

# Giant Segmented Mirror Telescope Science Working Group

*Rolf-Peter Kudritzki <sup>1</sup> for  
the GSMT Science Working Group*

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*[http://www.aura-nio.noao.edu/gsmt\\_swg/](http://www.aura-nio.noao.edu/gsmt_swg/)*

*[http://www.aura-nio.noao.edu/gsmt\\_swg/SWG\\_Report/SWG\\_Report\\_7.2.03.pdf](http://www.aura-nio.noao.edu/gsmt_swg/SWG_Report/SWG_Report_7.2.03.pdf)*

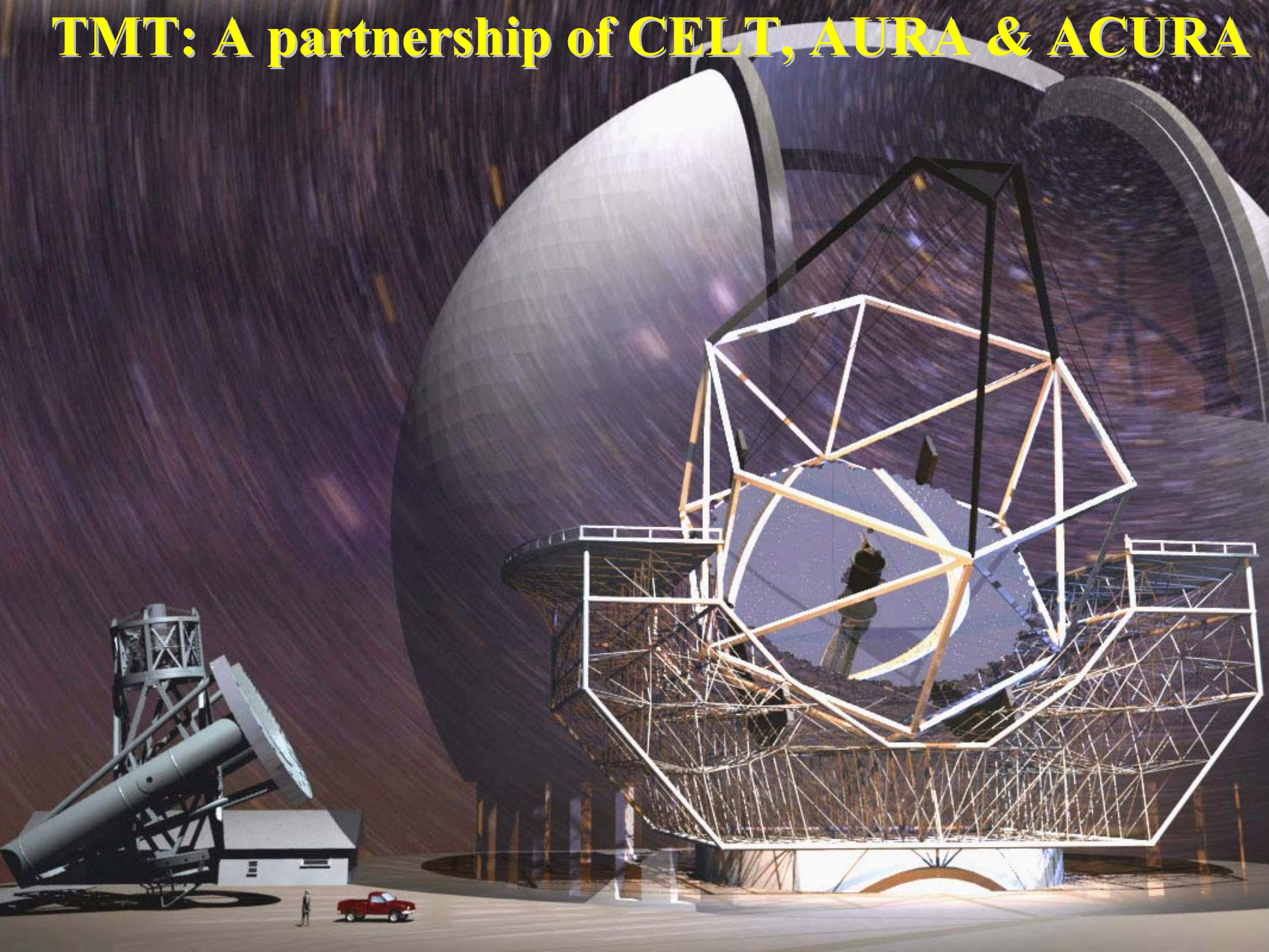
# Giant Segmented Mirror Telescope

- **Top priority of NAS/NRC 2001 decadal survey**
  - **30m segmented primary mirror**
  - **10x gain in light gathering power (sensitivity)**
  - **Diffraction limited, Adaptive Optics (AO),**
  - **3x gain in angular resolution (image sharpness)**
  - **Projected costs ~ \$ 700 M**
  - **Private/public/international partnership recommended for funding**

