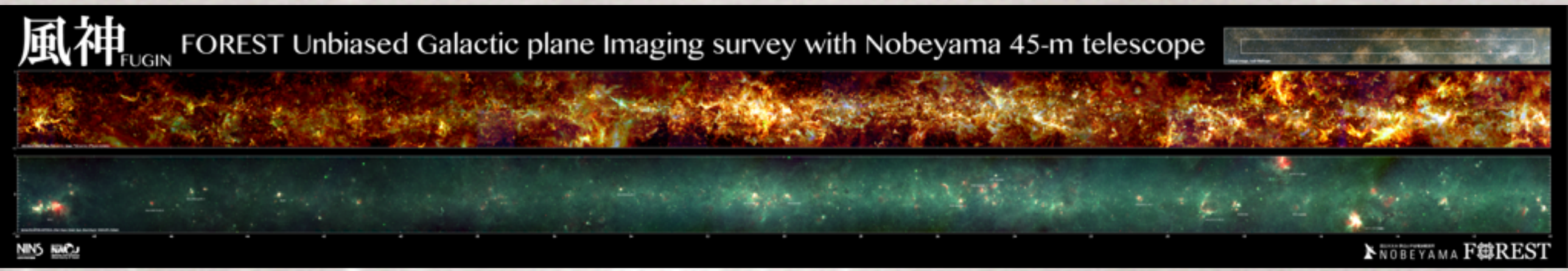


FUGINでみる銀河系における分子雲分布

Location of molecular clouds in the galaxy using FUGIN

Hiro Saito（南極）

00 Aims

- Establishment of method of molecular cloud identification
- Calculation of basic physical parameters of molecular clouds
- Reveal inner-structures of molecular clouds
- Identify far distant clouds
- Reveal size function and mass function of molecular clouds
- Distribution of clouds in the galaxy

Verification of Identification method

Identification Method using the results of Dendrogram

* Dendrogram : treat as a tree that represents the hierarchy of the structures

00 Aims

- Establishment of method of molecular cloud identification
- Calculation of basic physical parameters of molecular clouds
- Reveal inner-structures of molecular clouds
- Identify far distant clouds
- Reveal size function and mass function of molecular clouds
- Distribution of clouds in the galaxy

01 Introduction

- FUGIN survey

  * FUGIN : NRO45m + FOREST

    NRO 45m : High spacial resolution (~ 15" @ ^{12}CO)

    0.2 pc @ 2.0 kpc (sagittarius arm)

    —> detectable inner structures in clouds

    FOREST : detect multi lines simultaneously

    ^{12}CO : detect the structure with low column density

    ^{13}CO : detect the inner structure in the clouds

    $C^{18}O$: detect the dense gas in the clouds

01 About FUGIN

Survey Strategy

- Area : the first quadrant (10d < L < 50d ; -1.0 < b < 1.0)

  the third quadrant (198d < L < 236d ; -1.0 < b < 1.0)

- Line : ^{12}CO, ^{13}CO, $C^{18}O$

- effective velocity resolution : 1.0 km/s @ 3 mm

- effective angular resolution : 20″ @ ^{12}CO

- final map

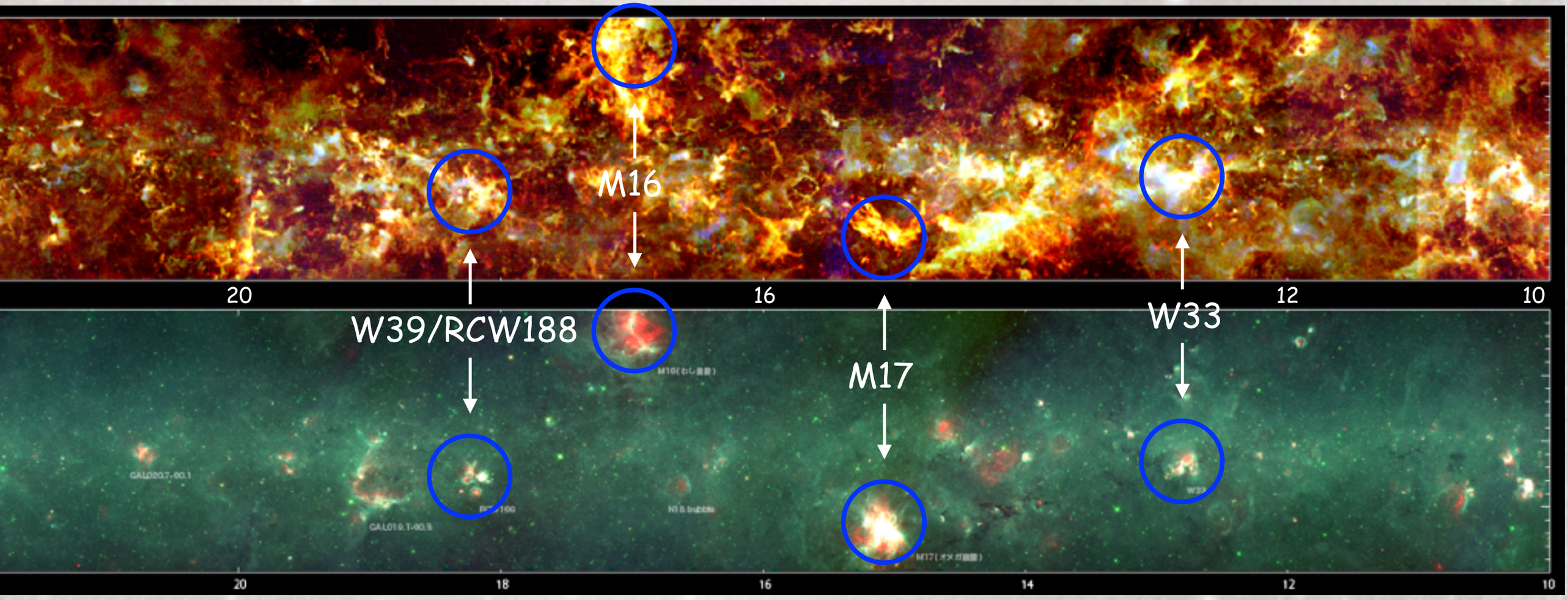
  * l,b grid = 8″.5, velocity grid = 0.65 km/s

    velocity range = -100 km/s < v < 200 km/s

    Noise level : 0.8 - 2.7 K @ dV = 1.3 km/s (^{12}CO)

02 Results of FUGIN data

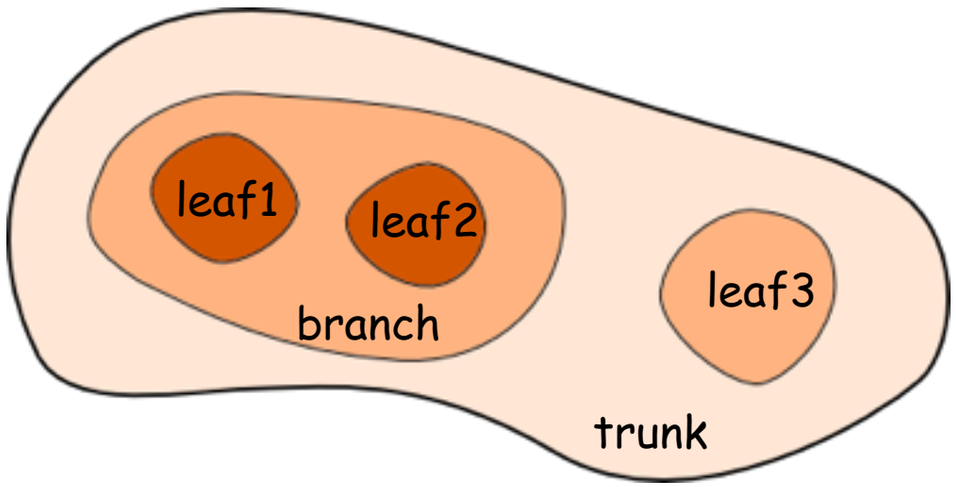
FUGIN : ^{12}CO (R) & ^{13}CO (G) & $C^{18}O$ (B) : NAOJ

