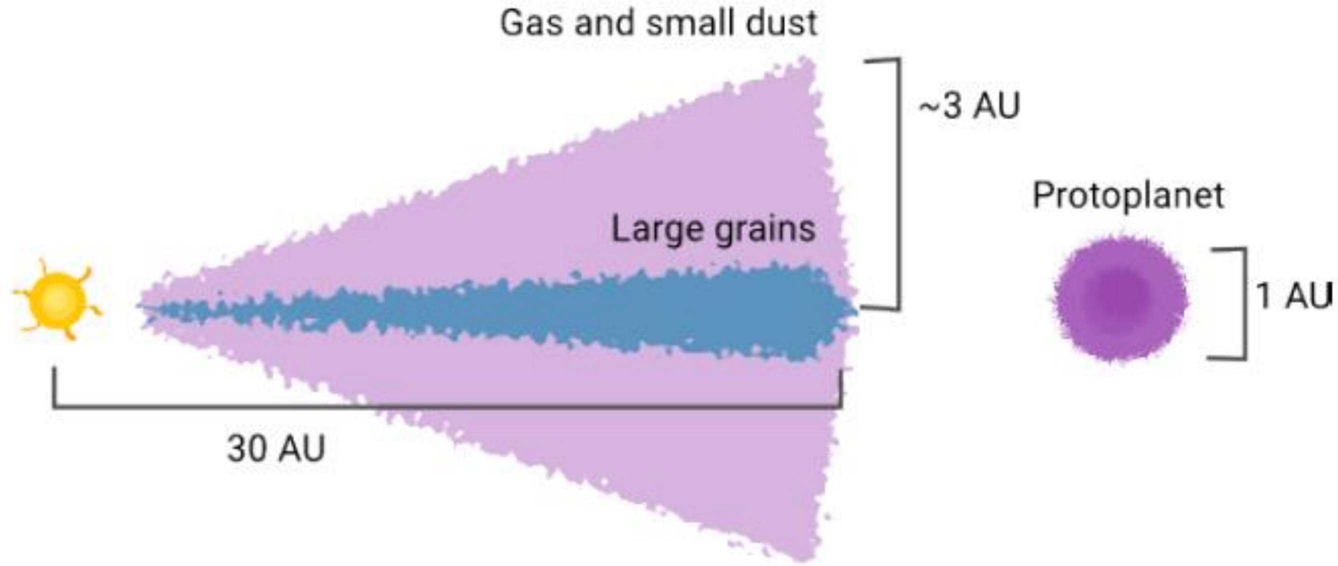
SFN333 (22-28)

藤井　通子

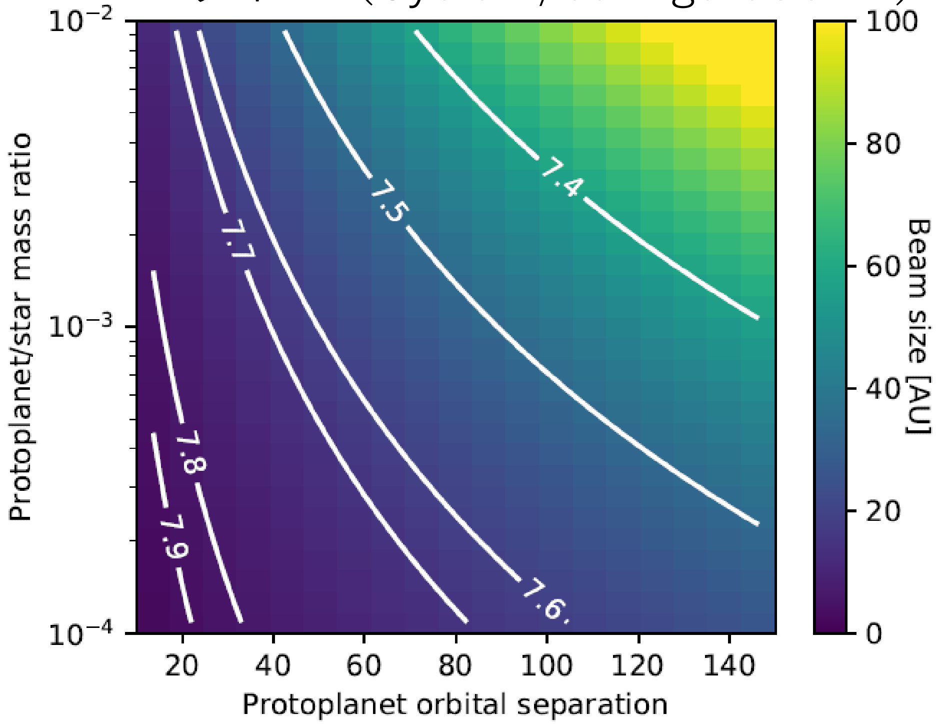
Searching for wide-orbit gravitational instability protoplanets with ALMA in the dust continuum

