APPENDIX

A. CHAMP ISO-CO COMPOSITE IMAGES, LINE RATIOS, AND X-FACTORS

For each Region, we show here two 3-colour overlays of 2D projected integrals from the respective 3D line data cubes, plus another map and three plots from the analysis of the line cube data (sometimes spread over 2 *Journal* pages). The top or top-left panel is an overlay of the velocity-integrated intensity (0th moment) for ^{12}CO (red), ^{13}CO (green), and C^{18}O (blue). The second or top-right panel is a similar overlay but integrated across one spatial coordinate, so a 3-colour position-velocity diagram (either lV or Vb, depending on the Region). For both of these panels, grey contours are in $N_{^{12}\text{CO}}$ at intervals of 10%–20% of the peak (see Appendix B or C for numerical scales), and labelled white ellipses in the first panel show the clumps' half-power sizes and orientations as measured in ^{12}CO from Paper III.

The third panel plots, in the iso-CO ratio-ratio diagram (RRD), the distribution of voxels with high S/N data in all three cubes, similarly to Figure 2. The curved grid lines in R_{18} and τ_{18} indicate loci of the radiative transfer solutions, as labelled. The fourth panel plots the ratio $N_{^{12}\text{CO}}/I_{^{12}\text{CO}}$ vs $I_{^{12}\text{CO}}$ for all voxels which allow an $N_{^{12}\text{CO}}$ solution, similarly to Figure 5. This is mostly limited by a S/N threshold in the ^{13}CO data; therefore, this panel shows more points than the third panel. The curved black grid lines again indicate loci of the radiative transfer solutions, this time in τ_{12} and T_{ex}. The parameters labelled in red are for a power-law fit to the binned data, typically above a 10σ $I_{^{12}\text{CO}}$ noise limit (solid red and green curves); below this, the distribution of points becomes less complete and no fit is made (dotted curves). These red and green curves respectively connect the I-bins' mean and $\pm\sigma$ $N_{^{12}\text{CO}}/I_{^{12}\text{CO}}$ values.

The fifth panel gives a map of the equivalent X factor formed from the ratio of integrals $\int N_{^{12}\text{CO}}\,dV / \int I_{^{12}\text{CO}}\,dV$ across the line emission in each pixel, and overlaid by the same $N_{^{12}\text{CO}}$ contours and ellipses as in the first panel. Finally, the sixth panel plots this integral X factor vs the velocity-integrated (moment-0) $I_{^{12}\text{CO}}$ for each pixel, analogously to panel four except for the integrations. In this panel, no radiative transfer grid is shown since the integration range varies from pixel to pixel, effectively smearing the gridlines along the x axis.
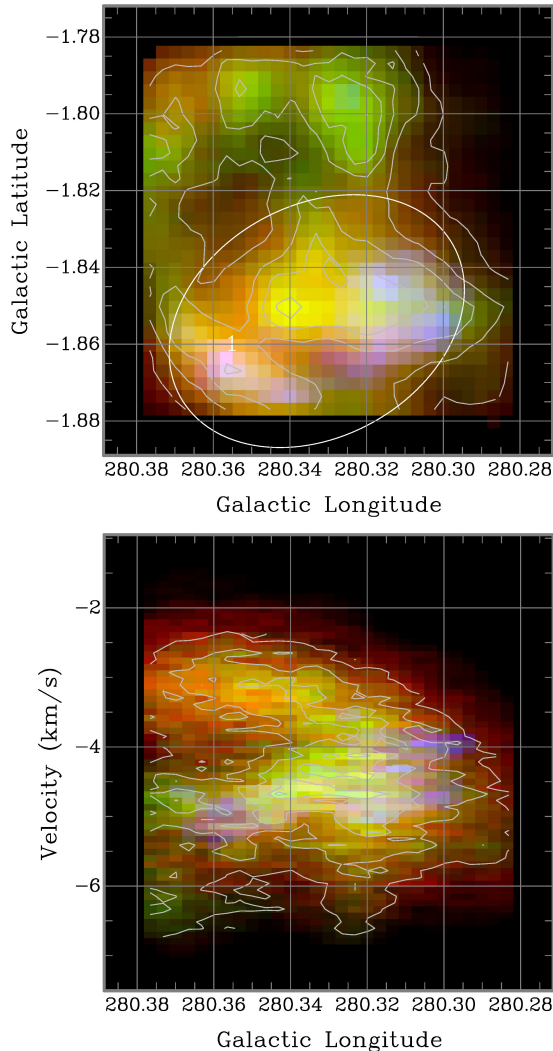

Figure A1. BYF 1. At an assumed distance of 3.2 kpc, the scale is $0°{.}1 = 5.6$ pc.
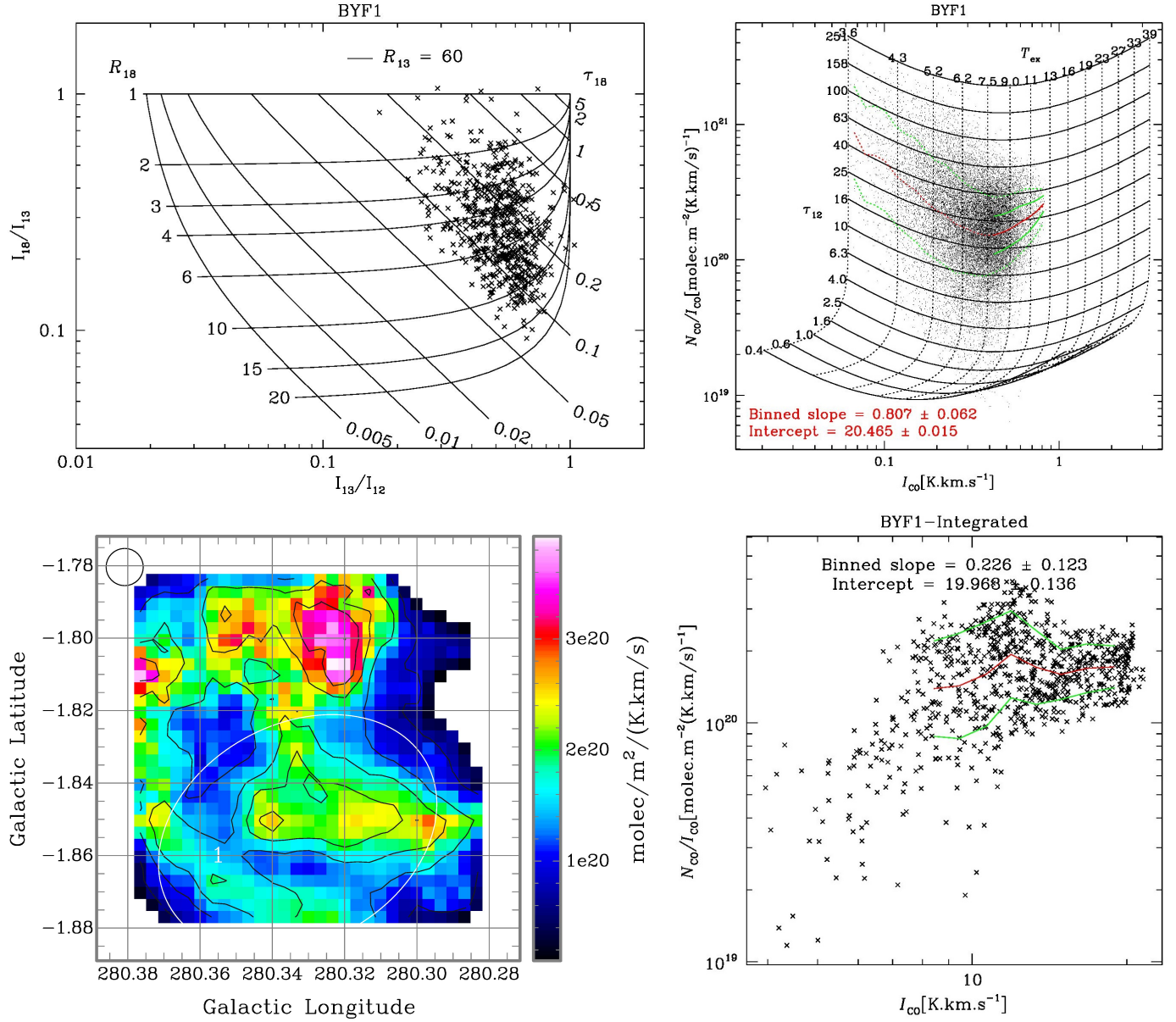
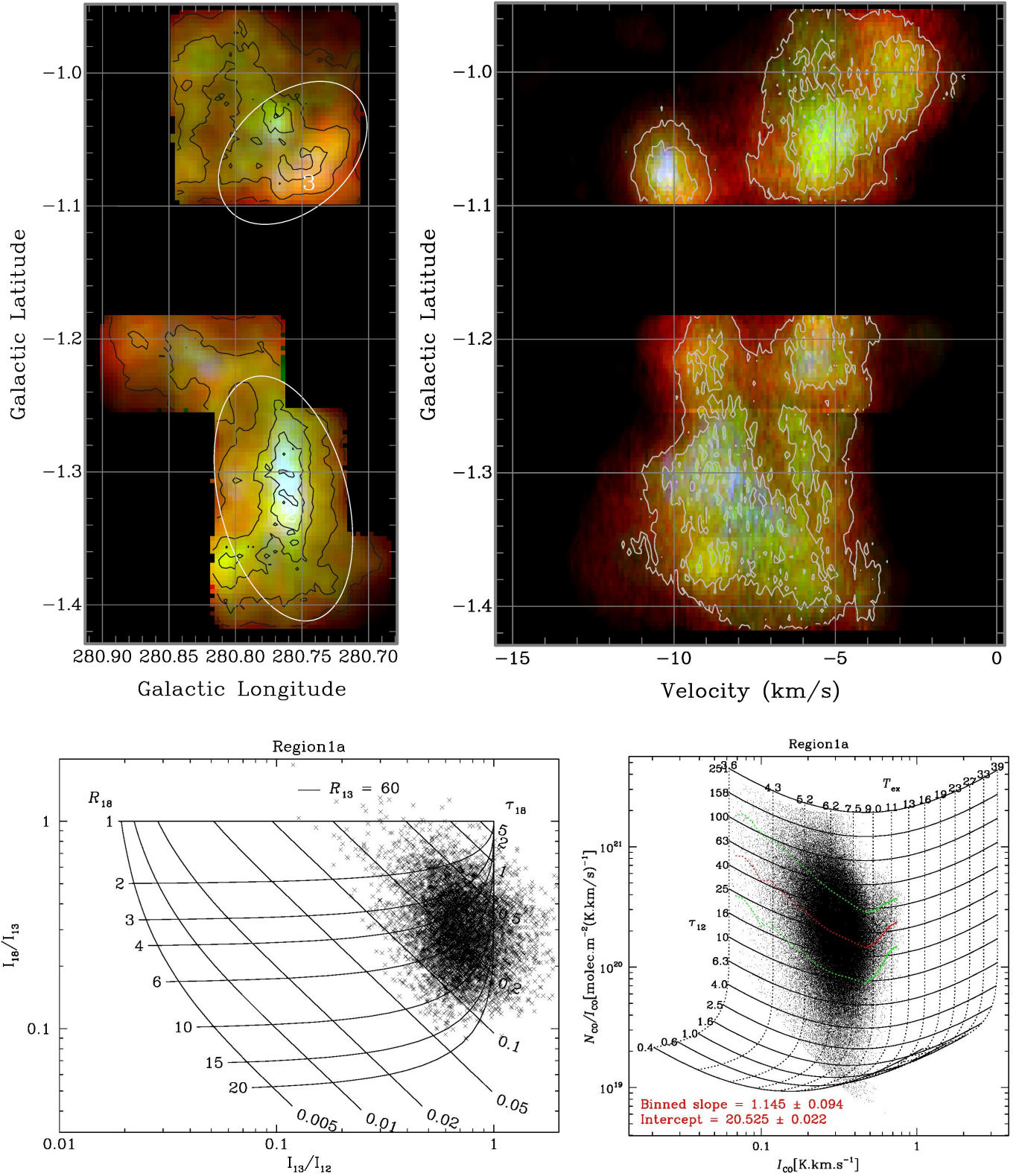**Figure A2.** BYF 1 *continued*. The Mopra HPBW is shown in the TL corner.

Figure A3. BYF 2 & 3 (Region 1a). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc.
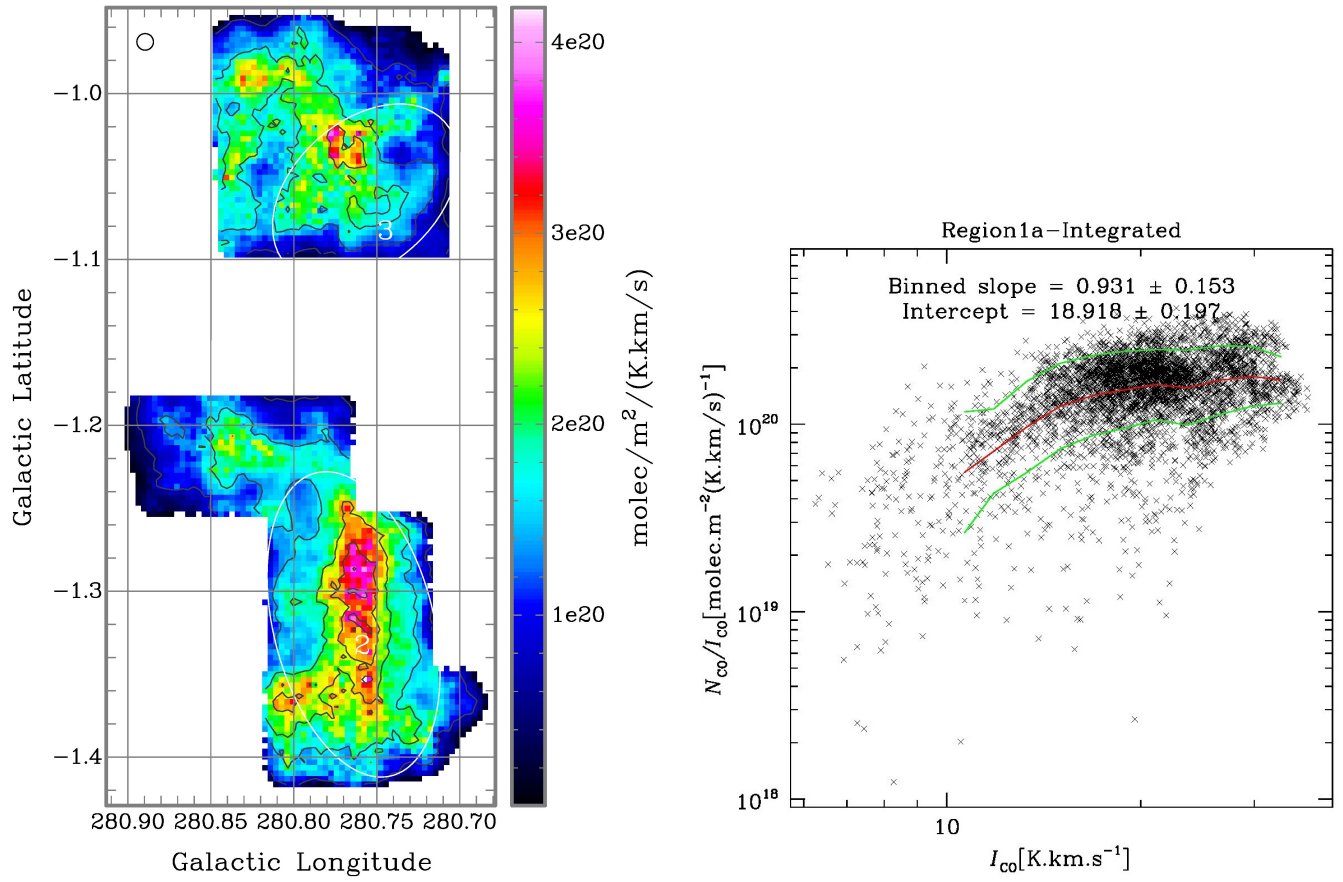
Figure A4. BYF 2 & 3 (Region 1a) *continued.* The Mopra HPBW is shown in the TL corner.
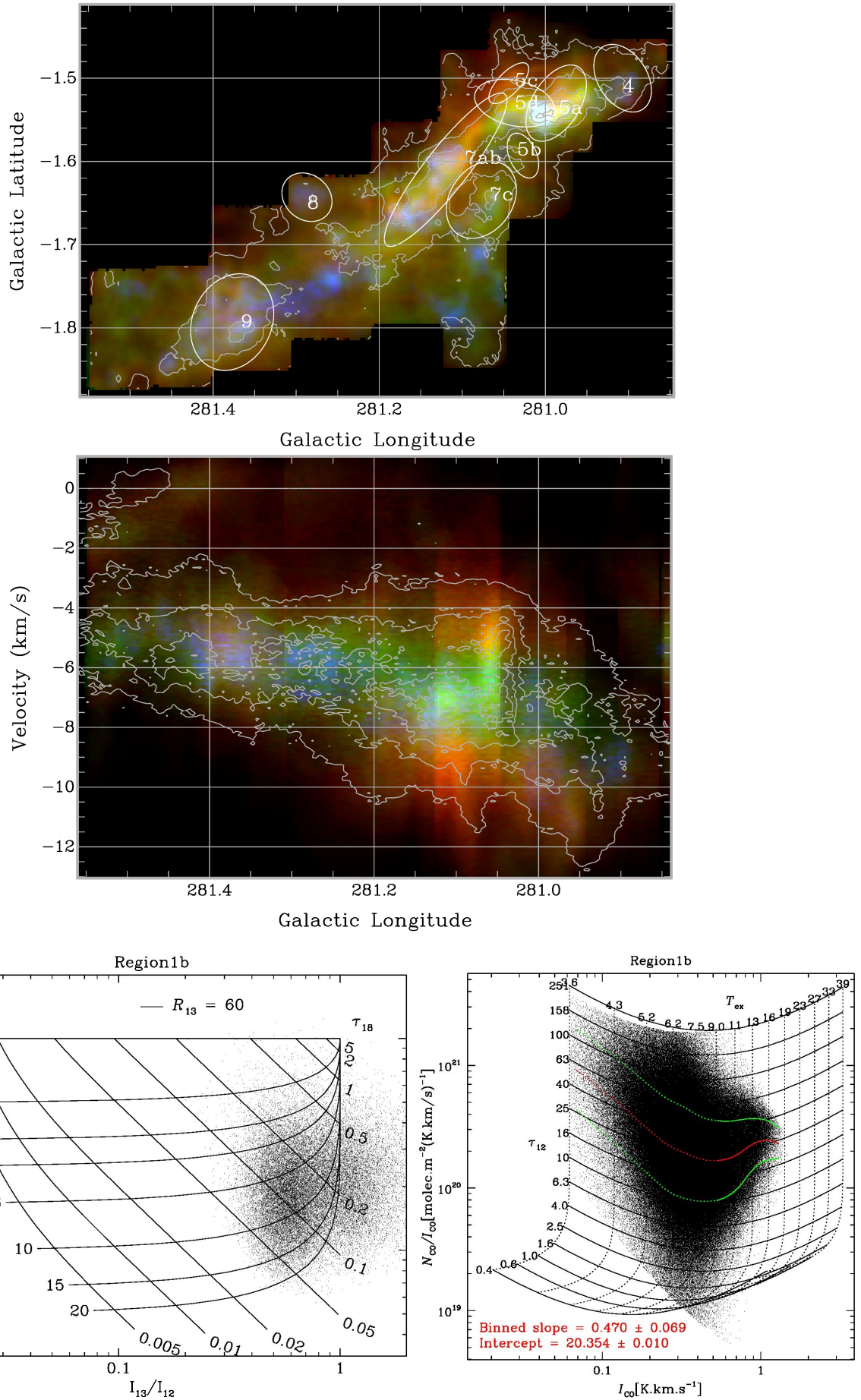
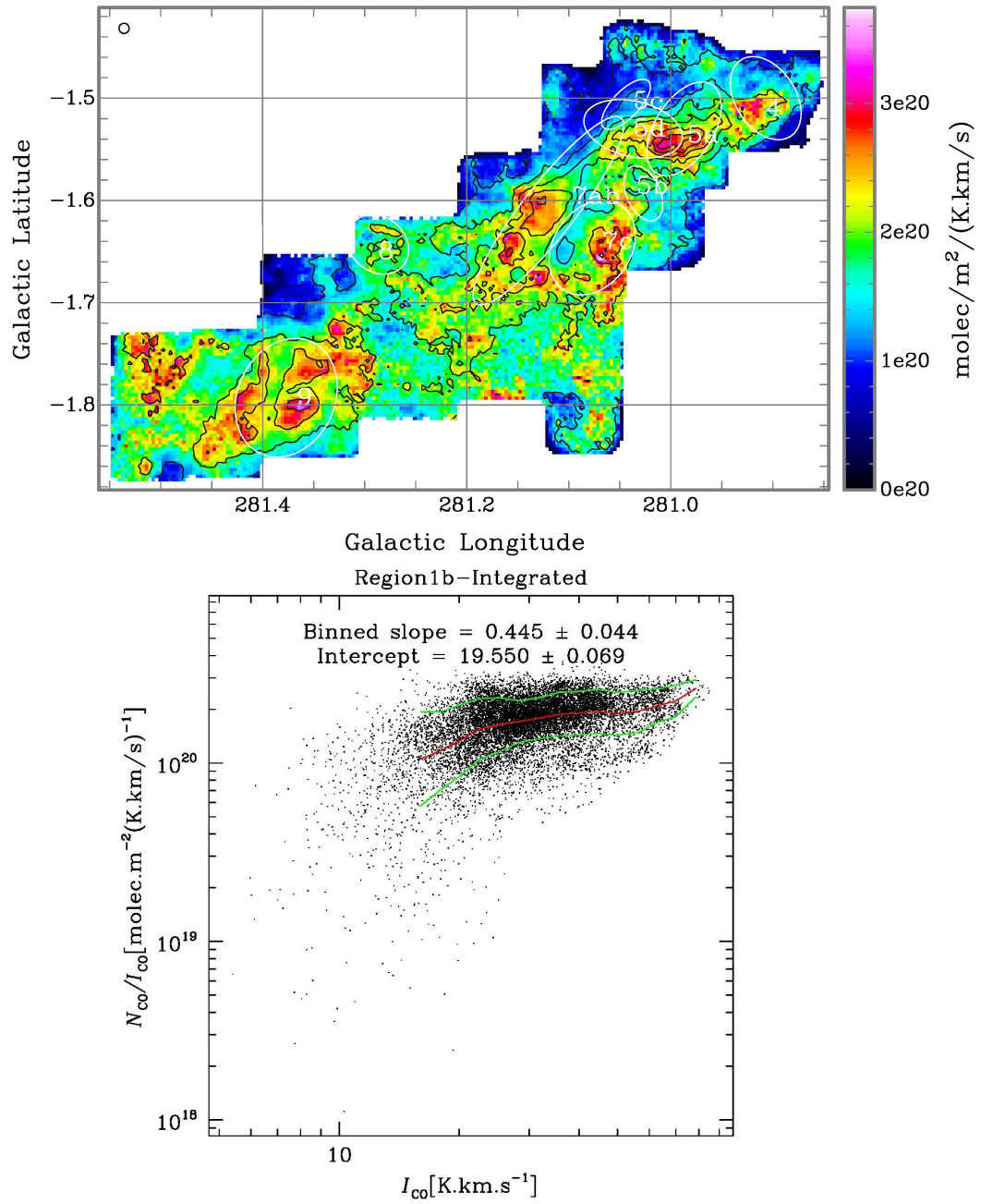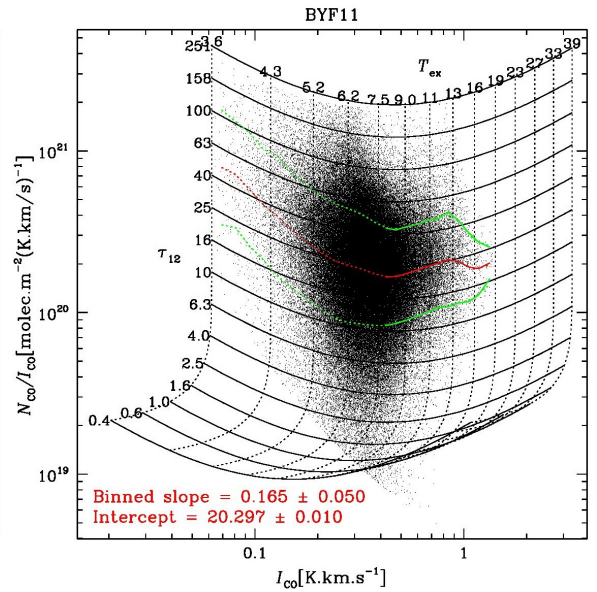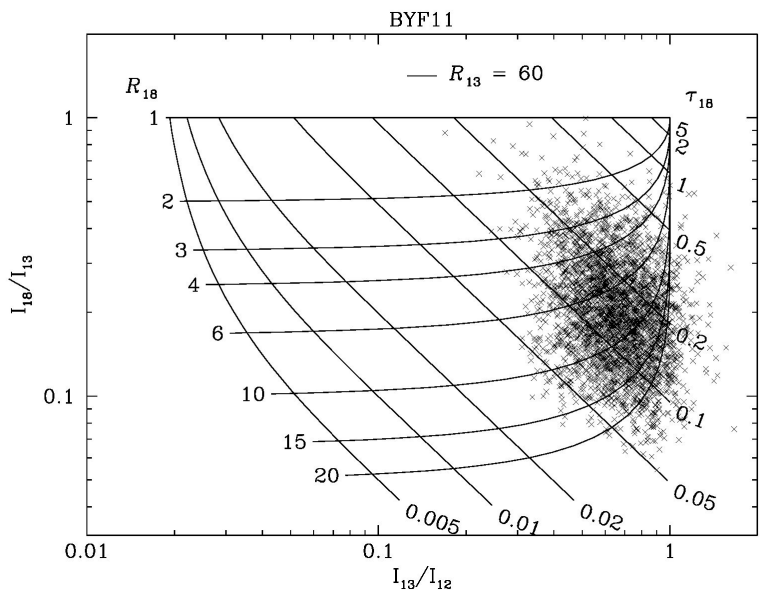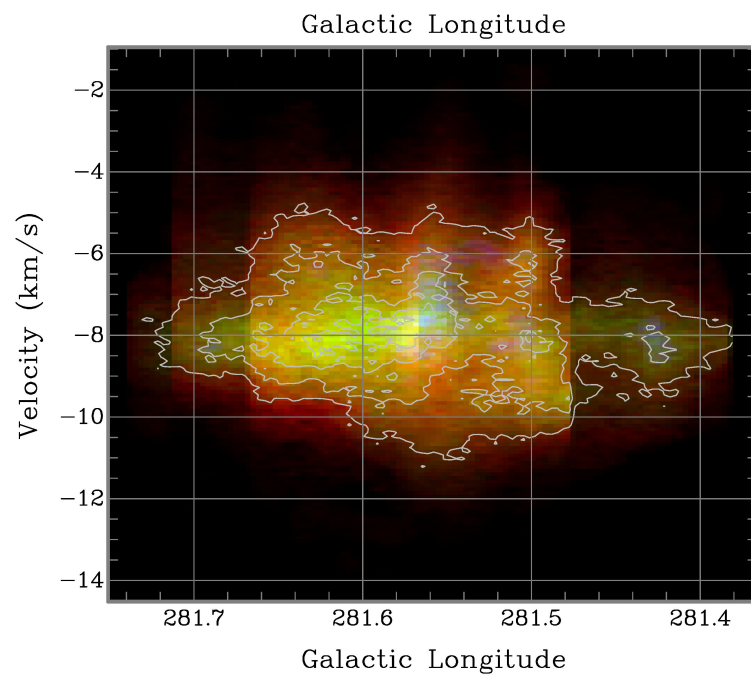**Figure A5.** BYF 4–9 (Region 1b). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc.

