Gaseous Dwarf-Dwarf Interactions in the Local Universe

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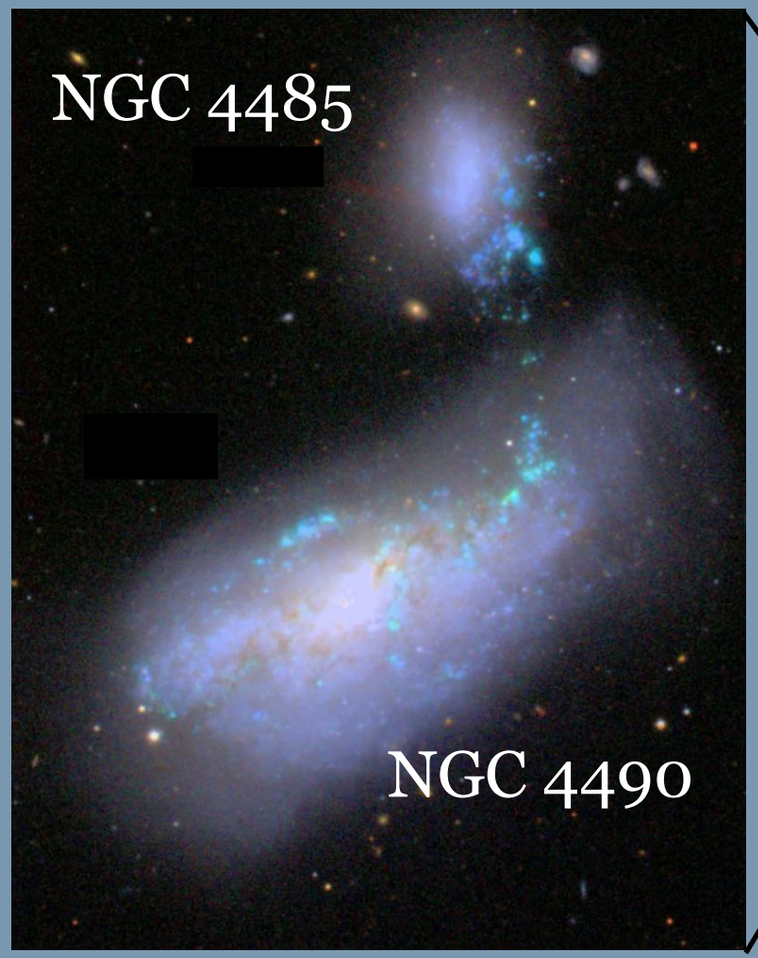
In collaboration with: G. Besla (UA), M. Putman (CU) & the TNT group

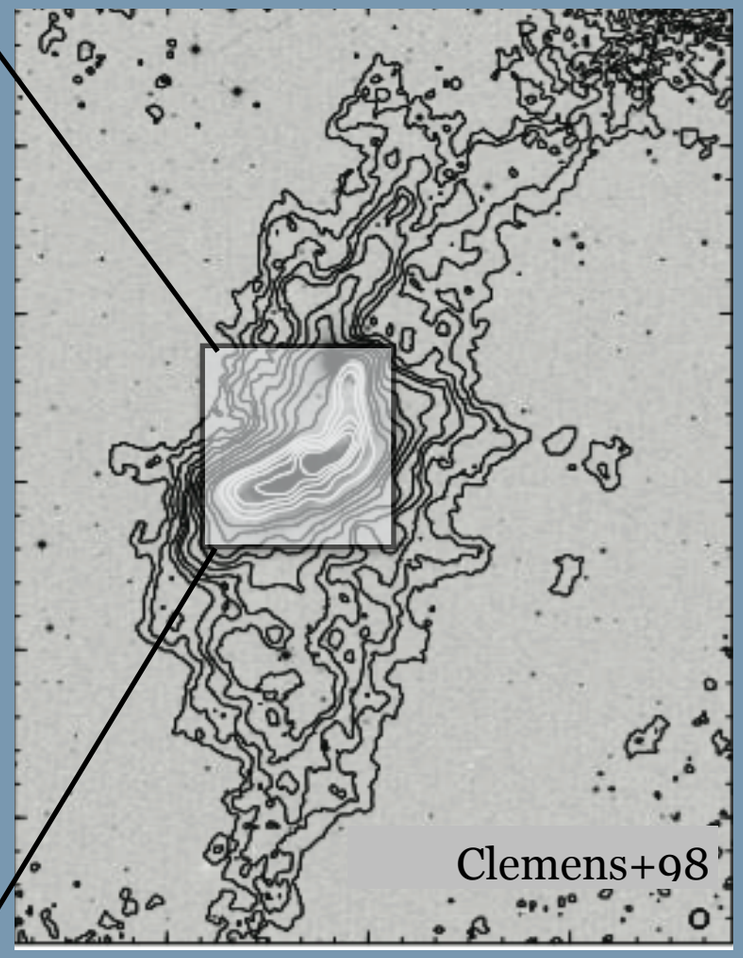
Importance of dwarf-dwarf interactions

Most frequent type of merger at all z

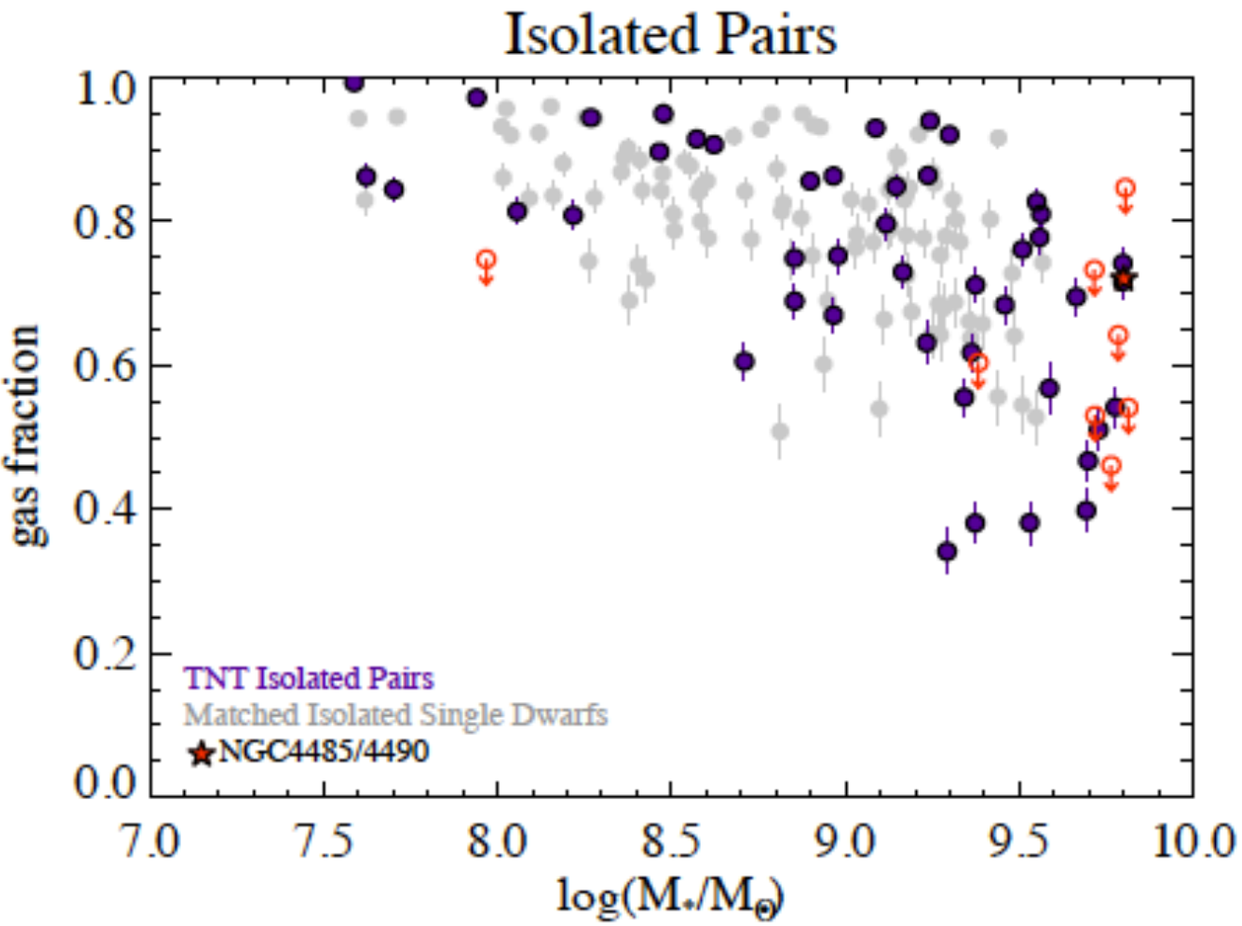
Hierarchical build up of galaxies

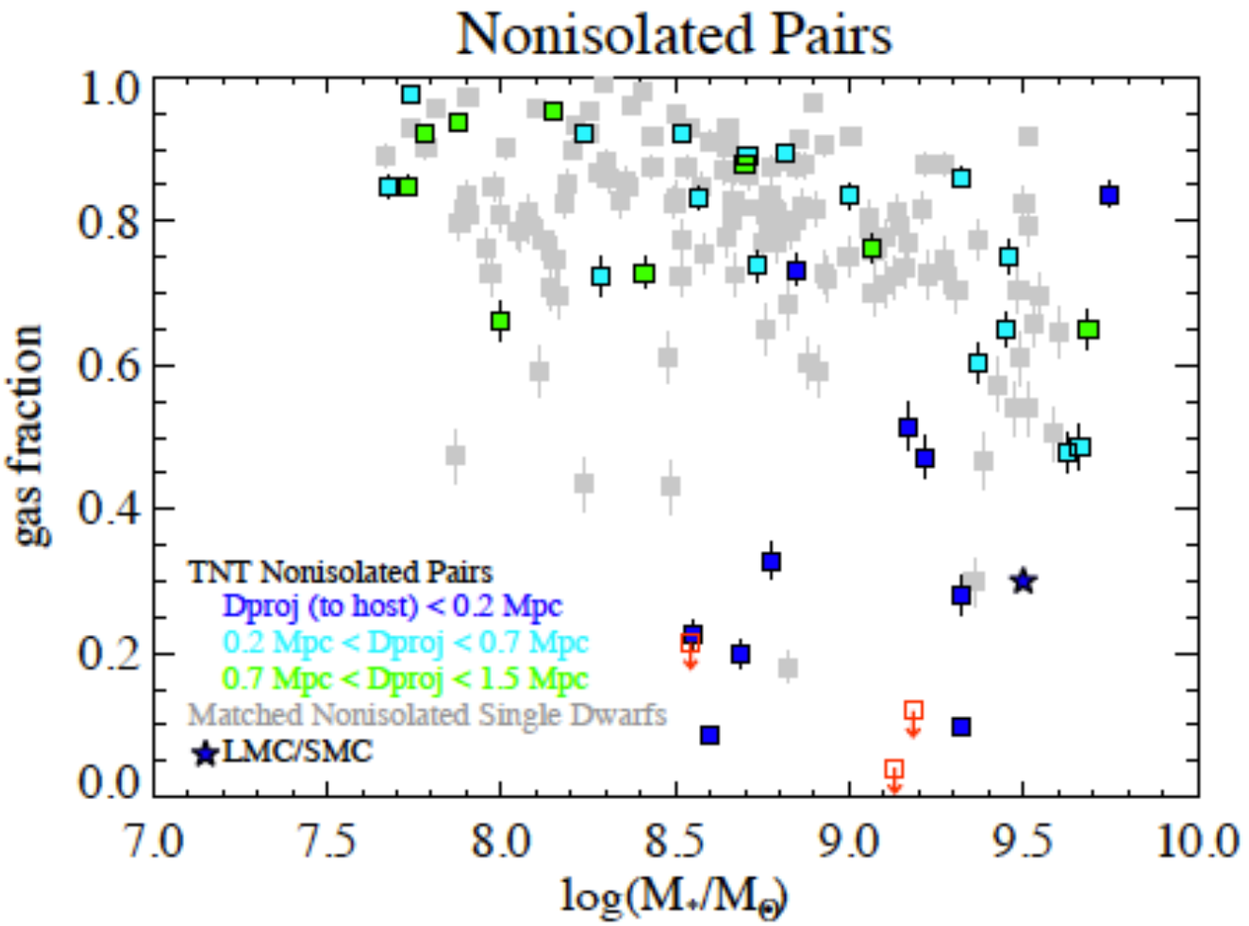
Baryon cycle of dwarfs **and** more massive galaxies (pre-processing, Besla's talk)





