C.E.G.O. initiative China Einstein Gravitational wave Observatory

R. DeSalvo

In behalf of: Tang Keyun, Wang Yunyong, Zong-Hong Zhu

Why am I talking to you

- Zong-Hong Zhu and Tang Keyun were scheduled to be here in Aspen
  - to present CEGO,
  - to present Zong's past esperience in GW analysis as a postdoc in TAMA
  - To present their proposed data analysis activities in Beijing Normal University
  - To initiate the process (with Peter S.) for application of membership to the LSC

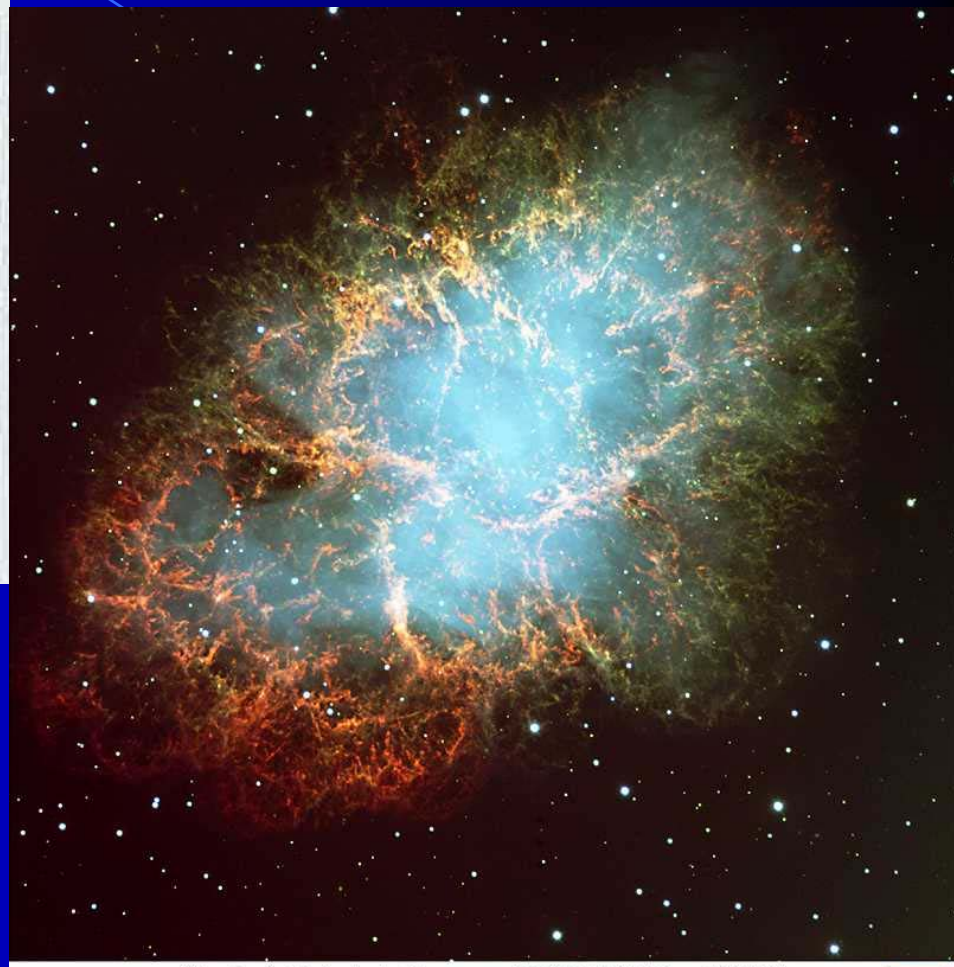
Why am I talking to you

- They both had trouble fingerprinting and having a visa in time.
- Albrecht and myself assisted them in fostering their proposal for CEGO in China
- They sent me an e-mail to ask me to make a presentation for them.

- Brief history of CEGO
- The present status of the initiative.

China has a long history of interest in the Universe

7-4-1054



The Crab Nebula in Taurus (VLT KUEYEN + FORS2)

ESO PR Photo 40f/99 (17 November 1999)

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遂古之初，谁传道之？
上下未形，何由考之？
冥昭瞢闇，谁能极之？
冯翼惟像，何以识之？

And two GW bars, Beijing and Guandong

CEGO:
China Gravitational Wave Observatory

Initiative main promoters

Keyun TANG [1 9]
Fei KANG [2]
Jun XU [3]
Yang ZHANG [4]
Zonghong ZHU [5]
Jin JIAN [6]
Zhuhui FAN [7]
Yunyong WANG [8]
Riccardo DESALVO[20]
Ren Yuan ZHU[21]
Yanbei CHEN[21]

100 Scientists interested, (50 Involved in kickoff meeting)
20 Institutions Interested (10 involved)

How did it happen

- In 2003 Wang Yunyong, visitor at Livingston got interested in GW detection
- Getting time to leave, looking for a way to continue, contacts Tang Keyun of Geophysics Institute of Beijing
- Tang Keyun proposes to Academia Sinica the idea of a Chinese group at LSC
- Instead of forming a group to join LSC, they are invited to propose a Chinese interferometer ! !

