birthday dessert arrived at the end of their meal.

Romance



- Bob started to date Joan (the roommate of his cousin Louise) while in grad school
- On an early date, Bob surprised Joan when a special birthday dessert arrived at the end of their meal.
- Joan had no idea how Bob knew it was her birthday.

Romance



- Bob started to date Joan (the roommate of his cousin Louise) while in grad school
- On an early date, Bob surprised Joan when a special birthday dessert arrived at the end of their meal.
- Joan had no idea how Bob knew it was her birthday.
- Actually, he arranged the date to celebrate his birthday.

Romance



- Bob started to date Joan (the roommate of his cousin Louise) while in grad school
- On an early date, Bob surprised Joan when a special birthday dessert arrived at the end of their meal.
- Joan had no idea how Bob knew it was her birthday.
- Actually, he arranged the date to celebrate his birthday.
- They were born on the same day!

Romance



- Bob started to date Joan (the roommate of his cousin Louise) while in grad school
- On an early date, Bob surprised Joan when a special birthday dessert arrived at the end of their meal.
- Joan had no idea how Bob knew it was her birthday.
- Actually, he arranged the date to celebrate his birthday.
- They were born on the same day!
- During his time at Columbia Bob and Joan married and then moved to Santa Barbara.

1970s and early 1980s

- Reggeon Field Theory: Formulation and Use, Abarbanel, Bronzan, and Sugar, Phys. Rept. 21 (1975) 119 is one of his most cited works from the period [179 citations]
- With Scalapino, Blankenbecler, and a few others, Bob made major progress on algorithm development
- There is a slide much later with some more information.
- Referee story



Institute for Theoretical Physics

- ◆ Around 1975, Boris Kayser at the NSF conceived an institute.
- ◆ Ray Sawyer spoke with Kayser and was invited to explain how it might be organized.
- ◆ Bob was one of the four founders: Hartle, Sawyer, Scalapino, Sugar
 - Some people were against funding theoretical physics in this way.
 - There was stiff competition from other proposals, e.g., CalTech.
- ◆ A vision of very active visitors program and a truly national effort was important
 - National advisory board
 - Kip Thorne comments at Hartle 80th birthday
- ◆ Bob was deputy director for four years.
- ◆ Obviously, Kavli Institute for Theoretical Physics has had profound impact.



Photo credit: Will Swalling

Initial Work with Bob

- ◆ I had been working with Mackenzie, Thacker, and Weingarten at Fermilab in my first lattice QCD project
- ◆ I moved to UC San Diego in 1982
- ◆ Julius Kuti and Doug Toussaint arrived a year later.
 - Doug and I had been housemates in Princeton. Great to be reunited.
 - Doug had been working with Bob Sugar and Doug Scalapino on condensed matter models.
 - I soon began working with Julius, Doug, Bob, Tony Kennedy, Steffen Meyer, and Brian Pendleton on deconfinement in pure gauge QCD.
- ◆ I continued working with Bob and Doug throughout their research careers.

Φ and R Algorithms

- ◆ Bob developed the R algorithm which advanced the state of the art for staggered quarks by clever choice of the times at which to update the gauge fields.
- ◆ His co-authors contributed to testing the algorithm.
- ◆ Errors in observables were order $(\delta t)^2$ rather than δt .
- ◆ For 19 years this was the preferred algorithm for 2 or 3 flavors of staggered quarks.
- ◆ PRD **35** (1987) 2531 [530 citations]
- ◆ In 2006, Clark and Kennedy developed the Rational Hybrid Monte Carlo (RHMC) Algorithm, which has replaced the R algorithm
 - PRD **75** (2007) 011502; PRL **98** (2007) 051601

MILC

- ◆ MILC was formed in 1990, as best I can determine.
- ◆ Initial members: Claude Bernard, Tom DeGrand, Carleton DeTar, S.G., Alex Krasnitz, Michael Ogilvie, Bob Sugar, and Doug Toussaint
- ◆ Bob was our most senior member and leader.
 - Alex was my postdoc. Tom and Michael eventually moved on to other efforts.
- ◆ Initial work was on high temperature calculations
- ◆ *QCD on the iPSC/860*, The MIMD Lattice Collaboration (MILC), from Workshop on Fermion Algorithms, April 10-12, 1991 is probably first publication.
- ◆ *Finite temperature lattice QCD simulations with staggered and Wilson fermions*, MIMD Lattice Calculation and High Temperature Monte Carlo Grand Challenge Collaborations, Hot Summer Daze, Aug. 7-16, BNL

MILC II

- ◆ Studying Quarks and Gluons on MIMD Parallel Computers, International Journal of Supercomputer Applications, Vol. 5, #4, published Dec. 1, 1991
 - Bob was the corresponding author
- ◆ *QCD thermodynamics with two flavors at $N_t = 6$* , Phys. Rev. D 45, 3854, (1992). (Received Nov. 1, 1991). [68 citations]
- ◆ *The spatial structure of screening propagators in hot QCD*, Phys. Rev. Lett. 68, 2125, (1992). [73 citations]

