TATA INSTITUTE OF FUNDAMENTAL RESEARCH

DEPARTMENT OF ASTRONOMY & ASTROPHYSICS

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Title : Ultra high energy particles and cosmic ray electrons/positrons, from massive star explosions

Day, Date & Time : Tuesday, 27 October, 2009 at 16.00 hrs

Venue : Lecture Theatre (AG-66)

Abstract

Particles near 10^{20} eV are the most energetic particles known to us in the universe, also called ultra high energy cosmic rays. Events have been detected of an energy up to $3 \, 10^{20}$ eV, which is a macroscopic energy. Independently, new components of cosmic ray electrons and positrons have been detected. Here we attribute all of these particles to the acceleration of charged particles in magnetic stellar winds: Considering all of 4π around a star with such a wind, over most of 4π the magnetic field is nearly tangential, while in a polar cap the magnetic field is radial. This leads for the polar cap component to a flatter spectrum, and also to more interaction. This in turn gives enhanced production of secondary particles such as positrons. The now abundant observations are readily and quantitatively interpreted with the action in magnetic stellar winds. On the other hand, when two galaxies merge, and their central black holes then also merge, the resulting spin of the final black hole is flipped around: Then a newly oriented relativistic jet can race through a region of a starburst induced as a first stage of the merger, when many massive stars form and explode. This propels the polar cap components of cosmic rays to very much higher energy, while obeying at the same time the Poynting flux limit constraint for active galactic nuclei. This then may explain the Auger data as due to the action of the relativistic jet in the radio galaxy Cen A. Coming from both low energy and high energy, we thus may have a contribution to a coherent and quantitative physical theory for the origin of cosmic rays.