# From LHC to ILC…

## …and Beyond

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# Realizing the ILC

- Three necessary ingredients …
  - Physics case
    - As strong as ever…
  - Political will
    - Changing tactics in turbulent times …
  - Public engagement
    - A unified front across the world …

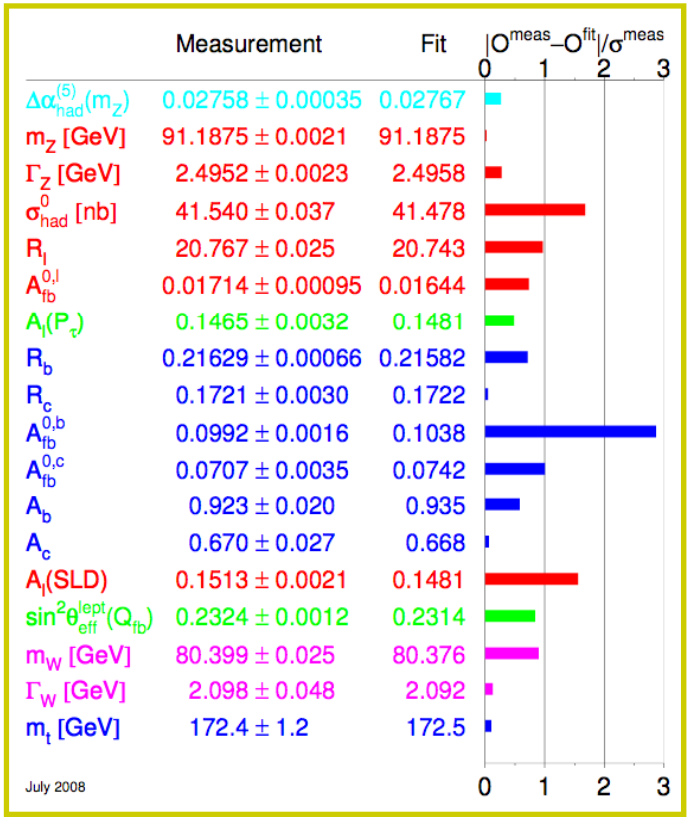
Realizing the ILC will require some luck, considerable planning, and the ability to move quickly when the opportunity arises … Strategy embraced by GDE!

# Physics case

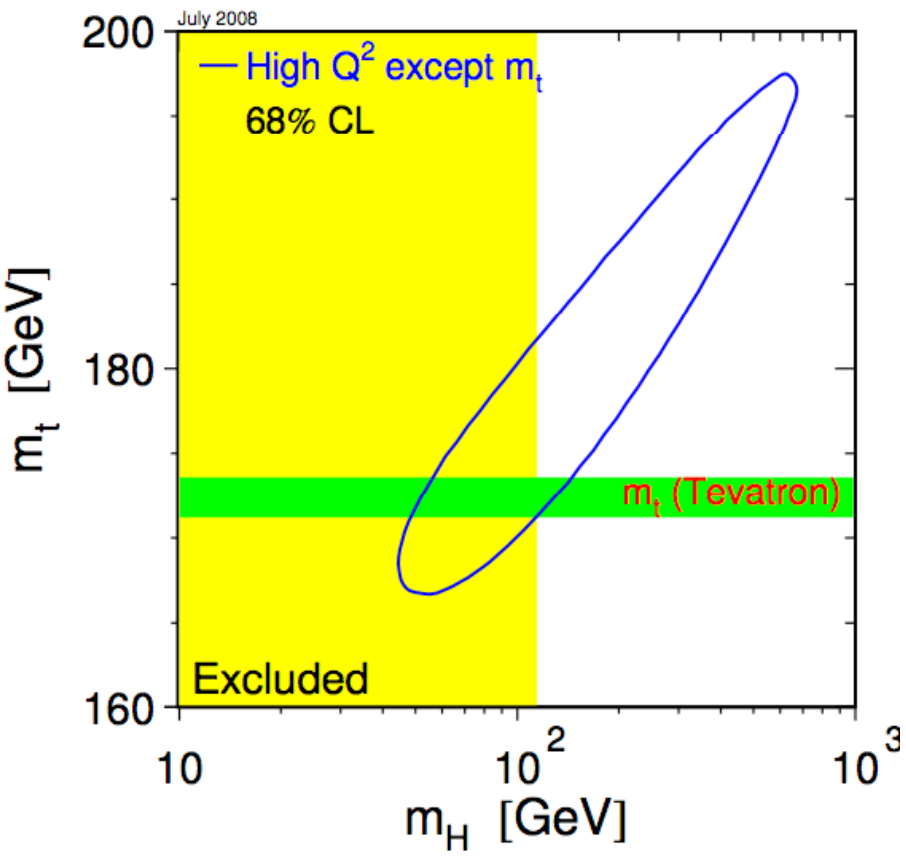
- The physics case must be built on the LHC
  - The LHC will open the Terascale …
    - We need to celebrate its success!
- The case has not changed!
  - We have every expectation that the ILC will be the appropriate follow-on to the LHC …
- But soon we will have proof …
  - A tremendous weight will be lifted from our shoulders …

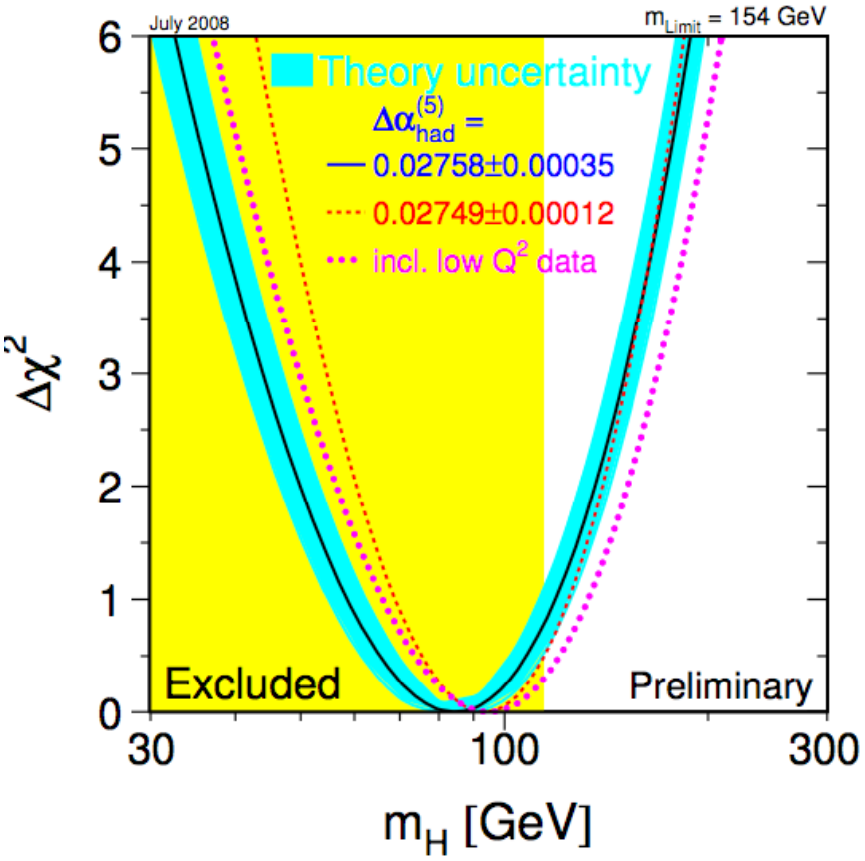
# Precision measurements

- A host of precision measurements, from laboratories around the world, are completely consistent with the Standard Model …
- They point to a light Higgs particle …
  - Well within reach of the LHC ….
  - And also the ILC …



