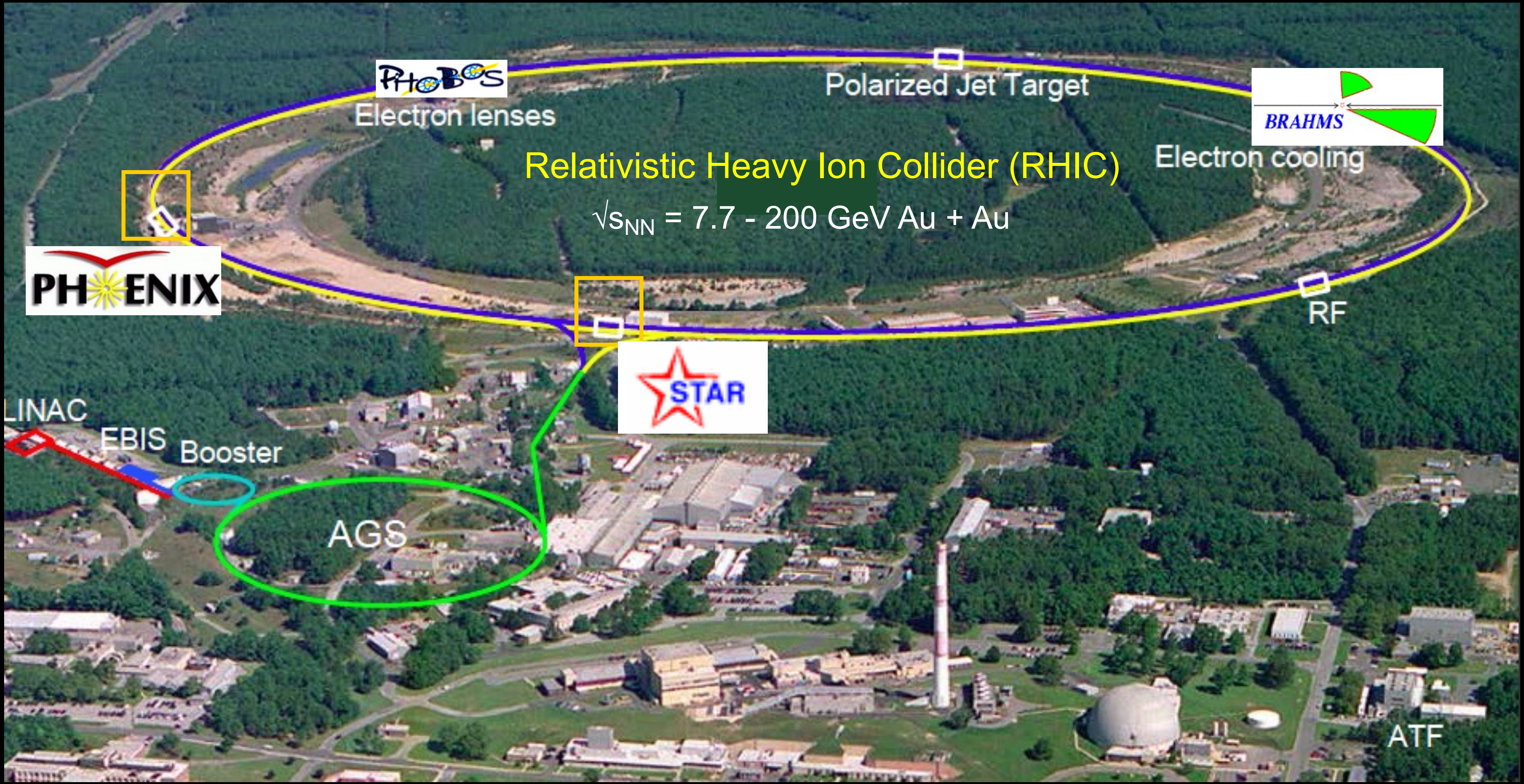
Birth of STAR



Approach to a New Experiment for RHIC

RNC was formed!

- See previous talk by HRG!
- A few personal comments – RNC, Art and me!

Applied for Director's Funds (1989)

- for new initiative to design an experiment for RHIC
- Requested funds for an engineer and a postdoc
- Plus, funds to invite speakers to discuss physics and detector aspects of a new RHIC experiment
- Received $200K

Hired Bill Edwards and Bill Christie

- Edwards (mechanical design) and Christie (GEANT experiment design)

Invited Theorists and Experimentalists for physics and detector discussions

- RHIC Planning Meetings at LBL (Oct '89 – July '90) described in next slides

Apologies as many of the slides to follow in this talk were digitized from archived transparencies!

Planning at LBL for an Experiment for RHIC

NSD/RNC Group

RHIC PLANNING CHRONOLOGY

5 Oct 89	NSD Retreat developed RNC plan
18 Oct 89	1st RHIC Planning Meeting (RPM)
30 May 90	23rd RPM
11-15 Jun 90	RHIC Experiment Workshop, LBL
2-7 Jul 90	4th Workshop on Experiments & Detectors for RHIC, BNL

RHIC PLANNING MEETINGS

October 18, 1989 - May 30, 1990

VOLUME I

1. Wednesday, October 18, 1989 — Miklos Gyulassy, LBL "Physics Objectives at RHIC"
2. Wednesday, October 25, 1989 — Doug Greiner, LBL "4π Tracking TPC"
3. Wednesday, October 25, 1989 — James Symons, LBL "Large Pt Jets at RHIC"
4. Tuesday, October 31, 1989 — John Harris, LBL "Tracking and Particle Identification at Midrapidity"
5. Tuesday, October 31, 1989 — Chuck Naudet, LBL "Jets in pA FermiLab"
6. Wednesday, November 8, 1989 — Hans-Georg Ritter. LBL "4π Calorimetry"
7. Wednesday, November 15, 1989 — Jim Carroll, UCLA/LBL "Electron Pairs"
8. Thursday, November 30, 1989 — Glenn Young, ORNL "Muon Pairs"
9. Wednesday, December 13, 1989 (not included) — Discussion on Future Plans

Planning at LBL for an Experiment for RHIC

VOLUME II

10. Wednesday, January 10, 1990	Lee Schroeder, LBL "RHIC the Machine"
11. Tuesday, January 16, 1990	Tom Ludlam, BNL "Getting Started with RHIC Experiments"
12. Wednesday, January 31, 1990	Chuck Gruhn, LBL "RHIC Tracking Detectors, Compromises and Physics"
13. Wednesday, February 7, 1990	Walter Geist, LBL "High pt Jets"
14. Wednesday, February 14, 1990	Grazyna Odyniec, LBL "Strangeness Production at RHIC"
15. Wednesday, March 7, 1990	Richard Kadel, LBL "The CDF Tracking Chamber"
16. Wednesday, March 14, 1990	RHIC Discussion on Jets Matt Bloomer, LBL Jim Carroll, UCLA/LBL
17. Wednesday, March 28, 1990	Xin-Nian Wang, LBL "The Role of Multiple Mini-Jets in High Energy Hadronic Interactions"
18. Tuesday, April 3, 1990	Shoji Nagamiya Columbia University "Thoughts on a RHIC Experiment"
19. Wednesday, April 11, 1990	Bill Carithers, LBL "The CDF Calorimeters"

VOLUME III

20. Tuesday, April 17, 1990	Barbara Jacak, LANL "RHIC R&D Efforts on Calorimetry at Los Alamos"
21. Wednesday, April 25, 1990 (not included)	Leon van Hove, CERN "Recent Developments in Soft Multiparticle Production"
22. Wednesday, May 23, 1990	Doug Shy and Bill Christie, LBL Reports of Tracking and Jet/Calorimetry Subgroups
23. Wednesday, May 30, 1990	Bill Christie, Matt Bloomer, Chuck Naudet, LBL Reports of Tracking and Jet/Calorimetry Subgroups

RHIC – A New Era of Experiments in Nuclear Physics

Technological and Detector Developments

New Detector Techniques
- TPC
- RICH
- Photon Detectors
- CCD's
- Smart Calorimeters
- Scintillating Fibers
- ...

Data Acquisition
- Large Event Sizes
- Fast High Density Electronics
- Rapid Online Data Reduction
- Large Scale Data Storage
- ...

Integration of Complex Detector Systems into Experiments

Technological Developments
- Data Storage Devices and Media
- Integrated Electronics
- ...

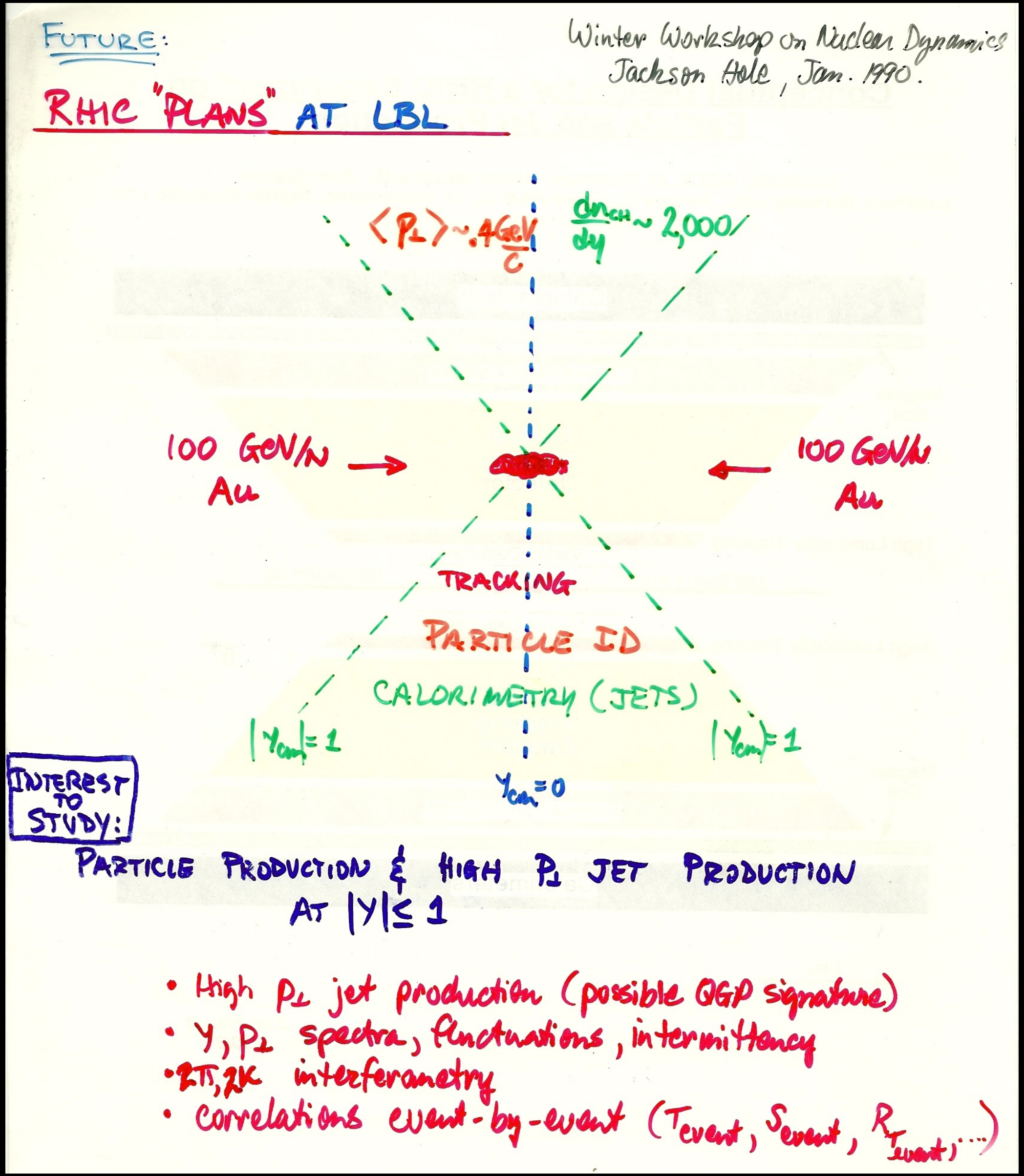
Operational and Sociological Experience

Large Collaborations
- Operation and Communication
- Planning and Organization

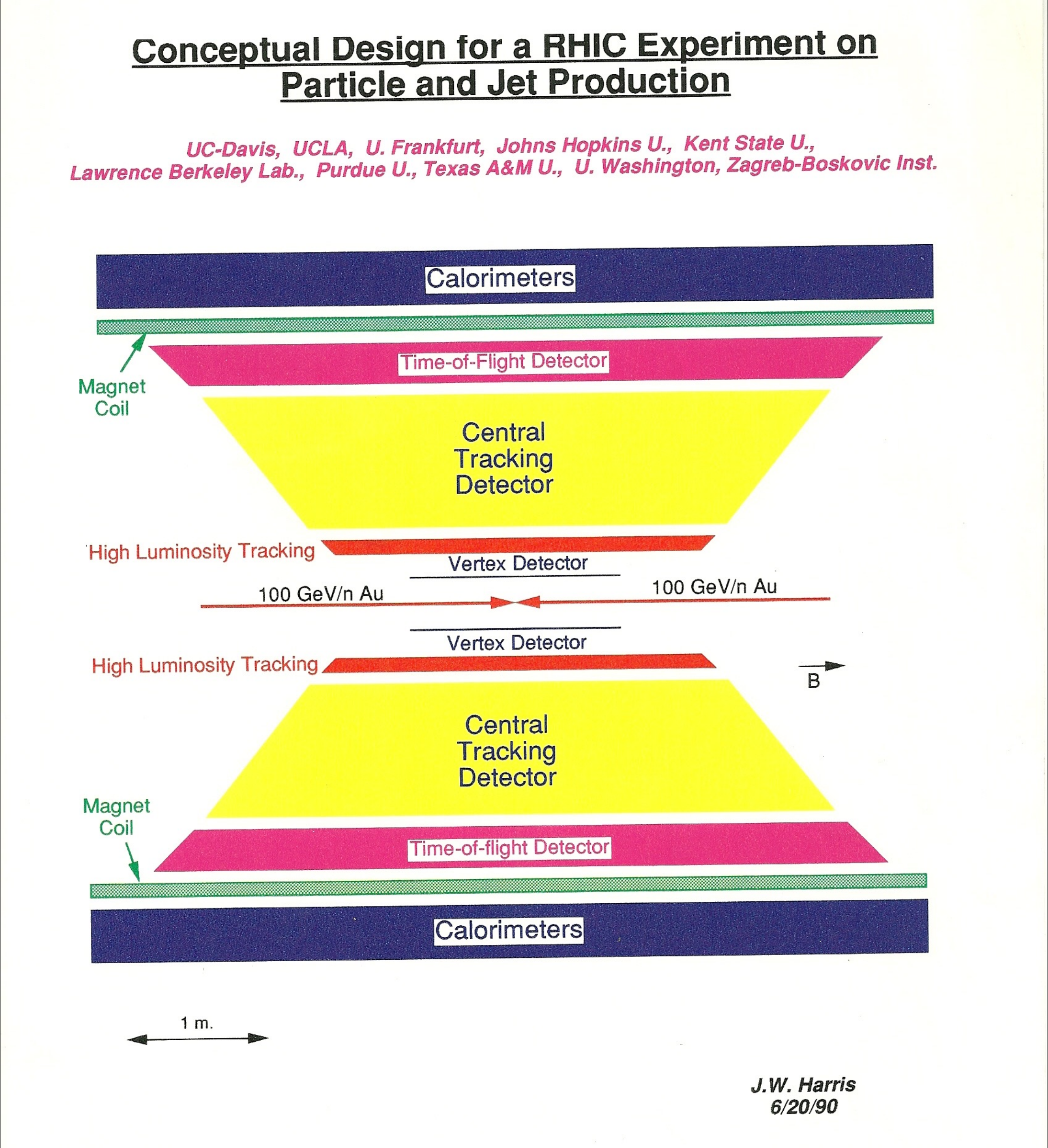
Infra-structure
- Lessons from High Energy Community
- Hiring Practices

General Remarks
- Must Combine Resources
- We Are Prepared - Is Nuclear Physics in General?

