Environment Workshop

Sejong University

Gas dynamics and star formation in NGC 6822

to be submitted to MNRAS

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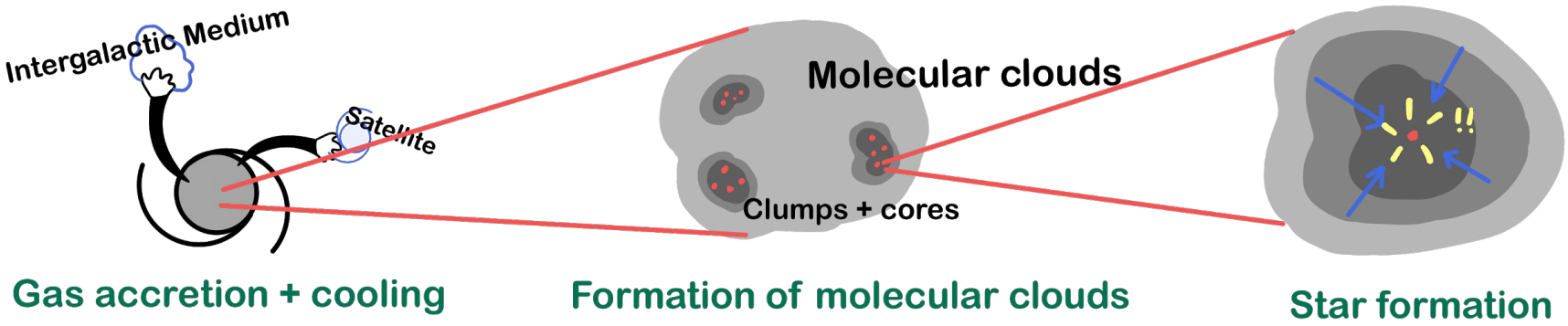
CONTENTS

INTRODUCTION

✓ **Star formation sequence** (Kennicutt & Evans 2012)

- Gas accretion from intergalactic medium/satellite object
- Gas cooling process
- Molecular clouds formation
- Fragmentation & accretion to clumps or cores
- Formation of star clusters or binary/single star

