



Extra-Galactic Astronomy - I Cosmology

IUCAA / NCRA Graduate School 2016-17

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Part I - Lecture 2



The Pioneer of Observational Cosmology



Edwin Hubble



Hubble's contributions

1924 *Nebulae are island Universes*



(Image:Wikimedia Commons)

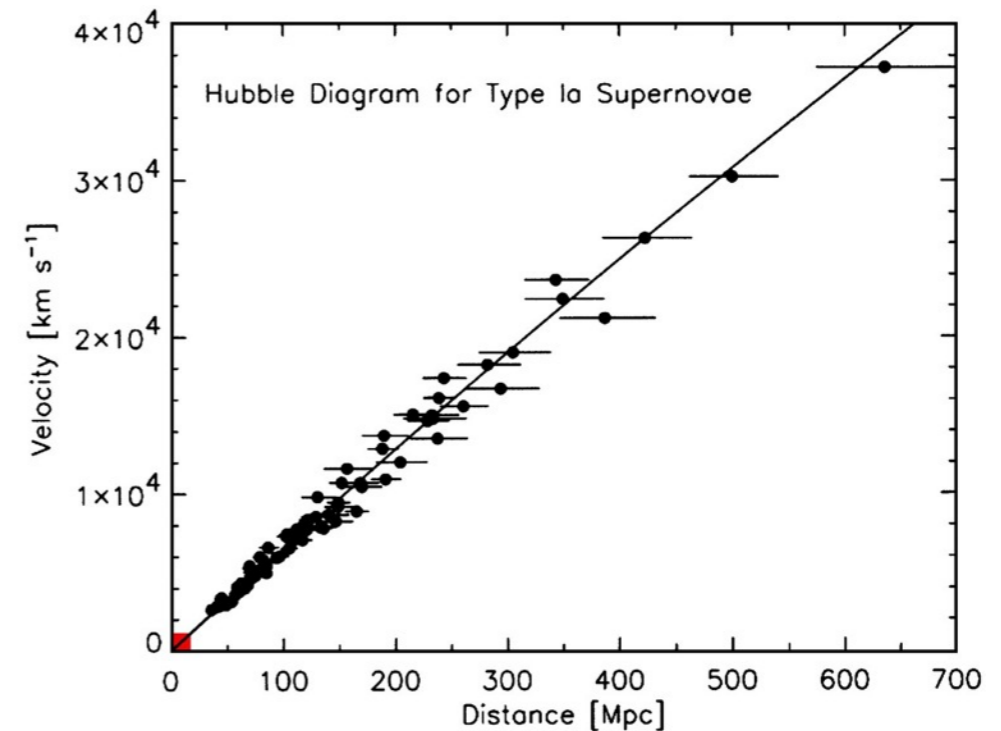
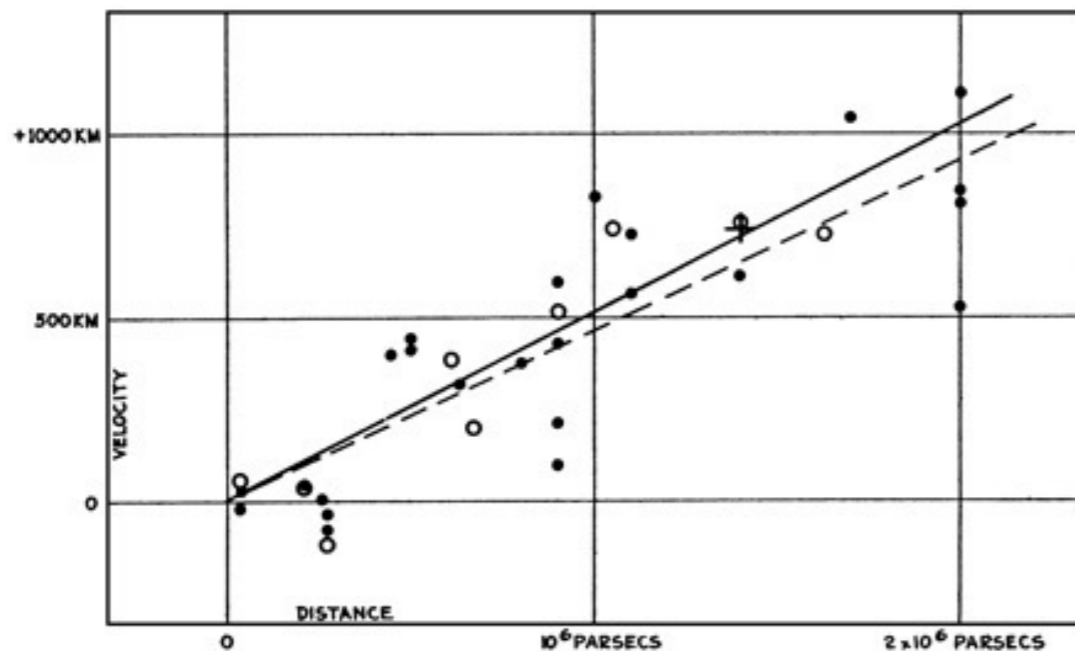
The nature of nebulae such as Andromeda was heavily debated. Hubble observed Cepheid stars in the nebulae and used these to determine distances. Concluded that the nebulae must lie *outside* the Milky Way.



Hubble's contributions

1929 *Linear distance-redshift relation (Hubble's Law)*

Hubble plotted distances d to galaxies (obtained from their brightest stars and Cepheids) against measurements of redshifts $z = \Delta\lambda/\lambda$ of the same (mainly obtained by Vesto Slipher)



Noticed an approximately linear relation $cz = H_0 d$ (he called the constant K).
Determined $H_0 = 500 \text{ km/s/Mpc}$.



The unsung (?) hero



Georges Lemaître

- 1927** Two years before Hubble's work. Paper in French predicting the linear relation. Estimates H_0 from published distance-redshift data.
- 1931** Hubble's paper well-known. *MNRAS* publishes an English translation of Lemaître's work, *sans* the paragraph discussing the linear relation. Identity of translator has been unclear.

Recently, some voices raised the possibility that Hubble may have influenced the translation and editing of the *MNRAS* version.



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Recently, some voices raised the possibility that Hubble may have influenced the translation and editing of the *MNRAS* version.

But correspondence between Lemaître and *MNRAS* uncovered by Mario Livio (*Nature*, 10 Nov 2011) conclusively shows otherwise:

- Lemaître himself translated his paper
- He deleted the discussion of the linear relation since "it is of no actual interest".

While Lemaître's reasons remain unclear, Hubble stands exonerated.