



Dark Matter

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TIP Astronomy Project at PARI

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Table of Contents

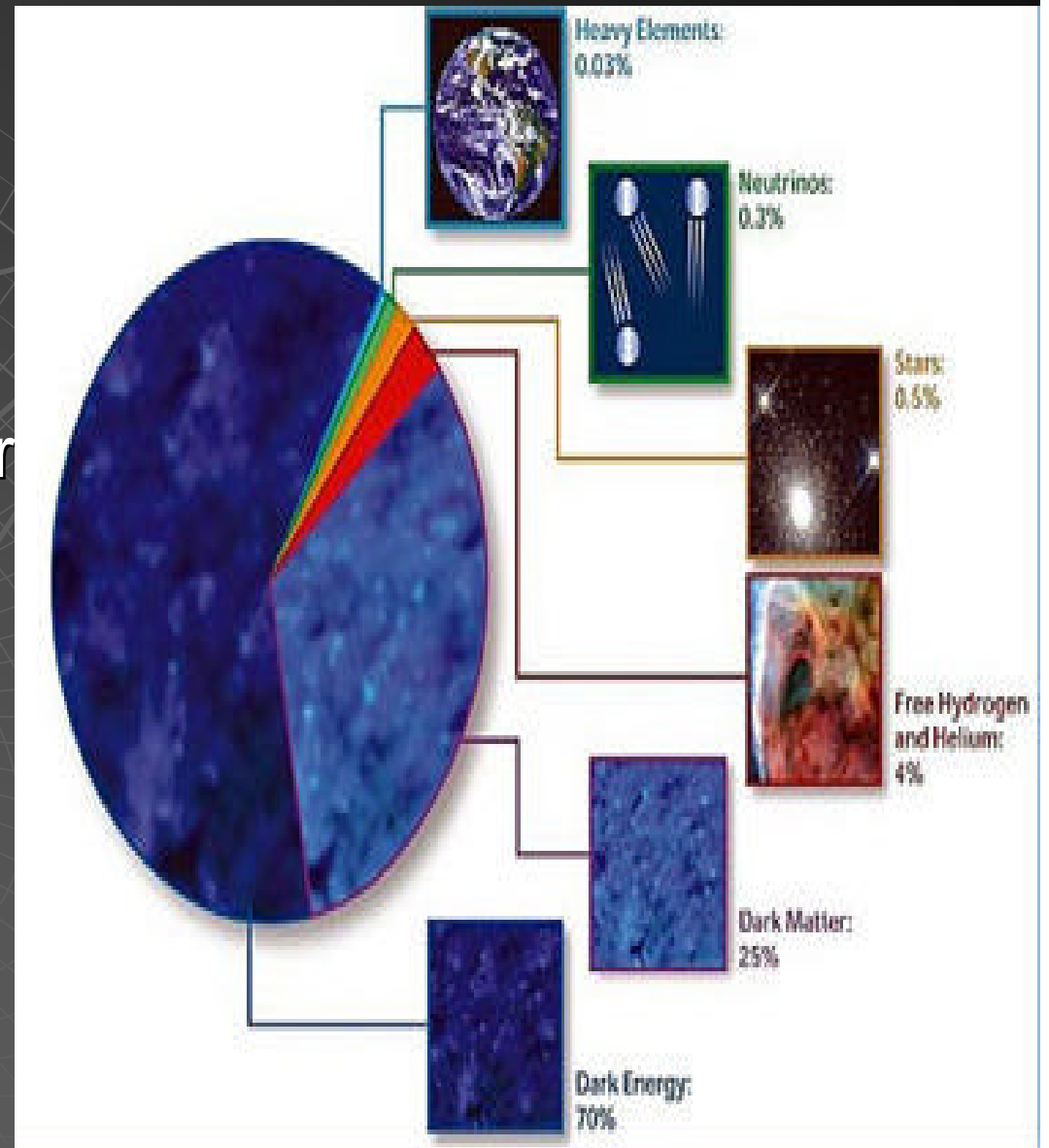
- ◆ What is dark matter?
- ◆ Candidates for dark matter (2 slides)
- ◆ History of dark matter
- ◆ Procedure (2 slides)
- ◆ 7 different smiley scans
- ◆ Velocity curve of the Milky Way
- ◆ Rotation curve for the Milky Way
- ◆ The amount of dark matter in the Milky Way
- ◆ Conclusions
- ◆ References