# Two incarnations of the GSMT

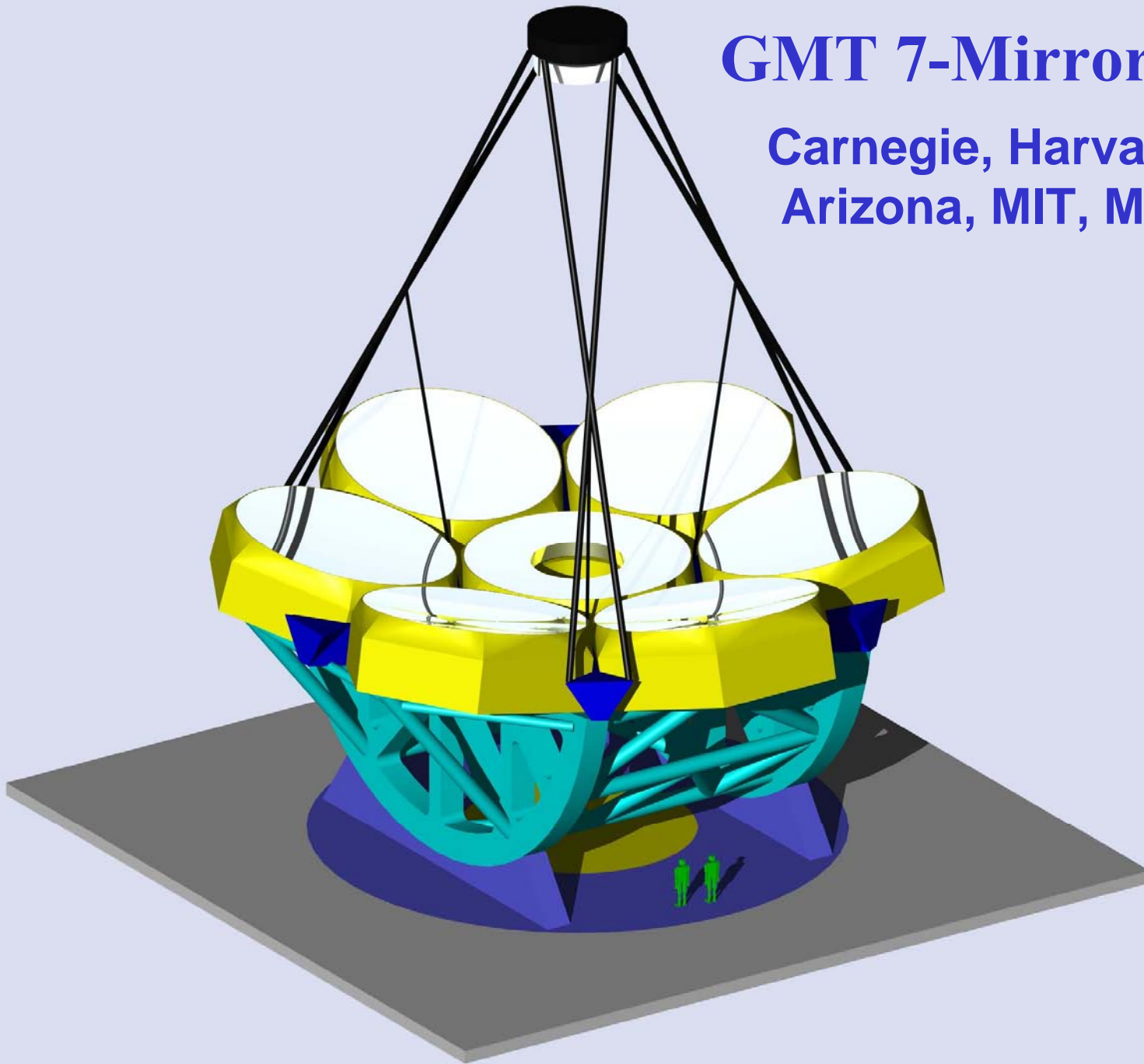
- **TMT** – 30m segmented mirror ( $\approx$  Keck)  
UC, Caltech, AURA, ACURA
- **GMT** – 20m consisting of seven 8.2m segments  
spatial resolution  $\approx$  25m  
Carnegie, Harvard, Arizona, MIT,  
Michigan

