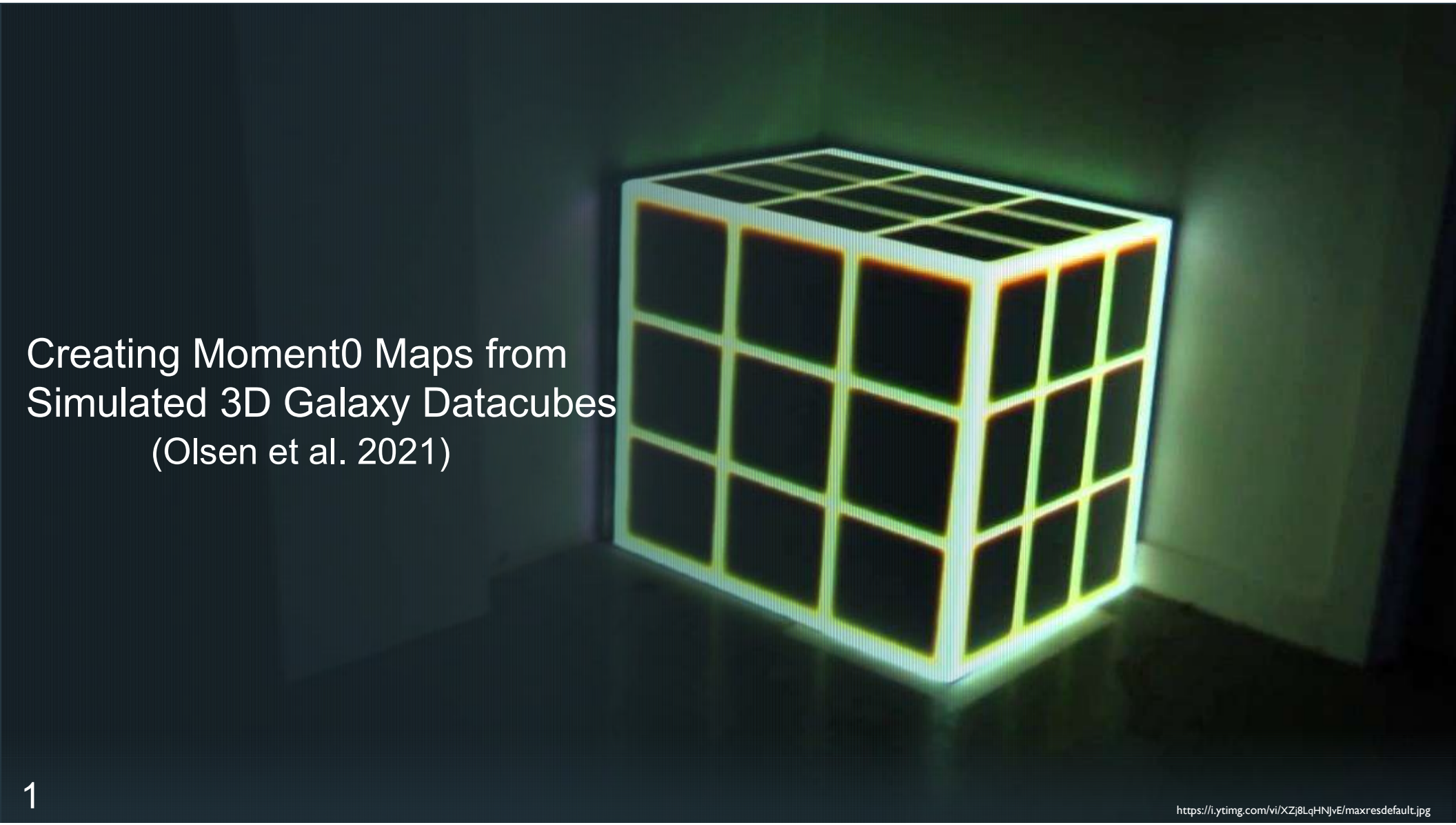
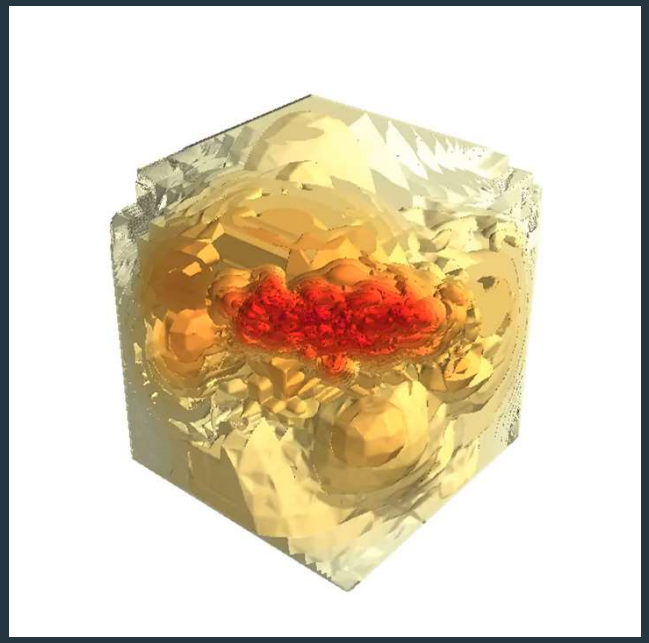
Creating Moment0 Maps from Simulated 3D Galaxy Datacubes

