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Appendix C: NIRCам images of the north of the Dark Bay, north of M42 and M43

In this Appendix, we present several prominent features arising in the images within the fields centered on north of the Dark Bay, north of M42 and M43 obtained in the NIRCам parallel mode. Figs. C.1, C.2 and C.4. show composite images in three selected filters F187N, F335M and F470N in north of the Dark Bay and F187N, F335M and F212N in north of M42 and M43. As in the field centered on the Bar, the molecular cloud border appears quite structured. Multiple patterns emerge such as ridges, waves, evaporating globules and bow-shocks (Fig. C.3). In Figs. C.5-C.11, all the images obtained in the filters listed in Table 1, and some filters continuum subtracted, are presented. Figs. C.12, C.13, C.14, C.15 show the proplyds detected in the north of the Dark Bay and M43. New proplyd candidates identified in the NIRCам F187N images of the north of the Dark Bay and M43 are given in Table C.1.

Appendix C.1. North of the Dark Bay

The NIRCам images of the material North of the Dark Bay reveal that there are linear bright features, such as the Bar (panels A and B in Figs. C.1 and C.3). Some of these features were previously seen in extinction corrected HST images (e.g., eastern and northern bright bar in Fig. 6 of O'Dell 2001b). The Dark Bay (and similar structures) are foreground extinction of visible light (Fig. 1) but seen in emission in PDRs tracers, such as AIBs and H₂ observed with NIRCам, and [CII] cooling line emission from *Herschel* and SOFIA (Goicoechea et al. 2015; Pabst 2021). The AIBs and H₂ line emission show the edges of these neutral warm regions with a very high level of detail. The bright PDR features (panels A and B in Figs. C.1 and C.3), which are at a projected distance of the order of 110''-120'' (0.22-0.24 pc) from the illuminating O7-type star θ^1 Ori C, are illuminated by a strong FUV radiation field comparable to the one on the Bar. Goicoechea et al. (2015) studied with *Herschel*/HIFI the [CII] velocity emission along with the CO J=2-1 line with IRAM-30m and found that most of these PDRs lack detectable CO emission (CO-dark molecular gas). In the northern-west part of the NIRCам map, there is a zone devoid of nebula emission where background stars are well visible. This is in agreement with the fact that no CO emission was previously detected and that this region does not contain much dense molecular gas.

In the southwest corner of the continuum subtracted H₂ 0-0 S(9) 4.69 μ m line map (Fig. C.7), several very bright features produced by shocks are detected. No AIB emission or Pa α and [FeII] line emission are detected on these features. The well studied outflow HH 513 lies in this region. Furthermore, several arches (like a bent-over cylinder) which are most likely bow-shocks are detected in the southeast corner of field (see panel A in Figs. C.1 and C.3). Bow-shocks can also be the result of multiple outflows that are close together in time like seen from the ground in clusters in various star-forming regions (Plunkett et al. 2013; Nony et al. 2020).

Appendix C.2. North of M42

Here, we present images within the fields covered the north of M42 obtained in the NIRCам parallel mode. As shown by the ionized gas line map in Fig. C.2, the north of M42 contains one main ionized gas region in the southwest part of the map. This region is irradiated by the Trapezium cluster. At the edge of the ionized region are the neutral zones, the PDRs. Particularly

interesting PDRs are the ones in panel C in Figs. C.2 and C.3 which are irradiated from the South by star θ^1 Ori C and from the north by the B0.5V star NU Ori in the center of M43 (see Sect. Appendix C.3). As shown in Fig. C.2, a remarkable spatial correlation is observed between the F335M filter (AIBs) and the F212N filter (vibrationally excited line H₂ 1-0 S(1)). Most likely, these PDRs are in a lower G_0/n_H regime than in the Bar. In fact, the incident FUV flux from the south on that PDR can be estimated to be about 10 times lower than in the Bar considering the projected distance from the star θ^1 Ori C. For lower G_0/n_H , the H⁰/H₂ transition is not driven by dust opacity but by H₂ self shielding (e.g. Hollenbach & Tielens 1999), and the H₂ emission peak is expected to spatially coincide with the emission peak of the AIBs. Spatial coincidence between H₂ and AIB emission peaks has been observed in several lower excited PDRs such as the ρ Oph-W and Horsehead nebula PDR (e.g., Habart et al. 2003; Habart et al. 2005). In high G_0/n_H regime (as at the main edge of the Bar), where the H⁰/H₂ is driven by dust opacity and H₂ is mostly photo-dissociated in the outer PDR layers ($A_V < 1$), H₂ emission appears after the emission peak of the AIBs. In the panel C of Fig. C.3, a thin structure (width of 1''), probably an Evaporating Gaseous Globule, is detected at the PDR edge.