# TMT: A partnership of CELT, AURA & ACURA



# GMT 7-Mirror Concept

Carnegie, Harvard/Smiths.,  
Arizona, MIT, Michigan



# **GSMT Science Working Group**

**Formed July, 2002, by NOAO on request by the NSF**

- Identify forefront astrophysical science likely to emerge over next decade**
- Science potentially enabled by GSMT**
- Design options that can achieve science**
- Technologies to be advanced or developed**
- Inform the NSF about investments needed**
- Become communities advocate in private/public partnerships**
- Establish working relationships with groups in Australia, Canada, Europe, Japan, Mexico**

# GSMT SWG Members

**Chair: Rolf-Peter Kudritzki, UH IfA**

**Vice-Chair: Steve Strom, NOAO**

## **SWG Members:**

- **Jill Bechtold -- UA**
- **Mike Bolte -- UCSC**
- **Ray Carlberg -- U Toronto**
- **Matthew Colless -- ANU**
- **Irena Cruz-Gonzales -- UNAM**
- **Alan Dressler -- OCIW**
- **Betsy Barton -- UA**
- **Terry Herter -- Cornell**
- **Masanori Iye -- NOAJ**
- **Paul Ho -- CfA**
- **Jonathan Lunine -- UA LPL**
- **Claire Max -- UCSC**
- **Chris McKee -- UCB**
- **Francois Rigaut -- Gemini**
- **Doug Simons -- Gemini**
- **Chuck Steidel -- Caltech**
- **Kim Venn -- Macalester**

# SWG activity

- **Five meetings (plus telecons), July 2002 through February 2004**
- **Identification of most important science themes for the next decades (input from SWG members, decadal survey, “Connecting Quarks to Cosmos”)**
- **Reports from AO and instrumentation experts**
- **Presentations by four principal telescope design groups: University of Hawaii, Magellan 20 (Carnegie, Harvard, Arizona, Michigan, MIT), LAT (Cornell, Illinois, Chicago, Northwestern), CELT (Caltech, UC)**
- **First report published on June 30, 2003**
- **All activity documented under**