\+ Environmental issue



INTRODUCTION

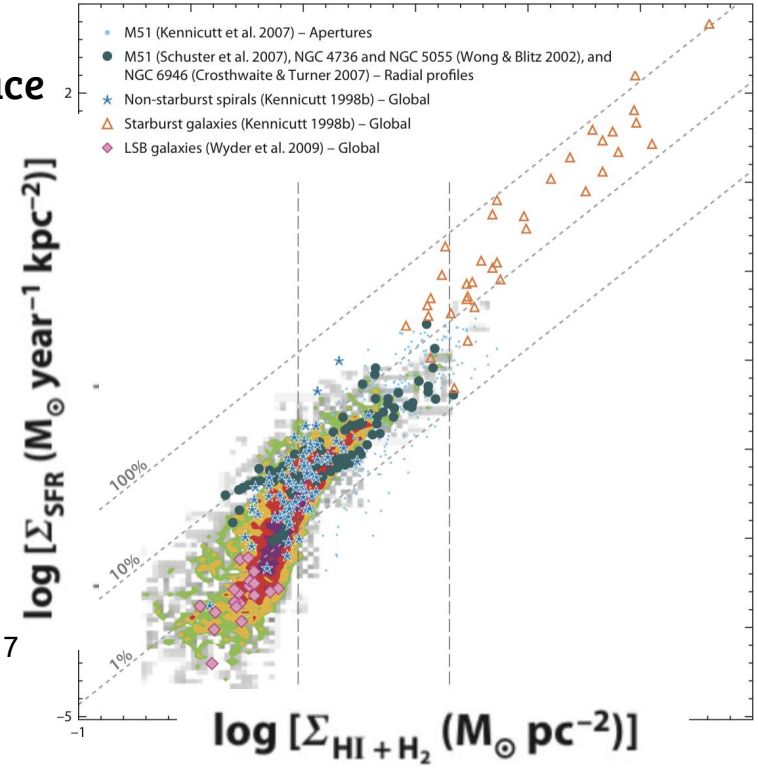
✓ **Kennicutt-Schmidt law (KS law)**

- **Gas surface density ↔ star formation rate (SFR) surface density**

$$\Sigma_{SFR} \sim \Sigma_{gas}^{N}$$

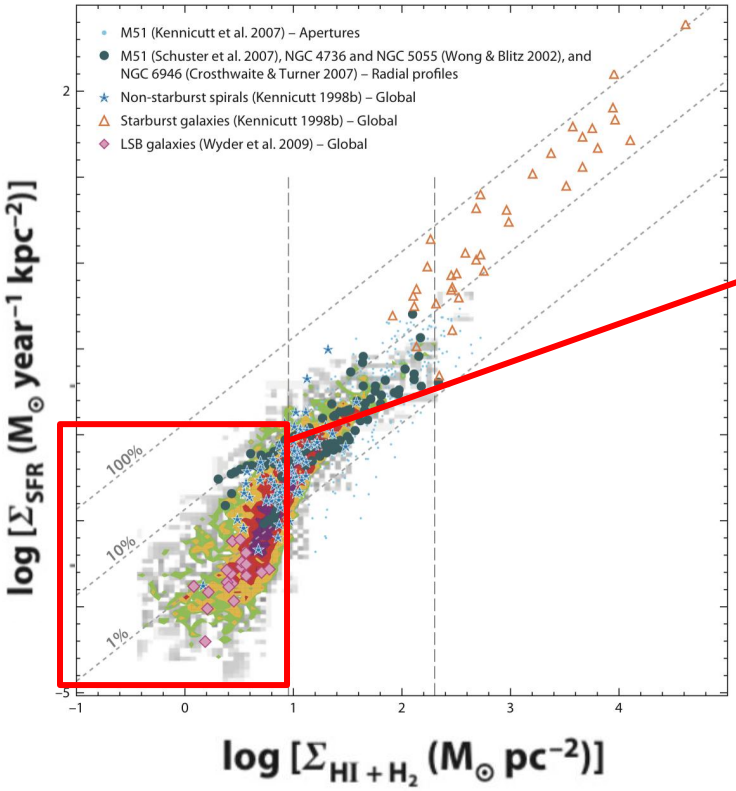
, N ~ 1.41 ± 0.07 (de los Reyes & Kennicutt 2019)

- **Global**
  : Kennicutt 1998b; Wyder et al. 2009
- **Disk-averaged**
  : Kennicutt 1998; Wyder et al. 2009; Filho et al. 2016; Roychowdhury et al. 2017
- **Sub-kpc scales**
  : Kennicutt et al. 2007; Bigiel et al. 2008, 2014; Leroy et al. 2008