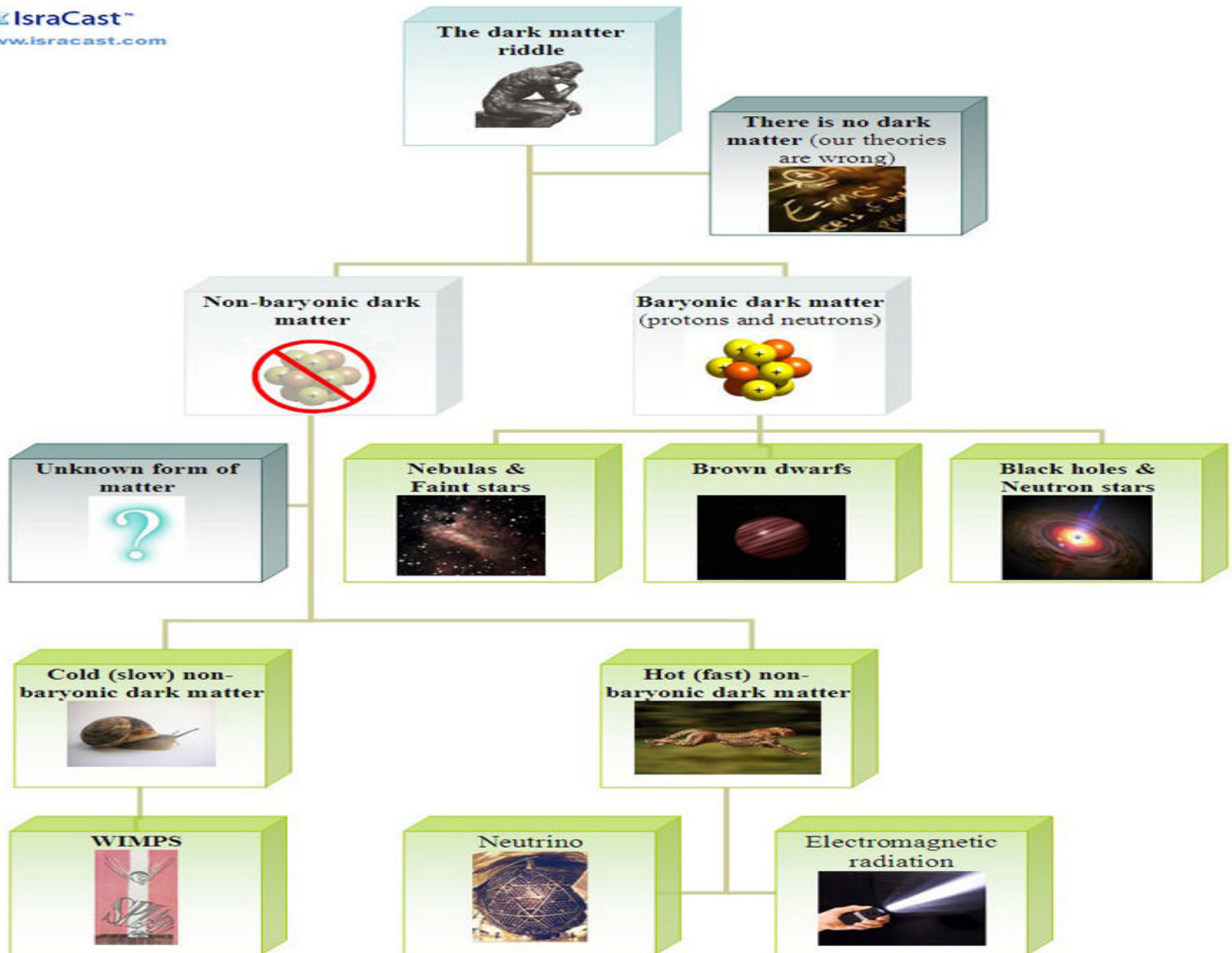
What is it ?

- ◆ An unknown substance
- ◆ Its presence is inferred from other data
- ◆ Occupies around 90% of our universe
- ◆ Two types: Cold and Hot Dark Matter
 - Cold: high mass with slow velocity
 - Hot: low mass with high velocity

Candidates for Dark Matter

- ◆ Baryonic matter
 - MACHOs
 - Brown dwarfs
- ◆ Non-baryonic matter
 - WIMPs





The History of Dark Matter

- ◆ 1930s- Francis Zwicky and radial velocities
 - Proposed dark matter
- ◆ 1970s-received more attention
- ◆ 2001-NASA's launching of WMAP (Wilkinson Microwave Anisotropy Probe)

Procedure

1. Galactic Latitude (all set at 0°)
2. Galactic Longitude (every 10°)
3. Calculate right ascension and declination using:
$$\sin(?) = \cos(b^{\text{II}}) \sin(l^{\text{II}} - 33) \sin(62.6) + \sin(b^{\text{II}}) \cos(62.6)$$

and:
$$\cos(?) \sin(a - 282.25) = \cos(b^{\text{II}}) \sin(l^{\text{II}} - 33) \cos(62.6) - \sin(b^{\text{II}}) \sin(62.6)$$
4. Observe the points via telescope

