Symposium to Honor Howard Wieman's contributions to STAR

The TPC

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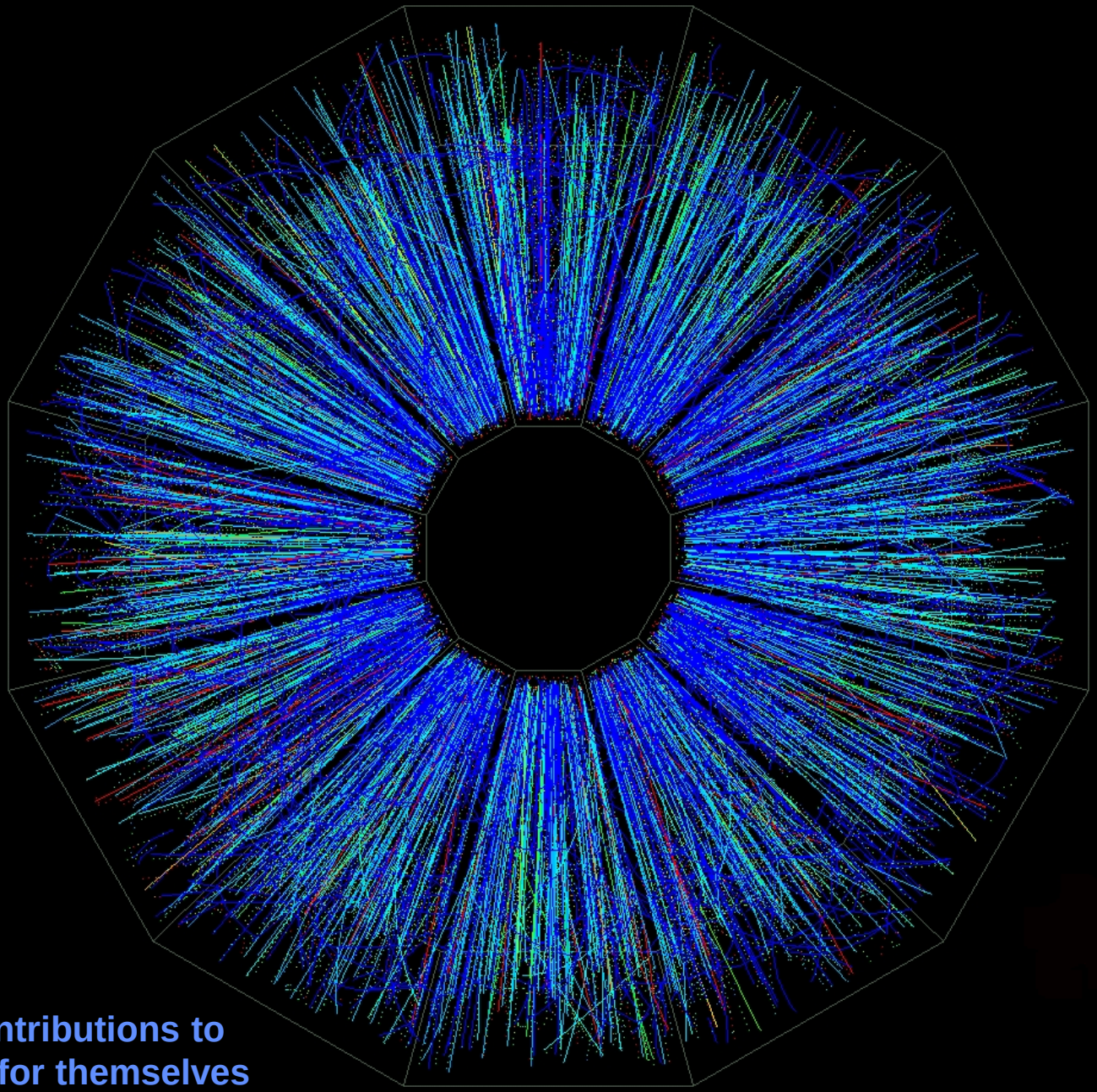
11/06/2014
Lawrence Berkeley Laboratory



Howard’s contributions to STAR speak for themselves

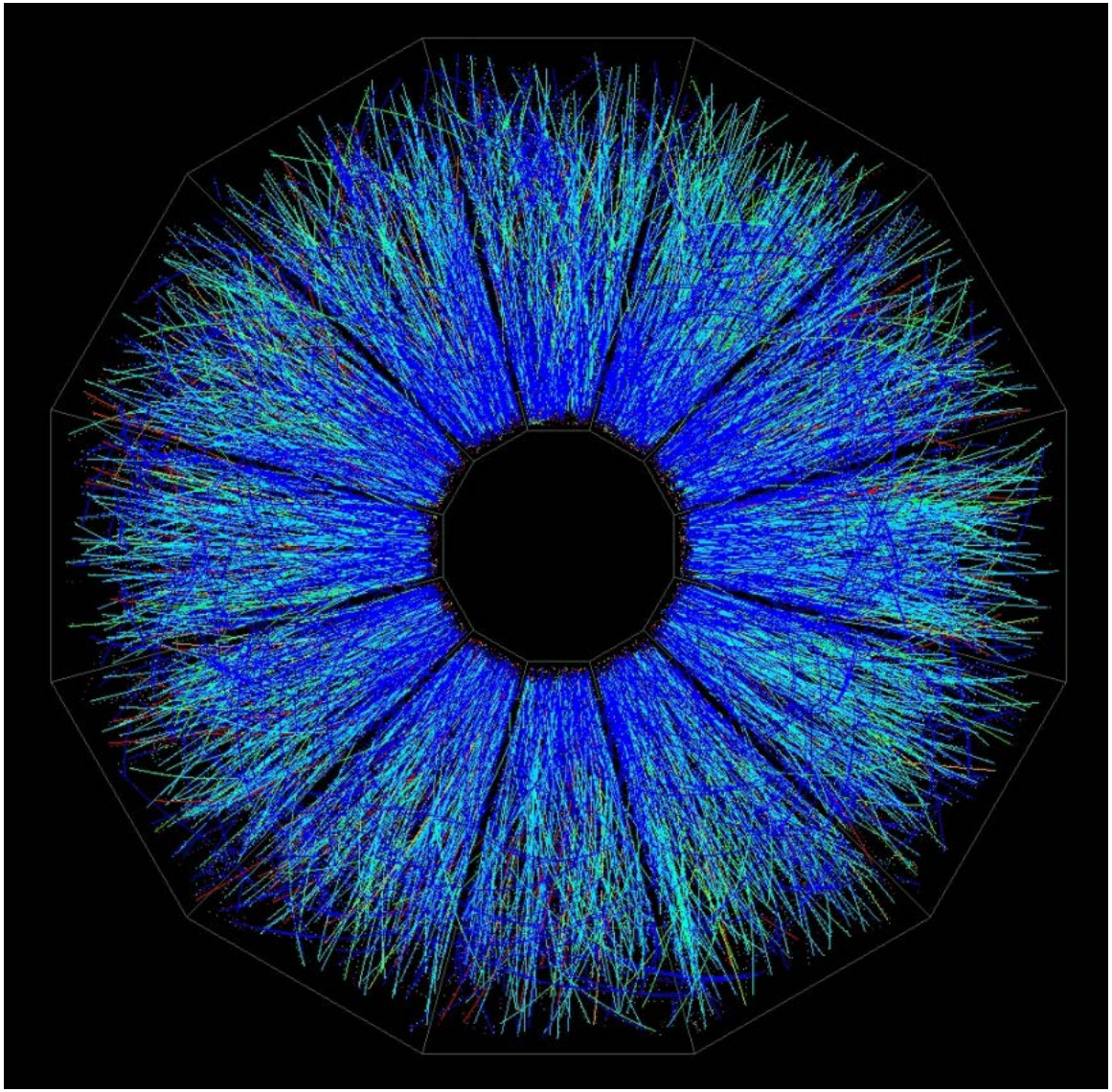
Au on Au Events at $\sqrt{S_{NN}}$ = 130 GeV

The 12th event recorded by STAR

Data Taken June 25th 2000

DAQ Rate 1 Hz

The TPC worked the first time !



