

IGC Internal Advisory Board Meeting

Friday, September 2nd, 2011

AGENDA

1. IGC Structure & Activities (Abhay)
2. The ECOS Review of IGC (Abhay & Dan)
3. The AMON Initiative (Paul)
4. Reorganization of the Current Centers (Paul)
5. Creation of a New Cosmology Center (Abhay)
6. Renewal of Appointment of Directors & Members (Abhay)
7. Advice on Development Initiatives (Abhay & Paul)
8. Any Other Business

IGC Structure & Activities

- Created in August 2007; Director: AA; Associate Director: PS
- Three Centers:
Center for Fundamental Theory (Director: Murat Gunaydin),
Center for Gravitational Wave Physics (Director: Ben Owen),
Center for Particle Astrophysics (Director: Peter Meszaros)
- Since inception, held
3 International Conferences (> 100 participants)
12 Focus Sessions & Workshops (20-50 participants)
(List included)
- Regular events: Four weekly seminar series and a monthly/biweekly colloquium series that brings together all institute members.
- Hosted 208 Visitors; 52 long term (each > week, up to six months)
- Current members:
24 full time faculty (+ 4 visiting faculty)
Approx. 25 post-docs; Approx. 40 graduate students
in Astronomy & Astrophysics, Mathematics, Philosophy & Physics
1 Administrative Assistant
- Journalist in Residence Program launched last year
- Outreach: All seminars, colloquia, and proceedings of workshops are available on line; Outreach webpage with [Videos](#), [YouTube clips](#), articles on the IGC research in the semi-popular press and by the IGC faculty.

Material in English, Spanish and German. [Examples:](#)

2011 YouTube video on 25 years of Loop Quantum Gravity

2011 Report on completion of "ICECUBE" featuring IGC participation

- 2011 An Art Exhibit in Madrid showing Art inspired by Loop Quantum Gravity
- 2010 "The Big Bang: My Ancestors and I" premiered at the *'Palais de la decouverte,'* Paris
- 2010 Loop Quantum Cosmology; A Spanish Clip on YouTube
- 2010 "Through the worm hole" program; Morgan Freeman narrates IGC research
- 2009 Report of the most distant cosmic explosion (the universe was then 630M years young)
- 2009 Report on the ICECUBE results that narrowed down possibilities for dark matter
- 2009 "From Big Bang to Big Bounce", Cover story, New Scientist
- 2008 "How to get out of a black hole", NSF/US News and World Report on IGC research
- 2008 "Heart of the Crab pulsar probed" report on LIGO upper bounds
- 2008 "Kosmos" – A documentary featuring IGC research; 150th birthday of Max Planck

Highlights of Recent Honors and Distinctions

- Undergraduate Students:
 - *Meagan Lang: Gerard A. Hauser Award for best presentation at the PSU Undergraduate Research Symposium;
 - *Karan Jani: First prize in the PSU Undergraduate Research Symposium and Finalist in the Vanderbilt Prize national competition.
- Graduate Students:
 - *Tyler Anderson: Won a Fellowship from the Pennsylvania Space Grant Consortium to work on the NASA supported CREAM (with Professor Coutu)
 - *Gabriel Caceres: Received a NSF Graduate Fellowship to work on Dark Matter (with Professor Mociou)

*Victor Taveras: Won the Hartle prize for the best student presentation at the 18th International Conference on General Relativity & Gravitation (GRG); Won the Bergmann-Wheeler prize of the International Society for GRG for the best Ph.D. thesis in all sub-areas of quantum gravity during the past 3 years for his work on “Loop Quantum Cosmology” (Professor Ashtekar)

*Edward Wilson-Ewing: Won the APS award for the best student presentation at the 12th Eastern Gravity Meeting; Won the Penn State Alumni Association Dissertation Award (Professor Ashtekar)

*Nicolas Yunes: Won the Juergen Ehlers prize of the International Society for GRG for the best Ph.D. thesis in all sub- areas of mathematical and numerical general relativity during the last three years for his work on “binary black holes and gravitational radiation (Professor Owen)

- Post-docs:

*Ivan Agullo: Won the first prize in the annual international competition of the Gravity Research Foundation; Won the “Best Ph.D. work for the year 2010” prize from the University of Valencia, Spain.