Concept of a New Experiment for RHIC



Art!



A Time Projection Chamber?

Why a TPC for central tracking detector? 🤔

Is it fast enough?

Can it handle the charged particle multiplicity?

What about two-track and momentum resolutions (B-field strength and design) 😰

What about space-charge distortions?

.

.

Howard Wieman became the TPC Project Director!!

Designed and/or oversaw TPC and electronics design …… whew!

😇

Designed for 2000 charged particles per unit rapidity (from theoretical predictions)

Later measured the multiplicity at RHIC to be ~800 per unit rapidity ….. whew!

TPC met all requirements for a successful tracking and PID detector….. whew! 🤗

RHIC Letter of Intent – September 1990

LBL-29651
UC-414

Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

RHIC Letter of Intent for
An Experiment on Particle and Jet Production at Midrapidity

The STAR Collaboration

September 1990

NUCLEAR SCIENCE DIVISION

Prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098

An Experiment on Particle and Jet Production at Midrapidity

K. Kadija,[1] G. Paic,[1] D. Vranic,[1] F.P. Brady,[2] J.E. Draper,[2] J.L. Romero,[2] J. Carroll,[3] V. Ghazikhanian,[3] E. Gulmez,[3] G.J. Igo,[3] S. Trentalange,[3] C. Whitten, Jr.,[3] M. Cherney,[4] W. Heck,[5] R.E. Renfordt,[5] D. Röhrich,[5] R. Stock,[5] H. Ströbele,[5] S.Wenig,[5] T. Hallman,[6] L. Madansky,[6] B. Anderson,[7] D. Keane,[7] R. Madey,[7] J. Watson,[7] F. Bieser,[8] M.A. Bloomer,[8] D. Cebra,[8] W. Christie,[8] E. Friedlander,[8] D. Greiner,[8] C. Gruhn,[8] J.W. Harris,[8] H. Huang,[8] P. Jacobs,[8] P. Lindstrom,[8] H. Matis,[8] C. McParland,[8] C. Naudet,[8] G. Odyniec,[8] D. Olson,[8] A.M. Poskanzer,[8] G. Rai,[8] J. Rasmussen,[8] H.-G.Ritter,[8] J. Schambach,[8] L.S. Schroeder,[8] P.A. Seidl,[8] T.J.M. Symons,[8] S. Tonse,[8] H. Wieman,[8] D.D. Carmony,[9] Y. Choi,[9] A. Hirsch,[9] E. Hjort,[9] N. Porile,[9] R.P. Scharenberg,[9] B. Srivastava,[9] M.L. Tincknell,[9] A. D. Chacon,[10] K. L. Wolf,[10] W. Dominik,[11] M. Gazdzicki,[11] W.J. Braithwaite,[12] J.G. Cramer,[12] D. Prindle,[12] T.A. Trainor,[12] A. Breskin,[13] R. Chechik,[13] Z. Fraenkel,[13] A. Shor,[13] and I. Tserruya,[13]

This work was supported in part by the Director, Office of Energy Research, Division of Nuclear Physics of the Office of High Energy and Nuclear Physics in the U.S. Department of Energy under contract DE-AC03-76SF00098.

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Two Proposals for TPC Experiments at RHIC

The experiment (soon to become known as STAR) was a solenoidal design

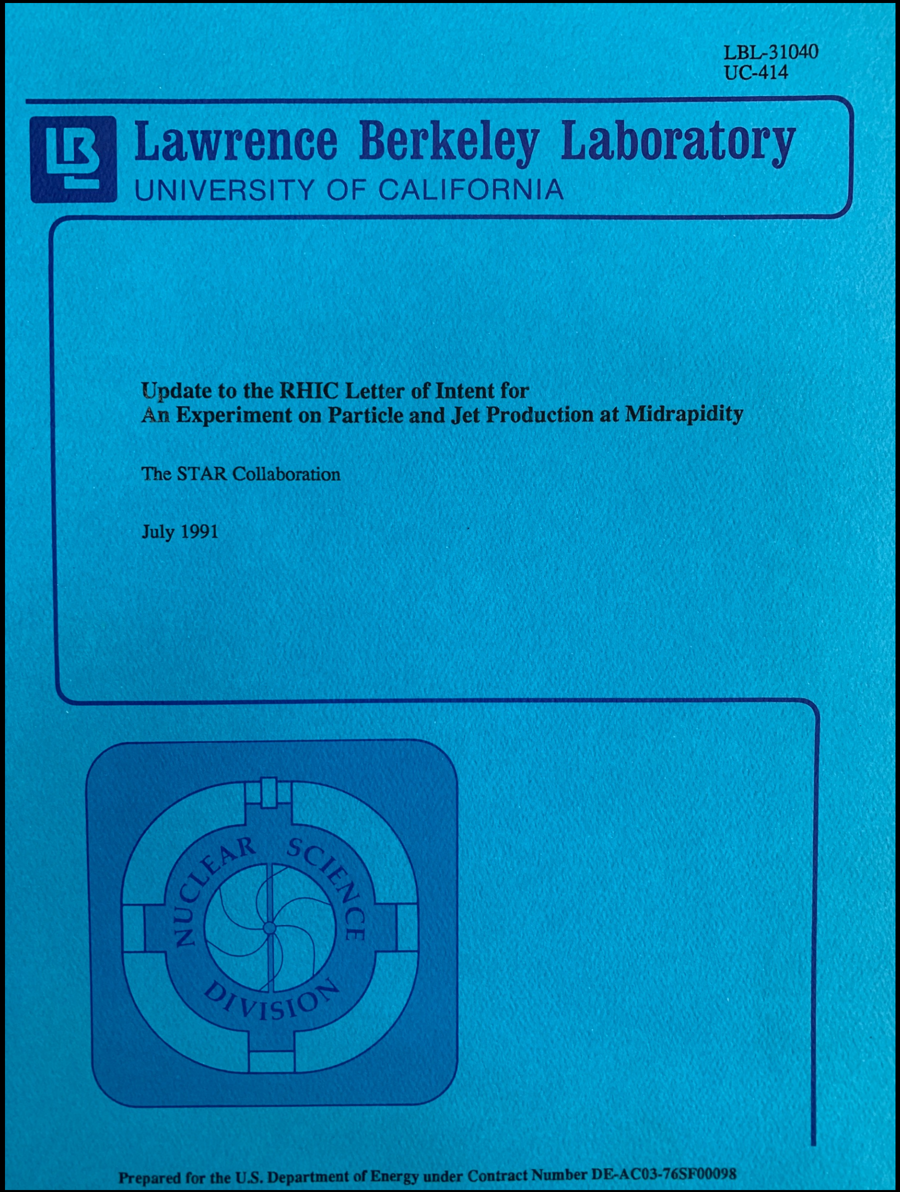
A TPC of dipole design was proposed by a BNL-Rice Collaboration

Newly appointed BNL Lab Associate Director (Nobel Laureate) Prof. Mel Schwartz

Instructed the two TPC collaborations to discuss a merger

[A few comments on the process and a side comment!]

RHIC Letter of Intent – July 1991



LBL-31040
UC-414

Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

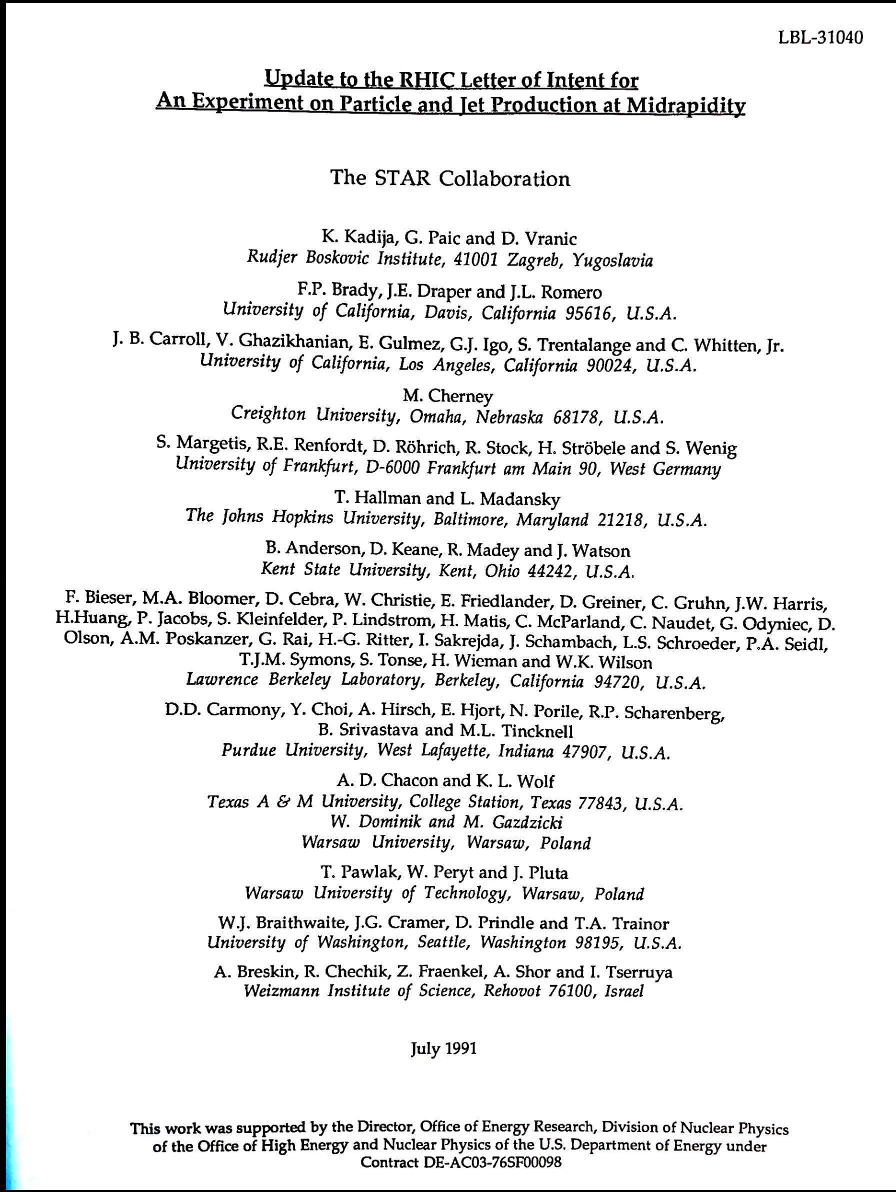
Update to the RHIC Letter of Intent for
An Experiment on Particle and Jet Production at Midrapidity

The STAR Collaboration

July 1991

NUCLEAR SCIENCE DIVISION

Prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098



LBL-31040

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July 1991

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Updated Letters of Intent at RHIC

BNL PAC Meeting (August 1991), PAC gave advice to Prof. Schwartz!

Schwarz decisions on experiments:

TPC experiment (soon to become known as STAR) approved with solenoidal design

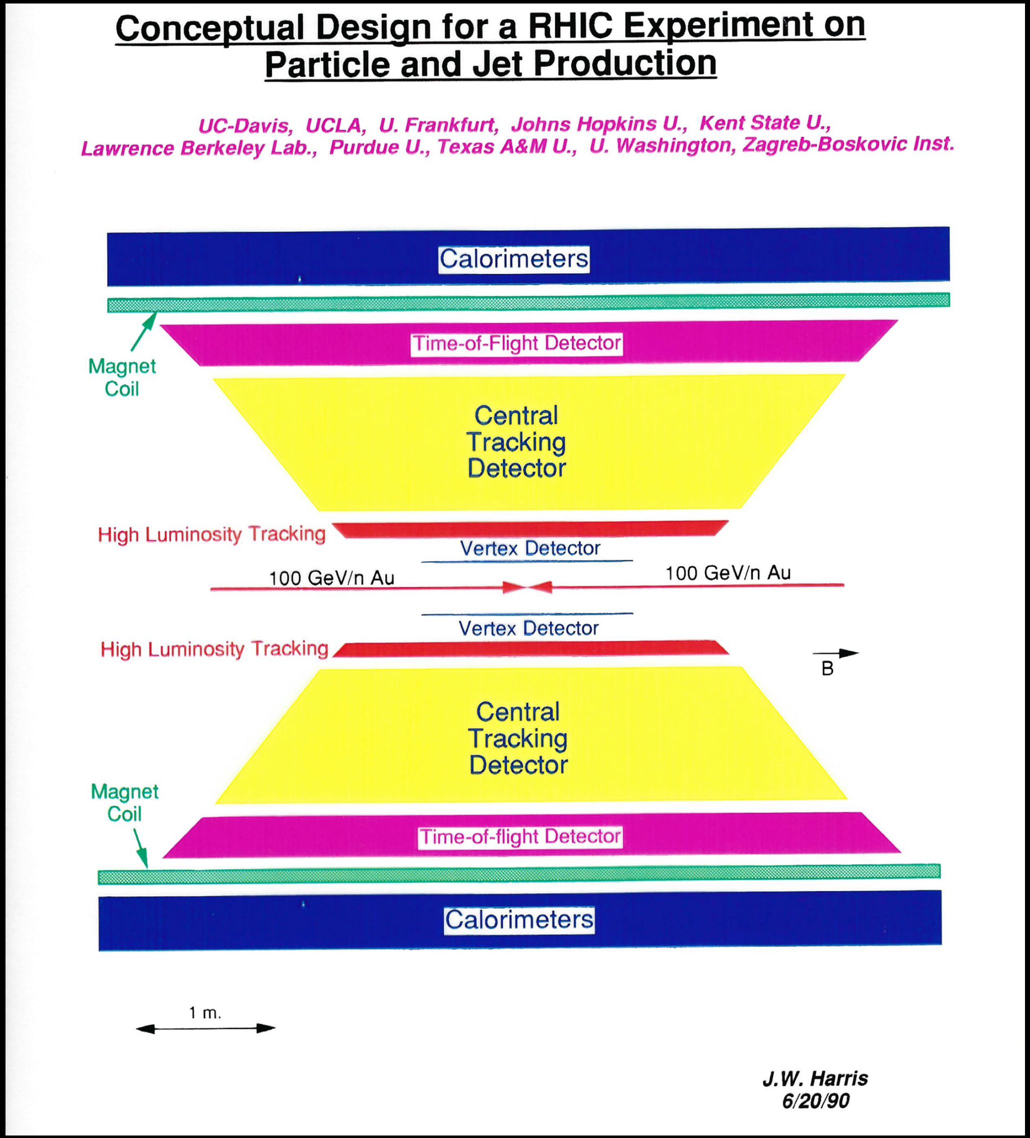
PHENIX experiment to be formed from merger of proposals

