

# DISK GALAXY ROTATION AND SATELLITE KINEMATICS

*SDSS-III Ancillary Science Proposal*

Changbom Park, Hong-Bae Ann,  
Yun-Young Choi & Graziano Rossi

Korea Institute for Advanced Study (KIAS)  
Seoul, South Korea

February 11, 2009

# What is this proposal about?

A detailed kinematic study of SDSS *isolated* disk galaxies (hosts) and of their *satellite* systems

## MAIN GOALS

- Understand kinematic properties of disk galaxies (*hosts*)
- Understand formation and evolution histories of *satellite* galaxies
- Understand **galaxy formation** and **evolution** in dark halo environment

# Scientific rationale: terminology

- **Isolated galaxy (i.e. host, target)** → Galaxy that is not located within the *virial radius* of any neighbour
- **Neighbours of a targeted galaxy** → Objects with magnitude brighter than  $M_r(\text{target}) + 1.0$  and velocity difference less than  $1000 \text{ km/s}$
- **Satellites of a targeted galaxy** → Objects with magnitude fainter than  $M_r(\text{target}) + 1.0$ , velocity difference less than  $500 \text{ km/s}$ , and projected separation  $r_p$  less than the *virial radius* of the host
- **System** → Host galaxy + its satellites
- **Local mass density due to neighbour** →  $\rho_n(r_p) = 3\gamma_n L_n / 4\pi r_p^3$
- **Virial radius of each galaxy** →  $\rho_n(r_V) \equiv 200 \rho_c$ , where  $\rho_c$  is the critical density

# Proposal in a nutshell (A)

## What we propose

- Measure **one additional spectrum for selected disk galaxies** in the SDSS spectroscopic sample
- Disk galaxies (*hosts*) selected among those that are confirmed to have *satellite* galaxies
- Conduct an unbiased survey of galaxy satellite systems over a large area of the sky

## What we have

- SDSS spectroscopic sample of late-type galaxies
- Host galaxies with redshifts at their centers and satellites with known redshifts
- Selection of  $H\alpha$  rotation curves for calibration purposes

# Proposal in a nutshell (B)

## What we want

- Obtain large homogeneous sample of *host* galaxies and their *satellites* with known rotational motion
- Measure relations between disk rotation and other properties of the *host* galaxies
- Study properties of *satellite* galaxies in prograde and retrograde motions separately (kinematics of satellites)
- Study physics of the dark halos associated with host satellite systems

# Asking very little ... but science goals are superb!

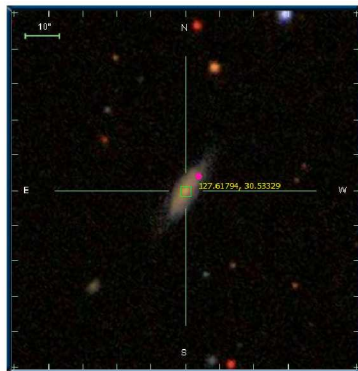
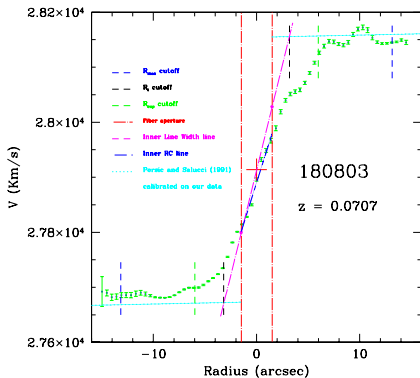
## What we ask

- **One fiber per plate** → yield a sample of over 2,000 host galaxies with known rotational motion
- Additional spectrum from disk of each targeted galaxy, which has already a spectrum at its center

## What you gain

- Increase size of such samples by a factor of 30
- One spectrum from a single point on the disk of each host → *sense of disk rotation, rotation speed and galaxy physical properties*
- Plenty of science goals

# Where would you place the fiber?



## Proposing

- A detailed kinematic study of SDSS *isolated* disk galaxies (hosts) and of their *satellite systems*

## Asking

- Take **one additional spectrum for selected disk galaxies** in the SDSS spectroscopic sample. Only **one fiber** per plate

## Achieving

- New large ( $\simeq 2000$ ) homogeneous sample of host galaxies and their satellites with known rotational motion
- Variety of science goals and possible studies
- Important impact in **galactic formation** and **evolution science**



- Ann, H. B., Park, C., & Choi, Y.-Y., *Galactic Satellite Systems: Radial Distribution and Environment Dependence of Galaxy Morphology*, 2008, MNRAS, 389, 86
- Hwang, H. S., & Park, C., *Galaxy Properties in Satellite Systems of Galaxies*, 2009, MNRAS