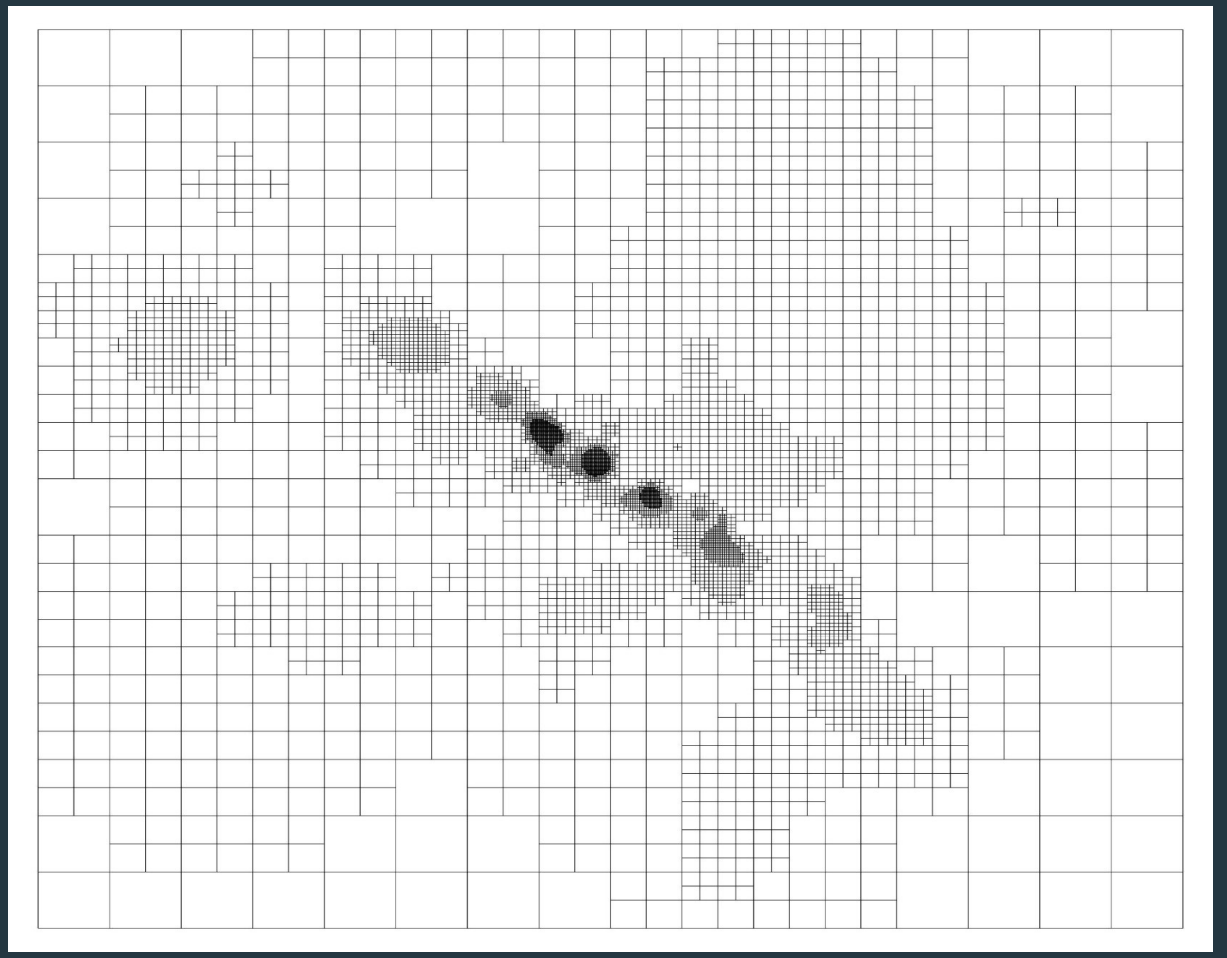
(Olsen et al. 2021)