J. Humphries, C. Hall, T. J. Haworth & S. Nayakshin

- Gravitational Instability (GI)で生まれたpre-collapse phaseの原始惑星は10^5-10^7年生き残るかもしれない (Helled+2011, Nayakshin 2020)
  - 原始惑星の半径: 1-10au、大気の温度: 20-30 K
  - Dust emissionがALMAで観測できるのでは？

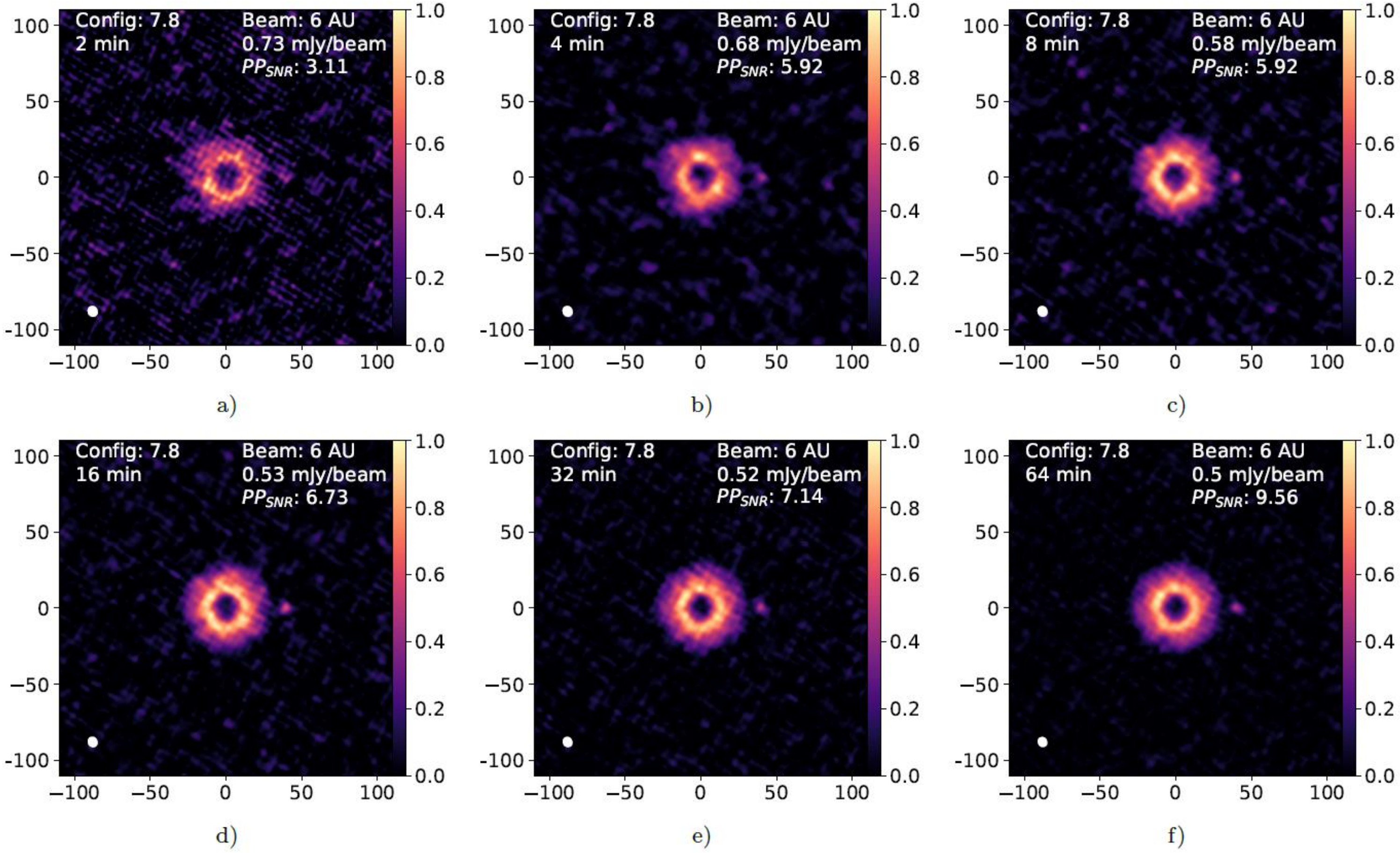


140pcにある天体の検出に必要なビームサイズ（Cycle 7, configuration 7）



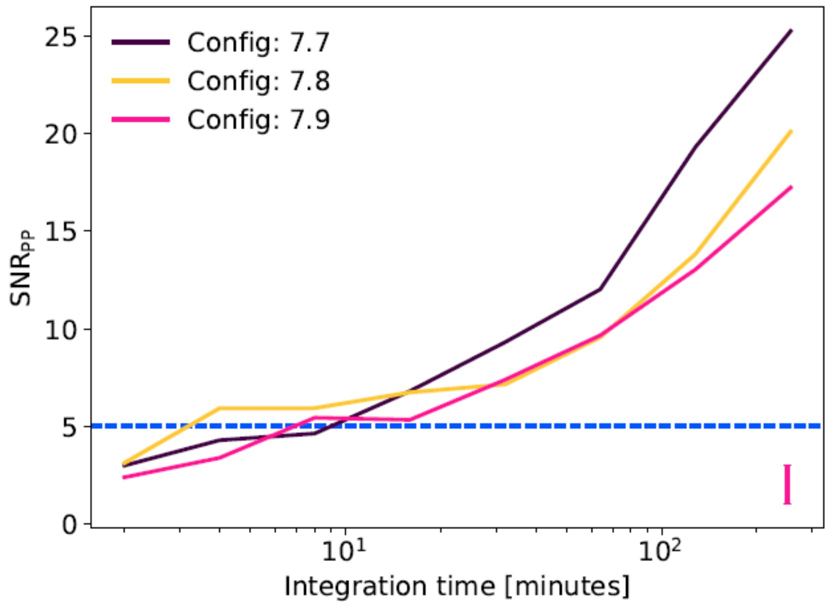
- 円盤モデル: $1M_J$, 10 au-30 au, gas to dust ratio = 100, dust mass = $3.18\ M_E$,
- 輻射輸送コード: RADMC-3D、dust opacity: OPACUTY TOOL
- ALMAシミュレータCASA、Atmospheric Transmission at Microwaves (ATM)

ALMA Cycle 7.8 configurationで積分時間を変えたもの



検出に必要な時間の見積もり

$$O_{\mathrm{time}} = 10 \times \frac{B_\nu(30\mathrm{K})}{B_\nu(T_{\mathrm{eff}})} \left(\frac{1.5\mathrm{AU}}{R_{\mathrm{PP}}}\right)^2 \ [\mathrm{minutes}]$$