First Refereed MILC Paper

- From MILC's first PRD paper.
- Lower points are for dynamical quarks with two flavors
- Upper points are quenched, some of which date from 1985.
- Only the middle point in the lower row if from this work.
- Left point is from 1987: S.G., W. Liu, D. Toussaint, R.L. Renken, R. L. Sugar, PRL **59**, 1513 (1987).
- scale was set by spectroscopy on $6^3 \times 24$ and $8^3 \times 24$ lattices for $N_t = 4$, $8^3 \times 24$ and $10^3 \times 24$ for $N_t = 6$.

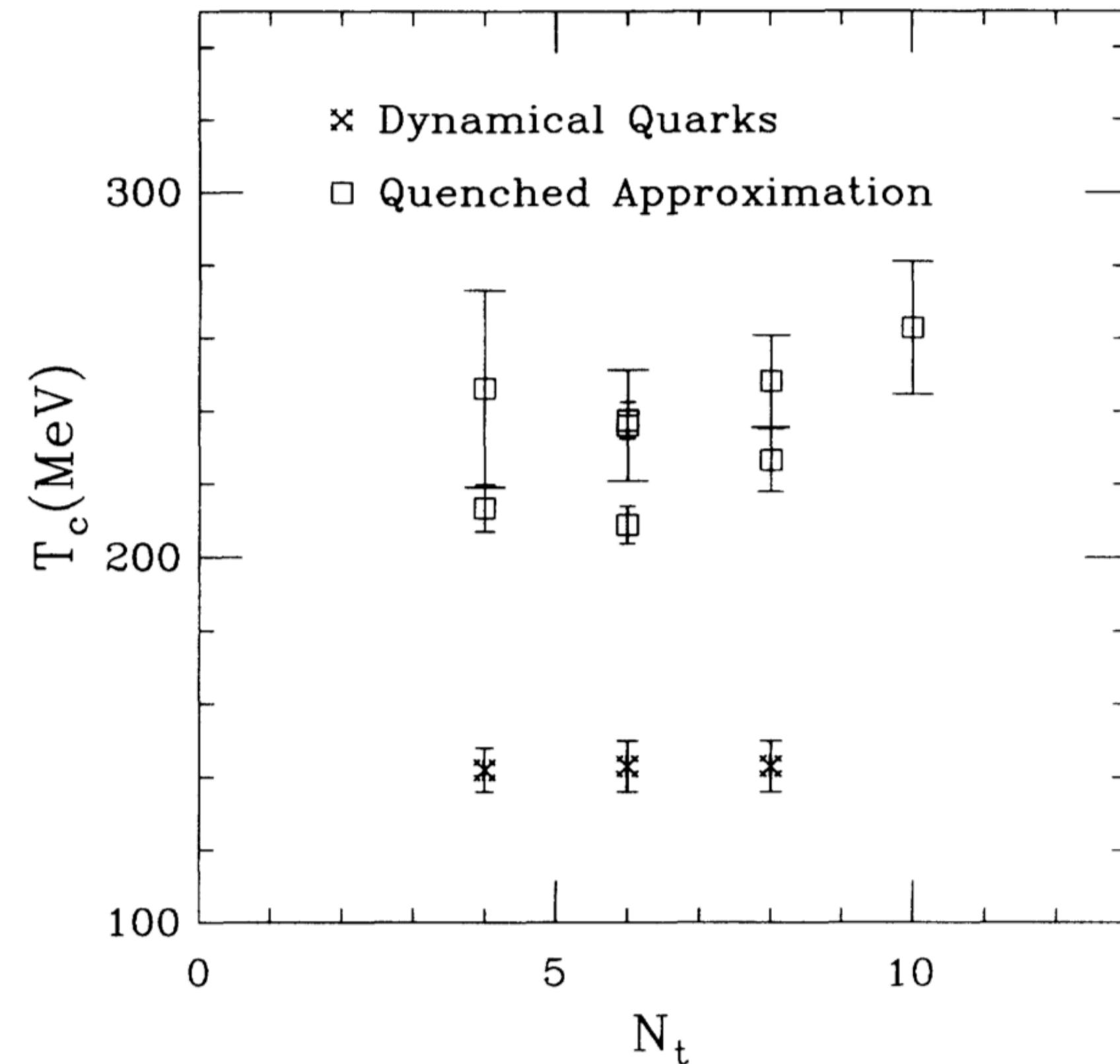


FIG. 7. The crossover temperature T_c in MeV as a function of N_t . The fancy crosses are for two flavors of dynamical quarks. The point at $N_t=4$ is from Ref. [6] and the one at $N_t=6$ from this work. The point at $N_t=8$ is from preliminary results of the $16^3 \times 8$ study of Ref. [8] combined with an extrapolation of the spectrum results of Ref. [16]. The squares are quenched results using data from Refs. [17] and [18].