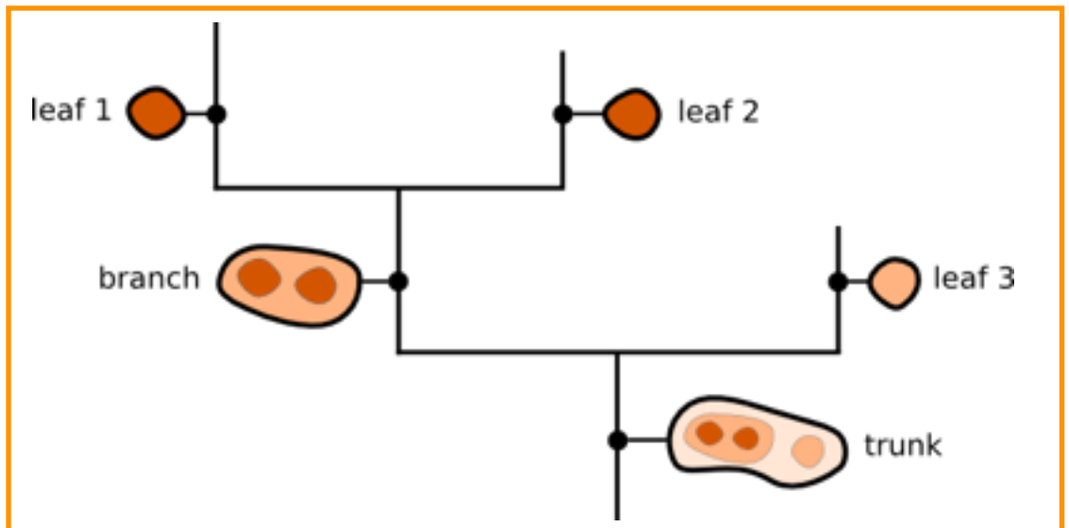


Spitzer : 24um (R) & 8um (G) & 5.8um (B) : NASA

03 Molecular Cloud Identification

Structure Identification using the results of Dendrogram





Dendrogram can identify the structures with various scales at the same time

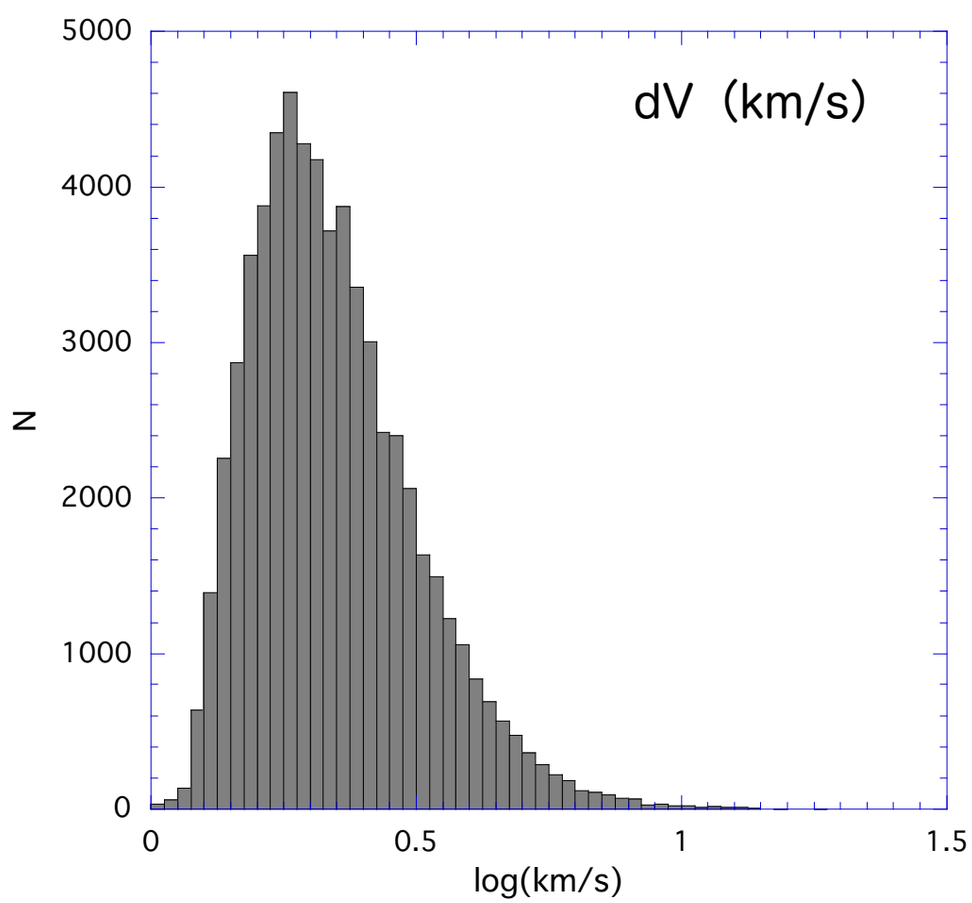
—> We can identify the molecular cloud as well as the internal structures