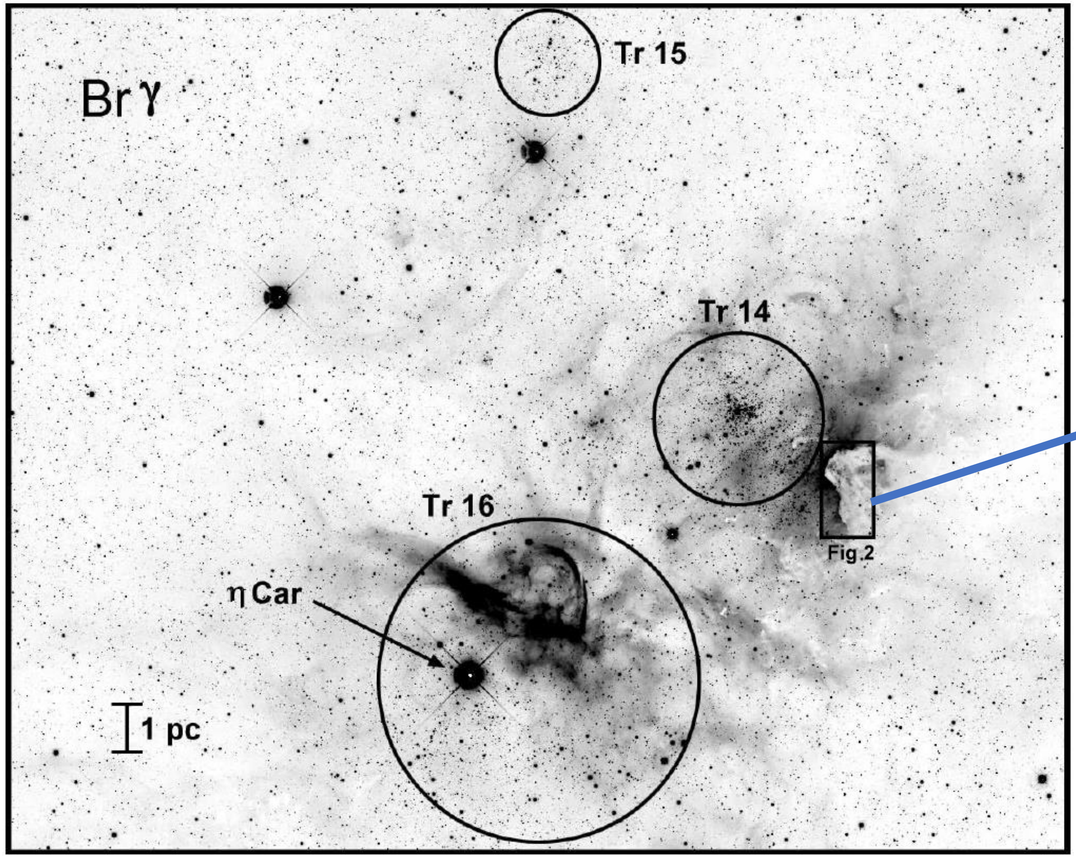


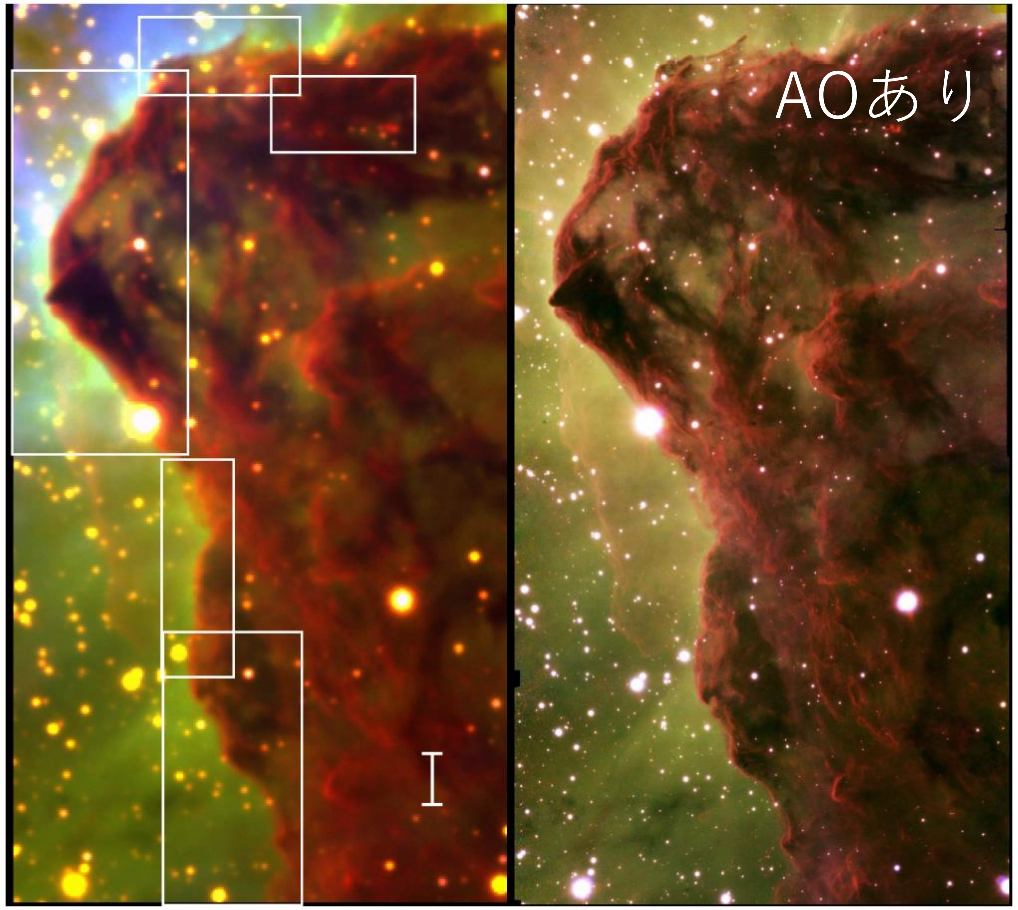
ALMAバンド6で、数百分あれば、3-5M_Jの原始惑星が観測可能という見積もり