The STAR Event is an icon

From sportswear to the cover of textbooks & Nobel lectures

STAR Physics … first year of operation

- **Flow**
  - **v_2 with 22,000 events @ 130 GeV ⇒ PRL**
- **R_{AA} suppressed; presented at QM2001**
  - **even before RHIC had taken pp data**
- **HBT**
  - **No sudden jumps in HBT radii are observed, "but lower energy RHIC measurements are needed ..."**
- **Multiplicity**
  - **below expectations for central collisions at 130 GeV**
- **Strangeness**
- **UPCs**

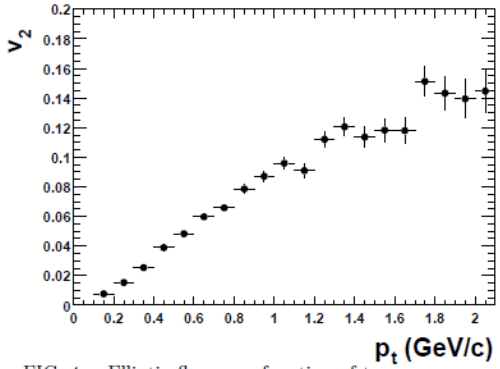
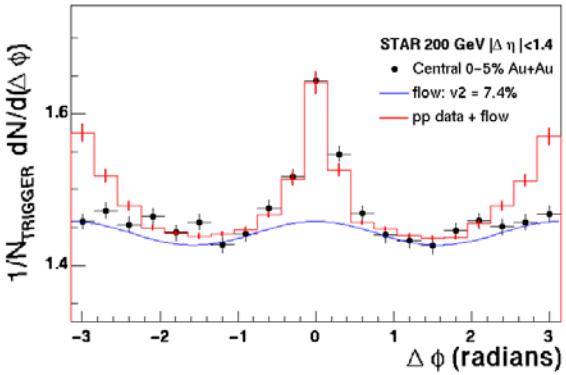


FIG. 4. Elliptic flow as a function of transverse momentum for minimum bias events.

- **And a year later when we had 200 GeV data**
- **Suppression of the away side jet**



An amazing harvest

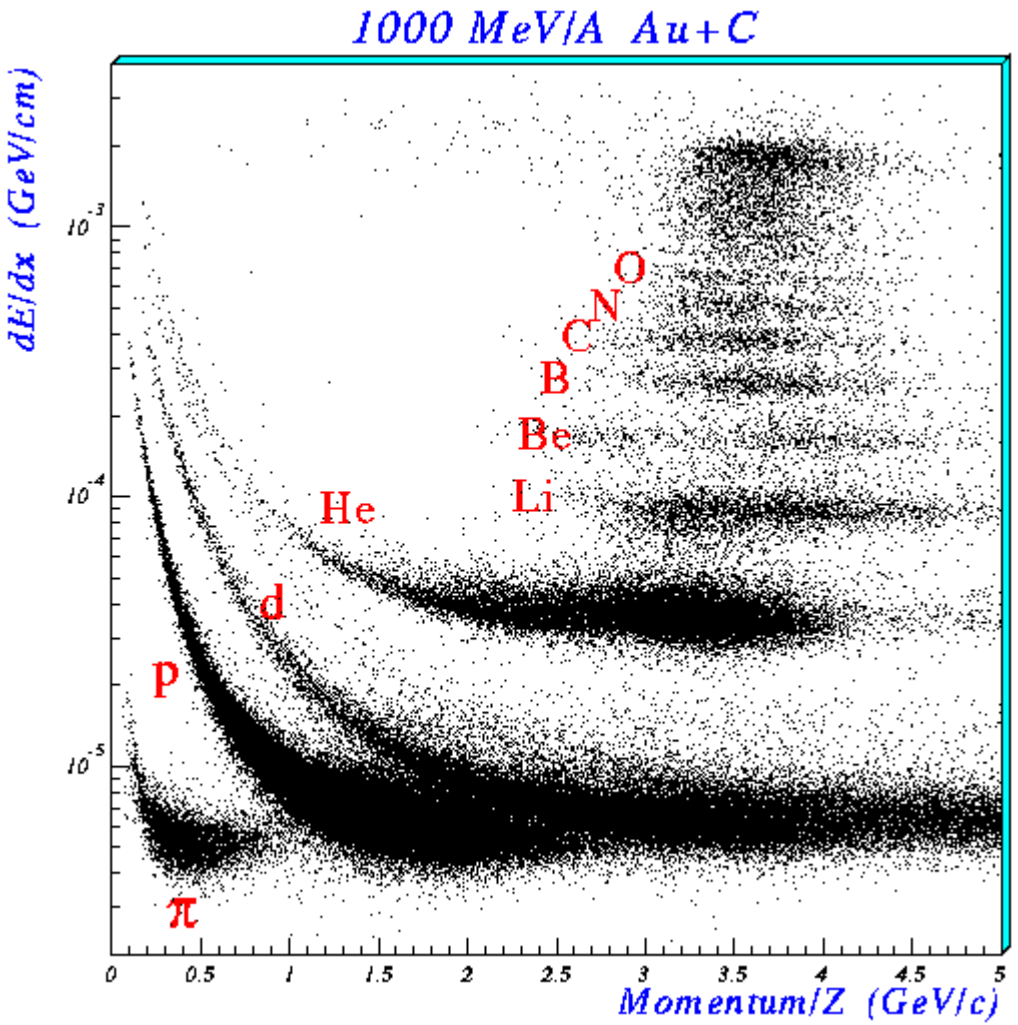
How to build a TPC

- **If you want to know how to build at TPC … just ask him**

- **The first thing you do is to go to a RHIC workshop and *propose a TPC for a different project !***

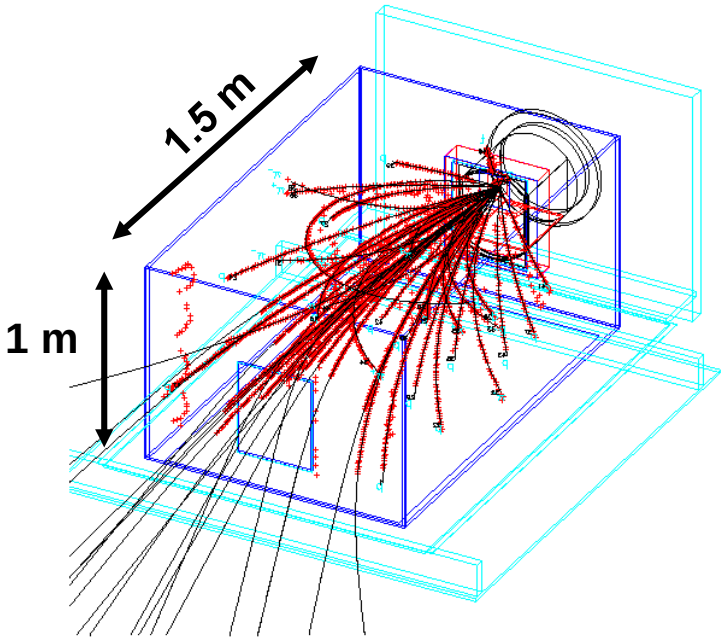
"A 4 pi Detector for the Study of N-N Collisions at the Bevelac"
2nd Workshop on Experiments and Detectors for RHIC (1987)