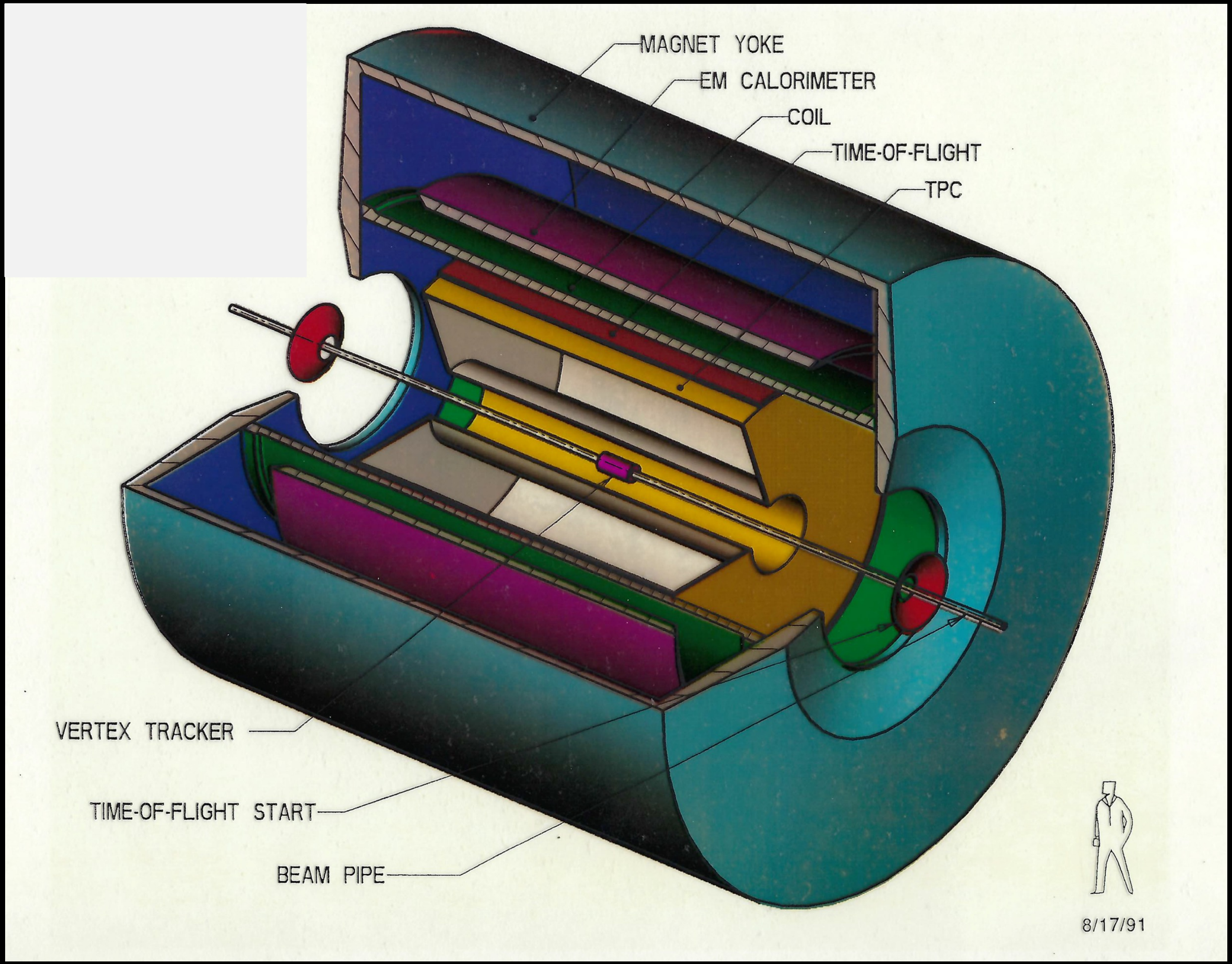
formerly TALES, SPARC, OASIS, and DIMUON

Small experiment for quick results approved PHOBOS

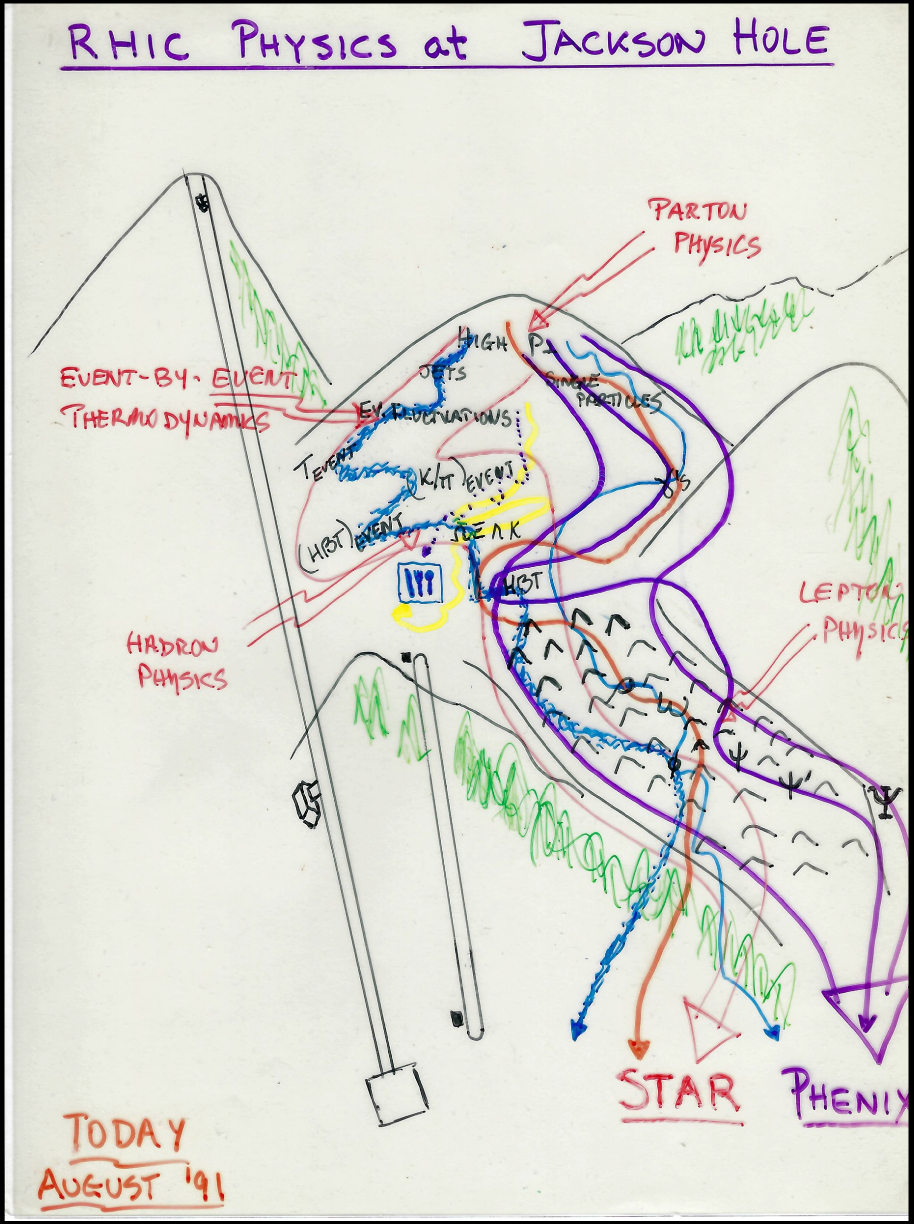
BRAHMS (proposed and approved later)

Design Evolution for Experiment at RHIC



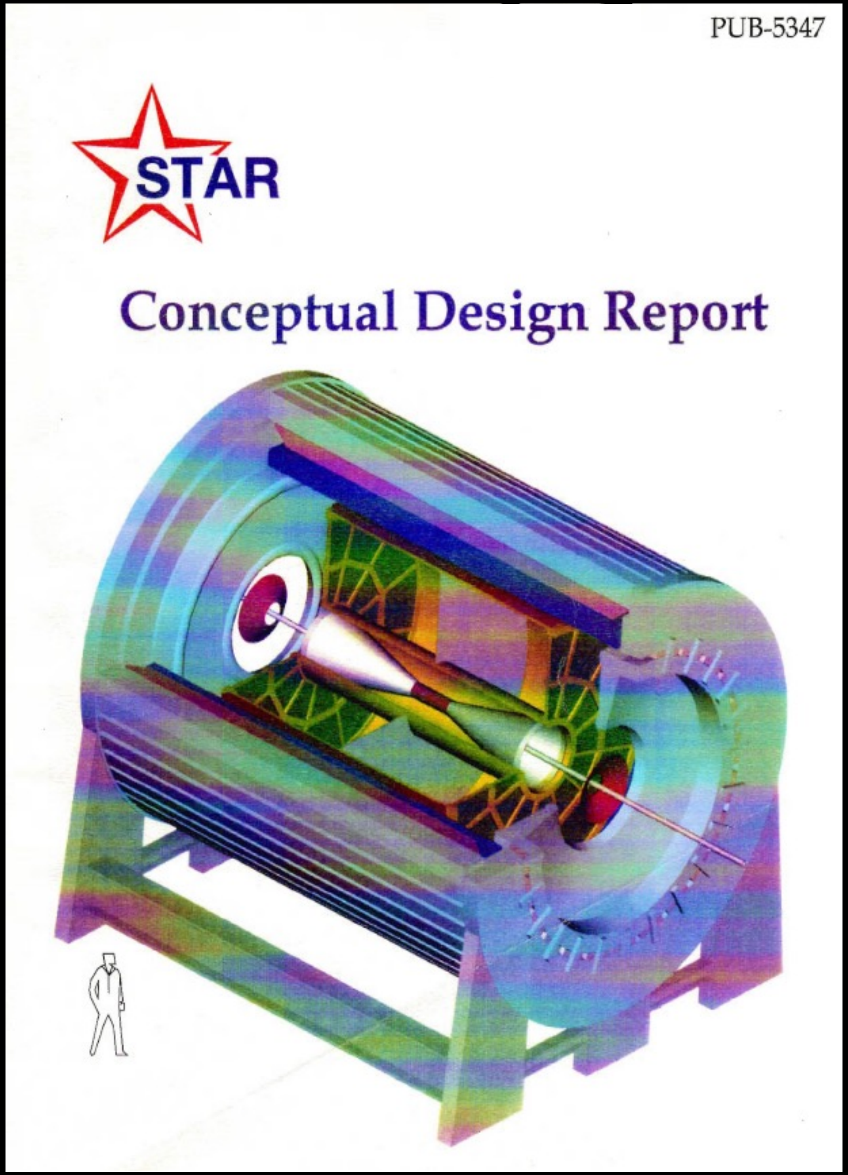


Evolution of Physics at RHIC Foreseen from 1990 - 1992



Presentation at
WWND Jackson Hole 1992

STAR Conceptual Design Report 1994



Jay Marx
Project Director!

The STAR Collaboration

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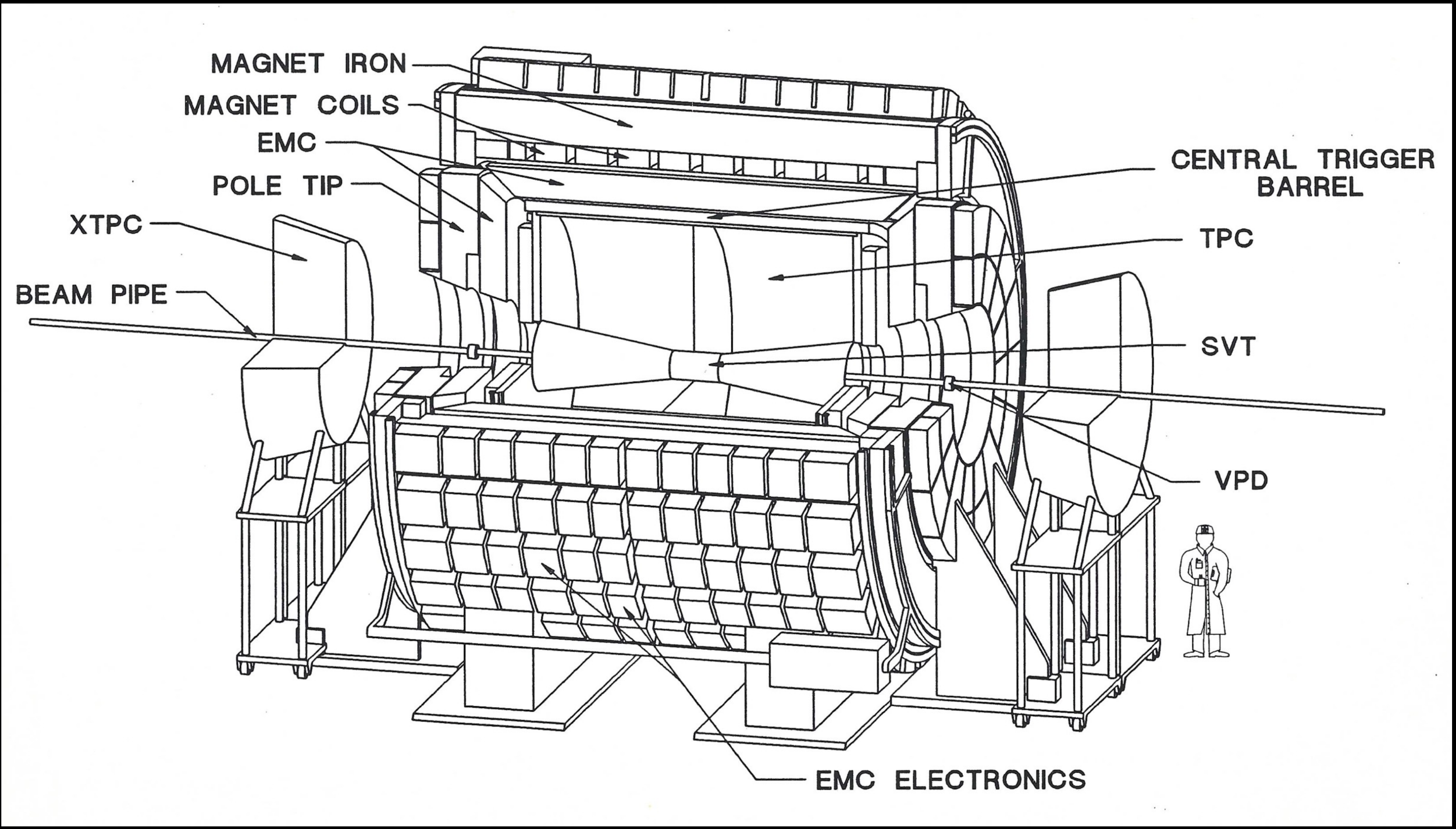
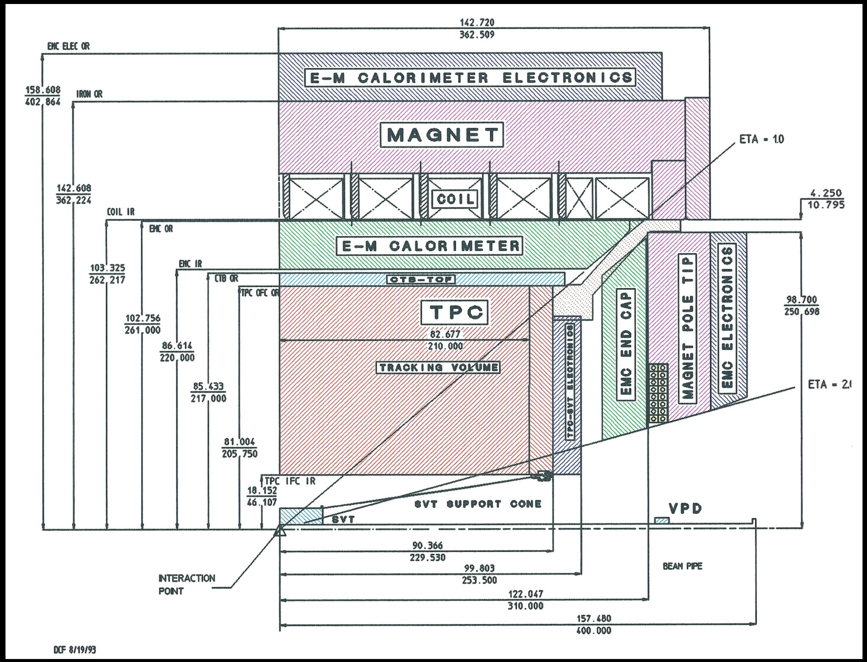
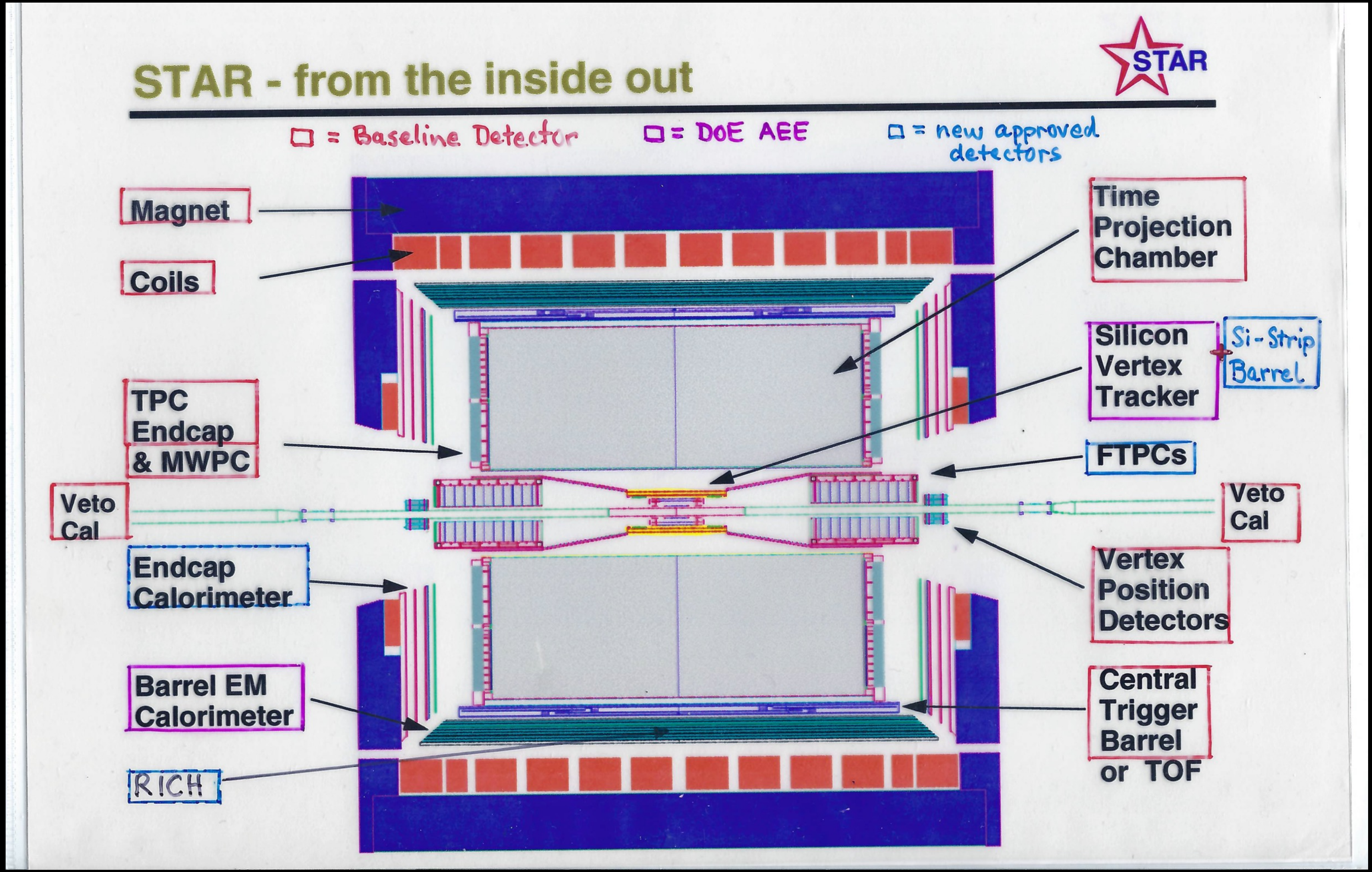
A Few of the Characters

