Panel A / Chapter 2
Extremes of the Universe

Enlarged panel 24 January 2007

Science Questions

- How did the Universe begin?
- What is dark matter and dark energy?
- Can we observe strong gravity in action?
- How do supernovae and gamma-ray bursts work?
- How do black hole accretion, jets and outflows operate?
- What do we learn about the Universe from energetic radiation and particles?

Broadest range of the panels:

Standard physics in exotic settings

But also the universe as a laboratory for new physics

Presentations

- Helene Sol — Physics of massive Black Holes and Active Galactic Nuclei
- Andrei Lobanov — Research prospects on cosmic black holes
- Luca Pasquini — Variability of physical constants and cosmic ray spallation
- Karl Mannheim — Extragalactic gamma rays from clumpy dark matter halos and blazars
- Sandro Dodorico — The EELT and key scientific questions in cosmology
- Alexandre Refregier — Cosmological gravitational lensing: ground vs space
- Heino Falcke — Promises of the low frequency sky
- Mariano Mendez — The equation of state of nuclear matter in neutron stars
- Norbert Schartel — XMM-Newton observations of the strong gravitational field and dark matter
- Rashid Sunyaev — MeV science

Will have an important impact on the report (as web-discussion)

Killer science

- Dark energy and dark matter
- Gravitational waves (inflation and compact objects)
- Black holes and supernovae as power engines
- Extreme accelerators
- Test of GR in the weak and the strong field (incl. fundamental constants)

Killer tools

- Large collecting area radio observatory
- Gravitational wave observatory
- CMB polarization
- Optical/IR survey telescope (ground and/or space)
- Extremely large optical/IR telescope
- Large collecting area X-ray telescope
- Cerenkov arrays
- Simulations and theory
- All-sky high-energy monitor, MeV observatory, mm-VLBI (small supporting facilities)

- Dark energy and dark matter.

  radio, opt/IR surveys, X-ray
- Gravitational waves (inflation and compact objects)

  CMBR polarization probe, GWO, radio
- Black holes and supernovae as power engines

  ELT, X-ray, radio, GWO
- Extreme accelerators of HE particles

  Cherenkov
- Test of GR in the weak and the strong field (incl. fundamental constants)

  GWO, ELT, radio

Notes

- More detailed specifications (wavelength ranges, depth and areas of surveys, spatial, temporal and spectral resolution, ….) in document
- Time scales of the different projects very different.
- Mix of space and ground
- Need to address role of current facilities. Eg. future dedicated ‘medium-size’ facilities (eg 8-10 m class telescopes). Closing any facilities?

- Needs more iterations among the panel members. List and motivations will evolve over the next few weeks
- Constructive input from community is welcome!