TNT: Systematic study of dwarf galaxy pairs





Stierwalt et al. 2015

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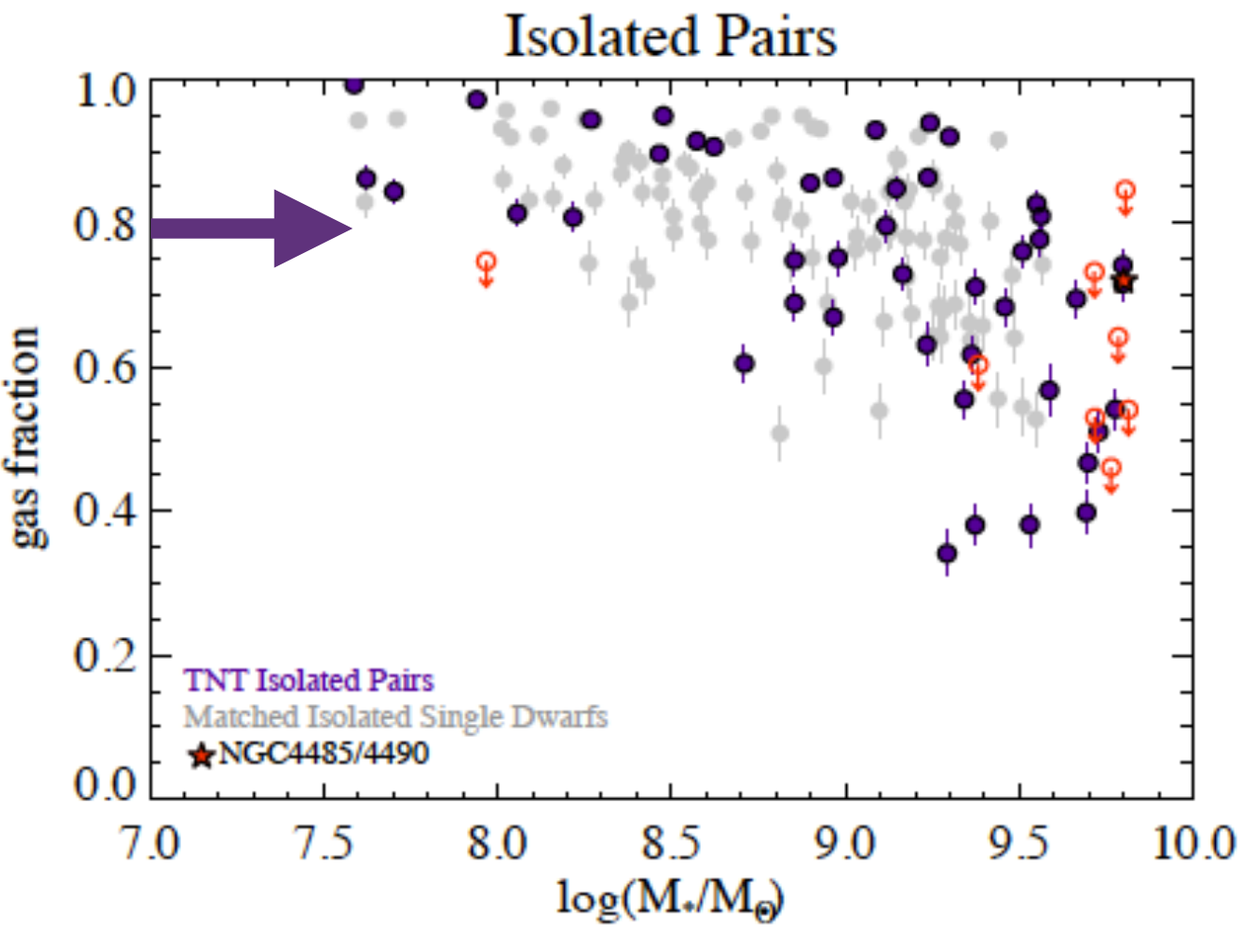