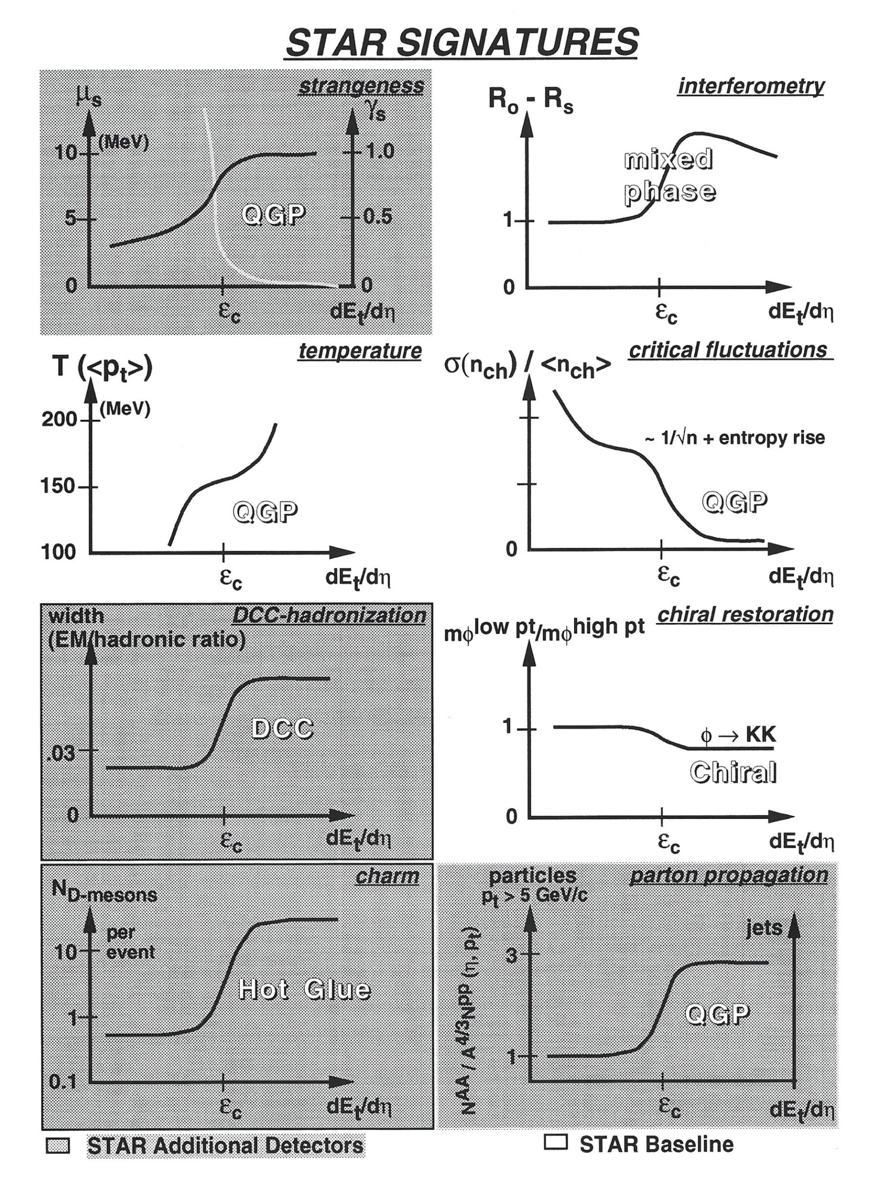
STAR Conceptual Design Report 1994





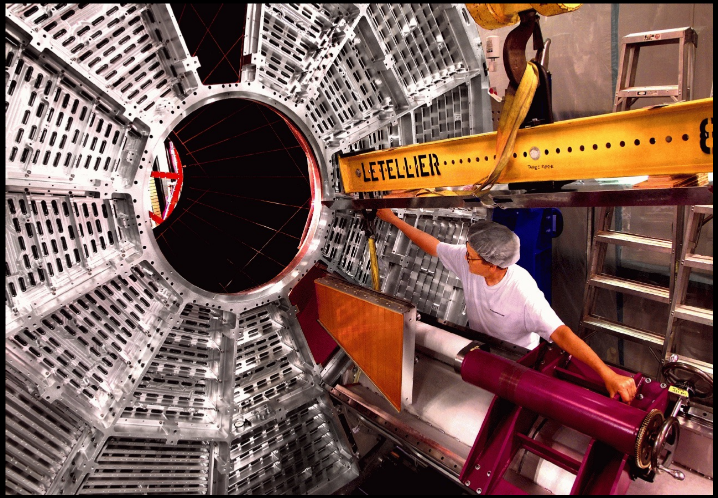
STAR Baseline Detector & Additional Equipment



