Same Data, New Insights: Virial Analysis of Ammonia-Identified Clumps in GMCs

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The KEYSTONE (KFPA Examinations of Young STellar Object Natal Environments; Keown+, 2019) Survey observed **NH_3 (1,1) line emission** toward 11 high-mass star-forming regions. In their 2019 data release they used results of their single-component ammonia fitting in combination with dust data from the HOBYS (*Herschel* OB Young Stars) Survey to **identify and perform virial analysis on star-forming cores**.

We re-analyse the NH_3 data applying a **multiple-component fitting** model to more accurately measure the **gas kinematics**. Here we show early analysis of the Cygnus X North (CygX) region, shown in *Fig. 1*.

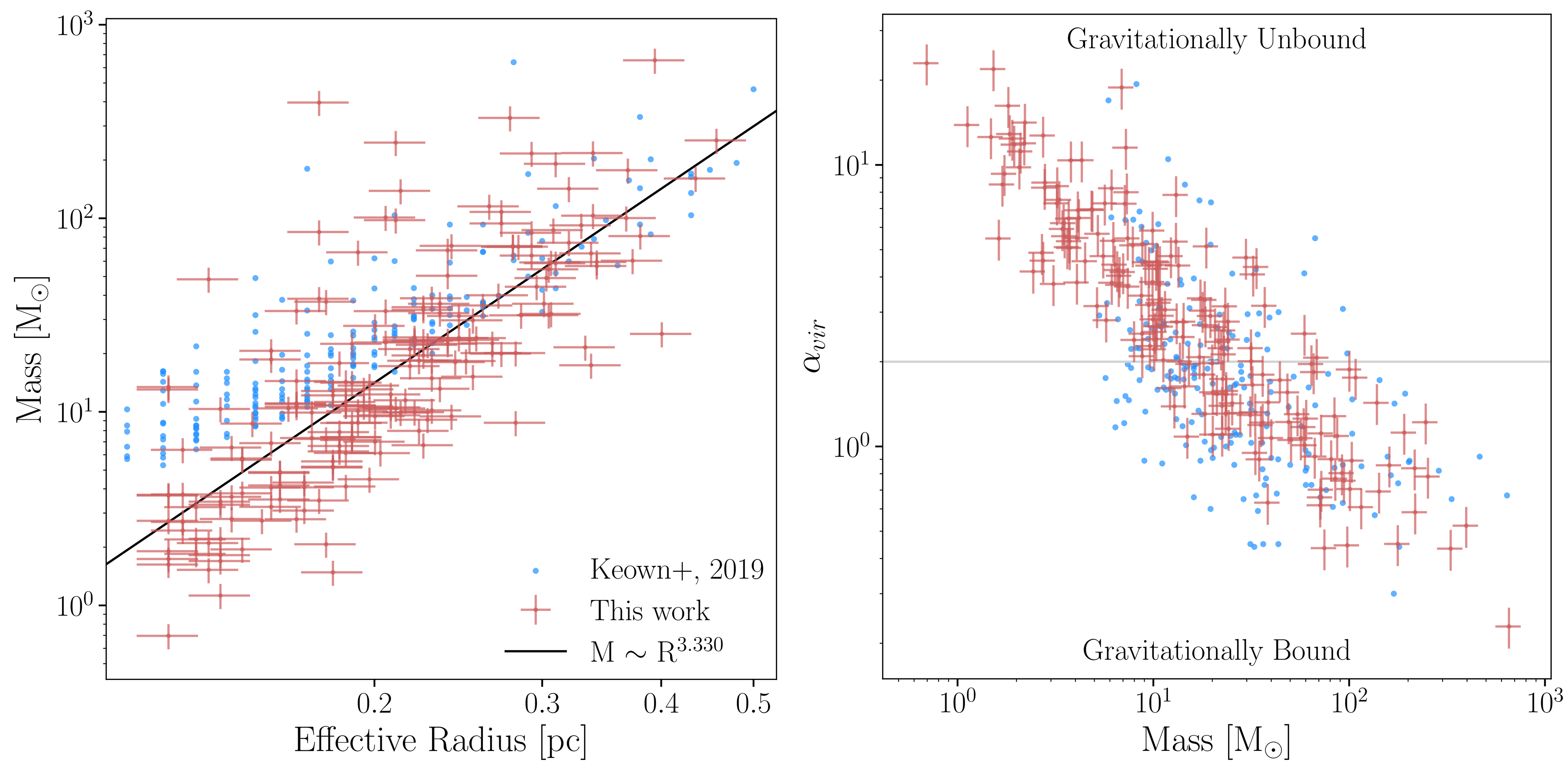

Fig. 2 Left: Mass-radius relation for the CygX clumps. The black line shows a power-law fit to our values. *Right:* Virial parameter vs. mass. The grey line denotes $\alpha_{vir}=2$ dividing the self-gravitating state of structures.