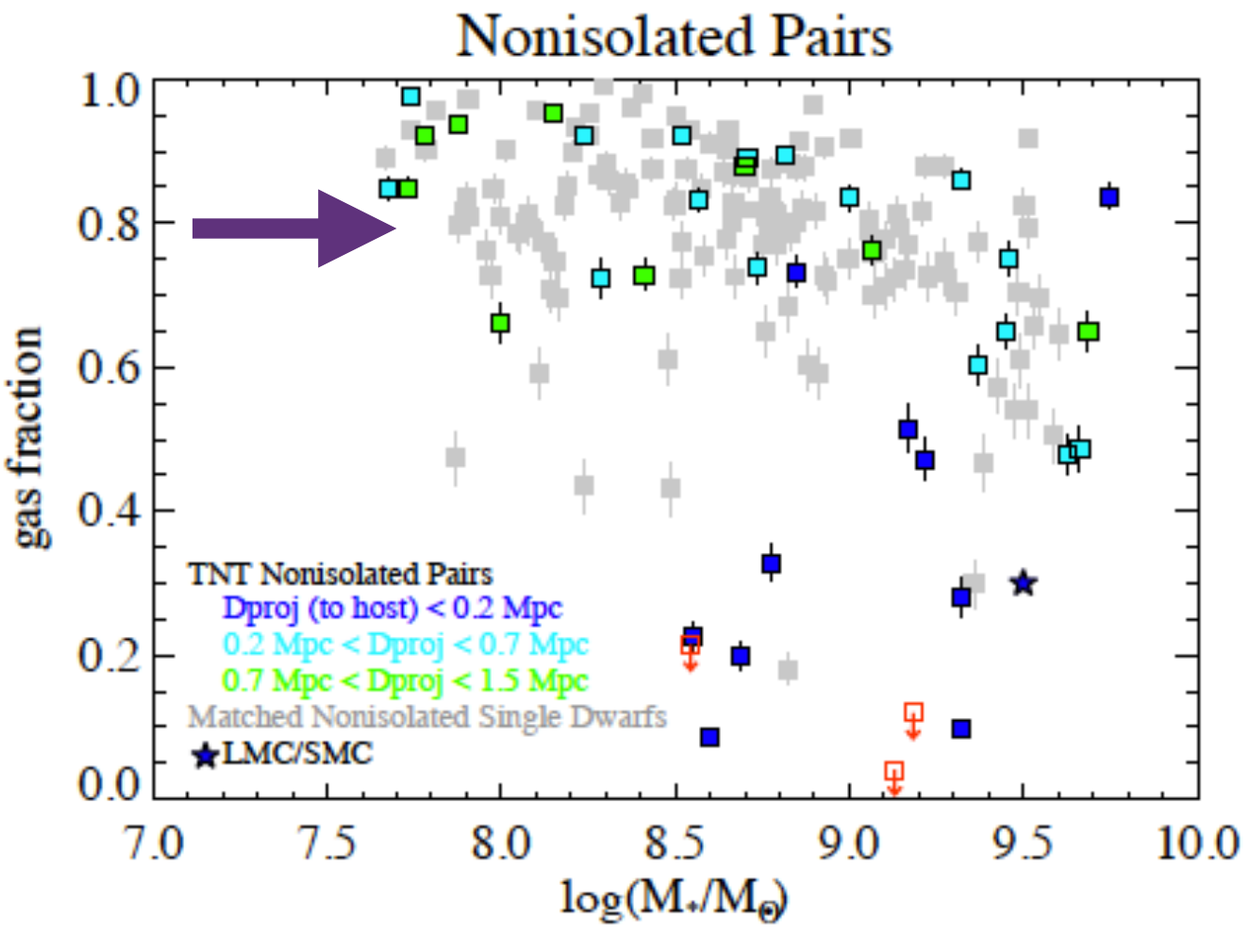

Stierwalt et al. 2015

high gas fractions

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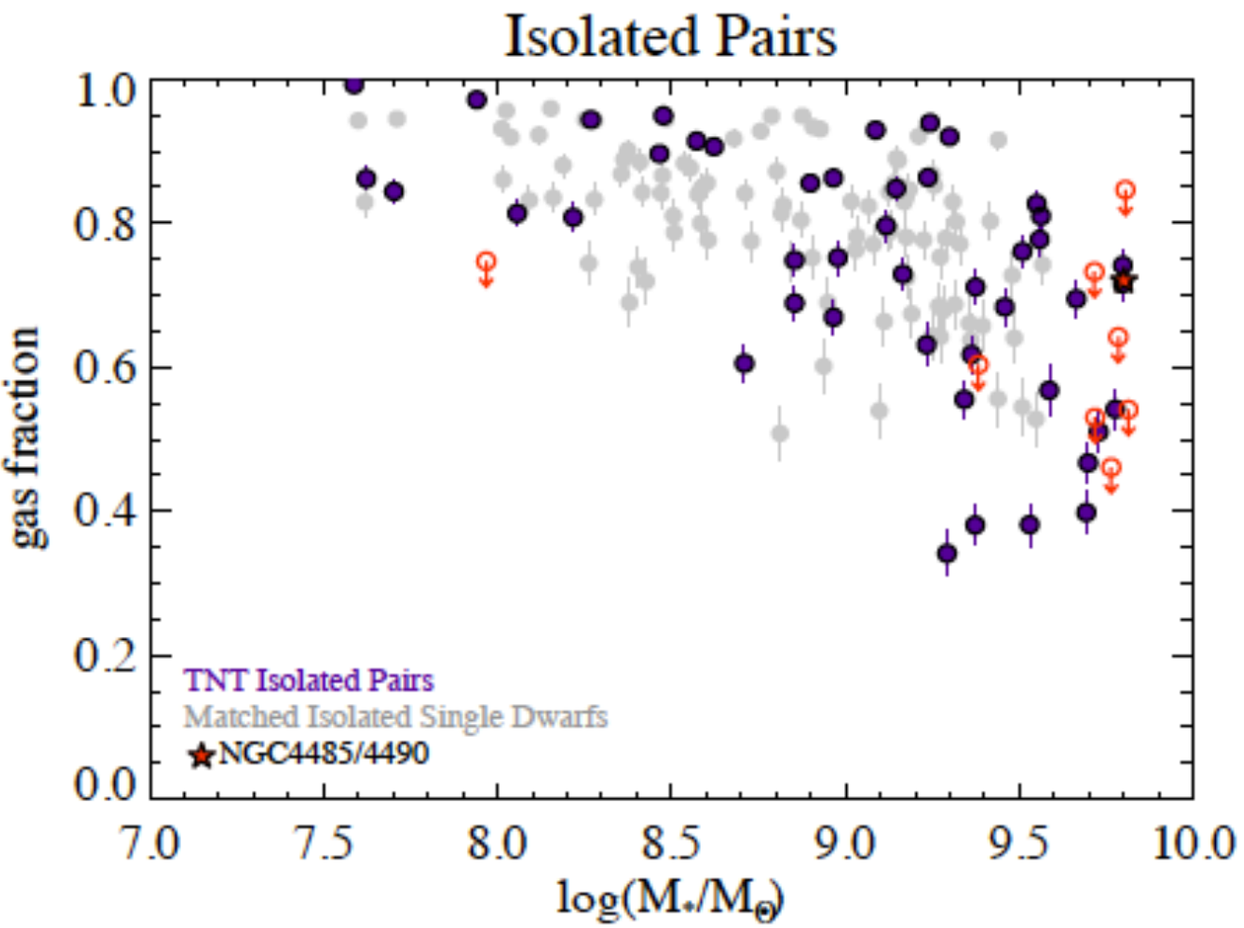

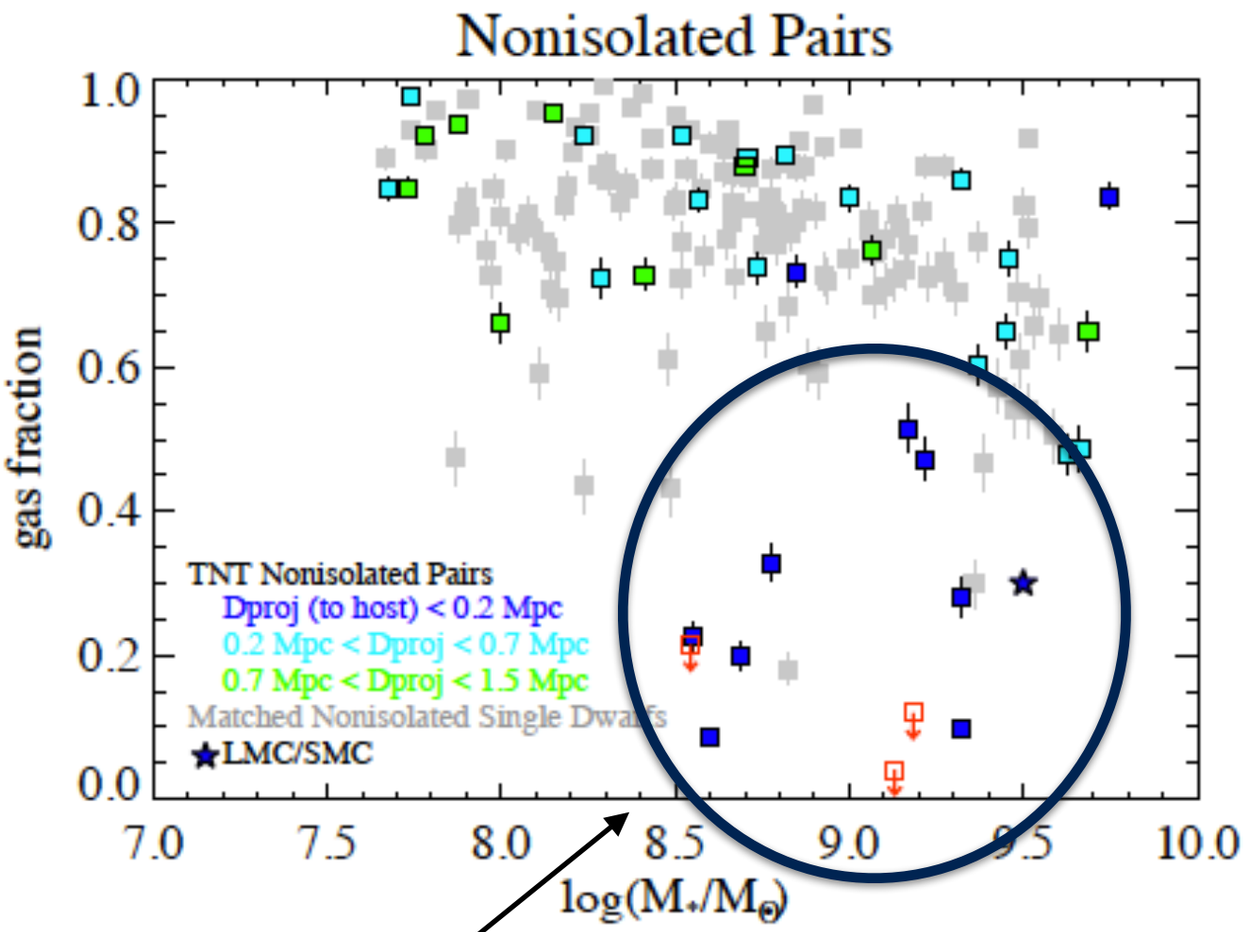

D_{proj} < 200 kpc from massive host

Stierwalt et al. 2015

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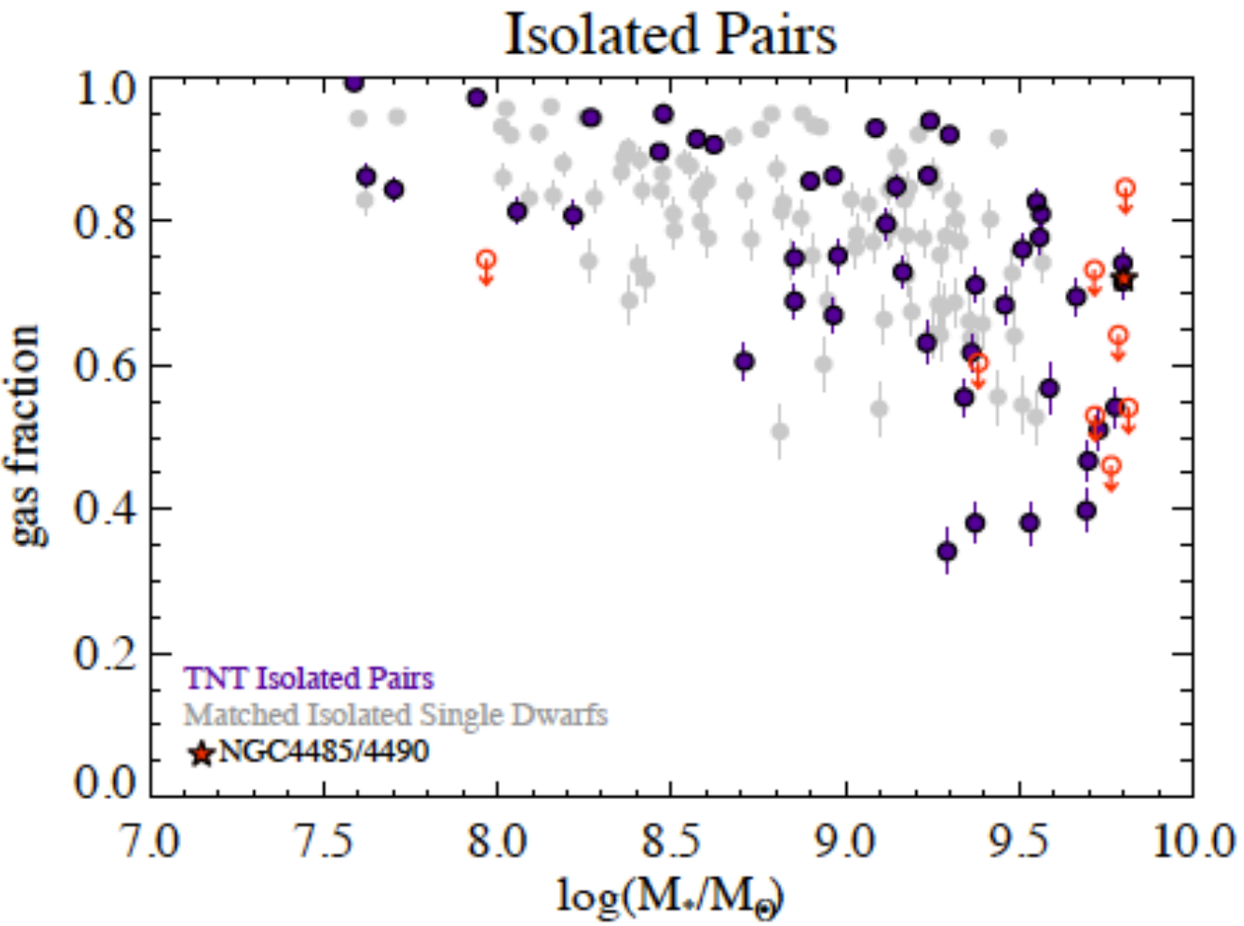
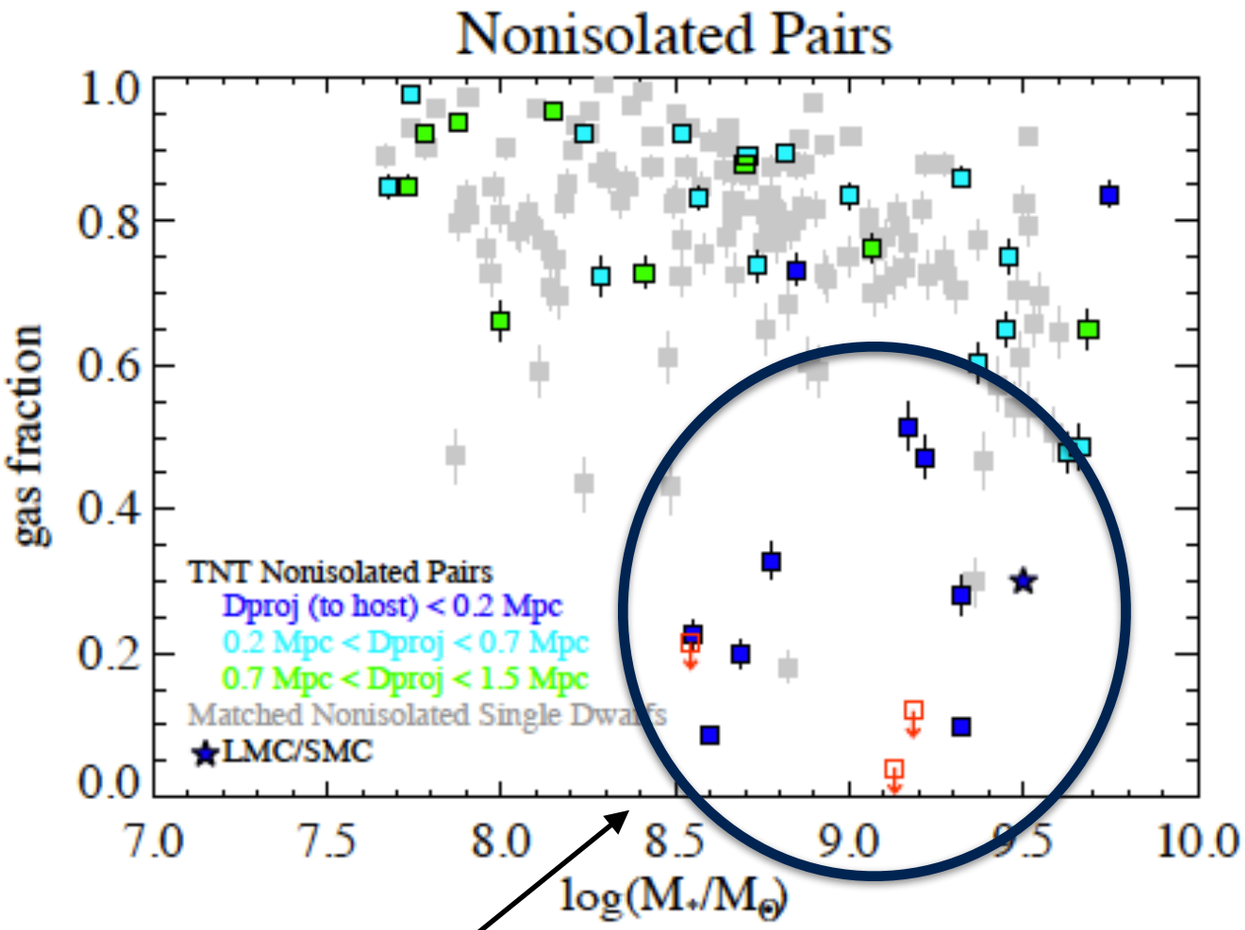