Appendix C.3. M43

As shown in Fig. C.4, M43 contains one main ionized gas region. M43 exhibits an expanding bubble structure, with an expansion velocity of 6 km s⁻¹ (Pabst et al. 2020). Looking at the NIRCам images, the UV flux appears significantly lower than in the inner Orion Nebula. The Pa α line is in fact much less bright than in the inner region of the nebula. The emission in the F335M filter is also significantly weaker. This is expected due to the much cooler and less luminous exciting star NU Ori. Pabst et al. (2020, 2022) estimated the local PDR physical conditions in M43, the incident radiation field G_0 ($\sim 10^3$) and the gas density n from the SED results and their [C II] and CO data. In the rim of M43, Pabst et al. (2020) found $n = 10^4$ cm⁻³ from the [C II] and CO peak separation. Gas temperature estimated from [CII] excitation temperature is about 100-120 K. Thus, the thermal pressure must be around few 10^6 K cm⁻³, 10 to 100 times lower than in the Bar. The PDRs around M43 are bright in aromatic emission but quite faint in H₂. This is consistent with the fact that the density should not be too high ($n \leq 10^4$ cm⁻³). The conditions of the local PDR are compatible with the conditions of pressure equilibrium with the ionized region using the results of O'Dell & Harris (2010). From their M43 Samples A in Table 10, the averages electronic temperature and density are $T_e = 7950 \pm 60$ K and $n_e = 510 \pm 40$ cm⁻³.