Kennicutt & Evans 2012

INTRODUCTION



Kennicutt & Evan 2012

✓ **Resolved KS law**

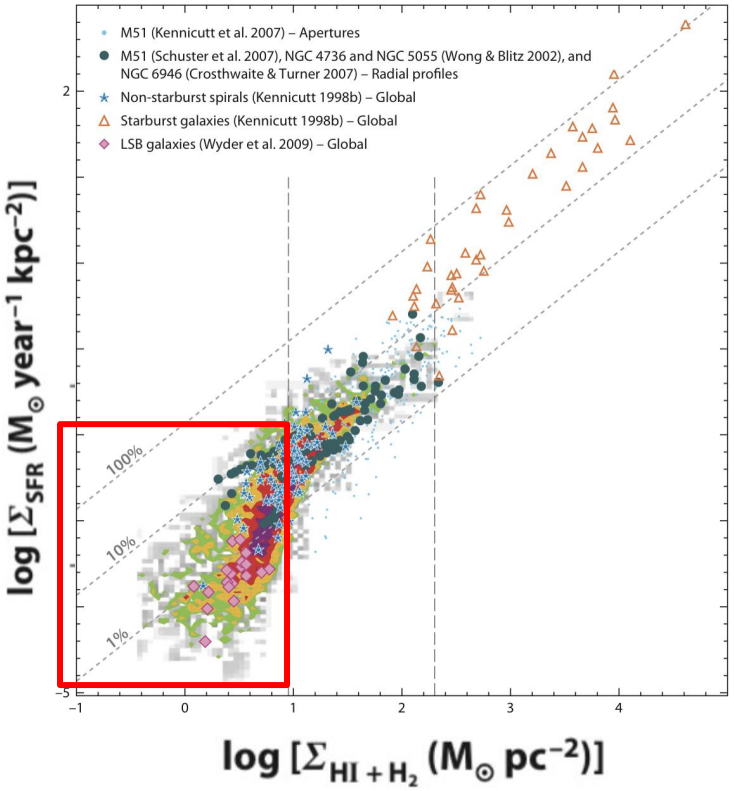
: Kennicutt et al. 2007; Bigiel et al. 2008; Bigiel et al. 2014

✓ **Resolved KS law at low surface density regime**

- **H I dominated system**
- **low-density turnover (truncation at ~ 9 $M_{\odot} pc^{-2}$)**
- **large scatter**

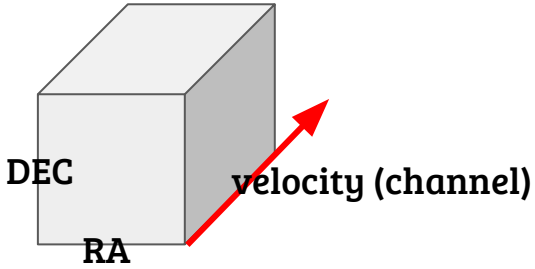
$\Rightarrow$ H I $\leftrightarrow$ SFR : no or little correlation

INTRODUCTION



Kennicutt & Evan 2012

✓ However, the gas is piled up along the LOS.



→**OUR AIM**

: to extend the KS law with "kinematically cold" H I gas which can be derived from

velocity profile decomposition !

DATA

✓ Science target: NGC 6822
- a nearby dwarf galaxy (d ~ 0.49 Mpc)

✓ H I data: Australia Telescope Compact Array (ATCA)
- beam: 42.4" x 12"
- pixel: 4" x 4"
- channel: 1.6 km/s
- de Blok & Walter (2000)

High resolution

⇒ hybrid SFR tracer: FUV + MIR

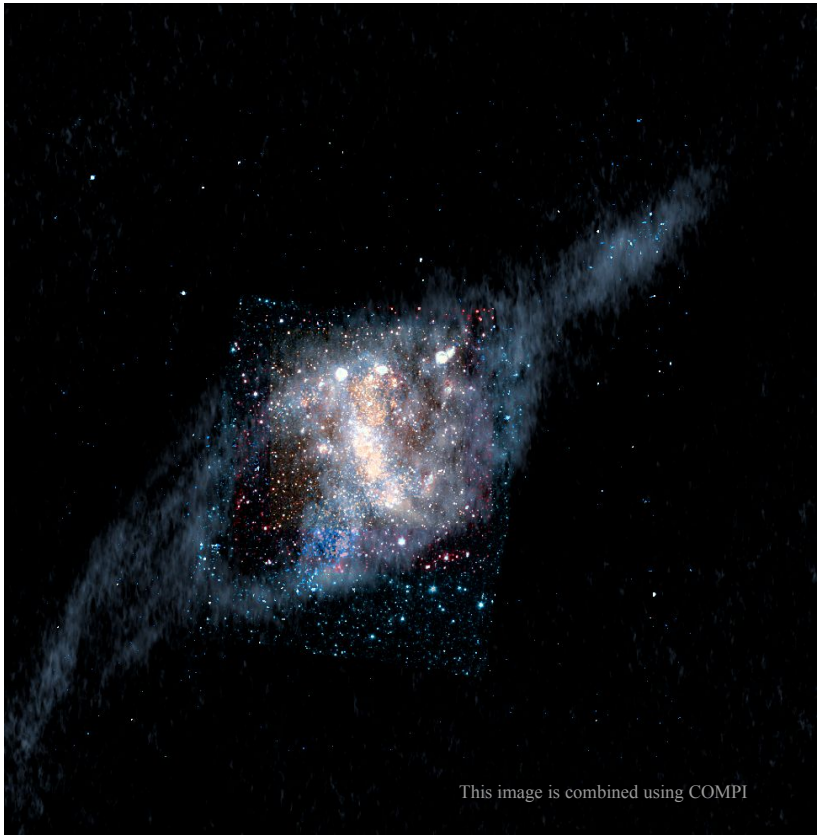
✓ FUV data: Galaxy Evolution Explorer (GALEX)