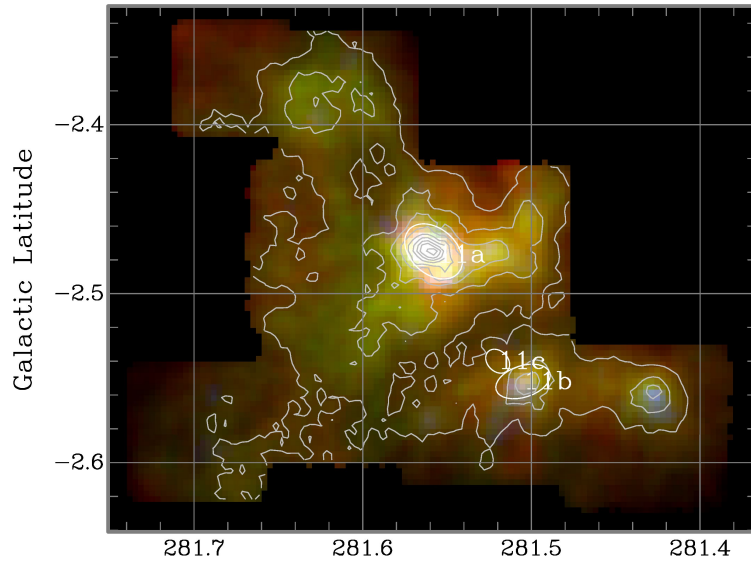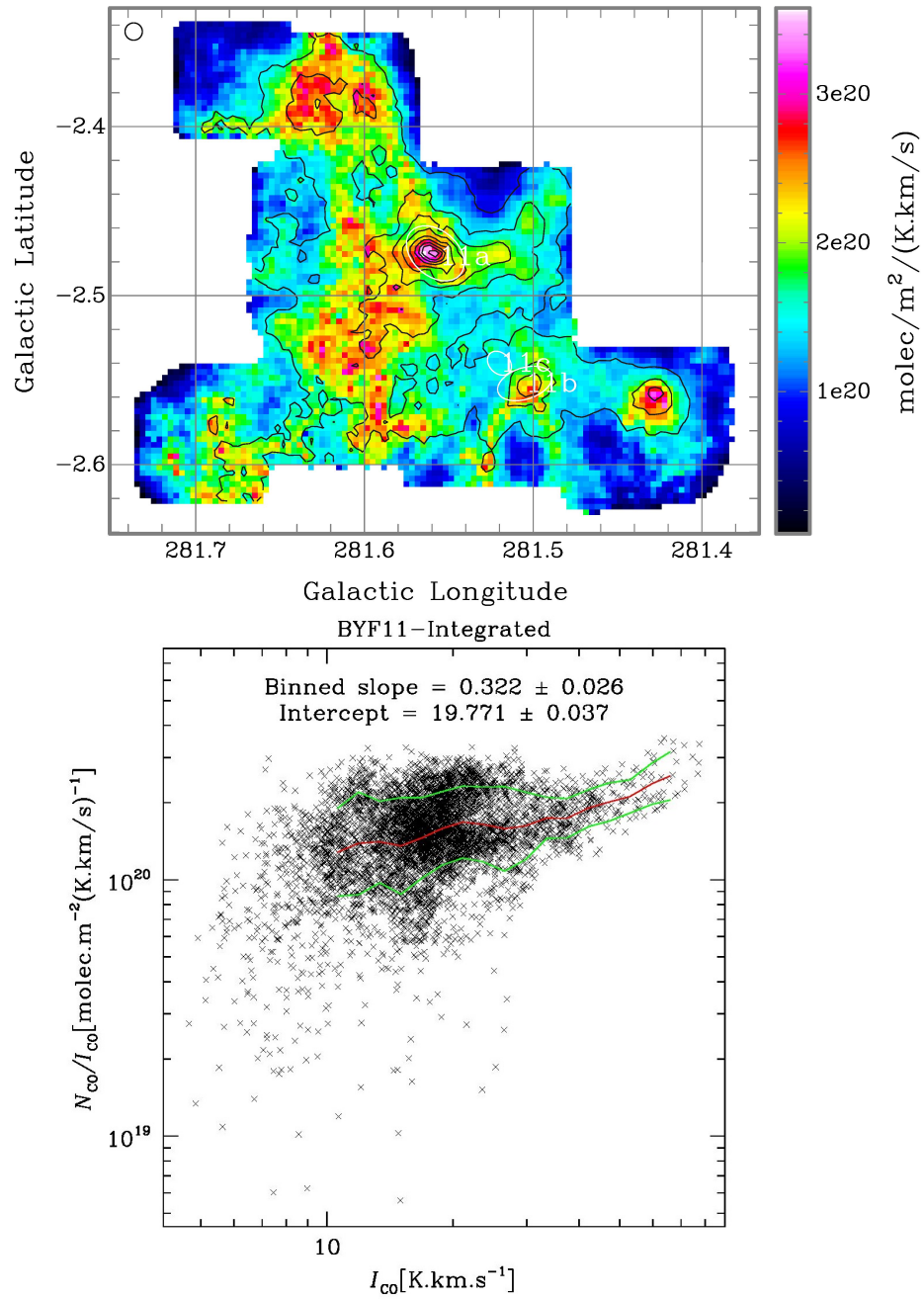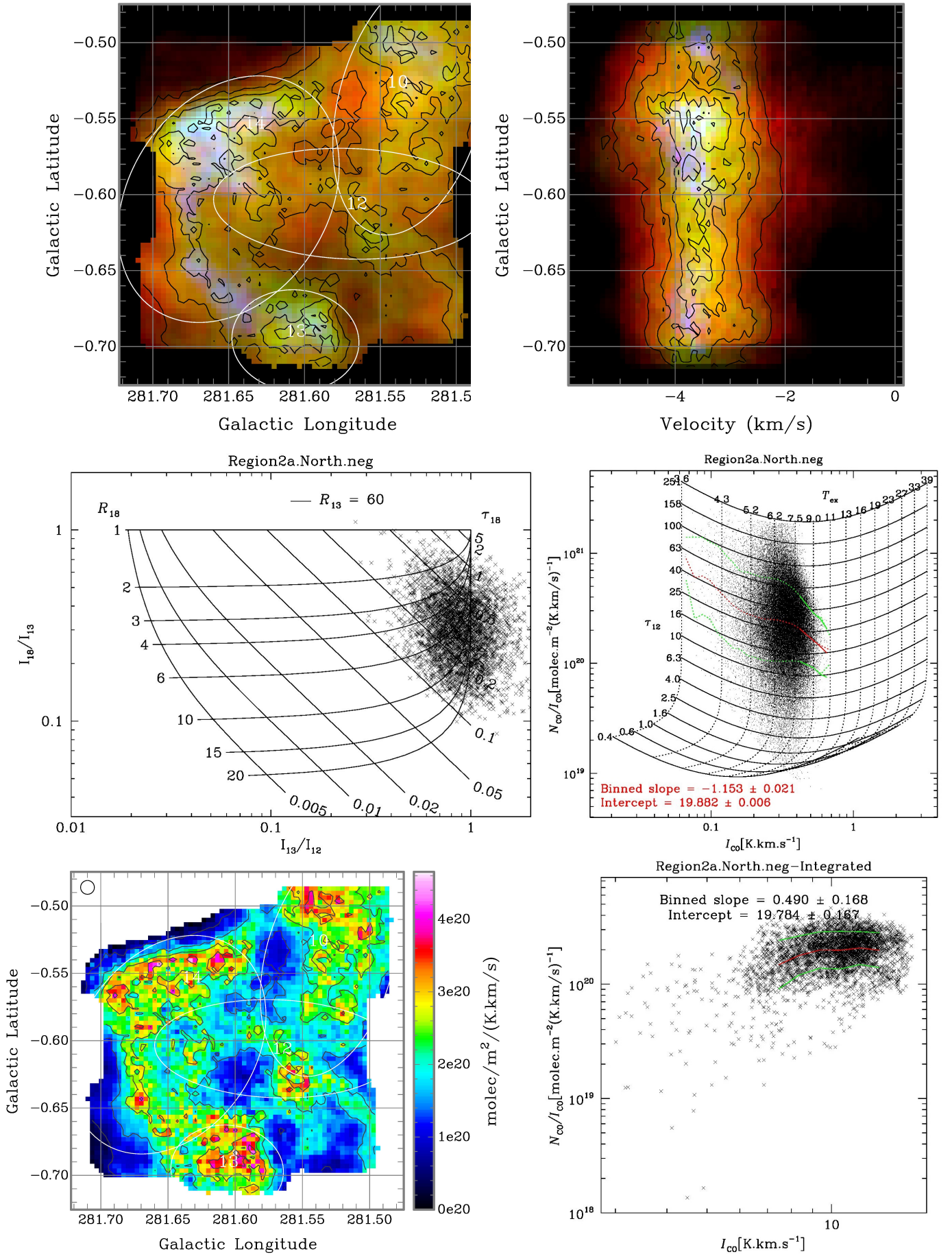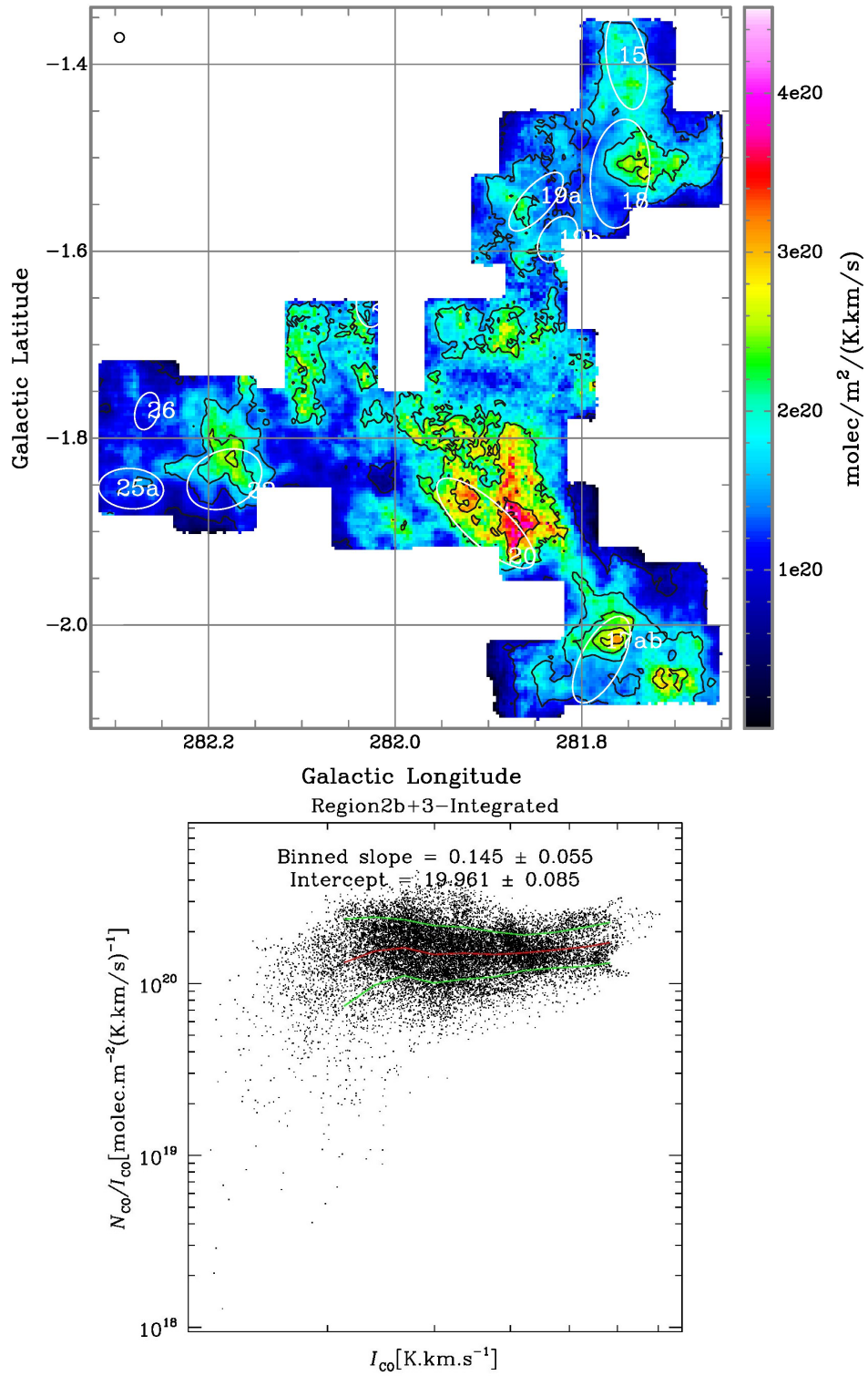**Figure A6.** BYF 4–9 (Region 1b) *continued*. The Mopra HPBW is shown in the TL corner.

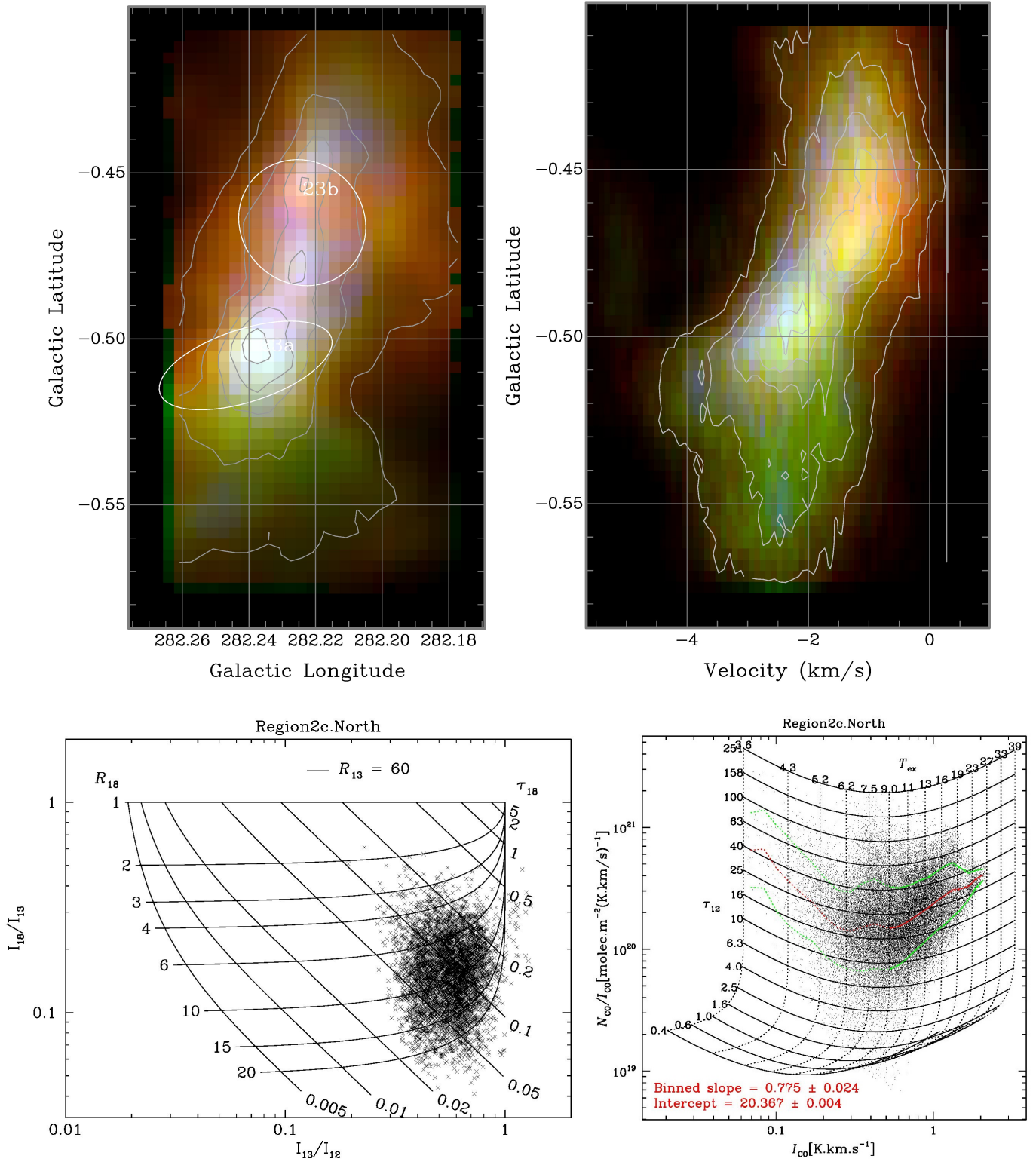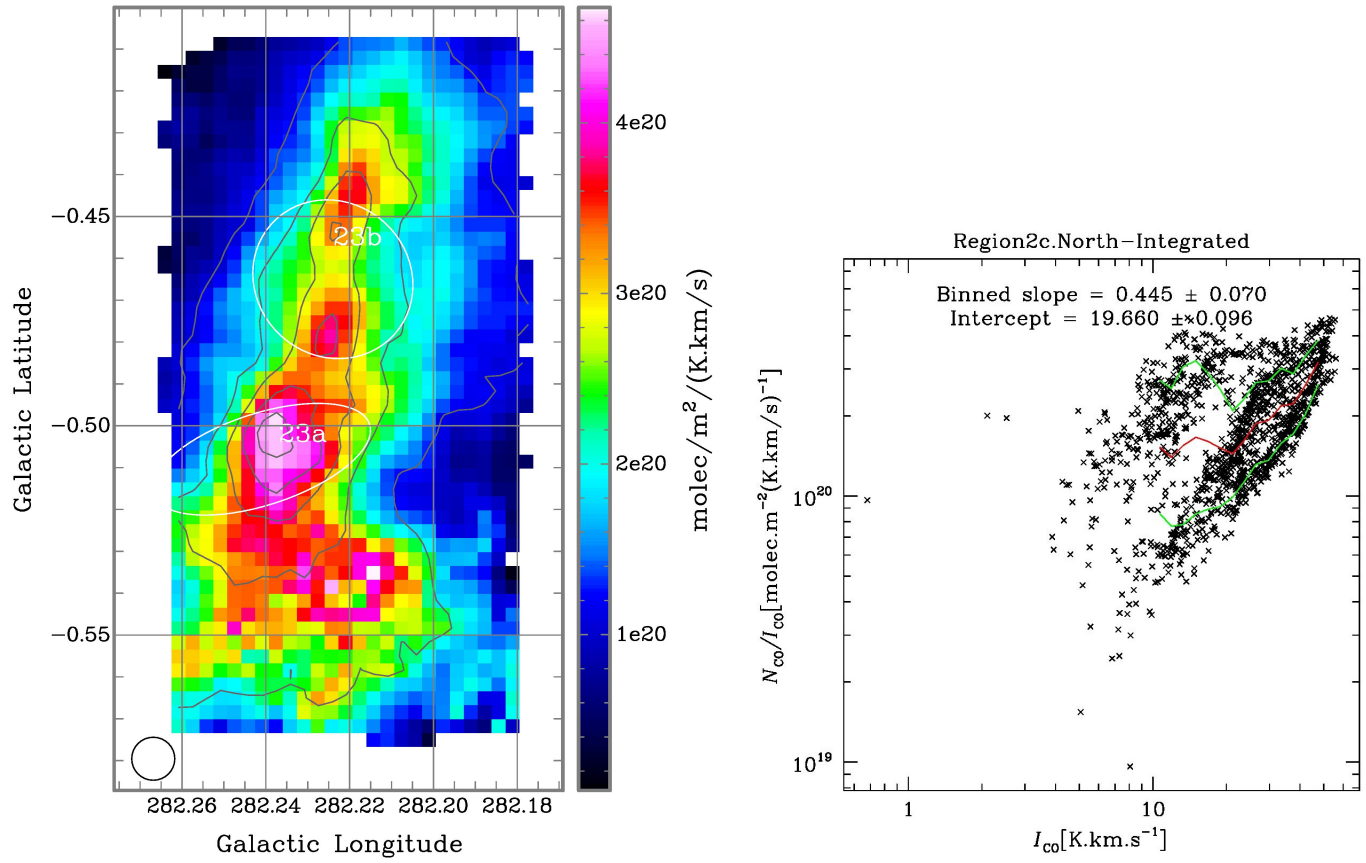**Figure A7.** BYF 11. At an assumed distance of 3.2 kpc, the scale is $0°.1 = 5.6$ pc.

Figure A8. BYF 11 *continued*. The Mopra HPBW is shown in the TL corner.
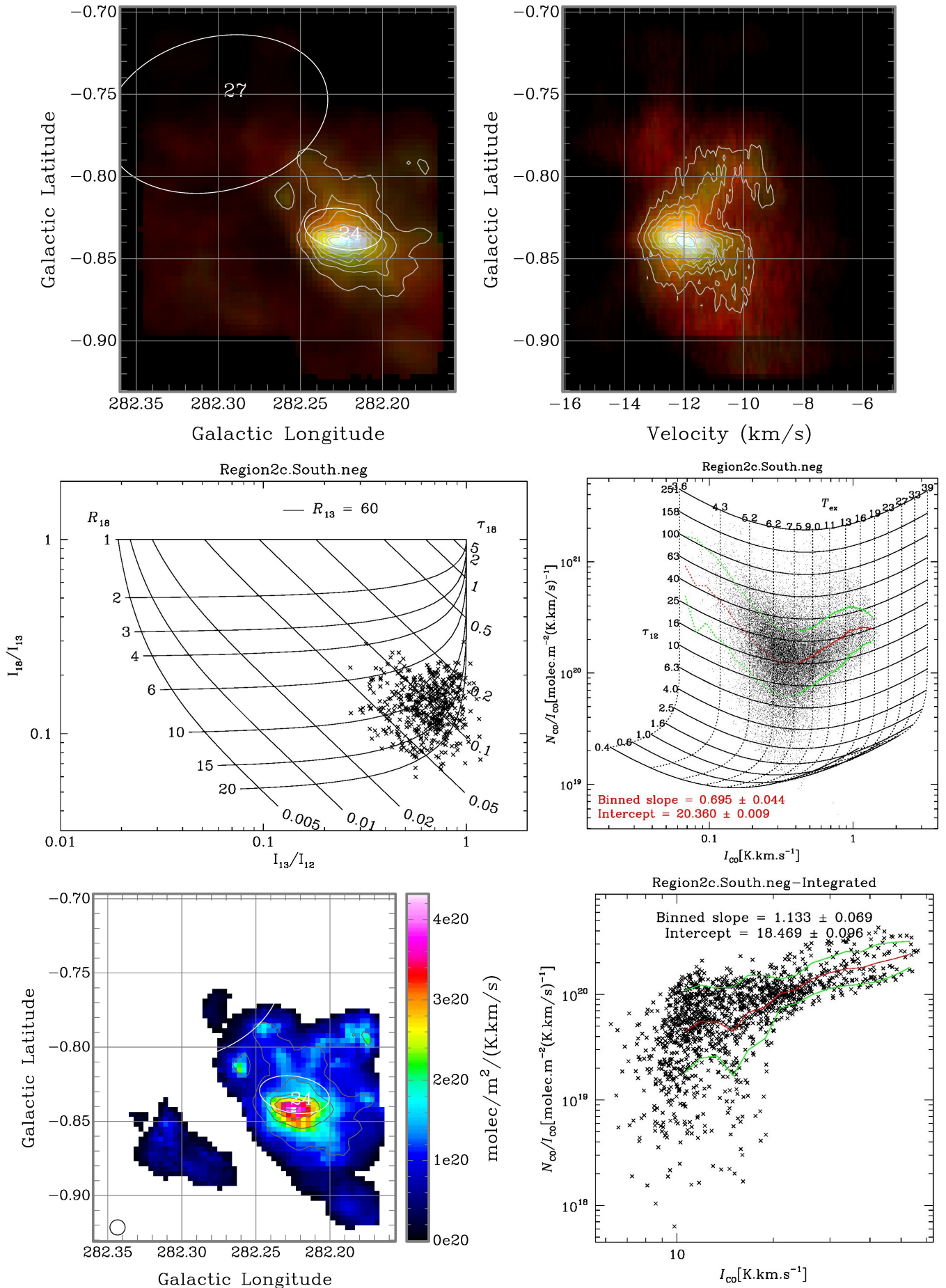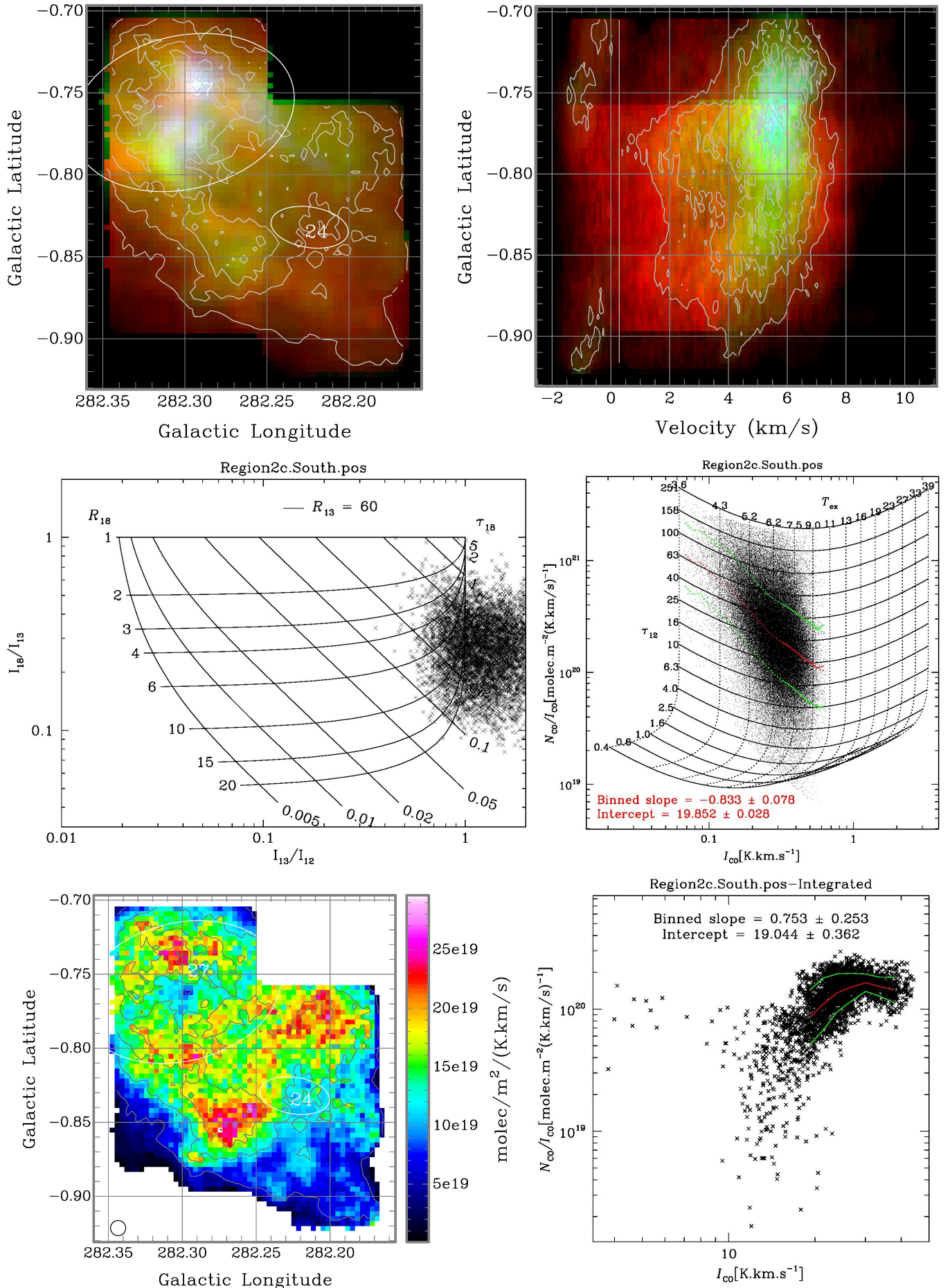
Figure A9. BYF 10, 13, 14 (Region 2a-North). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc. The Mopra HPBW is shown in the TL corner.
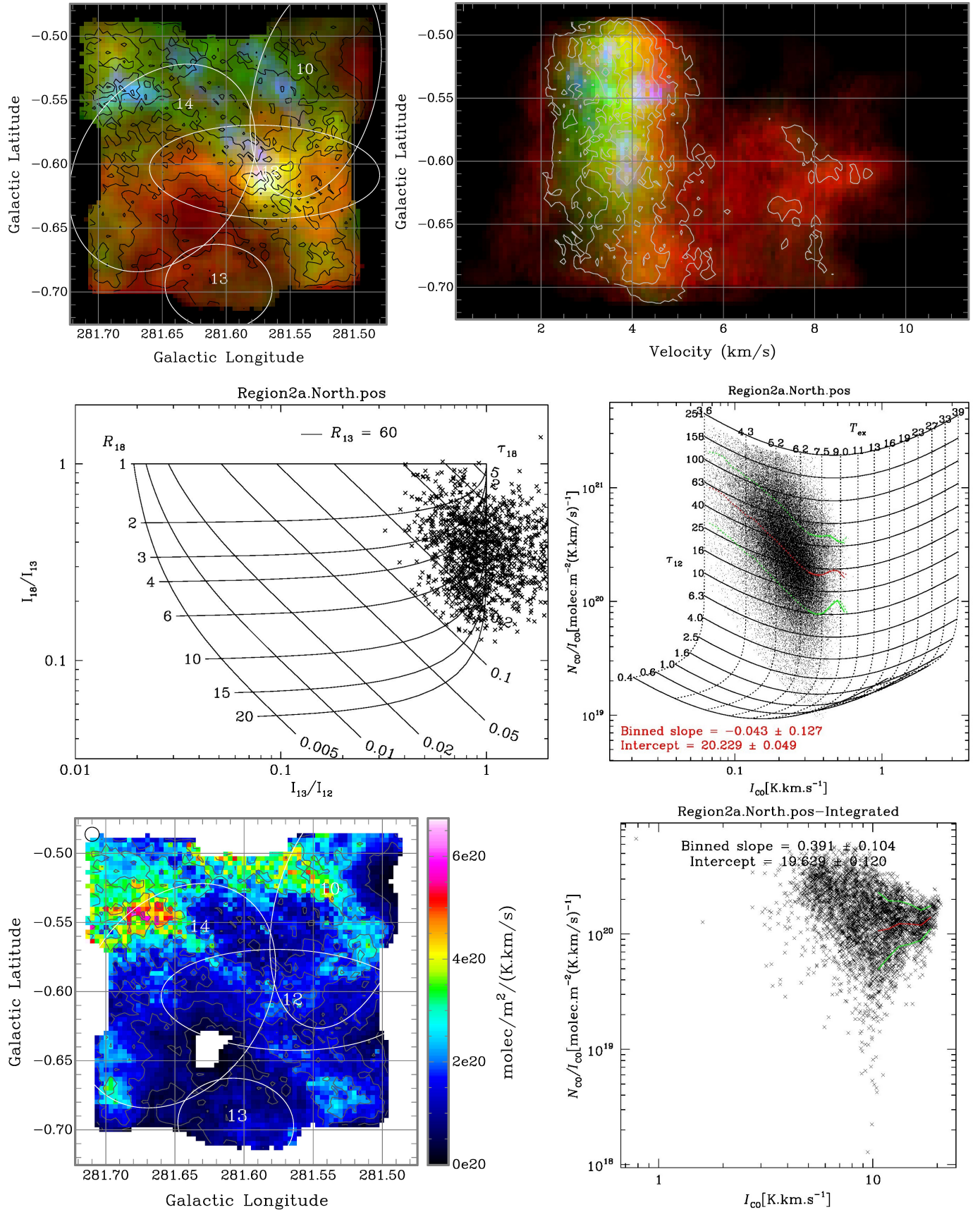
Figure A10. BYF 12 (Region 2a-North). At an assumed distance of 3.2 kpc, the scale is 0°1 = 5.6 pc. The Mopra HPBW is shown in the TL corner.
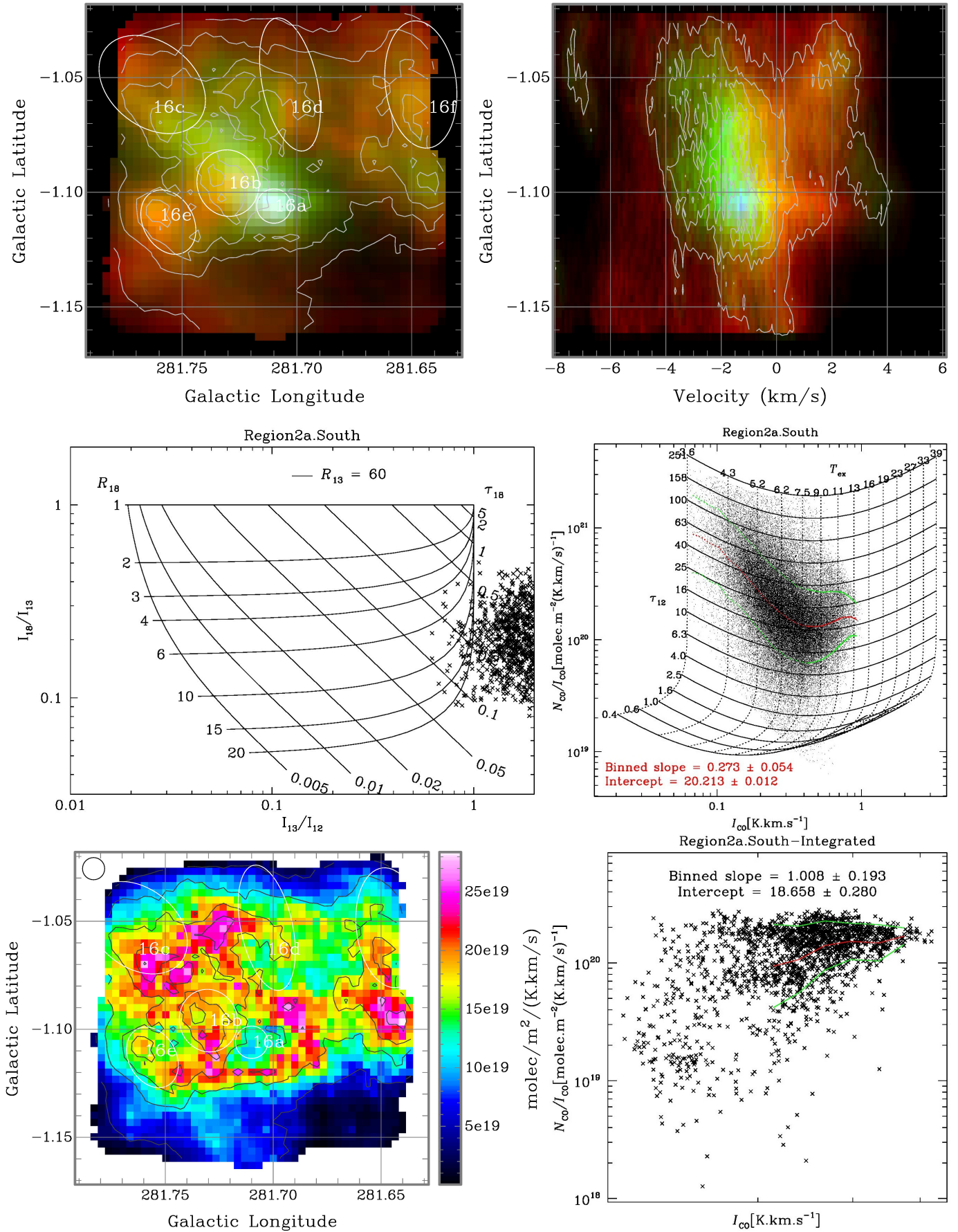
Figure A11. BYF 16 (Region 2a-South). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc. The Mopra HPBW is shown in the TL corner.
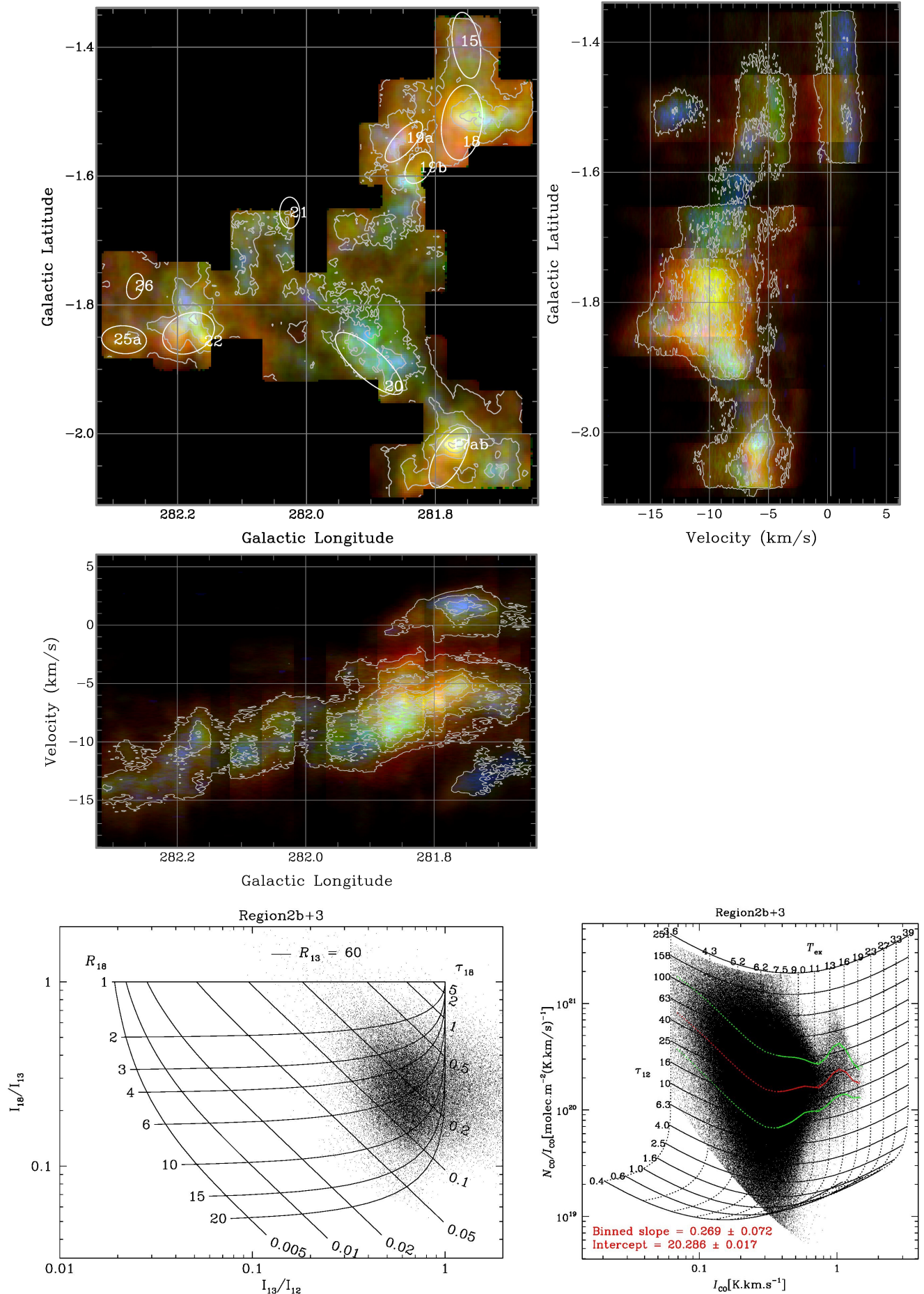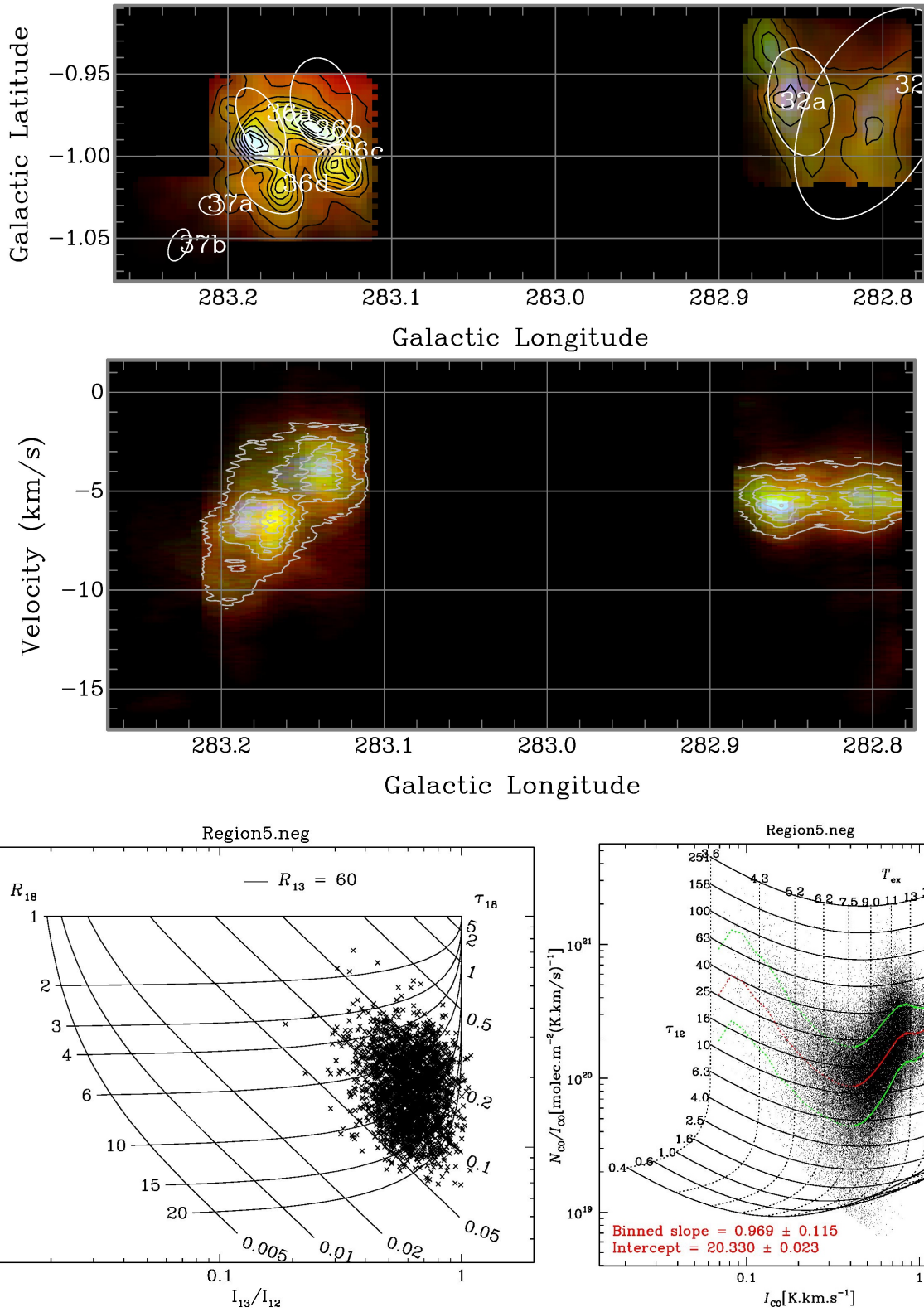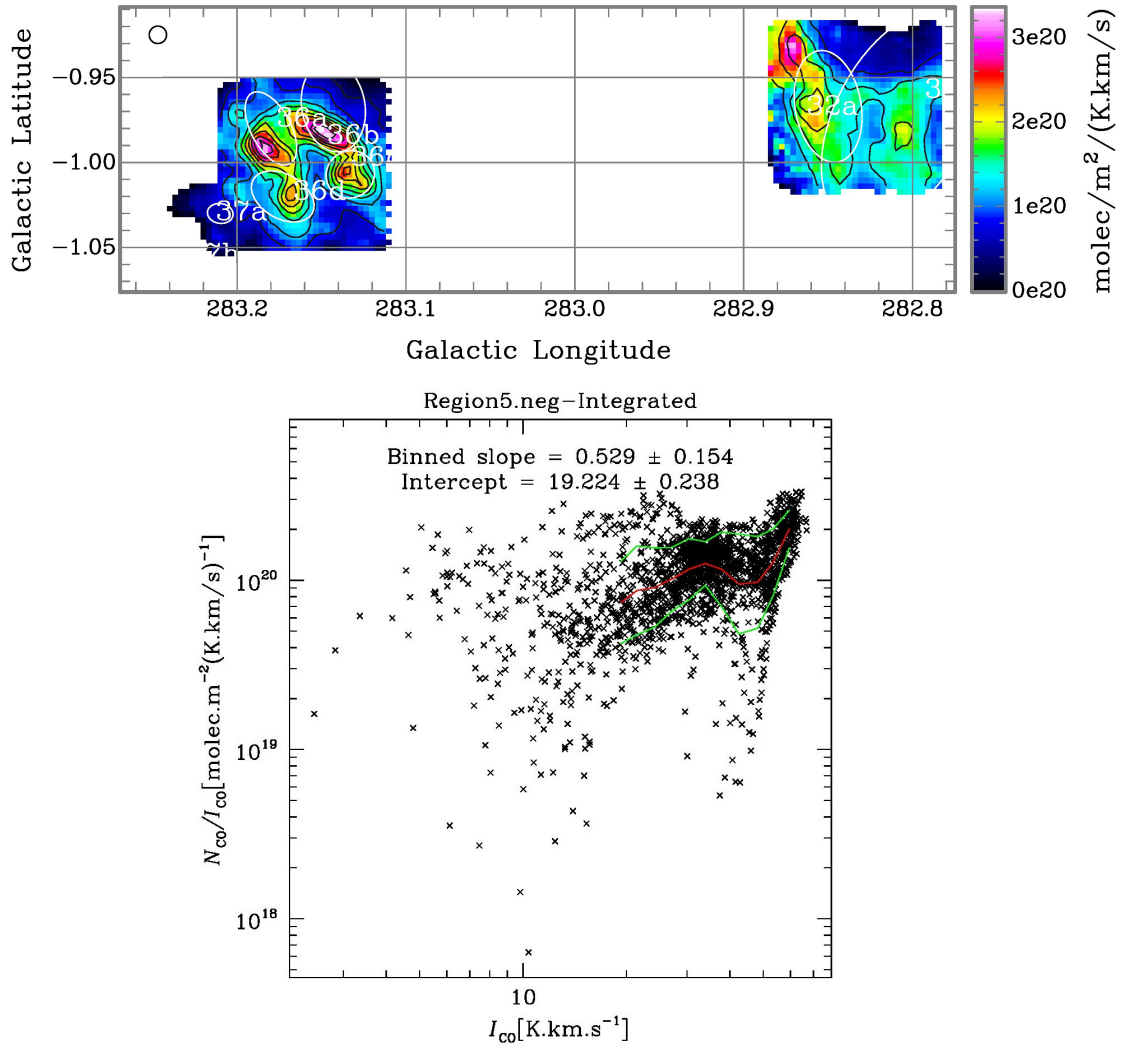
Figure A12. BYF 15, 17–22, & 25–26 (Regions 2b+3). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc.