EOS at the Bevelac – a heavy ion spectrometer - HISS



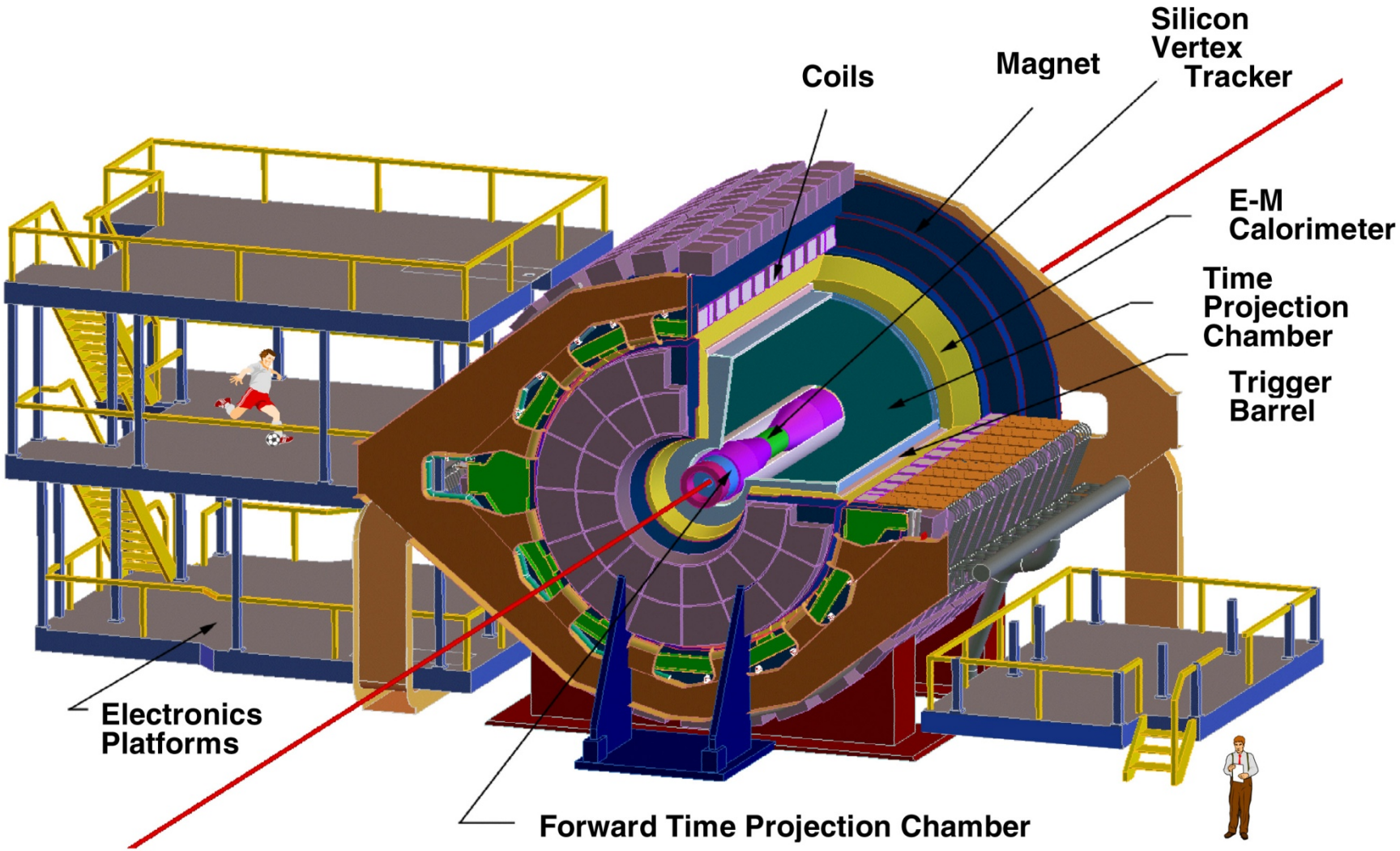
- **Beautiful dE/dx spectra and good dynamic range**
- **Space point resolution 300 μm**

- **Cubic meter scale**
- **Inherits technology from PEP4**
- **Contemporary of NA35**



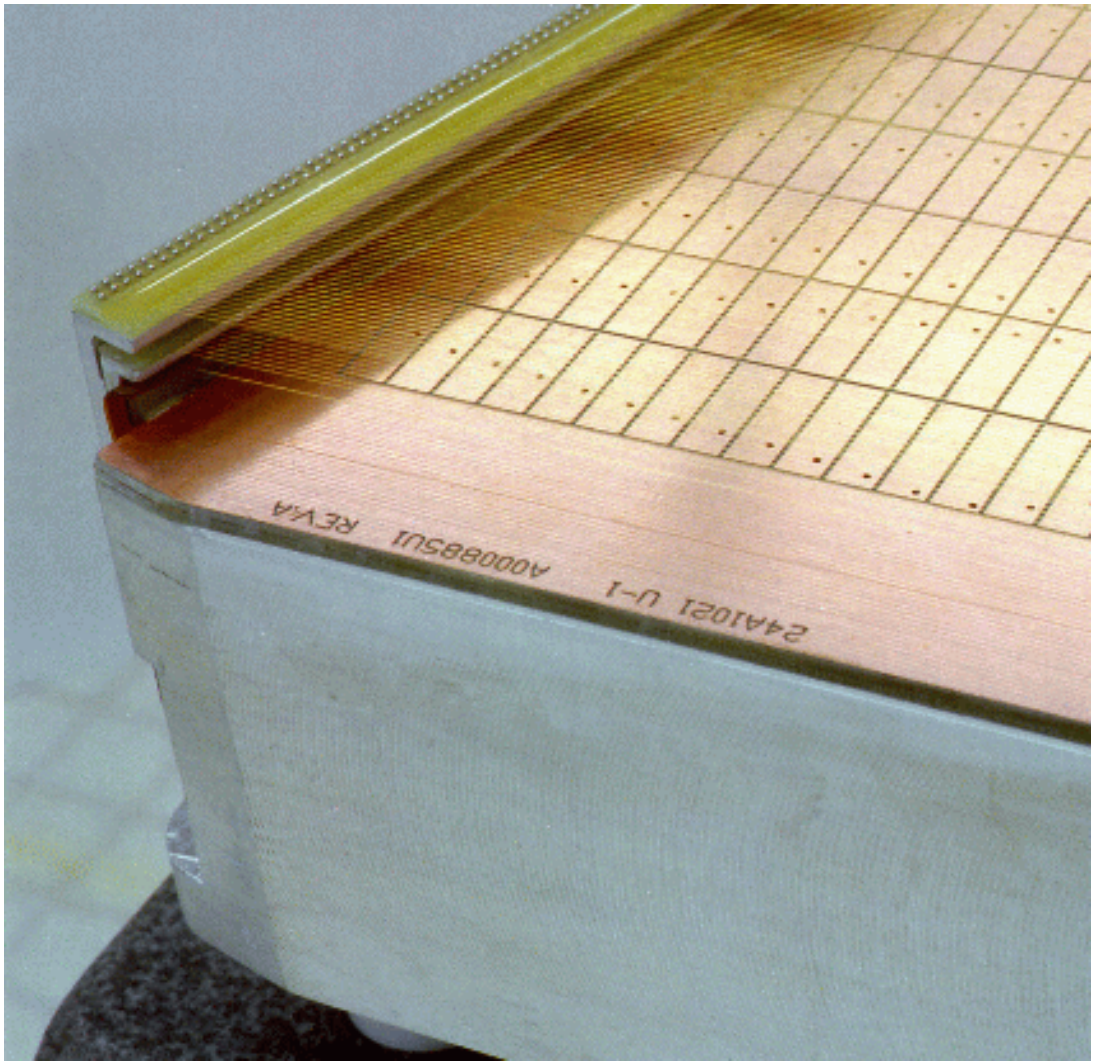
The EOS TPC ran at the Bevelac, AGS & Fermilab