✓ MIR data: Wide-field Infrared Survey Explorer (WISE)

$$SFR(FUV,24)_{local} = 4.6 \times 10^{-44}[L(FUV)_{obs} + 6.0 \times L(24)_{obs}]$$

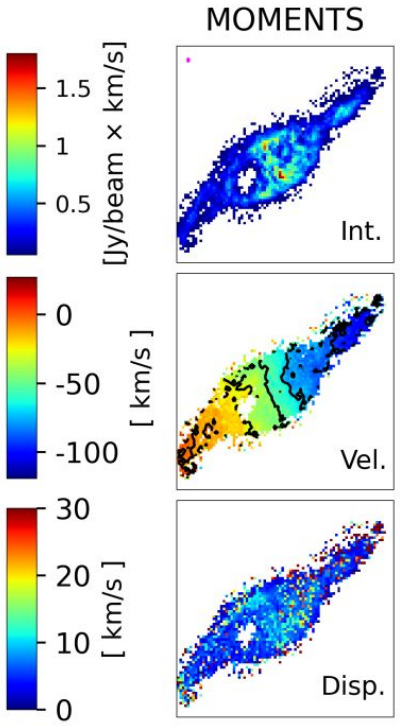
Calzetti et al. 2013

⇒ ~0.0117 $M_{\odot}$/yr



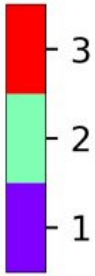
VELOCITY PROFILE DECOMPOSITION

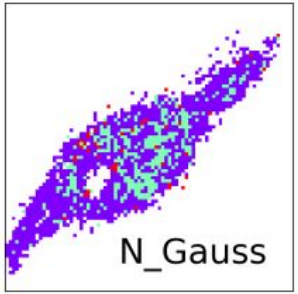
✓ **BAYGAUD (Bayesian Gaussian Decomposer; Oh et al. 2019)**