In *Fig. 2* we show early results of our work. Our clumps span the same radius range, but **are lower mass and less turbulent** than those previously found. Of the 191 clumps, 38% are gravitationally bound, marginally higher than the 34% of Keown+ (2019).

To fit multiple velocity components we use an **iterative process** that extends the MUFASA algorithm (Chen+, 2020). Our method which fits **up to three components** is called the Single Component Ammonia Reduction (SCAR+MUFASA). *Fig. 3* shows how the spectral line fits can **change dramatically between models**. When calculating mass, we assign H_2 column density to each component **proportional to its relative NH_3 moment zero**. This approach likely contributes to our lower mass values.

We found that **all KEYSTONE regions require multicomponent fitting** in an average of 16% of pixels, with regions such as M17 and W48 reaching multicomponent **proportions over 30%**. Future analysis will delve into external pressure on cores and statistical comparisons between regions.

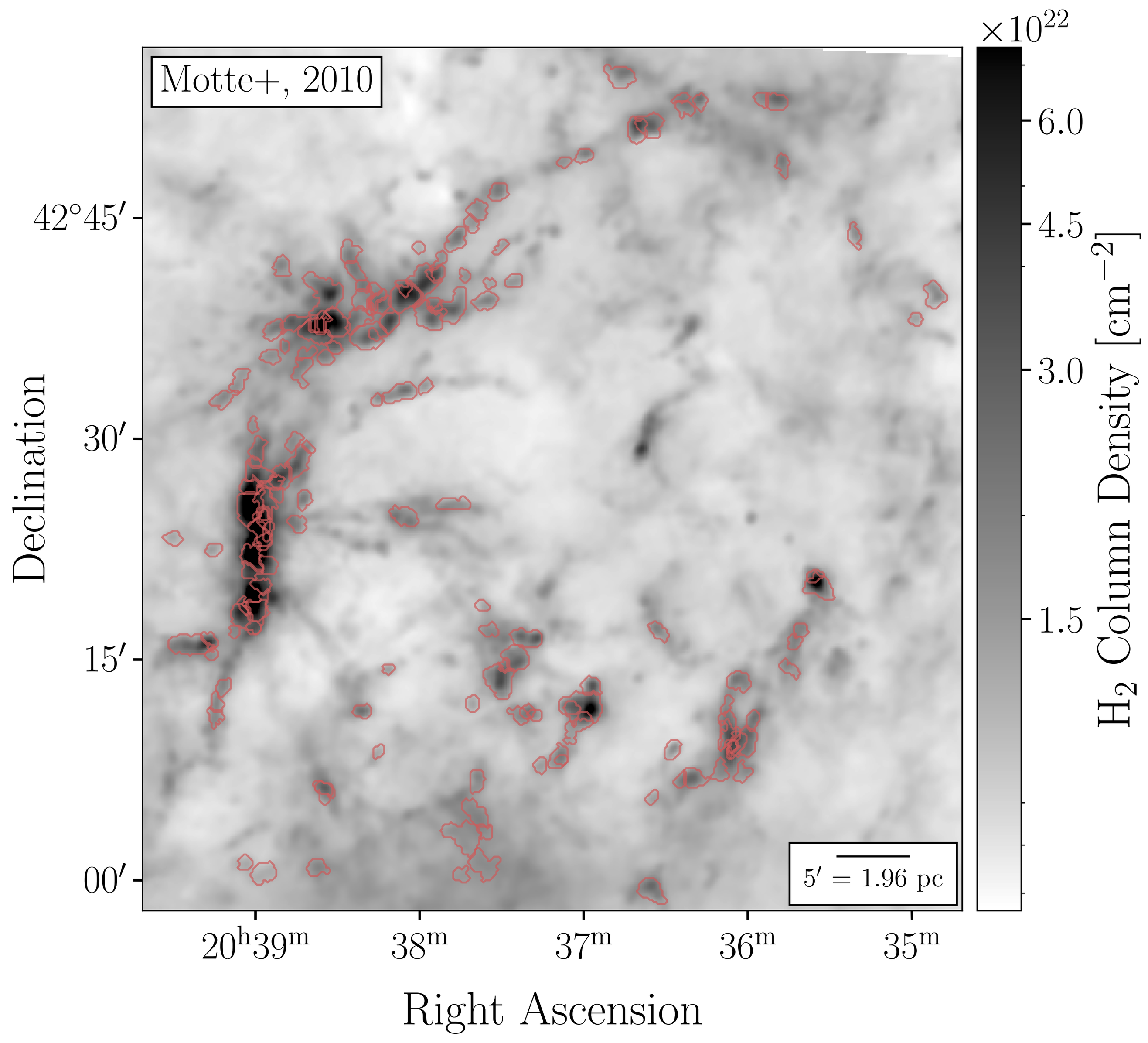

Fig. 1: H_2 column density map for CygX, as presented by Motte+, 2010. The coloured contours show outlines of the dense clumps identified from our NH_3 fitting results.