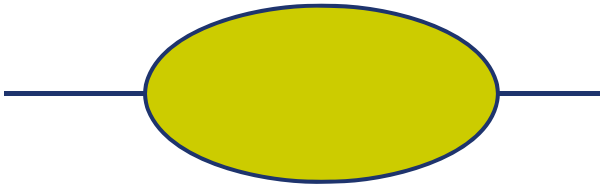
# Light Higgs


July 2008
High Q² except m_t
68% CL
m_t (Tevatron)
Excluded
200
180
160
10
10²
10³
m_t [GeV]
m_H [GeV]


July 2008
m_Limit = 154 GeV
Theory uncertainty
Δα(5)had =
0.02758±0.00035
0.02749±0.00012
incl. low Q² data
Excluded
Preliminary
Δχ²
6
5
4
3
2
1
0
30
100
300
m_H [GeV]

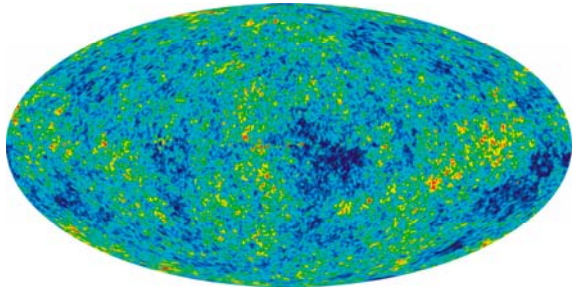
# Standard Model

- Despite this success, we also know the Standard Model is not the end of the story …
  - A fundamental Higgs particle is radiatively unstable …



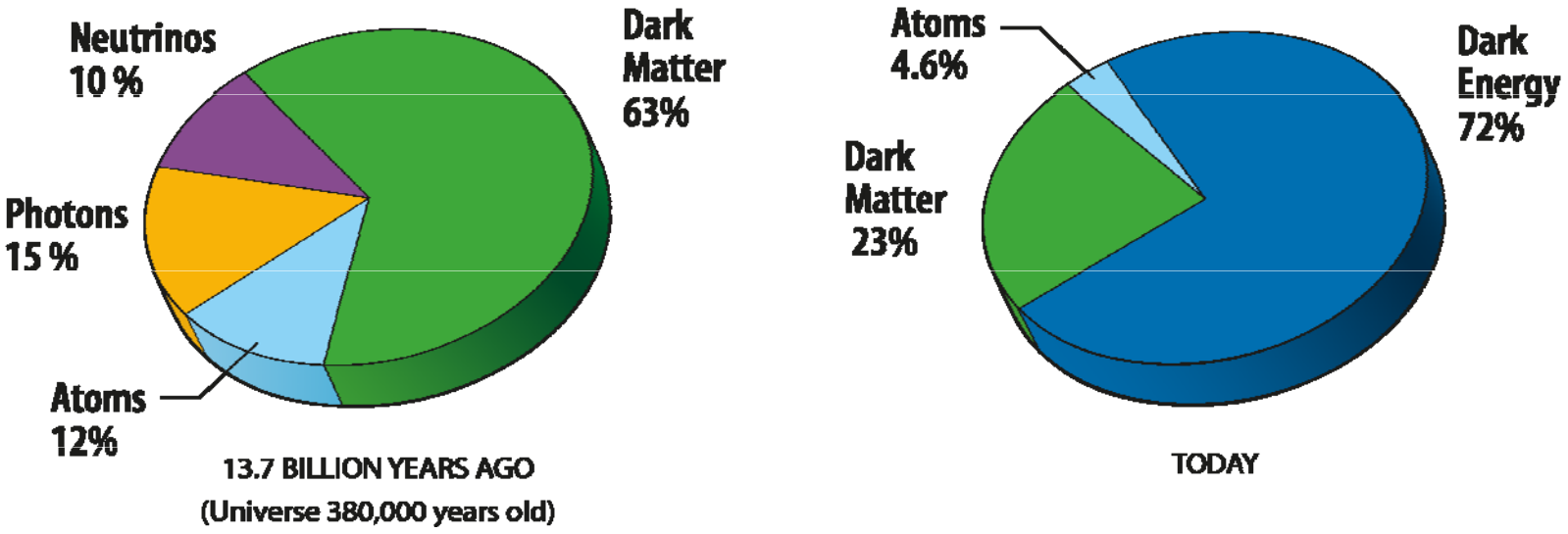
$\sim \Lambda^2$

  - The Standard Model describes just a fraction of the stuff of the Universe!



# WMAP Cosmology

- Dark matter dominated the early Universe …
- Dark energy dominates the present Universe




The Standard Model describes neither!

# Standard Model

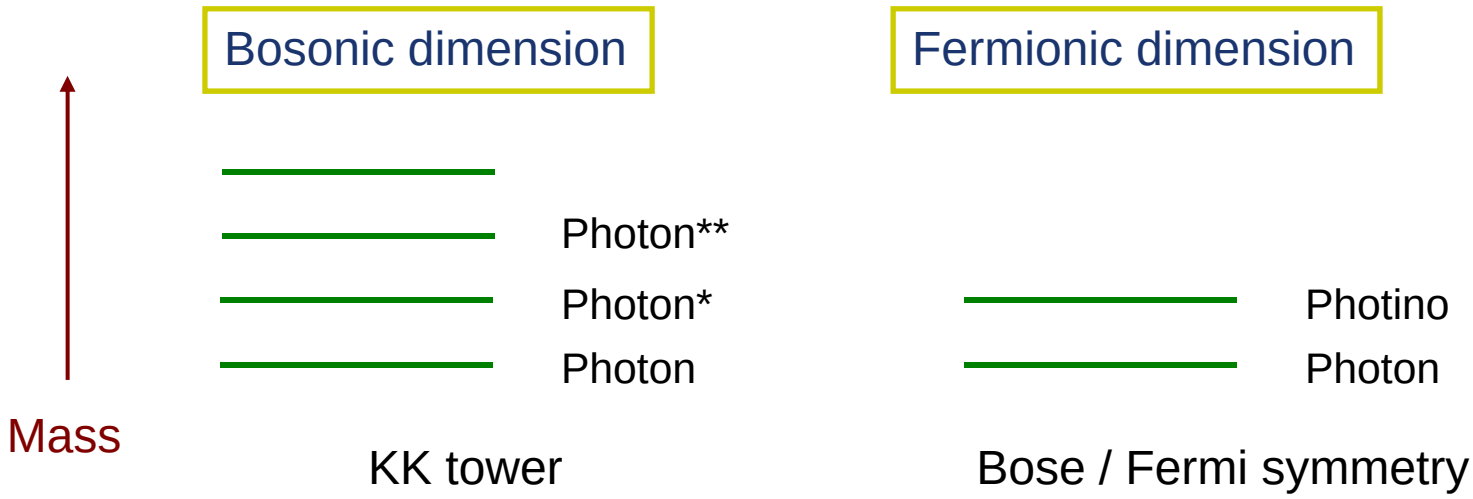
- We particle physicists are like the blind men examining the elephant …