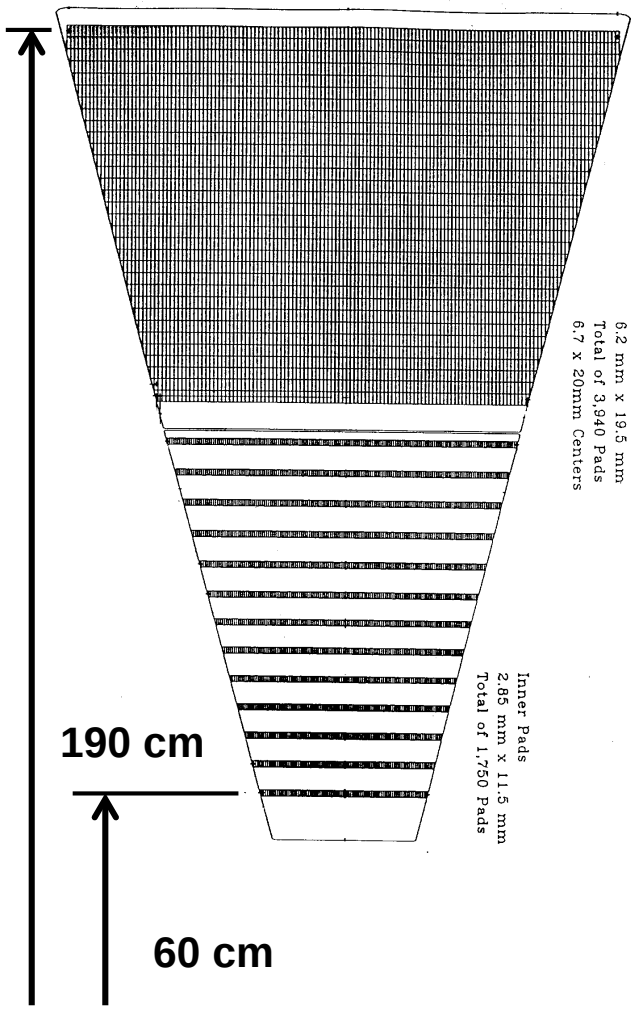
A TPC lies in the heart of STAR



CDR in 1992, CDR Update in 1993, Wayne Bett's Thesis 1996

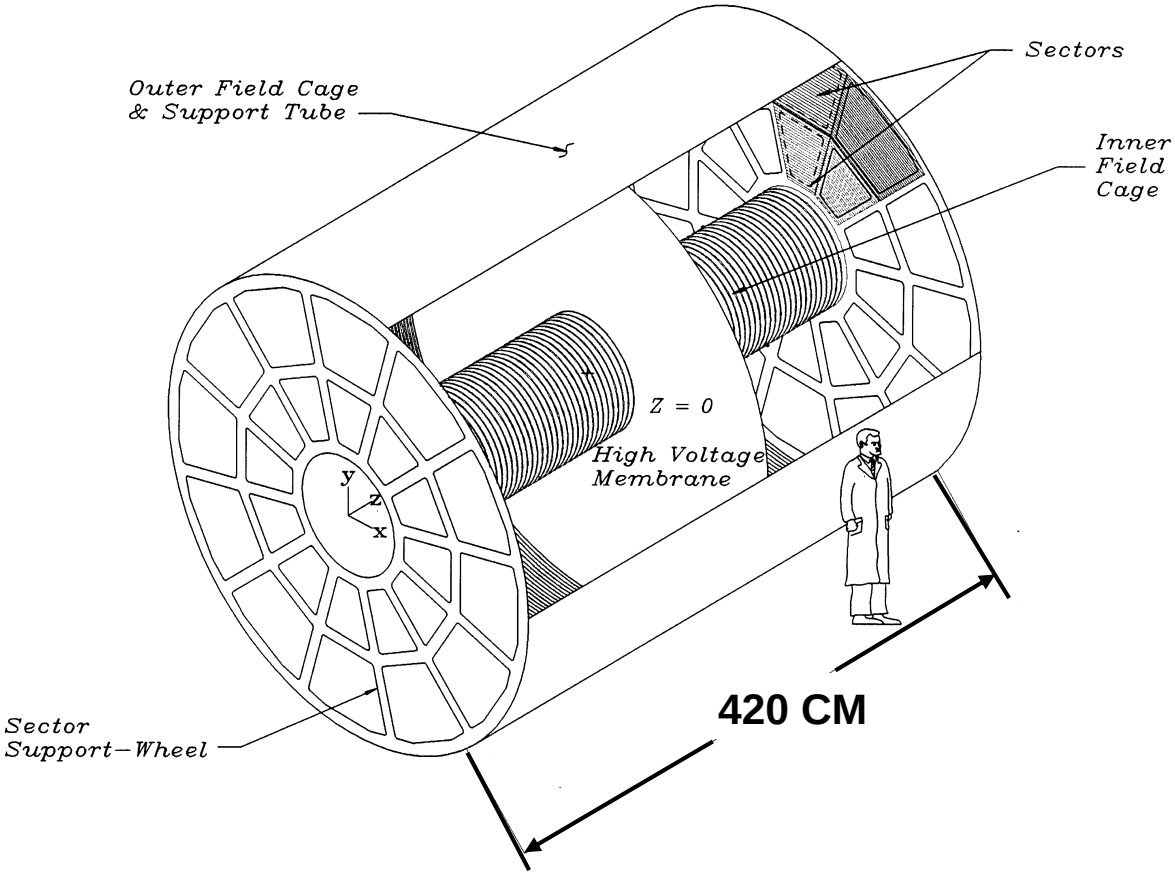
Anticipate and calculate … the hallmark of Howard's style





Define goals … design, calculate, anticipate, innovate, test and test again

From Conceptual Design … to Reality (1993-97)



- **Gas: P10 (Ar-CH_4 90%-10%) @ 1 atm**
- **Voltage : - 28 kV at the central membrane**
  135 V/cm over 210 cm drift path

Self supporting Inner Field Cage:
Al on Kapton using Nomex honeycomb; 0.5% rad length

The OFC, CM & Gas Vessel … unique solutions

- Winding the Outer Field Cage
- Mating the OFC & Gas Vessel
- OFC Check
- Moving the Central Membrane

Leadership

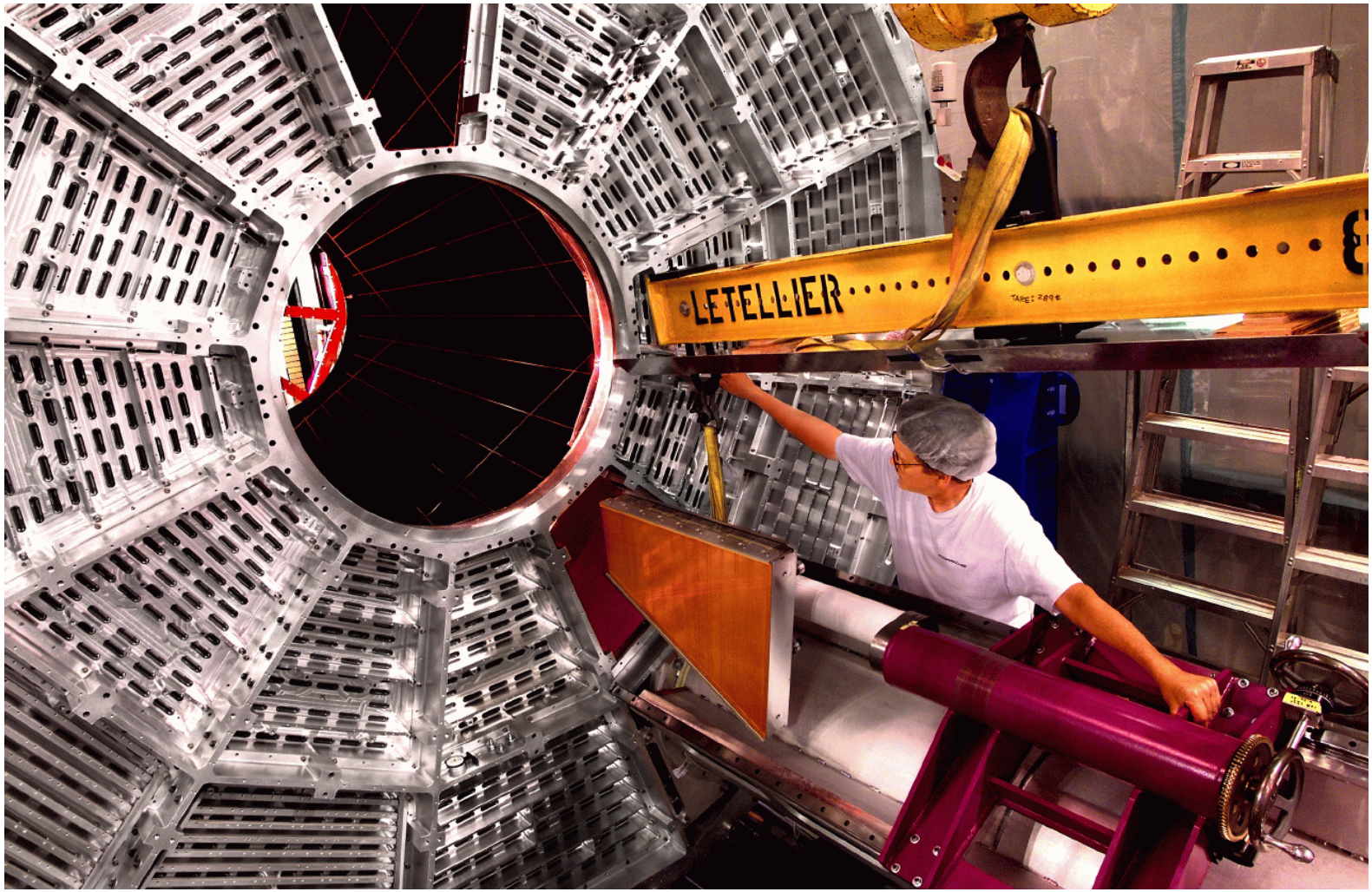
- **Howard's leadership style**
  - **Not by force**
  - **Not by intimidation**
  - **But simply by being the smartest scientist in the room**
- **Leadership – when no one else can (or will) do it …the boss has to do it**
  - **When a problem can't be solved**
    - **He becomes as good a mathematician as the best mathematician**
  - **When a problem can't be solved**
    - **He becomes as good an engineer as the best engineer**
  - **When a problem can't be solved**
    - **He becomes as good at Cost and Schedule as any Project Professional**
- **Howard works with the very best people, by choice**
  - **He will wait forever for the right person to be available**
  - **If the right person is available, his hands are completely off the project**
  - **If that person can't be found, he will develop the necessary expertise; independent of whether it is a scientific task, computation or engineering**