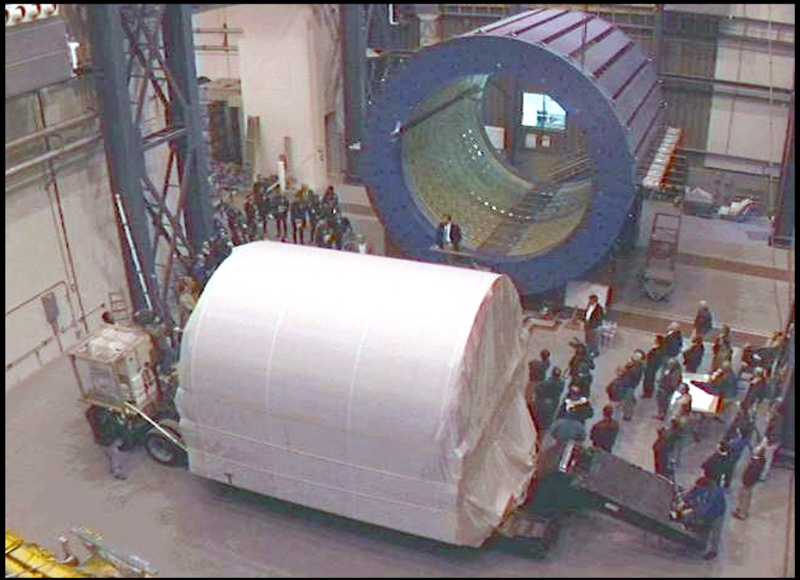


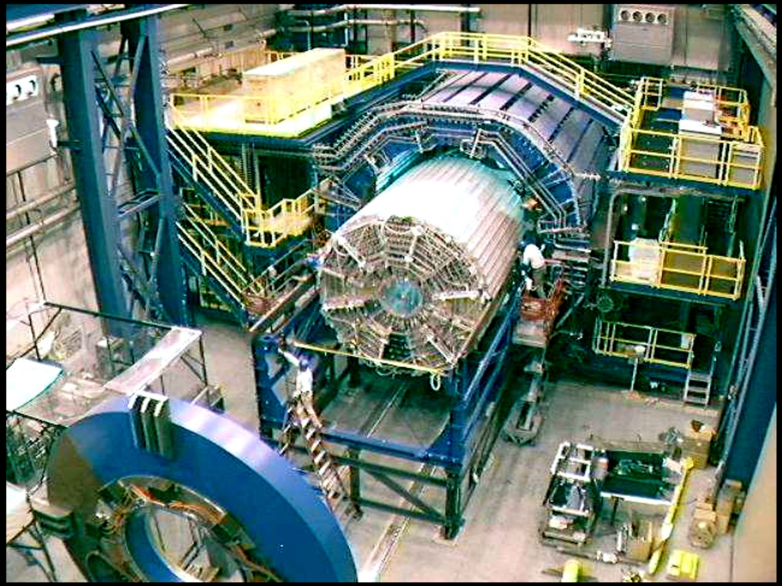
STAR TPC from LBL to BNL

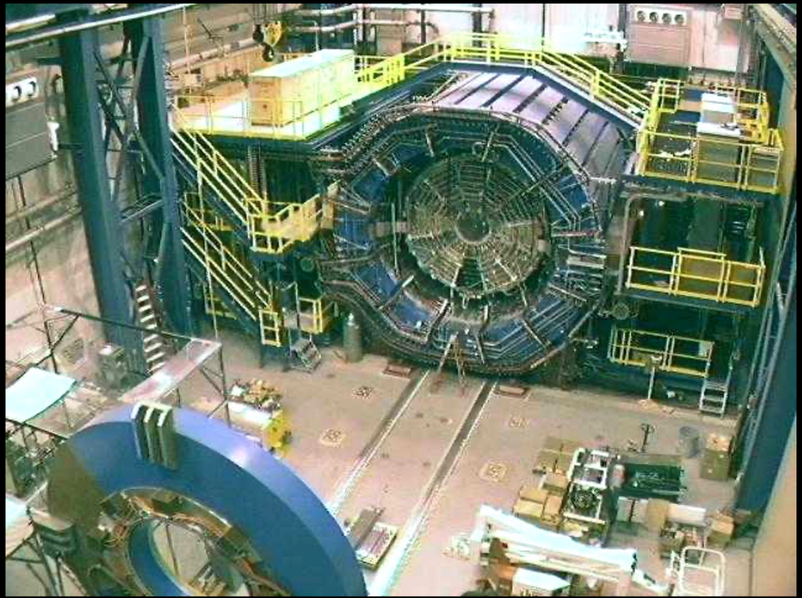
STAR

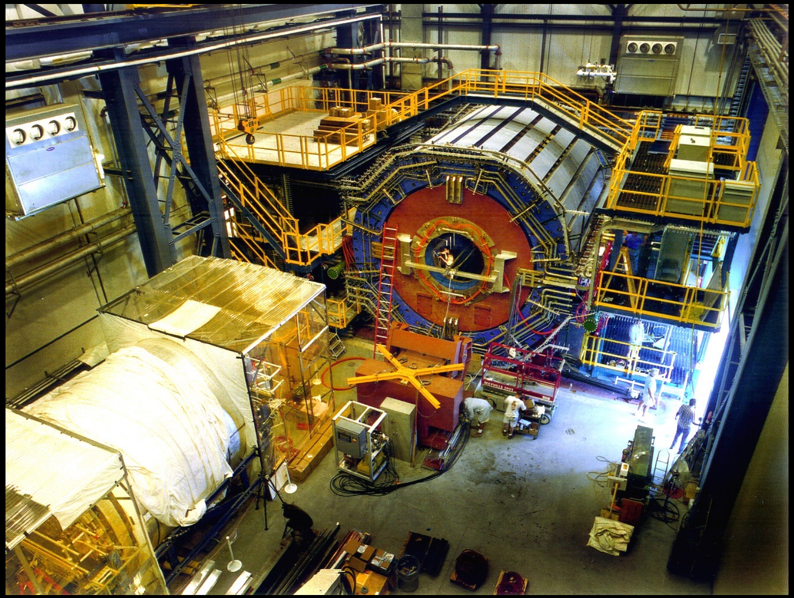


STAR TPC from LBL to BNL

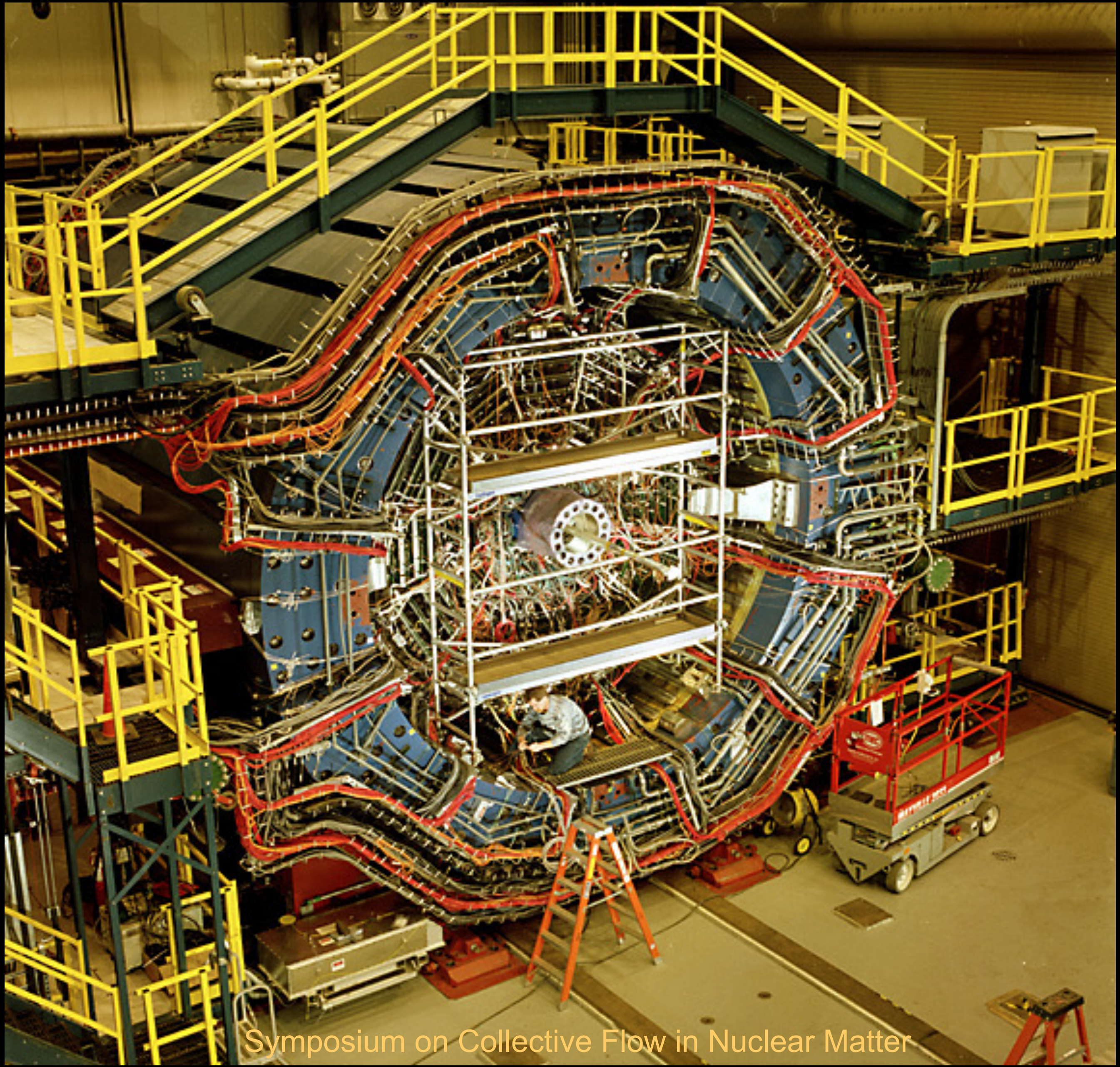






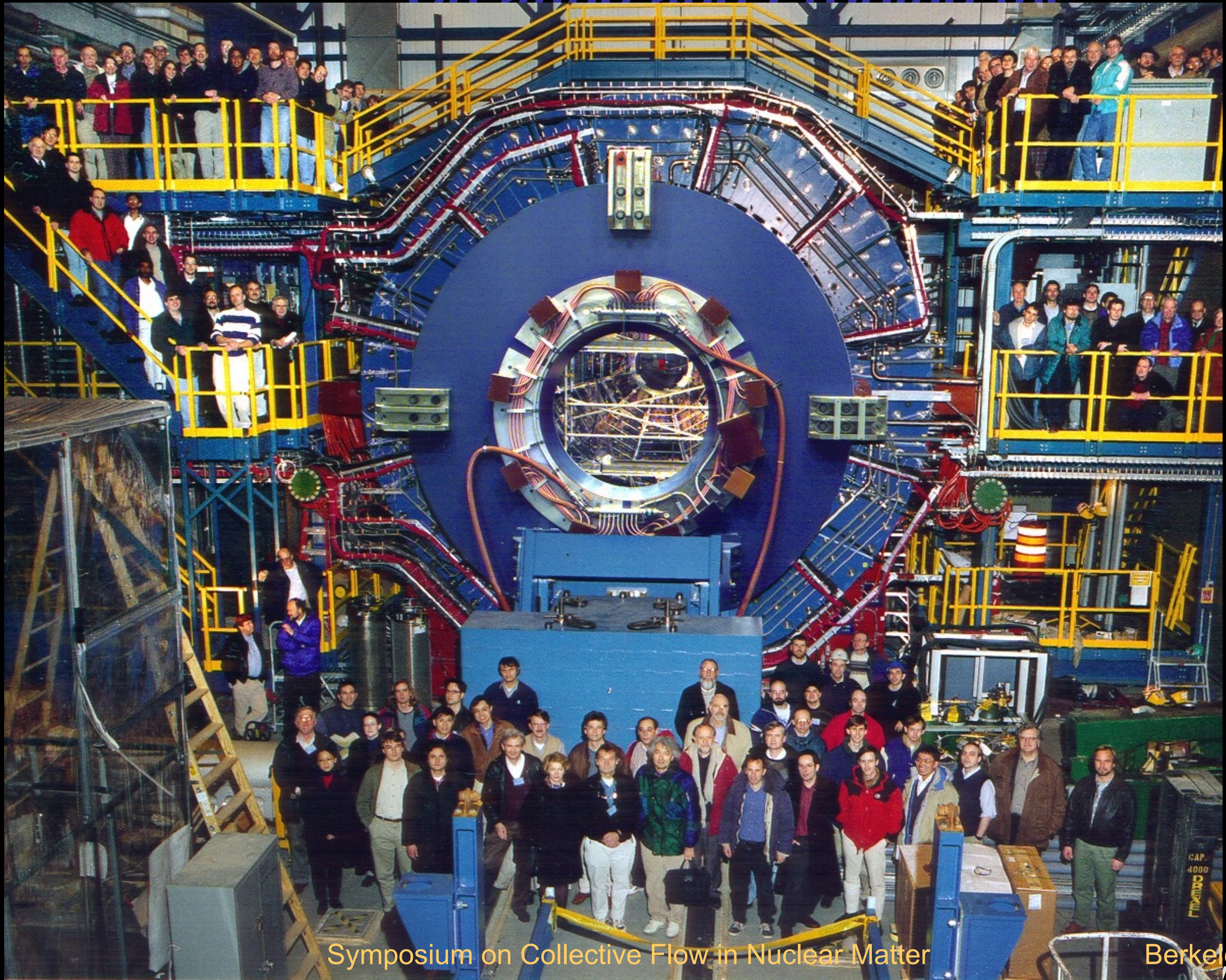


STAR Detector Ready to Roll!

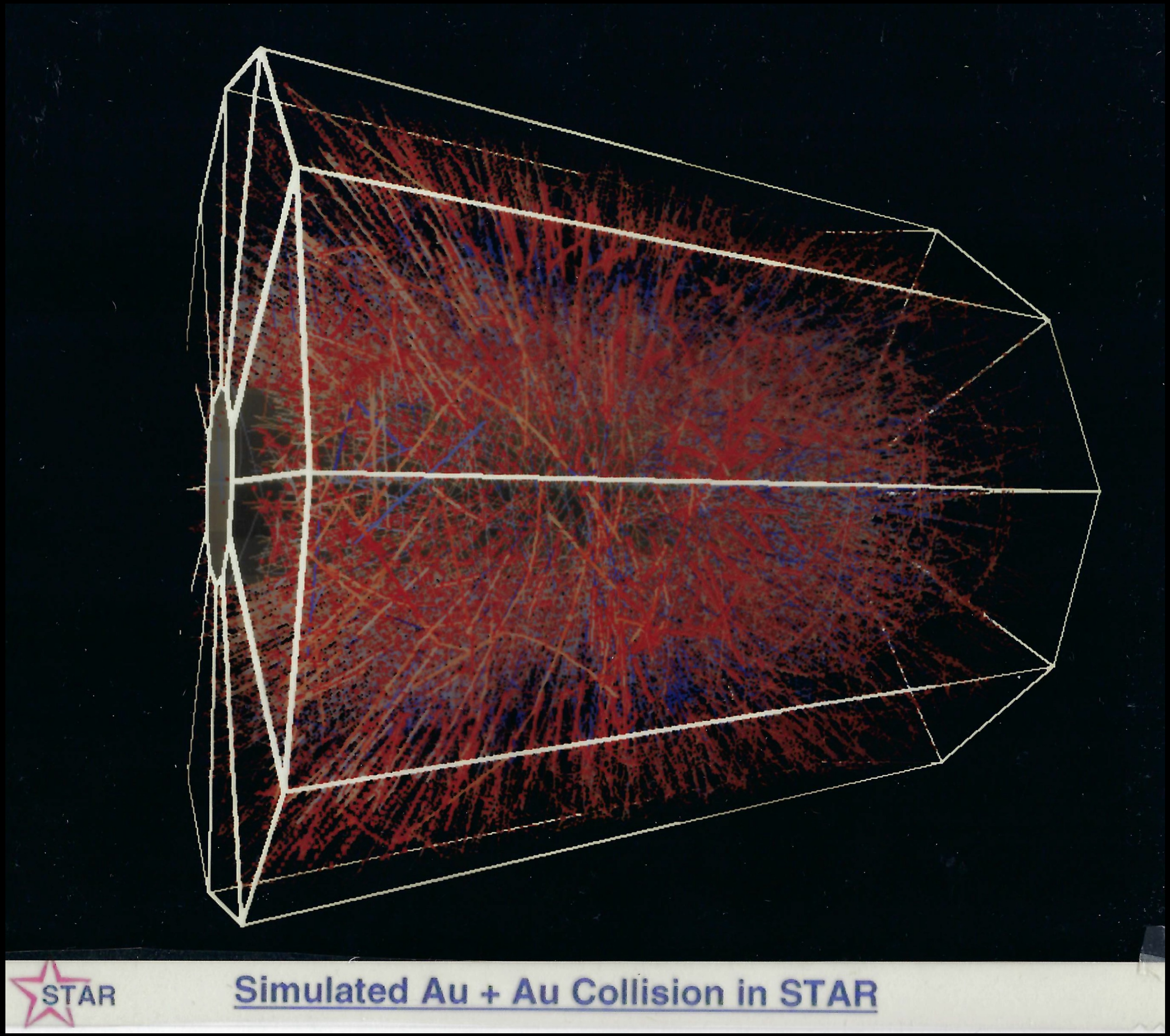


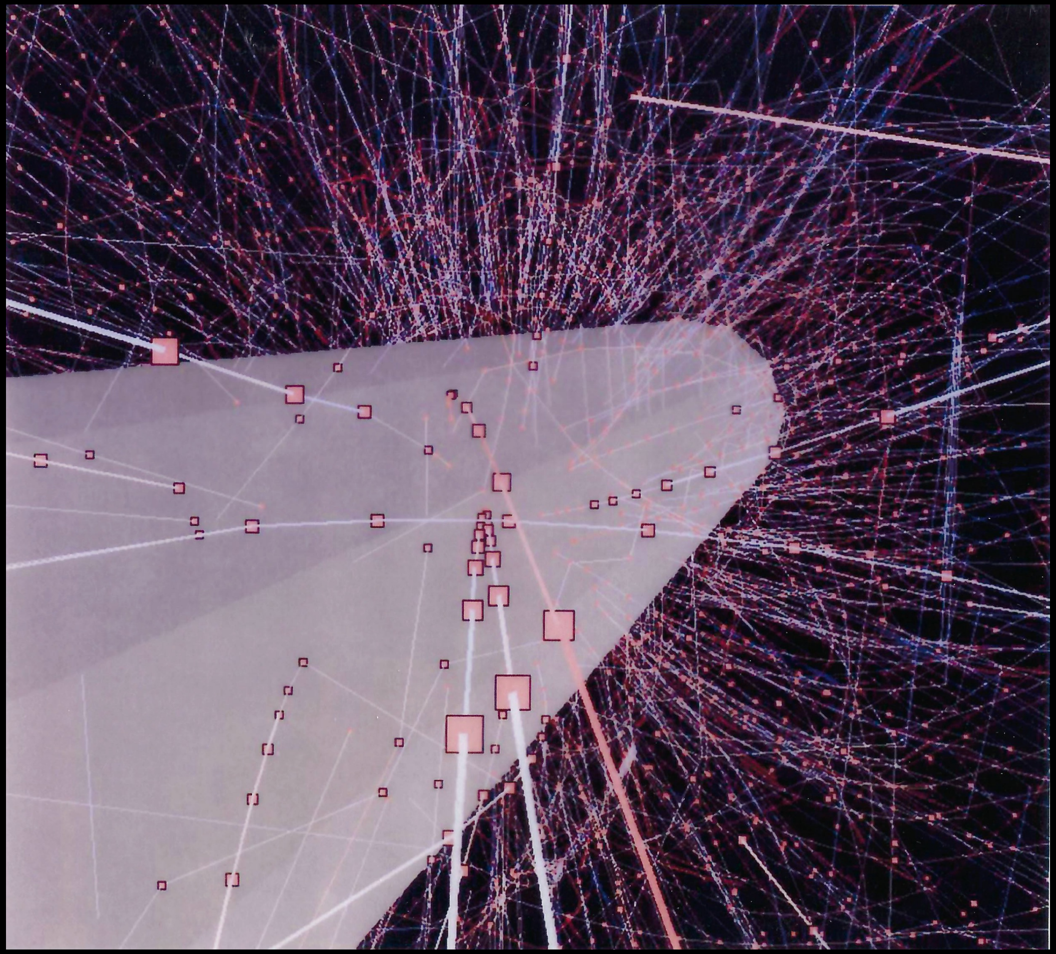
Collaboration Ready to Roll!