D_{proj} < 200 kpc from massive host

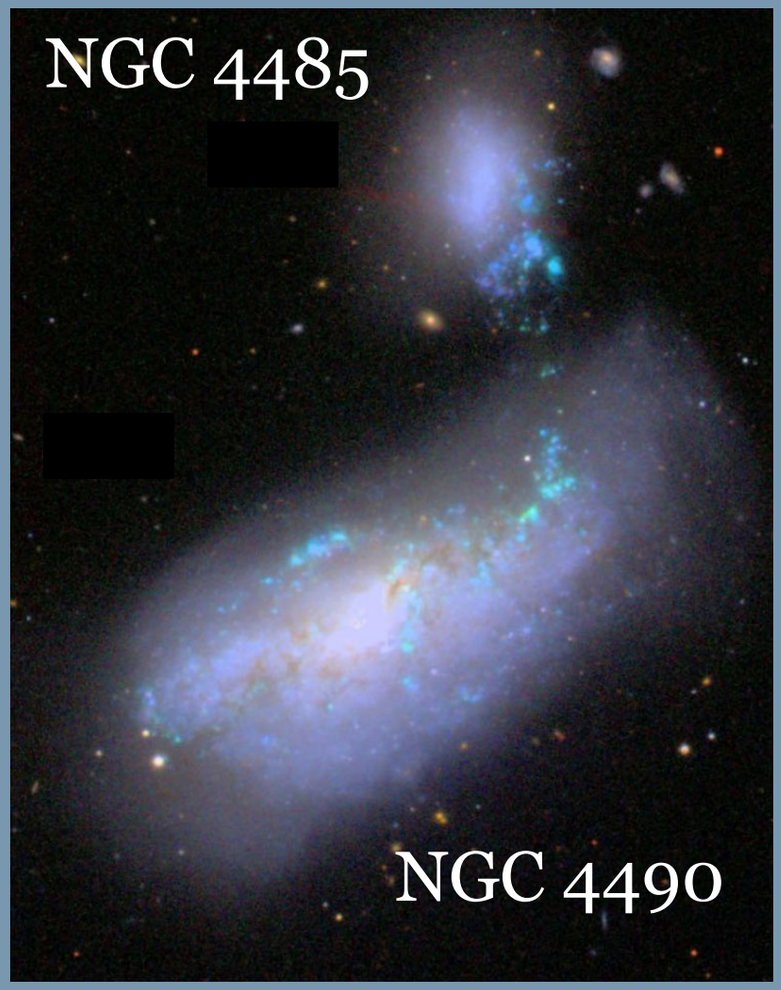
Stierwalt et al. 2015

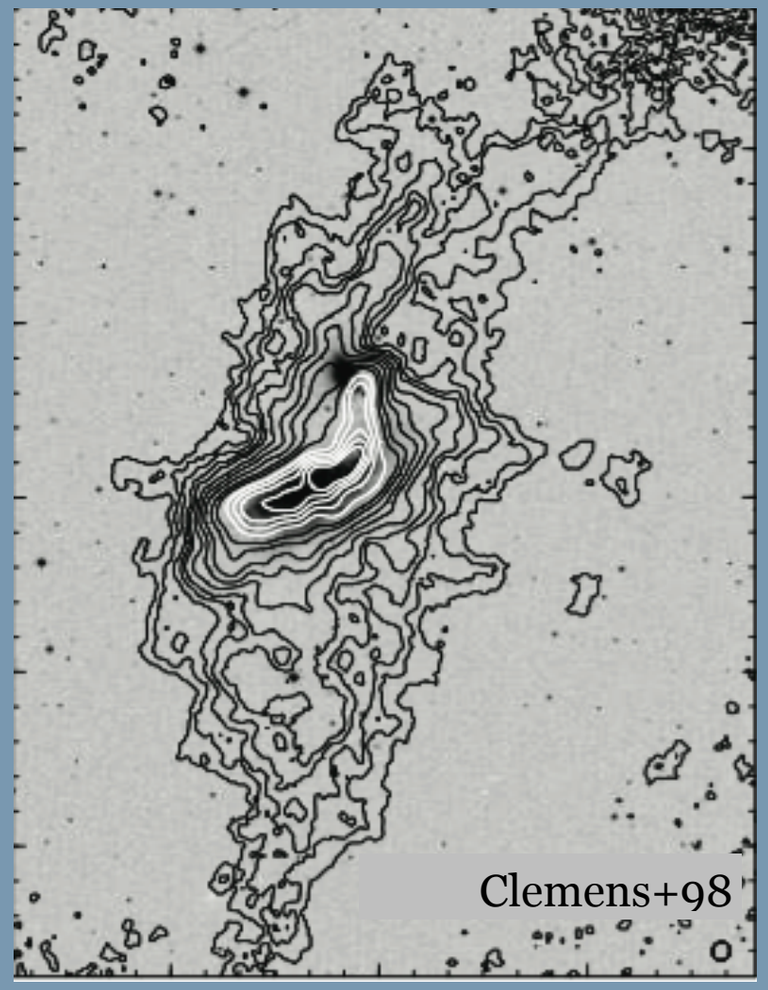
Similar results in Bradford+ 2015

Stierwalt+ 2015 & Bradford+ 2015:

Environment removes gas from dwarfs

What is the gas removal process?





A local sample can help us understand this

The diffuse gas can help us understand:

Where the gas is located

How the morphology of the gas distribution changes with environment

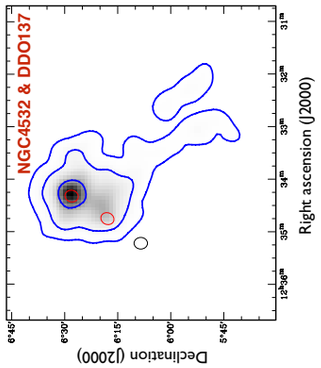
What regulates the baryon cycle of dwarfs and how they feed massive galaxies

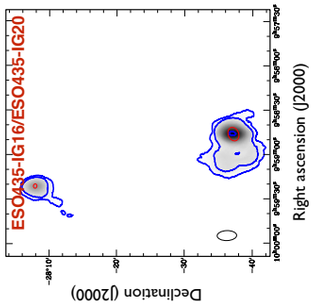
Magellanic type systems as a population

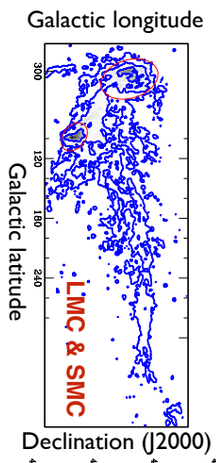
Initially 22 pairs within 50 Mpc

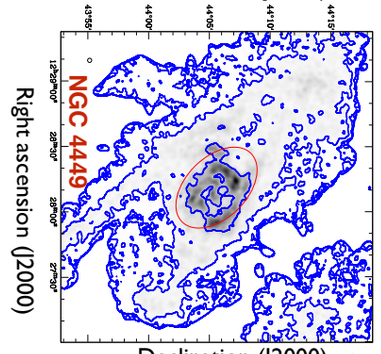
- N(HI) < 8 x 10^{19} atoms cm^{-2}
- M_* < 5 x 10^9 M_{sun}
- pair sep < 100 kpc
- v_{sep} < 300 km/s

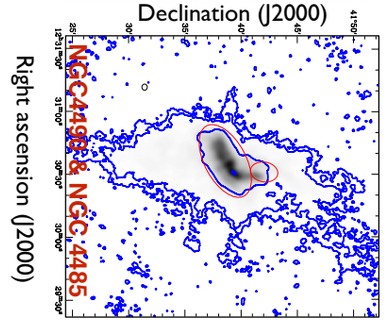
11 pairs remaining in various environments

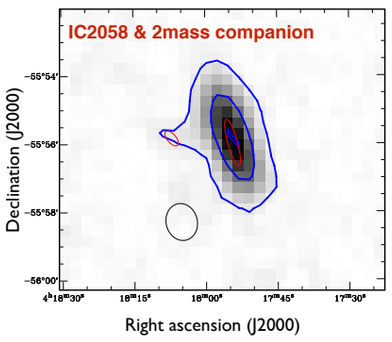


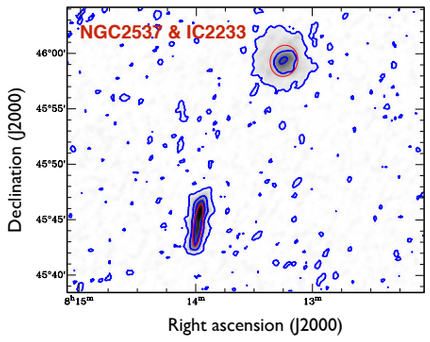


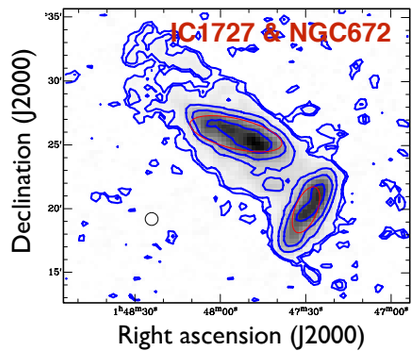


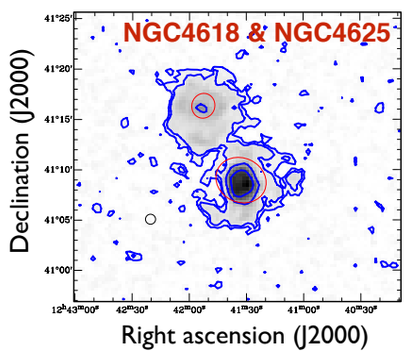


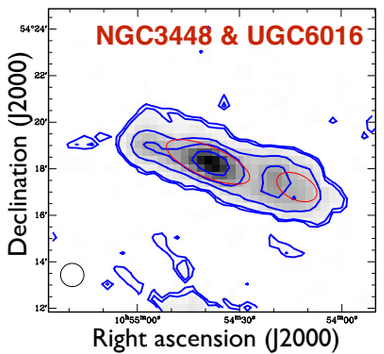












Properties of interest

Assessing the environment

Will the halo medium of the host lead to ram-pressure stripping of the dwarf galaxies? (Liang & Chen 2014)

How far away is the nearest host?