- **Objectives in Stages**
- **Scientists and Institutions**
- **Supports from MOST, CAS and NSFC**
- **Problems and solutions**
- **Ongoing Collaborations with LIGO, TAMA, EGO-VIRGO**
- **Requests and Thanks**

Staged CEGO Objectives

- People's Training
- R&D of Underground Detector
- Design of ~100 m Prototype

- Multi-Interferometer Underground GW observatory
- Open for international contributions.

Interested Institutes and Universities

1. National Astronomical Observatory , CAS
2. China Academy of Machinery Science
3. Shanghai Institute of Optics and Fine Machinery , CAS
4. University of Science and Technology of China
5. Beijing Normal University
6. National Institute of Metrology
7. Peking University
8. Institute of High Energy Physics, CAS
9. Institute of Geophysics, CAS

Tsinghua University ……

Host institution:
National Astronomical Observatory CAS(NAOC)
its main activities:

- **Moon Exploration**
- **LAMOST (telescope)**
- **SST (space solar telescope)**
- **CEGO (GW observatory)**

Initiative status

- **Conditional support from**
- **CAS (Cinese Academy of Science)**
- **NSFC National Science Foundation of China)**
- **MOST (Ministry Of Science and Technology)**

- Already received full Scientific approval from Academia Sinica, LIGO, Virgo-EGO, TAMA, and GWIC
- Applying for initial funding

Tentative program

- First stage: Training, organizing and designing test interferometer
- Seek second approval
- Second stage: construction of mid-size test interferometer, design of full size facility
- Seek final approval
- Third stage: facility construction

Problems and solutions

most Chinese senior scientist have no knowledge of GW and doubts to dispel

divulge information about GW in Journals, Magazines, Newspapers

publicize positive opinion from other chinese and foreign senior scientists (seminars and workshops)

C.E.G.O. kickoff workshop

- Kickoff workshop organized in Beijing, March 1-3 2004
- The workshop started with the support letters from GWIC, LIGO, Virgo and TAMA
- 70 scientist and 20 institutions participated, including representatives from GWIC, LIGO, Virgo and TAMA, at the presence of a Science Ministry representative
- Academia Sinica, NSF-C, NAO-C pledge support for the initiative for a three year starting period

The first C.E.G.O. workshop

Aim to Joining the International **G**ravitational **W**ave **D**etection **C**ommunity

LISA interferometer, with 5,000,000km in space

Next C.E.G.O. workshop

- will be organized under the GWIC auspices
- March or April 2005
- Beijing or Shanghai

Advertisement

Several divulgative papers in Chinese and abroad

Science magazine AAAS

Science, Vol 304, Issue 5669, 375 , 16 April 2004

CHINA

Underground Detector Proposed to Join Hunt for Gravitational Waves

BEIJING—Using Einstein's name as a selling point, a team of Chinese scientists hopes to build an underground physics facility that will let them join the global search for gravitational waves. The project, if approved, would also mark a significant milestone in China's support for fundamental research that doesn't promise an economic payoff.

Gravitational waves were posited by Einstein in his 1915 general theory of relativity. But these subtle ripples in spacetime, postulated to originate in violent events such as supernovas and the collision of black holes, have never been observed. The China Einstein Gravitational Wave Observatory (CEGO) would complement existing observatories such as LIGO in the United States and VIRGO in Europe, as well as LISA, a space-based antenna being developed jointly by NASA and the European Space Agency, and DECIGO, a similar antenna under consideration by the Japan Aerospace Exploration Agency.

China's effort is led by geophysicist Tang Keyun of the Chinese Academy of Sciences' (CAS's) Institute of Geology and Geophysics. Tang has spent a decade chasing solar eclipses for evidence of a graviton, a hypothetical particle responsible for gravity. According to one theory, the moon's juxtaposition between Earth and the sun during a total eclipse should alter, however infinitesimally, the sun's pull on Earth. Although apparatus set up by Tang and colleagues in China (1997), Zambia (2001), and Australia (2002) failed to detect any clear evidence of a dip in gravity, the group plans to continue its monitoring of total solar eclipses next year in South America and in 2008 and 2009 in China.

In the meantime, Tang is pushing the idea of an L-shaped underground interferometer, up to 5 kilometers on a side. He chose its name, he says, "because there are many more Chinese who know Einstein than know gravitational waves." The experiment would fill a geographic gap in the ground-based observatories that would help scientists triangulate any recorded measurements. It would also operate at frequencies below those of LIGO and VIRGO and above LISA's. Finally, its location 500 meters underground would eliminate the confounding effect of seismic noise at the surface. And CEGO would be only the first step, he says: "Our goal is to build an underground facility capable of hosting multiple interferometers."

U.S. scientists involved in LIGO are intrigued by China's plans. "The low-frequency interferometers would complement the performance of the present instruments," says physicist Riccardo De Salvo, who met Tang during the latter's recent visits to the California Institute of Technology (Caltech) in Pasadena, the scientific home of the $365 million U.S. instrument. "And the optimized sensitivity [of an underground facility] would provide much greater insight into phenomena like the genesis of the large galactic black holes."