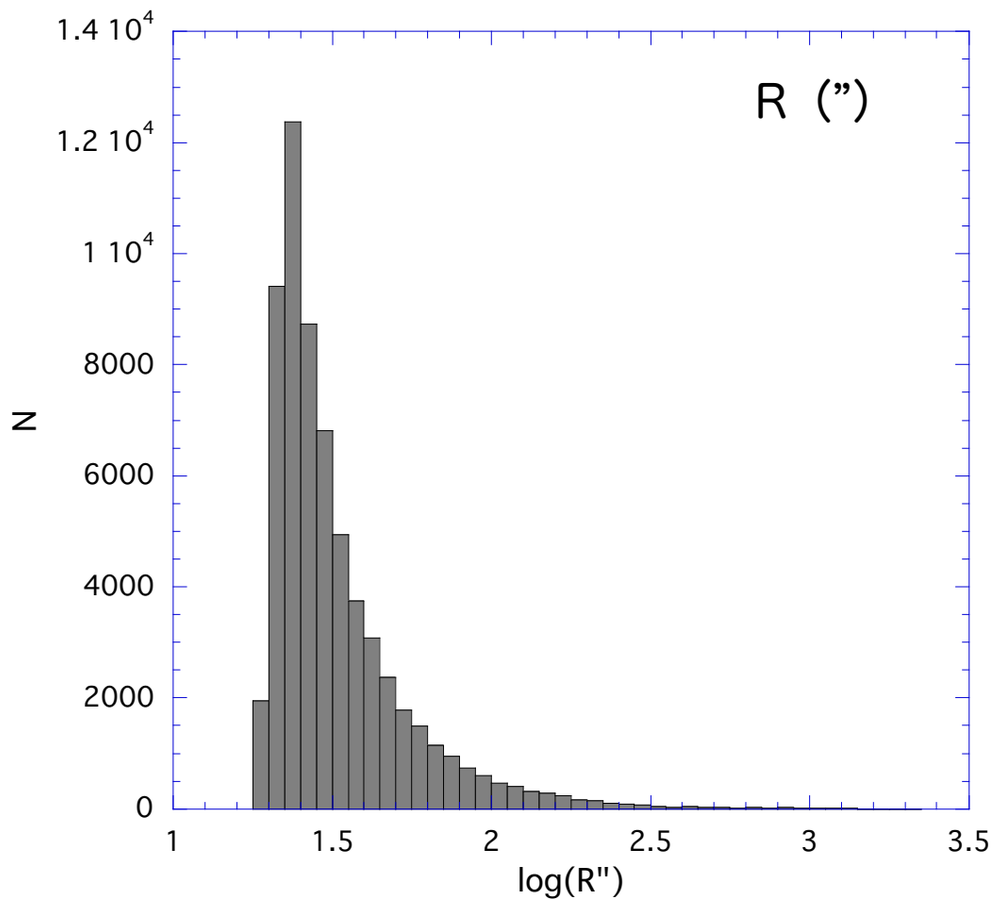
04 Molecular Cloud Identification

‹ Cloud candidates ›

- select separate velocity
- final identified structures : 93799
- Physical parameters of Trunks

dV = 1.0 - 18.3 km/s, R(") = 19.8 - 2190" , $N(H_2)$ = 3.8×10^{22} - 3.4×10^{27} cm^{-2}



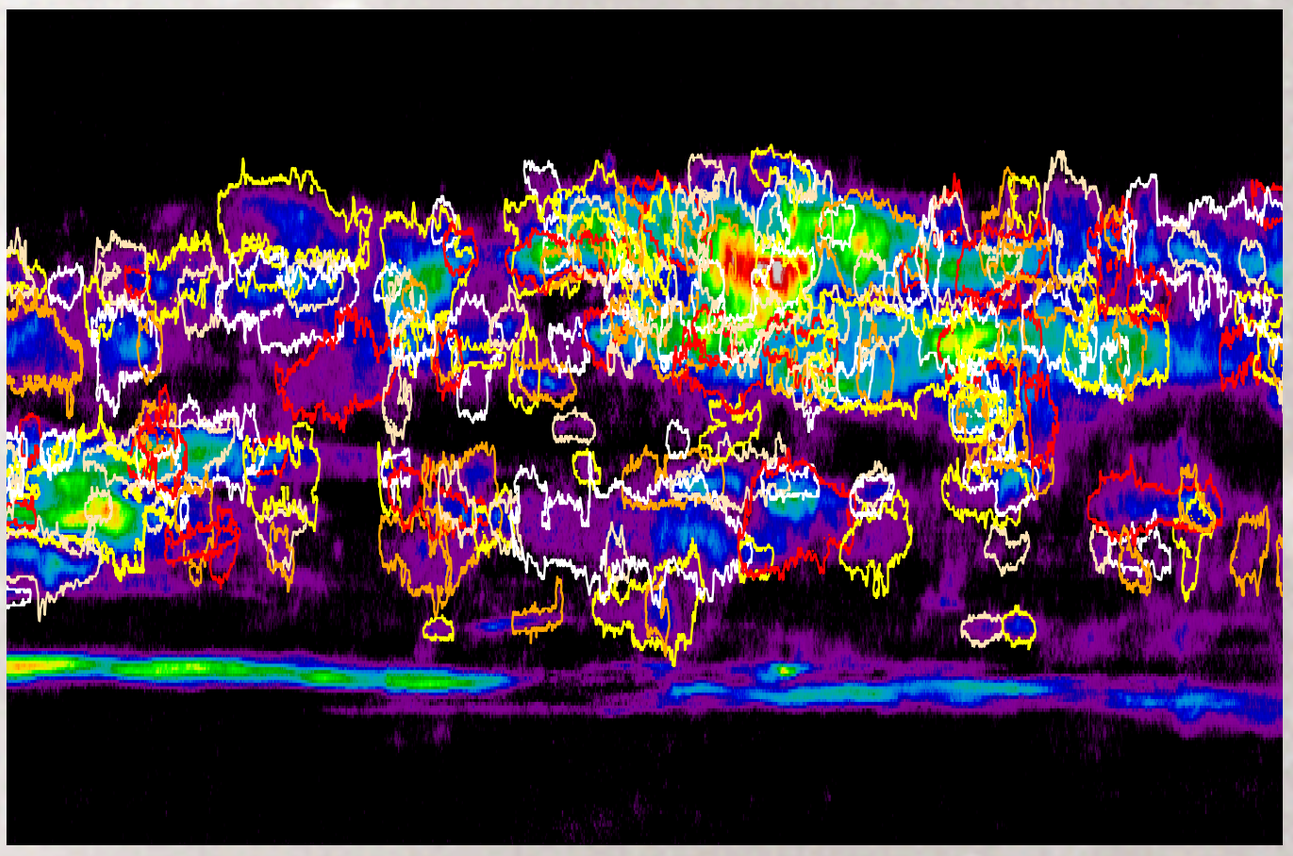


Molecular Cloud Identification

- final identified structures : 93799
- Physical parameters of Trunks

  dV = 1.0 - 18.3 km/s, R(") = 19.8 - 2190" , $N(H_2)$ = 3.8×10^{22} - 3.4×10^{27} cm^{-2}

