SFN #341 19-23

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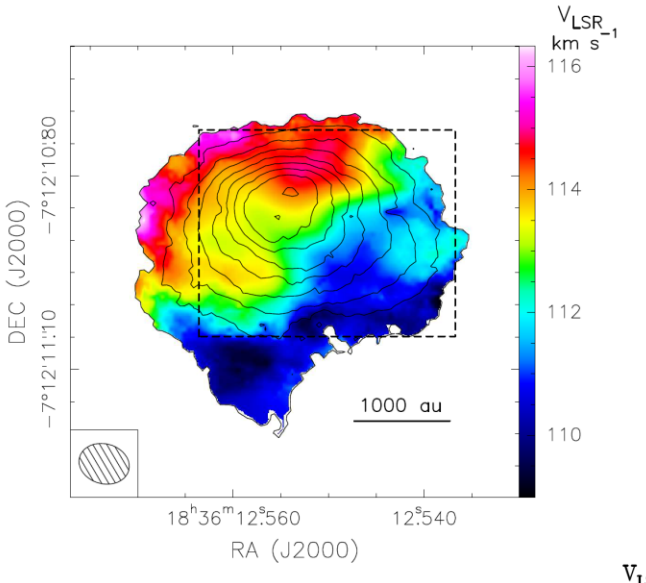
The ionized heart of a molecular disk. ALMA observations of the hyper-compact HII region G24.78+0.08 A1

L. Moscadelli1, R. Cesaroni1, M.T. Beltrán1, and V. M. Rivilla2, 1

- HC (Hyper-compact) HII region: <0.01 pc
- UC (Ultra-compact) HII region: <0.1 pc
- G24.78+0.08 A1 (HC HII region, high-mass star-forming cluster)をH30α、CH_3CN, $^{13}CH_3CN$で観測した(ALMA 1.4mm Cycle 6)
- PA=39° の速度勾配22km/s/mpc
  - 回転による速度勾配 3 km s−1 mpc−1 より大きい