# New Theories

- Fortunately, most theories that solve the Higgs problem also solve the dark matter problem
  - Coincidence?
- A new generation of theorists has populated the literature with new ideas
  - New dimensions
    - Bosonic or Fermionic
  - New dynamics
    - Little Higgs, Fat Higgs, Twin Higgs, No Higgs
  - Landscape …
- Each spawns its own narrative …

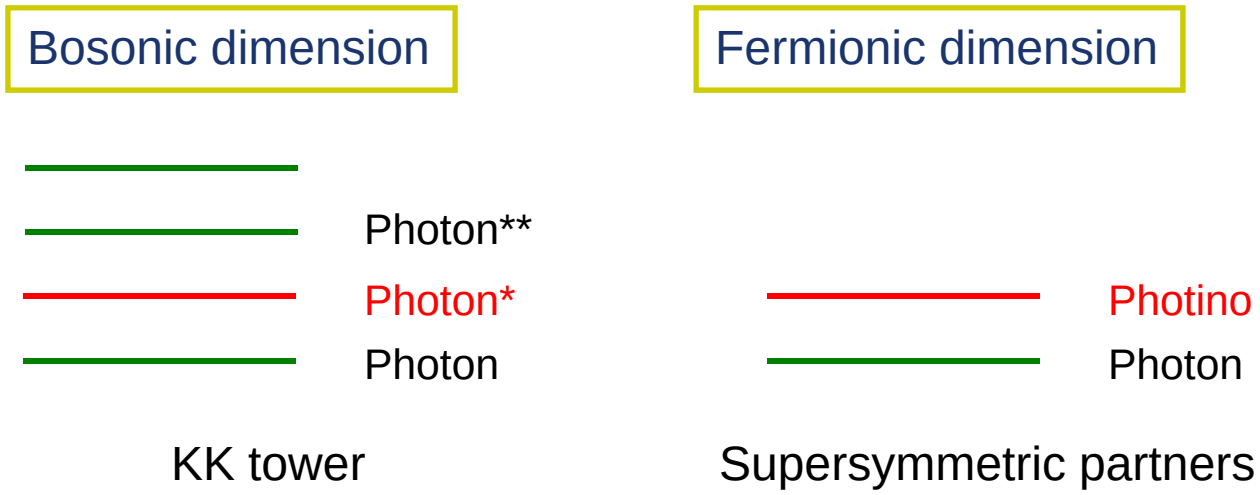
# Extra Dimensions

- Extra dimensions come in two types:
  - Bosonic ⇨ Kaluza-Klein partners
  - Fermionic ⇨ Supersymmetric partners
- The new particles stabilize the Higgs …



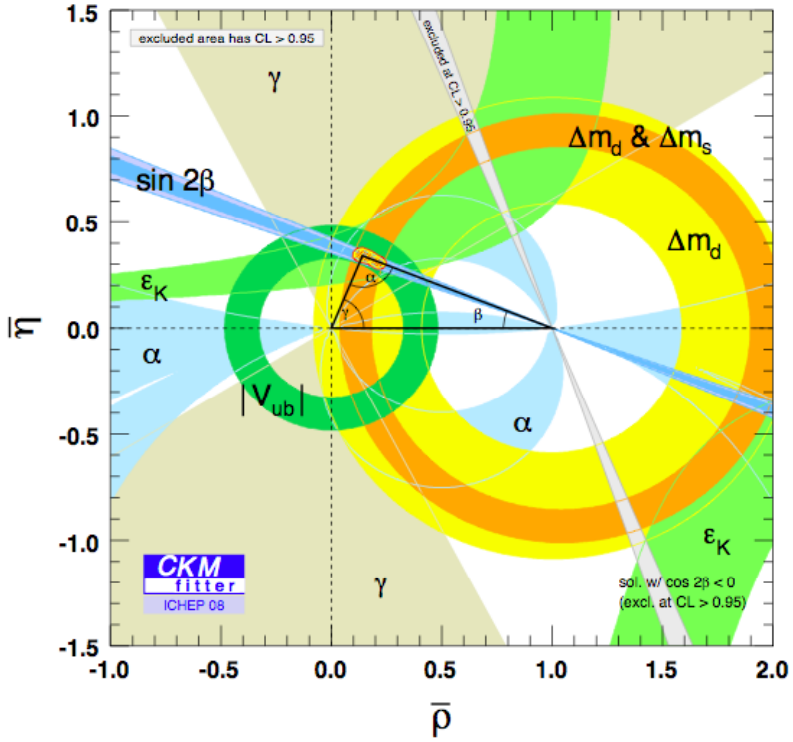
# Dark matter

- Both of these theories have viable dark matter candidates
  - The lightest KK and SUSY particles are typically stable and have appropriate masses and interactions to do the job



# Energy scale

- The $10B question of course, is the mass scale at which the new particles appear …
  - Precision measurements suggest it could be large …