Figure A13. BYF 15, 17–22, & 25–26 (Regions 2b+3) *continued.* The Mopra HPBW is shown in the TL corner.
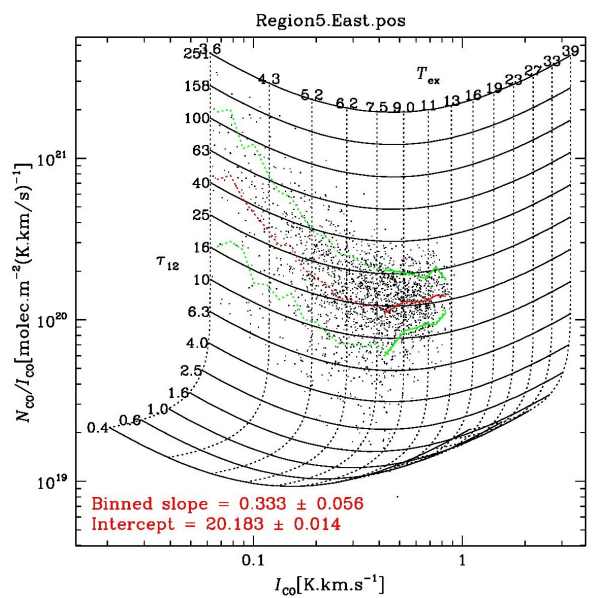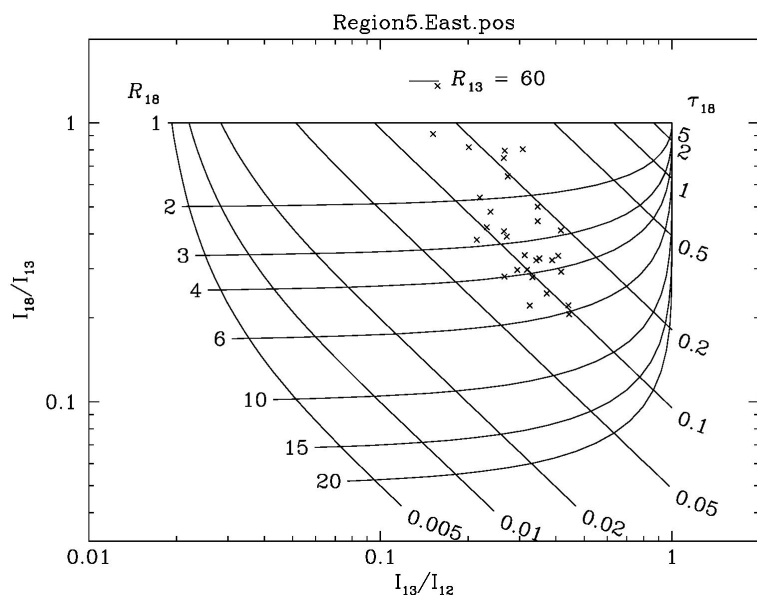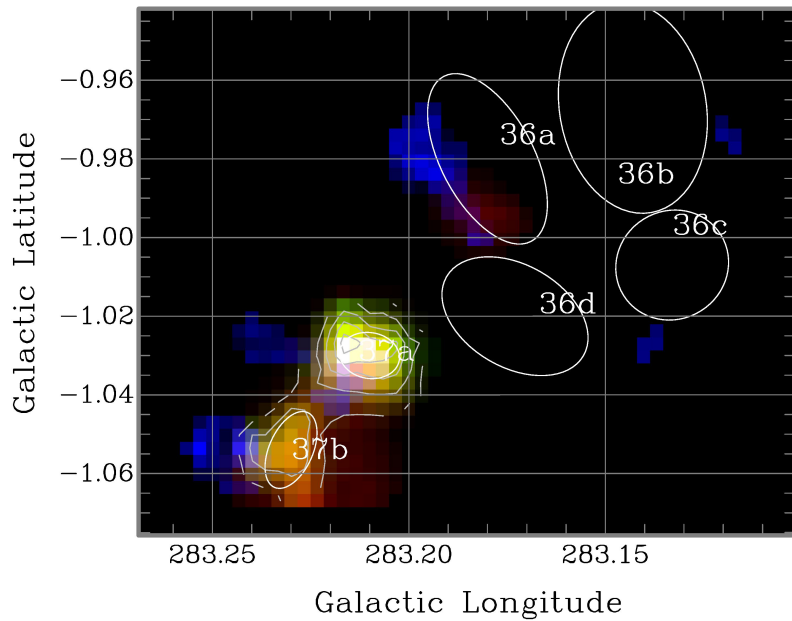
Figure A14. BYF 23 (Region 2c-North). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc.

Figure A15. BYF 23 (Region 2c-North) *continued*. The Mopra HPBW is shown in the BL corner.

**Figure A16.** BYF 24 (Region 2c-South). At an assumed distance of 3.2 kpc, the scale is 0°1 = 5.6 pc. The Mopra HPBW is shown in the BL corner.

Figure A17. BYF 27 (Region 2c-South). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc. The Mopra HPBW is shown in the BL corner.

Figure A18. BYF 32 & 36 (Region 5). At an assumed distance of 3.2 kpc, the scale is 0°1 = 5.6 pc.

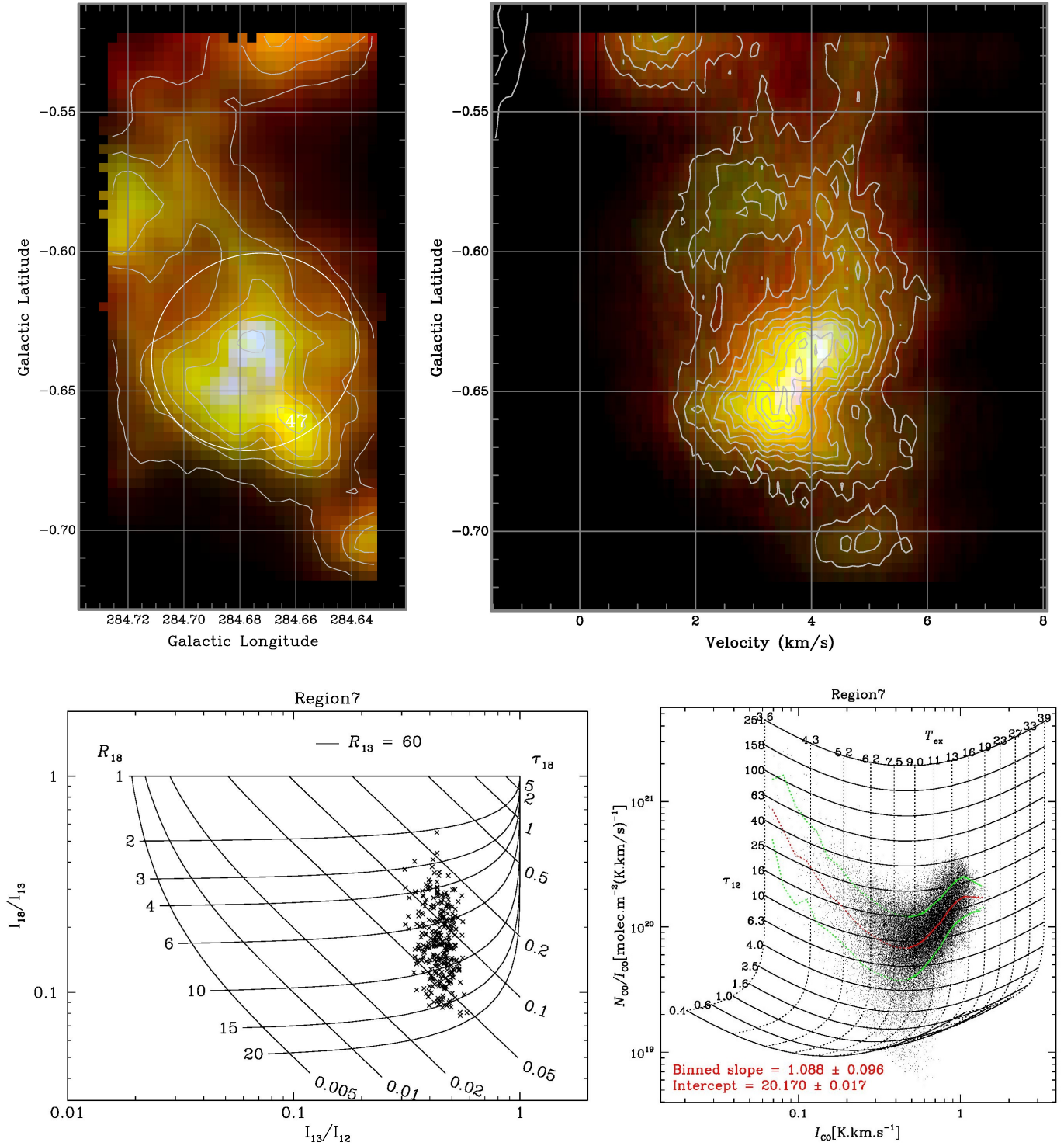**Figure A19.** BYF 32 & 36 (Region 5) *continued*. The Mopra HPBW is shown in the TL corner.
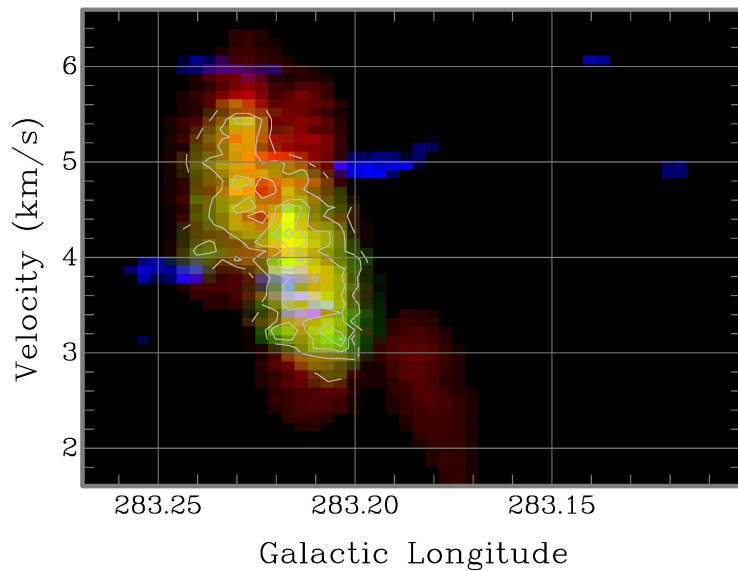
Figure A20. BYF 37 (Region 5-East). At an assumed distance of 3.2 kpc, the scale is 0°.1 = 5.6 pc.
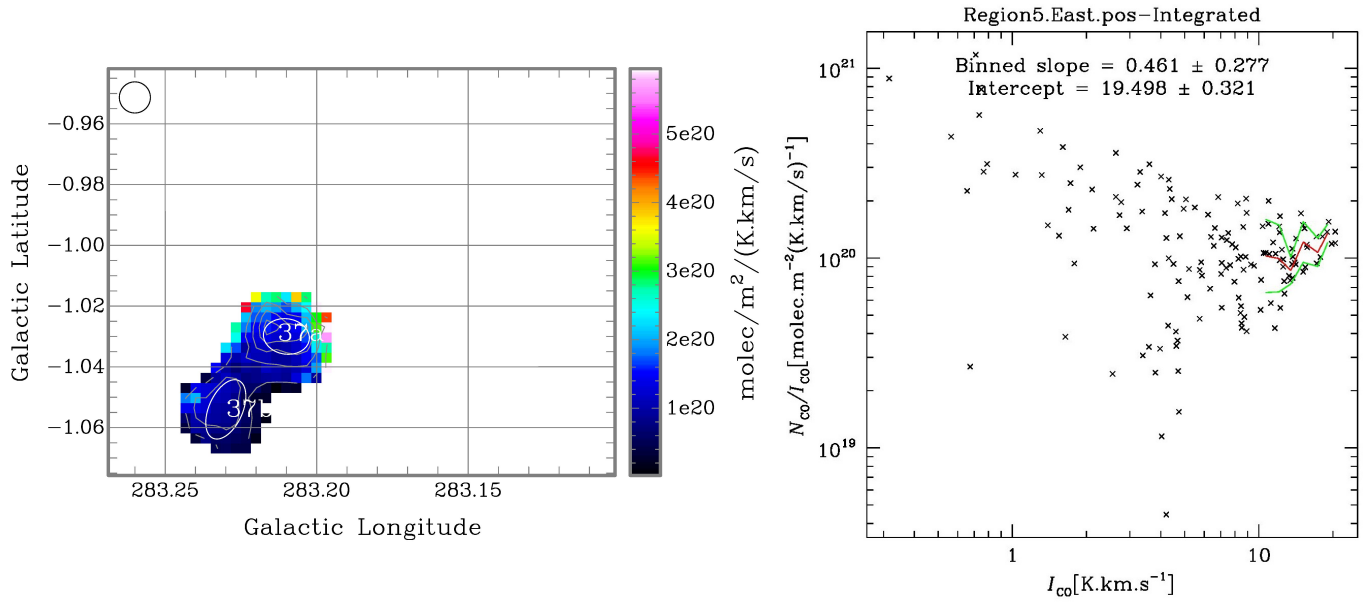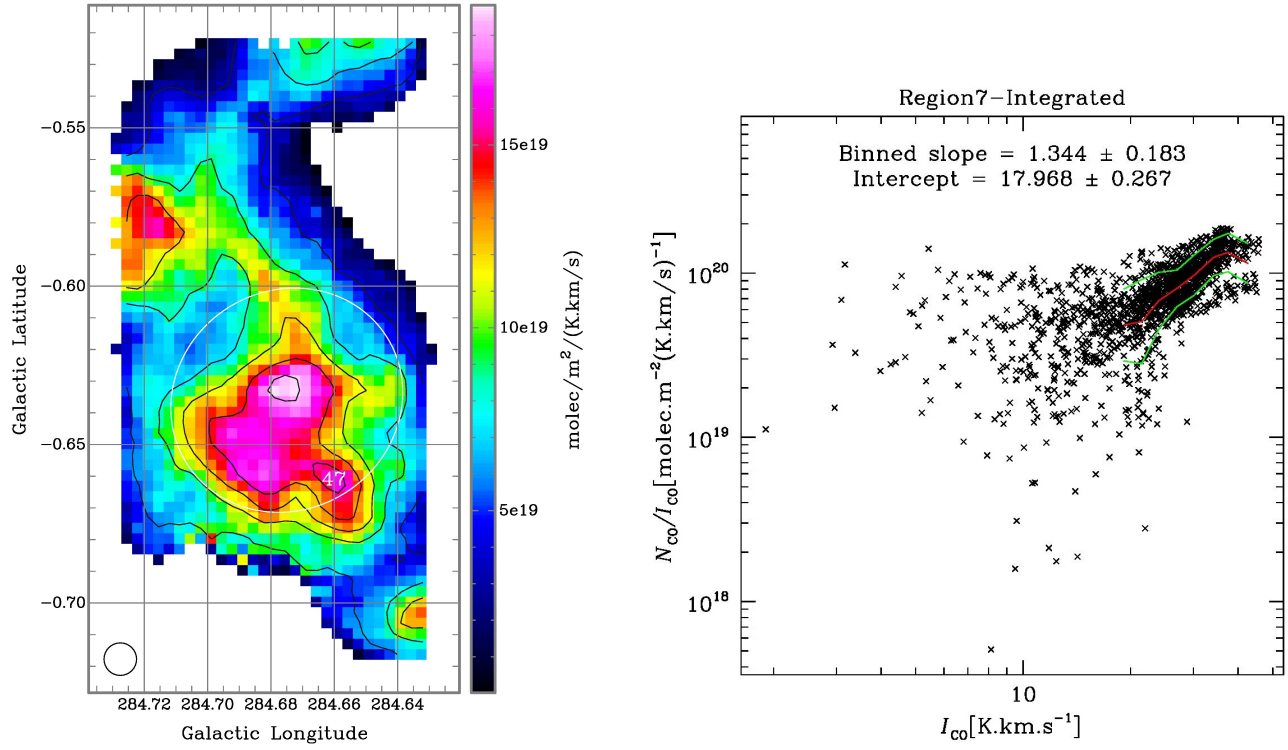
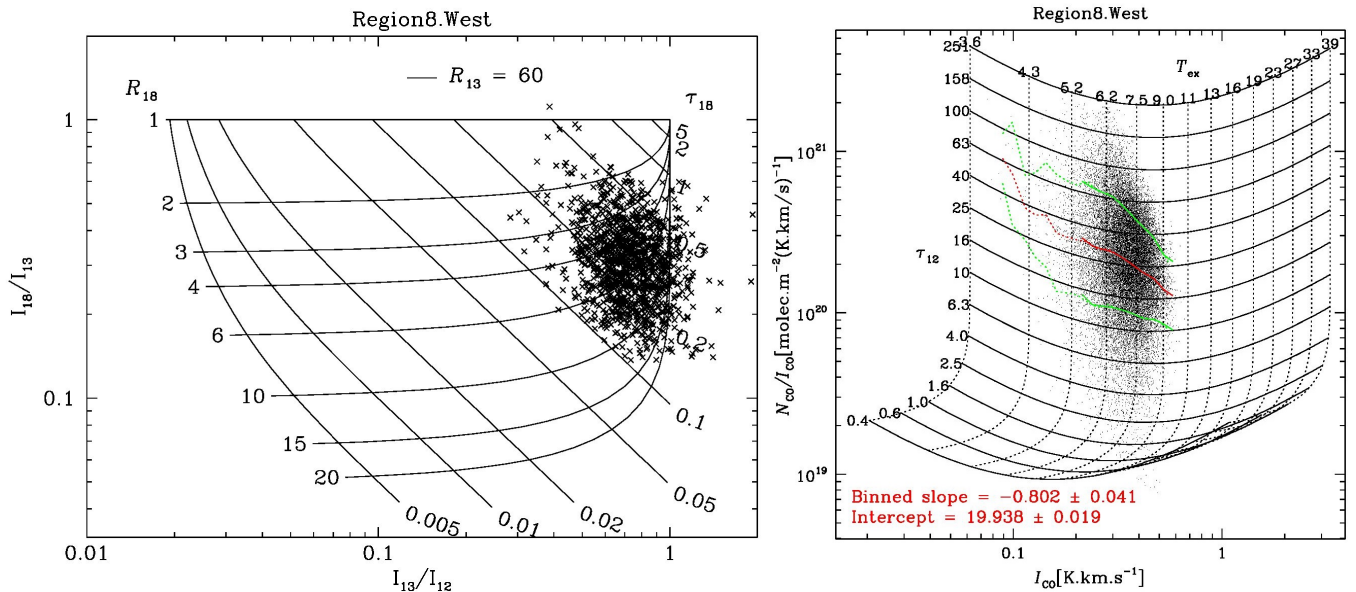**Figure A21.** BYF 37 (Region 5-East) *continued.* The Mopra HPBW is shown in the TL corner.