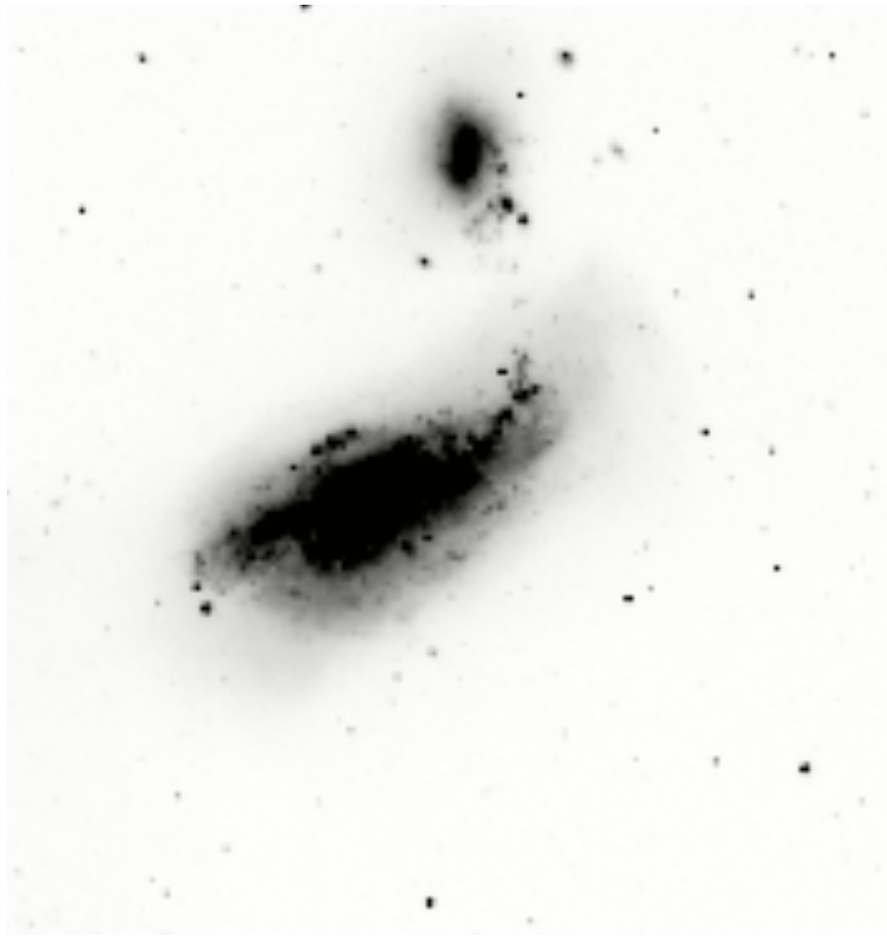
How massive is it? ($M_* > 10^{10}$ Msun)

$$\Theta = \log(M_*/D^3_{project})$$

Karachentsev & Makarov 1998

Investigating the gas

How much of the gas is residing within the dwarfs?



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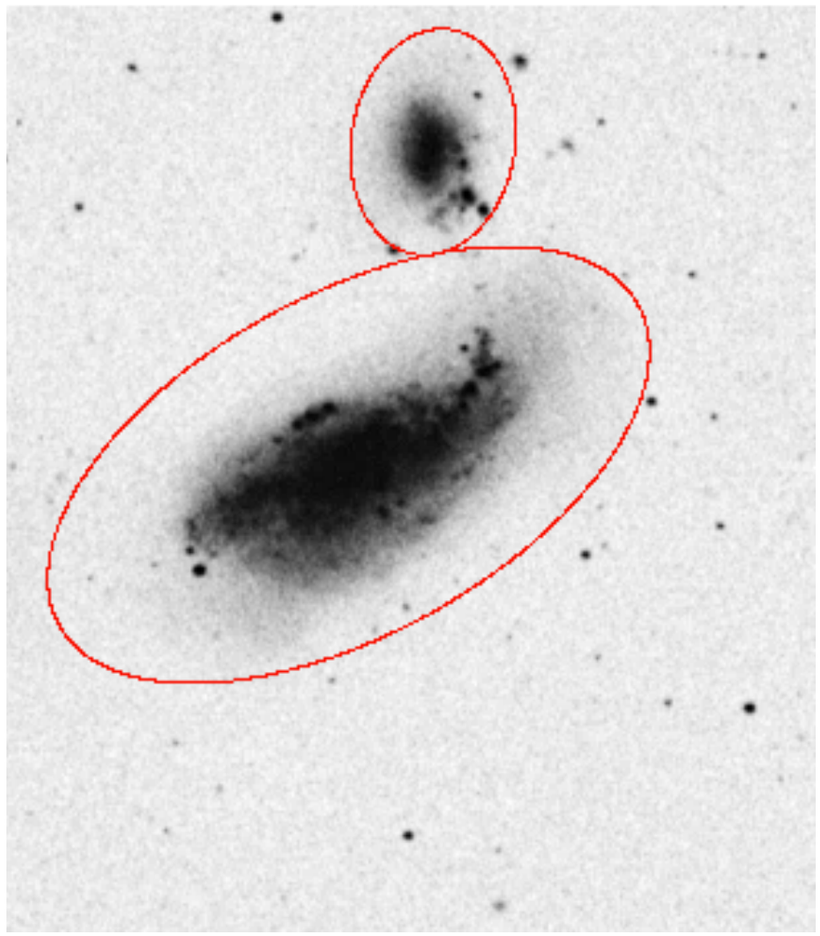

Investigating the gas

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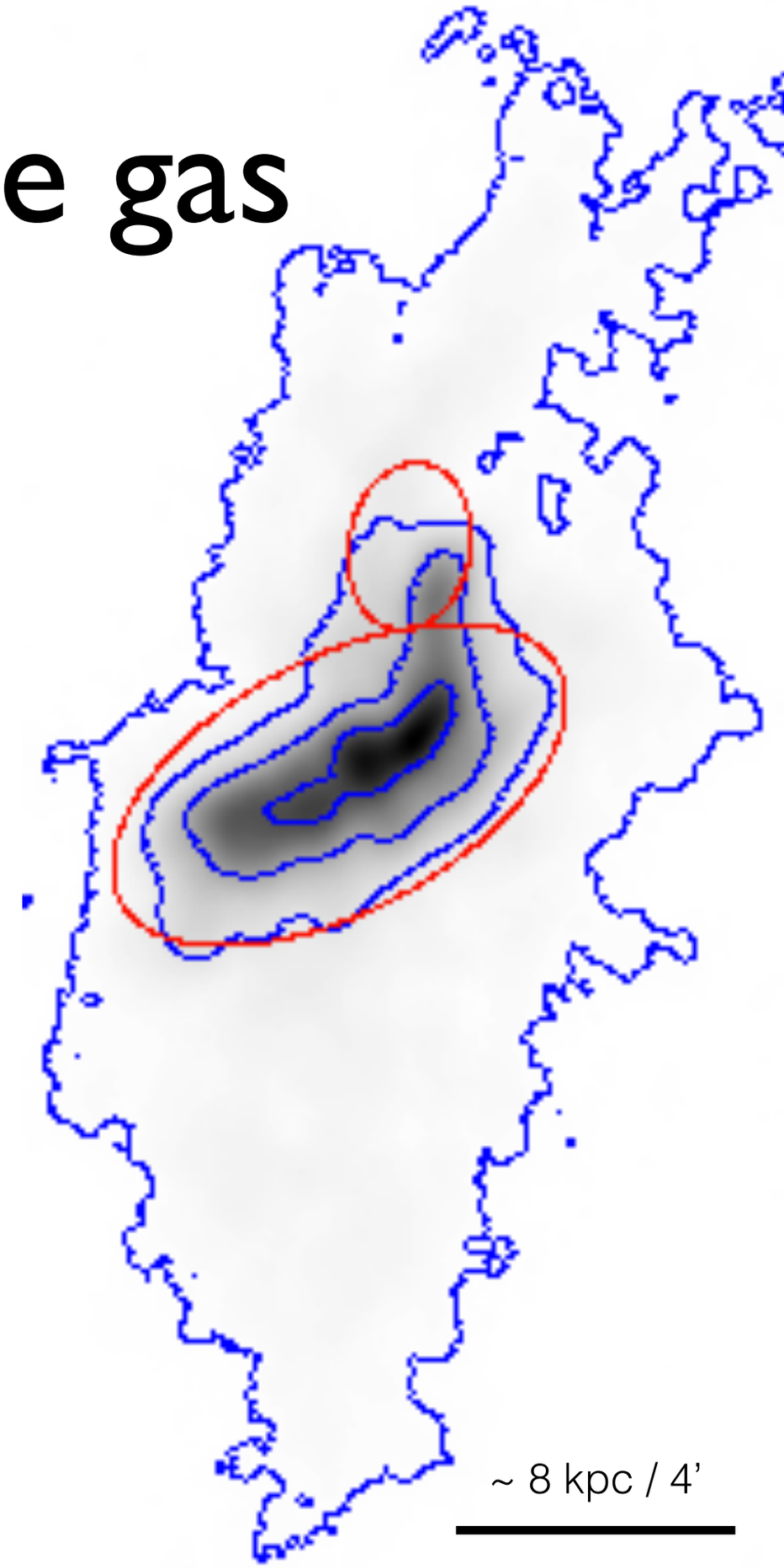
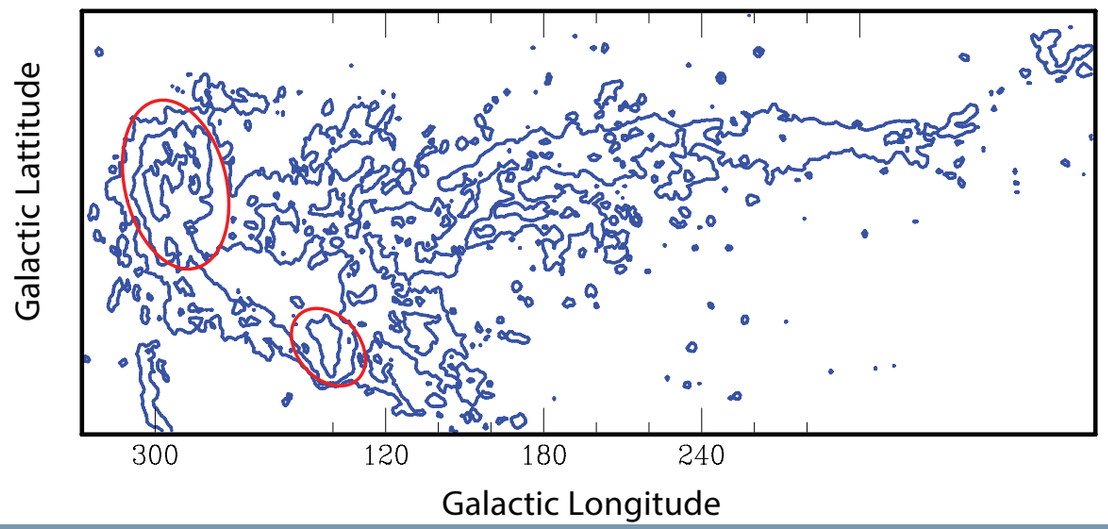
2mass extent of galaxies