‹ Example of Identified Structures ›

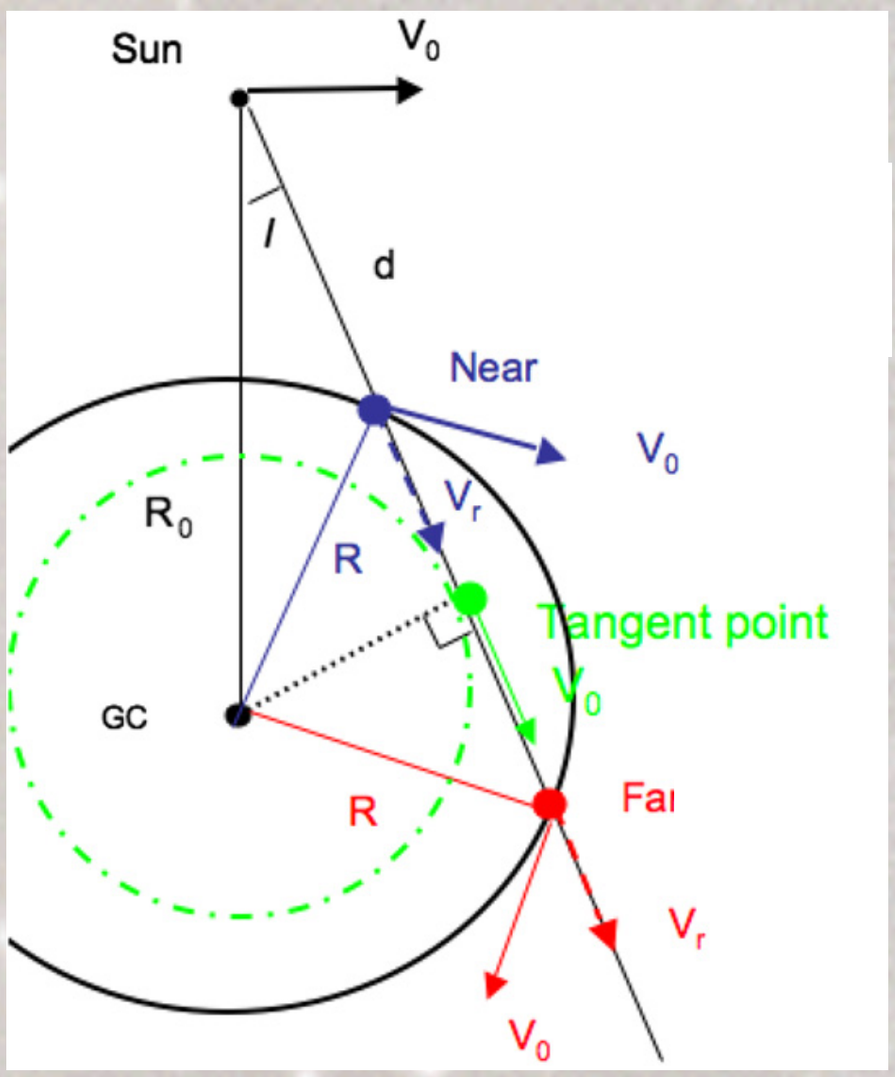


05 Distance of Molecular Structures

‹ Decision of Distance ›

- Using kinetic distance estimated using the LSR velocity
- Near / Far distance problem

Check - The different of parameters between the distant clouds and the local clouds

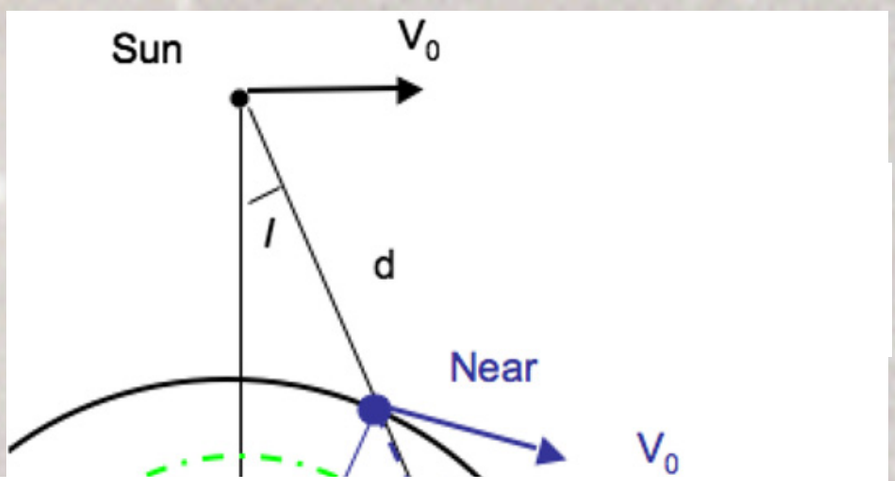


05 Distance of Molecular Structures

‹ Decision of Distance ›

- Using kinetic distance estimated using the LSR velocity
- Near / Far distance problem

Check - The different of parameters between
the distant clouds and the local clouds



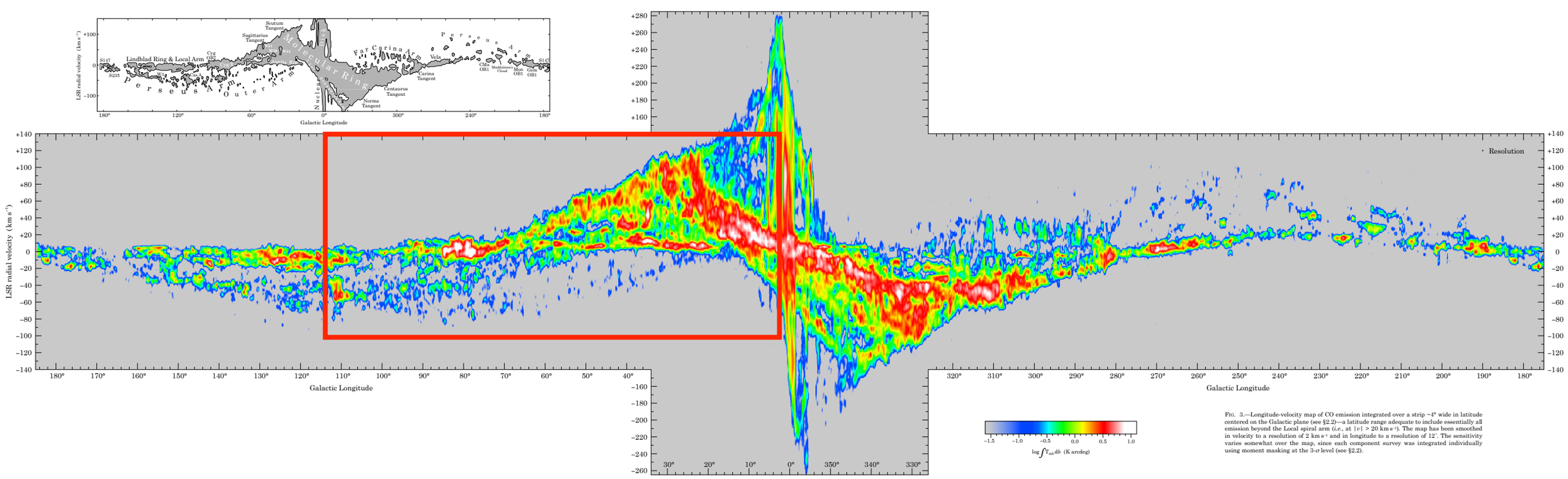
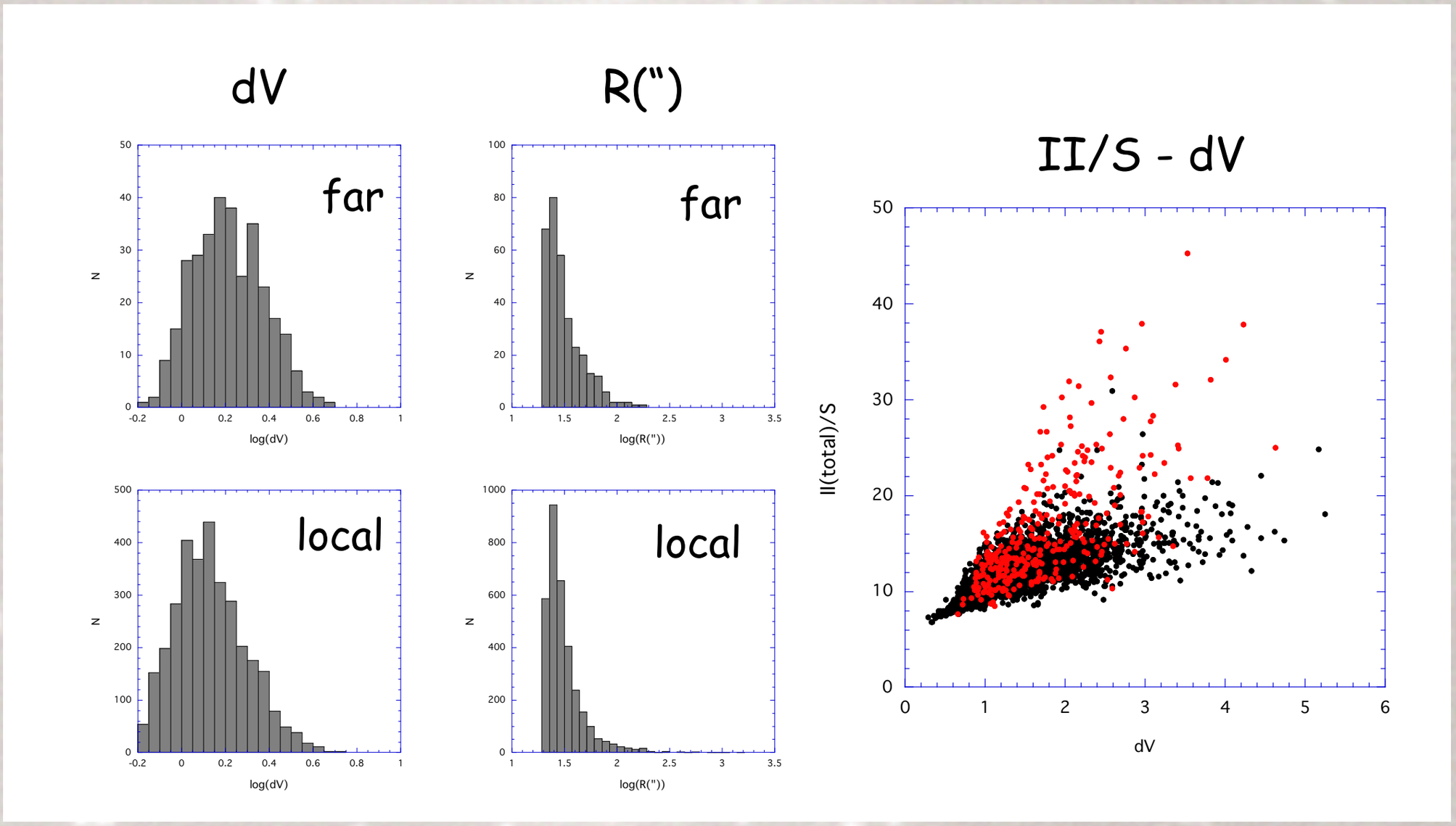