The STAR TPC Under Construction at LBL

First Successful Mating of:

- **Gas Vessel**
- **Outer Field Cage**
- **Sector Wheels**
- **Central membrane**
- **But without readout chambers**

Inner and Outer MWPC readout chambers



Sector Installation & Tooling

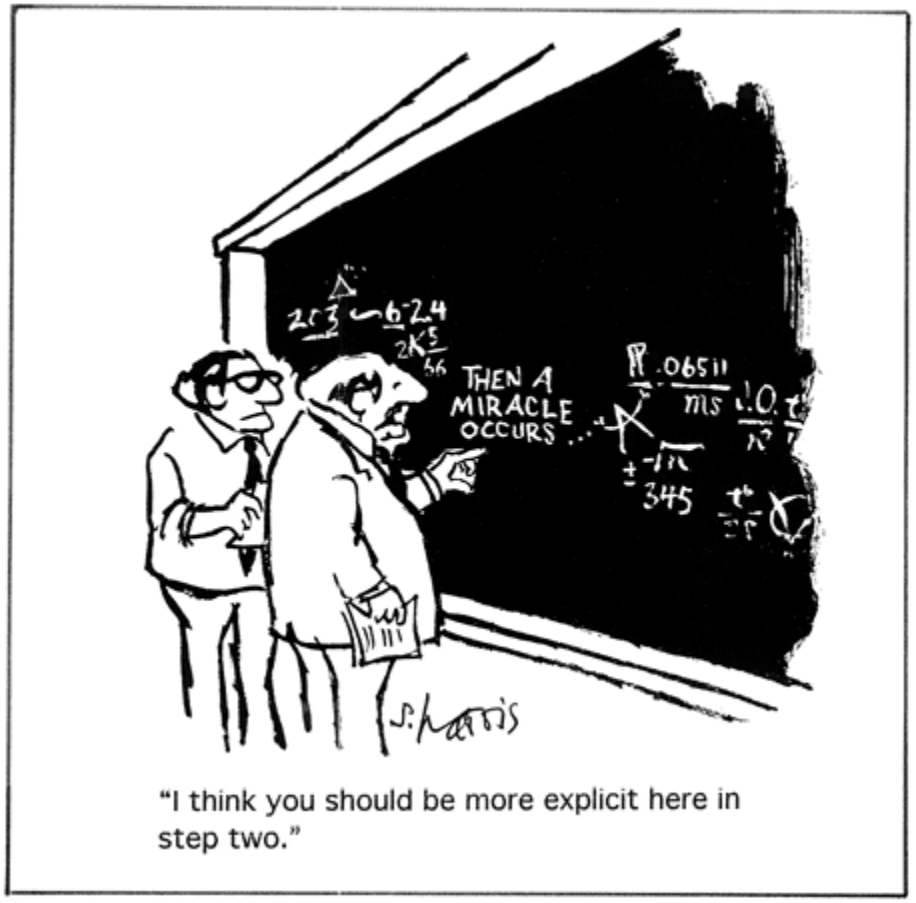
The TPC leaves LBL (circa 1997)

Leaving Travis Air Force base (CA)

Arrival on Long Island

The TPC got stuck coming out of the plane

Howard and his amazing notebooks …

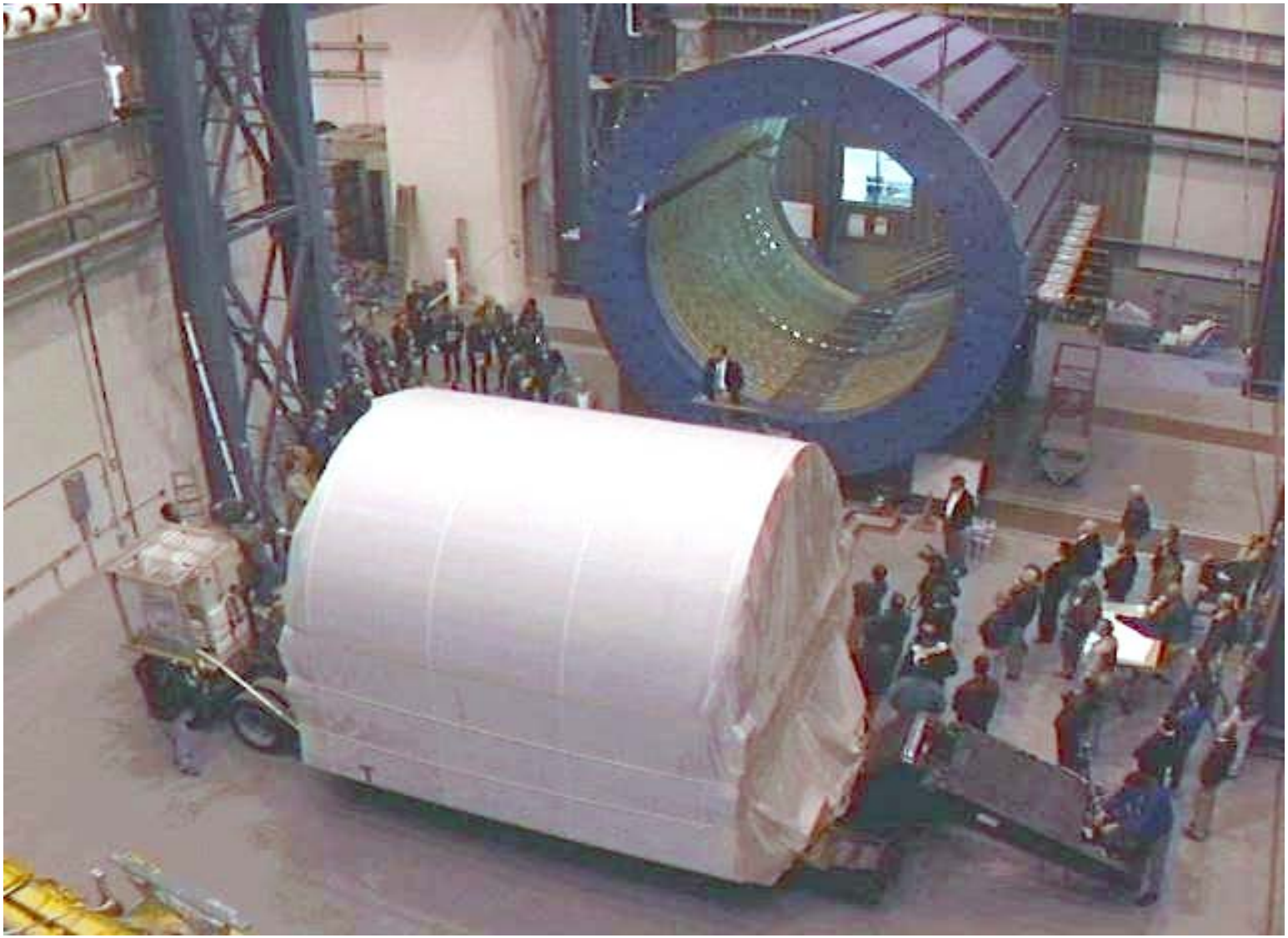


"I think you should be more explicit here in step two."