Procedure Continued

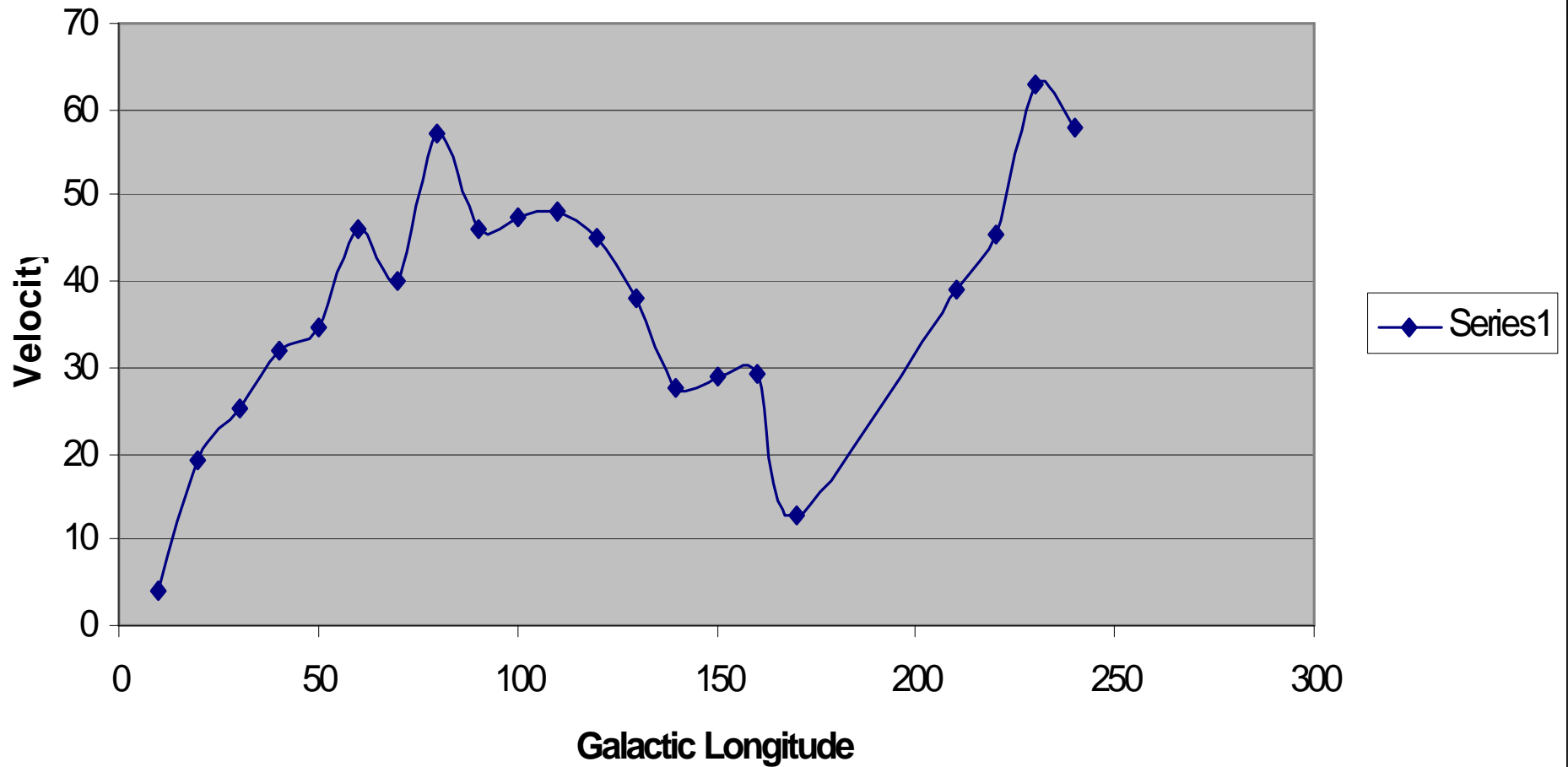
5. Calculate velocity from frequency using:
 $f/1420.406\text{Khz}(c) - 27.5 = v$
6. Calculate R_{\min} from galactic longitude using:
 $R_{\min} = 8 \text{ kpc} (\sin l)$
7. Graph velocity as a function of galactic longitude
8. Graph velocity as a function of distance (rotation curve)
9. Calculate the amount of dark matter based on rotation curve