https://i.ytimg.com/vi/XZj8LqHNJvE/maxresdefault.jpg

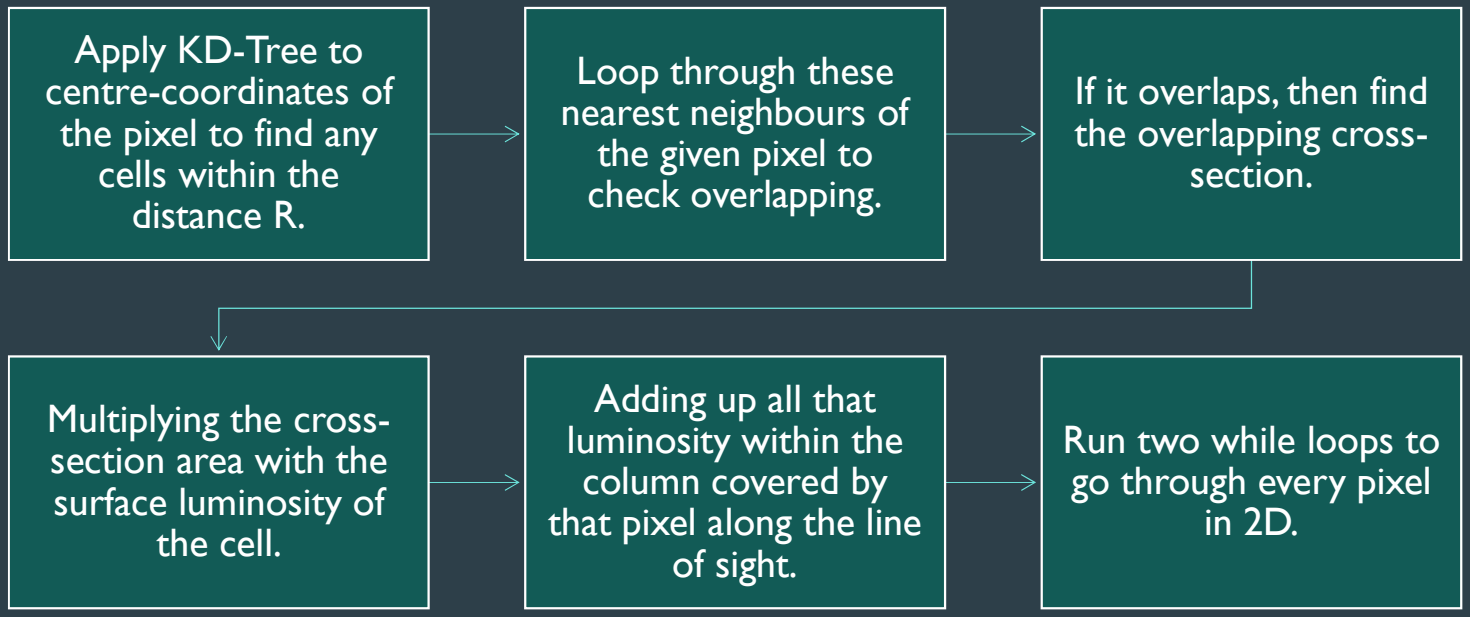
Data Cube





Credits: Dr. Karen P. Olsen

Algorithm

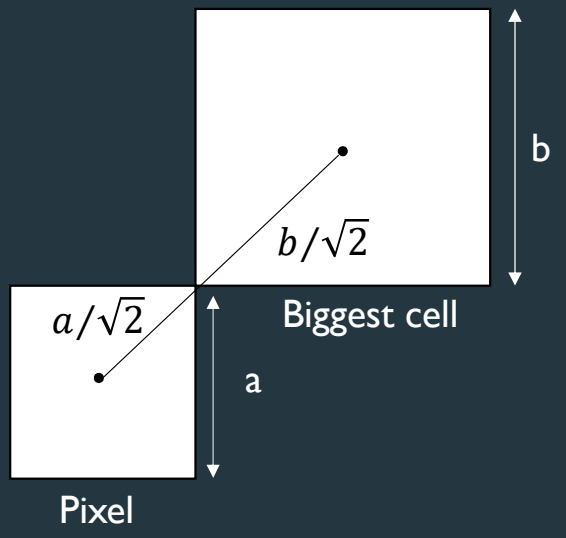

Apply KD-Tree to centre-coordinates of the pixel to find any cells within the distance R.
Loop through these nearest neighbours of the given pixel to check overlapping.
If it overlaps, then find the overlapping cross-section.
Multiplying the cross-section area with the surface luminosity of the cell.
Adding up all that luminosity within the column covered by that pixel along the line of sight.
Run two while loops to go through every pixel in 2D.