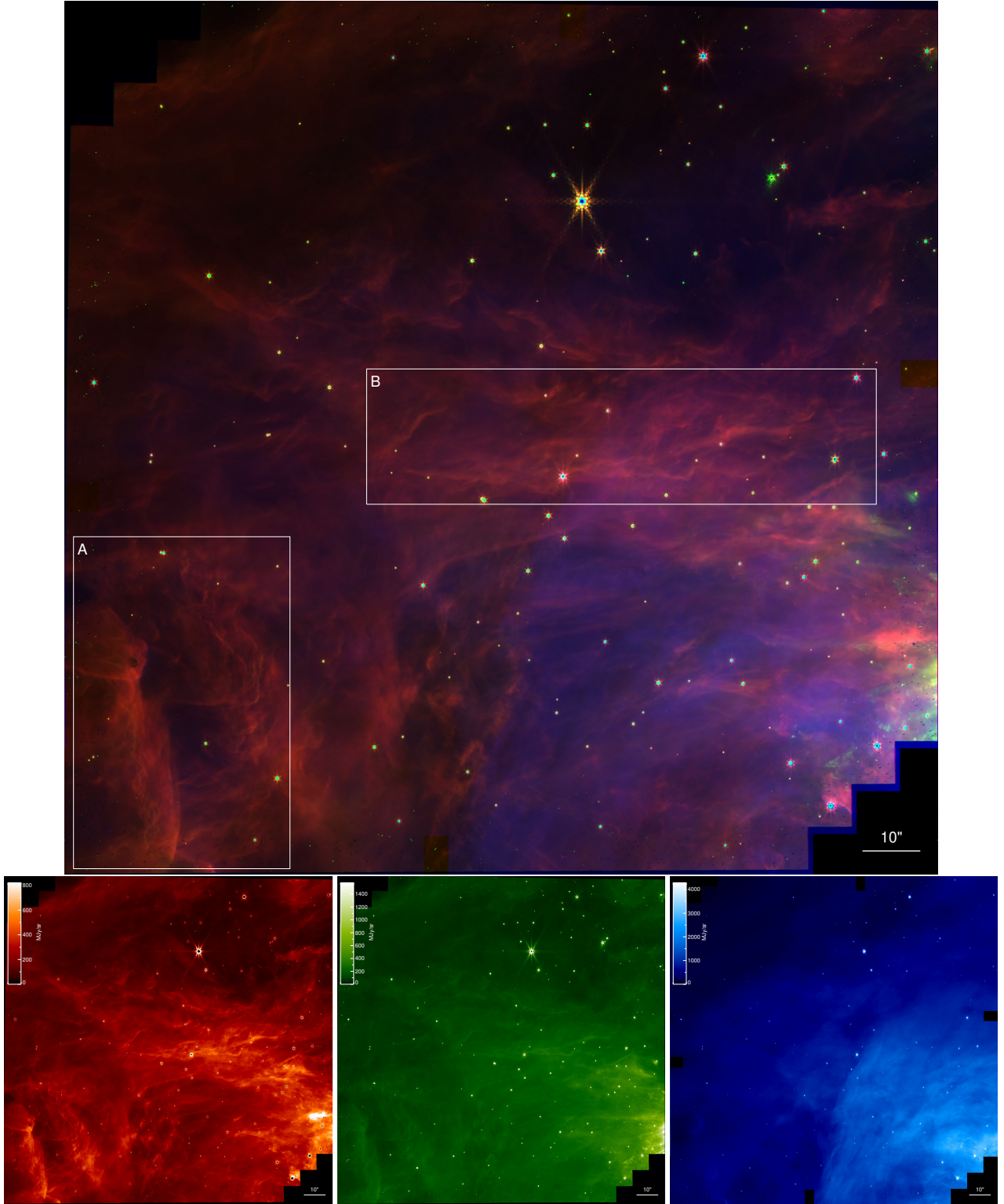


Fig. C.1. The North of the Dark Bay as seen by the JWST's NIRCcam instrument with north up and east left. Several images in different filters were combined to produce an RGB composite image as in Fig. 3: F335M (red), F470N (green) and F187N (blue) that trace emission from hydrocarbons (AIBs), dust and molecular gas (H_2 0-0 S(9) line), and ionized gas (Pa α line), respectively. The individual images used to make the RGB composite one are shown below. No continuum was subtracted. The size of the images is $\sim 150'' \times 150''$ and it is centered on RA=05^h35^m21^s.09, DEC=-05°21'40''01. White boxes (labeled A, B) are enlarged in Fig. C.3.