Open Source, Open Data

- ◆ From early days, MILC Collaboration shared our code freely.
- ◆ We also shared configurations through the NERSC Gauge Connection and later International Lattice Data Grid (ILDG).
- ◆ Bob's openness and encouraging everyone to grow the field were important to these efforts.
- ◆ We are still active in sharing our configurations using the HISQ action.

SugarFest (1998)

- We celebrated Bob's 60th birthday in Santa Barbara
- (L to R) Dick Blankenbecler, Richard Scalletar, myself, Bob, Doug Toussaint, Doug Scalapino
- Jim Hartle wrote the QCD song in Bob's honor.



MILC Physics Program

- ◆ We had a varied program first with two dynamical quarks, and eventually with three once we switched to Asqtad action developed by LePage and HPQCD.
- ◆ Topics included thermodynamics, spectrum including exotics, leptonic decay constants, heavy meson decays, topological susceptibility.
- ◆ The program was summarized in this paper:
 - Nonperturbative QCD Simulations with 2+1 Flavors of Improved Staggered Quarks, Rev.Mod.Phys. 82 (2010) 1349-1417 [539 citations]
 - Want to highlight an early indication of the influence of strange quark.

Three Flavor Breakthrough

- High Precision Lattice QCD
Confronts Experiment, PRL **94**
(2004) 022001
- work of HPQCD, UKQCD, Fermilab
Lattice and MILC Collaborations
- This plot was the early indication that
including dynamical up, down, and
strange quarks was necessary,
- After the development of the HISQ
action the dynamical charm quark is
also included.

