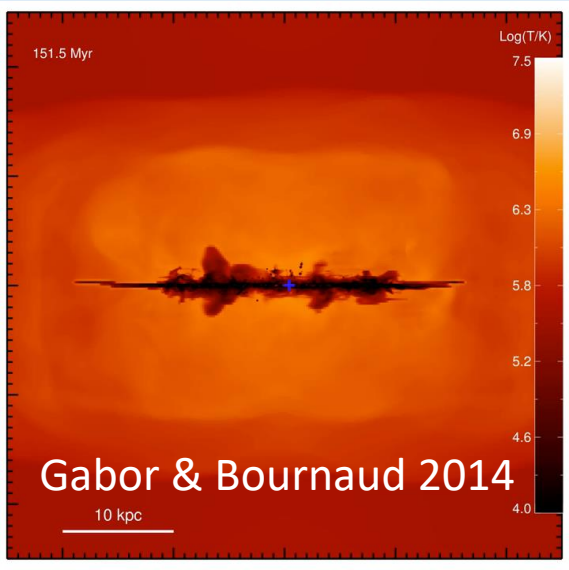
Intermediate Question: T-9

“Galactic Outflow”

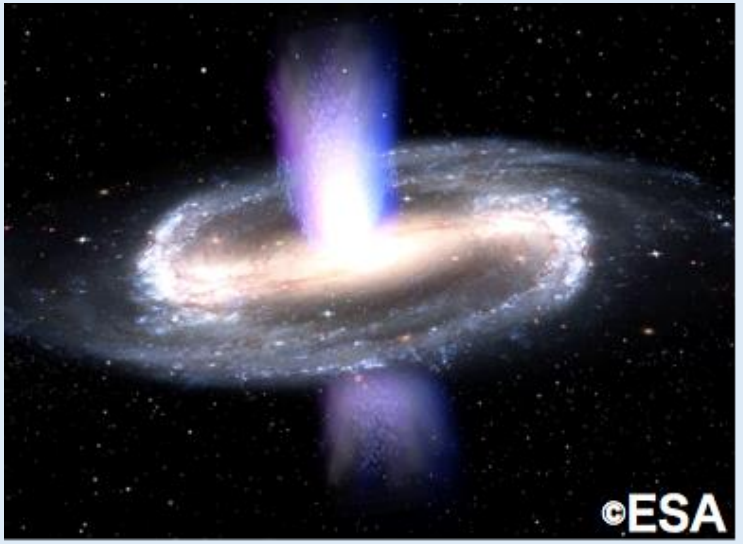
T-9, Galactic Outflow

Motivation

- Galactic outflow is a crucial mechanism in galaxy formation and evolution
  - Regulating the star formation activity
  - Enriching the chemical abundance of the intergalactic medium



Simulation of gas outflow



Gas flowing out of the galaxy

T-9, Galactic Outflow

Objectives

The ultimate goal is **to examine if the outflowing gas can escape a starburst galaxy, IRAS 08339+6517.**

1. Rotational velocity of the galaxy
2. Escape velocity
3. Outflow velocity of gas

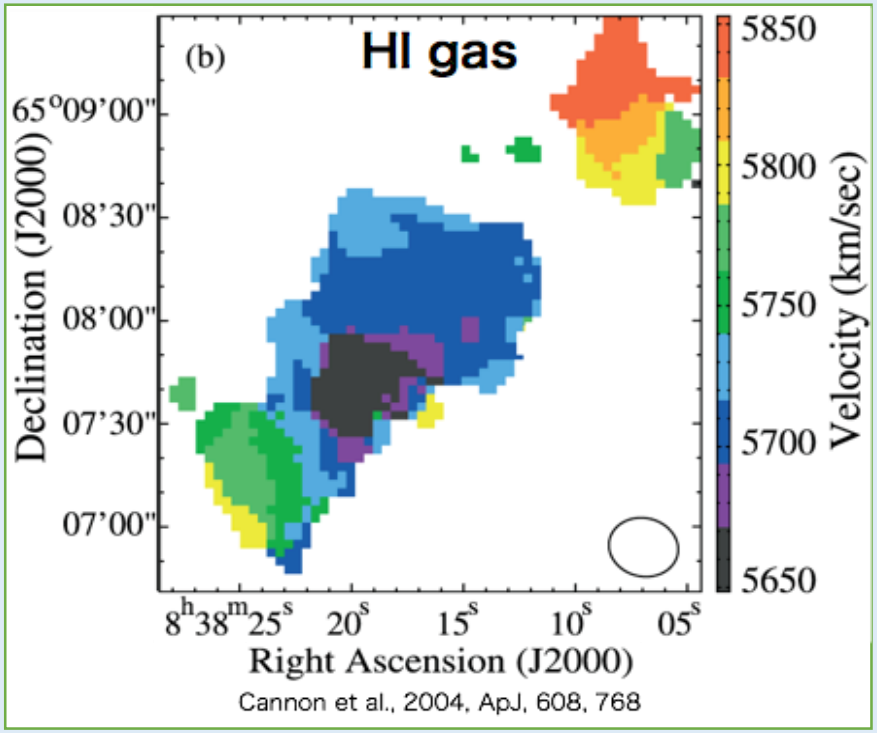
IRAS 08339+6517

Task 1 (5 marks)