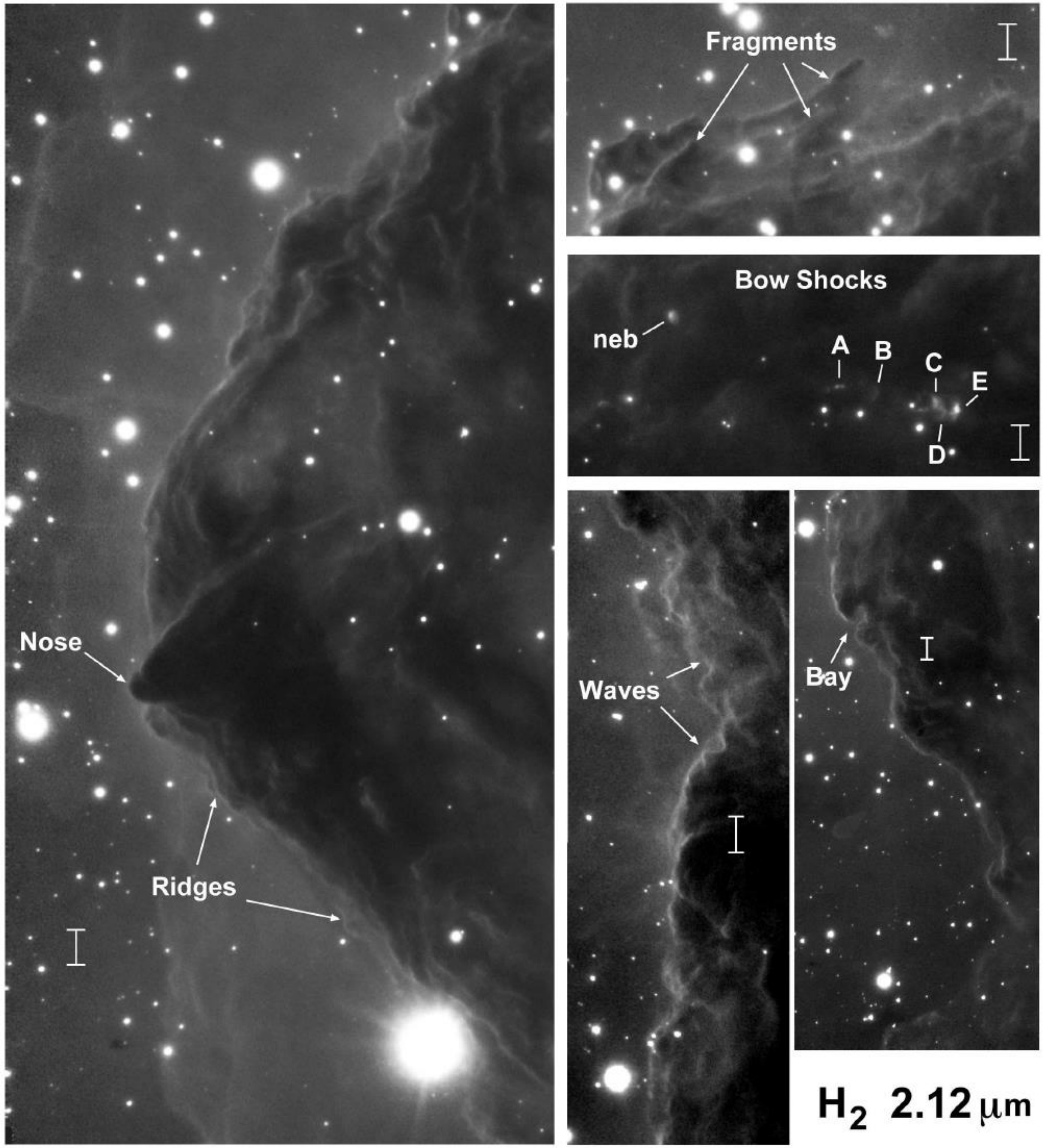
A JWST Preview: Adaptive-Optics Images of H2, Br-γ, and K-continuum in Carina's Western Wall