# LHC

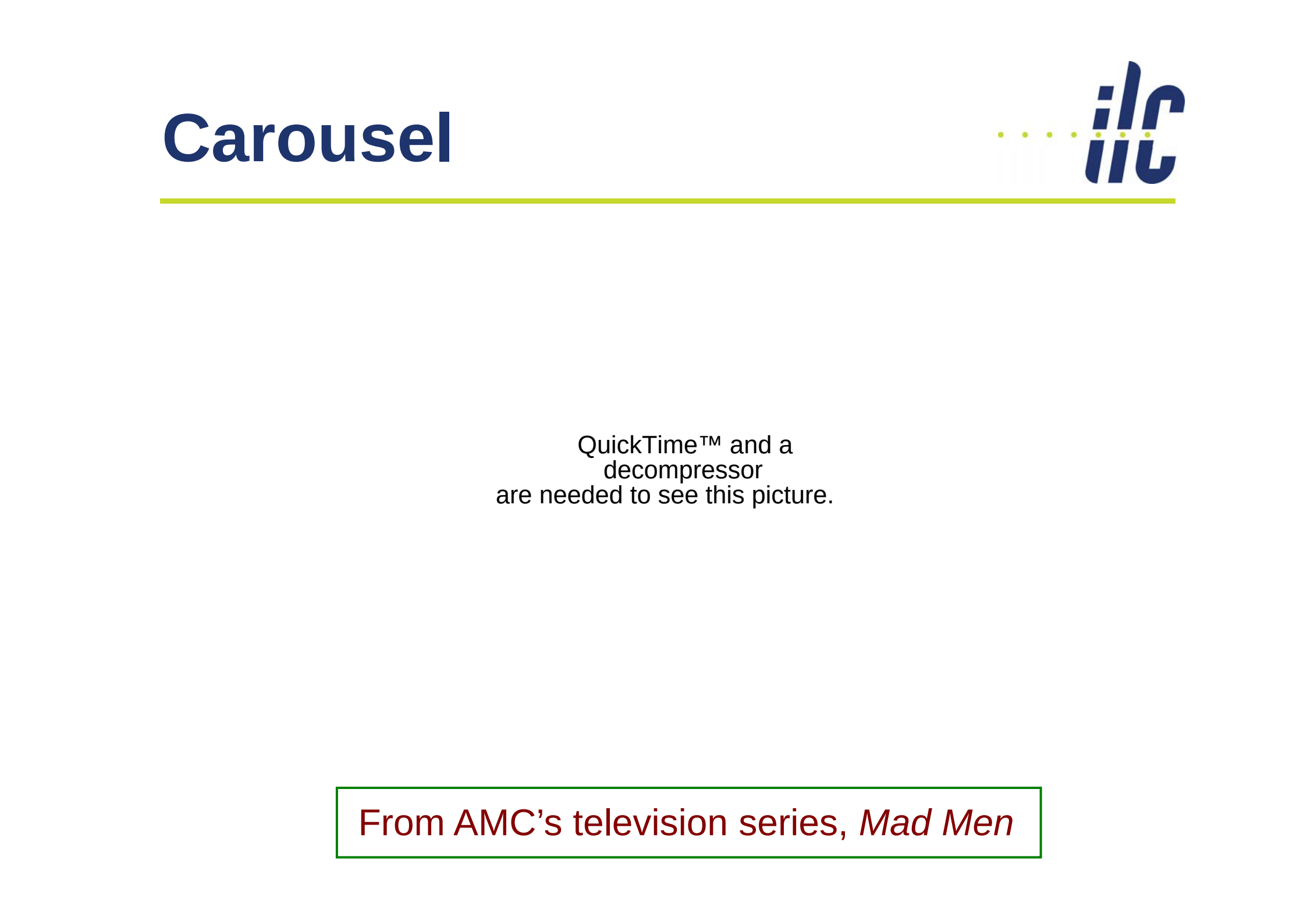
- So there is a tension …
  - Naturalness suggests new physics should be light
  - Precision measurements hint it may be heavy …
- Theorists assure us that some new physics is within reach of the ILC …
  - But what do they know?
- Fortunately, the LHC will answer the question!
  - It will open the Terascale and discover the scale of the new physics
    - And remove this albatross from our neck …

# Prerequisites

- Realizing the ILC will require some prerequisites
  - We must build our case on the success of LHC
    - It's job one!
  - We need one world, speaking with a single voice
    - We cannot have CERN - ILC dissonance
      - Delighted to see joint ILC - CLIC R&D
  - We need a compelling story …
    - And the means to tell it …

Case study – the Kodak Carousel

# Carousel




From AMC's television series, *Mad Men*

# Lesson?

- What does this mean for us?
  - We need to tell a story – one that connects our science to our deepest humanity …
  - We live in a time with many challenges …
    - Medicine
    - Public Health
    - Climate and Environment
    - Finance and Trade
  - The public is paying for our science …
    - Politicians have a choice of investments …
      - How do we compete?

# Lesson?

- We stand in awe of astronomers …
  - But their pictures do not happen by accident
  - They are the result of a comprehensive strategy


"All the News That's Fit to Print"

The New York Times

Washington Edition

VOL. CLI . . . No. 52,105 WEDNESDAY, MAY 1, 2002 ONE DOLLAR

WORLDCOM LEADER DEPARTS COMPANY IN TURBULENT TIME

PHONE PROFITS SQUEEZED

Factors That Built Career and a Communications Giant Led to Their Downfall

By SETH SCHIESEL

Bernard J. Ebbers, who spent 19 years building WorldCom into one of the biggest long-distance companies and Internet carriers in the world, has resigned as chief executive, government officials said yesterday.

If any executive represented the entrepreneurial epoch that was supposed to make telecommunications cheaper and the choices robust in an era of deregulation, it was Mr. Ebbers. It was he who exploited the deregulation of the telecommunications industry more than anyone else during the last two decades. With ruthless cost-cutting and fervent deal-making, he showed for years that it was possible to underprice AT&T in the long-distance market and still make a lot of money.

But Mr. Ebbers was brought down by wounds that, in some measure, were self-inflicted. He personally owes the company more than $400 million for loans and loan guarantees to cover his personal losses on his WorldCom stock as the share price plummeted. And the company, under his watch, is the subject of a wide-ranging and continuing investigation by the Securities and Exchange Commission, which is scrutinizing WorldCom's accounting practices and financial relations with Mr. Ebbers.

Yet Mr. Ebbers was also undone by industry and economic forces beyond any one executive's or company's control. While consumers enjoyed the long-distance price wars, the service eventually became a commodity from which few carriers



Postcards From the Edge

Now images of the far reaches of the universe, taken by the Hubble Space Telescope's new main camera, were revealed yesterday. Clockwise from upper left, the distorted Tadpole galaxy, a pillar of gas and dust called the Cone Nebula, the Sweet Nebula and colliding galaxies called the Mice. Page A20.

NEW STRATEGY SET BY U.S. AND SAUDIS FOR MIDEAST CRISIS

Americans to Focus on Sharon as Arab Leaders Press Arafat

By PATRICK E. TYLER

WASHINGTON, April 30 — President Bush and Crown Prince Abdullah of Saudi Arabia, during private discussions over five days last week, agreed on a new strategy of joint action and pressure to break the deadlock in the Middle East crisis, senior administration officials said today.

As part of that "division of labor," as one official described it, American officials plan to talk bluntly with Prime Minister Ariel Sharon of Israel during his visit to Washington next week about breaking the psychology of violence.

Arab leaders are expected to do the same at a meeting with Yasir Arafat, perhaps in Cairo. American and Arab officials said.

The agreement, though not formalized, targets the Bush administration sees the leading Middle East role that it had once removed, one in which it is now allied with a Saudi leader who had also traditionally resisted a highly visible role.