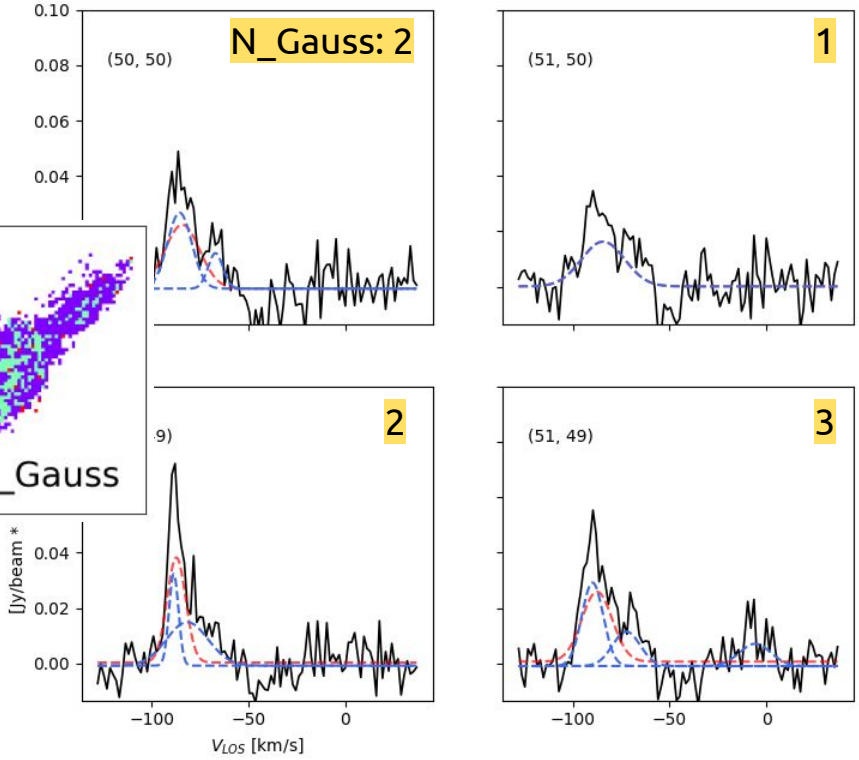


+ S/N > 4

BAYGAUD



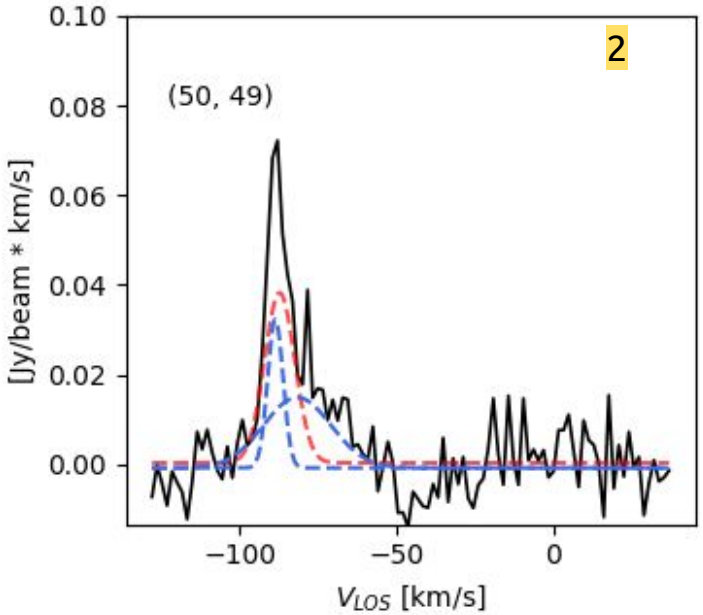




VELOCITY PROFILE DECOMPOSITION

✓ **BAYGAUD** - H I gas mass retrievition

e.g.,)