Compare gas fraction within/ outside the dwarfs



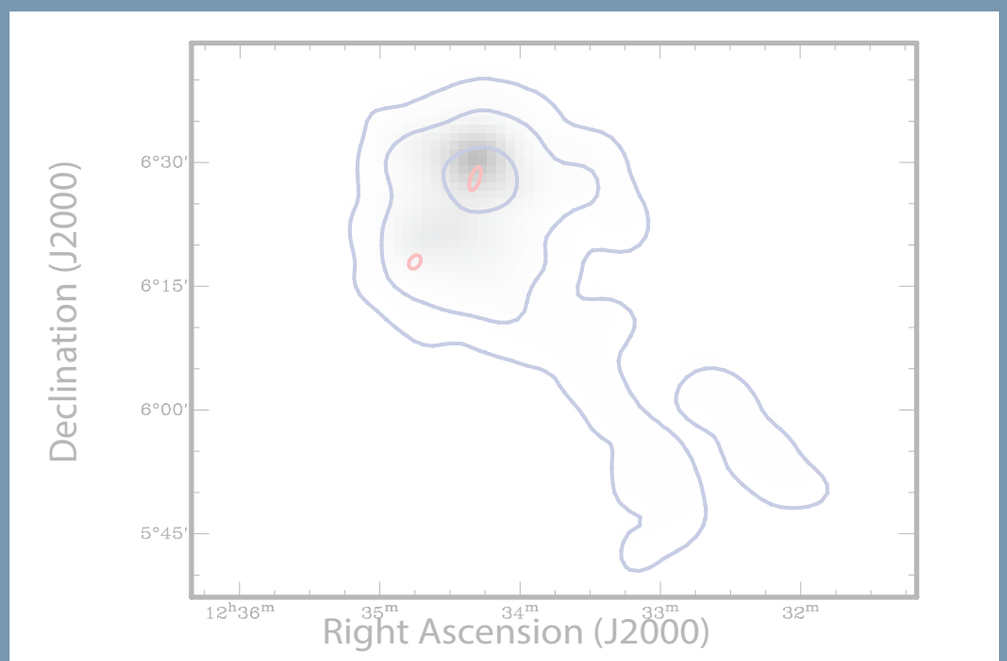
Examples of high tidal index systems

LMC & SMC



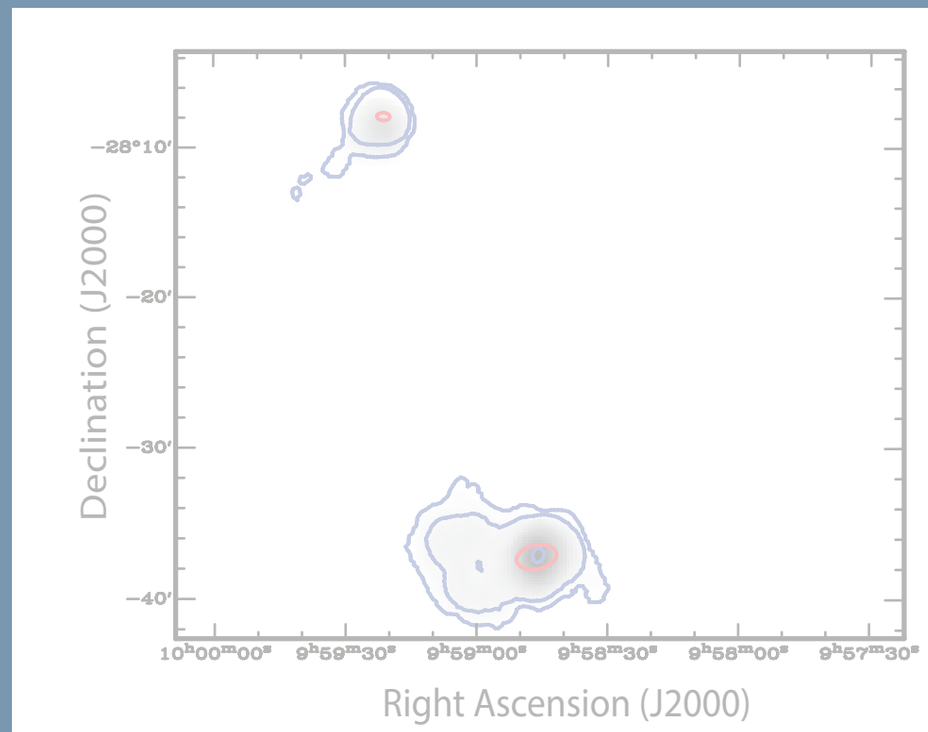
Putman et al. 2003

NGC 4532 & DDO137



Koopmann et al. 2008

ESO435-IG16 & ESO435-IG20

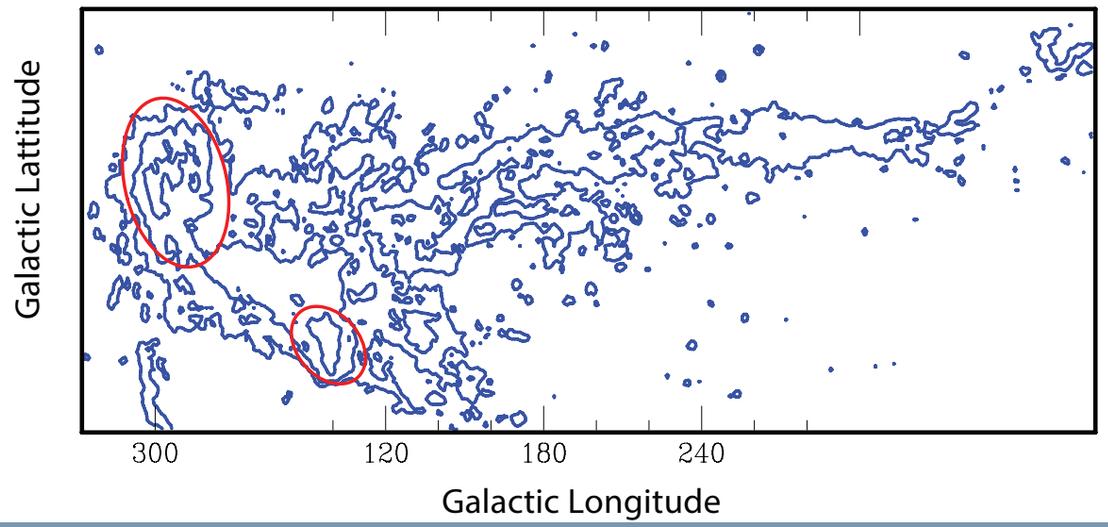


Kim et al, in prep

Examples of high tidal index systems

Truncated LMC: ram-pressure (Salem, Besla+ 2015)
Amount of gas in tail/bridge: pre-processing (Besla+ 10,12)

LMC & SMC



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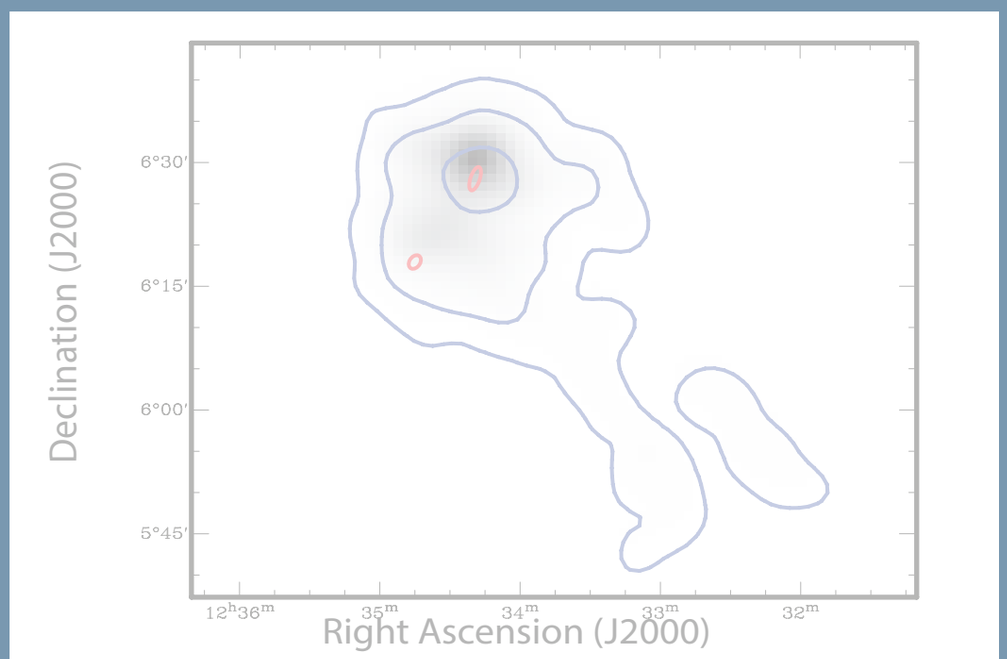