STAR



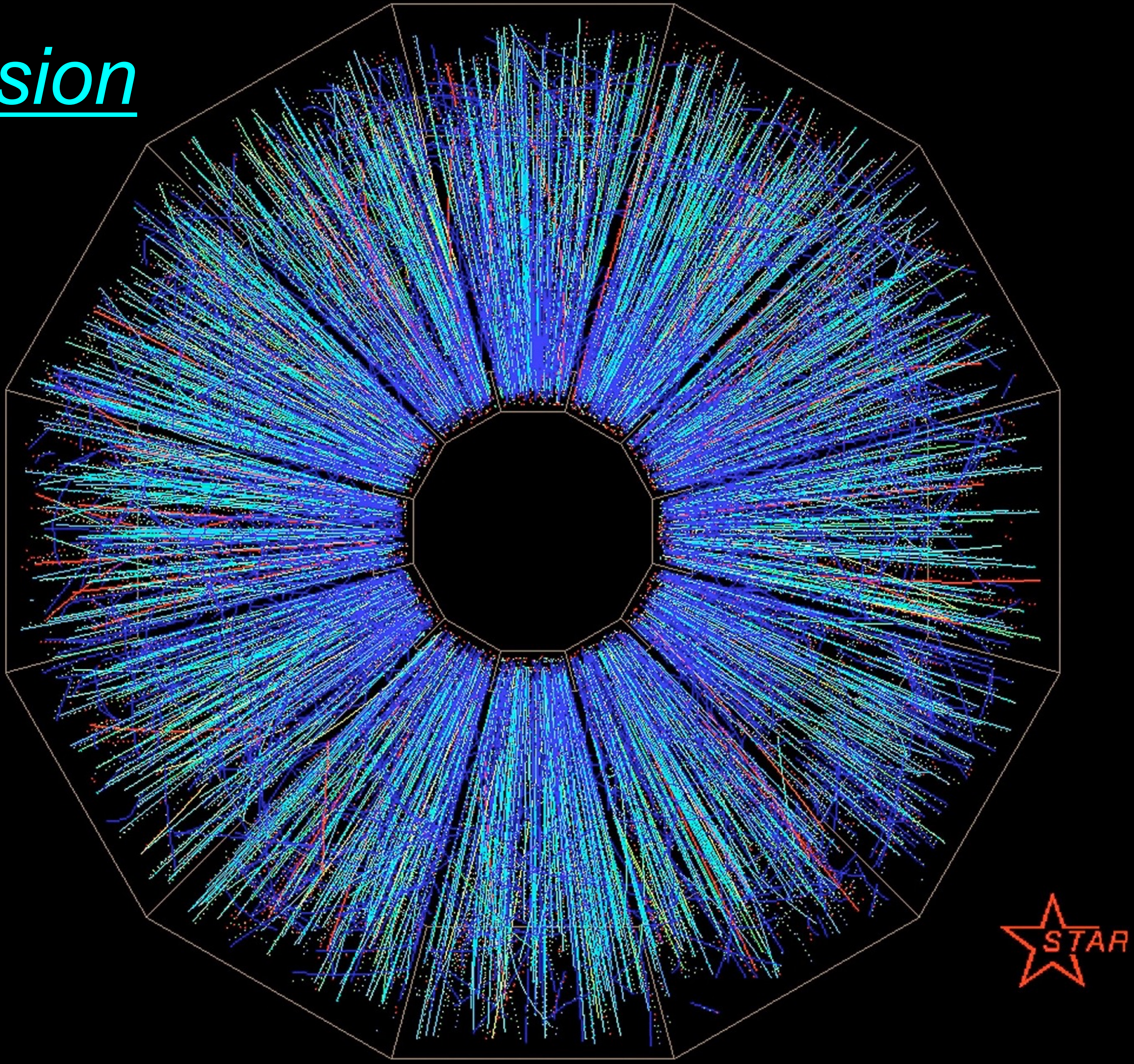
TPC Tracking Ready to Roll!





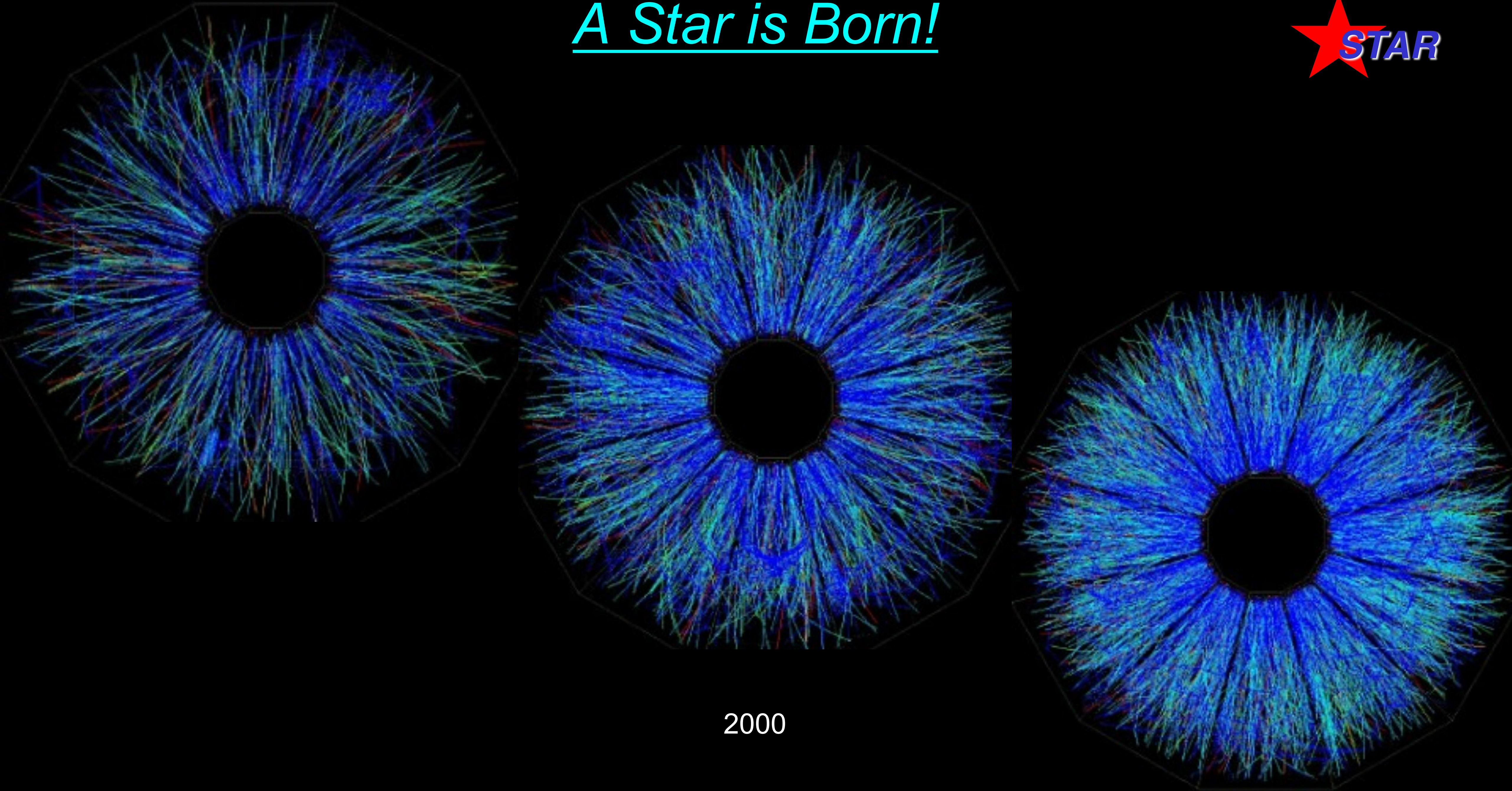
STAR Control Room - First Collisions!

Head-on Collision



A Star is Born!

STAR

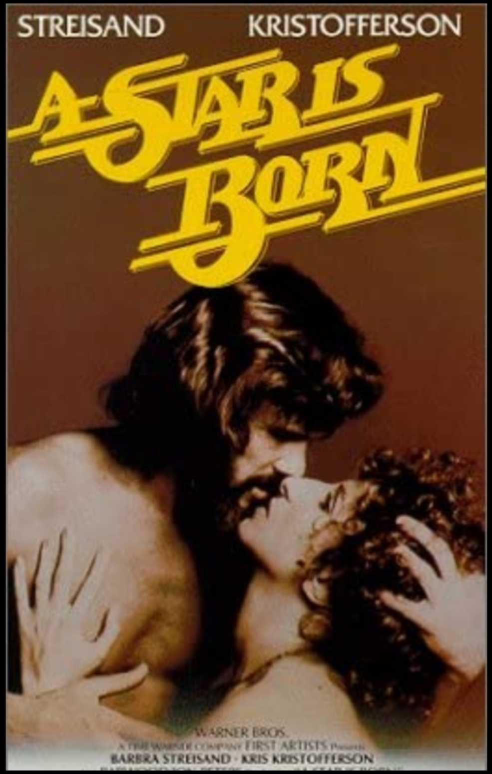


2000

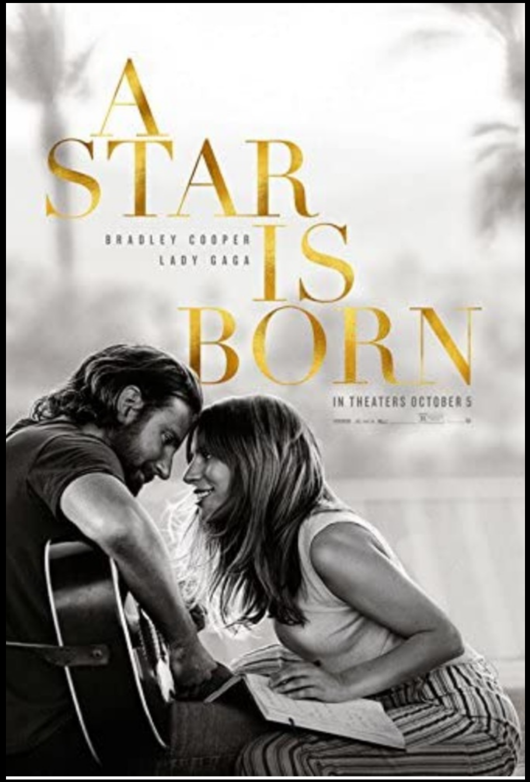
A Star is Born!

1937

1954



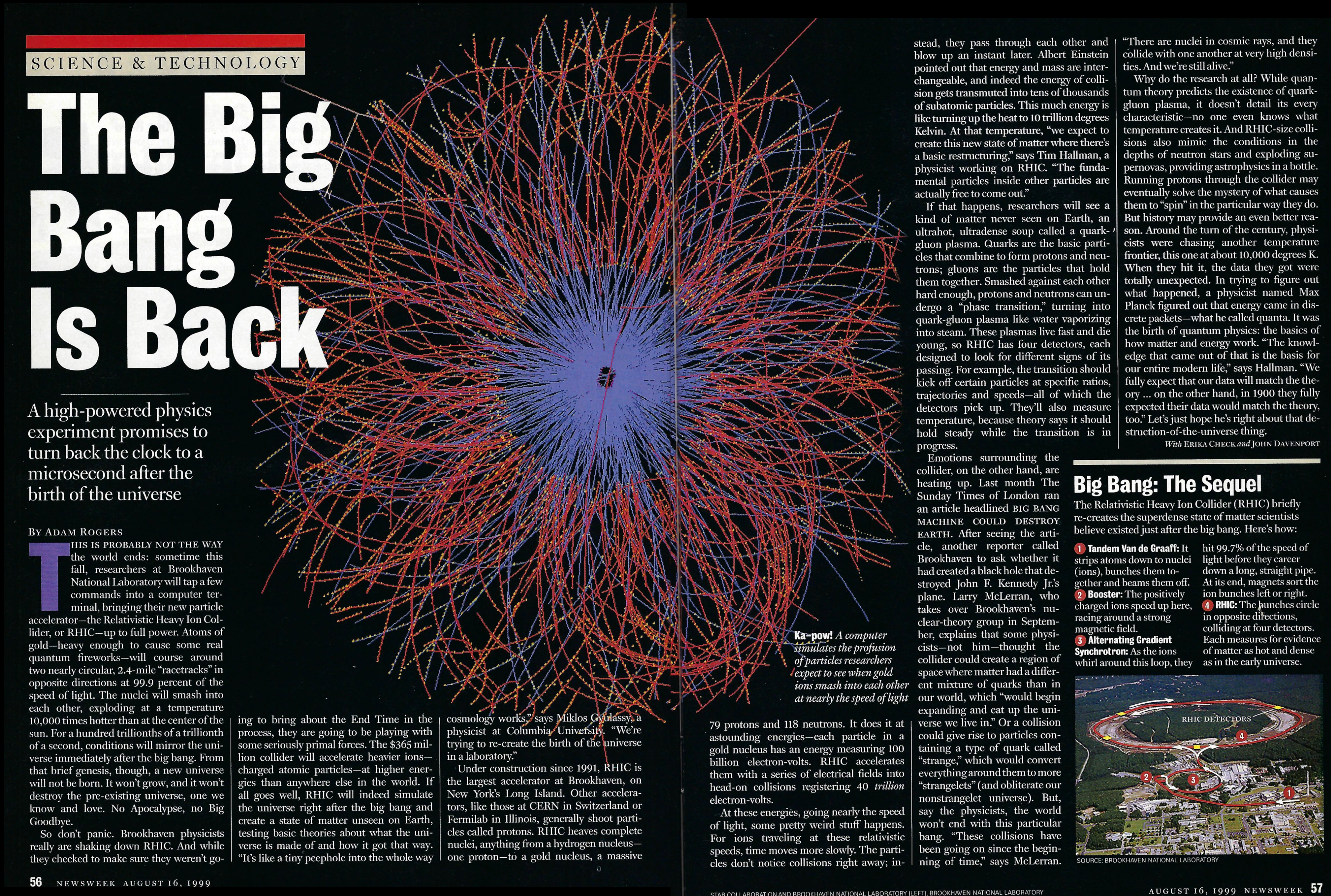
1976



2018

A Star is Born!

Newsweek – August 16, 1999



SCIENCE & TECHNOLOGY

The Big Bang Is Back

A high-powered physics experiment promises to turn back the clock to a microsecond after the birth of the universe

BY ADAM ROGERS

THIS IS PROBABLY NOT THE WAY the world ends: sometime this fall, researchers at Brookhaven National Laboratory will tap a few commands into a computer terminal, bringing their new particle accelerator—the Relativistic Heavy Ion Collider, or RHIC—up to full power. Atoms of gold—heavy enough to cause some real quantum fireworks—will course around two nearly circular, 2.4-mile "racetracks" in opposite directions at 99.9 percent of the speed of light. The nuclei will smash into each other, exploding at a temperature 10,000 times hotter than at the center of the sun. For a hundred trillionths of a trillionth of a second, conditions will mirror the universe immediately after the big bang. From that brief genesis, though, a new universe will not be born. It won't grow, and it won't destroy the pre-existing universe, one we know and love. No Apocalypse, no Big Goodbye.

So don't panic. Brookhaven physicists really are shaking down RHIC. And while they checked to make sure they weren't going to bring about the End Time in the process, they are going to be playing with some seriously primal forces. The $365 million collider will accelerate heavier ions—charged atomic particles—at higher energies than anywhere else in the world. If all goes well, RHIC will indeed simulate the universe right after the big bang and create a state of matter unseen on Earth, testing basic theories about what the universe is made of and how it got that way. "It's like a tiny peephole into the whole way cosmology works," says Miklos Gyulassy, a physicist at Columbia University. "We're trying to re-create the birth of the universe in a laboratory."

Under construction since 1991, RHIC is the largest accelerator at Brookhaven, on New York's Long Island. Other accelerators, like those at CERN in Switzerland or Fermilab in Illinois, generally shoot particles called protons. RHIC heaves complete nuclei, anything from a hydrogen nucleus—one proton—to a gold nucleus, a massive 79 protons and 118 neutrons. It does it at astounding energies—each particle in a gold nucleus has an energy measuring 100 billion electron-volts. RHIC accelerates them with a series of electrical fields into head-on collisions registering 40 *trillion* electron-volts.

At these energies, going nearly the speed of light, some pretty weird stuff happens. For ions traveling at these relativistic speeds, time moves more slowly. The particles don't notice collisions right away; instead, they pass through each other and blow up an instant later. Albert Einstein pointed out that energy and mass are interchangeable, and indeed the energy of collision gets transmuted into tens of thousands of subatomic particles. This much energy is like turning up the heat to 10 trillion degrees Kelvin. At that temperature, "we expect to create this new state of matter where there's a basic restructuring," says Tim Hallman, a physicist working on RHIC. "The fundamental particles inside other particles are actually free to come out."