For core identification we use ACORNS (Henshaw+, 2019) which allows plane-of-sky pixels to be associated with multiple line-of-sight structures. The resulting clusters represent structures which are **kinematically and/or spatially distinct**.

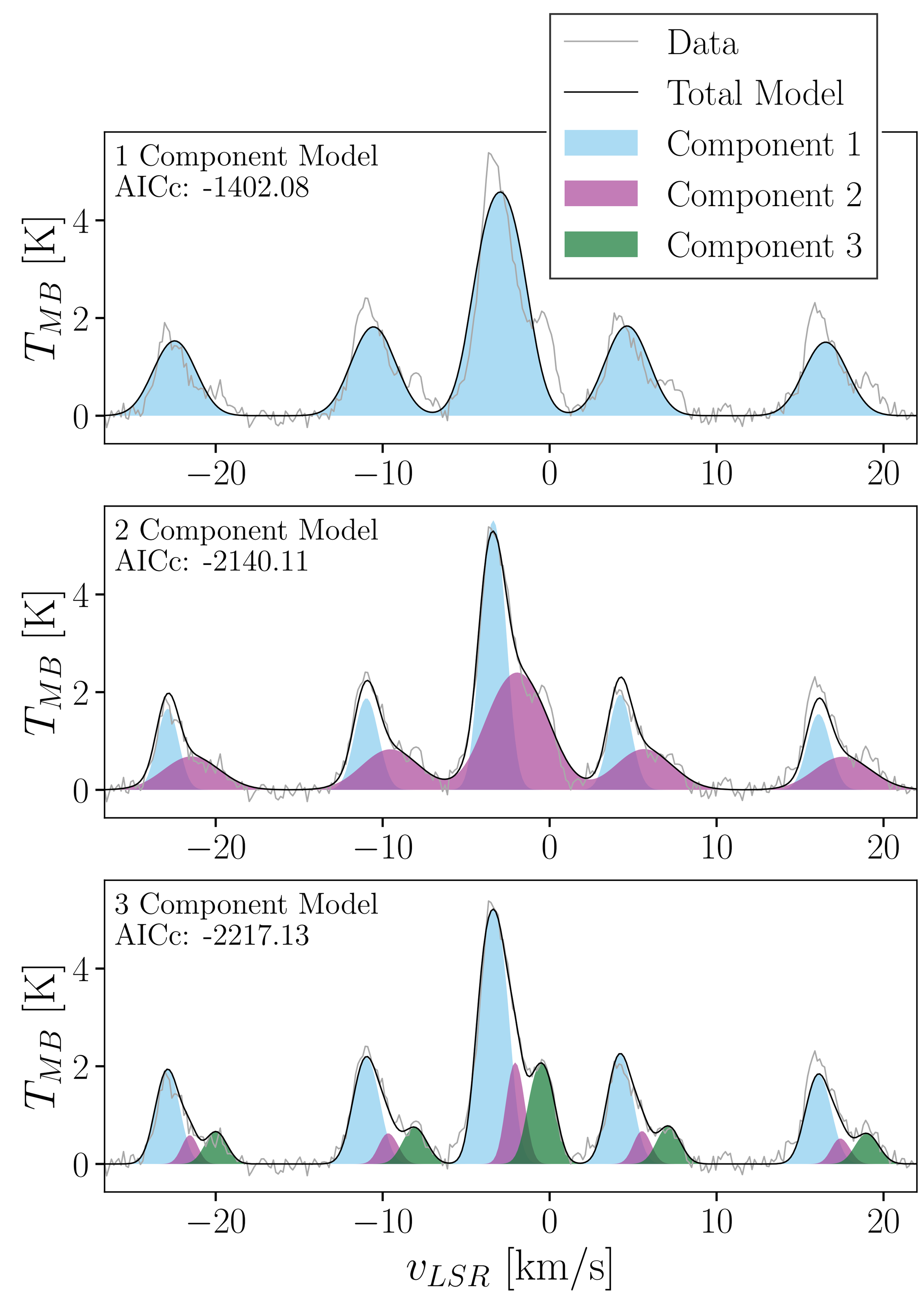

Fig. 3: Spectrum of one CygX pixel comparing each of our models. Lower AICc values are indicate a statistically better fit.

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References: Chen, et al. 2020, ApJ, 891, 84; Henshaw, et al. 2019, MRNAS, 485, 2; Keown, et al. 2019, ApJ, 884, 4; Motte, et al. 2010, A&A, 518, 77