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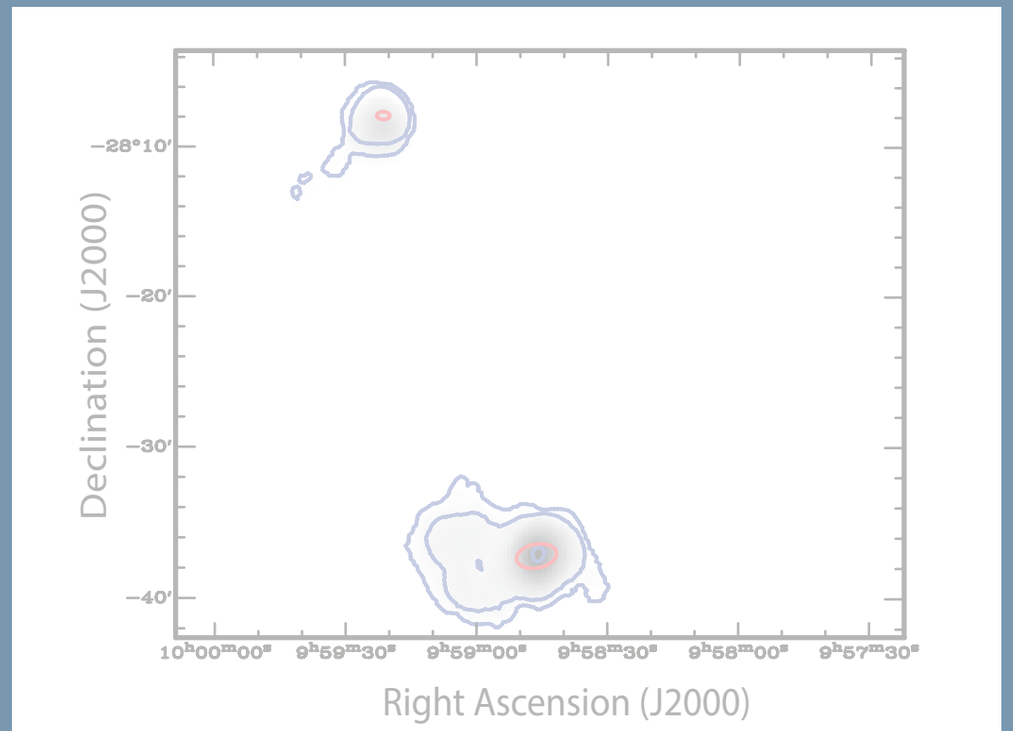

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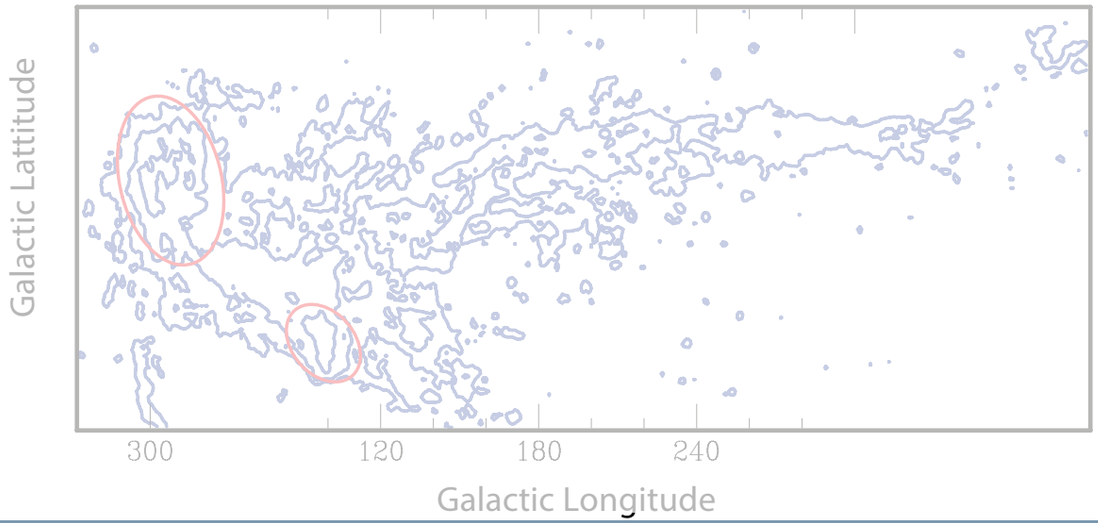

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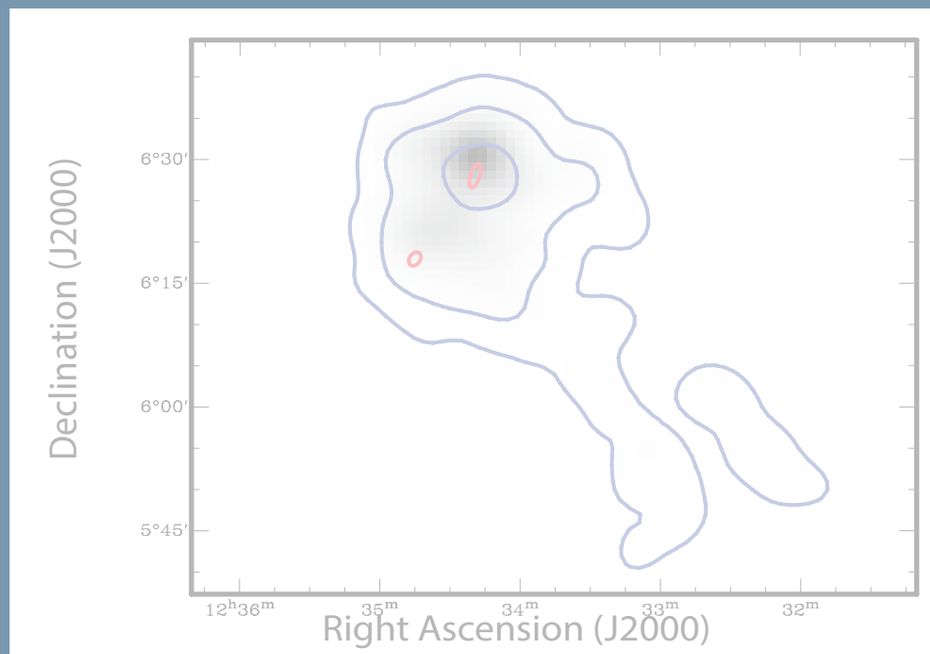

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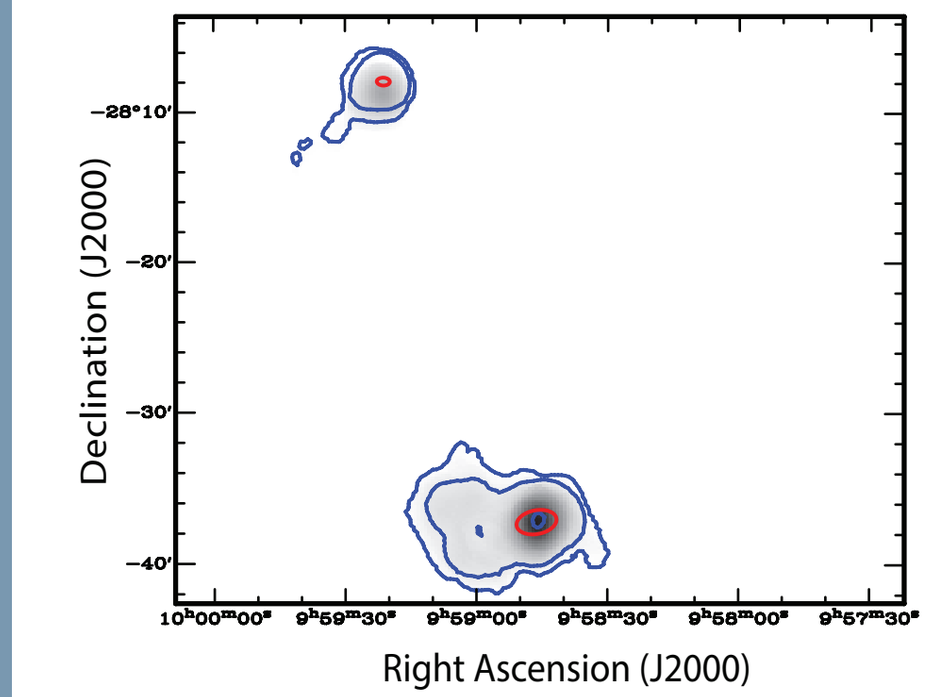

Kim et al, in prep

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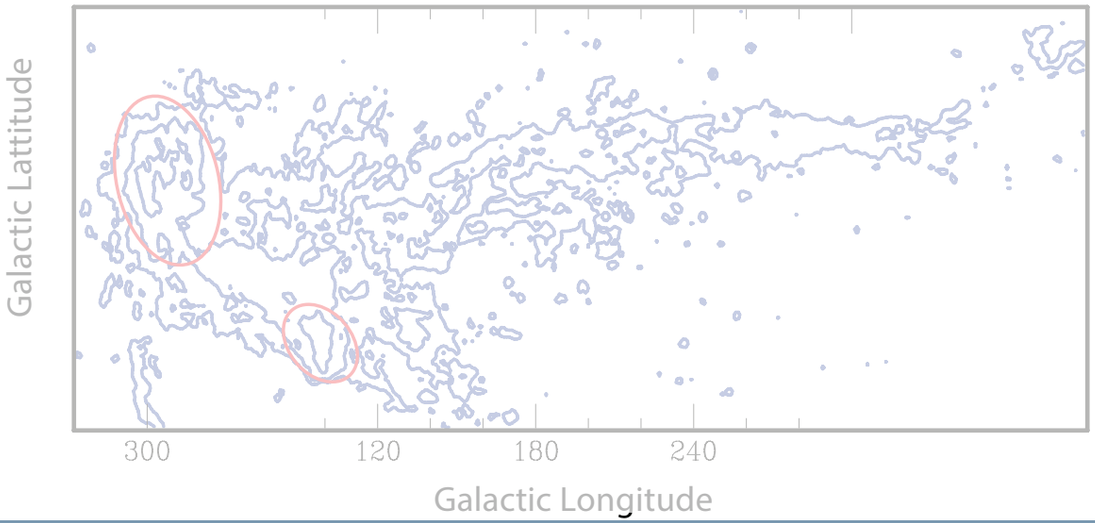

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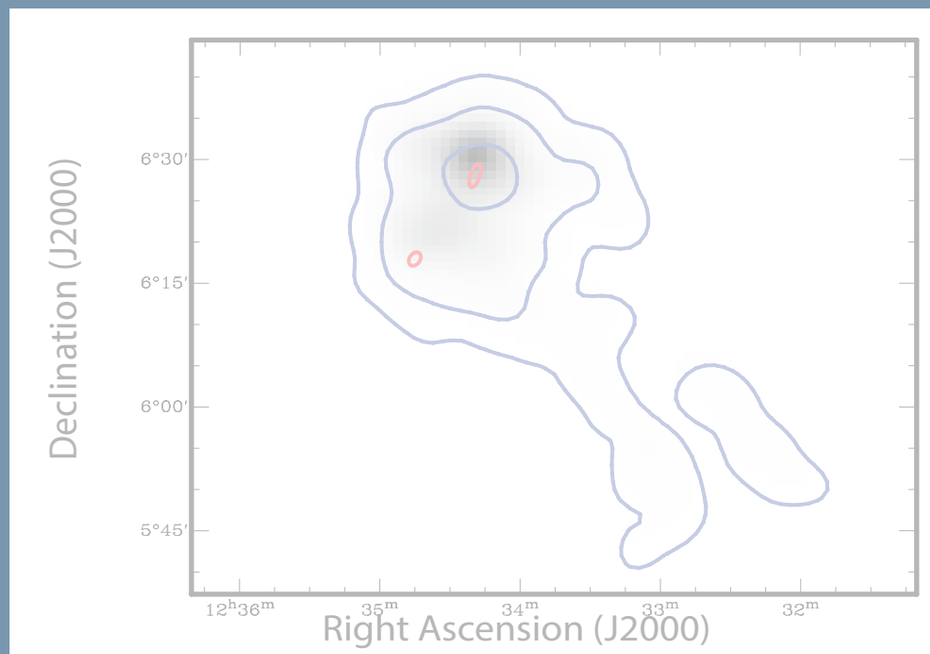