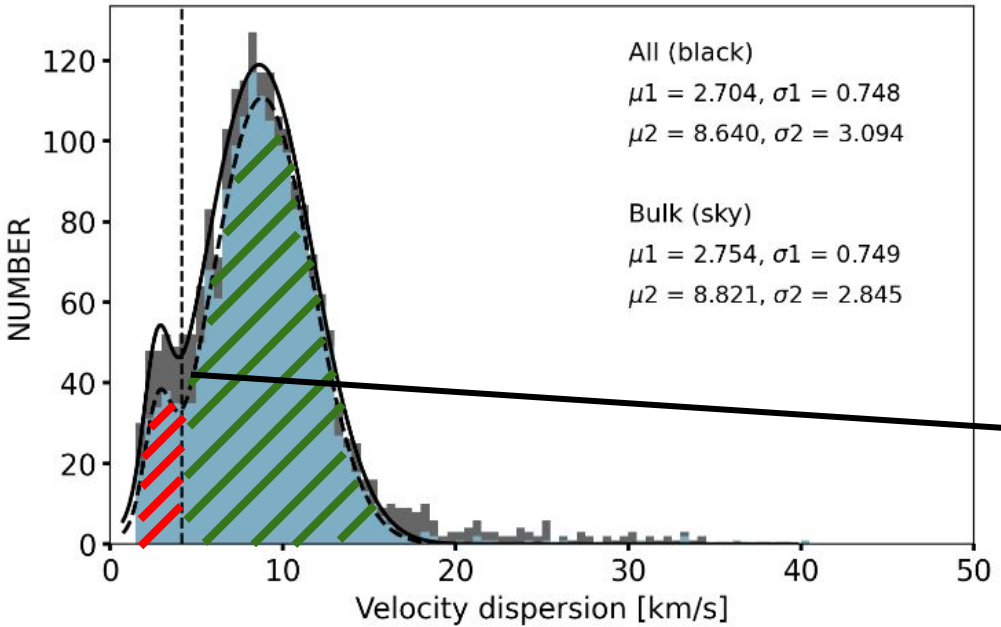


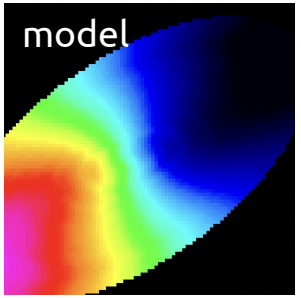
Method	H I mass [$M_\odot$]
moment analysis	1.007×10^8
Esingle Gaussian fitting	1.282×10^8
optimal Gaussian fitting	1.386×10^8