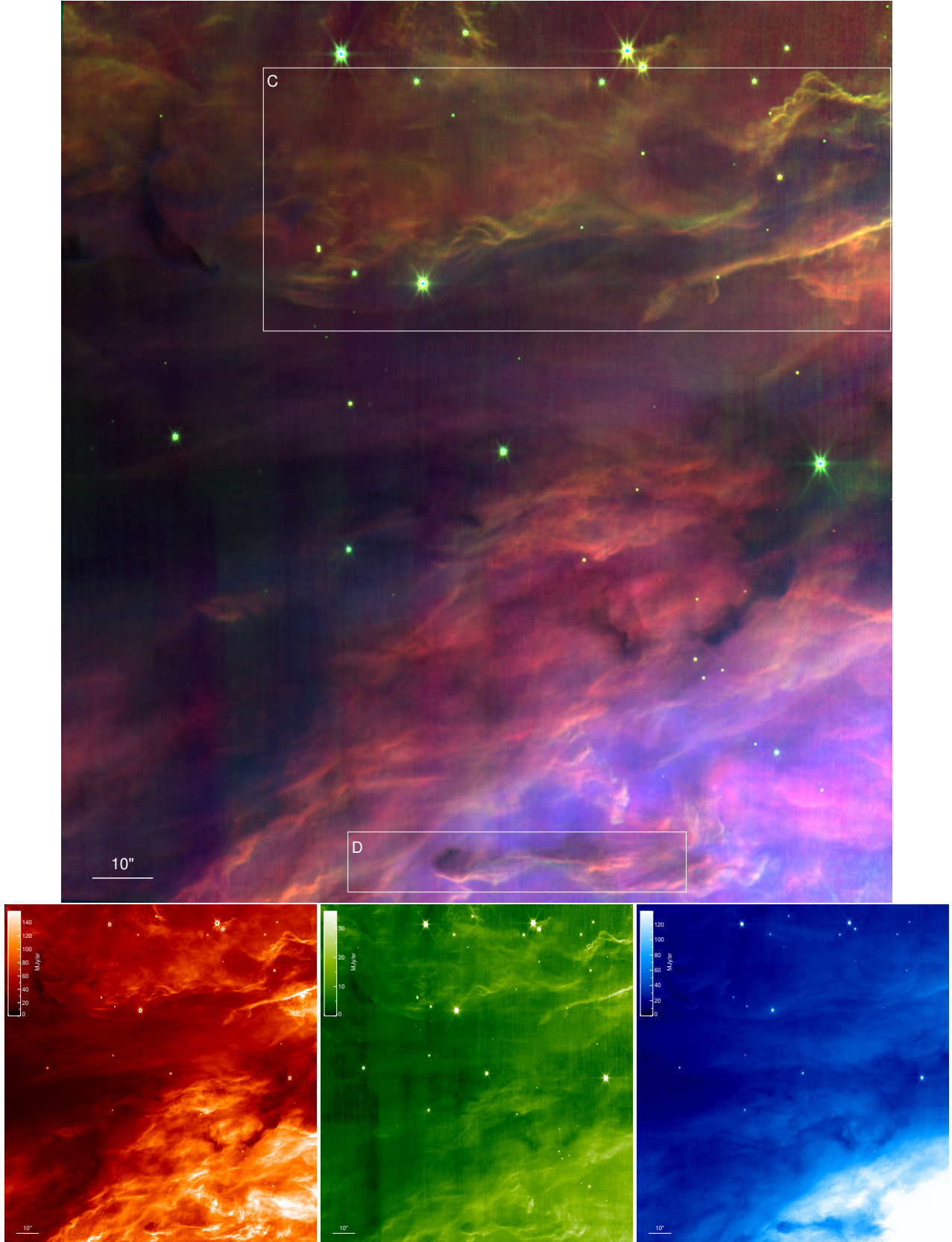


Fig. C.2. North of M42 as seen by the JWST's NIRCam instrument with north up and east left. Several images in different filters were combined to produce an RGB composite image : F335M (red), F212N (green) and F187N (blue) that traces respectively emission from hydrocarbons (AIBs), molecular gas (H_2 1-0 S(1) line) and ionized gas (Pa α line), respectively. The individual images used to make the RGB composite one are shown below. No continuum was subtracted. The image field was chosen to have an overlap between the different individual images. The size of the images is $\sim 135'' \times 145''$ and it is centered on RA=05^h35^m29^s.12, DEC=-05°20'3.66". White boxes (labeled C, D) are enlarged in Fig. C.3.