"It is obvious that the United States has influence with Israel and the Saudis could use their influence with Palestinians, a senior administration official said today, speaking of the new diplomatic venture."

Crown Prince Abdullah, of Saudi Arabia, is ready to travel to Arab capitals to organize a meeting with Mr. Arafat that would coincide with Mr. Sharon's visit in Washington. Officials close to the prince say his growing assessment of President Bush's leadership going into the meeting last week was transformed by five hours of talks with Mr. Bush.

In those talks, the officials said, Mr. Bush said he would demonstrate

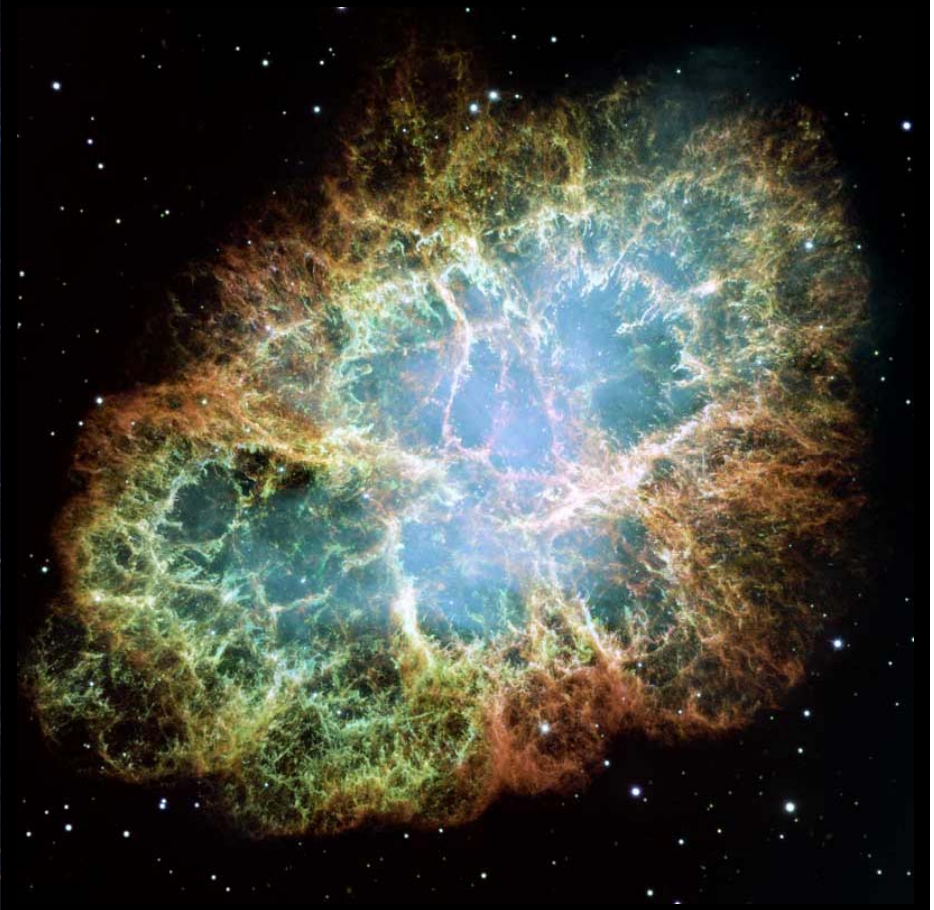
Continued on Page A10

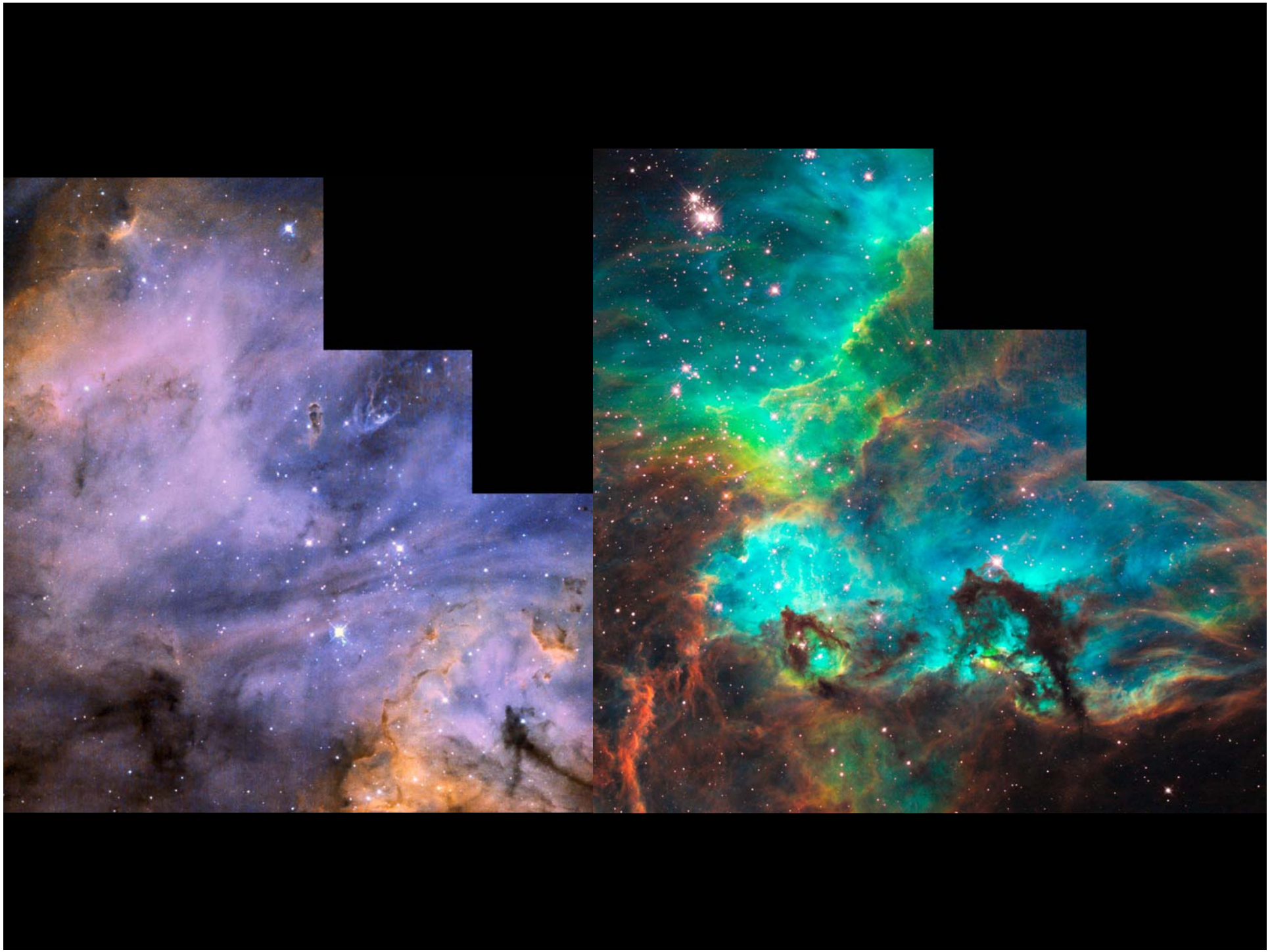
U.N. May Drop Inquiry at Jenin As Israel Resists