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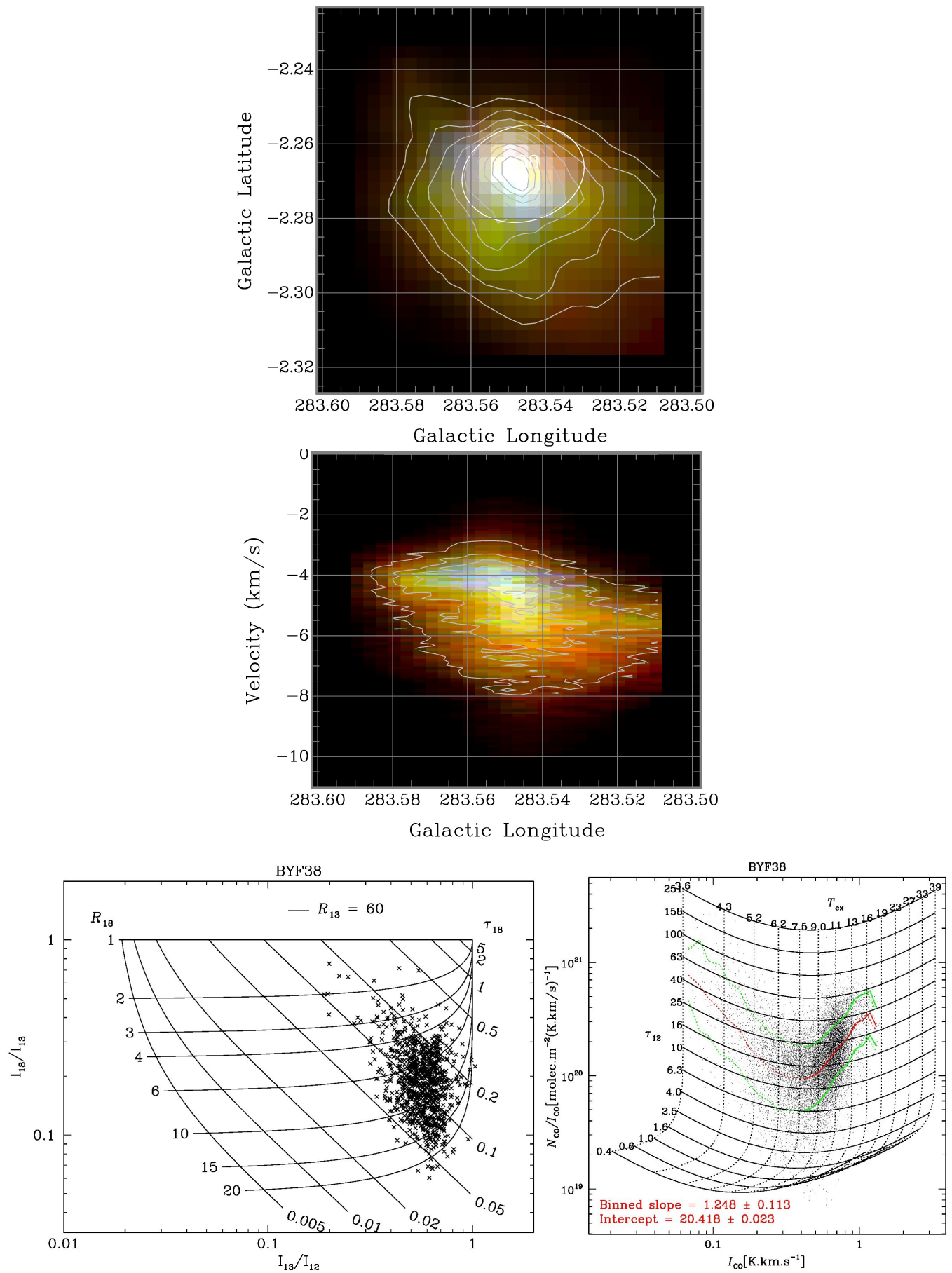
Figure A22. BYF 38. At an assumed distance of 2.0 kpc, the scale is 0°.1 = 3.5 pc.
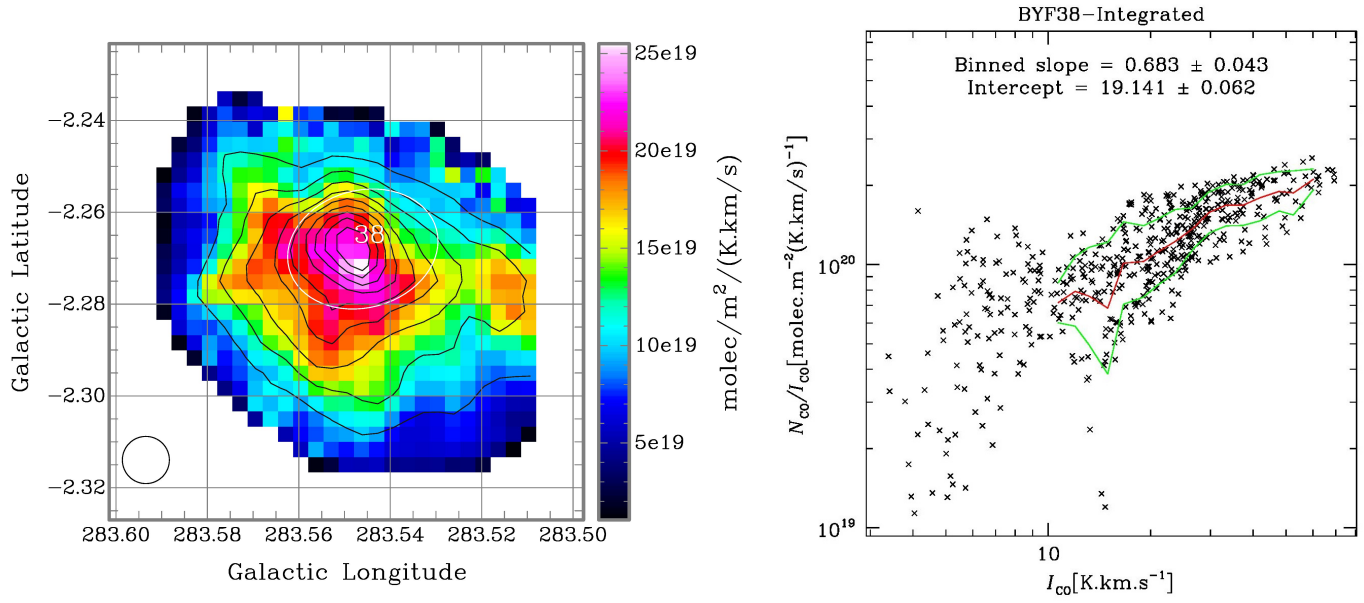
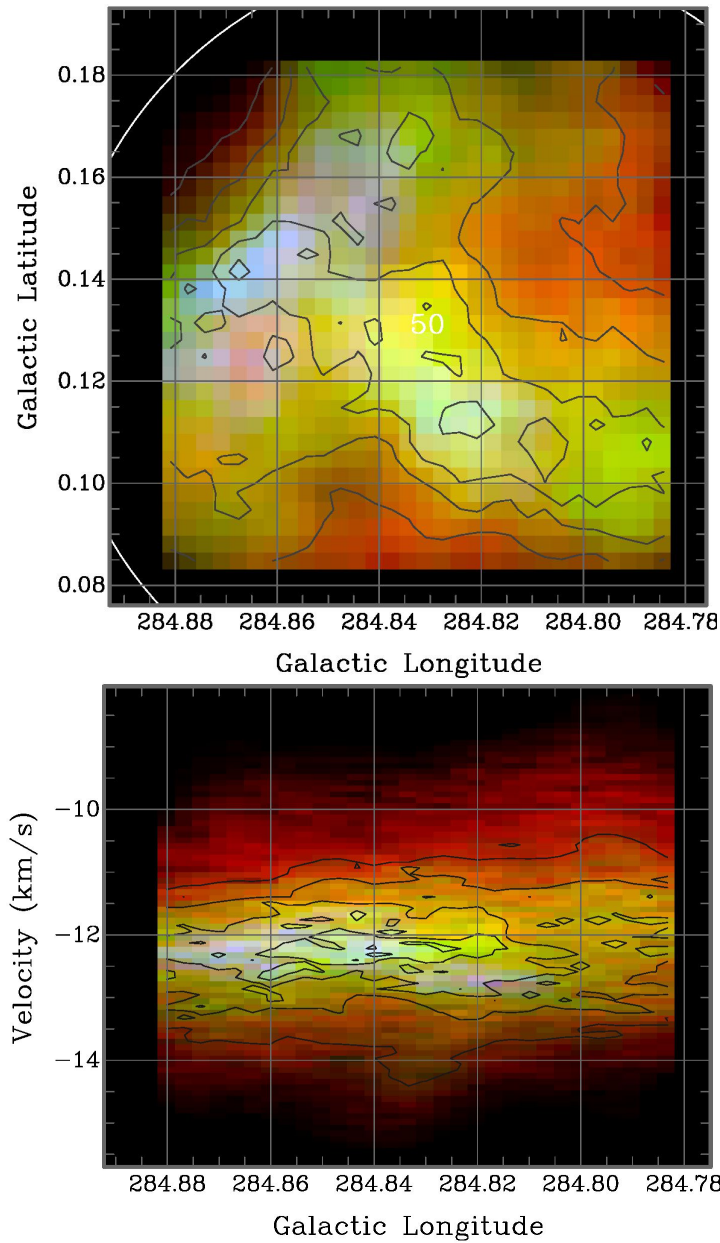**Figure A23.** BYF 38 *continued*. The Mopra HPBW is shown in the BL corner.
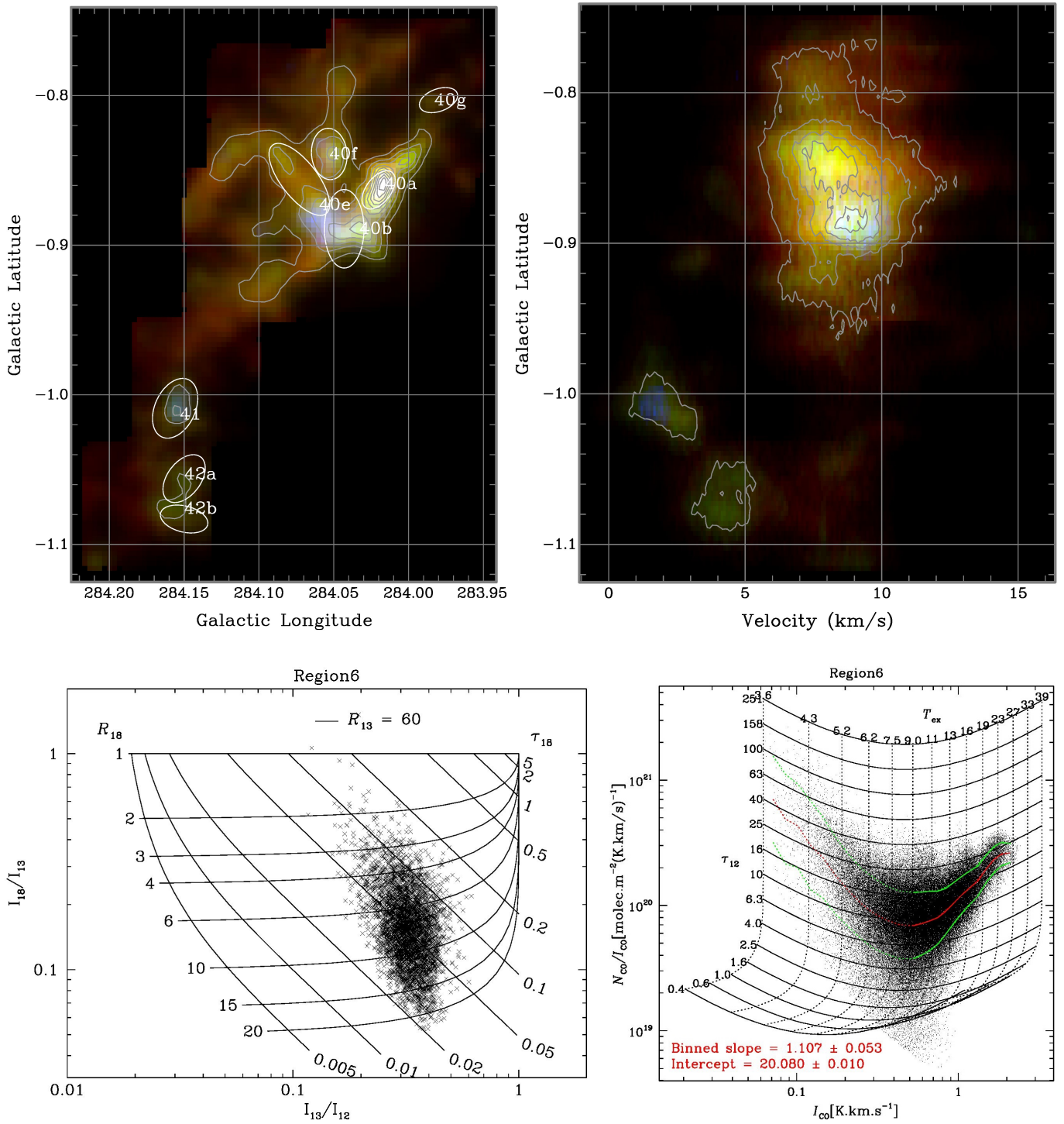
**Figure A24.** BYF 40–42 (Region 6). At an assumed distance of 6.6 kpc, the scale is $0°1 = 11.5$ pc.
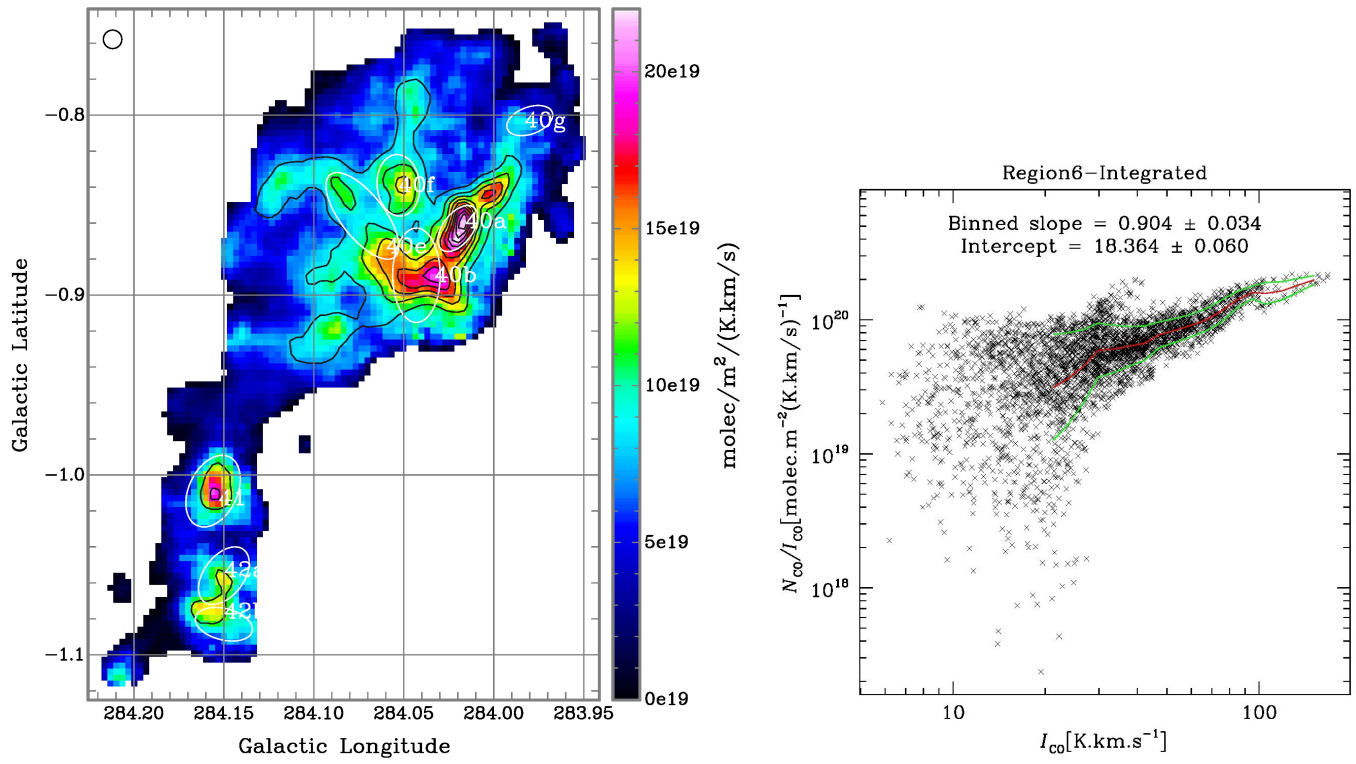
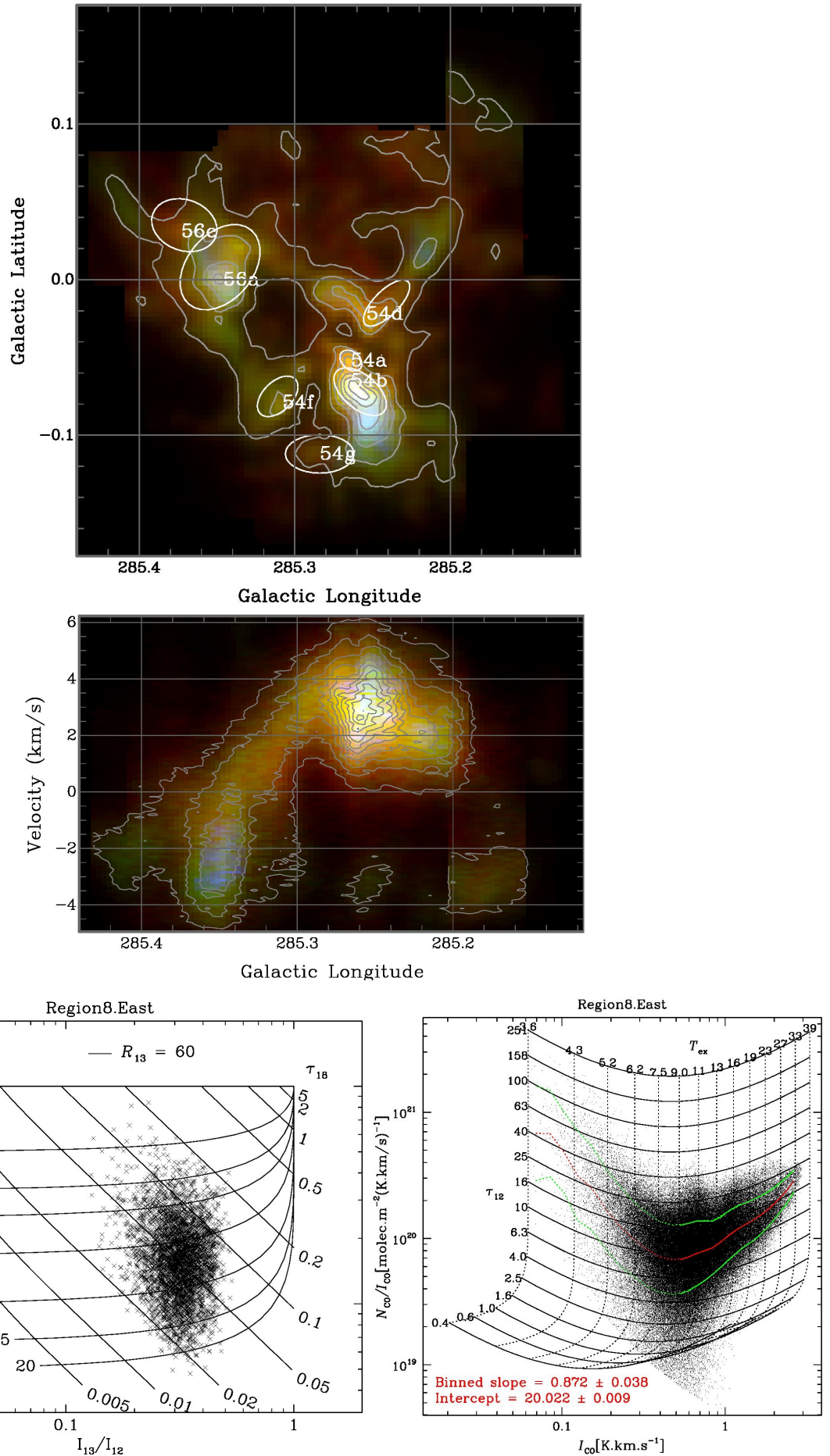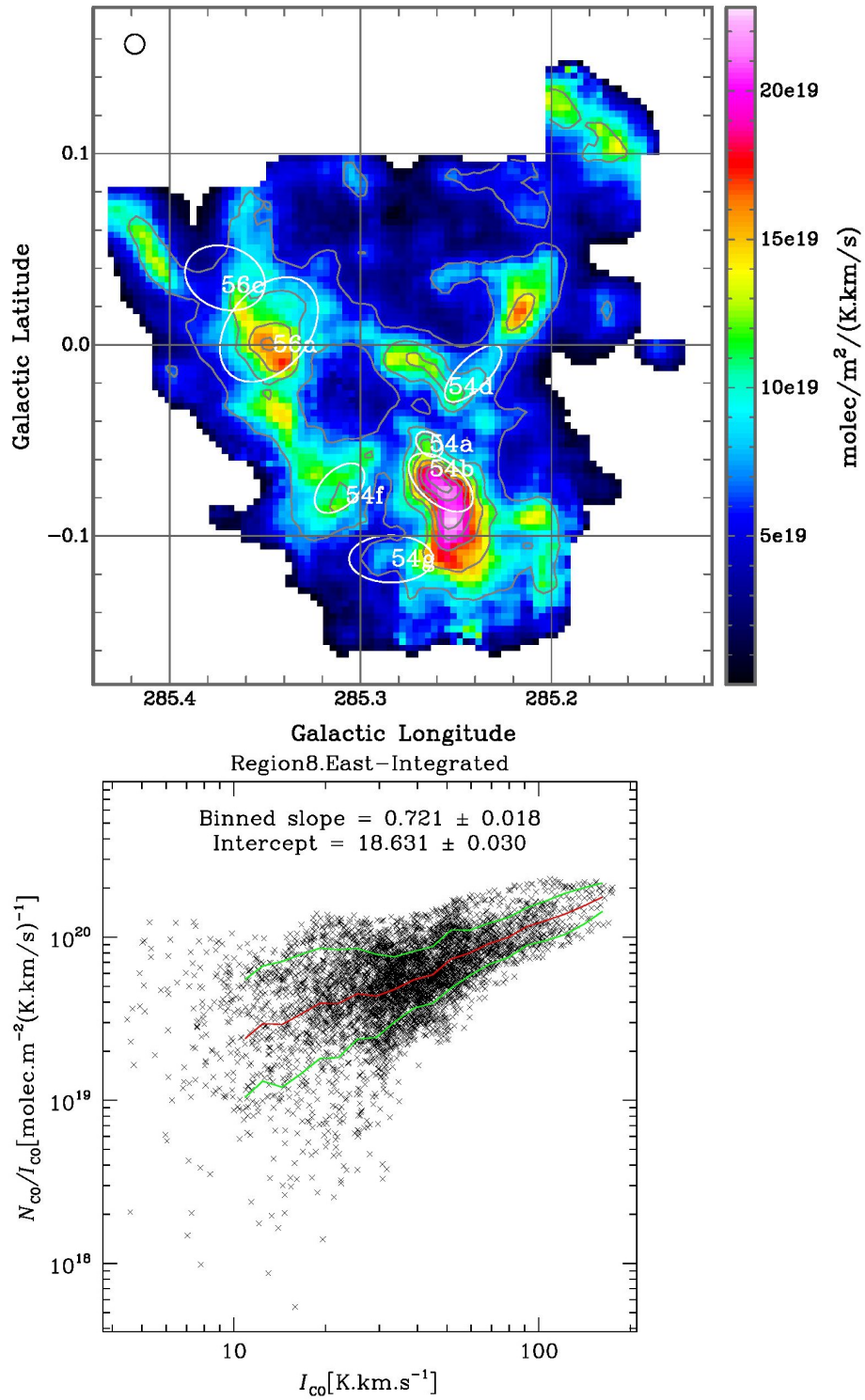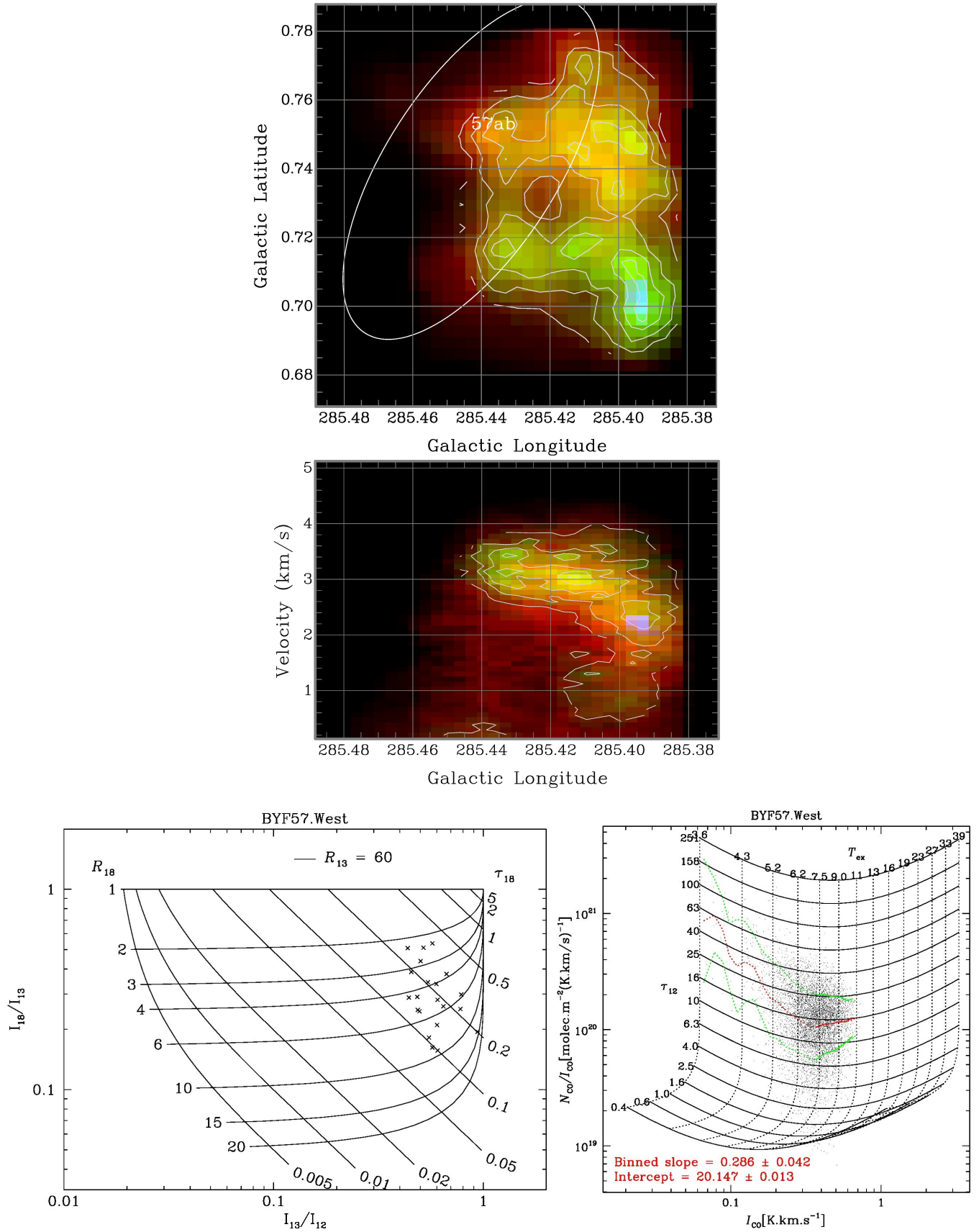**Figure A25.** BYF 40–42 (Region 6) *continued.* The Mopra HPBW is shown in the TL corner.

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Figure A26. BYF 47 (Region 7). At an assumed distance of 5.3 kpc, the scale is 0°.1 = 9.3 pc.

Figure A27. BYF 47 (Region 7) *continued*. The Mopra HPBW is shown in the BL corner.