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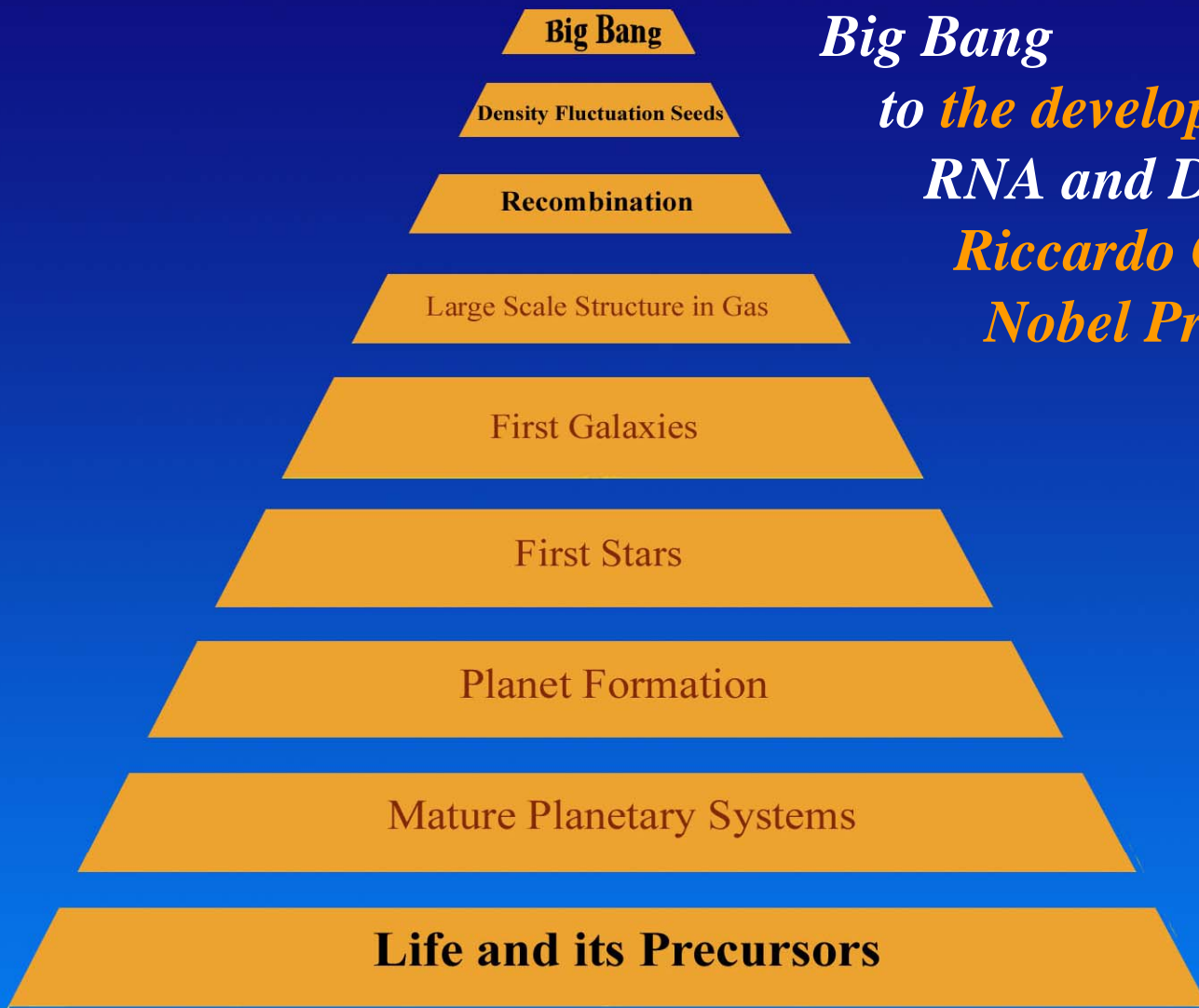


# SWG activity

- two meetings with NSF and presentations of report
- presentation of report to CAA of Academy of Sciences
- information session at Seattle AAS meeting 2003
- participation at NOAJ ELT meeting, Tokyo, Jan. 2004
- meeting with ESO SWG, Berlin, May 2004
- contact with JWST SWG
- special session at San Diego AAS meeting Jan. 2005
- all activity documented under

*[http://www.aura-nio.noao.edu/gsmt\\_swg](http://www.aura-nio.noao.edu/gsmt_swg)*

*“21<sup>st</sup> century astronomy is uniquely positioned to study the evolution of the universe in order to relate causally the physical conditions of the*

