Midterm Presentation: Characterizing the fractal dimension of molecular clouds

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Introduction

Rationale:

- Molecular clouds exhibit a filamentary, self-similar structure that governs their hierarchical organization. (Elmegreen & Falgarone, 1996)
- Recent observations reveal filaments break into smaller sub-filaments at high resolutions, reflecting the turbulent nature of interstellar gas and influencing star formation processes.

Goals:

- Characterize fractal properties of the Orion Molecular Cloud using topological methods.
- Investigate how fractal properties change with increasing column density.
- Explore the connection with mass-size relationship and star formation modes (isolated vs. clustered).

A Fractal Origin for the Mass Spectrum of Interstellar Clouds (Elmegreen & Falgarone, 1996)

Methods

Fractal dimension D provides a quantitative measure of border complexity.

Perimeter–Area Relation:

$$P \propto A^{D/2}$$

(e.g., *The Fractal Geometry of Nature*, *Mandelbrot 1982*)

Approach:

- Data: Herschel dust emission maps of *Orion* (*Lombardi et al.*, *2014*).
- Measure perimeter and area of each contour.
- The method allows one to pierce through the cloud and measure how border complexity evolves with increasing column density.

First Results and Outlook

- Fractal dimension increases with column density in both Orion A and B.
- Correlation observed with the **mass–size** relation.
- Collapse tracked by fractal dimension.

Work in Progress:

- Testing the robustness of the method.
- Exploring links to star formation modes (isolated vs. clustered).
- Comparison with current state-of-the-art models.

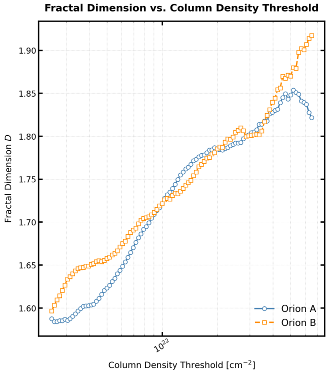

Figure: D for increasing column density.