FIG. 3.—Longitude-velocity map of CO emission integrated over a strip ~4° wide in latitude centered on the Galactic plane (see §2.2)—a latitude range adequate to include essentially all emission beyond the Local spiral arm (*i.e.*, at $|v| > 20$ km s^{-1}). The map has been smoothed in velocity to a resolution of 2 km s^{-1} and in longitude to a resolution of 12′. The sensitivity varies somewhat over the map, since each component survey was integrated individually using moment masking at the 3-σ level (see §2.2).

05 Distance of Molecular Structures

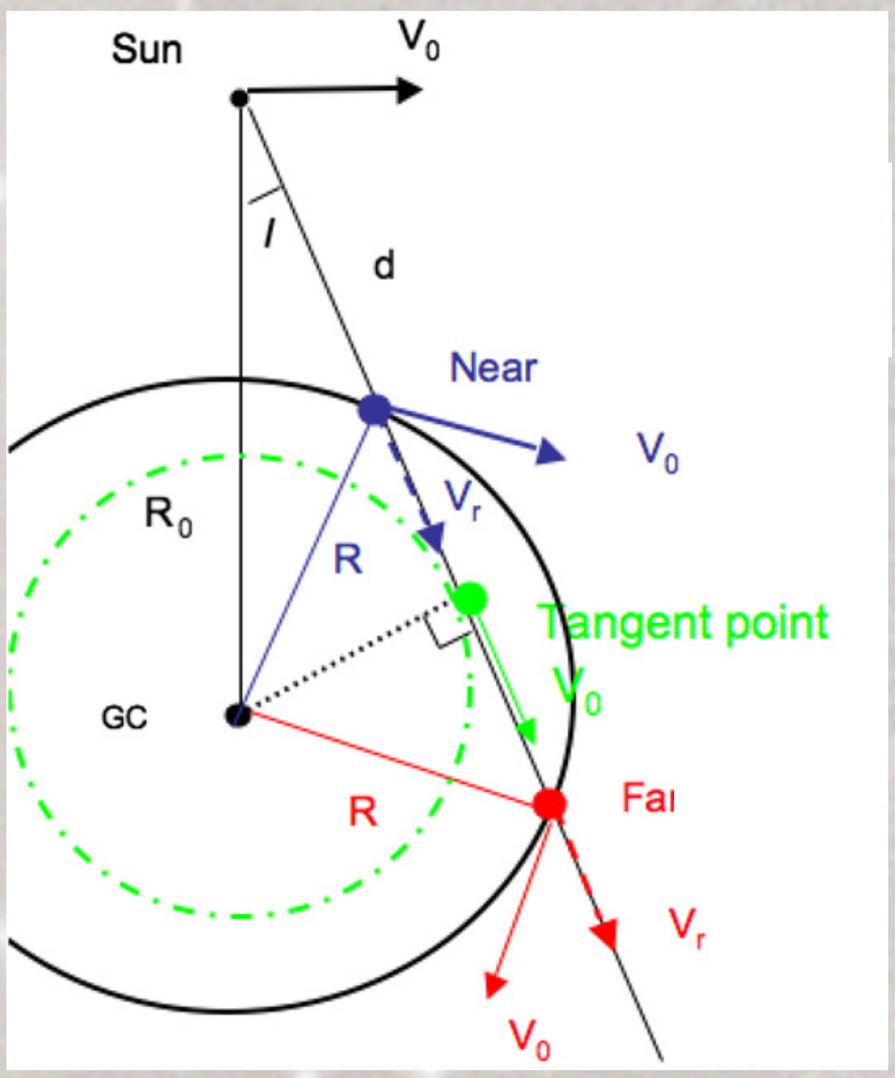
Check - The different of the parameters between the distant clouds and the local clouds



05 Distance of Molecular Structures

‹ Near/Far Check list›

- Average I.I. (Average Intensity)
- Virial ratio
- hight of the structures
- distribution of Arm in L-V diagram
- (Image : distribution of intensity)