Figure A28. BYF 50 (Region 8-West). At an assumed distance of 5.3 kpc, the scale is 0°.1 = 9.3 pc.
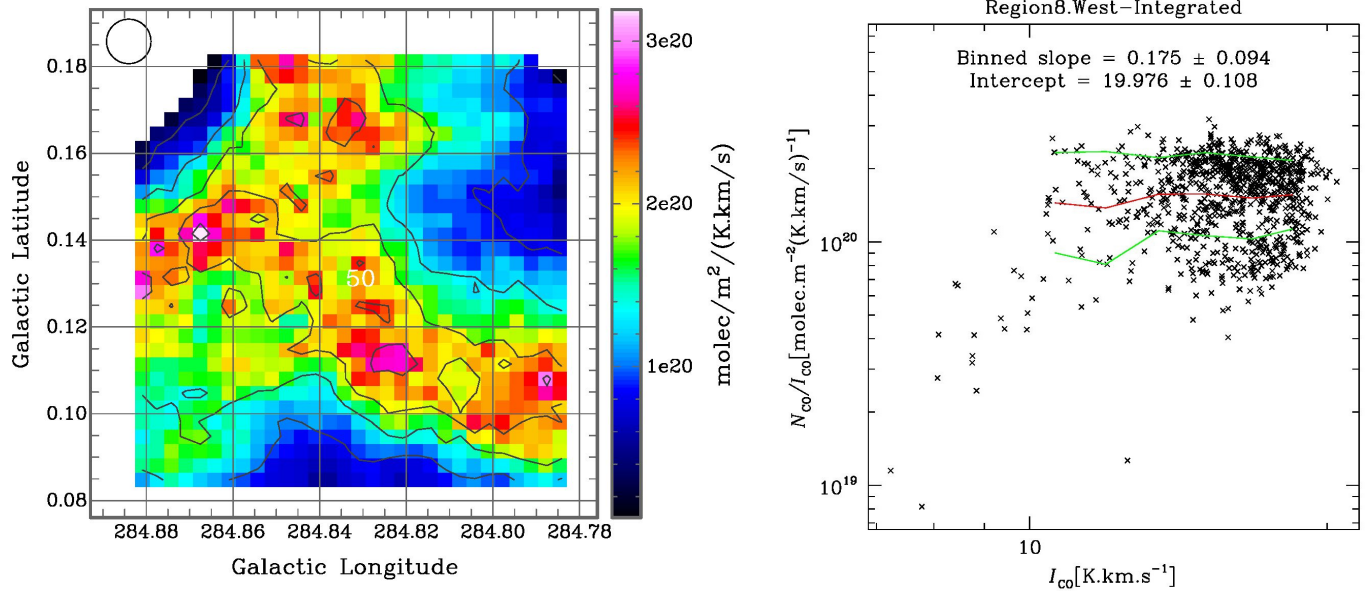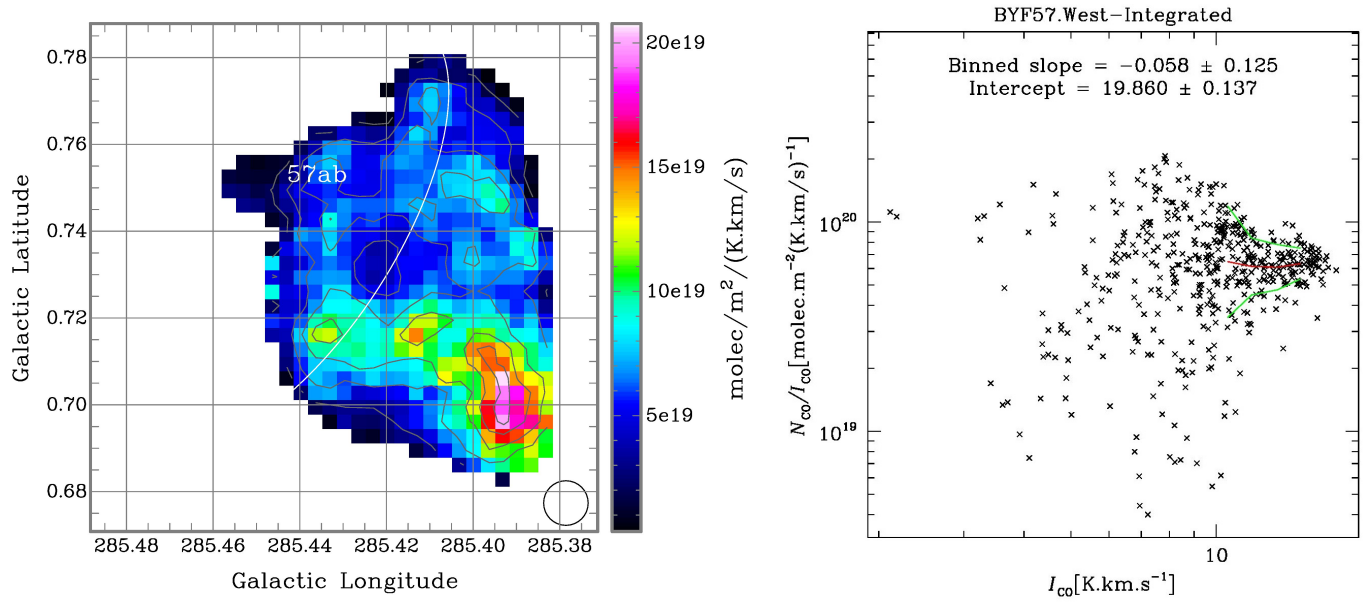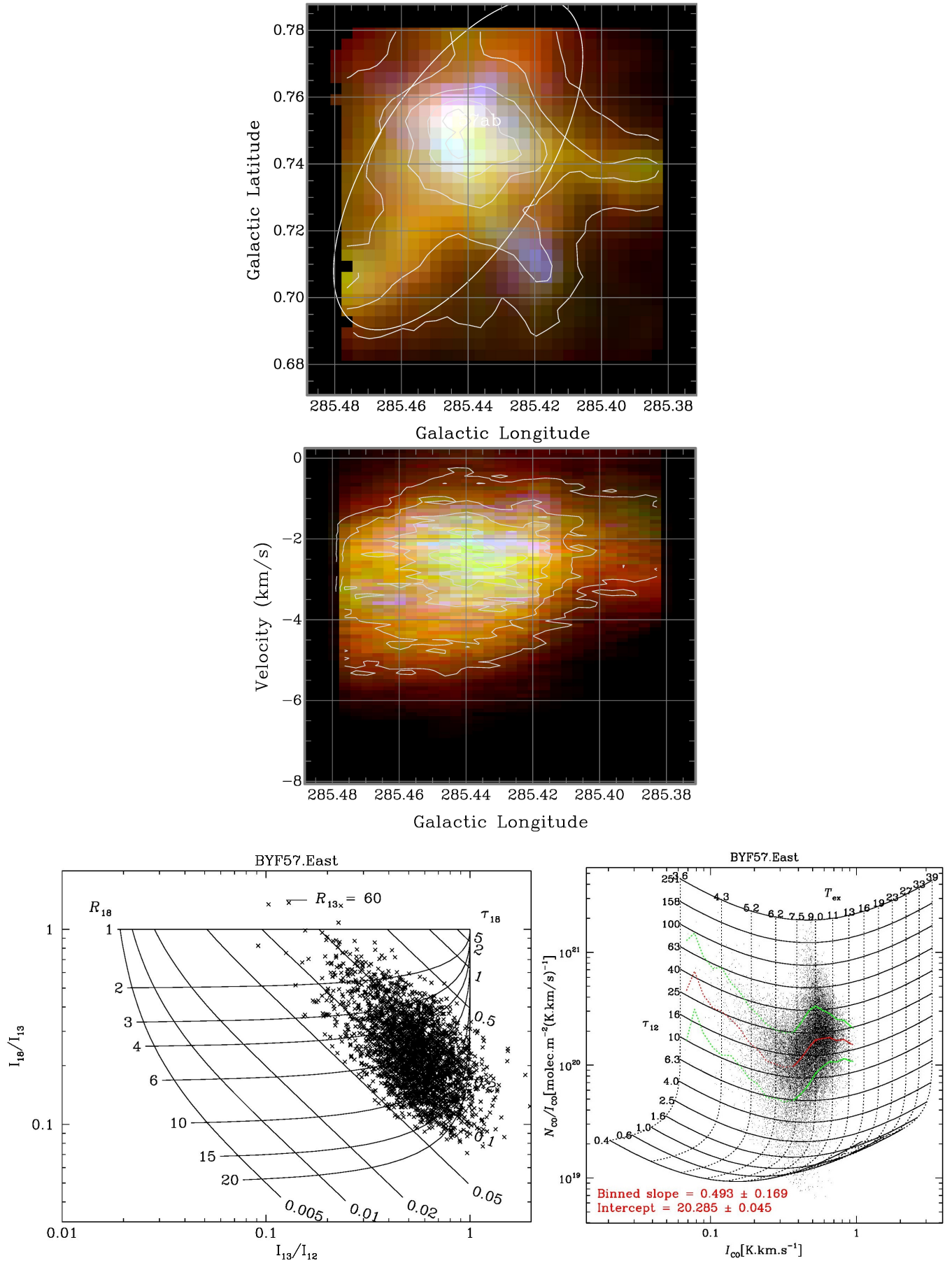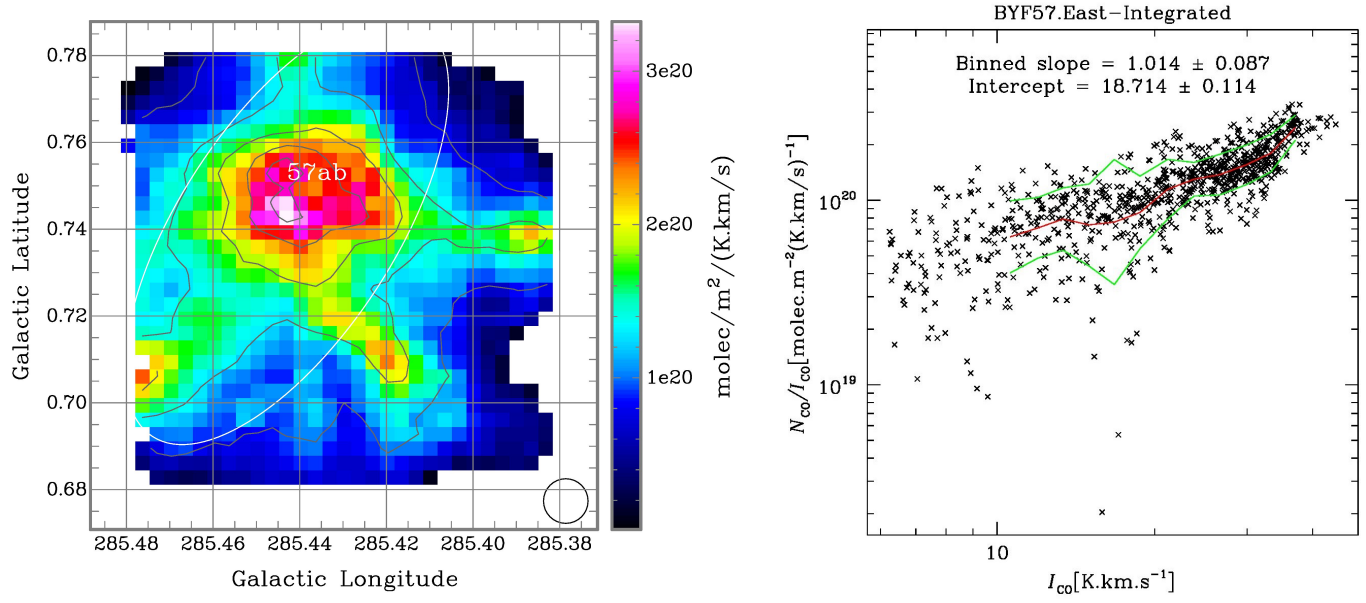
Figure A29. BYF 50 (Region 8-West) *continued.* The Mopra HPBW is shown in the TL corner.

Figure A30. BYF 51–56 (Region 8-East). At an assumed distance of 5.3 kpc, the scale is 0°.1 = 9.3 pc.

Figure A31. BYF 51–56 (Region 8-East) *continued*. The Mopra HPBW is shown in the TL corner.

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Figure A32. BYF 57-West. At an assumed distance of 5.3 kpc, the scale is 0°.1 = 9.3 pc.

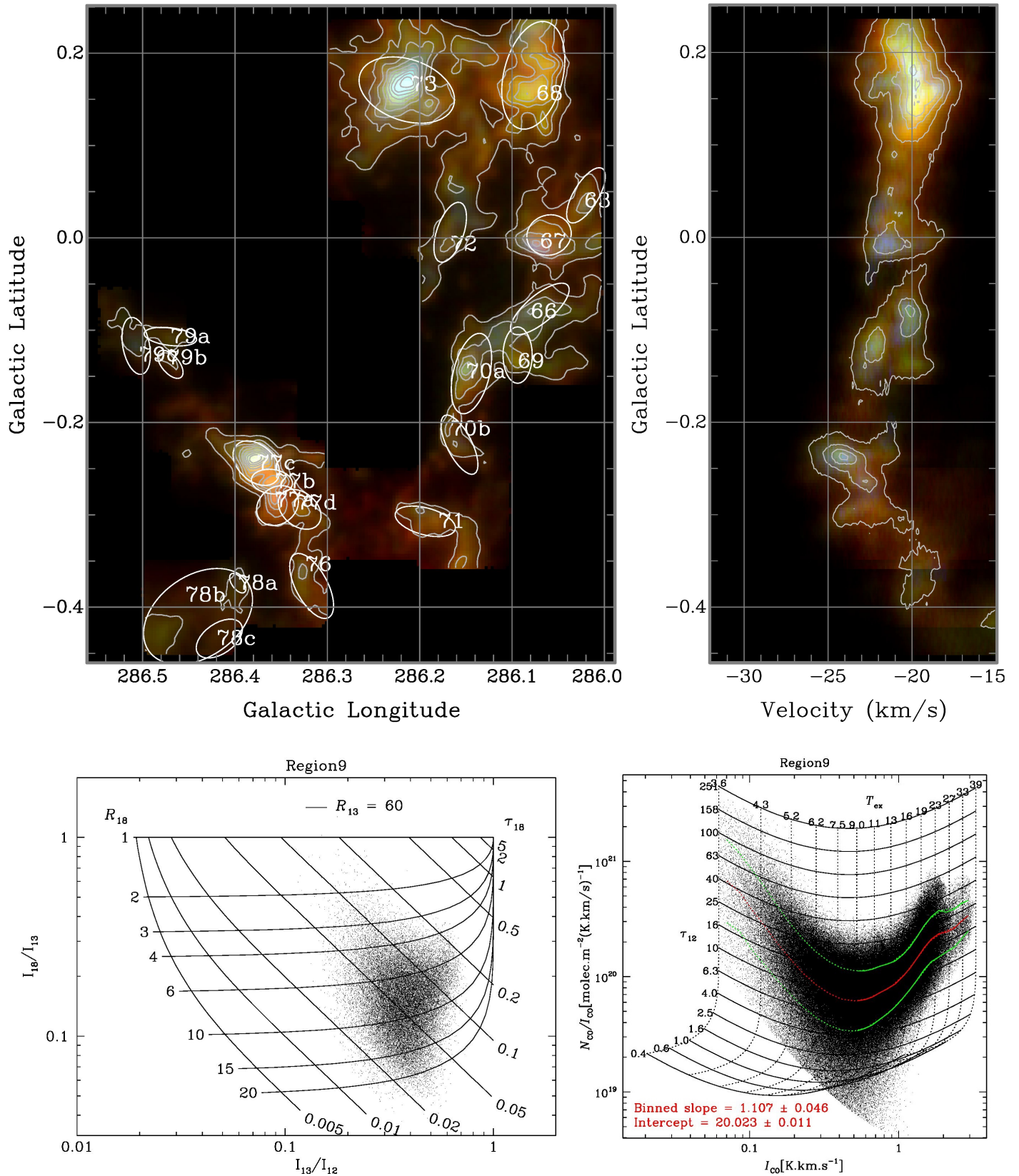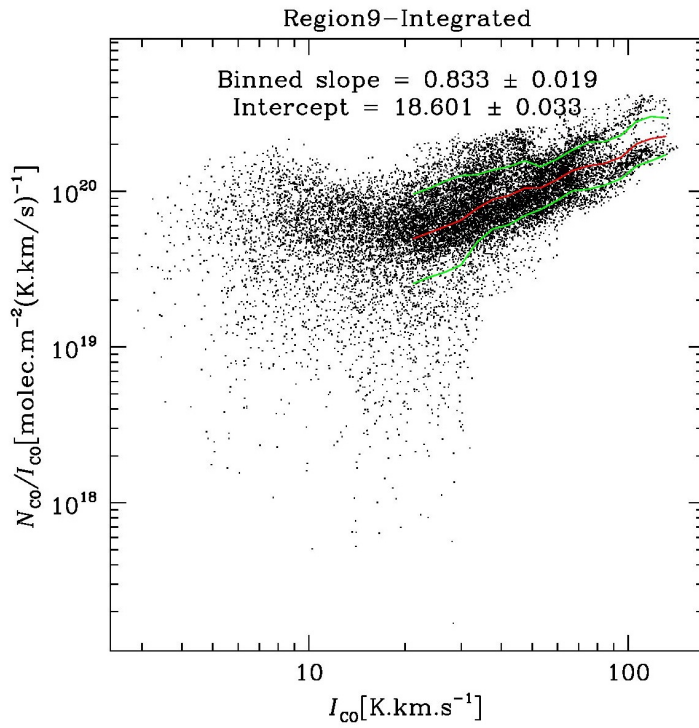**Figure A33.** BYF 57-West *continued*. The Mopra HPBW is shown in the BR corner.

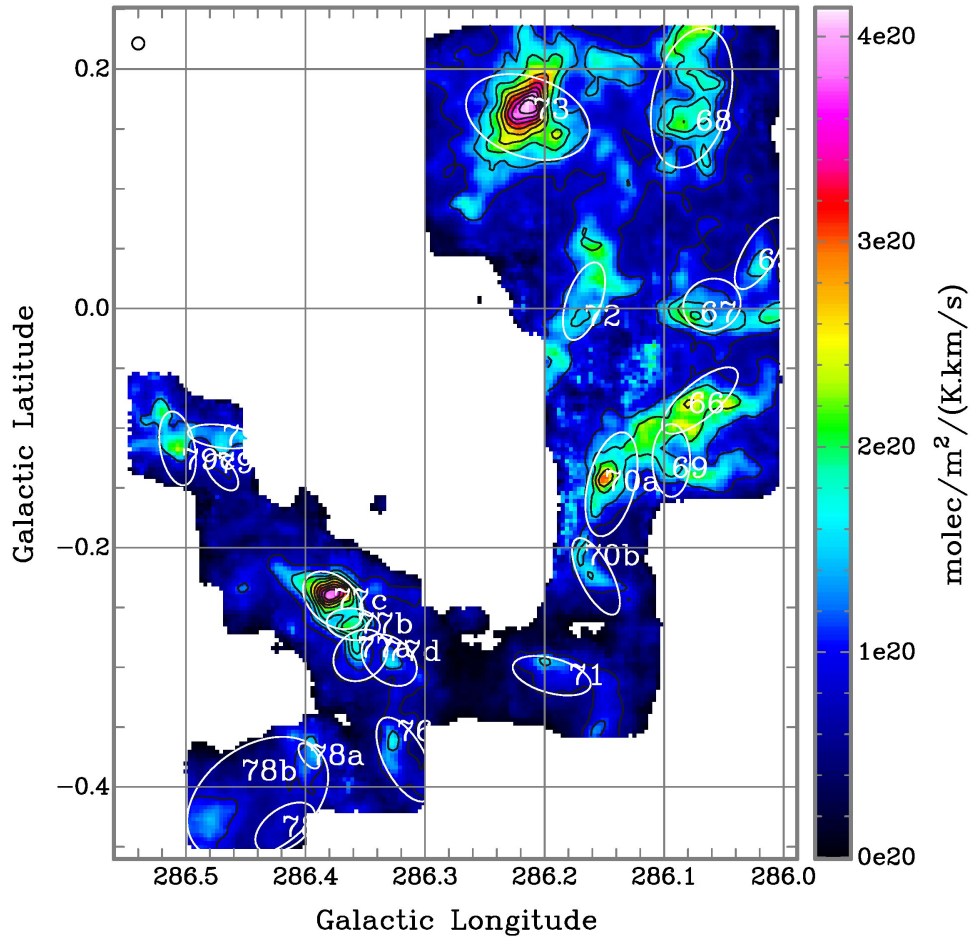**Figure A34.** BYF 57-East. At an assumed distance of 5.3 kpc, the scale is 0°1 = 9.3 pc.

Figure A35. BYF 57-East *continued*. The Mopra HPBW is shown in the BR corner.

Figure A36. BYF 63–80 (Region 9). At an assumed distance of 2.5 kpc, the scale is $0°\!.1 = 4.4$ pc.

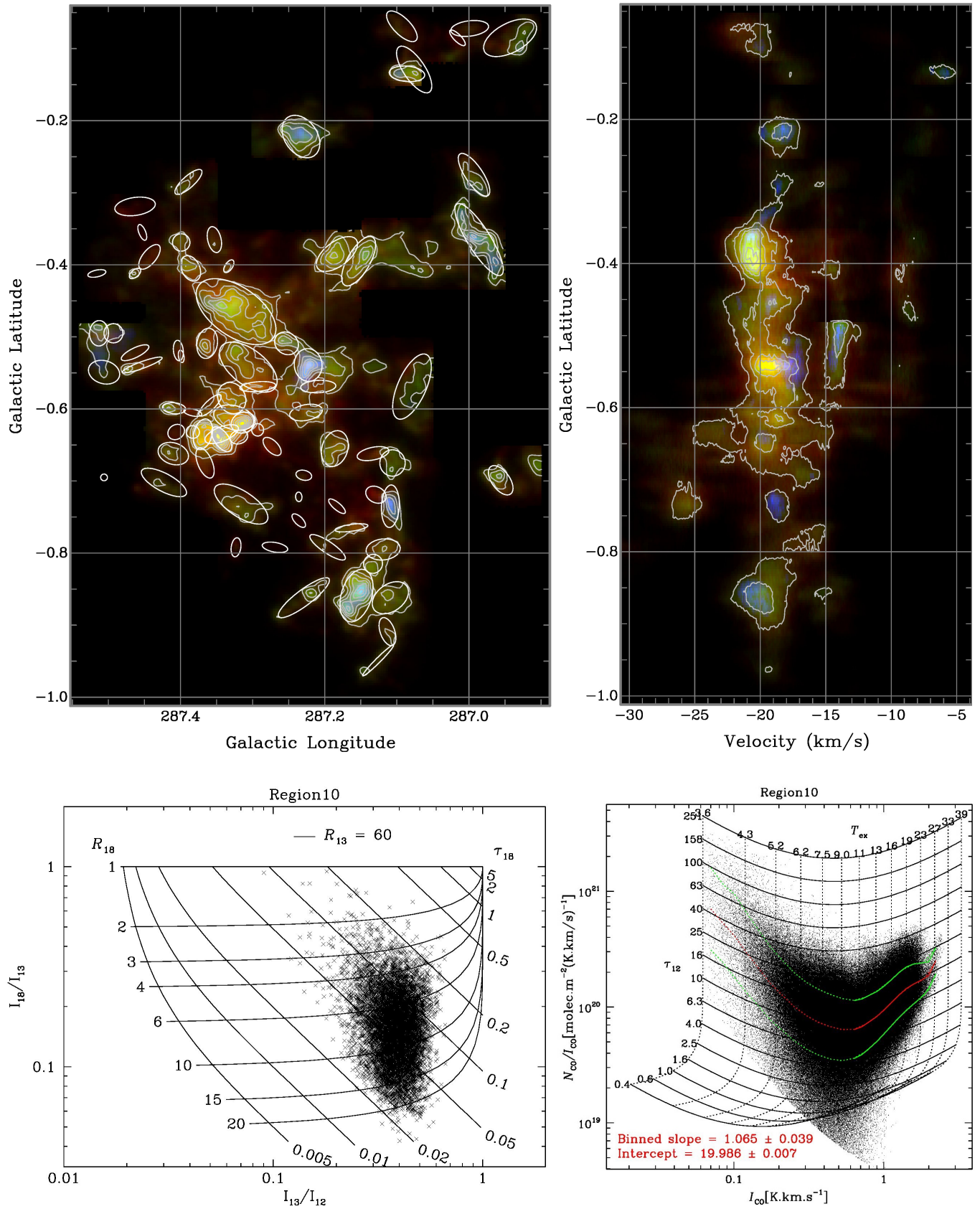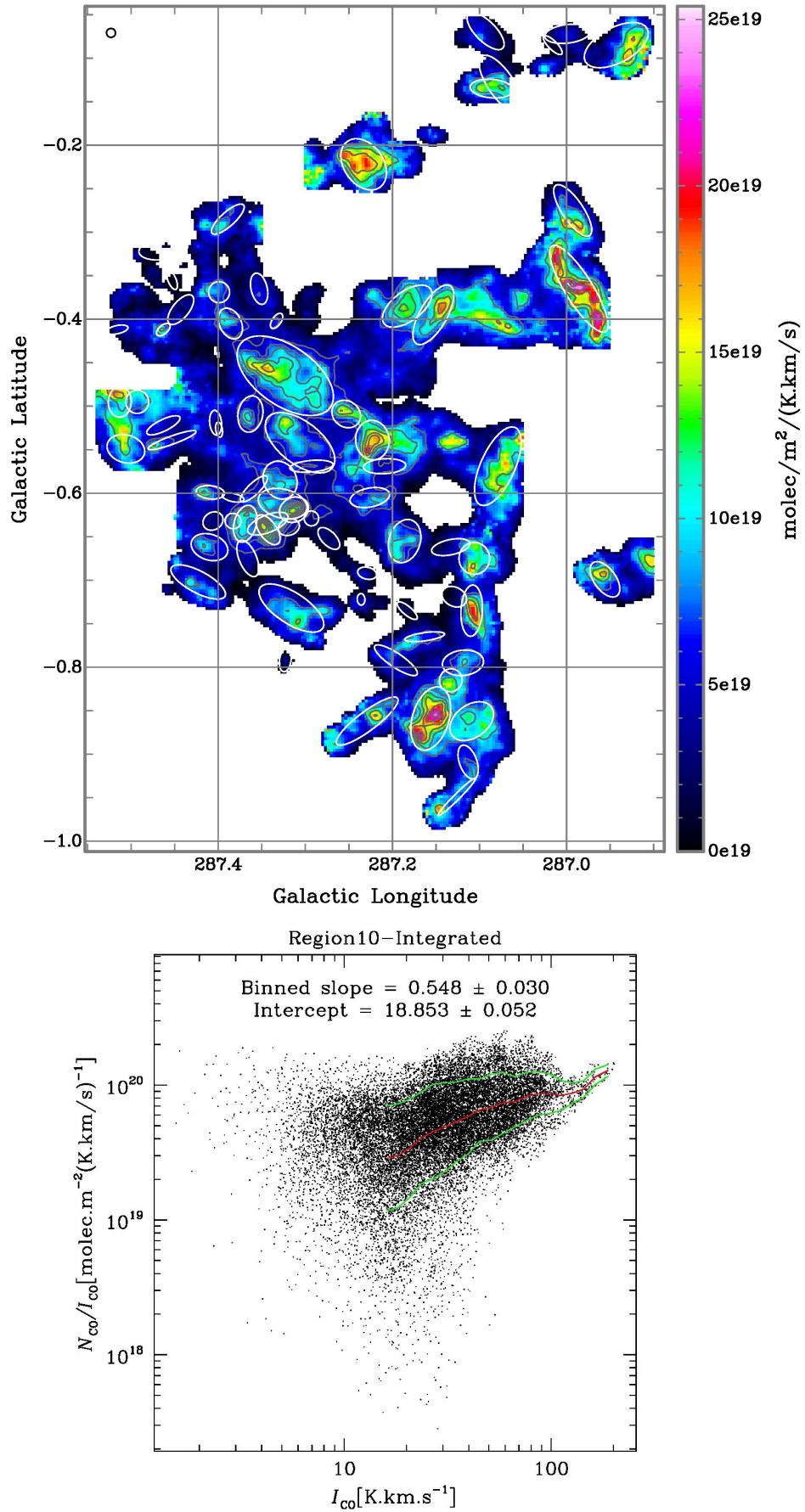**Figure A37.** BYF 63–80 (Region 9) *continued.* The Mopra HPBW is shown in the TL corner.

Figure A38. BYF 83–104 (Region 10). At an assumed distance of 2.5 kpc, the scale is 0°.1 = 4.4 pc. Because of the density of sources in this Region, for clarity we omit the clump names in panel 1.

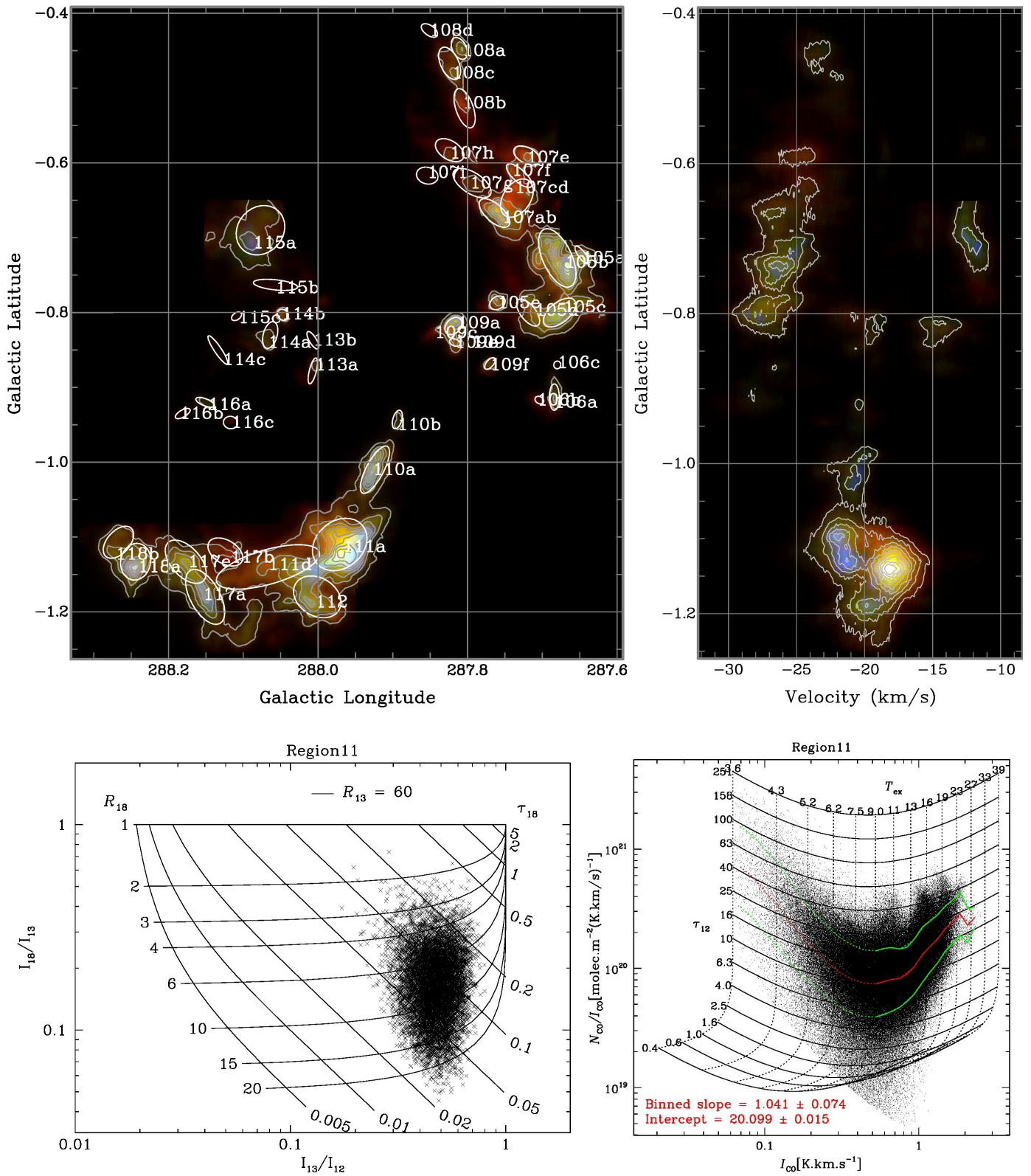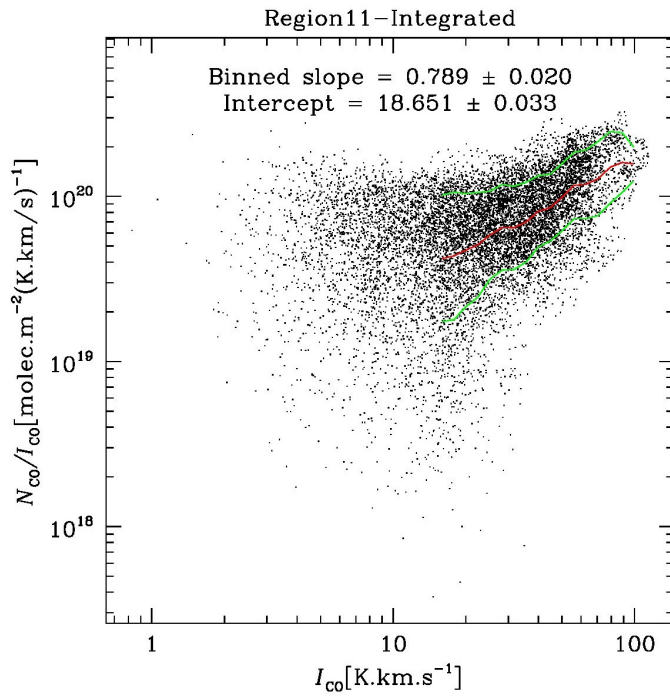**Figure A39.** BYF 83–104 (Region 10) *continued*. The Mopra HPBW is shown in the TL corner.

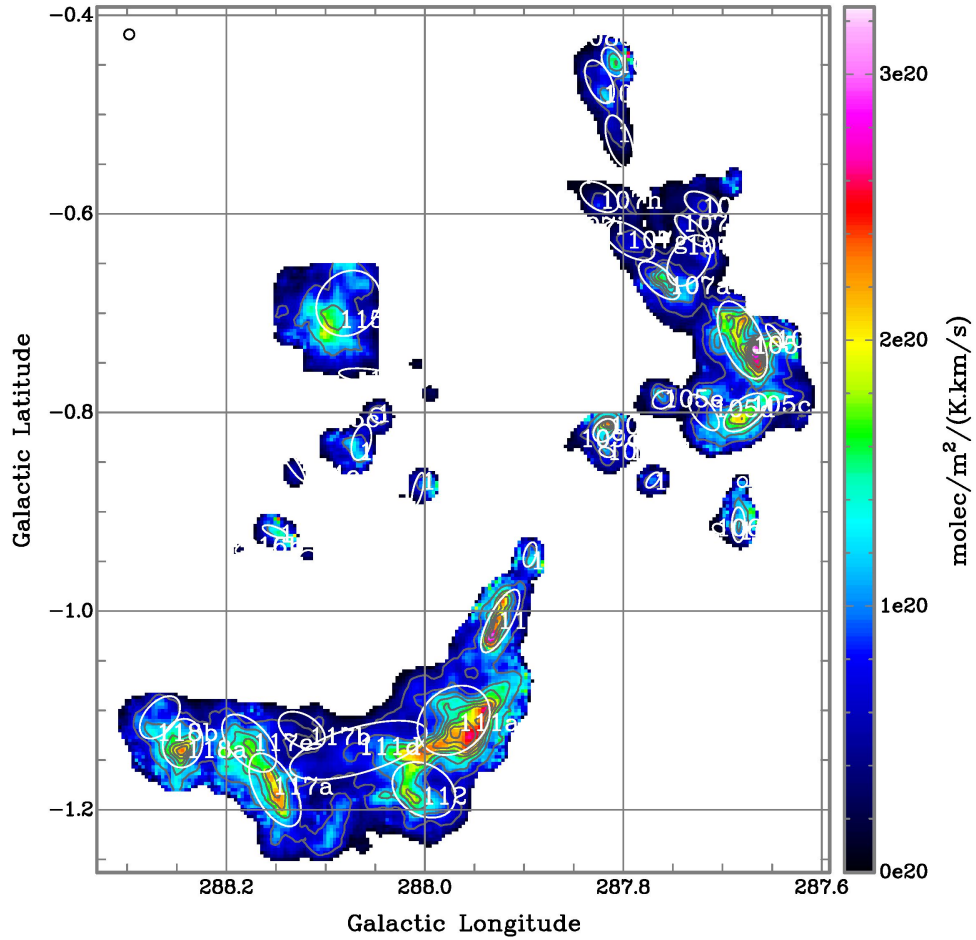**Figure A40.** BYF 105–118 (Region 11). At an assumed distance of 2.5 kpc, the scale is $0°.1 = 4.4$ pc.