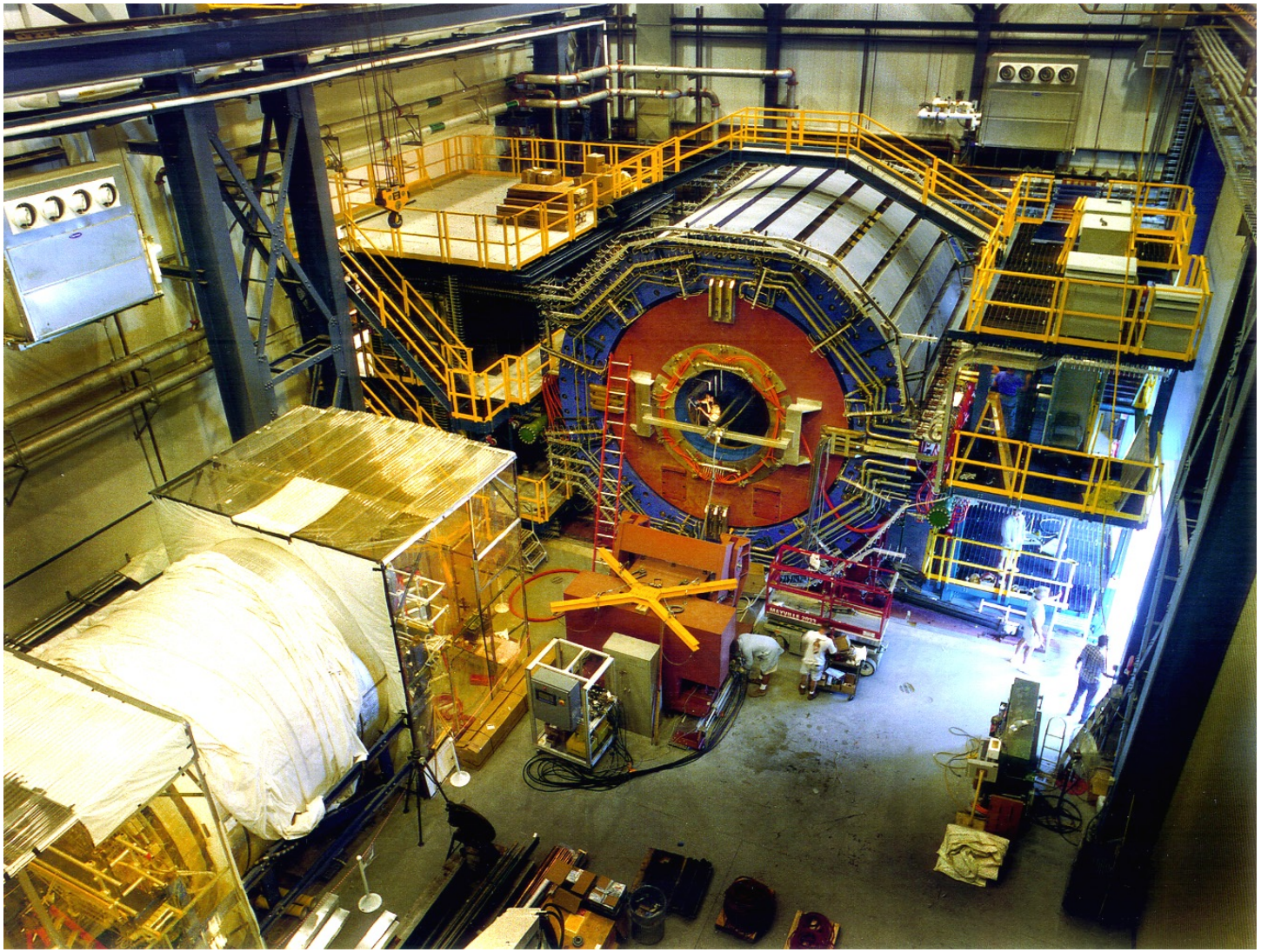
- **The secret to success is to think of everything and calculate/document in advance**
- **All of the tools we use to calibrate the TPC**
  - **Space charge**
  - **Shorted Rings**
  - **ExB field distortions**
- **came out of Howard's notebooks and STAR Notes. These tools were part of the original design and specification process**
- **For example, when the TPC got stuck coming out of the airplane, he flipped open his laptop …**

Police escort to BNL

Reception at BNL



If there is one thing I learned from Howard …

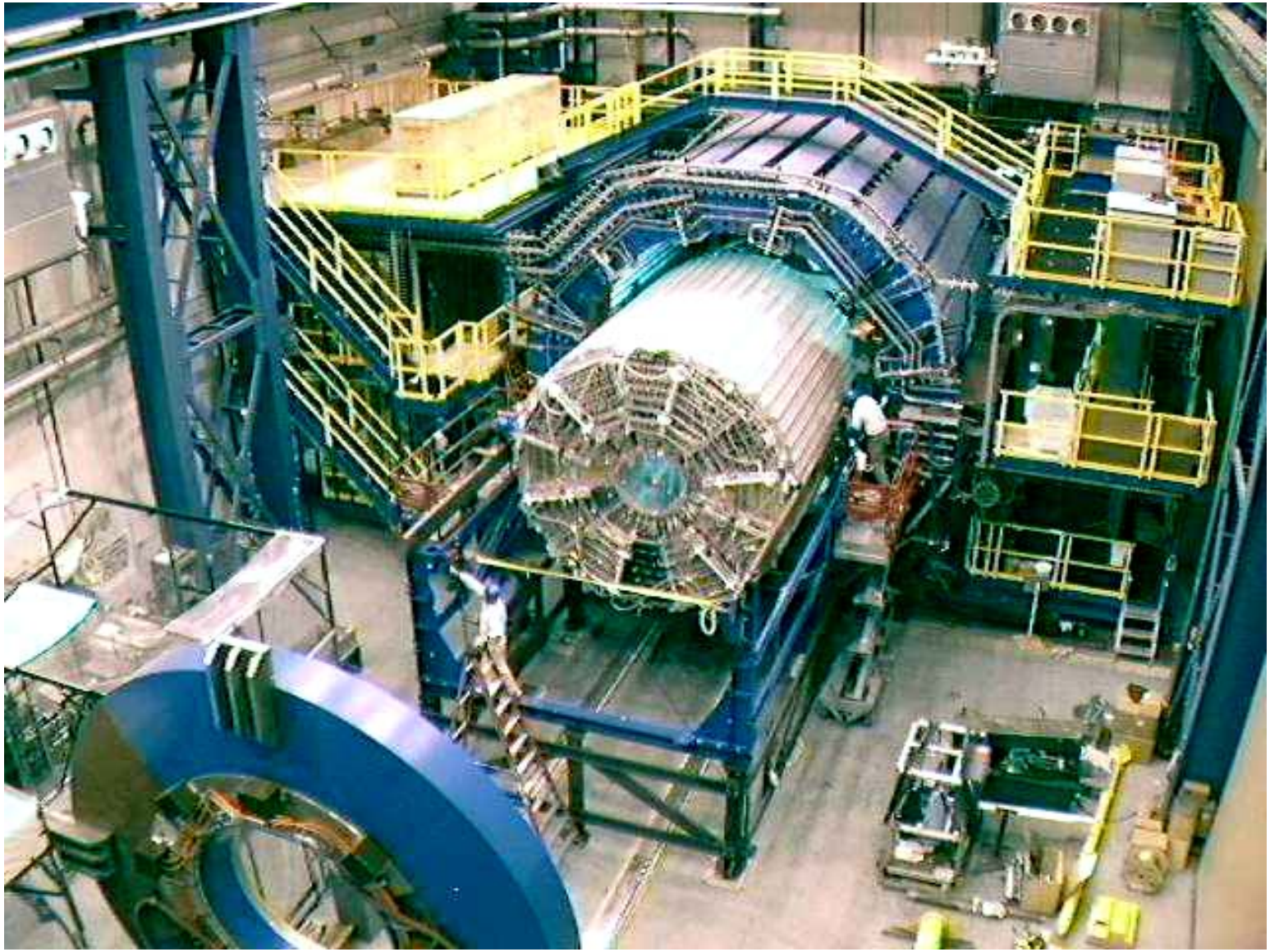


The TPC spent a year in the hall undergoing tests and studies before inserting it into the magnet