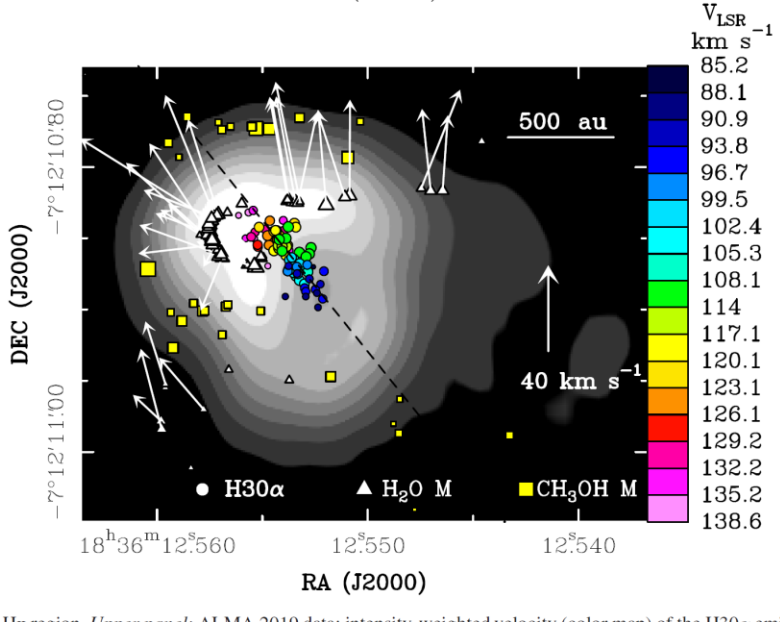
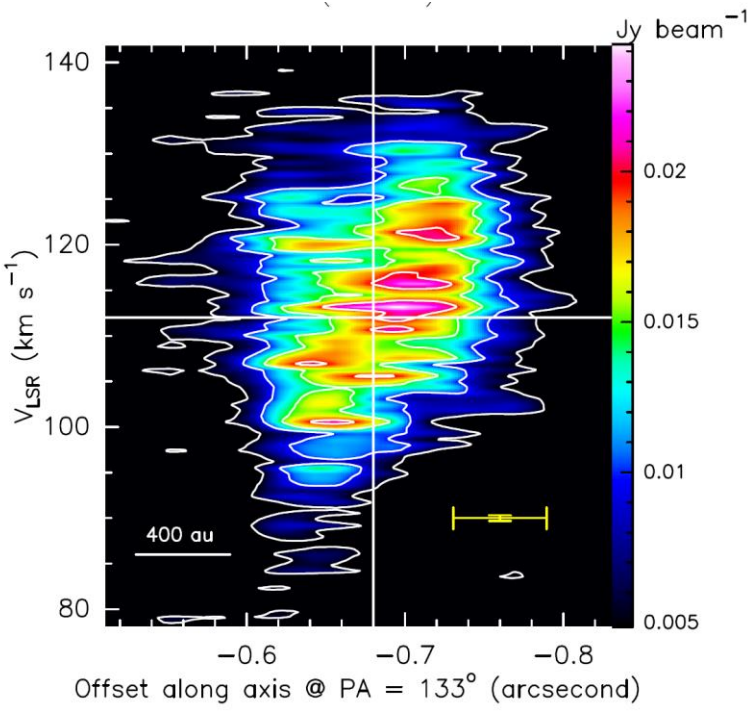
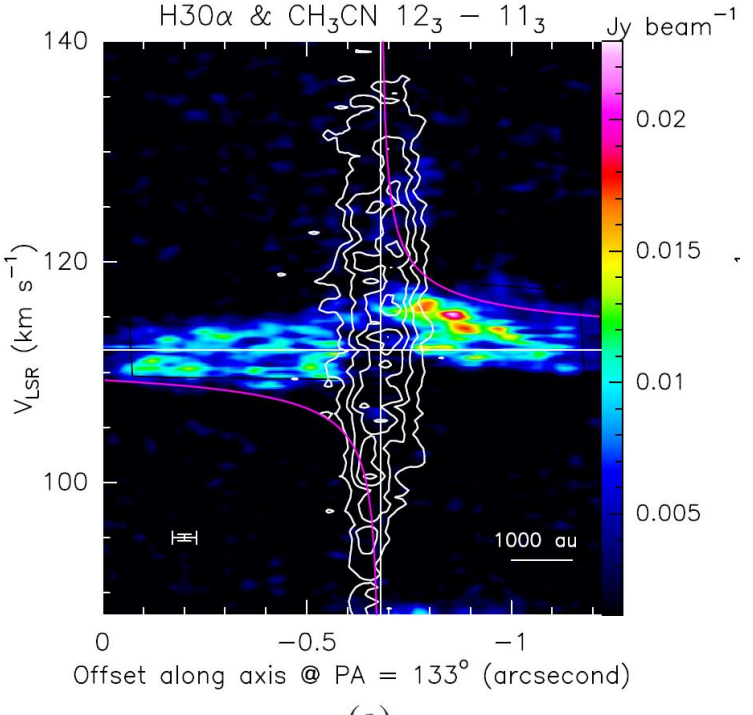


Fig. 2: The HC HII region. *Upper panel:* ALMA 2019 data: intensity-weighted velocity (color map) of the H30α emission, obtaine from averaging the channel maps produced with a natural weighting of the *uv*-data. The beam (FWHM 0.″080 × 0.″062, with P.A. = 75°) is shown in the lower left corner. The black contours represent the velocity-integrated intensity of the H30α line, showin levels from 0.26 to 1.3 in steps of 0.13 Jy beam^{-1} km s^{-1}. The dashed black rectangle delimits the field of view shown in the lowe panel. *Lower panel:* ALMA 2015, VLA, and Very Long Baseline Interferometry (VLBI) data. The grayscale image represents th VLA A-Array 7 mm continuum observed by Beltrán et al. (2007). The white triangles and yellow squares mark the VLBI position of the H_2O 22 GHz (Moscadelli et al. 2007) and CH_3OH 6.7 GHz masers (Moscadelli et al. 2018), respectively; the area of th symbol is proportional to the logarithm of the maser intensity. The white arrows show the proper motions of the H_2O masers, whic were first reported and analyzed in Moscadelli et al. (2007). The colored dots give the channel peak positions of the H30α lin emission obtained by Moscadelli et al. (2018) from ALMA data with 0.″2 resolution; the colors denote the V_{LSR} as indicated to th right of the plot. The dashed black line marks the axis of the spatial distribution of the H30α peaks.