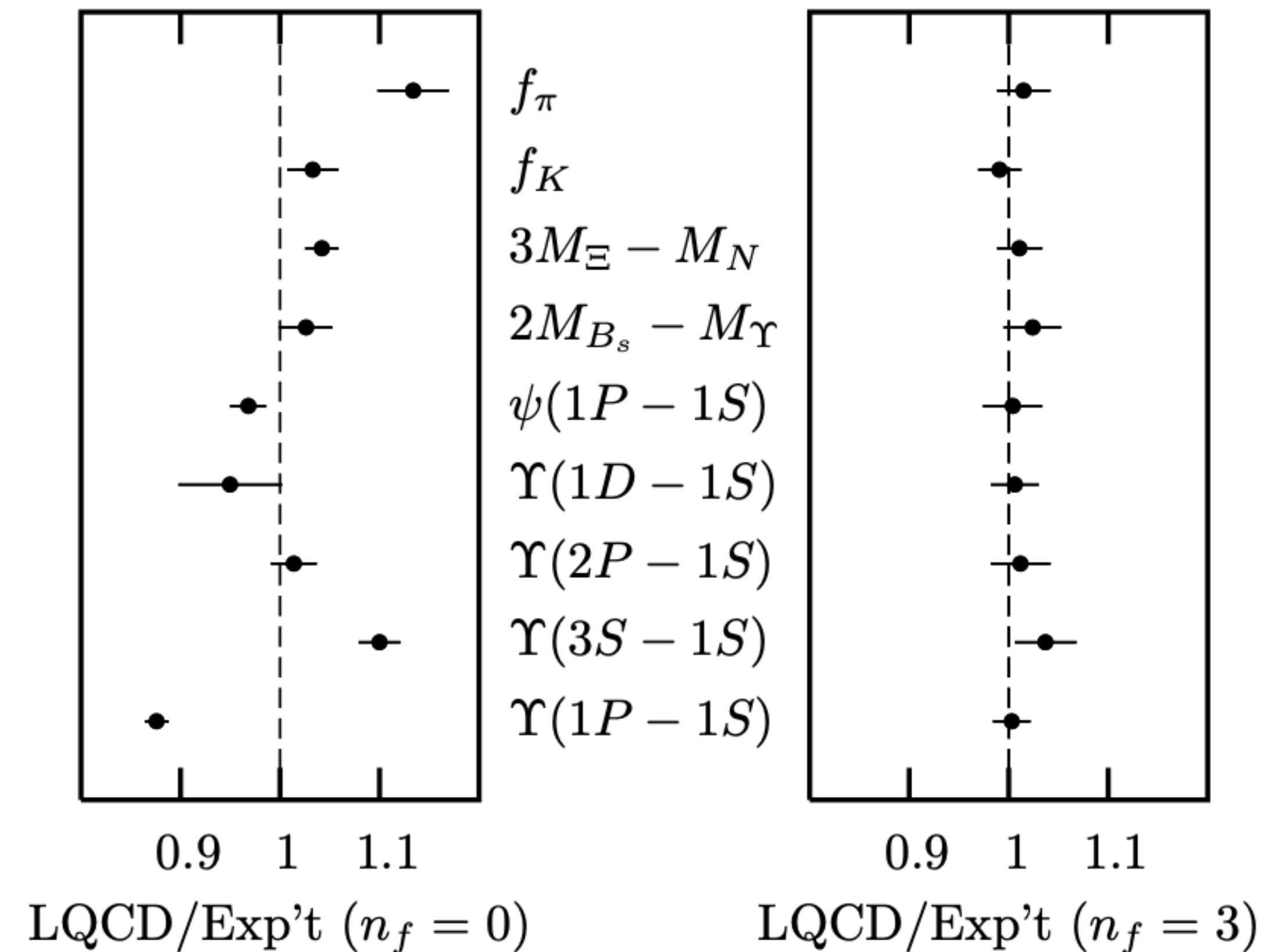


FIG. 1: LQCD results divided by experimental results for nine different quantities, without and with quark vacuum polarization (left and right panels, respectively). The top three results are from our $a = 1/11$ and $1/8$ fm simulations; all others are from $a = 1/8$ fm simulations.

USQCD

- ◆ Getting enough computer time was always a struggle.
 - Well, it still is.
- ◆ Jeff Mandula brought a group of lattice theorists together and brokered the establishment of USQCD, a community wide effort to develop software and host hardware.
- ◆ The initial executive committee (EC) was:
- ◆ Brower, Christ, Creutz, Mackenzie, Negele, Rebbi, Sharpe, Sugar & Watson
- ◆ Bob was the chair of the EC from inception in 1999 to 2009. He remained an EC member until 2016.
- ◆ Bob was succeeded by Paul Mackenzie.
 - Subsequent chairs only serve for about three years.

Executive Committee Leadership

- ◆ *It is fair to call Bob Sugar and Jeff Mandula the "Fathers of USQCD". In the late 90's Jeff Mandula and Vicky White organized and supported a small group of lattice theorists to push for funding under a new SciDAC initiative. This group, picked by Jeff, became the first USQCD Executive Committee.*

*Bob Sugar was the natural spokesperson for this group. Bob gave a critical presentation to HEPAP in October of 1999 which went well and gained the support of Robin Staffin, the head of the HEP division at the time. Funding for USQCD was finally sealed in May of 2002 during a meeting with Ray Orbach, the Director of the Office of Science. This meeting was attended on the lattice QCD side by T.D. Lee and Frank Wilczek, along with Bob and me. —**Norman Christ***

Executive Committee Leadership II

- ◆ *... my strongest impression is his tireless work at bringing together and holding together the USQCD Exec Comm and leading it successfully for many years. He did so in such a selfless manner, and always with good cheer, dealing deftly with various egos, but displaying none himself. It was the performance of a physics saint! It certainly inspired me to put in more effort and support his initiatives. I remember one visit to DC where Bob, Norman and I showed up to attend a HEPAP meeting, and lobby for LQCD support. He did a low-key but very effective job. —**Steve Sharpe***
- ◆ *I remember Bob Sugar as a good friend and valued colleague. He played a leading role in the group that established the USQCD collaboration, for which he became the first Chair, and I did my best to second his efforts. —**Claudio Rebbi***

Mentorship I

- ◆ *When I was a new faculty member at UCLA in the 1980s, I started getting interested in lattice gauge theory, but hadn't published anything in it yet. But Bob somehow got wind of my interest (I hadn't even met him yet!). He called me up out of the blue and invited me to visit the ITP for a program he was organizing about lattice issues. When I got there, he continued his mentoring of me and got me connected with others already deep into the subject, such as Doug Toussaint, Bob Pearson and John Richardson. What I learned from Bob Sugar, and from them, really jump started my research.*

*Bob continued his mentorship & friendship throughout my career. He was instrumental in getting me back to the ITP be in the late 80s, and I saw him often during my 2 years there. And in the early 90s, he and Steve Gottlieb approached me about joining the ongoing MILC collaboration, which I was thrilled to do. For many years Bob arranged for MILC members to join him in Santa Barbara in the summers to collaborate. I remember one particular visit where he showed us this thing that CERN physicists had created, called the "World Wide Web." He was really excited about it, but I didn't see the point: "What's the big deal about clicking a link to download something. That's what ftp is for." Shows who was a visionary (and who was a Luddite). —**Claude Bernard***

Mentorship II

- ◆ *I think I first met Bob at SLAC around 1986, when he was visiting Dick Blankenbecler. I was fairly new at the lattice game at that point, working with Rajan, Greg, Apoorva, and Bob was incredibly encouraging and enthusiastic. ... I got to spend some more time with him over dinner etc., and appreciate how nice a person he was. I'm sad that I didn't get to know him personally any better, or ever work on physics with him. In recent years I have read some of his work from the 1960's on amplitudes, and it is very impressive. —**Steve Sharpe***

It Pays to Double Check



It Pays to Double Check

◆ Neither Bob nor I had a talent for typing. There were sometimes typos.