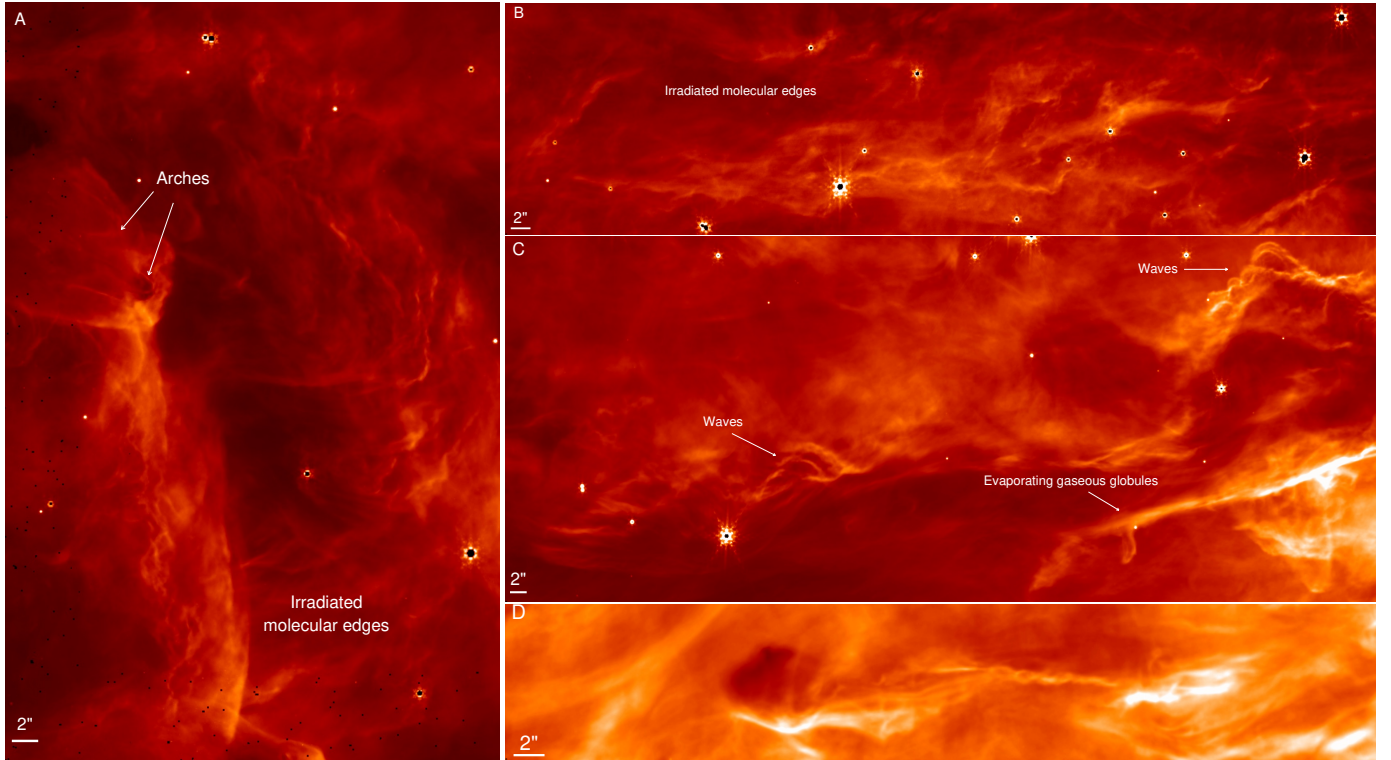


Fig. C.3. Zoom into the F335M image areas shown in Figs. C.1 (for panels A, B) and C.2 (for panels B, C). **A** Irradiated molecular edges showing many patterns such as ridges and arches (which are most likely bow-shocks) detected in the southeast area of M42 North. **B** Irradiated molecular edges detected in the north area of M42 North. **C** Irradiated molecular edges showing many patterns such as ridges, waves and evaporating gaseous globule detected in the northwest area of the M43 South field. **D** Features driven by a large outflow detected in the south area of the M43 South field.

Table C.1. New proplyd candidates identified in the NIRCам F187N images of M42 north and M43 (module A).

Proplyd ^a	α_{J2000}	δ_{J2000}	Region	Comments	2MASS
171 – 212	05 35 17.14	–05 22 11.9	M42	bright cusp with tail	no
180 – 218	05 35 18.04	–05 22 18.2	M42	near to filament, no tail	no
234 – 104	05 35 23.37	–05 21 03.7	M42	faint cusp, no tail	no
269 – 1713	05 35 26.87	–05 17 12.9	M43	bipolar jet, HH objects	yes, star

^aProplyd name following O’Dell & Wen (1994) coordinate-based convention.