- PA=133° の速度勾配 3 km s−1 mpc−1
  - 回転による速度勾配
- H30α lineは中心の大質量星(~20Msun)からのdisk-jet systemをトレースしていると考えられる
  - PA＝39° の運動はionized jet
- CH3CNと13CH3CN lineは20Msunの星のケプラー回転とconsistent

- 考えられるモデル：
  - 500-4000 auのmolecular diskがあり、外側から降着が続いている
  - 500 auより内側は星によって電離されていて、中心星への降着は続いている





The Single-Cloud Star Formation Relation

Riwaj Pokhrel,1 Robert A. Gutermuth,2 Mark R. Krumholz,3, 4 Christoph Federrath,3, 4 Mark Heyer,2 Shivan Khullar,5, 6 S. Thomas Megeath,1 Philip C. Myers,7 Stella S. R. Offner,8 Judith L. Pipher,9 William J. Fischer,10 Thomas Henning,11 and Joseph L. Hora7

- 近傍の星形成領域で、YSOで数えた星形成率とガスの密度を使って、各領域でのKennicutt-Schmidt関係を調べてみた。
  - Ophiuchus, Perseus, Orion-A, Orion-B, Aquila-North, Aquila-South, NGC 2264, S140, AFGL 490, Cep OB3, Mon R2, and Cygnus-X.
  - の関係を出した

ガス：

Herschel/SPIRE and Herschel/PACS

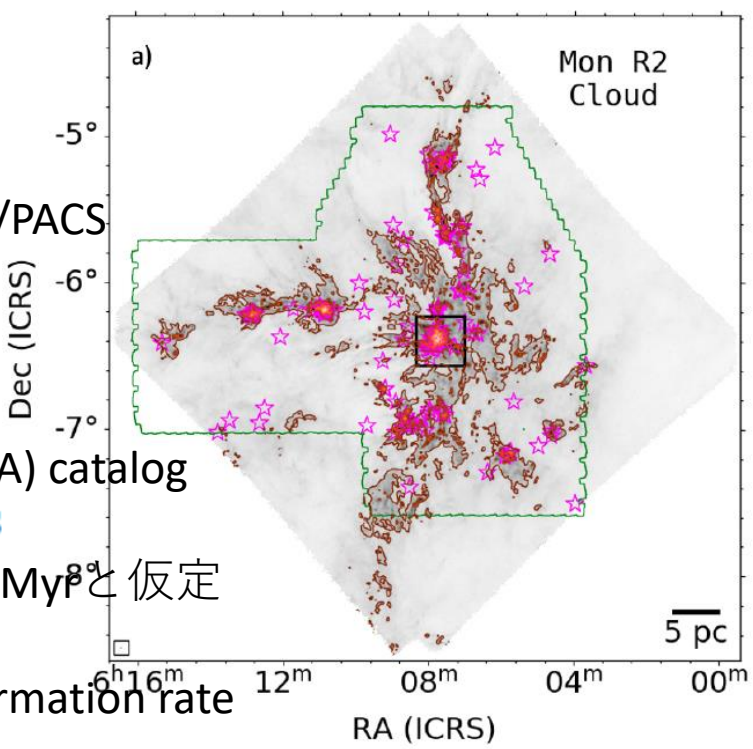
-> H_2 $\Sigma_{\rm gas} = \frac{2m_{\rm H}}{X} N({\rm H_2})$

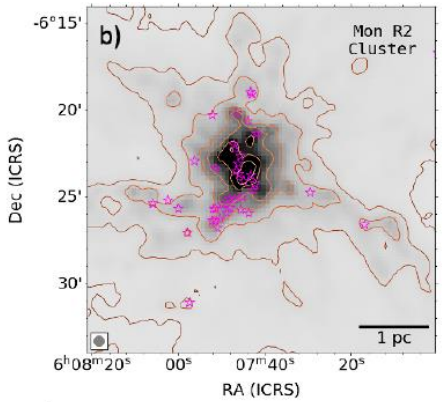
YSO: Spitzer Extended Solar Neighborhood Archive (SESNA) catalog