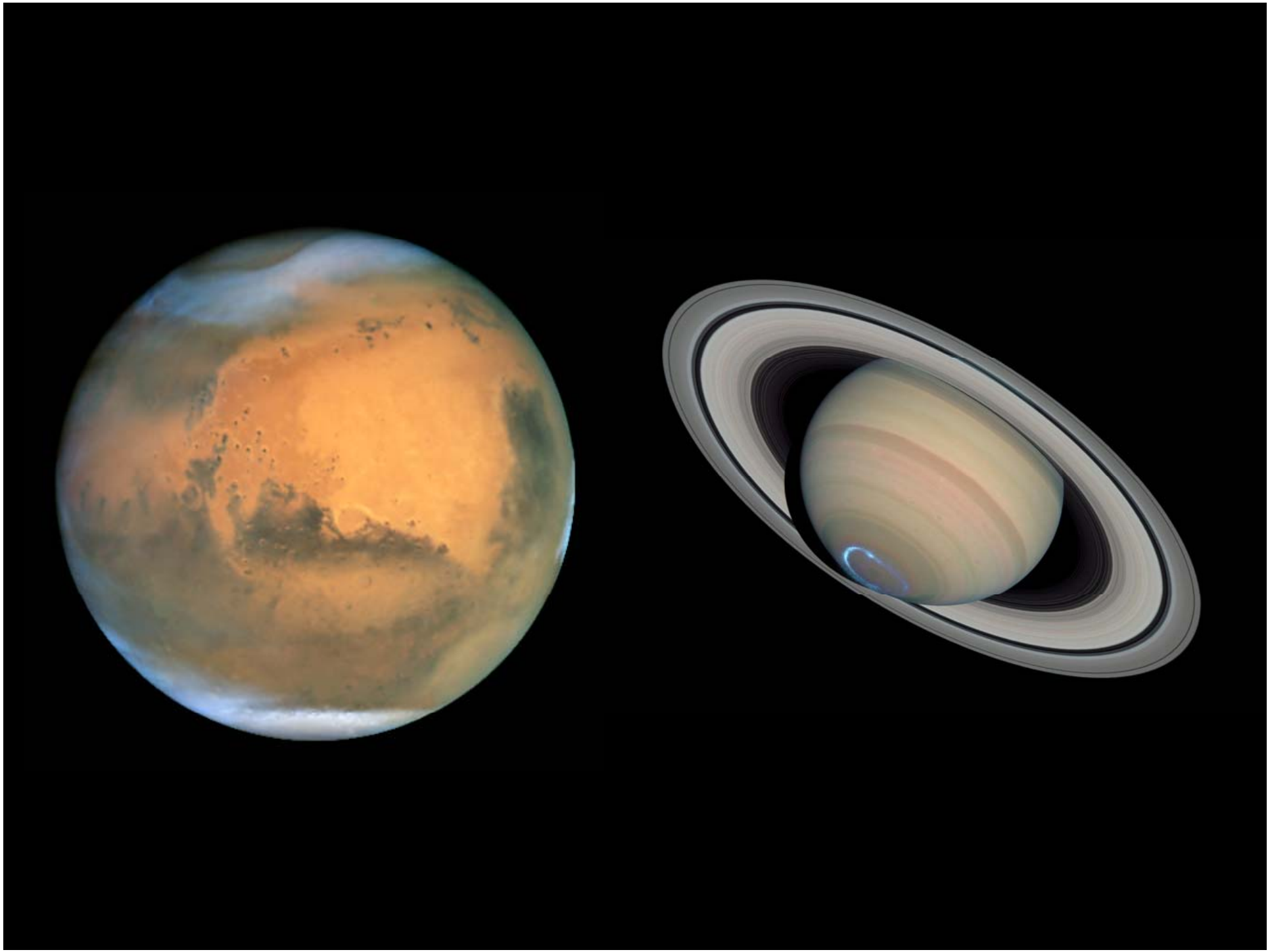
By JAMES BENNET

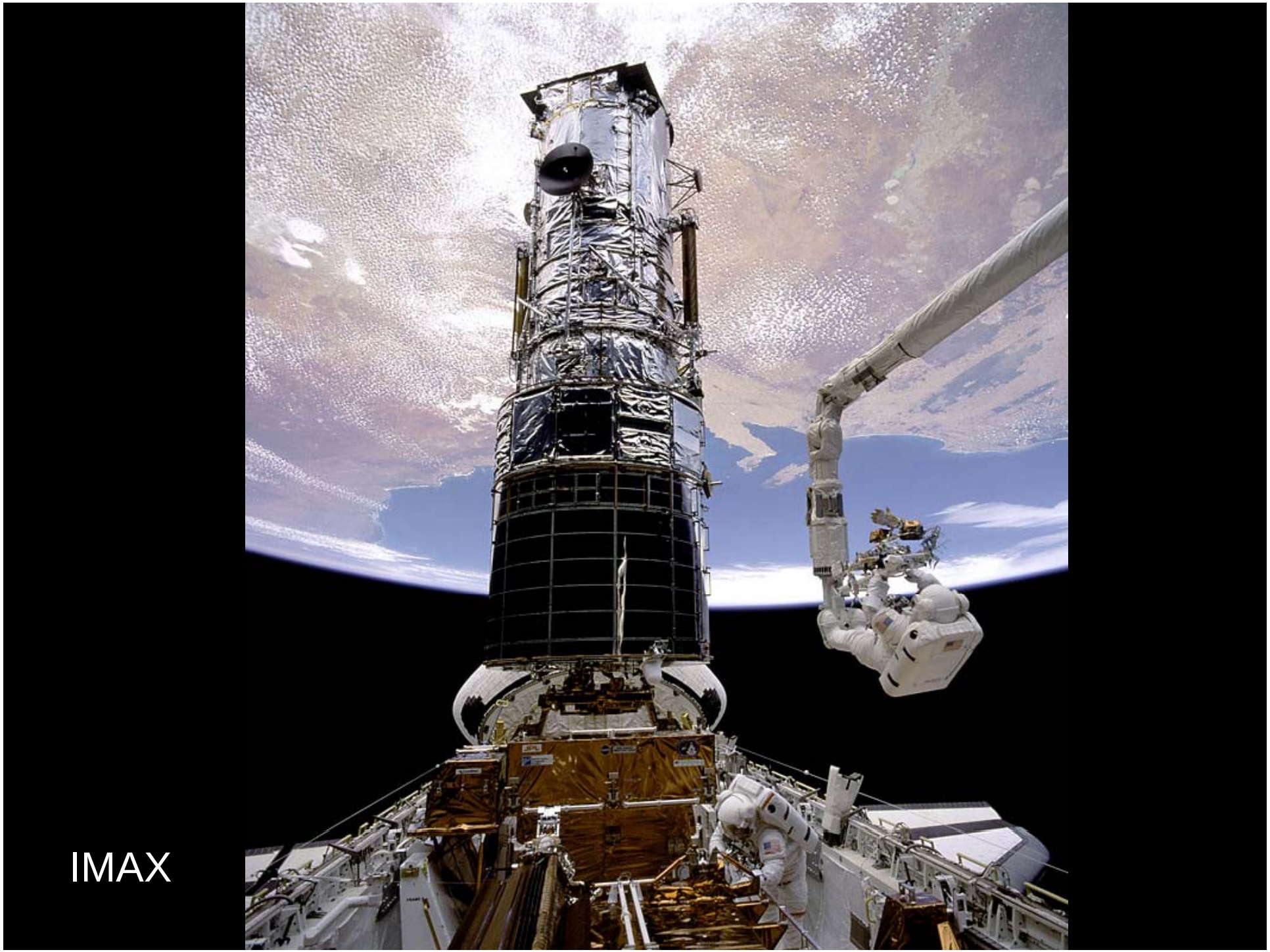
JERUSALEM, April 30 — Israel challenged the United Nations today by once again blocking a proposed fact-finding mission to examine fighting earlier this month in the Jenin refugee camp, prompting Secretary General Kofi Annan to consider disbanding the investigative team.