Patrick Hartigan, Turlough Downes, and Andrea Isella

- Carina's Western Wall (G287.38-0.62)のNIR広視野AOイメージを初めて撮った
  - 大質量星によってできたirradiated interface







- 2000AUくらいの幅の3－4個のridge
  -> large-scaleの力学的に重要な磁場
- Northern edgeでは1800AUくらいのswept-back fragmentsが見られる
  -> KH不安定？
- Wallの南の方では、波長の半分が2500AUくらいのsinusoidal-like variationが見られる
- MHO 1630で、はっきりとしたソースのないH_2 outflow (一列に並んだbow shocks)を見つけた

22. Emission-Line Datacubes of the HH 32 Stellar Jet

Patrick Hartigan[1], Lynne Hillenbrand[2], Matuesz Matuszewski[3], Arlindo Chan Borges[2], James D. Neill[3], D. Christopher Martin[3], Patrick Morrissey[3] and Anna M. Moore[4]

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We analyze datacubes of over 60 emission lines in the HH 32 stellar jet acquired with the Keck Cosmic Web Imager (KCWI). The data cover the less-explored blue portion of the spectrum between 3586Å and 6351Å, and have both high spectral (R $\sim$ 10000) and spatial ($<\sim$ 1") resolution. The study includes all three major ionization states of oxygen, three Balmer lines, multiple lines of Fe II and Fe III, as well as the first datacubes ever acquired for important unblended diagnostic lines such as He II λ4686, Ca I λ3933, and Mg I] λ4571. The data cubes generally sort according to excitation, and have a relatively continuous progression from the highest-excitation ions (He II, O III) through the intermediate-excitation ions (O I and H I) to the lowest-excitation ions (Ca II and Mg I). Merging the KCWI cubes with HST images leads to several new insights about the flow, including evidence for bow shocks, partial bow shocks, spur shocks, Mach disks, jet deflection shocks, a wiggling jet, and potential shock precursors. The most surprising result is that one of the velocity components of Fe II in the Mach disk suddenly increases in flux relative to other lines by a factor of two, implying that the Mach disk vaporizes dust in the jet. Hence, jets must accelerate or entrain dust to speeds of over 300 km/s without destroying the grains.

Accepted by Astronomical Journal

https://arxiv.org/pdf/2008.03466

25. Observing protoplanetary discs with the Square Kilometre Array – I. Characterising pebble substructure caused by forming planets

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High angular resolution observations of discs at mm wavelengths (on scales of a few au) are now commonplace, but there is a current lack of a comparable angular resolution for observations at cm wavelengths. This presents a significant barrier to improving our understanding of planet formation, in particular how dust grains grow from mm to cm sizes. In this paper, we examine the ability of the Square Kilometre Array (SKA) to observe dust substructure in a young, planet-forming disc at cm wavelengths. We use dusty hydrodynamics and continuum radiative transfer to predict the distribution and emission of 1 cm dust grains (or pebbles) within the disc, and simulate continuum observations with the current SKA1-MID design baseline at frequencies of 12.5 GHz (Band 5b, 2.4 cm) on 5-10 au scales. The SKA will provide high-fidelity observations of the cm dust emission substructure in discs for integration times totalling 100's of hours. Radial structure can be obtained at a sufficient resolution and S/N from shorter (10's of hours) integration times by azimuthal averaging in the image plane. By modelling the intensity distribution directly in the visibility plane, it is possible to recover a similar level of (axisymmetric) structural detail from observations with integration times 1-2 orders of magnitude lower than required for high-fidelity imaging. Our results demonstrate that SKA1-MID will provide crucial constraints on the distribution and morphology of the raw material for building planets, the pebbles in protoplanetary discs.

