GRAVTATIONAL WAVES

The search for gravitational waves has been conducted for several years in a spirit of co-operation between independent projects. In particular, the LSC and Virgo Collaborations share data and carry out collaborative data analysis work wherein all data analysis activities are open to all members of the Collaborations in a spirit of teamwork, open access, full disclosure and transparency with the goal of best exploiting the full scientific potential of the data. All data and their interpretation are held strictly within the membership of the Collaborations until both Collaborations have given their permission for public release. After the discovery of gravitational waves is published, both the LSC and Virgo will begin releasing especially significant triggers promptly to the entire scientific community, to enable a wider range of multi-messenger observations. There are future plans for making all data publicly accessible 24 months from the data taking.

HIGH ENERGY GAMMA RAY ASTRONOMY

Ground-based high energy gamma-ray astronomy has been very successful for the past ~25 years. Starting with the detection of the Crab Nebula in 1989, 147 sources have been discovered above 1 TeV. For ~2/3 of these, FERMI has found counterparts at energies below 100 GeV. However, the anticipated boost to the discovery of new sources will require sky survey capabilities at energies above 1 or even 10 TeV. HAWC, Tibet ASr+MD and LHAASO will achieve sensitivities at the level of 0.1 Crab in 5 years and 0.01 Crab in 10 years. CTA is pushing the threshold lower to make a connection with FERMI with a sensitivity of 0.001 Crab in 10 years. It is clear that energy coverage from 1 GeV to 1 PeV will enable thorough spectroscopic investigations for most candidate sources of galactic cosmic rays in the next decade. Moreover, detailed investigations of source morphologies by CTA are likely to enable a breakthrough in understanding cosmic ray origin.

ULTRA HIGH ENERGY COSMIC RAYS

In the field of Ultrahigh Energy Cosmic Rays, the basic questions remain unanswered: What generates such extremely energetic particles that reach above 10^20 eV (100 EeV)? Where do they come from? How do they reach these energies? What are they? How do they interact on their way to Earth and with the Earth's atmosphere? Thanks to the two giant extensive air-showers observatories, the Pierre Auger Observatory and the Telescope Array, we now know that the sources of ultrahigh energy cosmic rays (UHECRs) are extragalactic. We also know that either they interact with the CMB as predicted or they run out of energy at the same energy scale of the CMB interactions! Auger reports heavier nuclei at the highest energies which is either a surprising composition or hadronic interactions at 100 TeV CM are not a standard extrapolation of LHC energies. Hints of anisotropies, including a hotspot in the TA sky and the Auger correlations with the large-scale structure, begin to appear as energies reach 60 EeV, just when statistics become very limited. Auger and TA are now working together toward a close comparison of spectrum, a complete sky map, and an understanding of the differences in composition measurements. The composition or hadronic interaction discrepancies motivated the Auger collaboration to propose upgrades targeted at better studying the muon component. TA is proposing to match the Auger acceptance by increasing their area by a factor of 4. To answer these questions larger statistics at the highest energies is necessary. Space-based observatories can significantly improve the exposure to these extremely energetic particles. The first step is to place a wide field UV telescope at the International Space Station to monitor the Earth's atmosphere from above. This is the goal of the JEM-EUSO mission: the Extreme Universe Space Observatory (EUSO) at the Japanese Experiment Module (JEM). R&D on improving photo detection (e.g., SiPM) is a clear current technological need.

HIGH ENERGY NEUTRINO ASTRONOMY

Recent IceCube results confirm the evidence for extraterrestrial neutrinos reported in 2013, with a significance now up to ~6σ. The next step will be to pin down their origin e.g. by identifying point sources. This discovery puts plans for complementary detectors in the Northern hemisphere on a firmer footing, as well as plans to extend IceCube itself. The KM3NeT collaboration is working on a "Phase-1" detector of ~3x the sensitivity of ANTARES (completion 2016), to be followed by a "Phase-1.5" which will have a similar sensitivity to IceCube (completion ~2020, provided funding is secured). The final "Phase-2" will consist of 6 blocks, each with 60% of IceCube's volume. GVD in Lake Baikal is a 0.4 km^3 detector (completion 2020); the first of its 10 sub-clusters will be finished in 2015. The IceCube collaboration envisages an extension to 5-10 km^3 plus a densely instrumented core (PINGU – to determine the neutrino 'mass hierarchy'), altogether 120-140 strings. A "Global Neutrino Network" (GNN) was formed in October 2013 to join all efforts and develop a coherent strategy.