It Pays to Double Check

- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.

It Pays to Double Check

- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.
- ◆ I believe we were communicating by email.

It Pays to Double Check

- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.
- ◆ I believe we were communicating by email.
- ◆ Consider the difference in the following:

It Pays to Double Check

- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.
- ◆ I believe we were communicating by email.
- ◆ Consider the difference in the following:
- ◆ You may now delete that file.

It Pays to Double Check

- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.
- ◆ I believe we were communicating by email.
- ◆ Consider the difference in the following:
- ◆ You may now delete that file.
- ◆ You may not delete that file.

It Pays to Double Check

- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.
- ◆ I believe we were communicating by email.
- ◆ Consider the difference in the following:
- ◆ You may now delete that file.
- ◆ You may not delete that file.

It Pays to Double Check

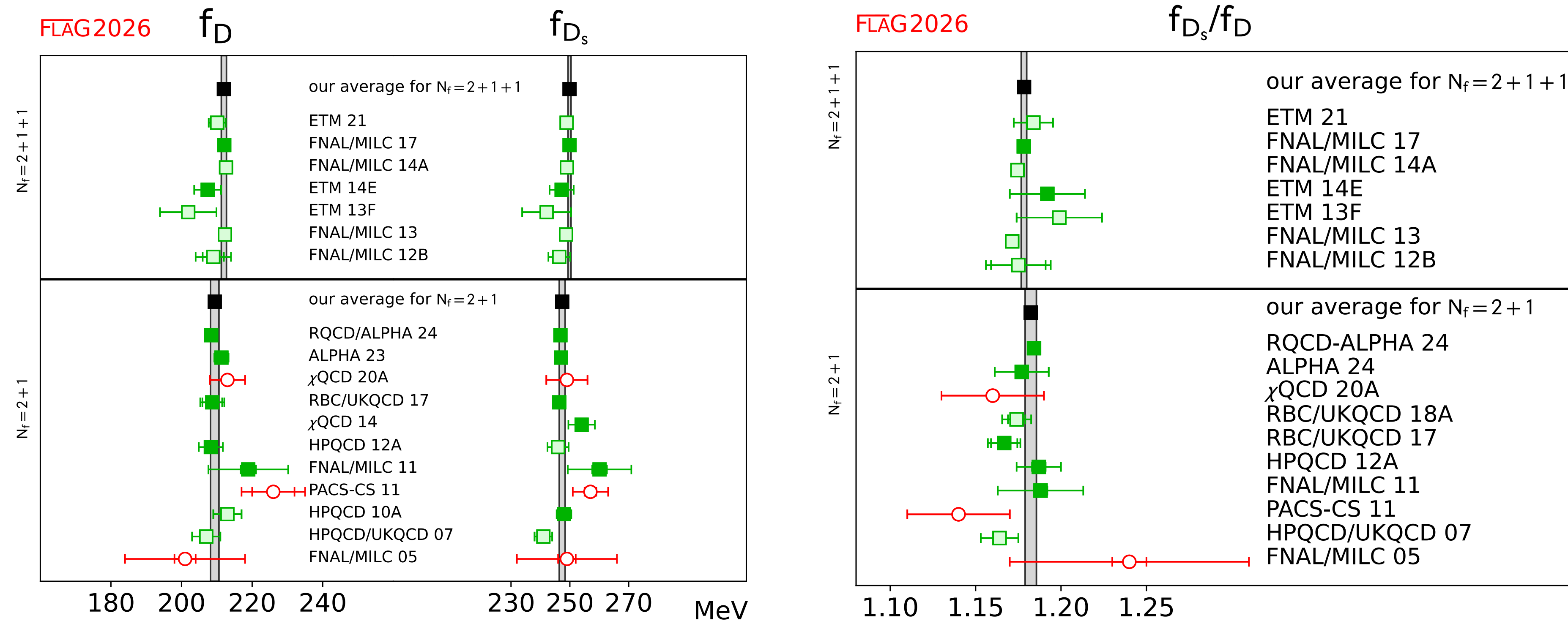
- ◆ Neither Bob nor I had a talent for typing. There were sometimes typos.
- ◆ Disk space was tight on the ST100 and in those days copying a file could take quite a bit of time.
- ◆ I believe we were communicating by email.
- ◆ Consider the difference in the following:
- ◆ You may now delete that file.
- ◆ You may not delete that file.

- ◆ What a difference a byte can make! We learned how important it is to double check.