Accepted by MNRAS

https://arxiv.org/pdf/2009.00562

26. Revisiting the Magnetic Field of the L183 Starless Core

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We present observations of linear polarization from dust thermal emission at 850 μm towards the starless cloud L183. These data were obtained at the James Clerk Maxwell Telescope (JCMT) using the Submillimetre Common-User Bolometer Array 2 (SCUBA-2) camera in conjunction with its polarimeter POL-2. Polarized dust emission traces the plane-of-sky magnetic field structure in the cloud, thus allowing us to investigate the role of magnetic fields in the formation and evolution of its starless core. To interpret these measurements, we first calculate the dust temperature and column density in L183 by fitting the spectral energy distribution obtained by combining data from the JCMT and the Herschel space observatory. We used the Davis-Chandrasekhar-Fermi technique to measure the magnetic field strength in five sub-regions of the cloud, and we find values ranging from $\sim$120$\pm$18 μG to $\sim$270$\pm$64 μG in agreement with previous studies. Combined with an average hydrogen column density ($N_{\mathrm{H_2}}$) of $\sim 1.5\times10^{22}$ cm^{-2} in the cloud, we also find that all five sub-regions are magnetically subcritical. These results indicate that the magnetic field in L183 is sufficiently strong to oppose the gravitational collapse of the cloud.

Accepted by ApJ

http://arxiv.org/pdf/2008.02841

27. First L band detection of hot exozodiacal dust with VLTI/MATISSE

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For the first time we observed the emission of hot exozodiacal dust in L band. We used the new instrument MATISSE at the Very Large Telescope Interferometer to detect the hot dust around κ Tuc with a significance of 3σ to 6σ at wavelengths between 3.37 and $3.85\,\mu$m and a dust-to-star flux ratio of 5 to 7 %. We modelled the spectral energy distribution based on the new L band data alone and in combination with H band data published previously. In all cases we find $0.58\,\mu$m grains of amorphous carbon to fit the κ Tuc observations the best, however, also nanometre or micrometre grains and other carbons or silicates reproduce the observations well. Since the H band data revealed a temporal variability, while our L band data were taken at a different epoch, we combine them in different ways. Depending on the approach, the best fits are obtained for a narrow dust ring at a stellar distance in the 0.1 to 0.29 au range and thus with a temperature between 940 and 1430 K. Within the 1σ uncertainty dust location and temperature are confined to $0.032 - 1.18$ au and $600 - 2000$ K.

Accepted by MNRAS Letters

https://arxiv.org/pdf/2009.02334

28. Interferometric study on the temporal variability of the brightness distributions of protoplanetary disks

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Context. Optical and infrared spatially unresolved multi-epoch observations have revealed the variability of pre-main sequence stars and/or their environment. Moreover, structures in orbital motion around the central star, resulting from planet-disk interaction, are predicted to cause temporal variations in the brightness distributions of protoplanetary disks. Through repeated observations of pre-main sequence stars with the Very Large Telescope Interferometer (VLTI) over nearly two decades, the ESO Archive has become a treasure chest containing unprecedented high-resolution multi-epoch near- and mid-infrared observations of the potential planet-forming regions in protoplanetary disks.
Aims. We aim to investigate whether the existing multi-epoch observations provide evidence for the variability of the brightness distributions of the innermost few astronomical units of protoplanetary disks and to quantify any variations detected.
Methods. We present different approaches to search for evidence of temporal variations based on multi-epoch observations obtained with the VLTI instruments PIONIER, AMBER, and MIDI for 68 pre-main sequence stars.
Results. For nine objects in our sample, multi-epoch data obtained using equal baselines are available that allow us to directly detect variations in the visibilities due to temporally variable brightness distributions. Significant variations of the near-infrared visibilities obtained in different epochs with PIONIER and/or AMBER for HD 50138, DX Cha, HD 142527, V856 Sco, HD 163296, and R CrA were found. HD 37806, TW Hya, and CPD-36 6759 show no significant variations. By estimating the impact of a small variation of the baseline on the measured squared visibilities, we are able to compare the data of another 12 pre-main sequence stars. Thereby, we find evidence for temporal variations of the brightness distribution of one additional object, AK Sco. Besides the two binaries DX Cha and AK Sco, HD 50138 and V856 Sco also show signs of variability caused by variations of asymmetric structures in the brightness distribution.

Accepted by A&A

https://arxiv.org/pdf/2008.08374