Test your detector before installing it in STAR

Insertion of the TPC into the Magnet

12/2/98



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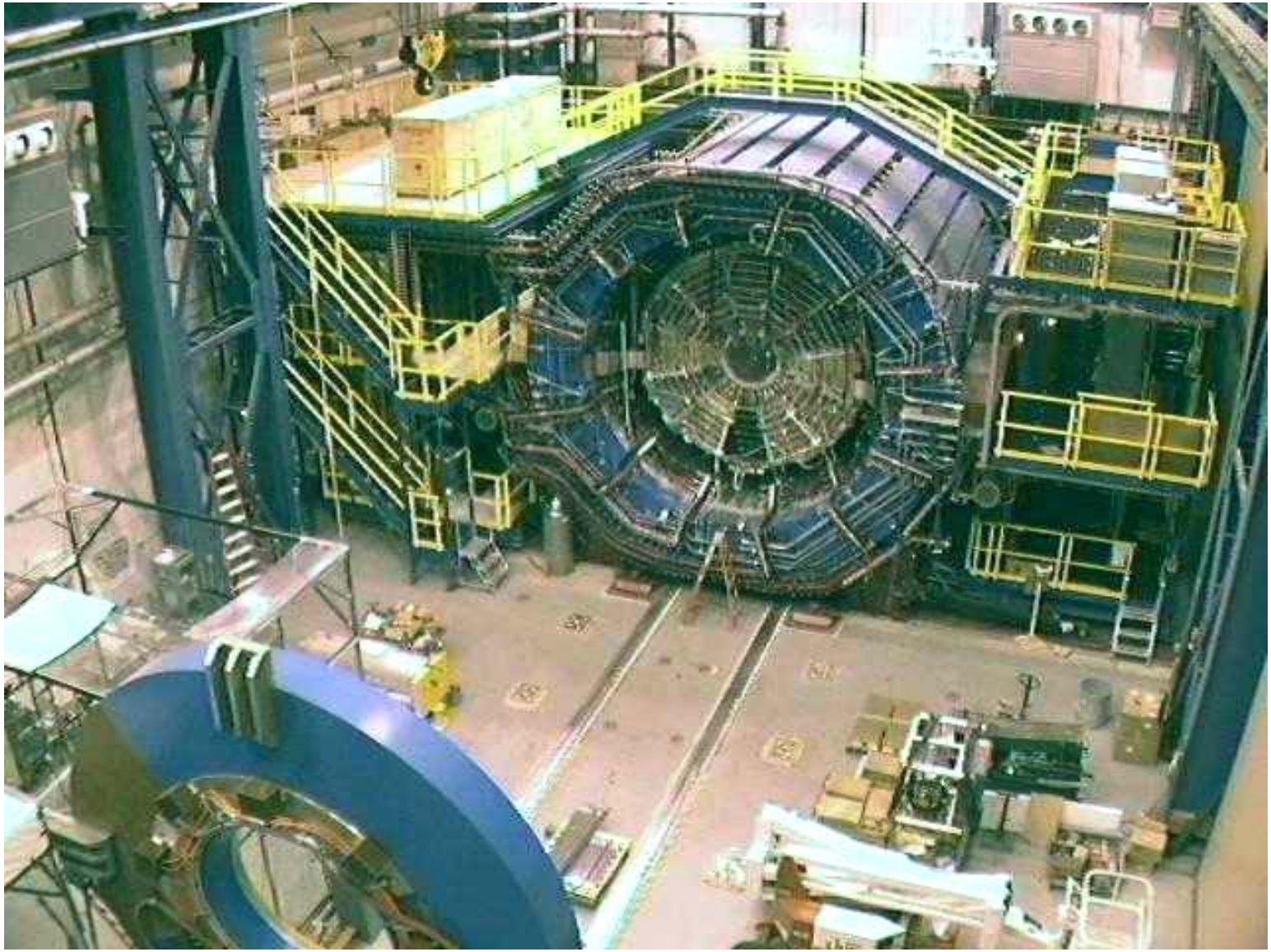
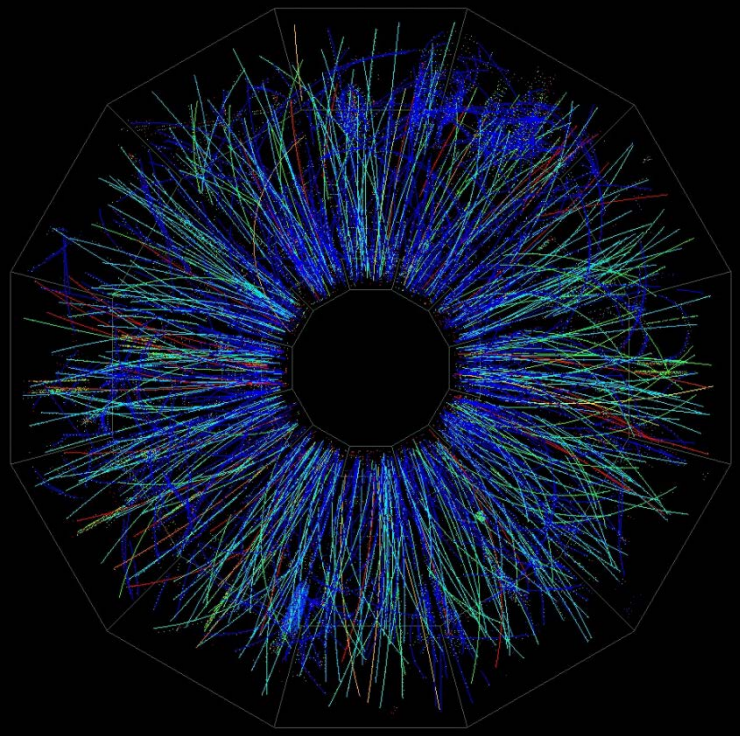
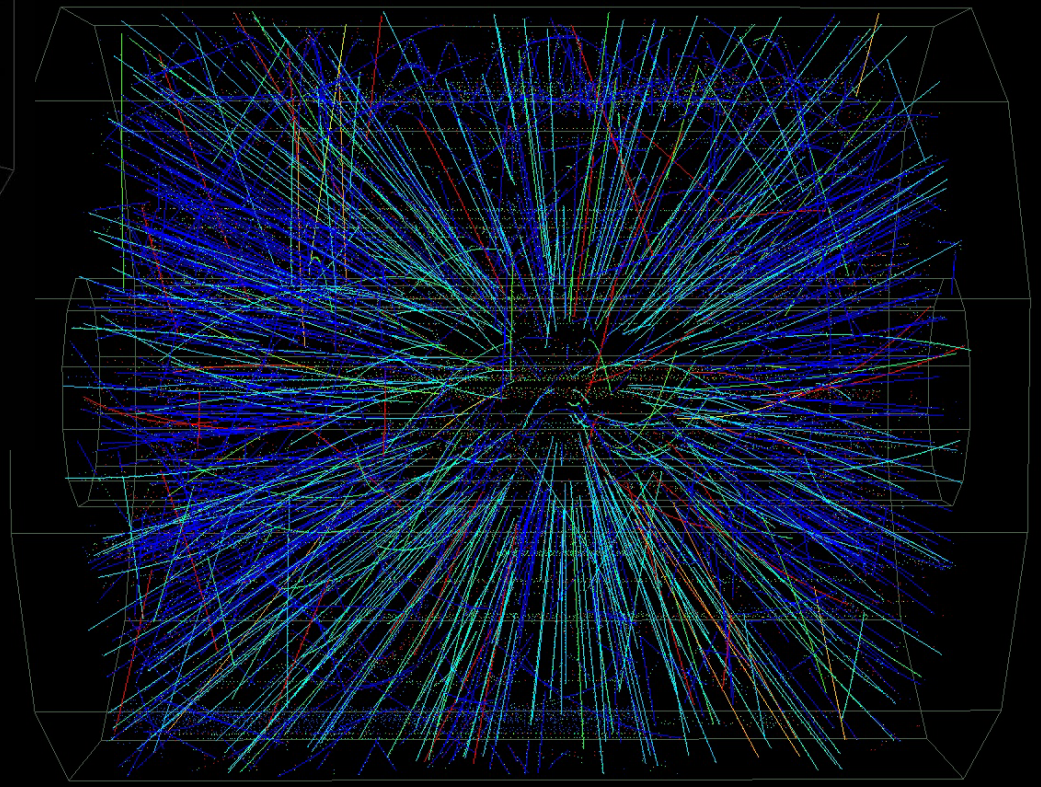
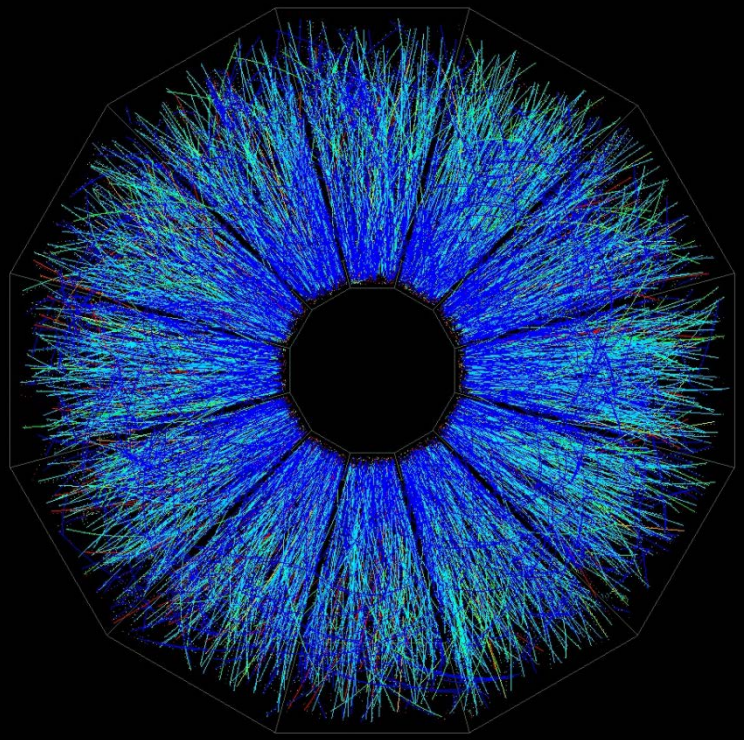
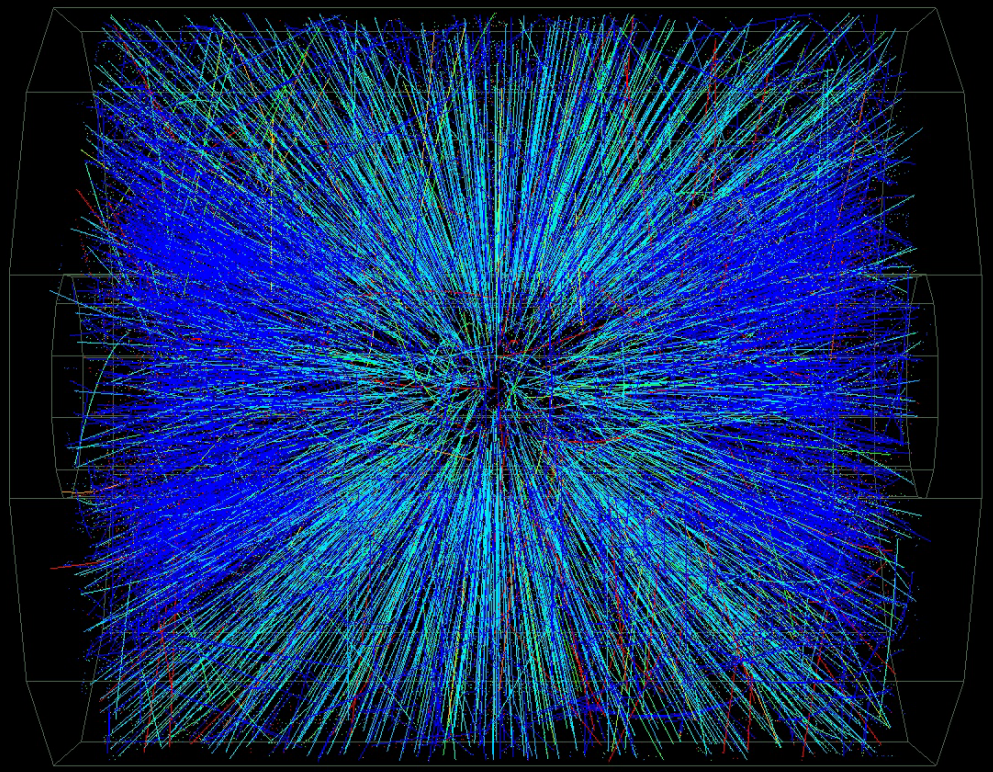