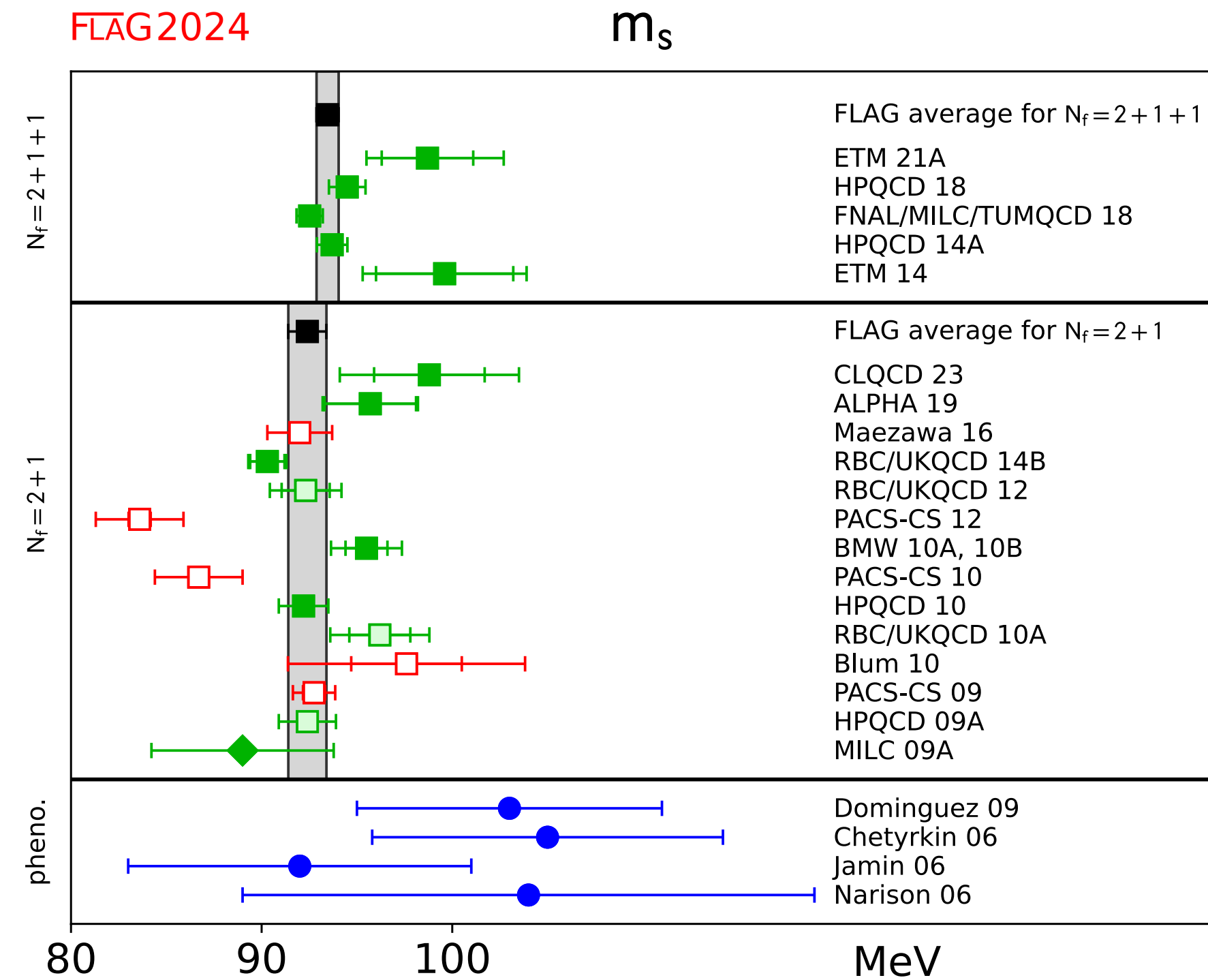
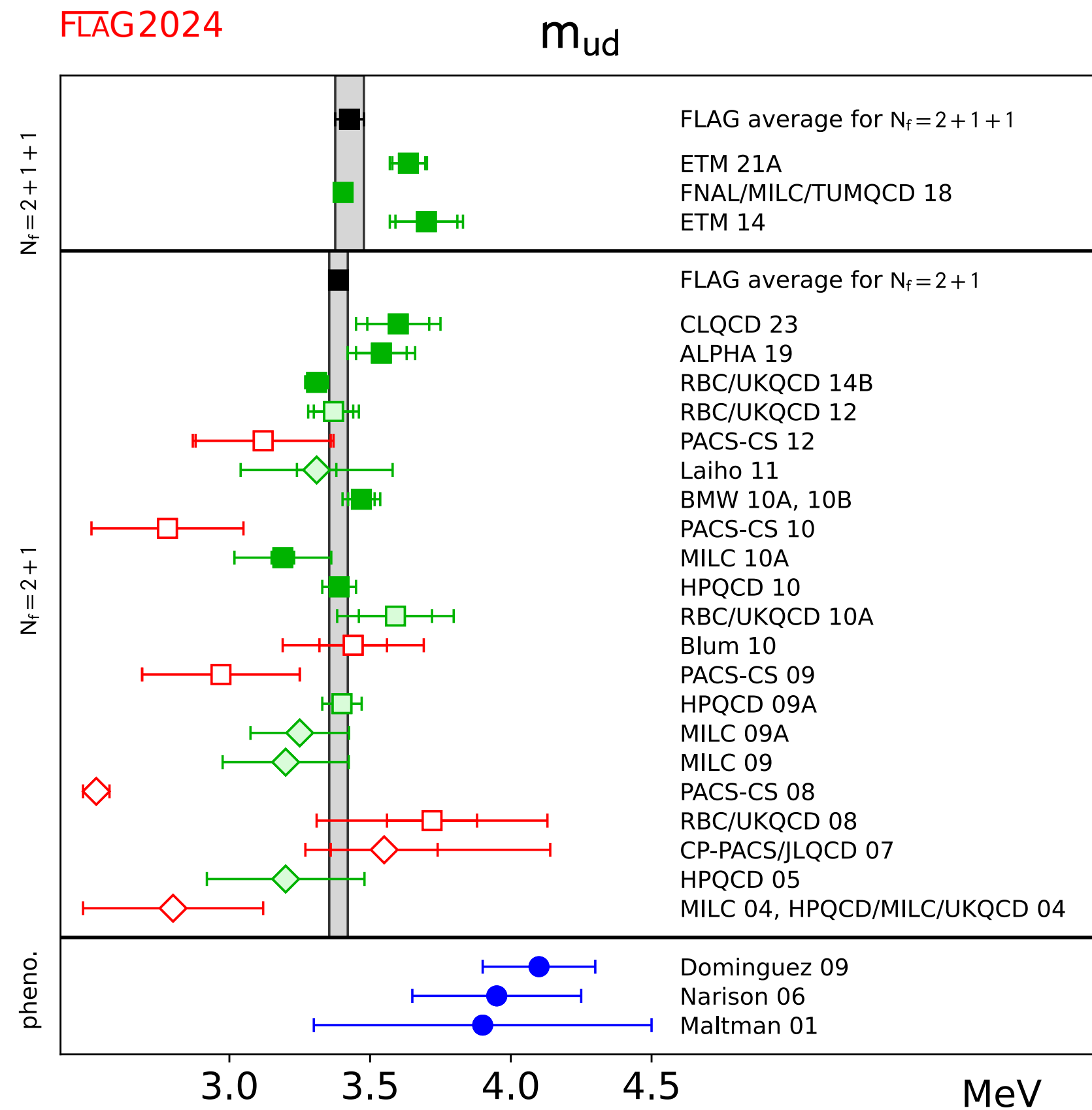
Fermilab Lattice & MILC