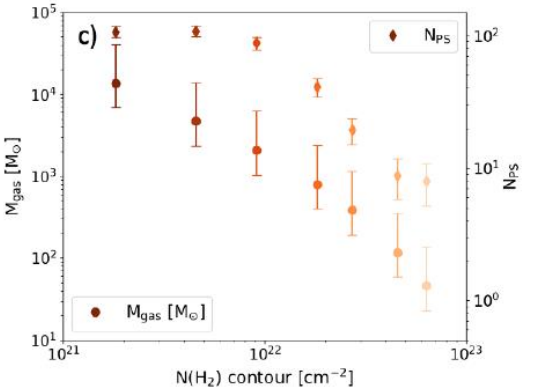
星形成率: $\mathrm{SFR} = N_{\rm PS} M_{\rm PS}$

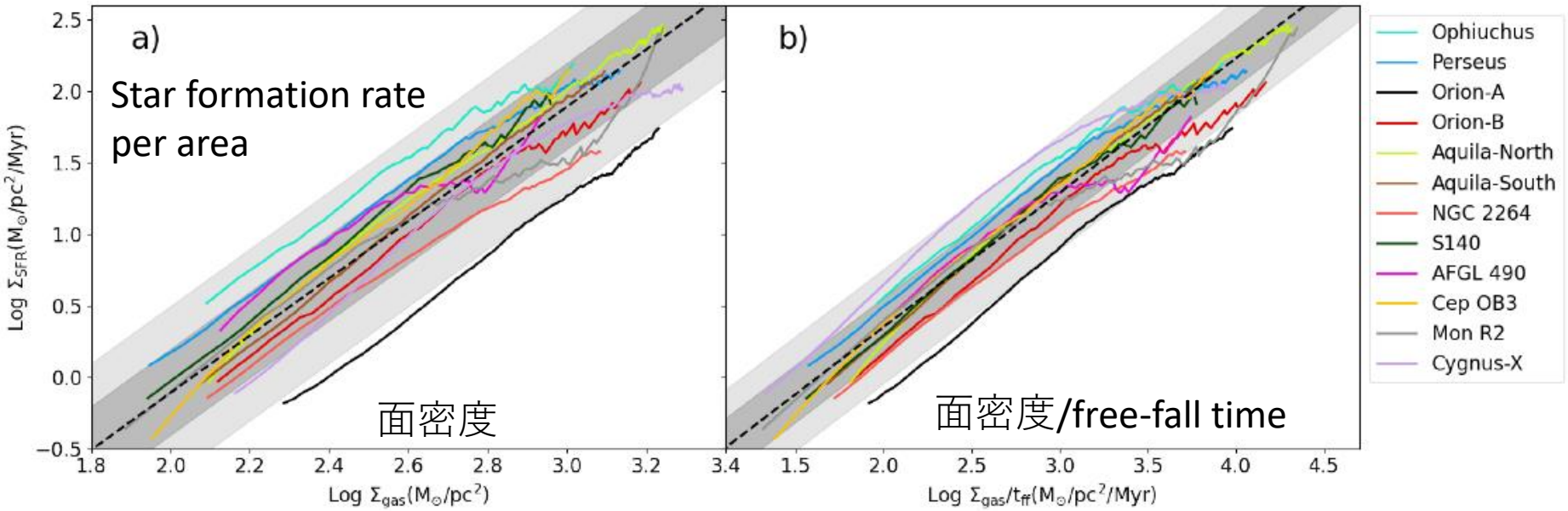
M_PS = 0.5 Msun, t_PS = 0.5 Myrと仮定

領域の中で、密度とstar-formation rate per areaを調べた





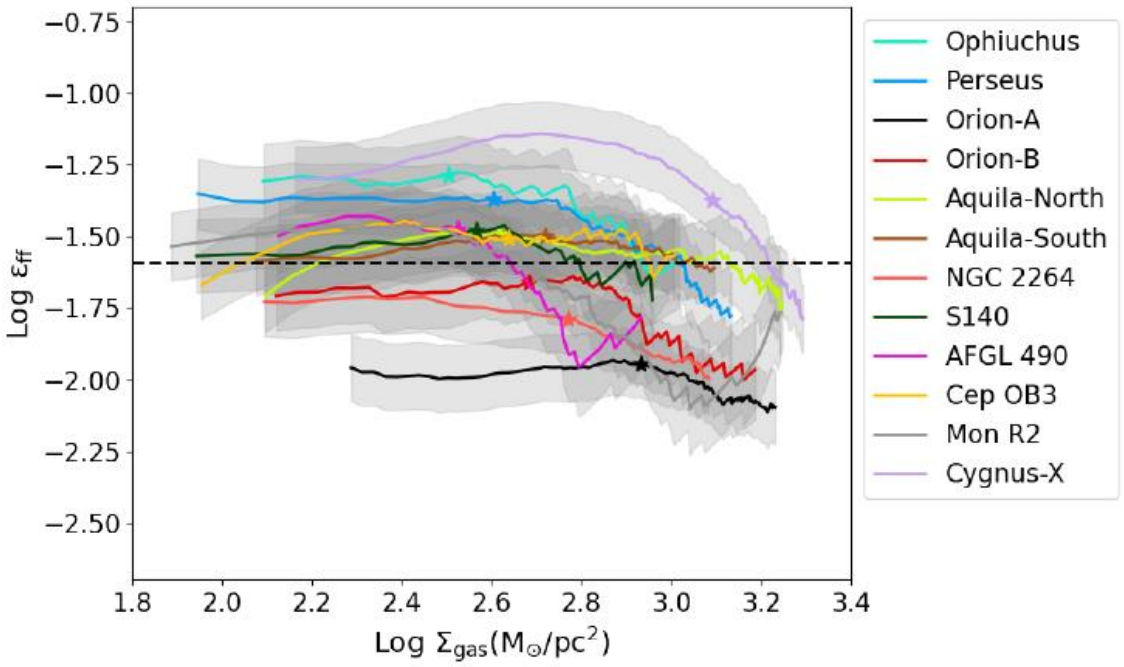




$$\log \Sigma_{\rm SFR} = \log\left(\Sigma_{\rm gas}/t_{\rm ff}\right) + \log \epsilon_{\rm ff} \qquad \epsilon_{\rm ff} \approx 0.026$$

$$\epsilon_{\rm ff} = {\rm SFR}/\left(M_{\rm gas}/t_{\rm ff}\right)$$

- 領域ごとにばらつきがあるが、ガスのfree-fall timeでガスの面密度を割ると、ばらつきが減る
- Free-fall timeあたりの星形成効率は0.026（この辺は銀河スケールで言われていた）
- 大質量星がない領域でもこの関係に乗るので、乱流やprotostellar outflowのようなローカルなプロセスが重要なのでは（と著者は言っている）



- 密度が高いところでstar-formation efficiencyが下がっている
- 考えられる理由
  - 観測的にYSOを見逃しやすい
  - 密度が高いほどYSOのlifetimeが短いかもしれない
  - Free-fall timeと星形成をカウントしている時間(ここでは0.5Myrとしている)でfree-fall timeの方が短いので、YSOが形成している間に密度が上がってしまっている