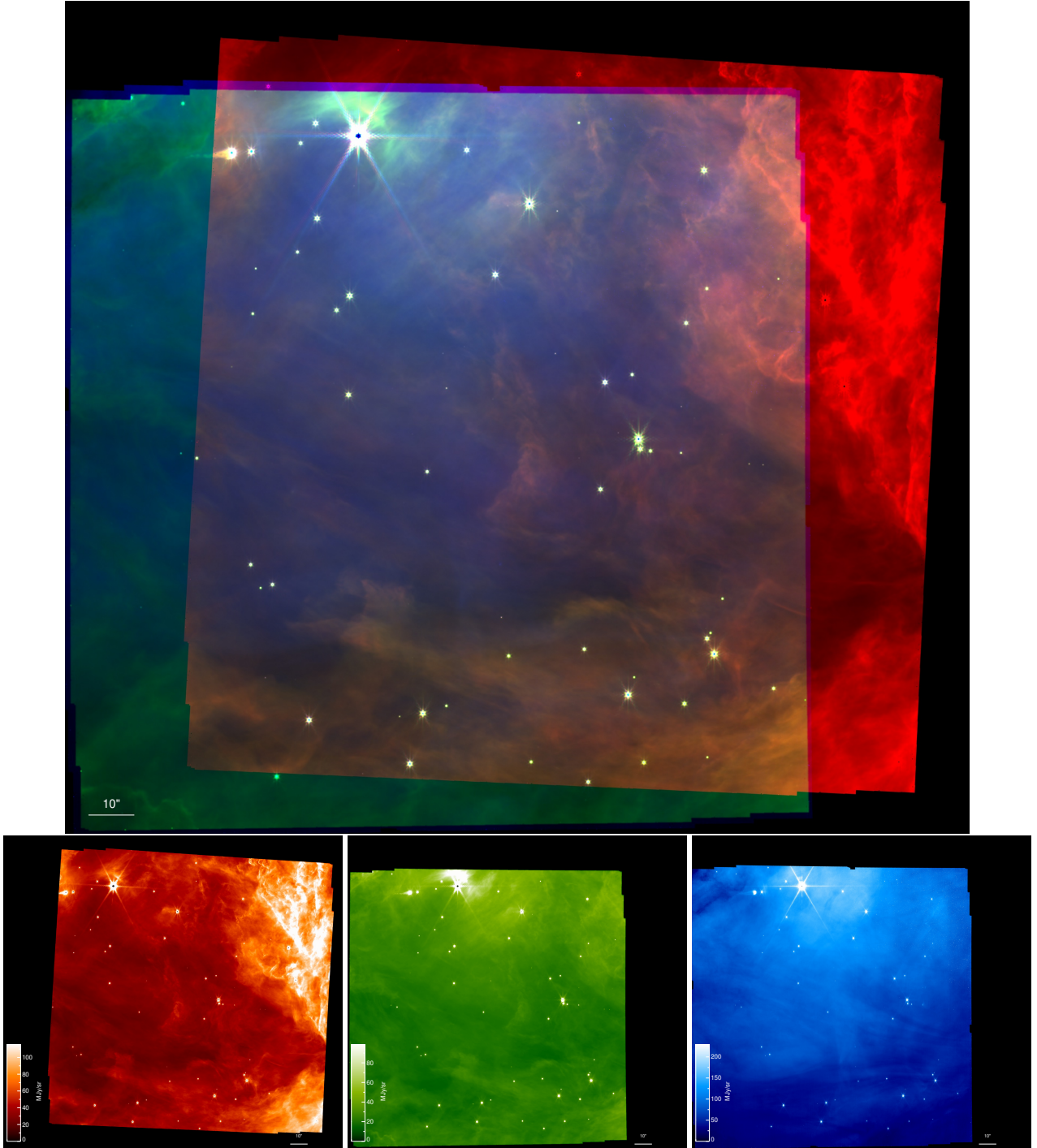


Fig. C.4. The M43 region as seen by the JWST’s NIRCам instrument with north up and east left. Several images in different filters were combined to produce an RGB composite image : F335M (red), F212N (green) and F187N (blue) that traces respectively emission from hydrocarbons (AIBs), molecular gas (H_2 1-0 S(1) line) and ionized gas (Pa α line), respectively. The individual images used to make the RGB composite one are shown below. No continuum was subtracted. The size of the images is $\sim 158'' \times 158''$ and it is centered on RA=05^h35^m28.92, DEC=−05°17′04.31″.