If that happens, researchers will see a kind of matter never seen on Earth, an ultrahot, ultradense soup called a quark-gluon plasma. Quarks are the basic particles that combine to form protons and neutrons; gluons are the particles that hold them together. Smashed against each other hard enough, protons and neutrons can undergo a "phase transition," turning into quark-gluon plasma like water vaporizing into steam. These plasmas live fast and die young, so RHIC has four detectors, each designed to look for different signs of its passing. For example, the transition should kick off certain particles at specific ratios, trajectories and speeds—all of which the detectors pick up. They'll also measure temperature, because theory says it should hold steady while the transition is in progress.

Emotions surrounding the collider, on the other hand, are heating up. Last month The Sunday Times of London ran an article headlined BIG BANG MACHINE COULD DESTROY EARTH. After seeing the article, another reporter called Brookhaven to ask whether it had created a black hole that destroyed John F. Kennedy Jr.'s plane. Larry McLerran, who takes over Brookhaven's nuclear-theory group in September, explains that some physicists—not him—thought the collider could create a region of space where matter had a different mixture of quarks than in our world, which "would begin expanding and eat up the universe we live in." Or a collision could give rise to particles containing a type of quark called "strange," which would convert everything around them to more "strangelets" (and obliterate our nonstrangelet universe). But, say the physicists, the world won't end with this particular bang. "These collisions have been going on since the beginning of time," says McLerran. "There are nuclei in cosmic rays, and they collide with one another at very high densities. And we're still alive."

Why do the research at all? While quantum theory predicts the existence of quark-gluon plasma, it doesn't detail its every characteristic—no one even knows what temperature creates it. And RHIC-size collisions also mimic the conditions in the depths of neutron stars and exploding supernovas, providing astrophysics in a bottle. Running protons through the collider may eventually solve the mystery of what causes them to "spin" in the particular way they do. But history may provide an even better reason. Around the turn of the century, physicists were chasing another temperature frontier, this one at about 10,000 degrees K. When they hit it, the data they got were totally unexpected. In trying to figure out what happened, a physicist named Max Planck figured out that energy came in discrete packets—what he called quanta. It was the birth of quantum physics: the basics of how matter and energy work. "The knowledge that came out of that is the basis for our entire modern life," says Hallman. "We fully expect that our data will match the theory ... on the other hand, in 1900 they fully expected their data would match the theory, too." Let's just hope he's right about that destruction-of-the-universe thing.

With ERIKA CHECK *and* JOHN DAVENPORT

Ka-pow! *A computer simulates the profusion of particles researchers expect to see when gold ions smash into each other at nearly the speed of light*

Big Bang: The Sequel

The Relativistic Heavy Ion Collider (RHIC) briefly re-creates the superdense state of matter scientists believe existed just after the big bang. Here's how:

1 **Tandem Van de Graaff:** It strips atoms down to nuclei (ions), bunches them together and beams them off.
2 **Booster:** The positively charged ions speed up here, racing around a strong magnetic field.
3 **Alternating Gradient Synchrotron:** As the ions whirl around this loop, they hit 99.7% of the speed of light before they career down a long, straight pipe. At its end, magnets sort the ion bunches left or right.
4 **RHIC:** The bunches circle in opposite directions, colliding at four detectors. Each measures for evidence of matter as hot and dense as in the early universe.

RHIC DETECTORS

SOURCE: BROOKHAVEN NATIONAL LABORATORY

STAR COLLABORATION AND BROOKHAVEN NATIONAL LABORATORY (LEFT), BROOKHAVEN NATIONAL LABORATORY

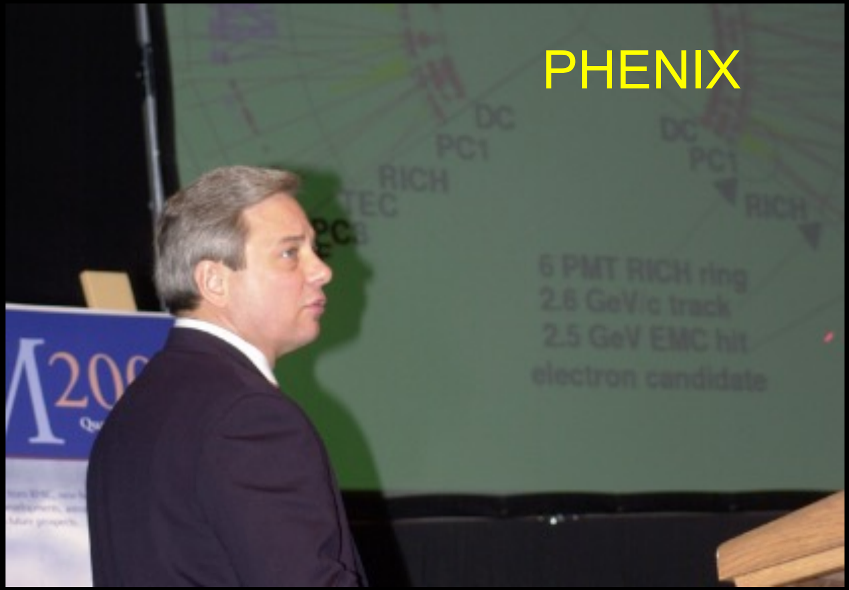
56 NEWSWEEK AUGUST 16, 1999

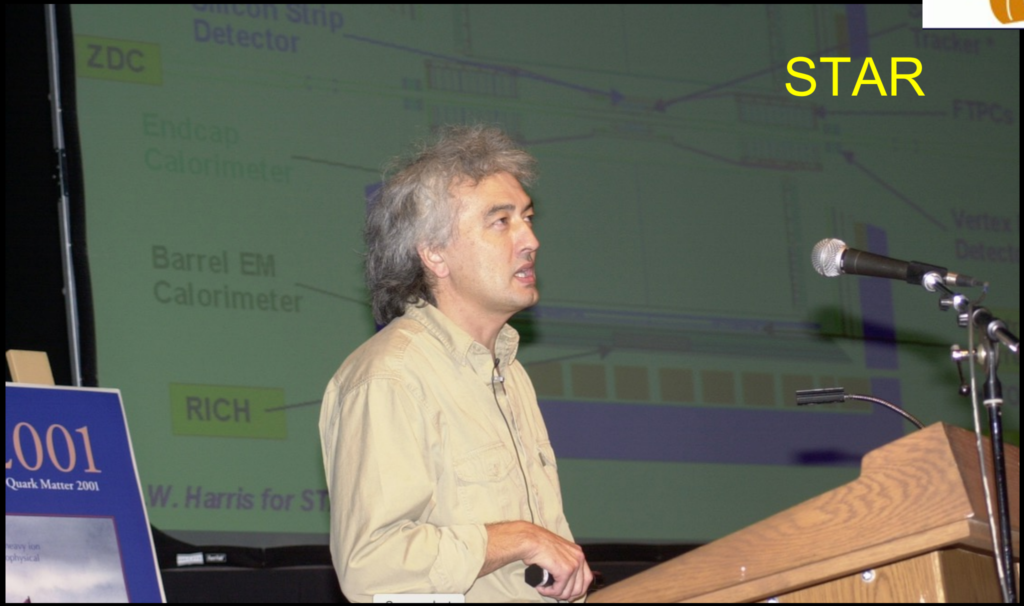
AUGUST 16, 1999 NEWSWEEK 57

The Dawn of RHIC Physics (2001)

(a real scramble)

The Dawn of RHIC Physics





PHOBOS

Flow at RHIC!

VOLUME 86, NUMBER 3 PHYSICAL REVIEW LETTERS 15 JANUARY 2001

Elliptic Flow in Au + Au Collisions at $\sqrt{s_{NN}} = 130$ GeV

K. H. Ackermann,[19] N. Adams,[28] C. Adler,[12] Z. Ahammed,[27] S. Ahmad,[28] C. Allgower,[13] J. Amsbaugh,[34] M. Anderson,[6] E. Anderssen,[17] H. Arnesen,[3] L. Arnold,[14] G. S. Averichev,[10] A. Baldwin,[16] J. Balewski,[13] O. Barannikova,[10,27] L. S. Barnby,[16] J. Baudot,[14] M. Beddo,[1] S. Bekele,[24] V. V. Belaga,[10] R. Bellwied,[35] S. Bennett,[35] J. Bercovitz,[17] J. Berger,[12] W. Betts,[24] H. Bichsel,[34] F. Bieser,[17] L. C. Bland,[13] M. Bloomer,[17] C. O. Blyth,[4] J. Boehm,[17] B. E. Bonner,[28] D. Bonnet,[14] R. Bossingham,[17] M. Botlo,[3] A. Boucham,[30] N. Bouillo,[30] S. Bouvier,[30] K. Bradley,[17] F. P. Brady,[6] E. S. Braithwaite,[2] W. Braithwaite,[2] A. Brandin,[21] R. L. Brown,[3] G. Brugalette,[34] C. Byrd,[2] H. Caines,[24] M. Calderón de la Barca Sánchez,[36] A. Cardenas,[27] L. Carr,[34] J. Carroll,[17] J. Castillo,[30] B. Caylor,[17] D. Cebra,[6] S. Chatopadhyay,[35] M. L. Chen,[3] W. Chen,[3] Y. Chen,[7] S. P. Chernenko,[10] M. Cherney,[9] A. 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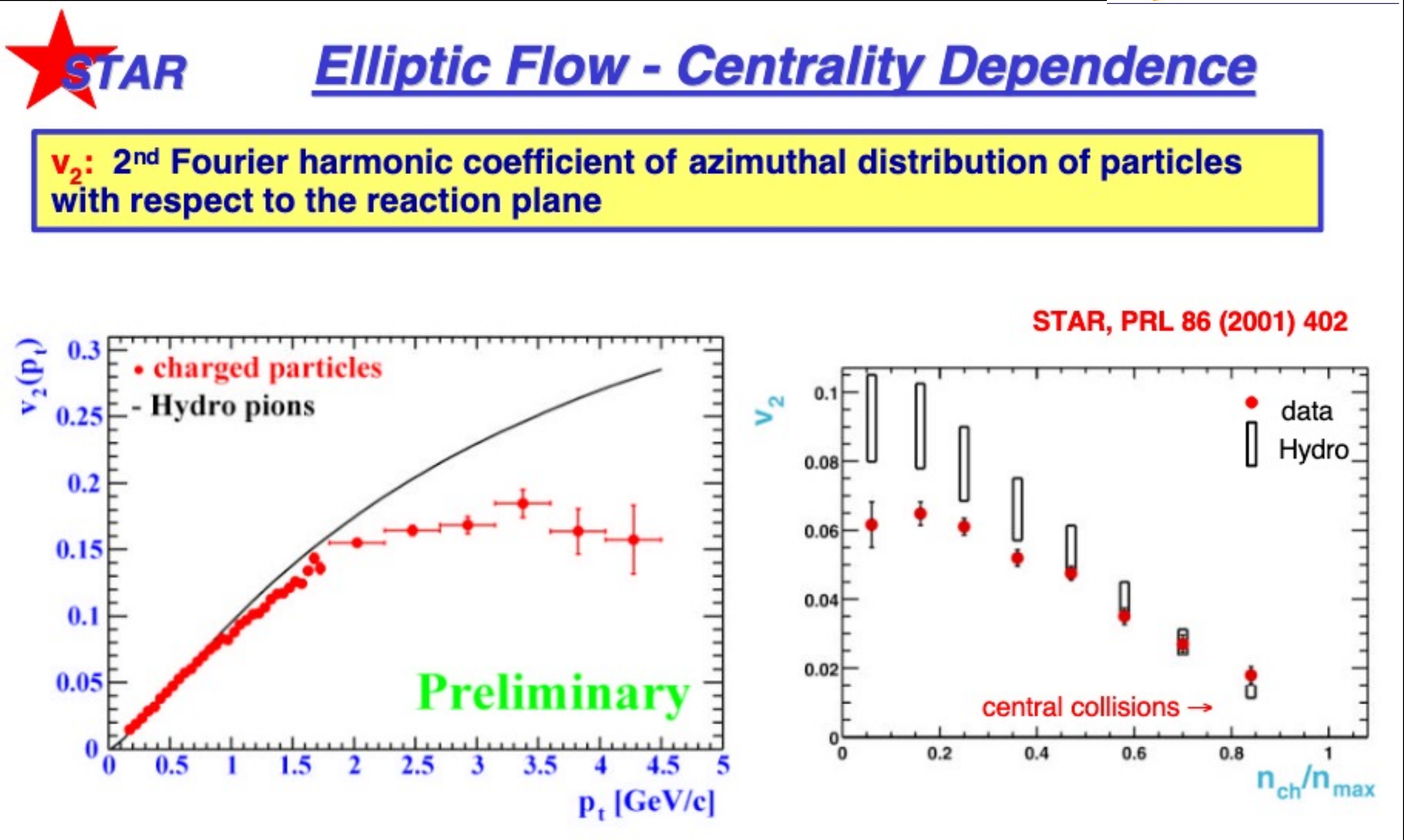
Tarchini,[14] J. Tarzian,[17] J. H. Thomas,[17] V. Tikhomirov,[21] A. Szanto de Toledo,[29] S. Tonse,[17] T. Trainor,[34] S. Trentalange,[7] M. Tokarev,[10] M. B. Tonjes,[20] V. Trofimov,[21]

QM2001 Quark Matter 2001



It Flows so Well – It's a Nearly Perfect Liquid!

Early Universe Went With the Flow

Posted April 18, 2005 5:57PM

Between 2000 and 2003 the lab's Relativistic Heavy Ion Collider repeatedly smashed the nuclei of gold atoms together with such force that their energy briefly generated trillion-degree temperatures. Physicists think of the collider as a time machine, because those extreme temperature conditions last prevailed in the universe less than 100 millionths of a second after the big bang.

New State of Matter Is 'Nearly Perfect' Liquid

Physicists working at Brookhaven National Laboratory announced today that they have created what appears to be a new state of matter out of the building blocks of atomic nuclei, quarks and gluons. The researchers unveiled their findings--which could provide new insight into the composition of the universe just moments after the big bang--today in Florida at a meeting of the American Physical Society.

SCIENTIFIC AMERICAN

Image: BNL

There are four collaborations, dubbed BRAHMS, PHENIX, PHOBOS and STAR, working at Brookhaven's Relativistic Heavy Ion Collider (RHIC). All of them study what happens when two interacting beams of gold ions smash into one another at great velocities, resulting in thousands of subatomic collisions every second. When the researchers analyzed the patterns of the atoms' trajectories after these collisions, they found that the particles produced in the collisions tended to move collectively, much like a school of fish does. Brookhaven's associate laboratory director for high energy and nuclear physics, Sam Aronson, remarks that "the degree of collective interaction, rapid thermalization and extremely low viscosity of the matter being formed at RHIC make this the most nearly perfect liquid ever observed."

The News of the QGP Hit the Streets

Universe May Have Begun as Liquid, Not Gas

Associated Press
Tuesday, April 19, 2005; Page A05

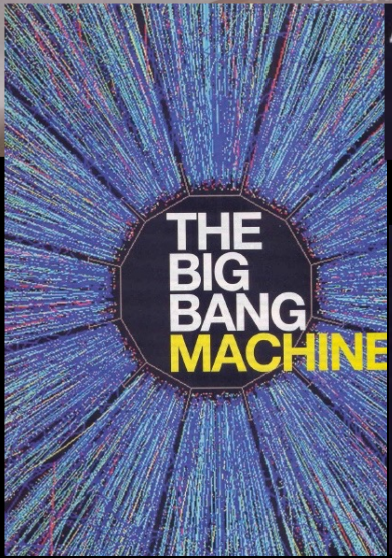
The Washington Post

New results from a particle collider suggest that the universe behaved like a liquid in its earliest moments, not the fiery gas that was thought to have pervaded the first microseconds of existence.