*Parampreet Singh (past post-doc): Won the S. Chandrasekhar prize for the best post-doc talk in the quantum gravity session of the 19th International Conference on General Relativity and Gravitation.

- Faculty:

*Stephon Alexander: Received an NSF Early Career Development award

*Abhay Ashtekar: Received an honorary Ph.D. from the Universite Mediterranee Aix- Marseille, France;

An international conference and festivities were held in Madrid, Spain to celebrate the 25th anniversary of his paper that marks the birth of loop quantum gravity;

Elected Fellow of the American Association for Advancement of Science;

Served as President of the International Society for General Relativity and Gravitation (2008-2011)

*Martin Bojowald: Received an NSF Early Career Development award

*Niel Brandt: Named Distinguished Professor of Astronomy & Astrophysics; Elected Fellow of the American Physical Society

*Tyce DeYoung: Received an NSF Early Career Development award

*Peter Meszaros: Was elected a Fellow of the American Academy of Arts and Sciences;
Ranked #1 in the number of papers and the total number of citations in Gamma Ray
Burst research by Thomas Reuter Science Watch

*Radu Roiban: Won the Alfred P. Sloan Research Fellowship; Received the DOE Outstanding Young Investigator Award

*Paul Sommers: Elected Fellow of the American Physical Society

*Jinchao Xu: Named Francis R. and Helen M. Pentz Professor of Science

- External Advisory Board:

- *Chris Liedel was awarded the ECOS Distinguished Service Award.

- Other noteworthy distinctions:

- Every year about a dozen publications from the Institute are highlighted by the journals in which they appear. These include the journals published by the American Physical Society and the British Institute of Physics. On the physics arXivs, the Institute has a notable presence. For example, among the top 100 cited papers of all time on the gr-qc (General Relativity and Quantum Cosmology) arXivs, every year about 13 are IGC publications and an additional 11 are on programs initiated at IGC and followed-up by colleagues elsewhere. Although the field has larger institutes, none of them come close.

ECOS Review: Spring/Summer 2010

Further details on IGC activities until 2010 spring can be found in the enclosed document that was submitted to ECOS for the extensive review of all research centers carried out by Dean Larson and Dr. Charles Fisher. These include a discussion of contributions to and by minorities and under-represented groups, details of external funding (*which for the period 2007-2010 amounted to \$12.3M*), of academic activities organized by the three Centers and future plans and needs of the Institute.

For a time, it seemed advisable and possible that the Institute could be moved to the auspices of the Office of the Senior Vice President of Research with an appropriate annual budget. However, in the end this did not materialize. Nonetheless, the Office of the SVPR was able to provide a one-time support of \$100K to help us launch the Multi-messenger Astrophysics project AMON.

AMON: The Astrophysical Multi-messenger Observatory Network

- This is an IGC initiative to combine information from observatories that are based on all 4 forces of nature so as to enhance sensitivity to cosmic bursts. AMON is based at Penn State but has participating scientists from numerous other universities and laboratories. Besides gamma rays (Swift and Fermi and HAWC), AMON correlates signals arriving in neutrinos (IceCube), gravitational waves (LIGO), and ultra-high energy neutrons (Auger). IGC faculty are collaborators in all of these observatories. These are the “triggering observatories” (and others will be added). AMON will also have participating optical telescope facilities that will be used for follow-up observations of detection alerts. See the enclosed overview titled “The Astrophysical Multimessenger Observatory Network.”

- The Center for Fundamental Forces and the Cosmos: A preproposal submitted to NSF on August 10, 2010, for a Physics Frontier Center. The PI was Peter Meszaros, and Co-PIs were Abhay Ashtekar, Doug Cowen, Ben Owen, and Paul Sommers. (See the enclosed summary of the proposal.) Numerous renowned external scientists joined the preproposal as senior investigators along with many IGC faculty. The external advisory board consisted of James Cronin, Francis Halzen, Martin Rees, and Cliff Will, each representing observations using a different force of nature (hadrons, neutrinos, photons, and gravitons, respectively). The CFFC proposed four major activities that would bridge theory and observations with a strong emphasis on multi-messenger observations. The AMON concept was one component of it.
- A proposal specific to AMON was submitted to the W.M. Keck Foundation, with help and support from Hank Foley (VPR) and the ECoS budget office. Derek Fox was the PI. That proposal would have funded construction of a dedicated follow-up telescope at the site of the Hobby-Eberly Telescope of the McDonald Observatory in Texas in addition to developing the alert system itself.
- With money provided by the VPR office, Miles Smith, a senior research associate, is working full-time on development of AMON and coordinating activities for it.
- There have been two meetings with people from IST and the Institute for Cyberscience to discuss the computational issues and to work toward a partnership across colleges on this project. The most recent meeting was held in David Hall's conference room on May 11, 2011.
- A 40-minute presentation of AMON was attended by Ed Seidel (NSF Assistant Director for Mathematical and Physical Sciences) when he was visiting the physics department March 24th of this year. He was highly enthusiastic about the idea and its potential for enhancing the scientific return of the various NSF observatories, and he suggested a presentation at NSF for a larger group.