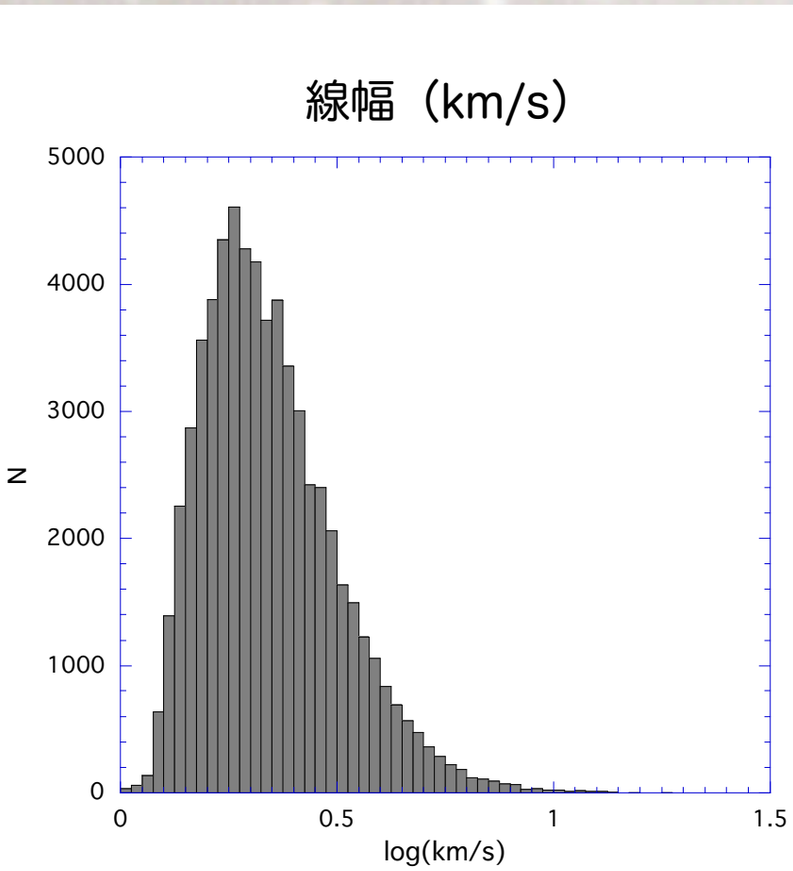


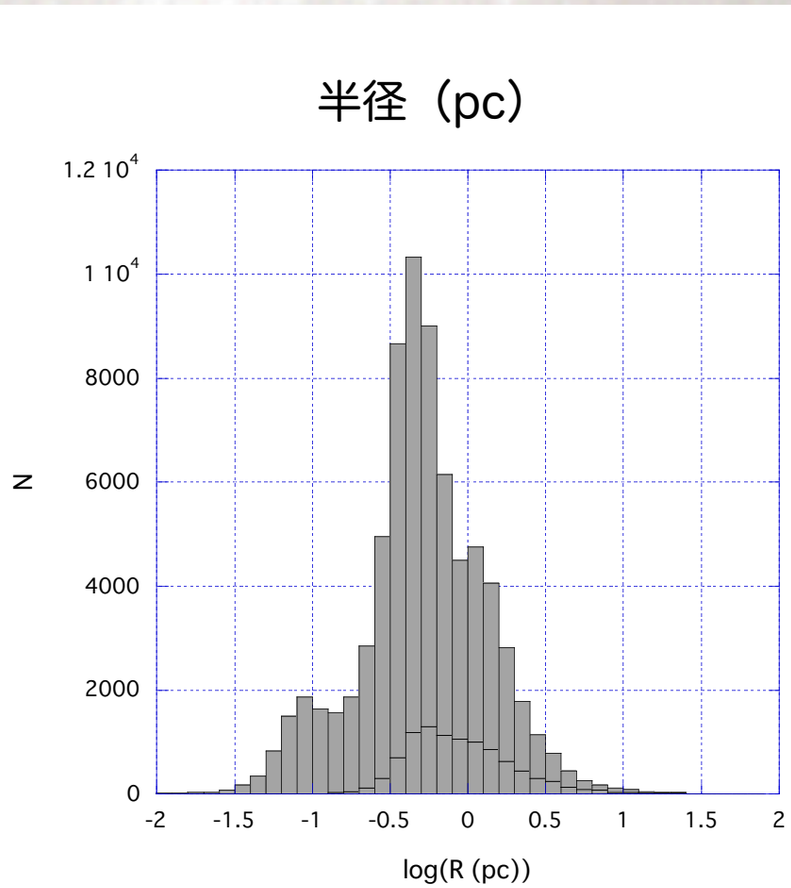
05 Physical Parameters of Molecular Structures