Scipy's spatial.KDTree class

https://docs.scipy.org/doc/scipy/reference/generated/scipy.spatial.cKDTree.html

- query_ball_point() method
- Identifies all the points within a particular radius from the particular point
- Set the radius to be the maximum distance between centre of any touching cell and centre of the pixel

- Radius (R) = $a/\sqrt{2} + b/\sqrt{2}$

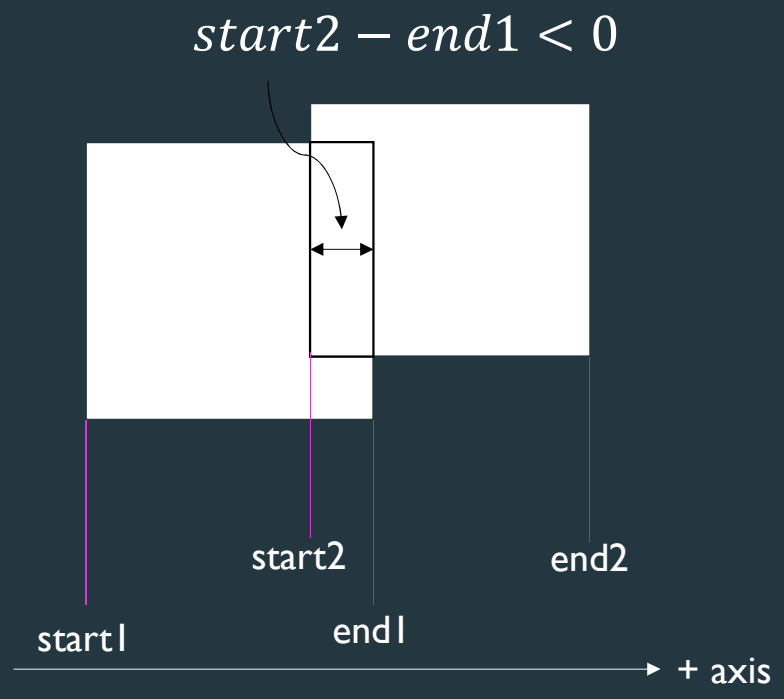


Overlapping

- Loop through each nearest neighbour cell to check overlapping

- Cell and pixel overlaps if and only if:

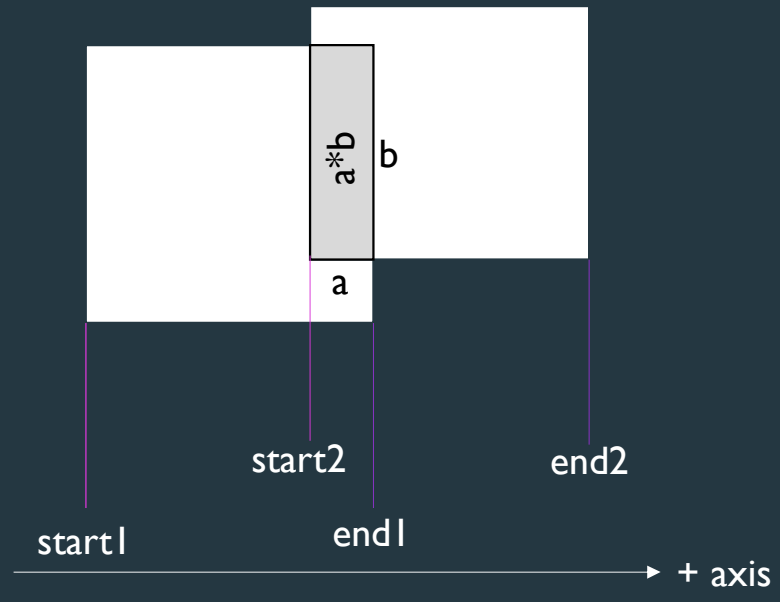
max(starting edges) – min(ending edges) < 0