- The presentation at NSF occurred on June 22nd and was attended by numerous program officers. Derek Fox, Miles Smith, and Doug Cowen made the presentation.
- A scientific publication is in preparation and should be completed in October.
- A workshop for AMON will be held here on October 1-2. Numerous collaborators from outside Penn State will attend, as well as scientists from IST and ISC.
- A proposal for NSF funding is under development, and program monitors are cognizant of it.
- The AMON proposal is a first step toward integrating multi-messenger data for the advancement of high-energy astrophysics. It concerns the detection of transient phenomena in real time. Multi-messenger astrophysics has a much larger scope. We are starting to plan for the time when all data from LIGO, IceCube, Auger, HAWC and other novel observatories will be public. The IGC and Penn State could play a major role in providing a unified repository for all of those data sets with a public interface that would facilitate studies that combine information from the different types of messengers. This larger scope entails interesting computational challenges.
- Related to AMON, the IGC is planning a workshop in the spring dedicated to advance planning for the next major astrophysical explosion (supernova, hypernova, gamma ray burst, etc.) that will occur in our Galaxy. There has not been a supernova or other major explosion in the disk of the Galaxy for an unusually long time. One could occur at any time, and the astrophysics community should have coordinated plans to learn as much as possible when it happens.

Reorganization of the IGC Centers

- When the Institute for Gravitation and the Cosmos was inaugurated in 2007, it was recognized that it would be sensible to combine, in one center, activities relating to astrophysical observations by all types of messengers. At that time, however, the Center for Gravitational Wave Physics was an NSF Physics Frontier Center, and it was decided to form a separate center for particle astrophysics.
- There is a consensus now that it is time to combine all of the astrophysical observational activities in a single IGC center. The CGWP and CPA will be merged to form the Center for Gravitational and Particle Astrophysics.
- Peter Meszaros will be the director of the new CPGA.

Proposal to Create A New Cosmology Center within IGC

- Philosophy: IGC should be regarded as a living organism that grows and changes, not a fixed inert entity. Should take advantage of new intellectual opportunities as well as new strengths at Penn State. Thanks to impressive observational missions over the past decade, Cosmology has become one of the most exciting fields in physical sciences. Thanks to recent appointments in Astronomy and Astrophysics and Physics Departments, we have a real opportunity to build a Center for observational and theoretical research at the forefront of Cosmology.
- Mission Statement: The goal of the Cosmology Center is to enhance our understanding of the very early universe using multi-wavelength surveys, computer simulations and fundamental theories, and by confronting theoretical paradigms with observations.

- Director: Don Schneider (A&A)
- Members: Stephon Alexander (Phy), Abhay Ashtekar (Phy), Martin Bojowald (Phy), Niel Brandt (A&A), Derek Fox (A&A), Yuexing Li (A&A), Peter Meszaros (A&A/Phy), Sarah Shandera (Phy)
Interests span Observations, Computational Physics/Astronomy, and Fundamental Theory.
- Two-fold Goals: A distinguishing feature of the Center is the breadth of its intellectual span. At one end of the spectrum we will address fundamental issues such as what replaces the Big Bang in quantum gravity, and explore the formation of the first cosmic structures at the earliest epochs accessible to direct observation; on the other, we will carry out observations aimed at revealing the properties of the "Dark Energy" that pervades the cosmos and drives its current accelerated expansion. Thanks to this diversity in research goals, the Center aims to play a leading role in advancing a variety of traditional directions in cosmology. More importantly, by fostering interactions between sub-disciplines, we hope to raise new issues at their interface and develop novel approaches to address them.