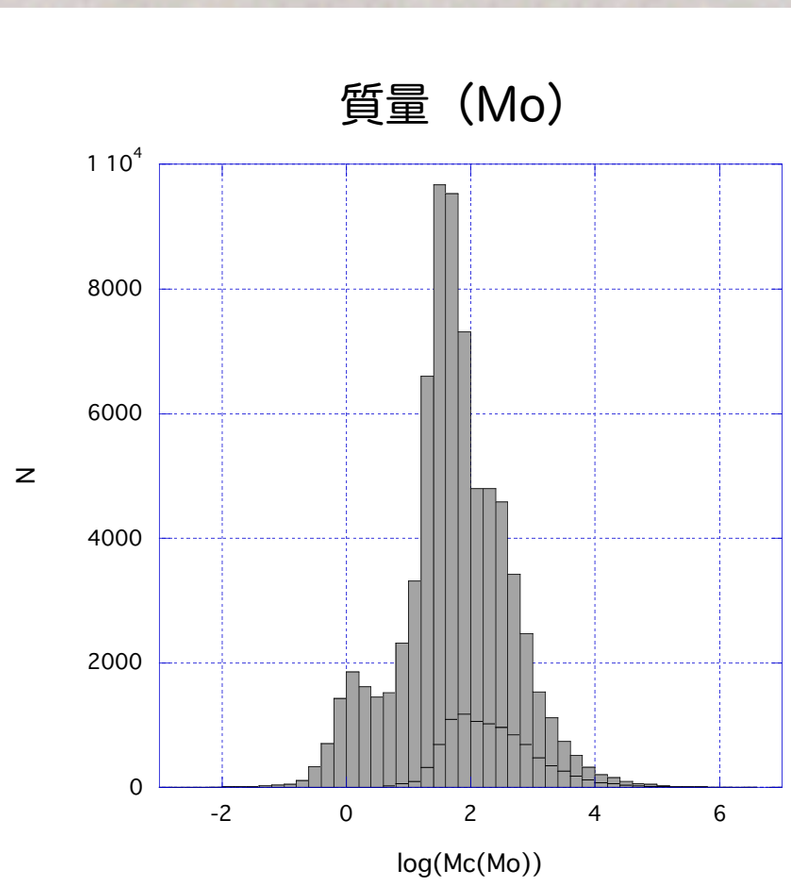
< Molecular Clouds >

- Physical parameters of Trunks

dV = 1.0 - 18.3 km/s, R(pc) = 0.03 - 72.4 pc, M(Mo) = 0.1 - 3.0×10^6 Mo



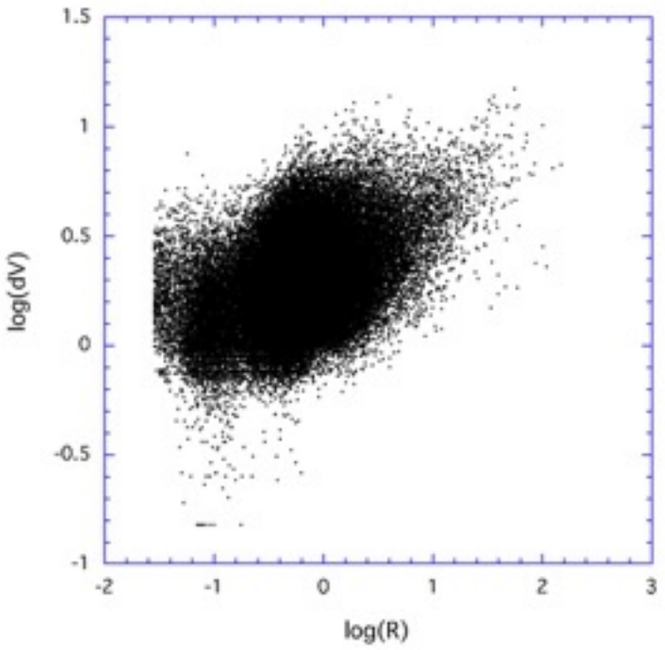




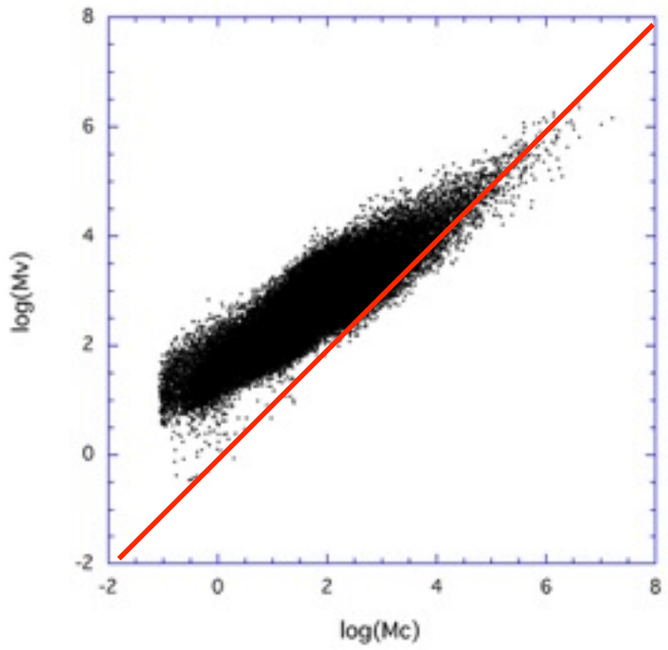
05 Physical Parameters of Molecular Structures

‹ Relation of Physical Prameters ›

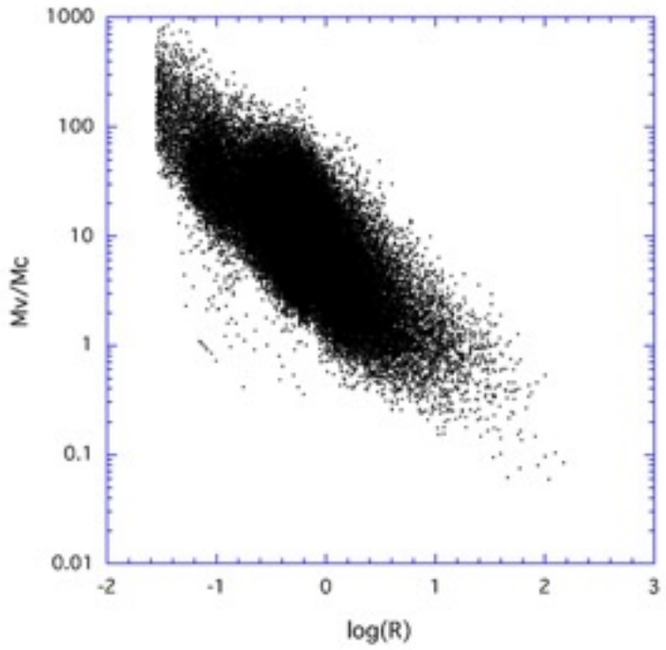
dV vs R



Mv vs Mc



Mv/Mc vs R

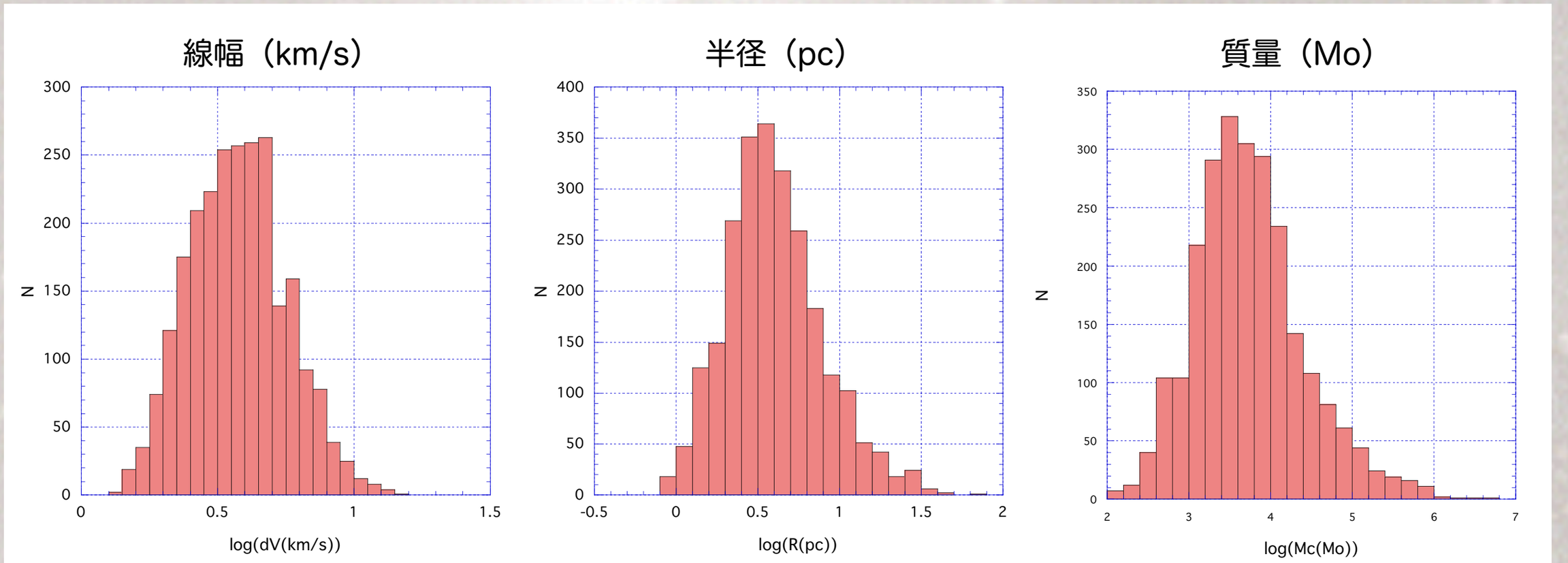


銀河系内における分子雲の分布

・比較的サイズが大質量の構造で調査（Mc > a few x 10^3 Mo）

・銀河系内域（Rg < 7 kpc)