- ◆ These two collaborations have been working together for over 20 years.
- ◆ Heavy quark physics was the initial motivation
- ◆ Used valence clover quarks with the Fermilab interpretation on MILC dynamical configurations
- ◆ Later turned to an all HISQ program, sometimes cooperating with HPQCD, sometimes competing
- ◆ Currently active in muon $g-2$, leptonic & semileptonic decays, quark masses, and other emerging topics

Charm Decay Constants from FLAG



Light Quark Masses from FLAG



HotQCD

- ◆ Our last efforts in finite-temperature QCD were in the HotQCD Collaboration.
- ◆ Several of our most cited papers emerged from this effort.
- ◆ Equation of state and QCD transition at finite temperature, PRD **80** (2009) 014504 [796 citations]
- ◆ The chiral and deconfinement aspects of the QCD transition, PRD **85** (2012) 054503 [1,499 citations]
- ◆ Equation of state in (2+1)-flavor QCD, PRD **90** (2014) 094503 [1,754 citations]
- ◆ *[Bob] was a great colleague and an important support of our common research interest. Without him and the strong MILC support the HotQCD collaboration would certainly not have come alive! — Frithjof Karsch*

Frank Wilczek's Comments

- ♦ *Bob Sugar was a joy to know — unfailingly engaging, cheerful, and generous. He leaves two great scientific legacies.*

He was one of the founders of modern lattice gauge theory, and continued to be a leading contributor and community-builder for many years. This “domestication” of relativistic quantum field theory, forging a strong, precise, and fruitful correspondence with empirical reality, is one of the greatest scientific success stories ever.

He was central to the emergence of Santa Barbara as a central hub of the physics community — a place where people and new ideas from all over the world come together and sparks fly.

Bob Sugar was an admirable person, and he leaves an enviable scientific legacy.

Another Form of Legacy



- Bob, Gareth, Michael, Catherine, Daniel, Joan
- Catherine, Bob, Michael, and Daniel at Michael's recent graduation from Stanford
- Photo credits: Catherine Sugar

Summary

- ◆ When I think of Bob Sugar my primary emotion is gratitude.
- ◆ I am so lucky to have known him and to have benefitted from his wisdom and mentorship.
- ◆ I don't think my career would have lasted without his support. Doug T. feels the same way.
- ◆ Our wise, beloved colleague *Claude Bernard* very succinctly put it:
- ◆ **What a great, sweet man Bob was.**
- ◆ He truly lived up to his name.