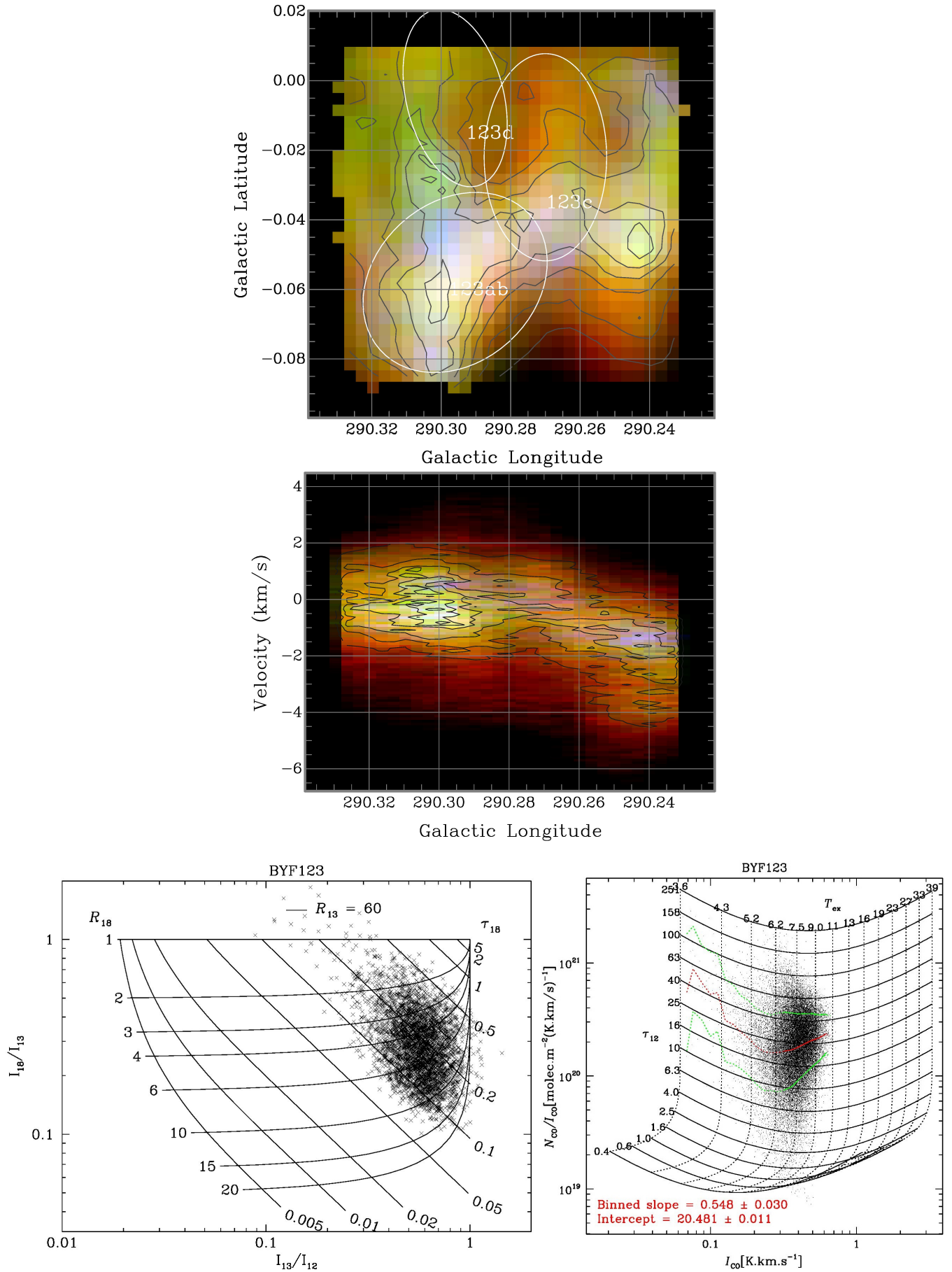**Figure A41.** BYF 105–118 (Region 11) *continued.* The Mopra HPBW is shown in the TL corner.

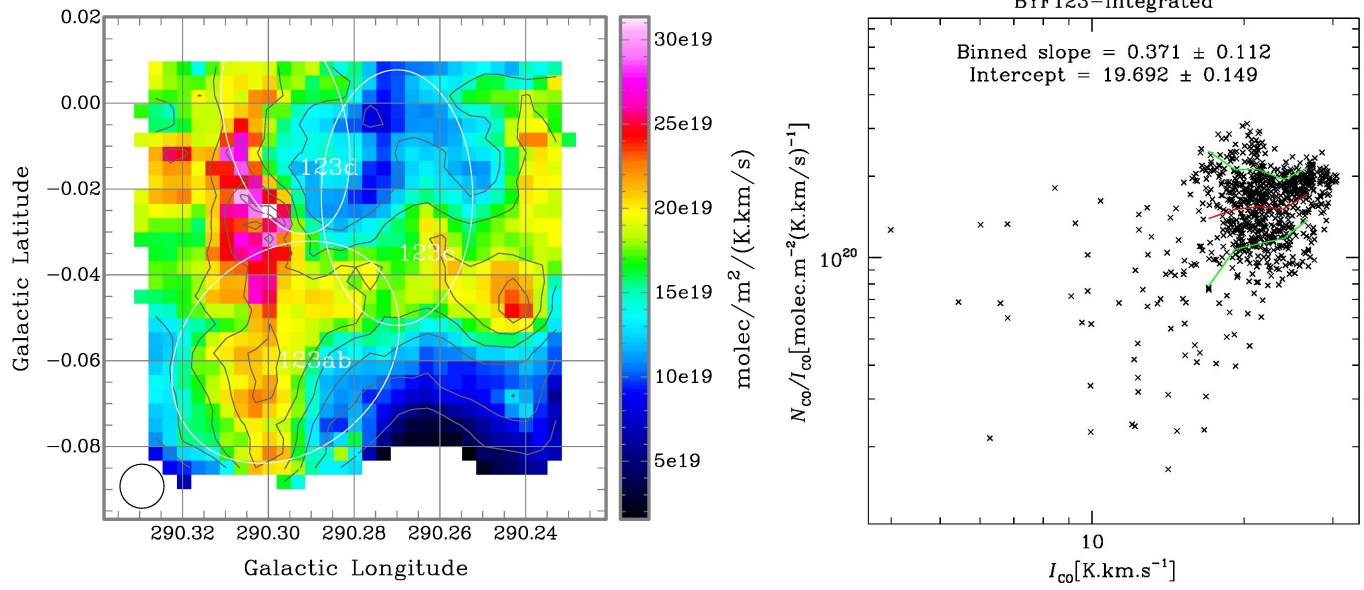**Figure A42.** BYF 123. At an assumed distance of 6.8 kpc, the scale is 0°1 = 11.9 pc.

Figure A43. BYF 123 *continued*. The Mopra HPBW is shown in the BR corner.

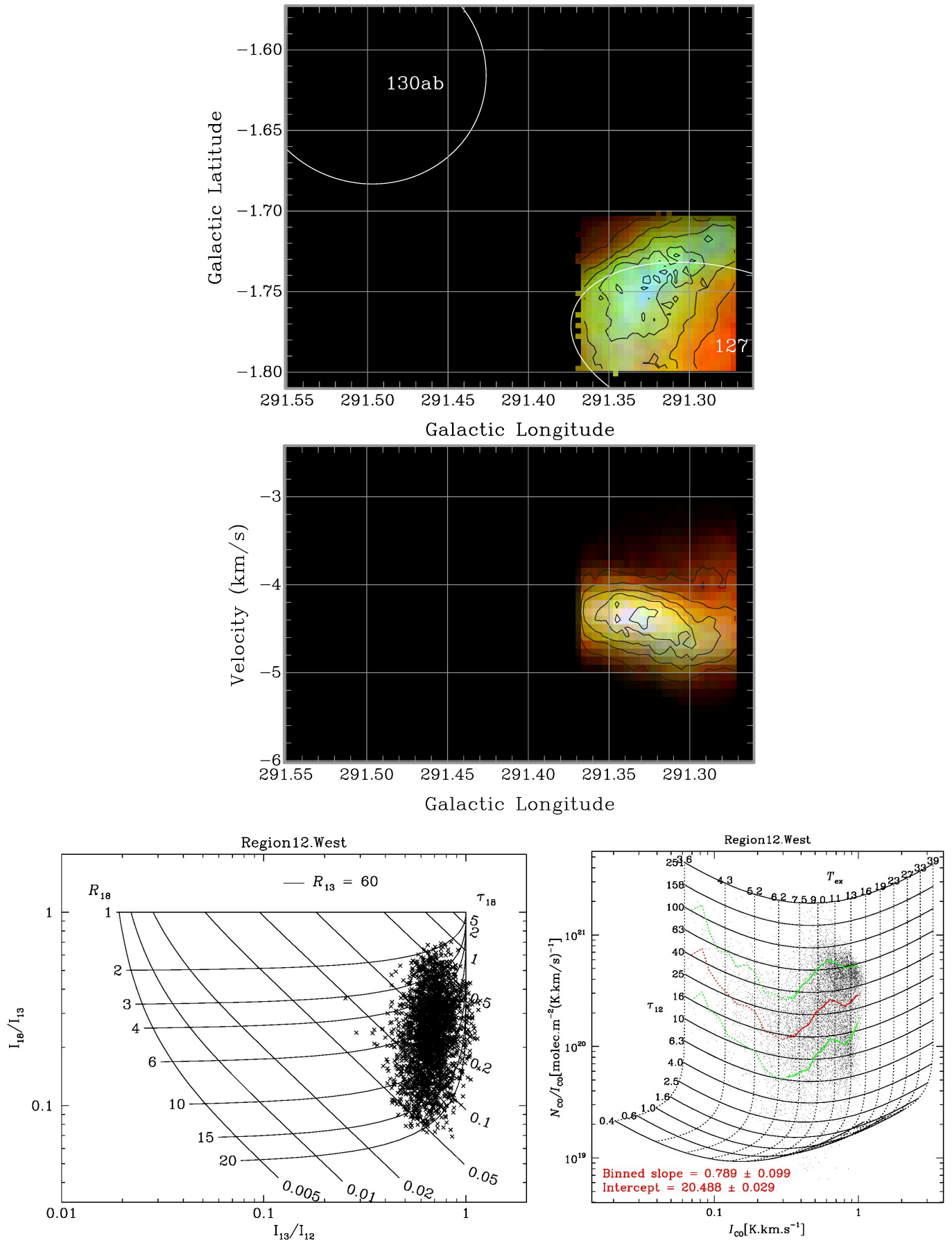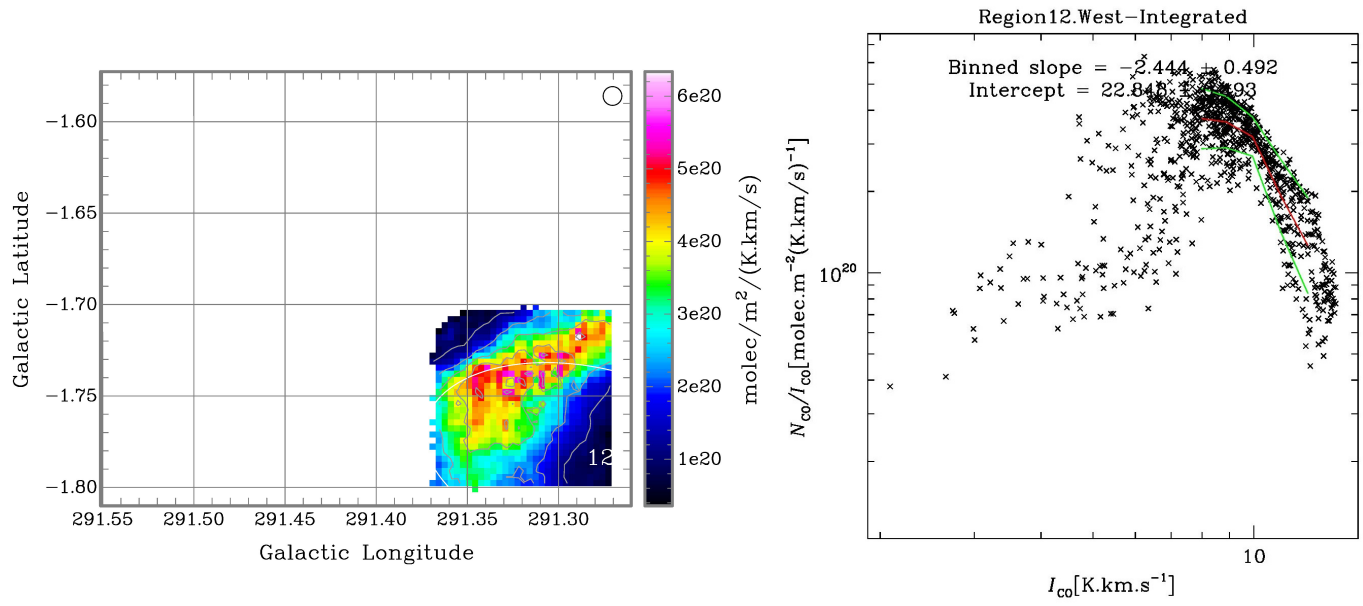**Figure A44.** BYF 127 (Region 12-West). At an assumed distance of 1.1 kpc, the scale is 0°1 = 1.9 pc.

Figure A45. BYF 127 (Region 12-West) *continued*. The Mopra HPBW is shown in the TR corner.

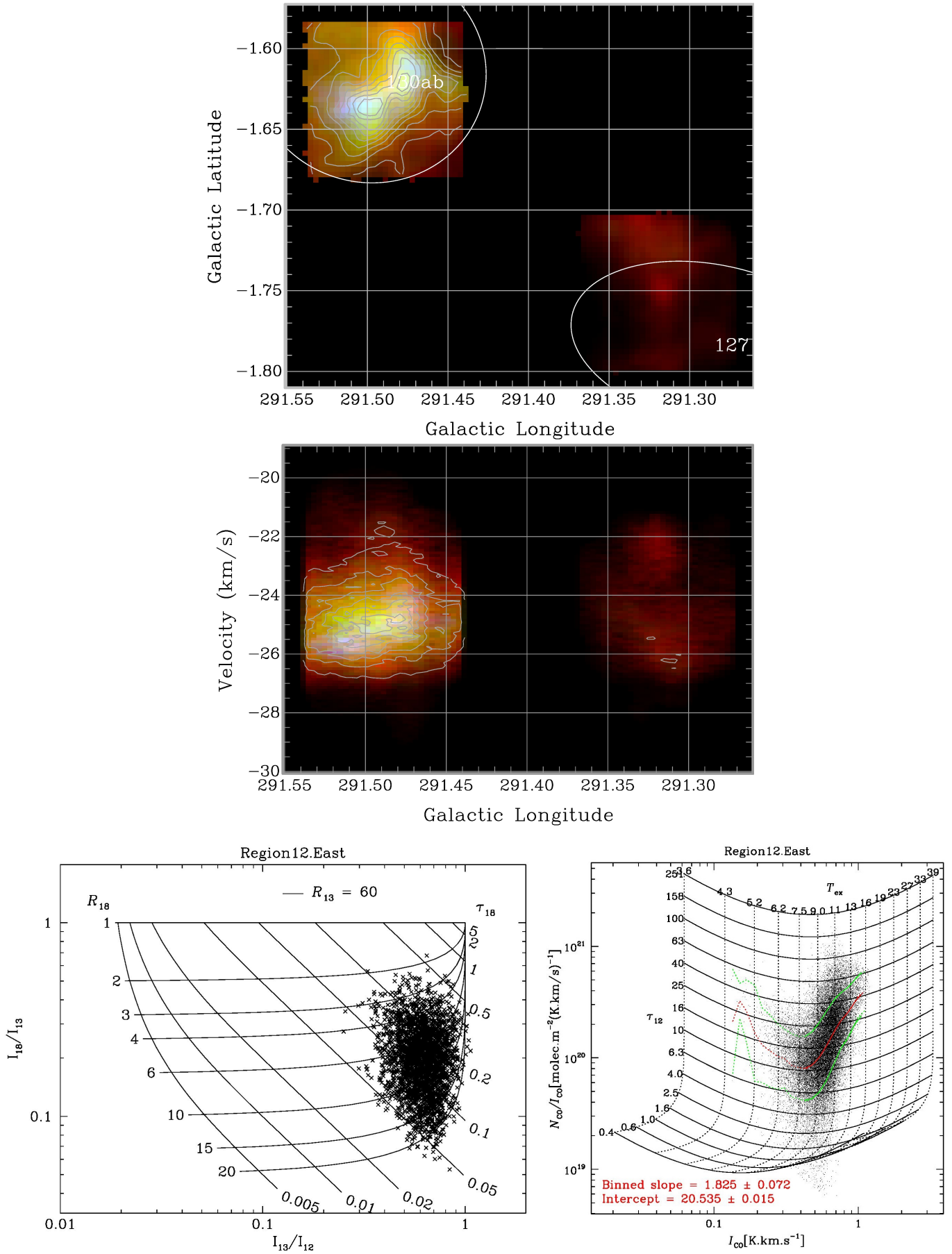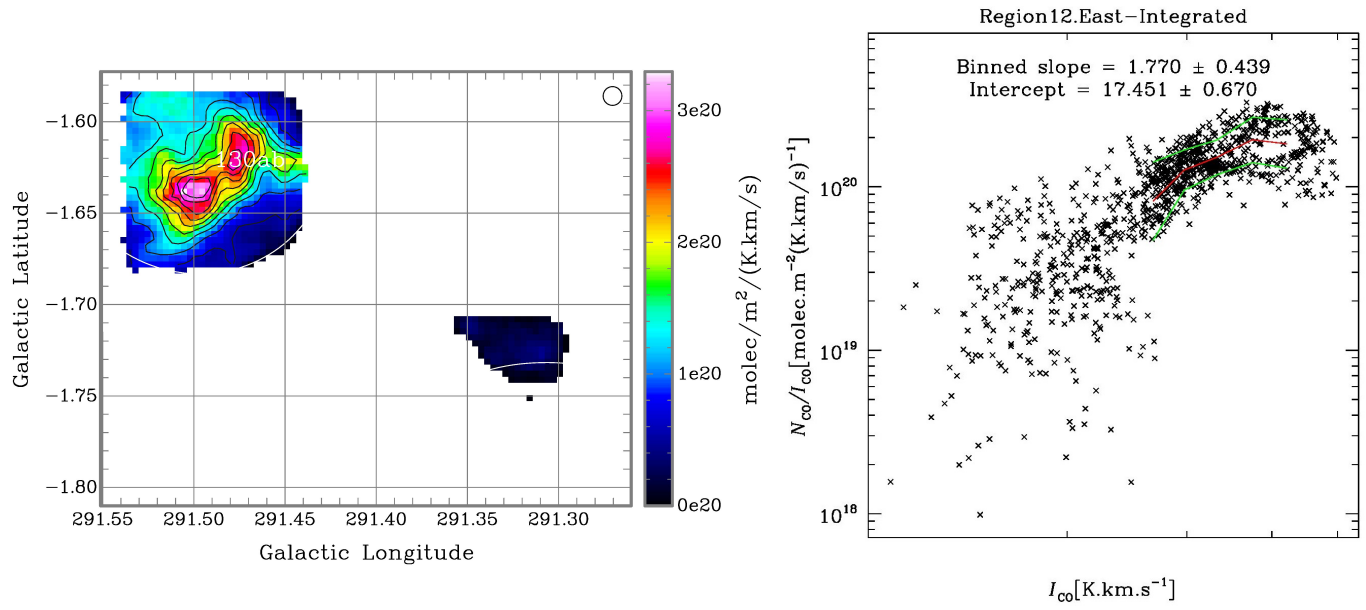**Figure A46.** BYF 130 (Region 12-East). At an assumed distance of 2.4 kpc, the scale is $0°1 = 4.2$ pc.

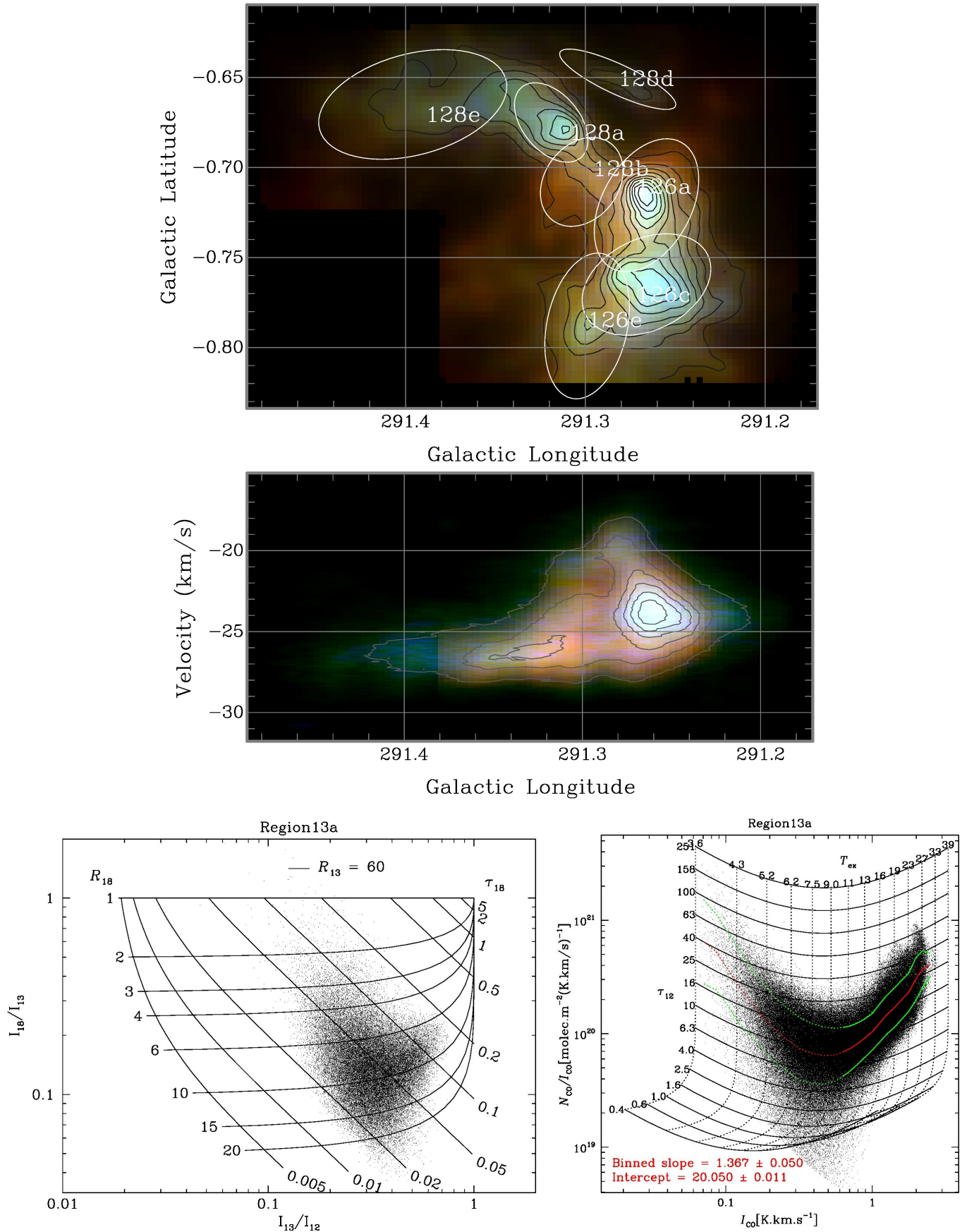**Figure A47.** BYF 130 (Region 12-East) *continued*. The Mopra HPBW is shown in the TR corner.

Figure A48. BYF 126 & 128 (Region 13a). At an assumed distance of 2.4 kpc, the scale is 0°1 = 4.2 pc.

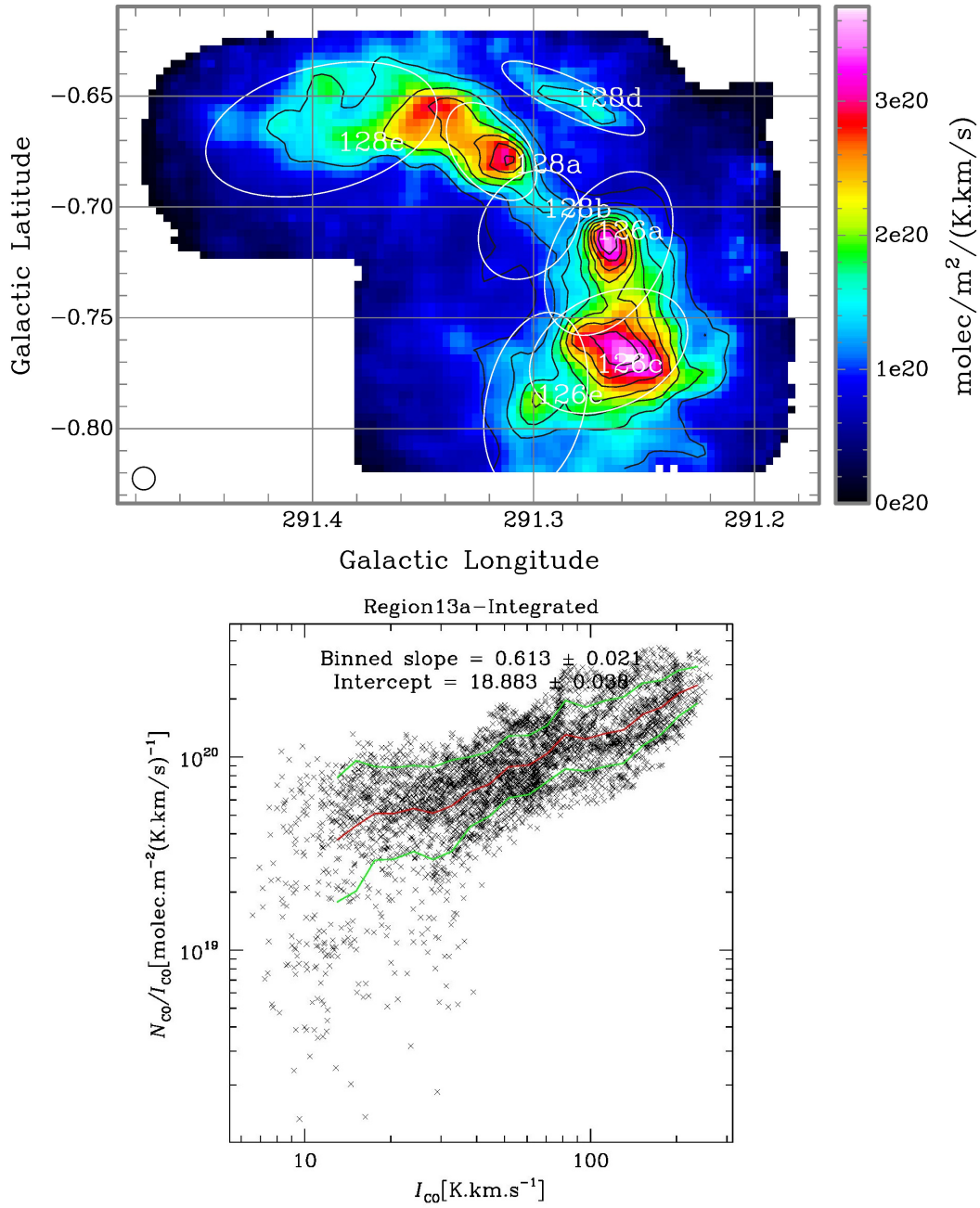**Figure A49.** BYF 126 & 128 (Region 13a) *continued*. The Mopra HPBW is shown in the BL corner.
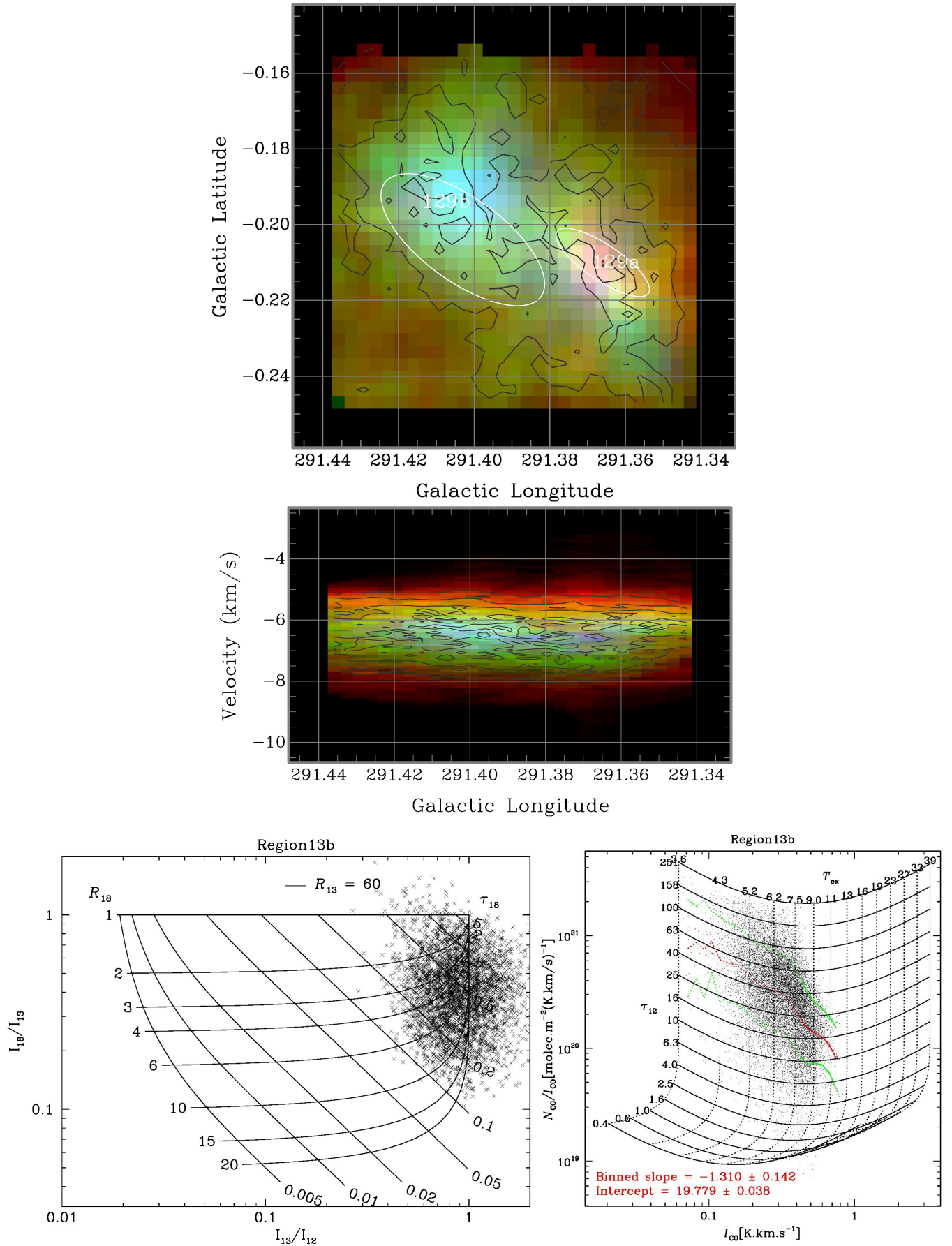
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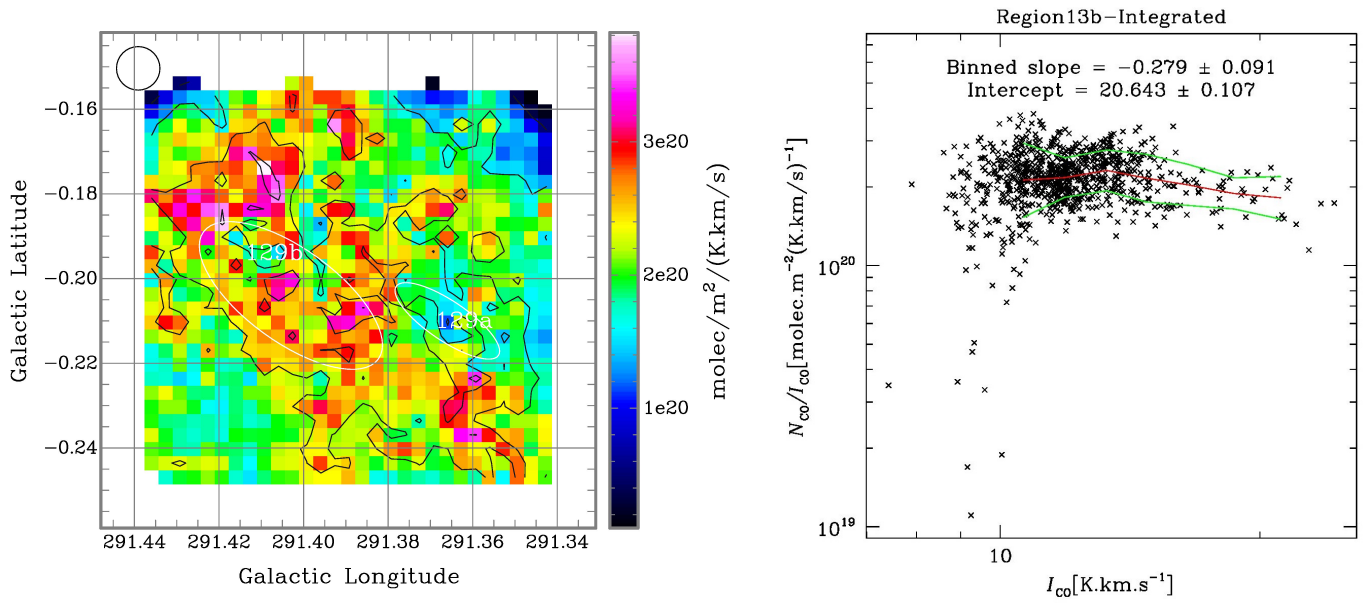**Figure A50.** BYF 129 (Region 13b). At an assumed distance of 1.2 kpc, the scale is 0°1 = 2.1 pc.