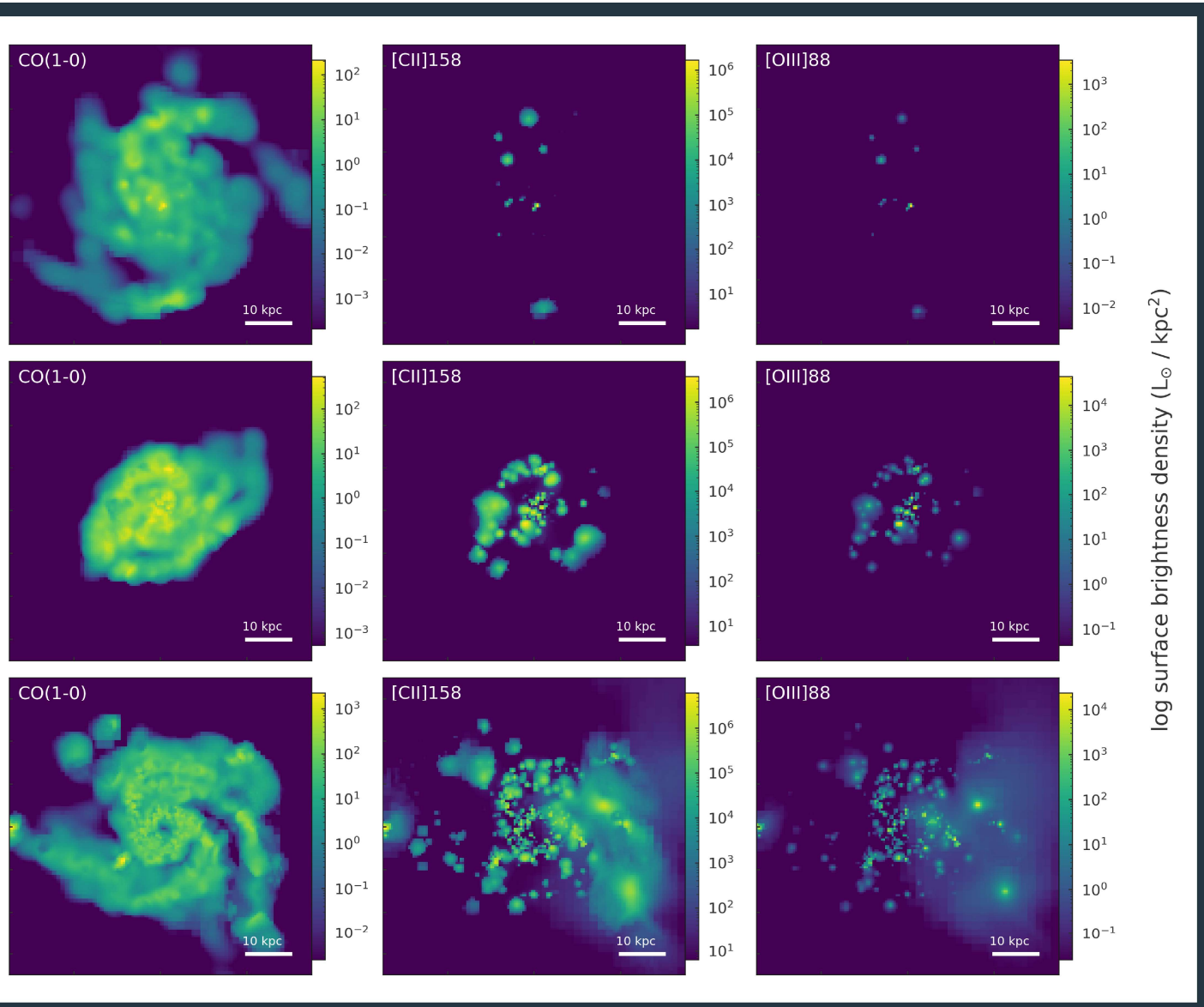
Cross-section Area and Adding up Luminosity

- Then, we find cross-section area of the overlapping cell and pixel.
- We multiply this cross-section area with the surface luminosity of the cell.
- We add up all the luminosity in that particular pixel.
- We find surface luminosity of every pixel using while loops.

$$a = end1 - start2 = \min(ends) - \max(starts)$$



Results


CO(1-0)
[CII]158
[OIII]88
10 kpc
log surface brightness density (L⊙ / kpc²)

Further Developments

- Creating line ratio maps from the moment0 maps and analysing them.
- Correlating moment0 maps of line emissions to various properties of ISM.
- Creating radial maps.
- Implementation of higher order moment maps.

Acknowledgment

Olsen, K. P., Burkhart, B., Mac Low, M.-M., et al. 2021, ApJ, 922, 88

doi:10.3847/1538-4357/ac20d4

Special thanks to:

Dr. Karen P. Olsen, research advisor & principle investigator

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