"Conference Overview"

OR

What did I learn at ICGC-2004 ?

Grouping of Talks

"Culture Talks": Testing GR – C. Will
Naked Sing. – T. Harada

Grav. Waves: Detector Runs – G. Gonzalez
Detector Phys. – B. Bhawal
Event Rate Expect. – V. Kalogera
Data Analysis – S. Dhurandar
Wave form Comp^n – L. Blanchet
– M. Shibata

Cosmology: CMBR – R. Crittenden
M. Kaplighat
+SDSS + others – J. Ostriker
cluster Surveys – S. Majumdar
Weak lensing – B. Jain
Dark Energy Desperation – R.C. (E.C)

Quantum Grav.: Entropy – S. Das, P. Majumdar
Strings – S. Trivedi
LQG – J. Pullin
LQC – M. Bojowald
Brane Cos. – M. Sasaki

Testing GR :

- Confirmation of GR in traditional test
- Phasing formula for GW as a discriminator for alternate theories
- Speed of gravity (mass of graviton) from modified chirp form

Naked Singularities :

- Spherical collapse of perfect fluid with $p = k\rho$ can exhibit generic occurance of N.S.
- stability w.r.t. non-spherical pert. not known
- Not much definitively known about non-spherical collapse.
- Near L.T.B., GW emission is possible. Some Weyl $= \infty$ at Cauchy hor. but. Still with finite GW flux.
- Proposition of 'Effective Naked Sing'

LIGO Runs:

- LIGO-I is ready & has had 3 science runs each lasting between 1-2 months.
- sensitivity progressively increased expecting to reach design goal level in couple of years.
- Can currently 'see' out to ~1 Mpc
- Real data available for data analysis & upper bounds on some parameters can be obtained.

Event Rates:

- Types of events to detect -(inspiralling compact binary)
- Discovery of a new highly relativistic pulsar (double), provides for further type of populations pushing up the total event rate.
- Precessing binaries could be looked for (but before LIGO-II)

Detector Physics:

- Complexities of detector assembly
- Simulation checks on reliability & predictability of the detector behaviour

Data Analysis:

- Grand tour of types of signals
- sophistication needed to extract signal & infer sources & their distribution.
- " Rings, Algebras, Graph Theory..."

Signal defn : (Blanchet)

- Chirps & their computation to 3.5 PN order
- Theory & complexities of the formalism behind the computations
- Still one parameter ambiguity due to self-field effects unresolved (θ)
- Results compatible with numerical compntations.

(Shibata)

- BSSN evolution system (stable)
- Hydro-dyn evol. with 'high resolution shock capturing' (more physical)
- Dynamical gauge conditions
- Super computer capable of handling $600^2 \times 300$ (minimum) grid
- Quantitative runs with 1% accu. possible.
- Templet computation still in the future but optimistic.

CMBR (Crittenden)

- Hot news from WMAP - all sky, ~½°, Pol^n anisotropies

Confirms: Adiabatic pert.;
Scale inv. spectrum;
Integrated Sach-Wolfe seen;
reionization rather early;
Gaussianity test o.k.;
S-Z effect ?
lower multipole suppression
- not beyond doubt; topology not fully settled;
North-South asymmetry ?

(Kaplighat)

CMBR determination of 'optical depth' (τ) contains more info.

- Detection of B-mode indicates tensor pert. and/or weak lensing.
  ↳ has implication for inflation.

+ SDSS + others :

- while most precise, CMBR alone is not enough.
- Combine info from SDSS, SNa, cluster surveys ... etc.
- There is also the Dark matter.
- Need to constrain concordance as well as inflationary models.

→ Overall LCDM etc.

→ small scale info needed

→ Nature of Dark matter ?

Qns for theorist:

Cluster Surveys, weak lensing

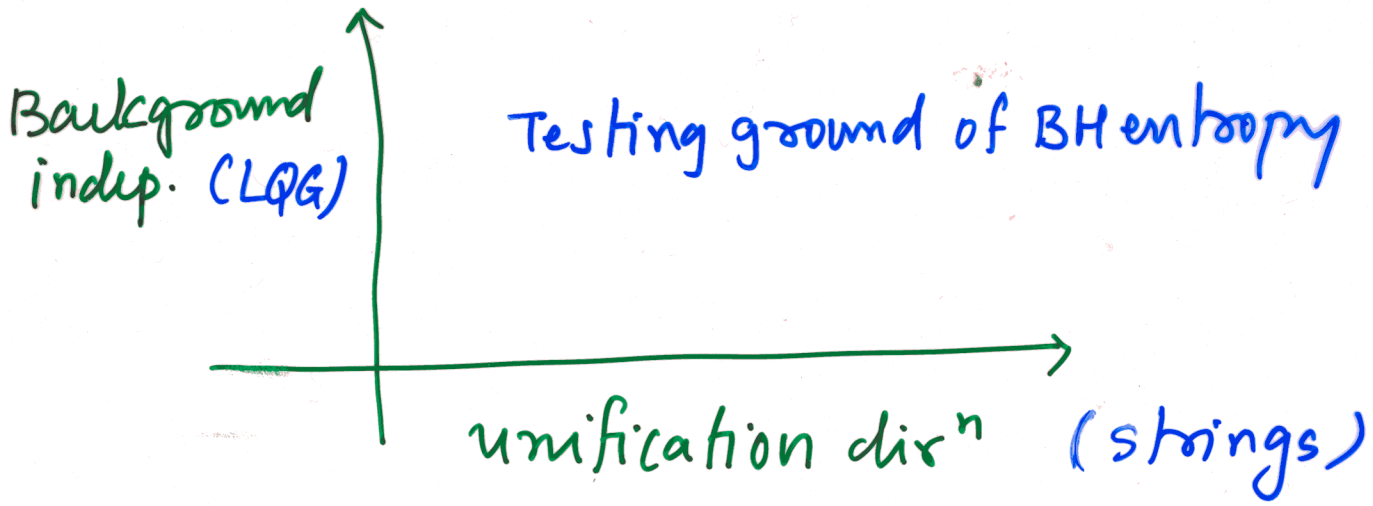
- still somewhat in the future (~ 10 yrs)
- Clusters have a lot of structure i.e. more probing methods available
- future surveys will have ~ 10^4 clusters allowing newer methods

- ~~Micro~~ weak-lensing allows mass distribution power spectra into using lensing tomography
- Gives info on intervening grav. pot'l
- Can measure eqn of state for Dark energy; study of halos etc.

Dark energy desperation:

- Dark energy exists - properties & nature unknown. Currently beyond observation
- "Coincidence problem" puts severe constraints on models of Dark energy
- ~~Generically~~ fine tuning emerges
- Desperate models - no solution
- Hope for further observational input.

Quantum Gravity :



Strings :

Construct a unified theory (framework) incorporating matter (known & unknown) and gravity.

- stringy framework 'natural & flexible
- Dualities $\longrightarrow$ underlying M theory
- Phase describing our world ?
  How to identify it ?
  Any "reason" for our phase ?

- Discovery of accl^n $\leftrightarrow$ $\Lambda > 0$
- Challenge for strings due to NO-GO thm for getting $\Lambda > 0$ compactification.
- NO-GO avoided by using 'compactification with fluxes' - permits controlled susy breaking to achieve $\Lambda > 0$ local minima.
- Enormously "Rich" structure of superpote
- Indication for cosmology : multi-inflaton model building ; there could be a variety of epochs before observable inflation
- Vacuum selection - unclear.

LQG :

- Not a unified theory of 'everything'.
- Focus on background independence (or Non-perturbative ~~for~~ quantization)
- Main steps in development :

→ connection formulation
→ Formal loop repⁿ, discrete spectra
→ Construction of connection repⁿ
→ Concrete proposal for Hamiltonian Constraint

Qn: Well defined o.k. but is it physically "correct"? semiclassics?

Try a fully discrete approach (Pullin)

- evolution is via finite canonical transfn
- For theories with constraints, preservation of constraint can be used to solve for Lagrange multipliers & now no more constraints
- proceed to quantization
- Method works for YM, BF, QC.
- 'Solves problem of time' (∵ no constraints)
- Avoids singularities
- Can 'solve' information loss problem by having non-unitary evolution.

"Testing QG"

At the theoretical level microscopic explanation of B.H. entropy has been a "testing ground" for various QG proposals. The test involves in getting Bekenstein-Hawking formula.

- Most QG approaches get the B.H. formula
- There are logarithmic corrections which seem to discriminate among different approaches. (S.D.)
- Universality arguments for log correction and canonical entropy. (P.M.)
- QG effects could be observable due to cummulative enhancement
  - → light, neutrino propagation on QG
  - → modified dispersion rel^n
- → Theory rather weak
- → Local Lorentz inv. in tact.

Transparency ? had forgotten to show:

In addition, we had two more talks related to the Grav. wave theme:

One related to Neutron star equation of state relevant for the merger & ring down phase of ~~a~~ coalesence of a binary system, was given by F. Rasio and another one by P. Dasgupta discussed statistics of short GRBs. (Not really GW-y)

Two more "culture talks" (i.e. not directly related to the themes): S. Kar discussed issue of "small" violations of energy conditions in the context of traversable wormholes while R. P. Kerr recalled the Kerr-schild metrics.

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- Conf. had a strong emphasis on "observations" or application of GR in an understanding of the cosmos at ever more detailed level.
- There are 'embarrasing riches' for strings & semiclassics block for LQG.

The summary won't be complete without mentioning the delightful cartoons & commentary by C. V. Vishveshwara (Vishu).