19. ## Compact Disks: an explanation to faint CO emission in Lupus disks

Anna Miotello, Giovanni Rosotti, Megan Ansdell, Stefano Facchini, Carlo F. Manara, Jonathan P. Williams, Simon Bruderer ★ A large fraction of observed protoplanetary disks in nearby Star-Forming Regions (SFRs) are fainter than expected in CO isotopologue emission. Disks not detected in 13CO line emission are also faint and often unresolved in the continuum emission at an angular resolution of around 0.2 arcseconds. Focusing on the Lupus SFR, the aim of this work is to investigate whether the population of CO-faint disks comprises radially extended and low mass disks - as commonly assumed so far - or if it is of intrinsically radially compact disks, an interpretation that we propose in this paper. The latter scenario was already proposed for individual sources or small samples of disks, while this work targets a large population of disks in a single SFR for which statistical arguments can be made. A new grid of physical-chemical models of compact disks has been run with DALI in order to cover a region of the parameter space that had not been explored before with this code. Such models have been compared with 12CO and 13CO ALMA observations of faint disks in Lupus. Disks that are not detected in 13CO emission and with faint or undetected 12CO emission are consistent with compact disk models. For radially compact disk, the emission of CO isotopologues is mostly optically thick and it scales with the surface area: i.e., it is fainter for smaller objects. The fraction of compact disks is potentially between roughly 50% and 60% of the entire Lupus sample. Deeper observations of 12CO and 13CO at a moderate angular resolution will allow us to distinguish whether faint disks are intrinsically compact, or if they are extended but faint, without the need of resolving them. If the fainter end of the disk population observed by ALMA disk surveys is consistent with such objects being very compact, this will either create a tension with viscous spreading or require MHD winds or external processes to truncate the disks.

21. Linking ice and gas in the Lambda Orionis Barnard 35A cloud

G. Perotti, J. K. Jørgensen, H. J. Fraser, A. N. Suutarinen, L. E. Kristensen, W. R. M. Rocha, P. Bjerkeli, K. M. Pontoppidan

★ Dust grains play an important role in the synthesis of molecules in the interstellar medium, from the simplest species to complex organic molecules. How some of these solid-state molecules are converted into gas-phase species is still a matter of debate. Our aim is to directly compare ice and gas abundances of methanol (CH_3OH) and CO, and to investigate the relationship between ice and gas in low-mass protostellar envelopes. We present Submillimeter Array and Atacama Pathfinder EXperiment observations of gas-phase CH_3OH and CO towards the multiple protostellar system IRAS05417+0907 located in the B35A cloud. We use archival AKARI ice data toward the same target to calculate CH_3OH and CO gas-to-ice ratios. The CO isotopologues emissions are extended, whereas the CH_3OH emission is compact and traces the giant outflow emanating from IRAS05417+0907. A discrepancy between submillimeter dust emission and H_2O ice column density is found for B35A−4 and B35A−5, similar to what has previously been reported. B35A−2 and B35A−3 are located where the submillimeter dust emission peaks and show H_2O column densities lower than for B35A−4. The difference between the submillimeter continuum emission and the infrared H_2O ice observations suggests that the distributions of dust and H_2O ice differ around the young stellar objects in this dense cloud. The reason for this may be that the sources are located in different environments resolved by the interferometric observations: B35A−2, B35A−3 and in particular B35A−5 are situated in a shocked region plausibly affected by sputtering and heating impacting the submillimeter dust emission pattern, while B35A−4 is situated in a more quiescent part of the cloud. Gas and ice maps are essential to connect small-scale variations in the ice composition with large-scale astrophysical phenomena probed by gas observations.

23. HH 175: A Giant HH Flow Emanating From A Multiple Protostar

Bo Reipurth, Per Friberg ★ HH 175 is an isolated Herbig-Haro object seen towards the B35 cloud in the lambda Ori region. We use deep Subaru 8m interference filter images and Spitzer images to show that HH 175 is a terminal shock in a large collimated outflow from the nearby embedded source IRAS 05417+0907. The body of the eastern outflow lobe is hidden by a dense ridge of gas. The western outflow breaks out of the front of the cometary-shaped B35 cloud, carrying cloud fragments along, which are optically visible due to photoionization by the massive lambda Ori stars. The total extent of the bipolar outflow is 13.7 arcmin, which at the adopted distance of 415 pc corresponds to a projected dimension of 1.65 pc. The embedded source IRAS 05417+0907 is located on the flow axis approximately midway between the two lobes, and near-infrared images show it to be a multiple system of 6 sources, with a total luminosity of 31 Lsun. Millimeter maps in CO, 13CO, and C18O show that the B35 cloud is highly structured with multiple cores, of which the one that spawned IRAS 05417+0907 is located at the apex of B35. It is likely that the embedded source is the result of compression by an ionization-shock front driven by the lambda Ori OB stars.