—> 2450個の分子雲で調査



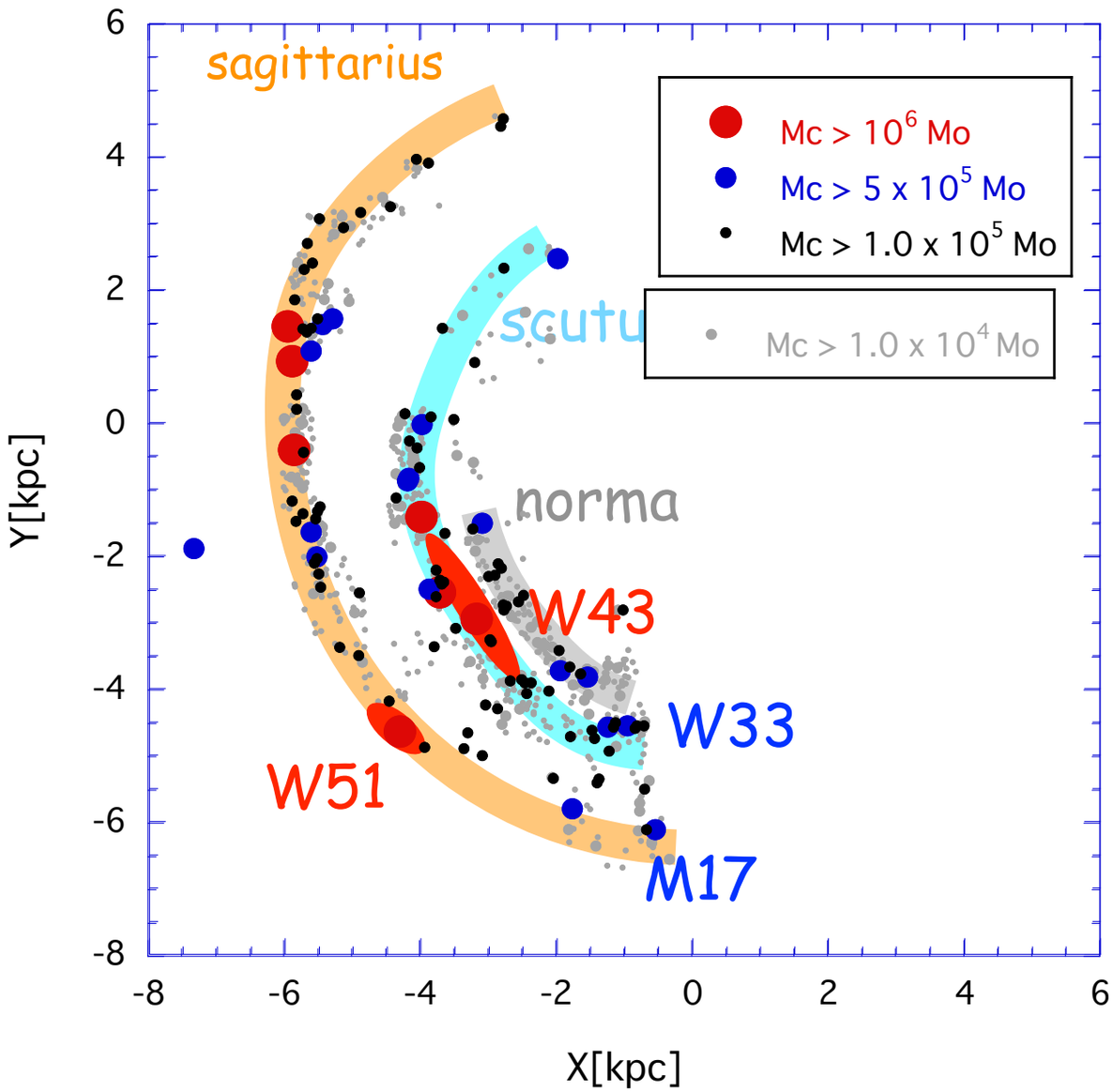
物理量：dV = 1.4 ~ 14.9 km/s, R = 0.8 ~ 72 pc, Mc = 1000 ~ 3.0 x 10^6 Mo

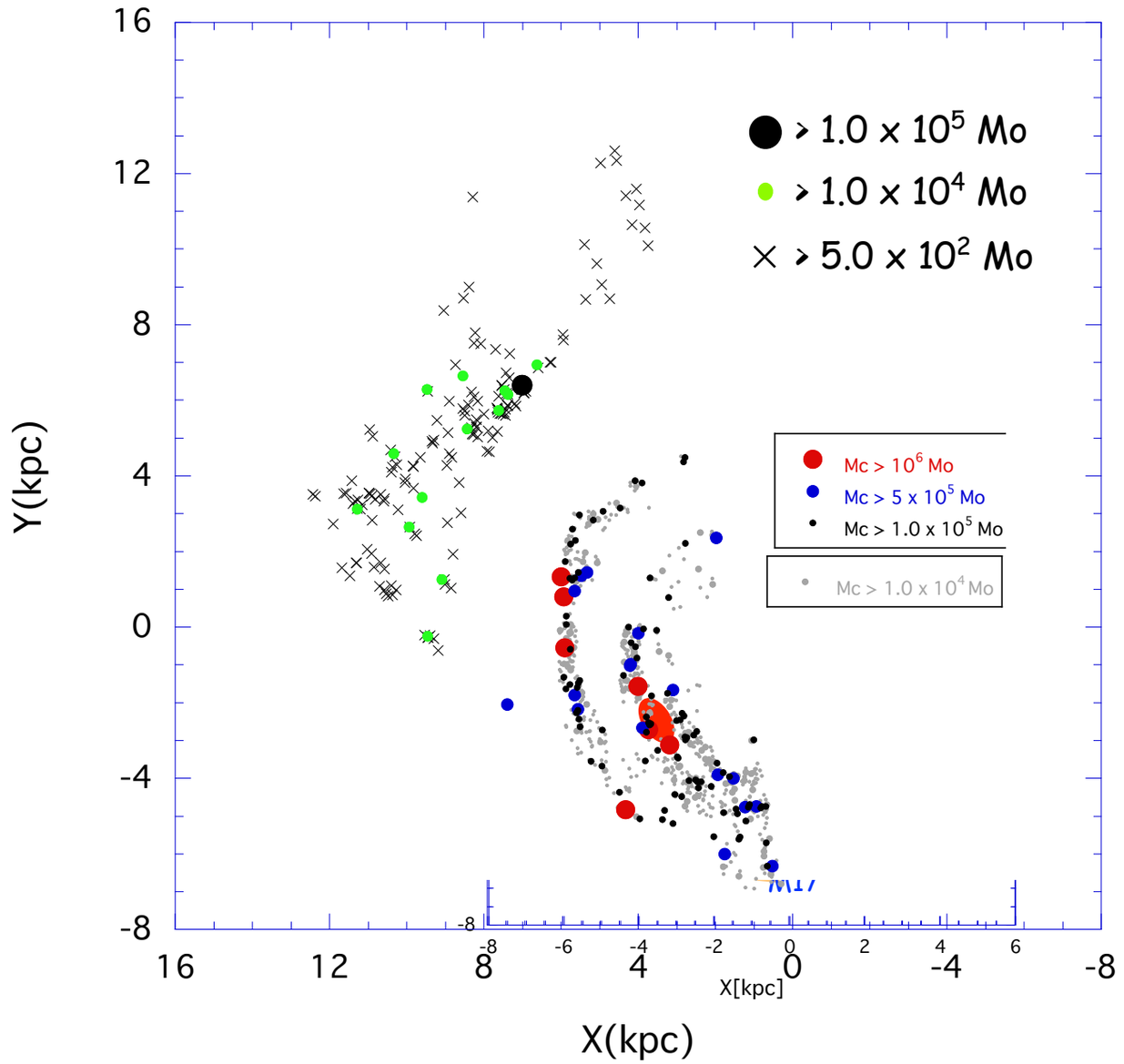
銀河系内における分子雲の分布

・銀河中心座標系に分子雲配置

・質量ごとに分布を調査　—>　GMCは渦状腕内に存在すると期待

腕間にどの程度の質量の分子雲が存在するか





< 結果 >

銀河系内の分子雲分布調査

- 10^3 Mo以上の分子雲（2450個）について調査
- 10^5 Mo以上の分子雲は概ね腕状に分布

  sagittarius, scutum, norma腕を確認
- 腕間領域には10^4 Mo以上の分子雲はほとんど存在しない

  たたし、sagittarius-scutum腕間の一部に10^4 Mo程度の分子雲が存在

渦状腕ごとの相違

- scutum腕とnorma腕では有意義な違いは見られない
- sagittarius腕は線幅、質量が小さい（？）