General Discussion on Dark Matter

Abstract

A concise report on the general discussion is presented (composed by K.S. de Boer)

The idea of having a further component of matter in galaxies is based on the fact that the observed spatial distribution or kinematcs of material requires a gravitational force stronger than can be accounted for by the spatial distribution of mass in known objects. The first proposals to have Dark Matter (*DM*) go back to Oort (1932) for the Milky Way disk and to Zwicky (1937) for clusters of galaxies. Rotation curves of spiral galaxies then indicated the presence of additional gravitational force, too, brought on firm footing using new radio synthesis observations of other galaxies by Bosma (1981).

The problem of finding the amount of *DM* was addressed during the discussion in some detail. How good is the information about *DM* we obtain from rotation curves?

Clearly, the details of the galaxy observations matter a lot. It is really mandatory to resolve the inner part of the galaxy, in order to properly make mass model fits (see Swaters 2001). The criticality is demonstrated by the existence of *minimum-disk* and *maximum-disk* models and the discrepancy in the total mass from these two for almost every galaxy studied.

Then the question was asked, whether we have any hope of seeing the *DM* itself. It was noted by de Boer that, although the effect of *DM* is in spiral galaxies more noticeable at large galactocentric radii (due to its contribution to the rotation curve), the *volume density* of the *DM* increases in galaxies in the diskward and inward direction. The increase is easily two orders of magnitude from the edge to the centre of a spiral galaxy. In fact, this is already clear from Fig. 4 in the first paper with an overview of rotation curves and *DM* (Bosma 1981). This aspect was discussed also after a talk Bosma gave last year during the 36th Meeting of the GK here in Bad Honnef. So, if we wish to 'see' *DM* we have the best chance when looking for it locally.

Steinmetz commented that we know of *DM* only through the effects of gravity and these effects are more noticeable at larger scales. So to find out about the amount of *DM* one has to look at galaxy clusters and at gravitational lensing.

Again the question was raised, if baryonic matter and dark matter are well mixed, given that in galaxies also the volume density of baryonic matter raises inward. Gallagher emphasized, that baryonic matter interacts with itself, thereby having the possibility to loose energy through collisions and radiation. Most theories about the (as yet theoretical) *DM* assume thusfar that it is frictionless.

How essential is then *DM* for the formation of galaxies? If *DM* is frictionless indeed, statistical density enhancements in the *DM* distribution may form the central points of gravitational wells in which baryonic matter may sink and through dissipative processes settle permanently (see Steinmetz 2001).

References

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