Israeli officials said they preferred the short-term cost in world opinion of resisting the United Nations to the long-term risk of possibly








IMAX

# Lesson?

- These are iconic images
  - They have made Hubble into the People's Telescope
  - The public rose up to save it after the Columbia accident
    - Can you imagine the public rising to save the SSC?
- We have our own story to tell
  - But we need to tell it better than we ever have before …

# HST Public Outreach

- Hubble Space Telescope was a $4B project
- Each year the Space Telescope Science Institute spends 0.1% of that amount on outreach
  - $4.5M per year, approximately 35 FTE's
- STScI serves the schools, the press, the public …
  - All while propagating a clear, coherent and consistent message

# HST Public Outreach

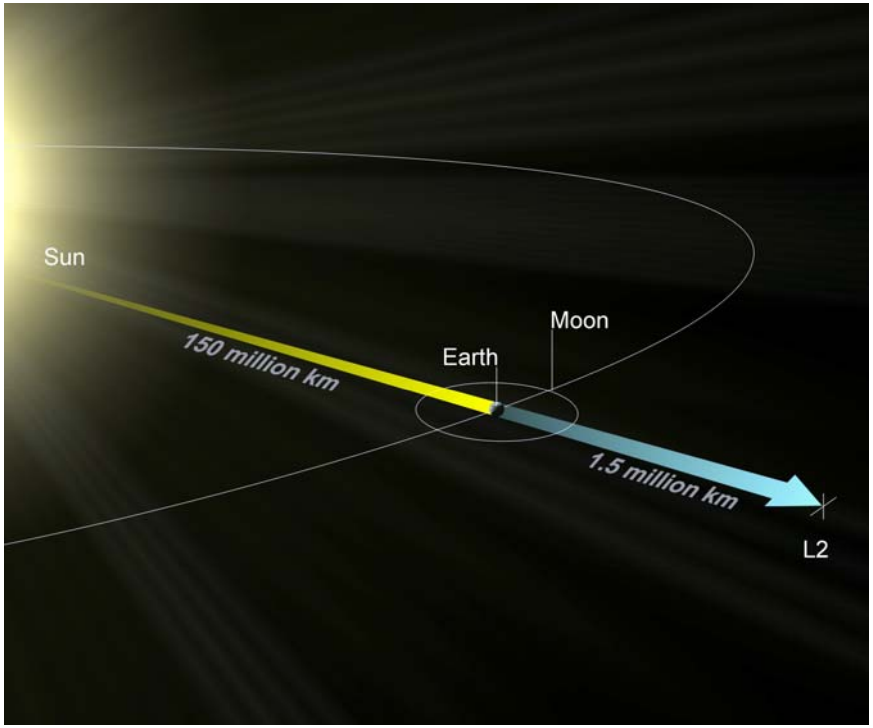
- View Space
  - 100 installations, changing daily, viewed by 40M visitors per year
- Amazing Space
  - K-12 and informal education materials used at over 1400 sites across the United States
- Hubble Site
  - 1.2M web views per month
- National Air and Space Museum
  - 765,000 visitors per month

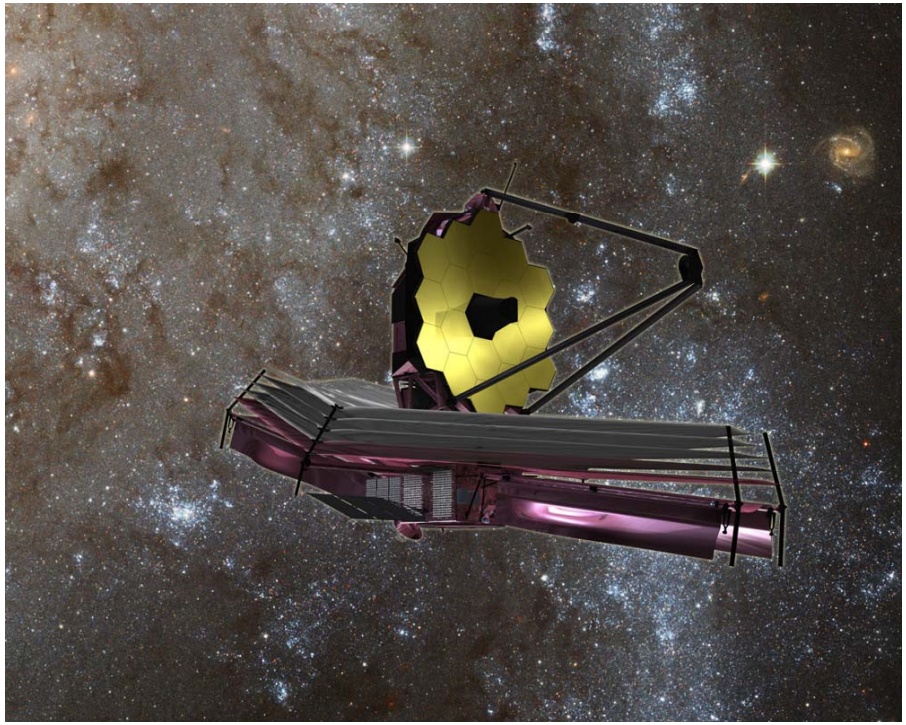
# HST Story

- The space telescope story follows a clear arc with a natural cadence …
  - Hubble Space Telescope (1990) is a 2.4 meter visible / UV telescope that opened new territory …
    - It was the first large telescope to get above the atmosphere
      - Discovered that galaxies evolve
      - Discovered planets orbiting distant suns
      - Not to mention black holes, dark energy …
  - Successor telescopes will build on these discoveries
    - And make quantum leaps in our understanding