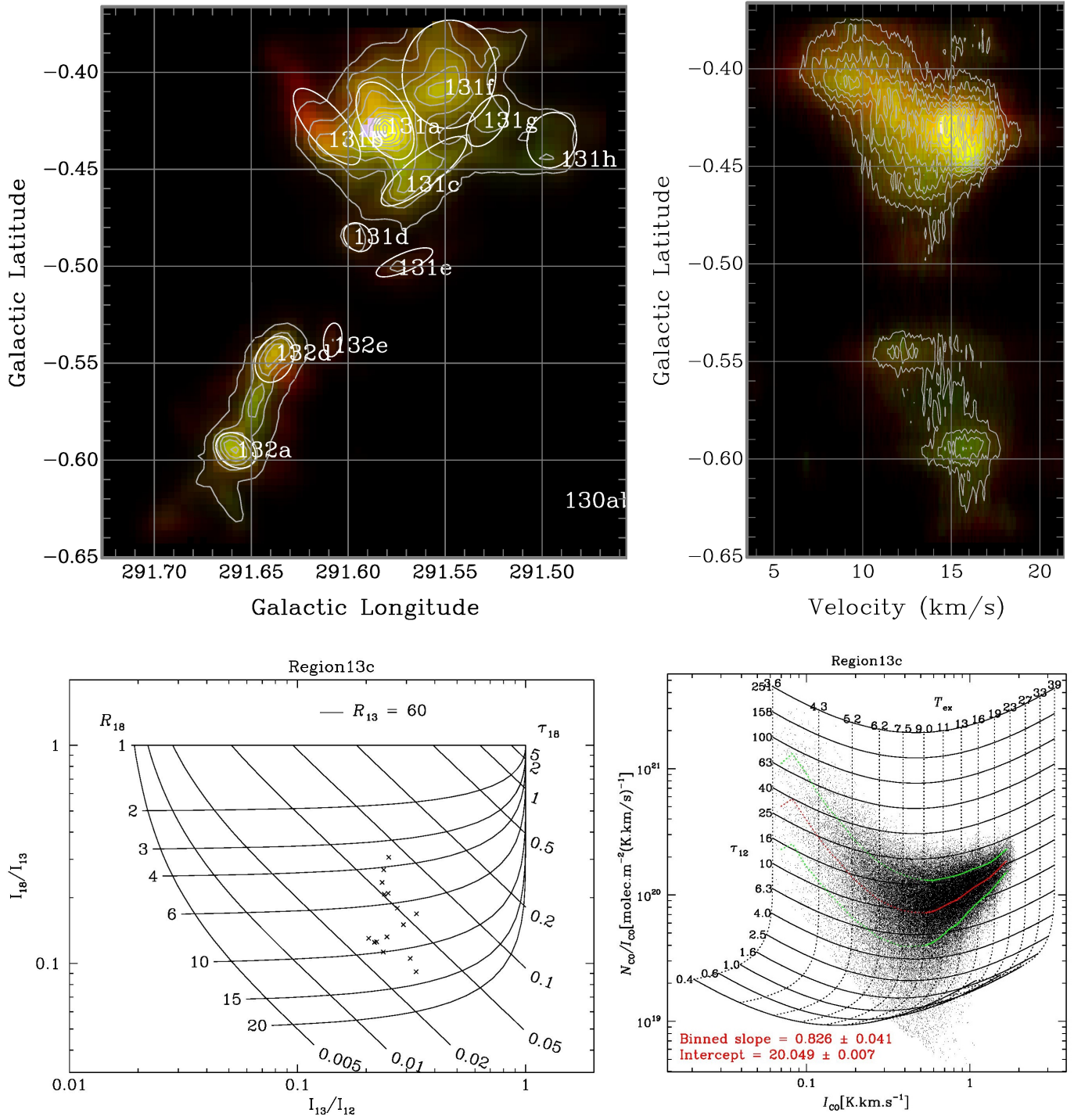**Figure A51.** BYF 129 (Region 13b) *continued*. The Mopra HPBW is shown in the TL corner.

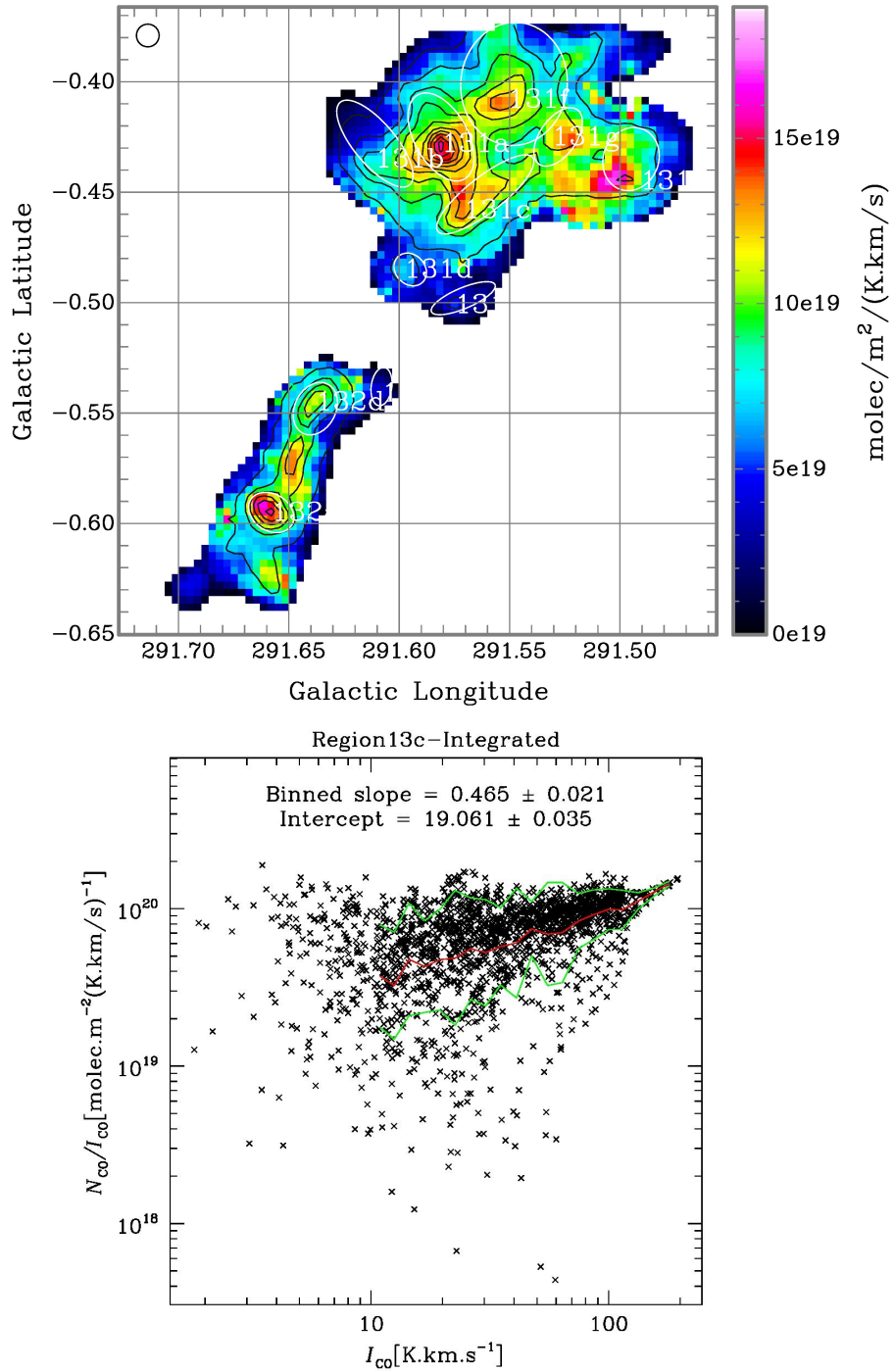**Figure A52.** BYF 131 & 132 (Region 13c). At an assumed distance of 6.0 kpc, the scale is 0°.1 = 10.5 pc.

Figure A53. BYF 131 & 132 (Region 13c) *continued*. The Mopra HPBW is shown in the TL corner.
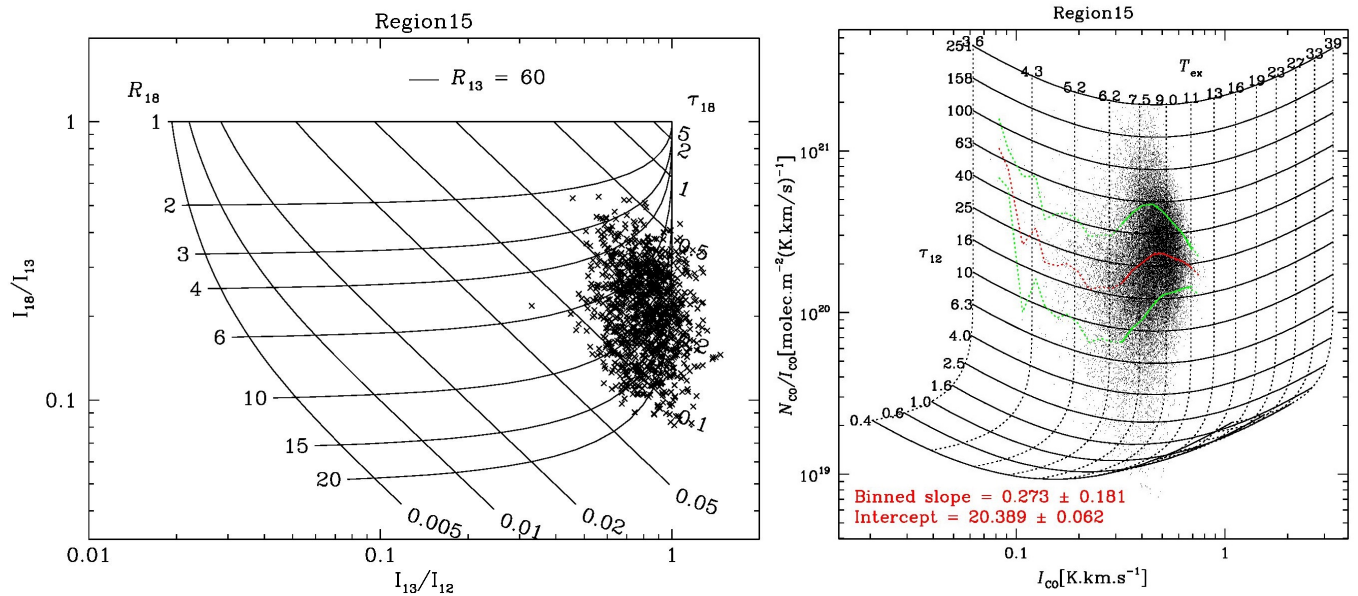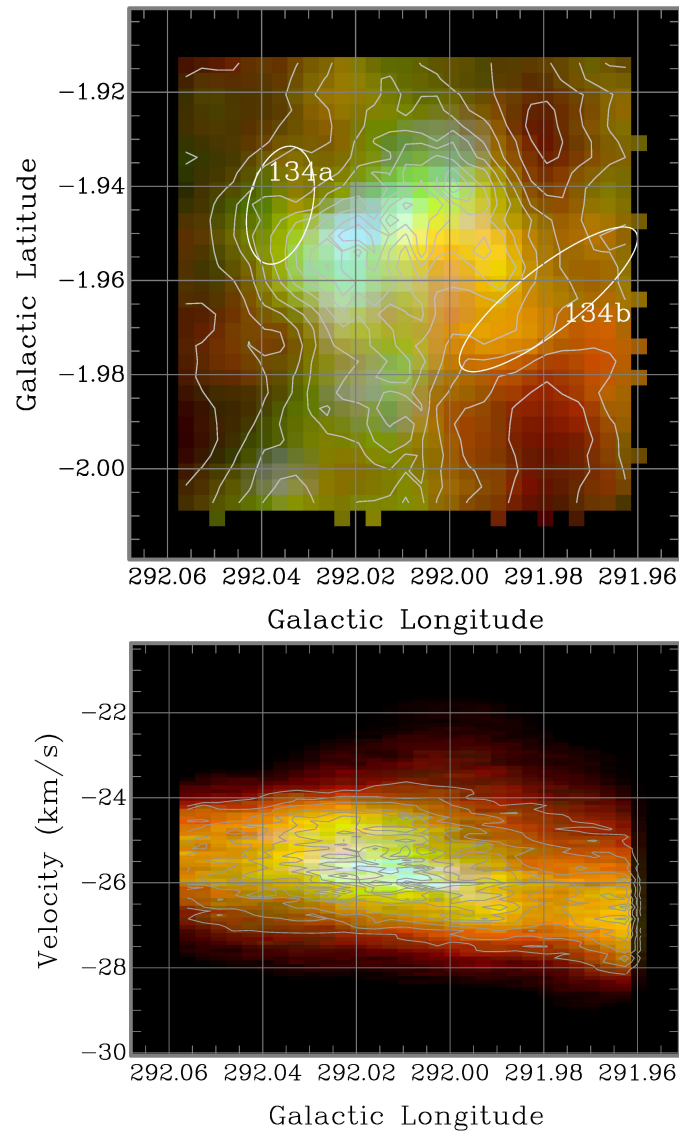
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Figure A54. BYF 134 (Region 15). At an assumed distance of 2.4 kpc, the scale is 0°.1 = 4.2 pc.
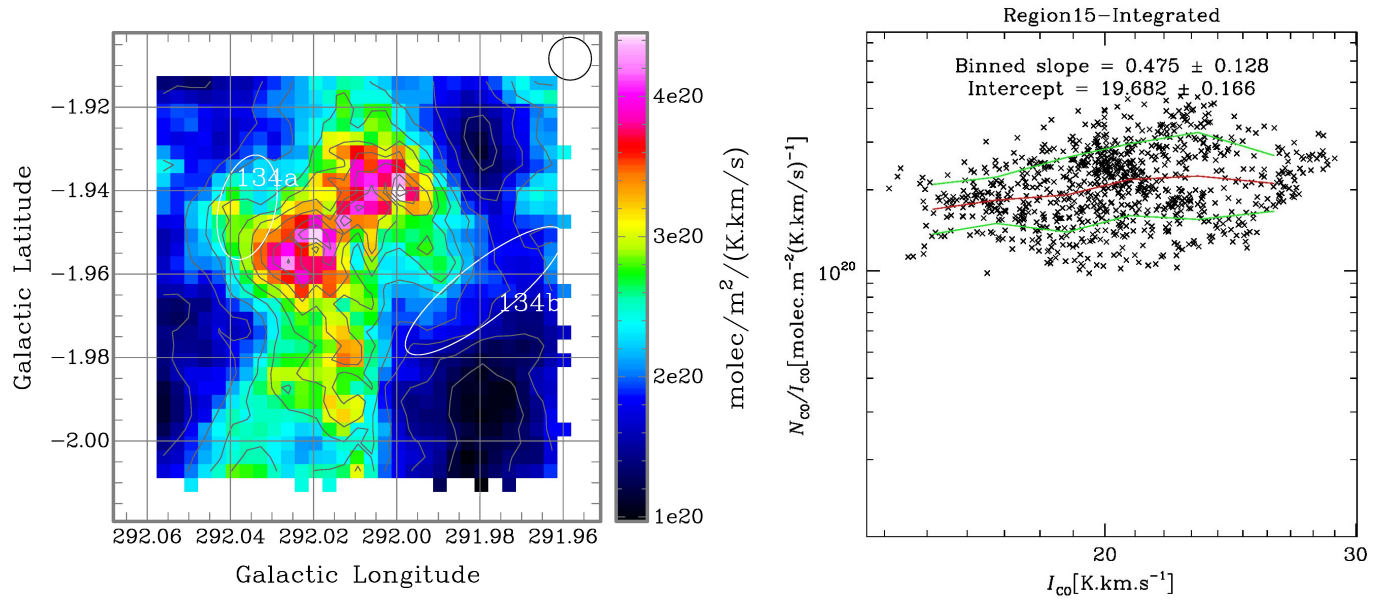
Figure A55. BYF 134 (Region 15) *continued*. The Mopra HPBW is shown in the TR corner.
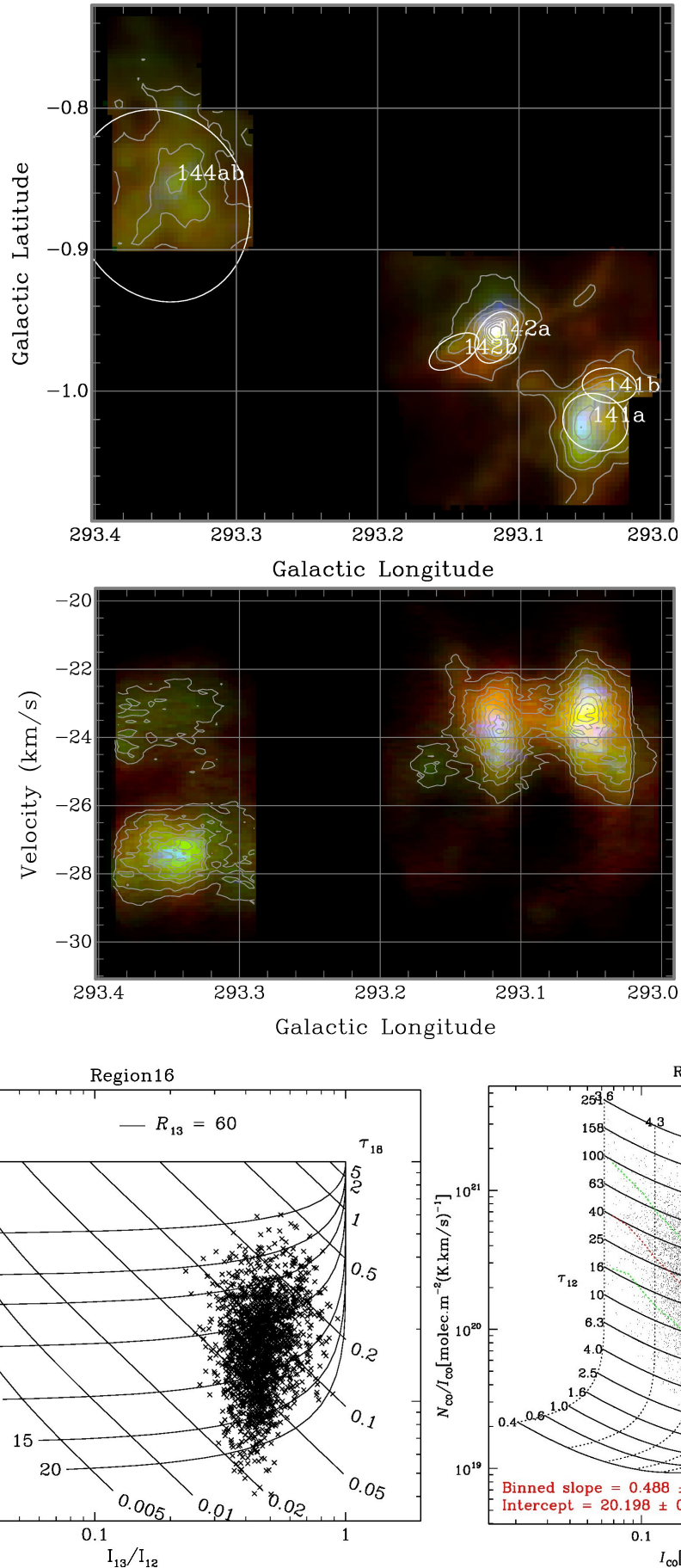
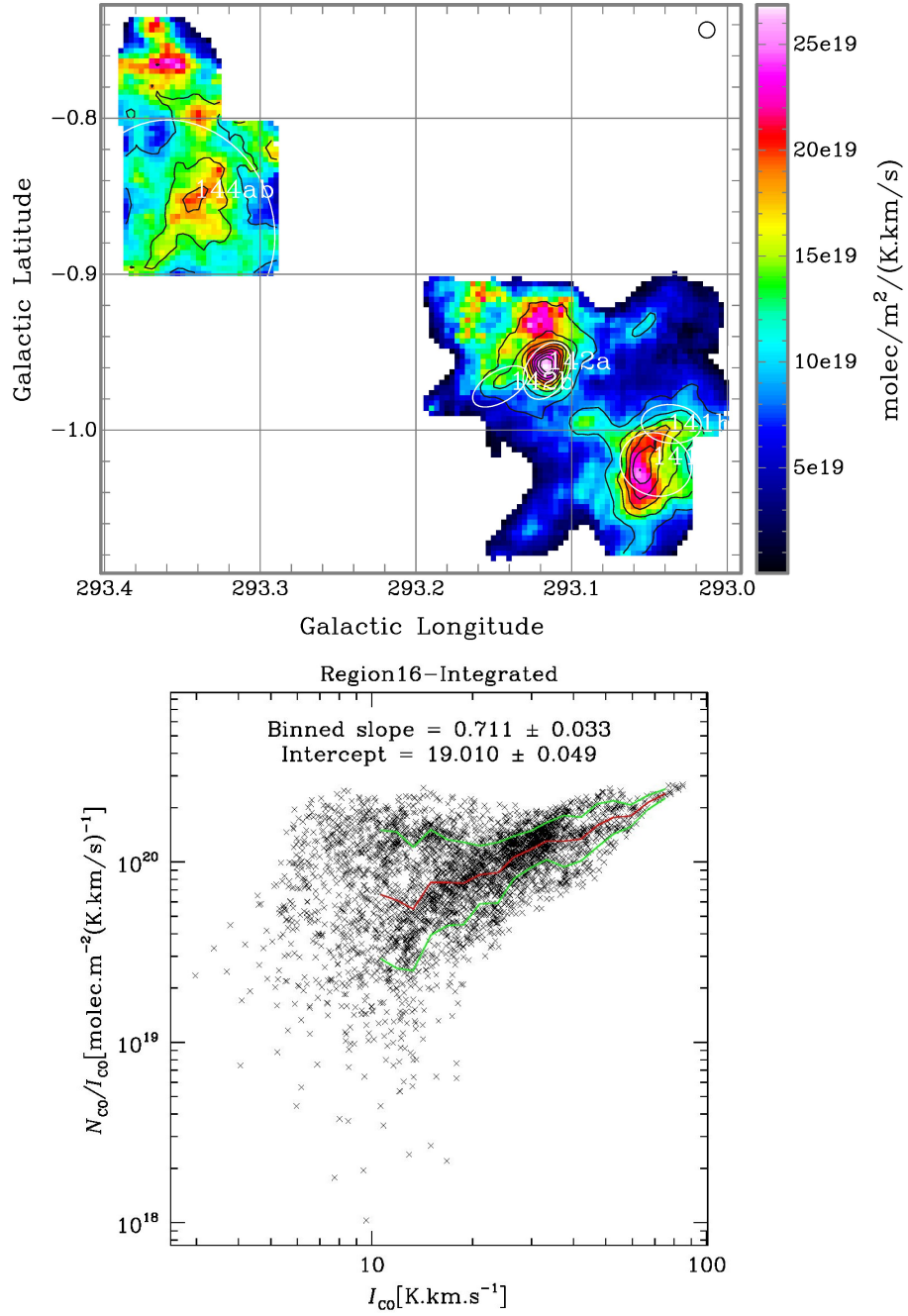**Figure A56.** BYF 141–144 (Region 16). At an assumed distance of 2.4 kpc, the scale is $0°.1 = 4.2\,\mathrm{pc}$.