- Determine the rotational velocity of IRAS 08339+6517
- **Given information:**
  - Distance of the galaxy
  - Inclination angle
  - The observed velocity of HI gas at a given radius
- **Students need to determine**
  - Systemic velocity (Hubble's law)

  → Rotational velocity

$$v_{sys} = H_0 d \longrightarrow v_{rad} = v_{sys} + v_{rot} \sin i$$



HI velocity map of IRAS 08339+6517

T-9, Galactic Outflow

Task 2 (9 marks)

- Evaluate the escape velocity

- **Given information:**
  - The rotational velocity obtained from Task 1
  - The radius that the HI gas is observed

- **Students need to evaluate**
  - Dynamical mass → escape velocity (via virial theorem)

$$M_{dyn}(<R) = \frac{v_{rot}^2 R}{G} \quad \Rightarrow \quad v_{esc} = \sqrt{\frac{2GM_{dyn}}{R}}$$

T-9, Galactic Outflow

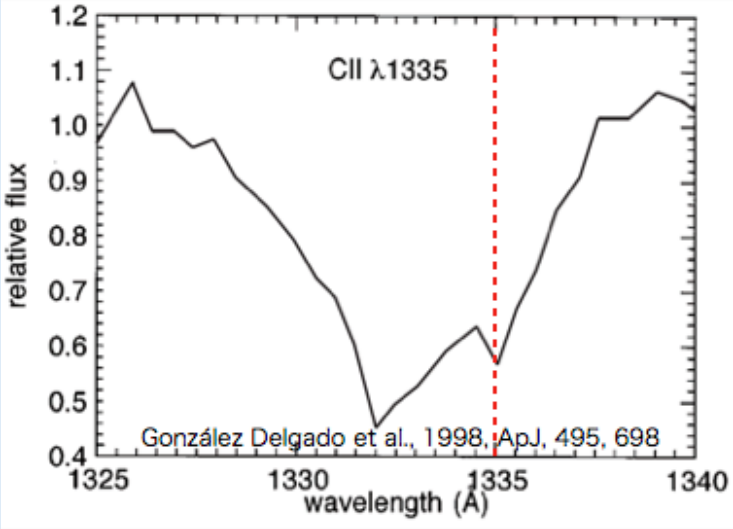
Task 3 (6 marks)

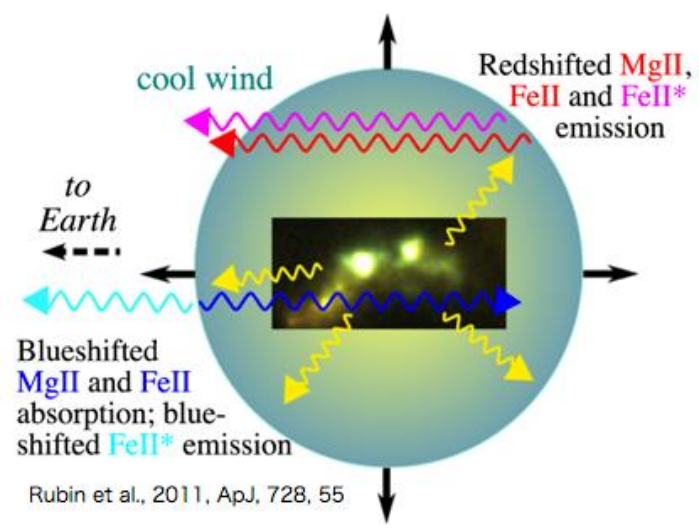
- Examine if the outflowing gas can escape the galaxy
- **Given information:**
  - Blueshifted absorption line of CII λ1335

velocity offset

$$\frac{\Delta v}{c} = \frac{\Delta \lambda}{\lambda}$$

$$\Delta v \quad \text{vs} \quad v_{esc}$$



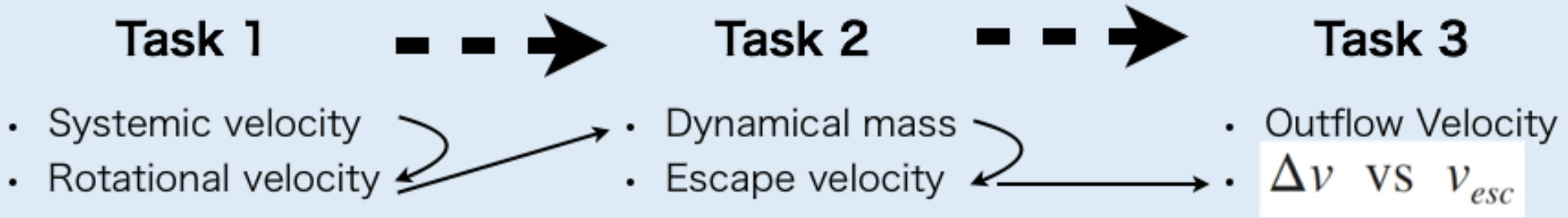


T-9, Galactic Outflow

Knowledge

- **Basic Astrophysics:**
  - Spectroscopic and atomic physics
- **Stellar Systems:**
  - Interstellar medium
  - Galaxies
- **Cosmology:**
  - Elementary cosmology
- **Instrumentation and Space Technologies:**
  - Multi-wavelength astronomy

Modularity


Task 1
Task 2
Task 3
Systemic velocity
Rotational velocity
Dynamical mass
Escape velocity
Outflow Velocity
Δv vs v_{esc}