# HST Story

- The James Webb Space Telescope (2013) is a 6.5 meter infrared telescope that will park at L2 and detect the first light in the Universe



# HST Story

- Planning is already underway for a follow-up telescope to JWST (2025?)
  - Motivated by the search for life on distant planets

The New York Times
nytimes.com

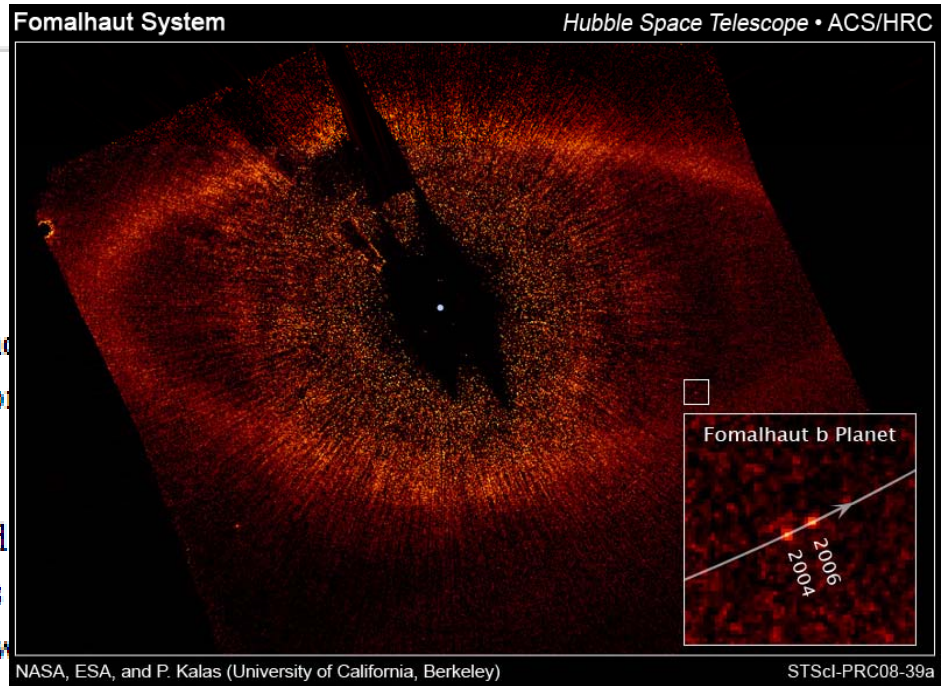
November 14, 2008

## Now in Sight: Far-Off Planets

By DENNIS OVERBYE

A little more of the universe has been pried out of the shad
taken the first pictures of what they say — and other astro
going around other stars.

The achievement, the result of years of effort on improved
data analysis, presages more such discoveries, the experts
investigations and discoveries of what planets are and how



# HST Technology

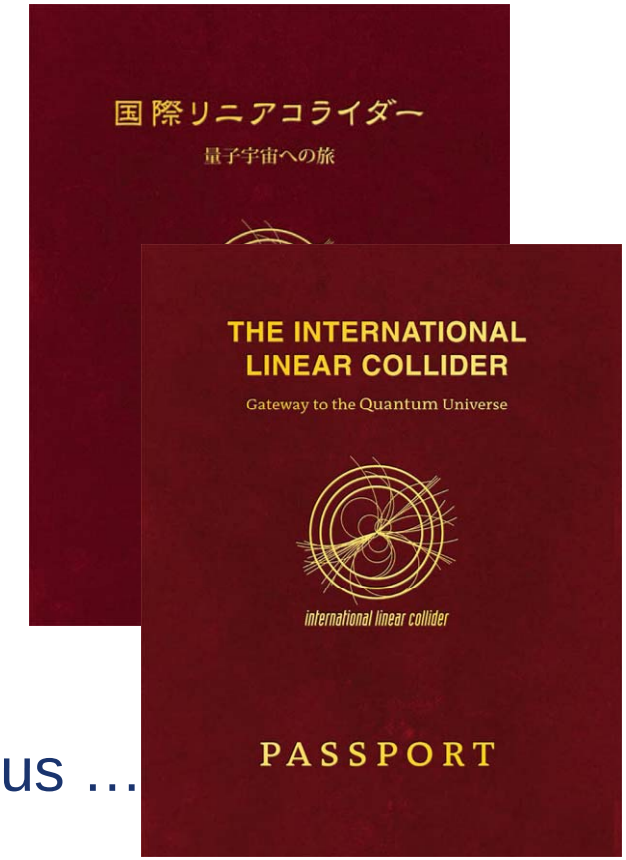
- The costs are essentially capped. HST and JWST are $4B efforts …
  - Technological developments drive the costs down
- The designs for the new telescopes are optimized to take advantage of synergies with industry and elsewhere …
  - Hubble took advantage of Shuttle, and investments in national technical reconnaissance
  - The JWST successor is being designed to exploit Ares, NASA's new heavy-lift rocket

# Particle Physics?

- We have our own story – and it is a good one!
  - We do incredibly compelling science
    - Uncovering the elements that make up the Universe
  - We drive important technologies
    - Including accelerators, detectors, computing
  - We transcend international boundaries
    - Uniting people towards a common goal
  - We inspire the public
    - Drawing students into science and technology

# Public Outreach

- We have important pieces in place
  - Science
    - The LHC will frame the story …
      - Just like Hubble did for JWST
  - Technology
    - The focus on risk reduction, optimization and industrial-ization is appropriate …
  - Public
    - The GDE communicators are fabulous …



# Public Outreach

- But we need to do more!
- LHC is a $5B - $10B project.  HST was $4B
  - Will the public get as much value from LHC?
    - Very encouraging initial signs …
      - Global interest in LHC startup!
  - Are we investing enough?
    - Using the Hubble 0.1% rule, we need 50-100 FTE's worldwide to help us develop, propagate and sustain our story …
      - This is not lobbying!

# Public Outreach

- It is important to develop a single narrative, one the reflects the global nature of our science
  - CERN, FNAL, KEK, SLAC, DESY …
    - Again, encouraging signs …
      - interactions.org
- We need a seamless tale, one that touches the soul and builds from LHC to ILC and beyond
  - I believe that public engagement is our most important product …
    - We can learn from the astronomers …

# Realizing the ILC

- Achieving our goals will require real leadership

  But can we do it?

  - With apologies to Obama …

**YES WE CAN!**