Food

- Joan was an excellent cook and they both enjoy eating very much.
- Bob introduced me to Thai food which is one of my favorite cuisines.
- Bob would always order at our greatly enjoyed collaboration feasts at Your Choice or Your Place.
- He was also a great fan of La Super-Rica Taqueria in Santa Barbara (as was Julia Child).
- Catherine recalls going to London and Paris with her Dad to visit Michelin starred restaurants.
- If you have a chance to drink Armagnac, think of Bob.



Computer Tales & Style Notes

- ◆ Don't let Giorgio Parisi on your system
- ◆ Bob rescues the ST100
- ◆ Bob's advice on when to wear a tie
- ◆ How the Intel folks dressed at the Oak Ridge Paragon dedication

MILC in Pictures



- (L) 2004 Back row: Eric Gregory, Christopher Aubin, Bob Sugar, Urs Heller, Jim Hetrick; front row: myself, Claude Bernard, Carleton DeTar, James Osborn, Doug Toussaint
- (R) 2009 Tommy Burch, James Osborn, Urs Heller, Ludmila Levkova, Claude Bernard, Carleton DeTar, Jim Hetrick, Ruth Van de Water, Alexei Bazavov, Doug Toussaint, Bob, Jack Laiho, myself

MILC in Pictures II



- (L) Doug and Bob at Berlin Lattice Conference
- (R) Bob, Claude, and Jim at Doug's home in Tucson

Additional National Service

- NSF Advisory Committee for the Directorate of Computer and Information Science and Engineering, 1992-96
- Chair, Special Emphasis Panel on the NSF Theoretical Physics Program, 1996
- Chair, User Advisory Committee, National Computational Science Alliance, 1997-2004
- User Advisory Committee, National Partnership for Computational Infrastructure, 1997-2004
- Chair, NSF Work Group on Applications of High Performance Computing, 1998
- Search Advisory Committee for the Director of the NSF Physics Division, 1998
- Review Committee for the NSF Terascale Computing System, 2000
- Terascale Advisory Committee, Pittsburgh Supercomputer Center, 2000-2004
- Co-Chair, NSF Computational Physics Steering Committee, 2001-2002
- HECRTF Workshop Organizing Committee, 2003
- SciDAC 2005 Organizing Committee, 2005

Gang of Four



it: Will Swalling



- (L) standing: Robert Sugar, Raymond Sawyer, James Hartle; seated: Douglas Scalapino
- (R) Sawyer, Sugar, Hartle, Scalapino (photo credit: Mia Nie)

Old Spanish Days Parade



- Catherine Sugar promised her parents that she would not do anything dangerous when her high school gymnastics team participated in Santa Barbara's Old Spanish Days Parade.
- Her parents were not happy the next morning when this photo was splashed across the front page of the Santa Barbara News-Press.

Jim Hartle Honors Bob

The QCD Song*

By James Hartle

(To the tune of O' Tannenbaum)

On the lattice we will be

'Till we solve it, QCD

Dimensions come and dimensions go

But there's one thing that we know

Beyond four we're not meant to see

So it's in four that we'll always be

Hail to thee, oh, QCD

To thee we pledge our loyalty!

*written on the occasion of the 60th birthday celebration of Bob and Joan Sugar. Hartle shares the same birthday with the Sugars but is a year younger. He has recently taken to saying that he is much younger than they are. Unfortunately, Hartle does not have access to the sophisticated MILC data analysis codes. If he did, he would undoubtedly realize that the age difference, a 50% effect in 1940, is now less than a 2% effect. We wish them all well and hope that in the future the effect will be reduced below 1%.

Also From SugarFest



- I modified a Berry's World cartoon for my presentation at Bob's 60th birthday celebration. I think I underestimated the number of proposals he would have to prepare each year.

More Algorithmic Papers

- ◆ Bob co-authored numerous algorithmic papers many focussed on condensed matter systems. One needs to check Google Scholar to start to measure the impact. What follows is a small sample.
- ◆ A Method for Performing Monte Carlo Calculations for Systems with Fermions, Scalapino and Sugar, PRL **46** (1981) 519 [152 citations; 256 according to Google Scholar]
- ◆ Monte Carlo Calculations of Coupled Boson - Fermion Systems. 1., Blankenbecler, Scalapino, and Sugar, PRD **24** (1981) 2278 [430 citations according to inspirehep.net; 1764 according to Google Scholar]
- ◆ An Efficient Monte Carlo Procedure for Systems With Fermions, Hirsch, Scalapino, and Sugar, PRL 47, (1981) 1628 [80 citations]
- ◆ Monte Carlo Simulations of One-dimensional Fermion Systems, Hirsch, Sugar, Scalapino, and Blankenbecler, PRB **26** (1982) 5033 [132 citations; 655 according to Google Scholar]