Figure A57. BYF 141–144 (Region 16) *continued*. The Mopra HPBW is shown in the TR corner.
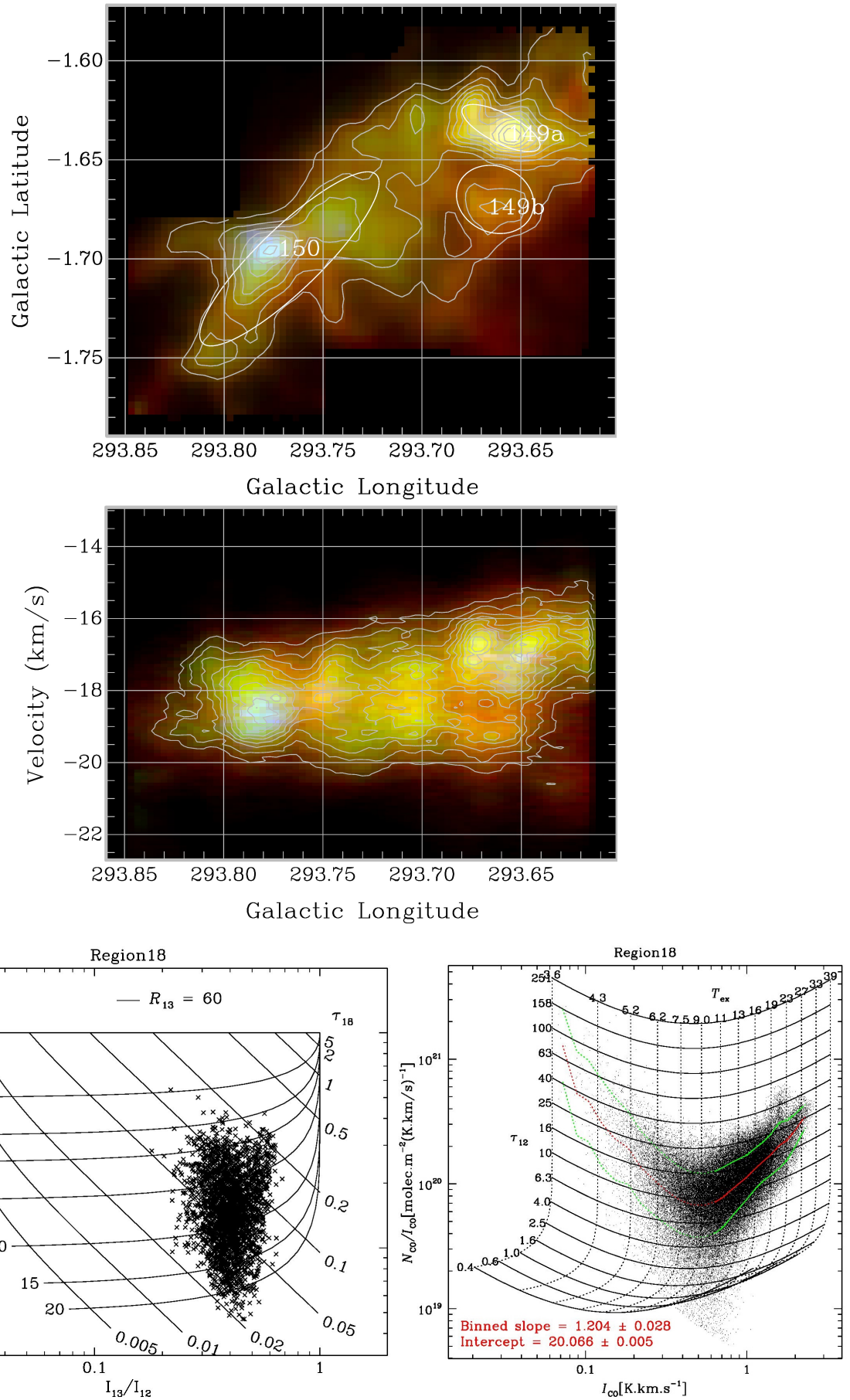
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Figure A58. BYF 149 & 150 (Region 18). At an assumed distance of 2.4 kpc, the scale is 0°.1 = 4.2 pc.
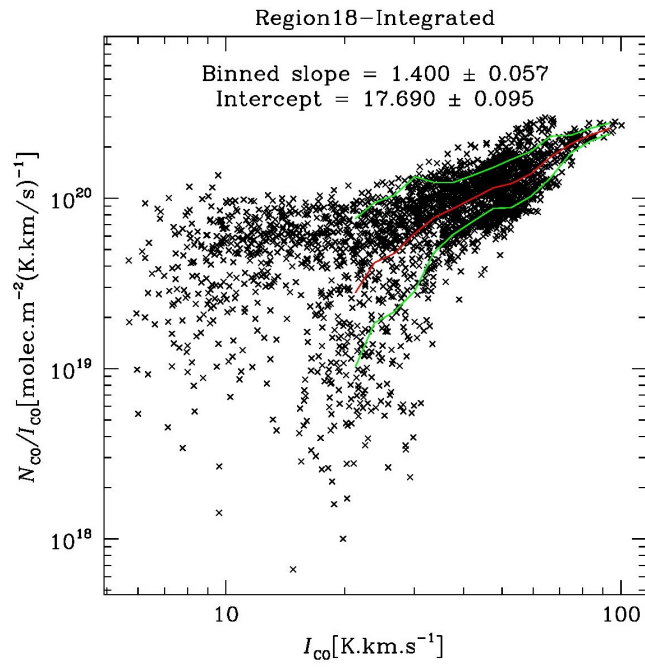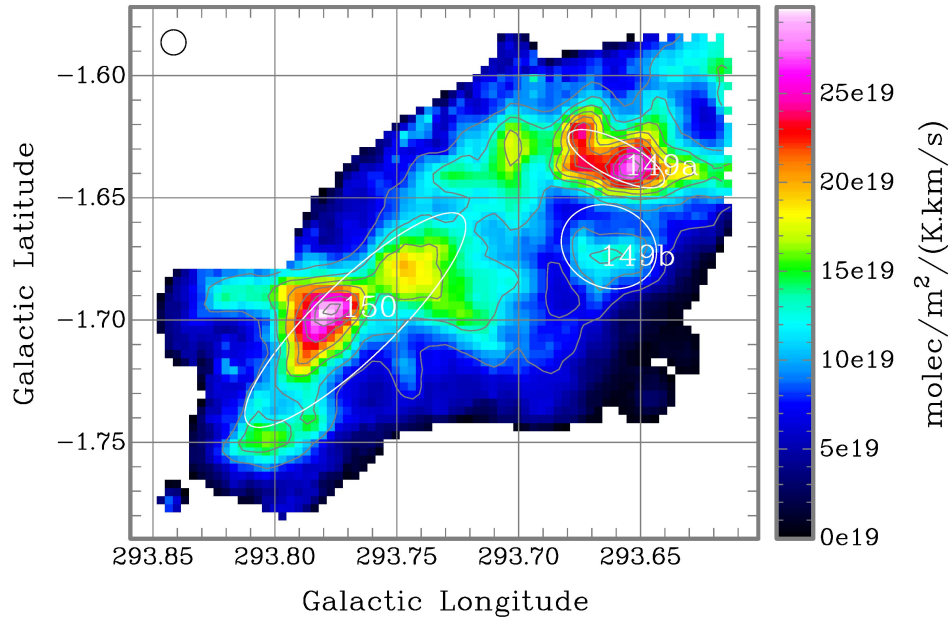
Figure A59. BYF 149 & 150 (Region 18) *continued*. The Mopra HPBW is shown in the TL corner.
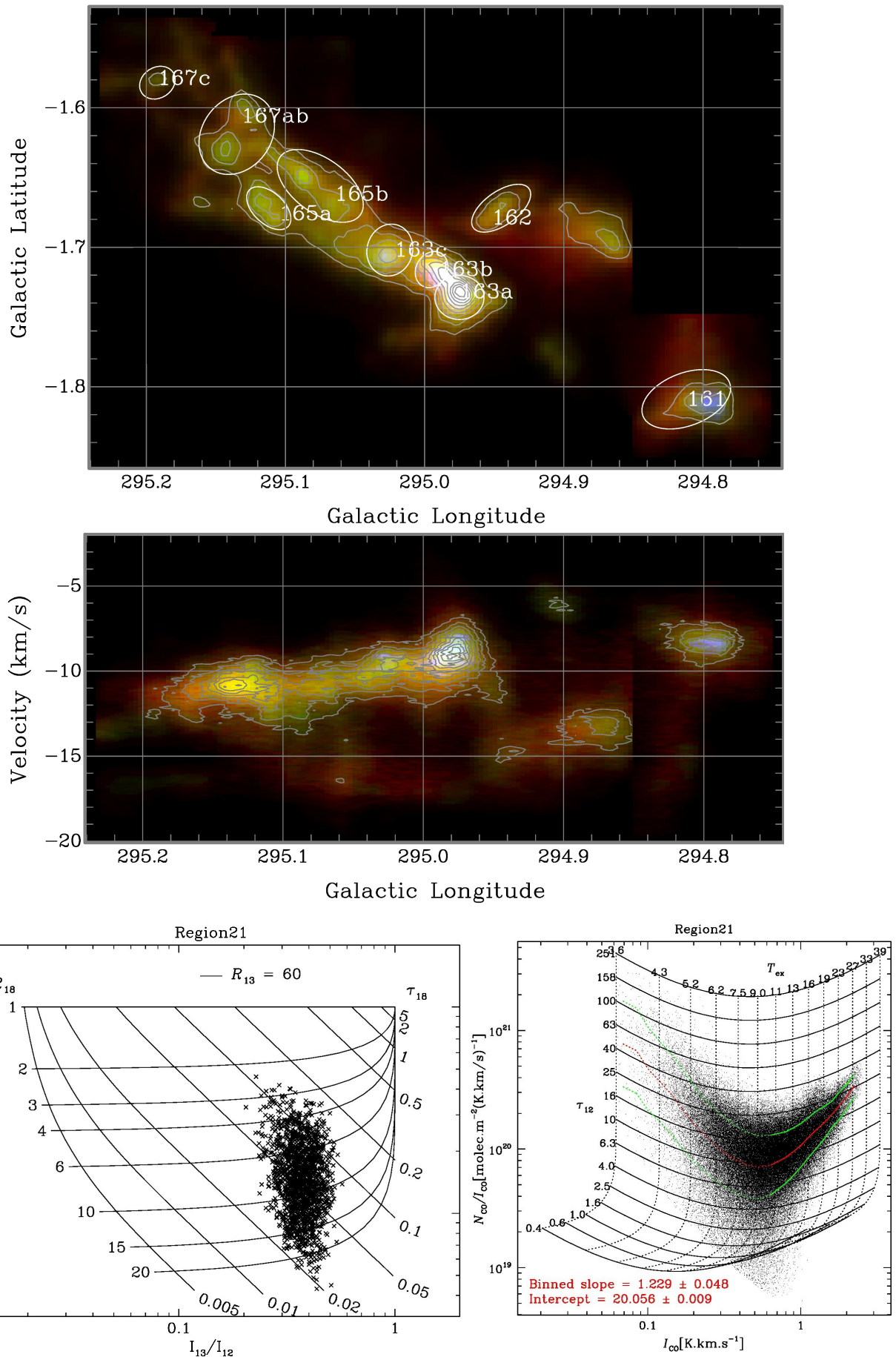
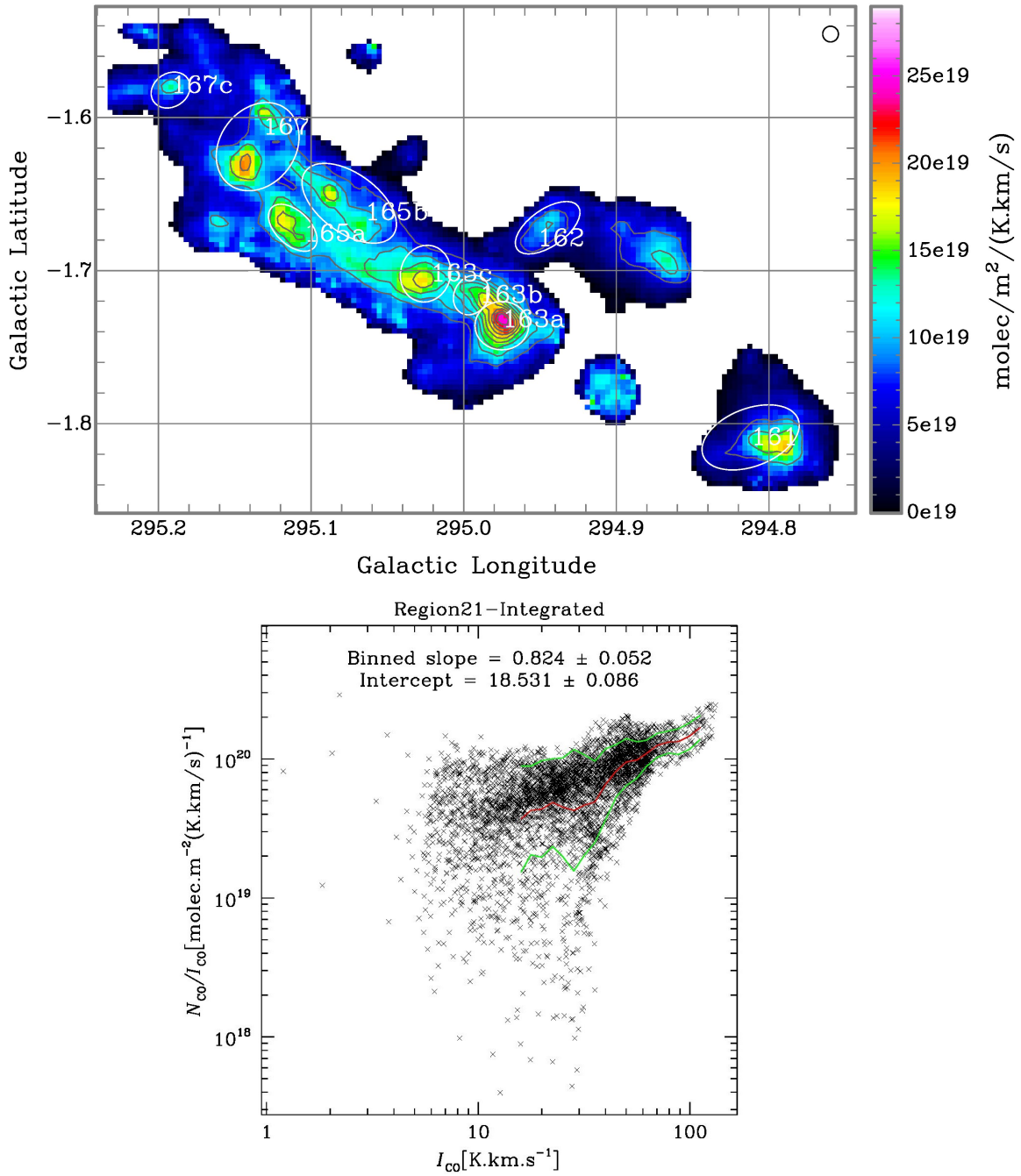**Figure A60.** BYF 161–167 (Region 21). At an assumed distance of 2.4 kpc, the scale is 0°.1 = 4.2 pc.

Figure A61. BYF 161–167 (Region 21) *continued*. The Mopra HPBW is shown in the TR corner.
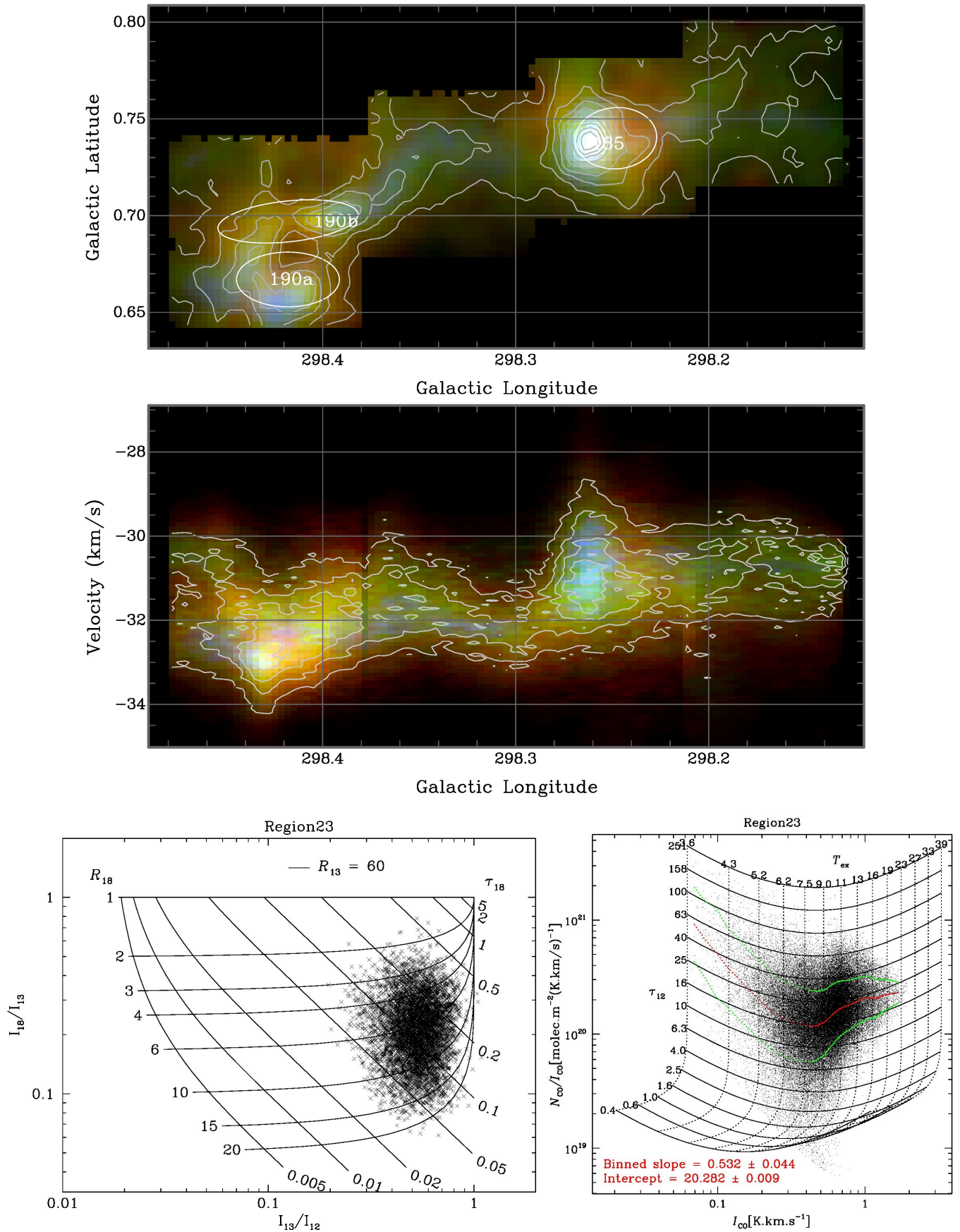
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Figure A62. BYF 183–190 (Region 23). At an assumed distance of 4.7 kpc, the scale is $0°.1 = 8.2$ pc.
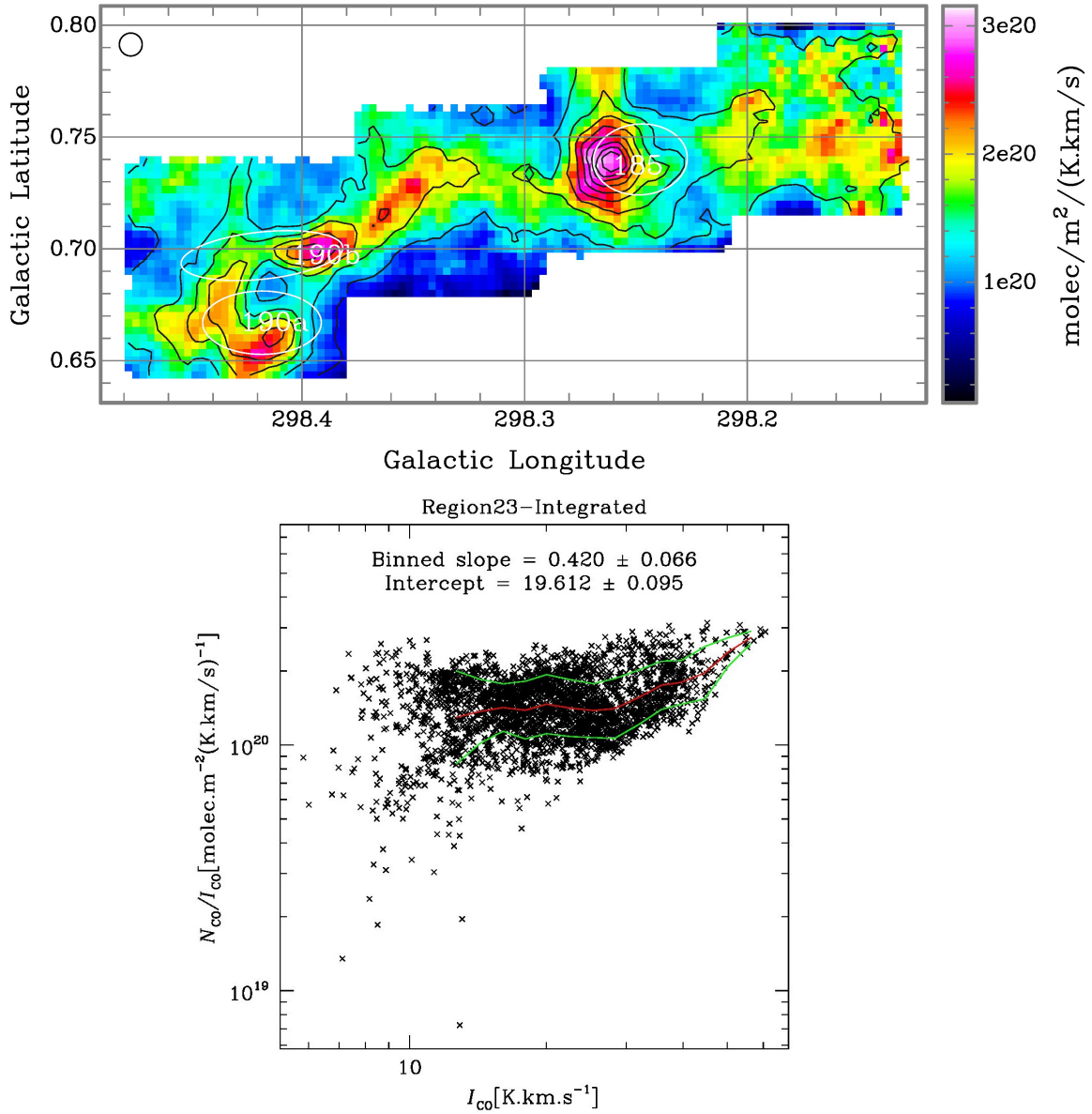
Figure A63. BYF 183–190 (Region 23) *continued*. The Mopra HPBW is shown in the TL corner.
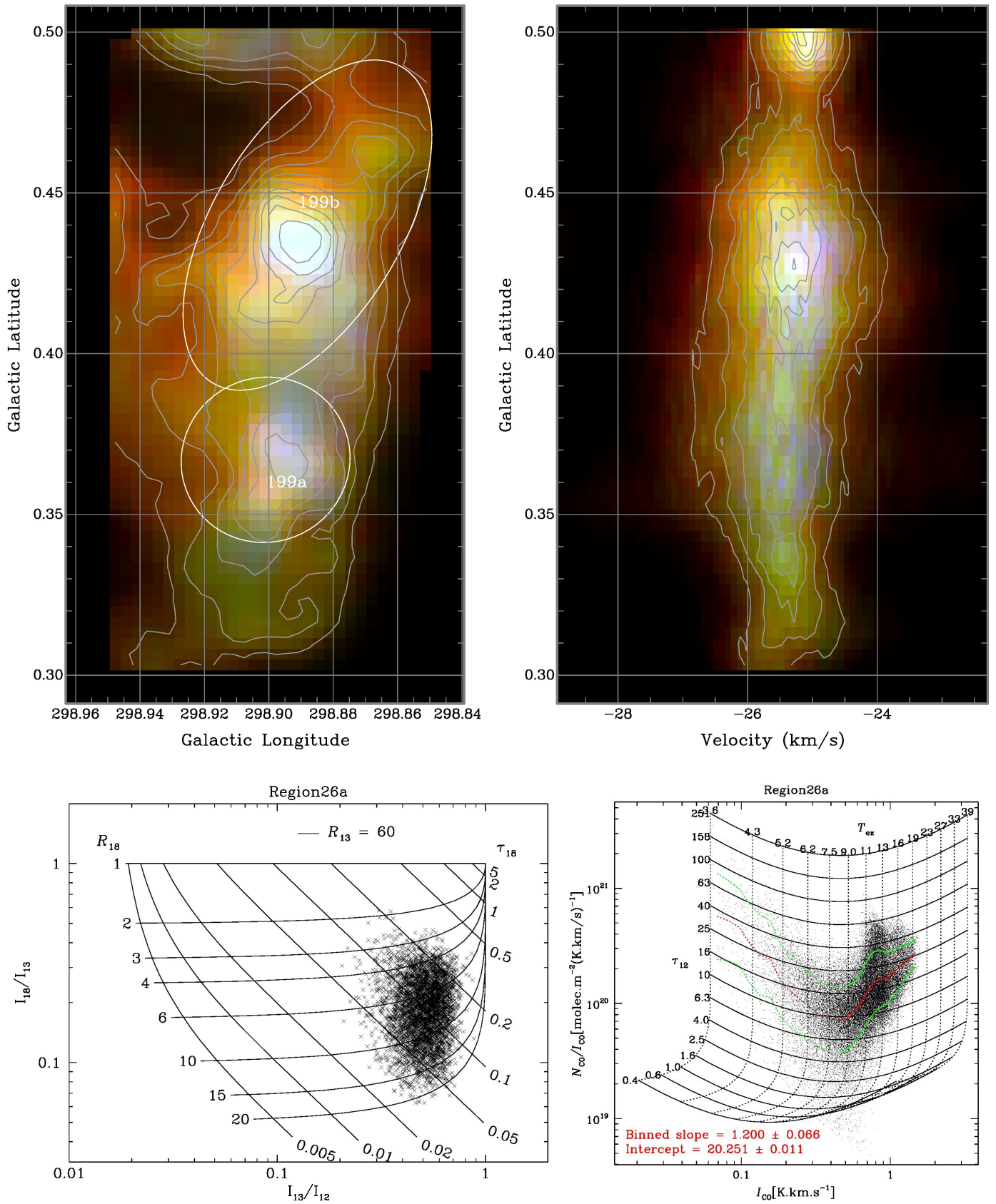
Figure A64. BYF 199 (Region 26a). At an assumed distance of 4.7 kpc, the scale is 0°.1 = 8.2 pc.
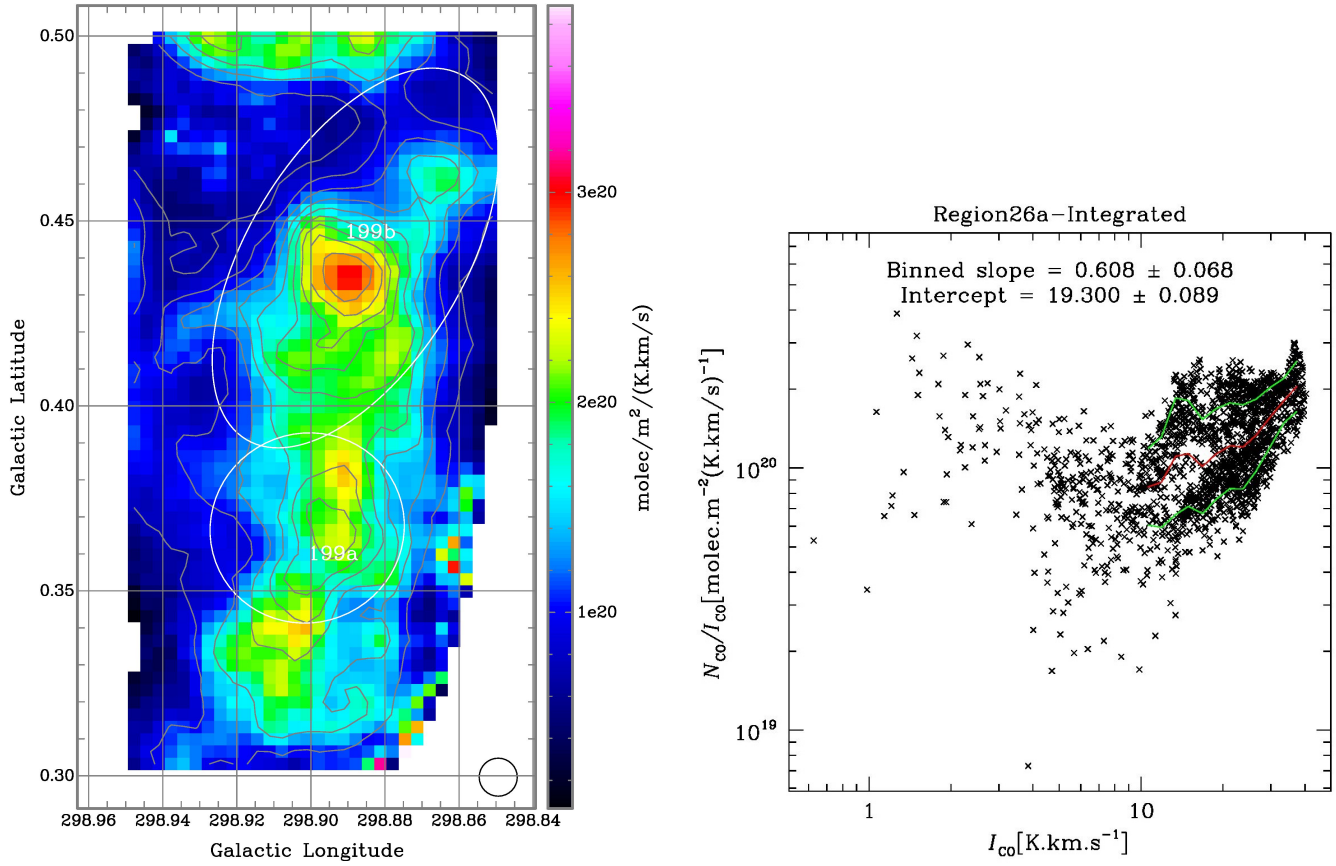
Figure A65. BYF 199 (Region 26a) *continued.* The Mopra HPBW is shown in the BR corner.
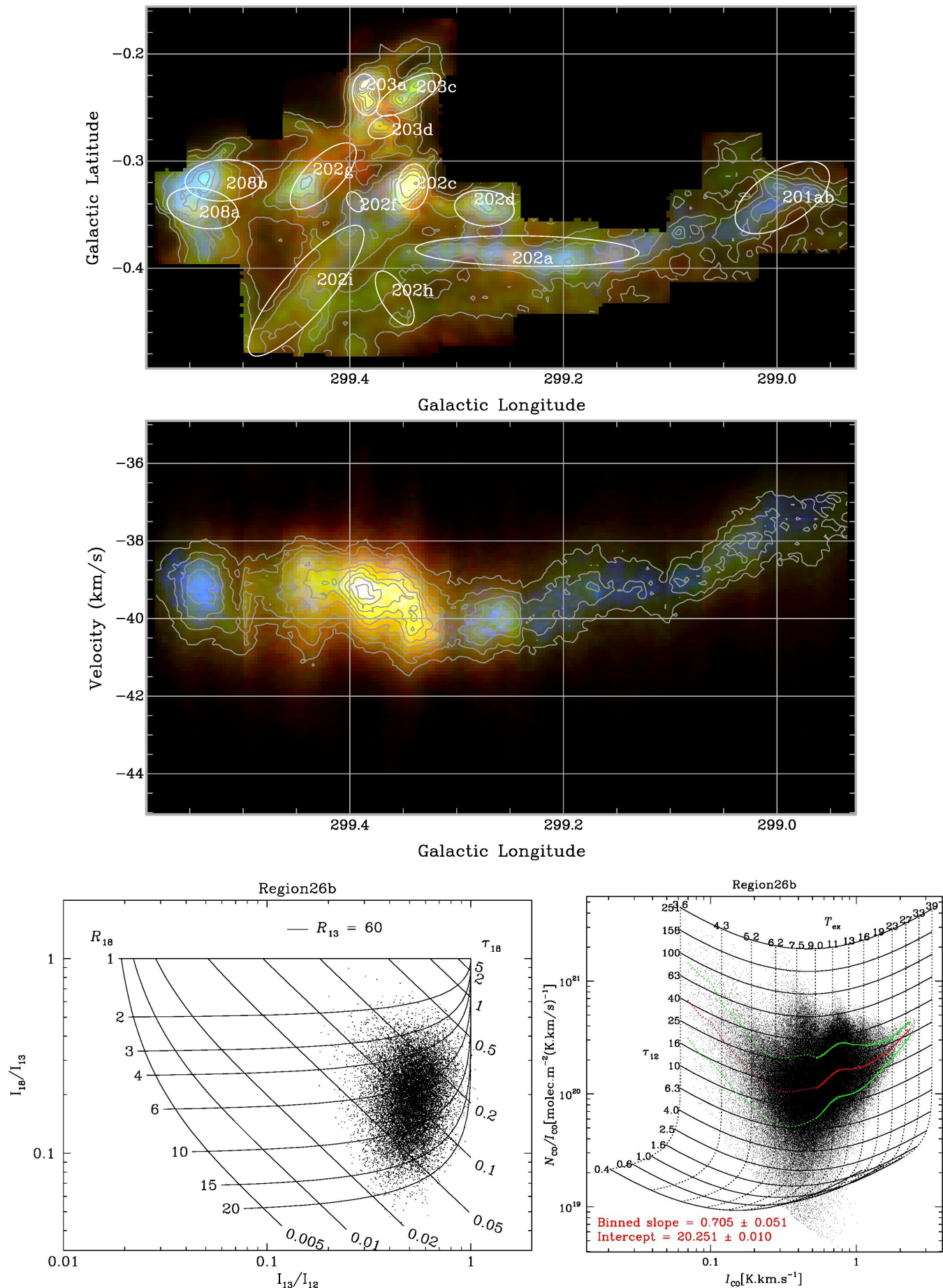
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Figure A66. BYF 201–208 (Region 26b). At an assumed distance of 4.7 kpc, the scale is 0°.1 = 8.2 pc.
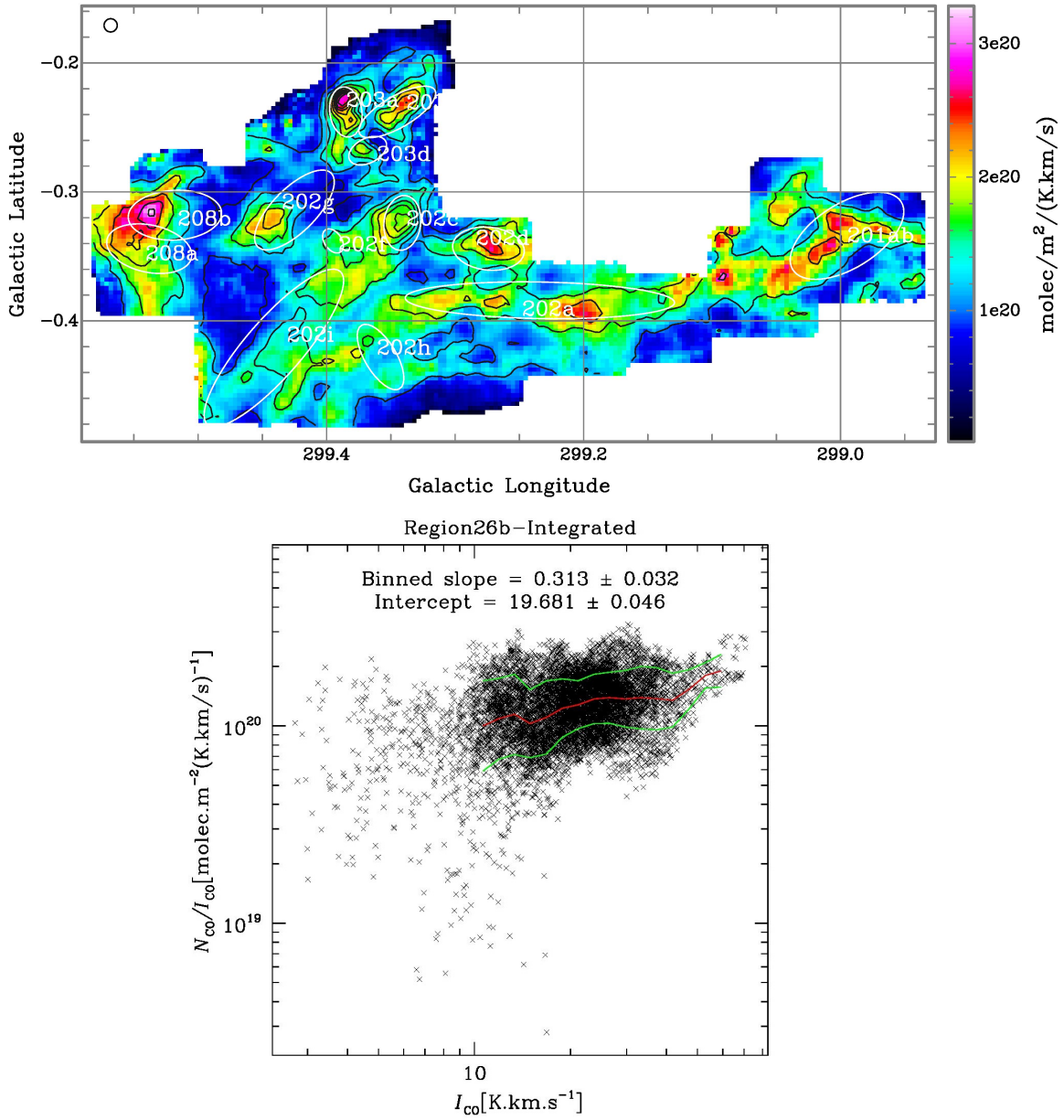
Figure A67. BYF 201–208 (Region 26b) *continued*. The Mopra HPBW is shown in the TL corner.