> "I [wanted] the Chinese [to] know that other scientists take the project seriously."
> –BARRY BARISH

De Salvo had already proposed that an aboveground, low-frequency interferometer be installed in parallel with planned upgrades to LIGO, which began operations in 2002. So when he heard about Tang's plans, "the synergy was obvious." Last month De Salvo and colleagues attended a workshop on gravitational wave observatories that Tang put on in Beijing.

LIGO's director, Caltech physicist Barry Barish, says it's "much too early" to know what will become of Tang's project. But he's happy to share with the Chinese his team's knowledge of building and operating such observatories. He's written letters of support for CEGO to China's Ministry of Science and Technology, CAS, and the National Natural Science Foundation of China, which will ultimately make the call on whether to fund the facility, and he plans to ask the U.S. National Science Foundation to fund a series of scientific exchanges with Chinese scientists in fields—from laser interferometry, precision optics, advanced control, and high-vacuum systems to seismic isolation and crystal materials—essential to the project's success. "I wrote the letters to let the Chinese know that other scientists take the project seriously," Barish says.

Even so, Chinese authorities are moving with caution. One major concern is the project's price tag, which Tang estimates at roughly $75 million—cheap by Western standards, perhaps, but still a lot for such esoteric research. "We have decided to support the international personnel exchange on gravitational wave studies and the training of Chinese scientists at LIGO," says Zhang Jie, director of the Bureau of Basic Research at CAS. "But we need some time to do feasibility studies before we approve the establishment of the CEGO project."

In the meantime, Tang will be setting up shop at the Beijing Astronomical Observatory, which is providing space for the team to build a prototype interferometer that will test key elements and provide hands-on training. Almost two dozen Chinese institutes and universities have offered to work on the project, he says, which he hopes will persuade the government to fund a full-sized version.

In a poem that compares the waves to "the arrow of the universe," Tang asks his country "to not shy away from joining this international feat any more, since we have gathered the strength to leap to the frontier of gravitational wave studies." In fact, Tang is even willing to go head-to-head with the government's biggest planned investment in science—its space program. "The impact of CEGO on basic science," he asserts, "would be even bigger than manned flight." –DING YIMIN

Ding Yimin writes for *China Features*. With reporting by Elena Giorgi in Pasadena, California.

CREDIT: MADDALENA MANTOVANI

A scientific feast. China's Tang Keyun (second from right) discusses gravitational waves over a meal with Caltech's Riccardo De Salvo, Erika D'Ambrosio, and Maddalena Mantovani.

Workshops, seminars, advertisement

Albrecht Ruediger and Riccardo DeSalvo

Already made seminars in China

Other scientists are warmly invited to go (hosting provided)

Advertisement

- Translation in Chinese of GR and GW books for interesting Political VIPs and general and scientific community

What's next

- NAOC will provide premises and staff to organize a mid size test interferometer and prepare a proposal for a full facility in three years
- A data analysis group was formed studying TAMA playground data
- Applying for LSC membership

Possible site for the Beijing (~100 m) prototype

Support from LIGO, TAMA, EGO-VIRGO, …GWIC

Training Chinese scientists & engineers

Foreign scientists invited to visit China and give lectures

Collaborative Design of CEGO and its test interferometers

Chinese scientists to collaborate with existing experiments

Design the Beijing test interferometer

collaboration with TAMA, LIGO, etc.

prove that the chinese scientists can deal with an interferometer complexities

train themselves in view of the future facility

make some science on the side

Summarizing

- CEGO initiative for a GW detection facility
- Fully Open to international collaboration
- CEGO needs support from International community to start with a good first step

CEGO Initiative present Activities

- 1. A submitted proposal will be reviewed in next weeks
- 2. To construct a small laser interferometer Lab,
  - a test interferometer will be constructed inside an existing cave

CEGO Initiative present Activities

- 3. To Set up CEGO Data Analysis Center at Beijing Normal University
- Member institutions:
  - Beijing Normal University
  - National Astronomical Observatories
- Members:
  - Professors: Zhu Zonghong, Wang Yunyong,
  - Postdocs: Dr. Liu Wenbiao,
  - Graduate Students: Huang Yumei, Zhu Lilan

CEGO Initiative present Activities

- 3. To Set up CEGO Data Analysis Center at Beijing Normal University
- would like to to Join inspiral data analysis group, contribute to the development of applied software
- would like to transplant LDAS software and LIGO tools and, set up a LIGO Data base in BNU, get LIGO data (science run data)
- would like to contribute to data taking, such as run shift
- Existing Hardware
- SGI ALTIX3000, and some work stations

CEGO Initiative present Activities

- 4. The activities in 2005
  - a. The 2nd CEGO International Workshop
  - b. Summer School on Gravitational Wave Detection and Data Analysis
- c. Translate and Publish a Book about Gravitational Waves

年代：先秦
作者：屈原
作品：天问

Asking the Universe

(250 B.C.)

遂古之初，谁传道之?
上下未形，何由考之?
冥昭瞢闇，谁能极之?
冯翼惟像，何以识之?