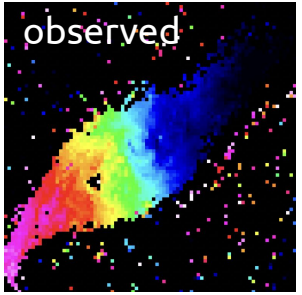
KINEMATIC CLASSIFICATION OF H I GAS

⇒ BULK, NON_BULK

✓ Velocity dispersion histogram of Bulk rotating gas components



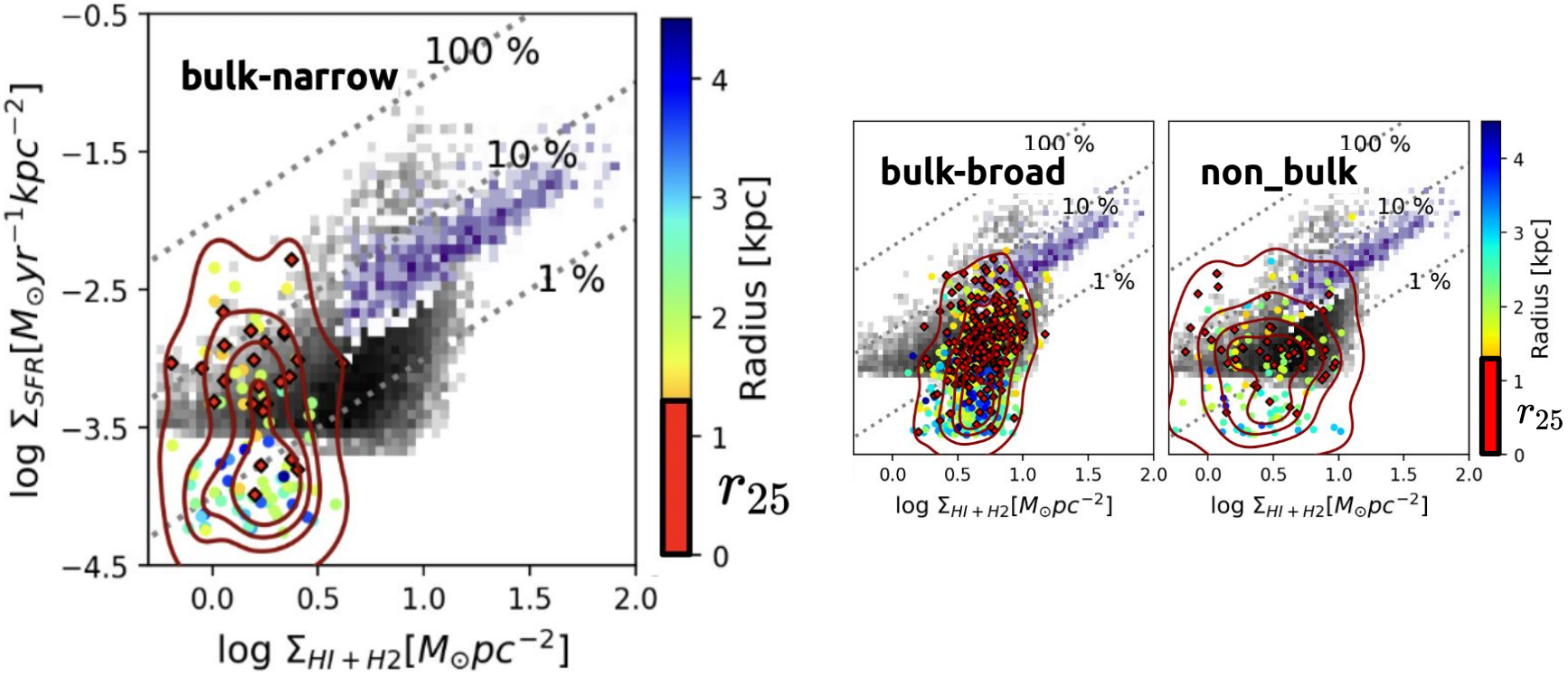




- Bimodality
- bulk-narrow / bulk-broad → **4.15 km/s**
- non_bulk

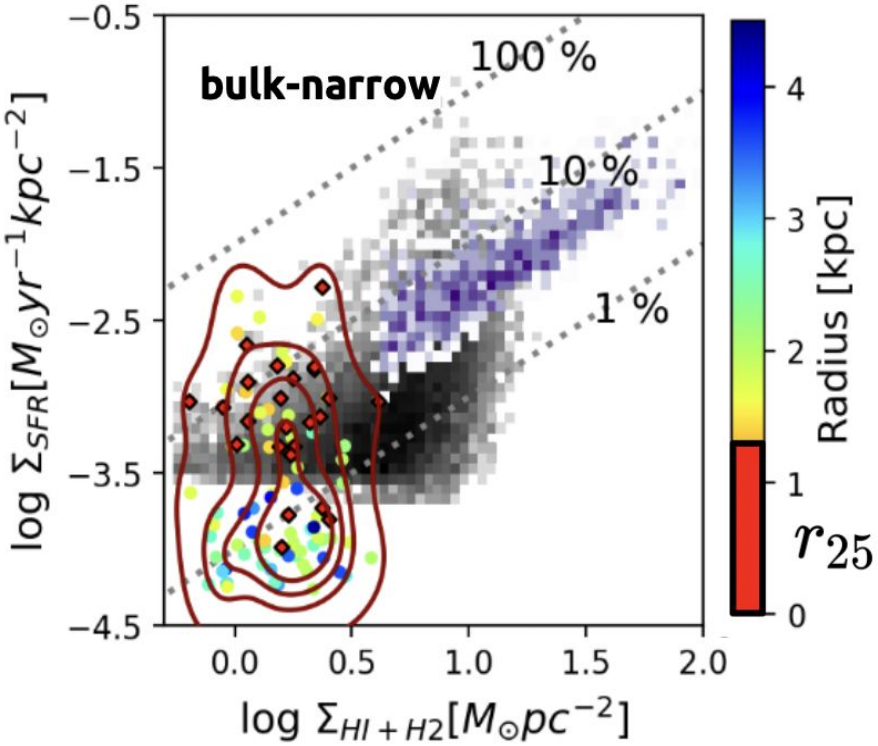
RESULT - KS law

✓ **The KS law for each type of gas components**



DISCUSSION

✓ The KS law of bulk-narrow component



✓ Bulk-narrow gas components within r25

: Bounded kinematically cold components

: Correlation with SFR surface density

