Probing the interstellar ice composition in the dense star forming cloud Chamaeleon I: first results of JWST programme CHEERIO

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INTRODUCTION

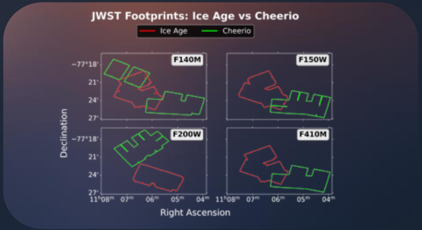
The study of dense molecular clouds is directly linked to our understanding of the initial conditions of protostar formation. Molecules and atoms freeze out onto dust grains, forming ice layers. This volatile material is delivered to later stages of star and planet formation.

Our aim is to characterize these reservoirs by measuring the C and O budgets through IR absorption spectroscopy.

The Chamaeleon I (ChaI) cloud has been characterized by imaging and spectroscopy using the NIRCam instrument of the JWST. The ERS programme Ice Age (IA) concentrated on the central dense core of ChaI [1] [2] [3]. Here we present data from the new CHEERIO (CH) programme studying dust properties across the wider cloud and deriving visual extinction from near-infrared imaging observations.

OBSERVING STRATEGY & SETUP

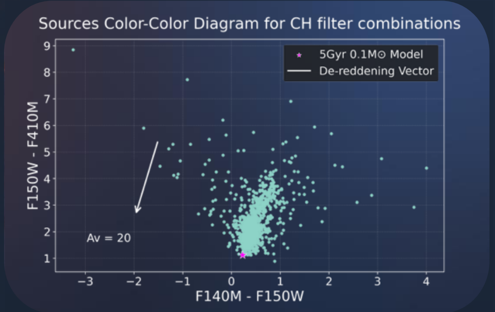
- Two observing programmes: Ice Age and CHEERIO
- Sky map footprints inverted between the two programs to ensure maximum spatial coverage
- JWST NIRCam filters used: **F140M, F150W, F182M, F200M, F410M**



METHODOLOGY FOR PHOTOMETRY DERIVATION ON SOURCE CATALOGUE

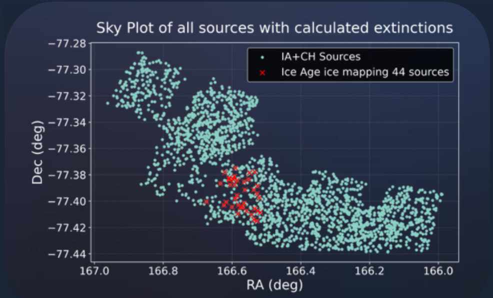
- Master catalogue of **source positions** (DAOStarFinder and manual selection)
- **Background subtraction** (photutils: Background2D & SExtractor)
- **Aperture Photometry** (photutils) on master catalogue target sources
- Source classification: stellar vs. non-stellar separation based on flux profile criteria (shape & FWHM)

RESULTS



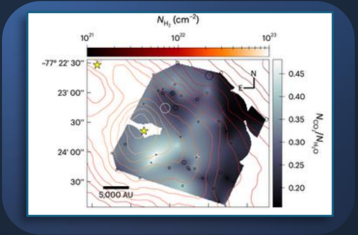
We estimate the visual extinction for each source by blending filters from both programmes across the full catalogue. For each band pair, we compute the expected colours of a representative model star[4] and compare them to the observations. The difference between the two along the de-reddening[5] vector provides an extinction estimate per source. The final Av is then calculated across all available filter combinations.

We obtain a final sample of ~2000 sources possessing at least one calculated Av value. Because extinction correlates with dust density, these measurements benchmark the dust distribution across the cloud. This will be compared with ice spectroscopy in the next step of the project. For context, 44 sources studied in a recent publication[1] based on the IA data alone are displayed on the right, highlighting the significantly expanded coverage of this new study combining IA and CH datasets.



CONCLUSIONS

- Photometry has been derived for ~6000 sources detected towards Chamaeleon I. An extinction map will be determined via colour-colour diagrams across multiple filter combinations to probe the dust distribution across the cloud.
- The extension of the CHEERIO programme's sky coverage compared to Ice Age is important in understanding how ices grow and evolve as a function of density, from the most diffuse to the densest parts of the cloud.
- The cloud density will be compared with the ice spectroscopy when deriving ice maps for the H_2O, CO_2, and CO abundances like those derived by Smith et al. (2025):



ACKNOWLEDGEMENTS & REFERENCES

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