Smiley Data

- ◆ <http://smiley.pari.edu:8080/smiley/analyze/mainpanel.html>

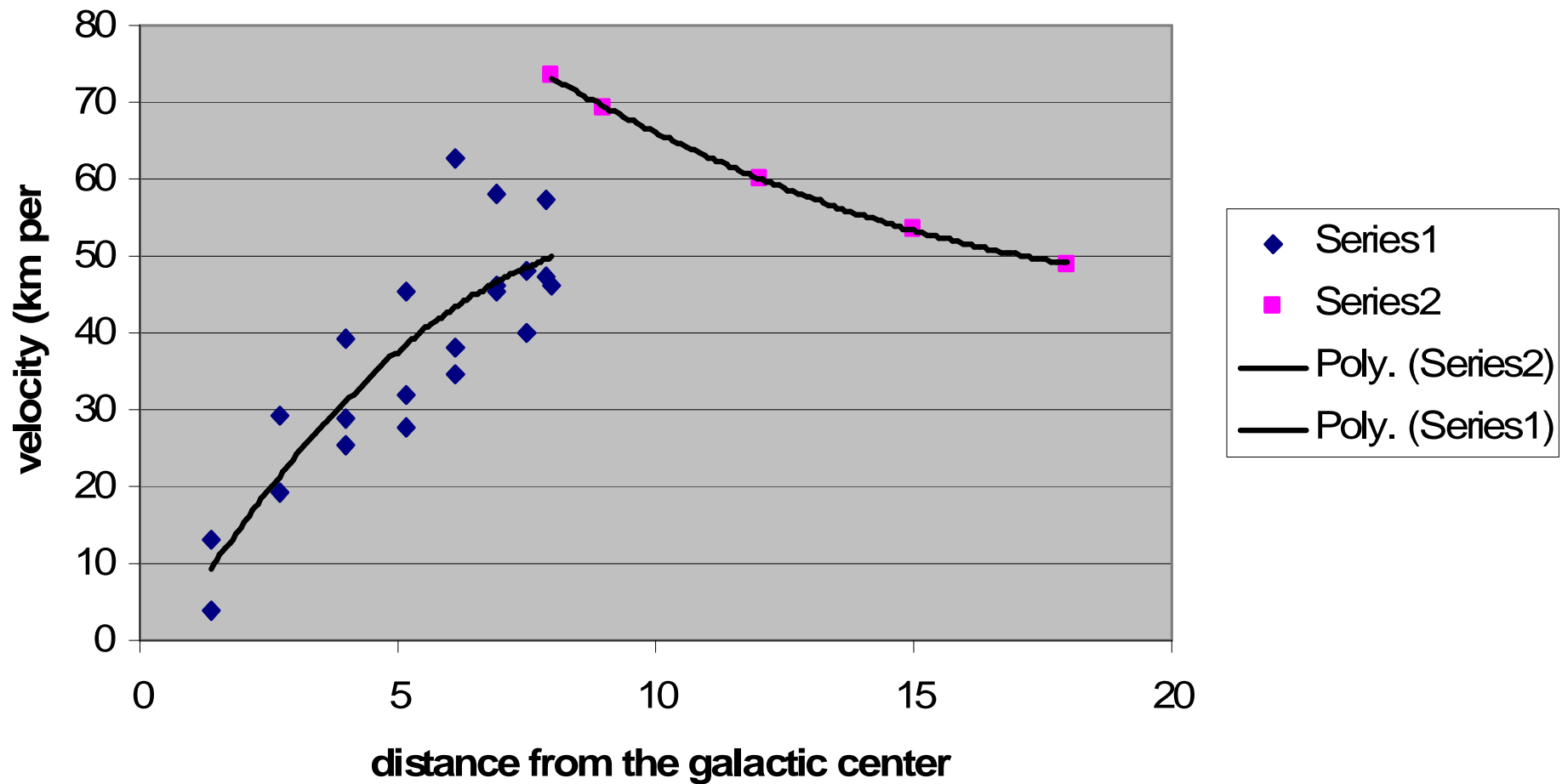
Velocity Curve

Milky Way velocity curve



Rotation Curve

Milky Way Rotation Curve



Conclusions

- ◆ Dark matter exists in our galaxy
 - Detected through rotation curve
 - Could be several objects
 - Still largely unknown
- ◆ Can be detected

References

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- ◆ www.space.com/scienceastronomy/astronomy/cosmic_darkmatt_020108-1.html
- ◆ astro.berkeley.edu/~mwhite/darkmatter/dm.html
- ◆ en.wikipedia.org/wiki/Dark_matter
- ◆ www.physorg.com/news7058.html
- ◆ Lectures by Dr. Michael Castelaz and Dr. Mel Blake