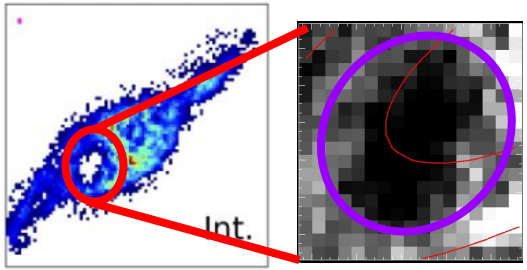
: Prospective molecular gas

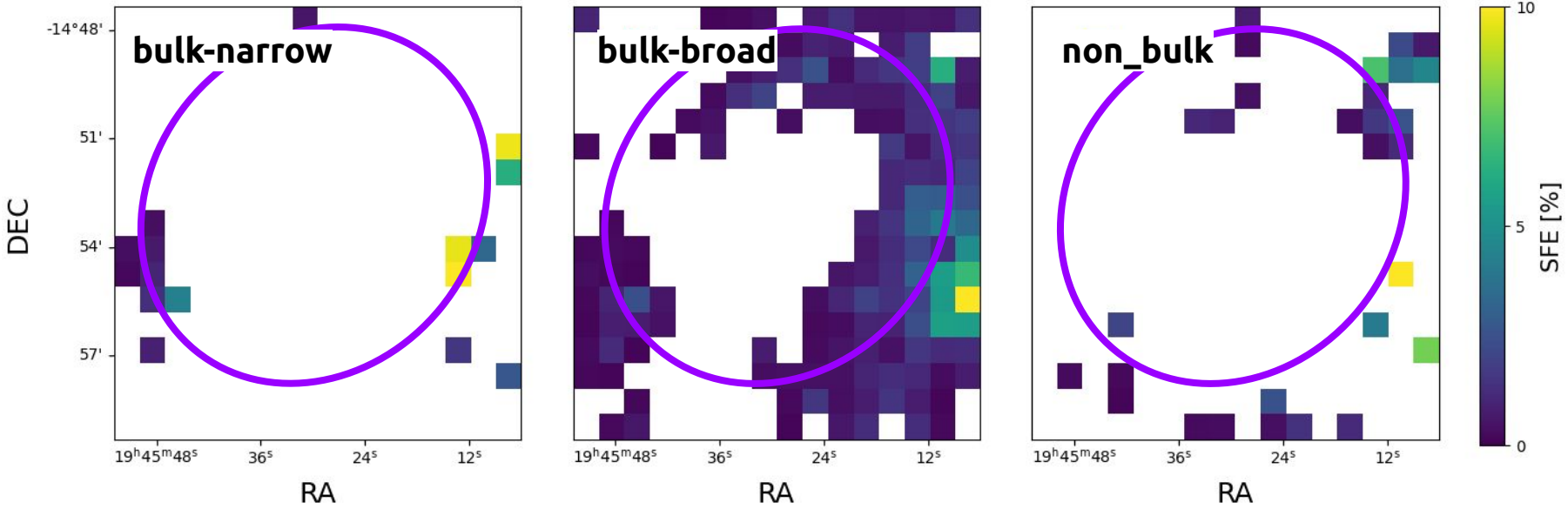
: Constant gas depletion time

DISCUSSION

✓ **The Supergiant H I Hole: R~250", ~0.5 kpc**

- Created by past star formation activity





SUMMARY

1. Resolved Kennicutt-Schmidt law at low surface density regime
2. A resolved isolated dwarf galaxy, NGC 6822
3. Velocity profile decomposition: BAYGAUD
4. Kinematic classification of H I gas: Bulk-narrow / Bulk-broad / Non_bulk
5. KS law for Bulk-narrow
6. SFE of the Supergiant H I hole