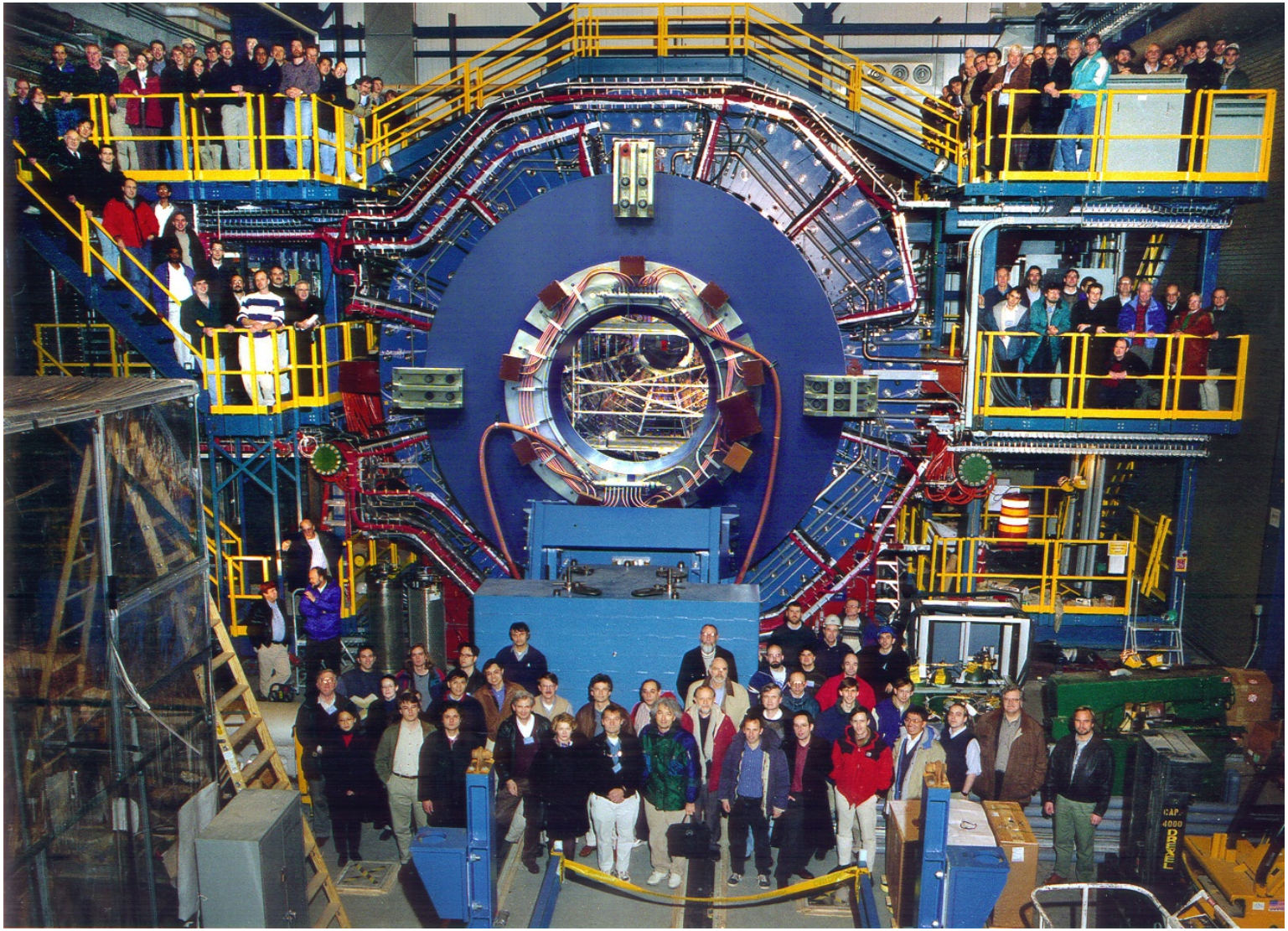
In 2014, the TPC is operating at 50x its design specification for DAQ rate and 100x its design specification for luminosity





You know the rest of the story from here …

The STAR TPC – 14 years of flawless running



A letter from Home …

Dear Howard,

Thank you & congratulations.

The end