DISCOVER

Science, Technology, and The Future

THE BIG BANG MACHINE
A Long Island Particle Smasher Re-creates The Moment Of Creation



An atom smasher on Long Island re-creates the particle soup that gave rise to the universe

"Here is where the action takes place. This is where we effectively try to turn the clock back 14 billion years. Right above your head, about 13½ feet in the air."

Looking up, I try to imagine the events Tim Hallman is describing—atoms of gold colliding at 99.99 percent the speed of light; temperatures instantly soaring to 1 trillion degrees, 150,000 times hotter than the core of the sun. Then I try to picture a minuscule five-dimensional black hole, which, depending on your point of view, may or may not have formed at that same spot over my head. It's all a little much for an imagination that sometimes struggles with the plot of *Battlestar Galactica*.

Early Universe was a liquid

Quark-gluon blob surprises particle physicists.

nature

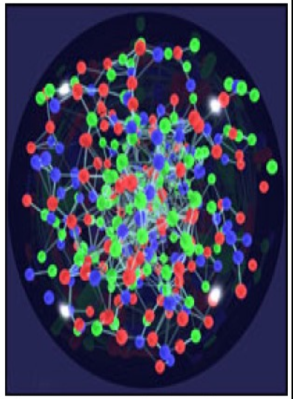
by Mark Peplow
news@nature.com

The Universe consisted of a perfect liquid in its first moments, according to results from an atom-smashing experiment.

Scientists at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory on Long Island, New York, have spent five years searching for the quark-gluon plasma that is thought to have filled our Universe in the first microseconds of its existence. Most of them are now convinced they have found it. But, strangely, it seems to be a liquid rather than the expected hot gas.

Early Universe was 'liquid-like'

Physicists say they have created a new state of hot, dense matter by crashing together the nuclei of gold atoms. BBC NEWS



The impression is of matter that is more strongly interacting than predicted

The high-energy collisions prised open the nuclei to reveal their most basic particles, known as quarks and gluons.

The researchers, at the US Brookhaven National Laboratory, say these particles were seen to behave as an almost perfect "liquid".

The work is expected to help scientists explain the conditions that existed just milliseconds after the Big Bang.

SCIENTIFIC AMERICAN

Bringing DNA Computers to Life

MAY 2006
WWW.SCIAM.COM

Quark Soup

PHYSICISTS RE-CREATE THE LIQUID STUFF OF **THE EARLIEST UNIVERSE**

…. and the "Nerd" Haunts!

SHARE | Print

Contacts: Karen McNulty Walsh, (631) 344-8350 or Peter Genzer, (631) 344-3174

RHIC Scientists Serve Up 'Perfect' Liquid

New state of matter more remarkable than predicted — raising many new questions

Monday, April 18, 2005

TAMPA, FL — The four detector groups conducting research at the Relativistic Heavy Ion Collider (RHIC) — a giant atom "smasher" located at the U.S. Department of Energy's Brookhaven National Laboratory — say they've created a new state of hot, dense matter out of the quarks and gluons that are the basic particles of atomic nuclei, but it is a state quite different and even more remarkable than had been predicted. In peer-reviewed papers summarizing the first three years of RHIC findings, the scientists say that instead of behaving like a gas of free quarks and gluons, as was expected, the matter created in RHIC's heavy ion collisions appears to be more like a *liquid*.

SCIENTIFIC AMERICAN CELEBRATING 175 YEARS

THE SCIENCES

New State of Matter Is 'Nearly Perfect' Liquid

By Sarah Graham on April 18, 2005

CERNCOURIER | Reporting on international high-energy physics

Physics | Technology | Community | In focus | Magazine

NEWS

RHIC groups serve up 'perfect' liquid

5 May 2005

APS physics

Publications | Meetings & Events | Programs | Membership

APS NEWS

June 2005 (Volume 14, Number 6)

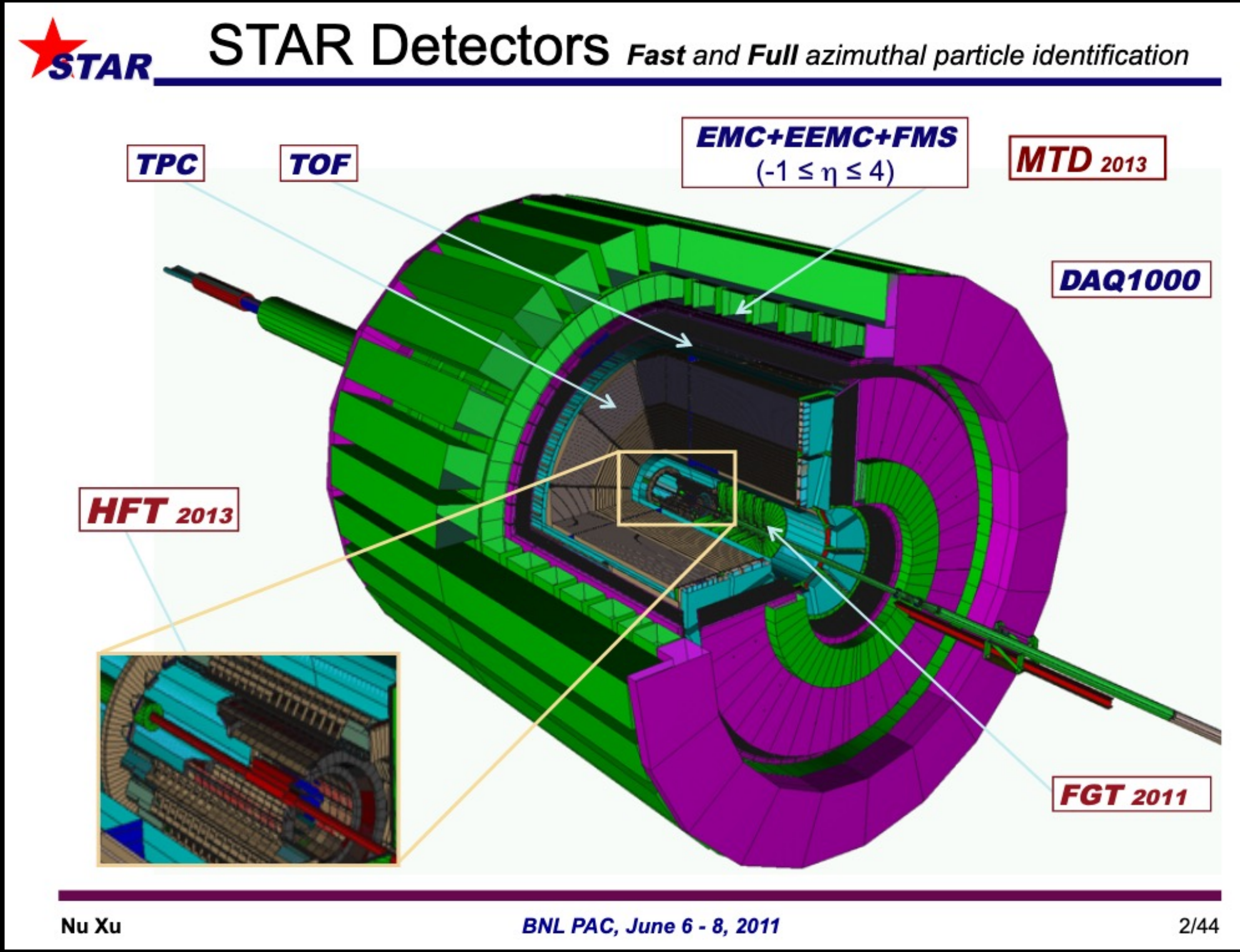
RHIC Detects Liquid State of Quark-Gluon Matter

By Ernie Tretkoff

First Dignitaries Visit STAR and RHIC

STAR – Growing Up!

STAR



STAR Mid-term Upgrades

Time of Flight

Forward Meson Spectrometer

DAQ1000

Heavy Flavor Tracker

Intermediate Stage Tracker

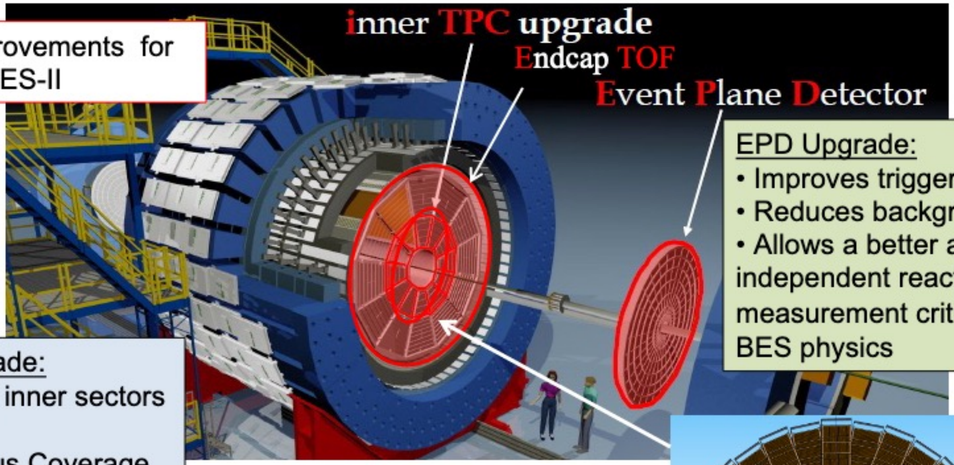
Forward Tracking

Completion of STAR – Growing Up!

STAR

STAR detector at BESII

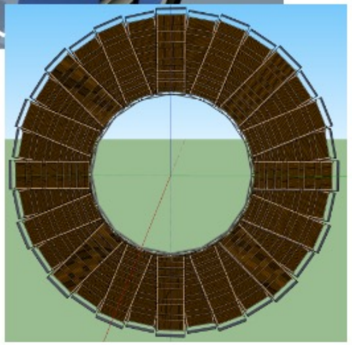
Major improvements for BES-II



EPD Upgrade:
- Improves trigger
- Reduces background
- Allows a better and independent reaction plane measurement critical to BES physics

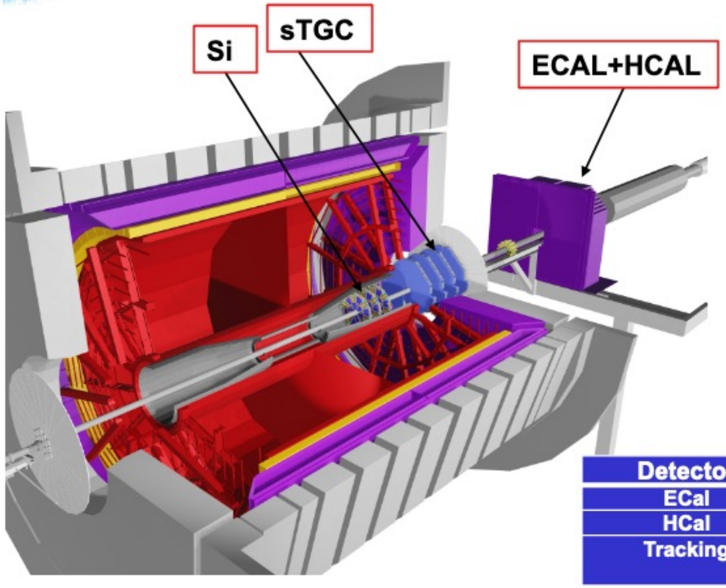
iTPC Upgrade:
- Replaced inner sectors of the TPC
- Continuous Coverage
- Improves dE/dx
- Extends η coverage from 1.0 to 1.5
- Lowers p_T cut from 125 MeV/c to 60 MeV/c

EndCap TOF Upgrade:
- Rapidity coverage is critical
- PID at η = 1 to 1.5
- Improves the fixed target program
- Provided by CBM-FAIR



Lijuan Ruan, BNL 40

STAR forward upgrades

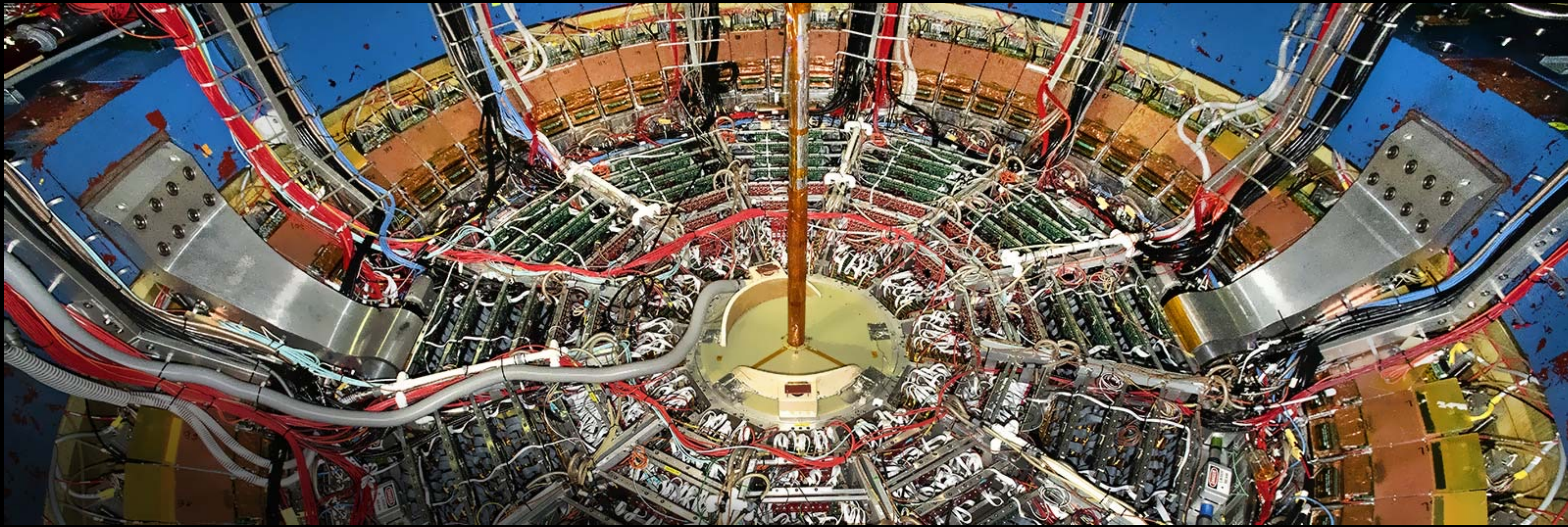


At 2.5<η<4
- Jets
- PID (π^0, γ, e, Λ)
- charged particle momentum resolution 20-30% at $0.2<p_T<2$ GeV/c
- event-plane reconstruction and trigger capability

Detector	pp and pA	AA
ECal	~10%/√E	~20%/√E
HCal	~50%/√E+10%	---
Tracking	charge separation photon suppression	$0.2<p_T<2$ GeV/c with 20-30% $1/p_T$

Lijuan Ruan, BNL 41

STAR – All Grown Up!



To date: 337 theses → 296 (PhD), 33 (Masters) and 8 (diploma)

295 publications → 94 in PRL and 7 in Science Advanced and Nature Physics

26 publications in this year alone!

Special Thanks to

All my STAR Collaborators

and

the Organizers of this Symposium