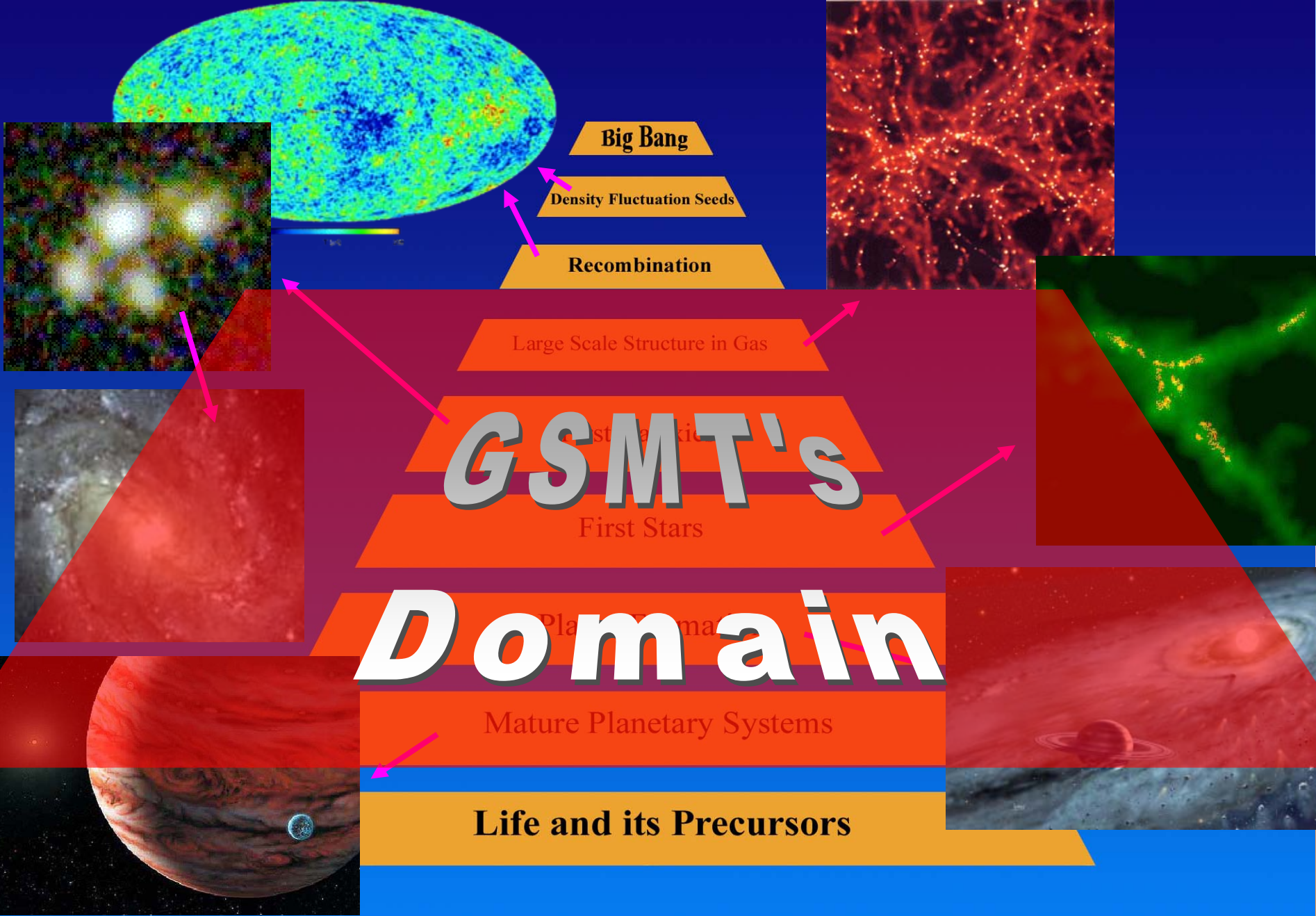


*Big Bang*

*to the development of  
RNA and DNA”*

*Riccardo Giacconi  
Nobel Prize, 2002*

Connecting the First Nanoseconds to the Origin of Life



**Big Bang**

Density Fluctuation Seeds

**Recombination**

Large Scale Structure in Gas

**GSMT's**

First Stars

**Domain**

Mature Planetary Systems

**Life and its Precursors**

Connecting the First Nanoseconds to the Origin of Life

# Conclusions: Science

- **Fundamental science**
  - connection first structures of Big Bang to origins of life
  - 3D-structure and chemical evolution of early universe
  - physics of formation of first stars and galaxies and evolution to mature galaxies of today
  - nature of dark matter, dark energy
  - physics of thousands of proto-planetary disks and planet formation
  - physical characterization of hundreds of extra-solar planetary system
  - formation of terrestrial planets and habitable zones

# Conclusions: Telescope

- **Unprecedented light gathering power and angular resolution**
  - completely new detections space
  - unanticipated phenomena
- **Extensive analysis by several groups**
  - costs ~ \$ 700 M
- **Formidable technical challenge but no “show stoppers”**

# SWG recommendation

- **Immediate NSF investment in support of a technology program to develop a viable, cost-effective GSMT concept within next four years (echoing decadal survey)**
- **Proposals should show**
  - **evidence of value of proposed investment to multiple GSMT-type programs**
  - **proactive commitment to share results among programs**
- **Coherent supervision and coordination needed**
- **Investment should result in public access to telescope time**

# Technology Development for ELTs

**Four key areas require technology development to achieve required performance:**

- Telescope systems**
- Facility Adaptive Optics systems**
- Site Evaluation**
- Science instruments**

# Future work of the SWG

- **Feedback from community concerning key science**
- **Develop community-based view of performance goals and requirements for GSMT**
- **Review scientific instrument concepts**
- **Monitor progress of technology development**
- **Scientific feedback to GSMT designing groups**
- **Establish working relationships with groups abroad**
- **Work closely with JWST SWG**
- **Continue reporting to NSF, AAAC, CAA**
- **Ensure input from U.S. research community**