Koopmann et al. 2008

Asymmetric diffuse gas
Indication of tidal tails

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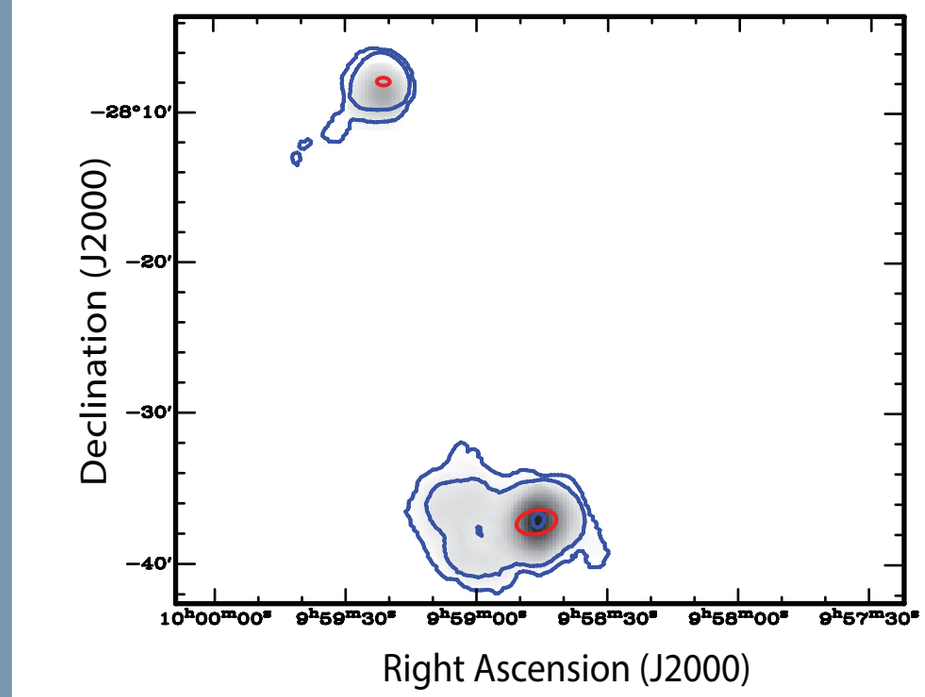

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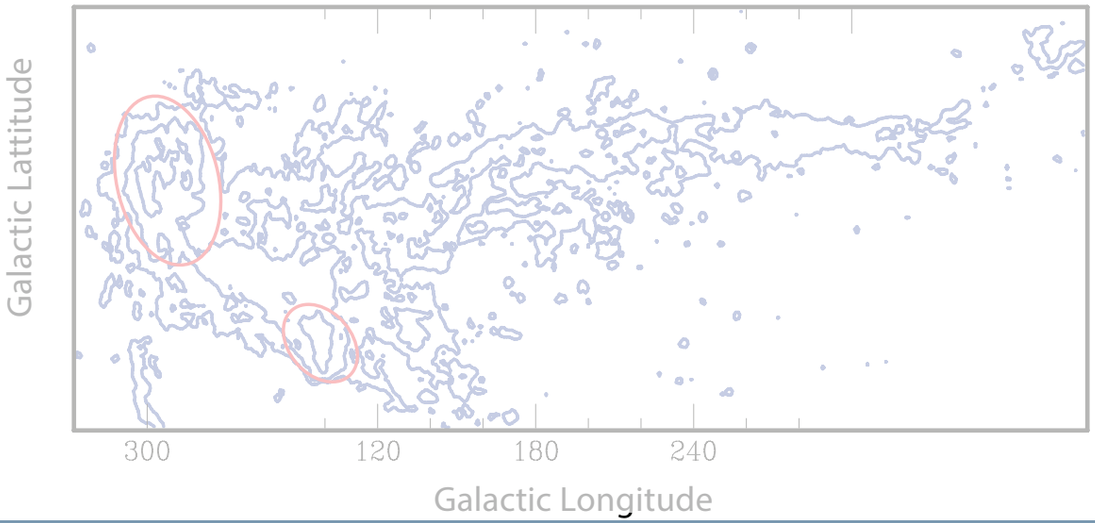

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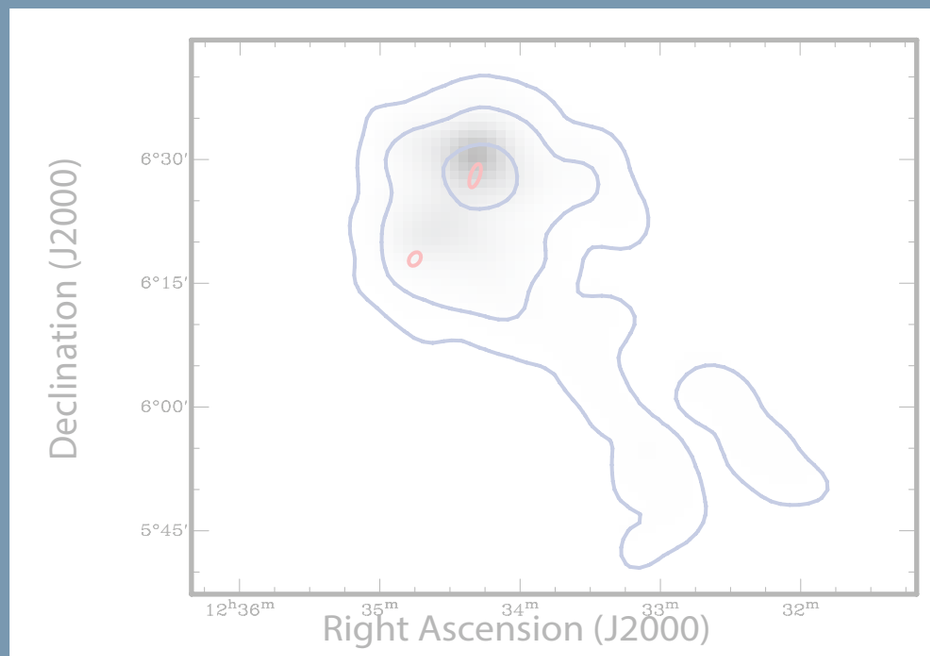

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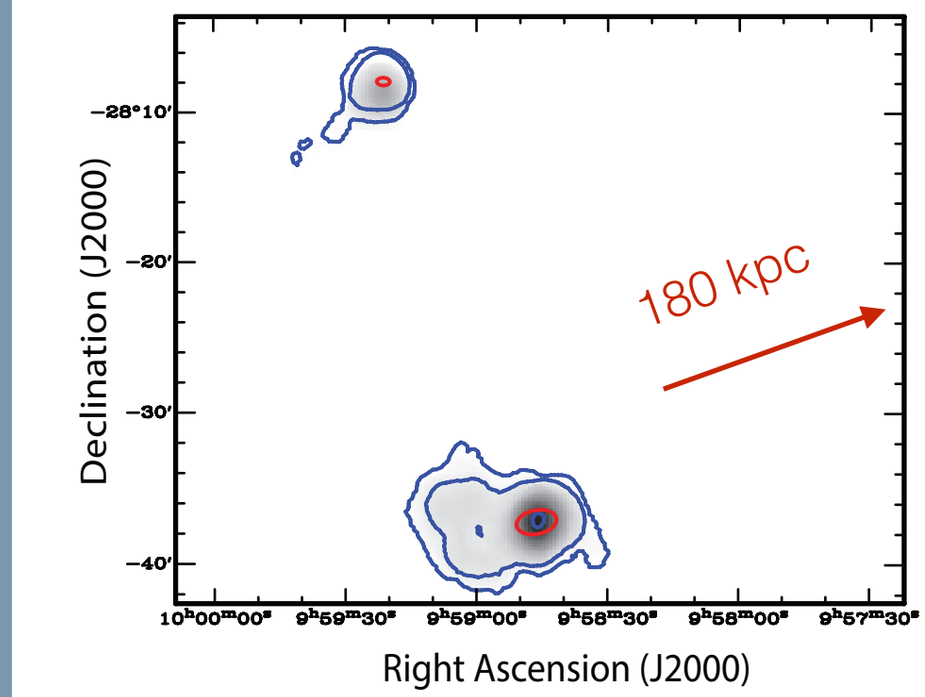

Kim et al, in prep

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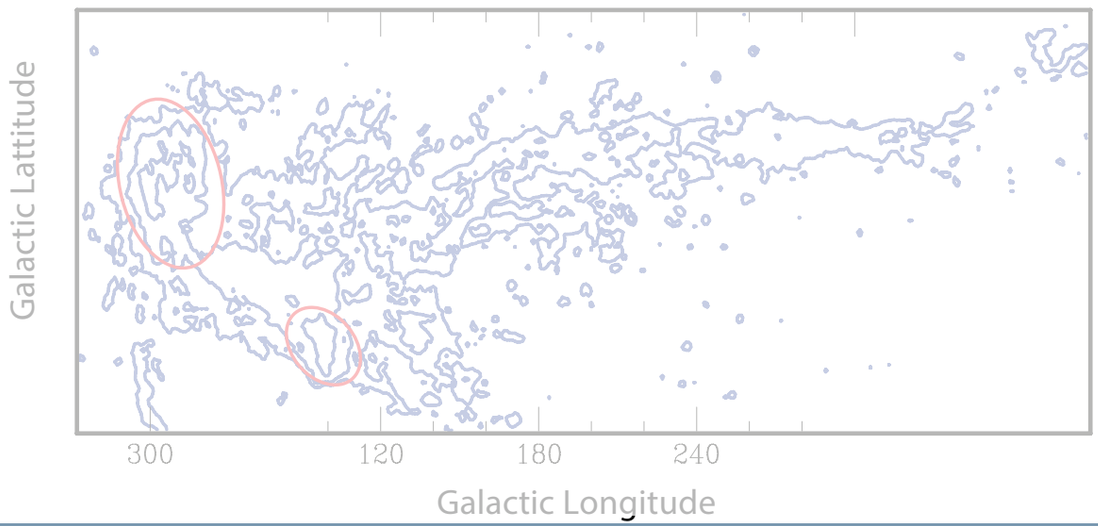

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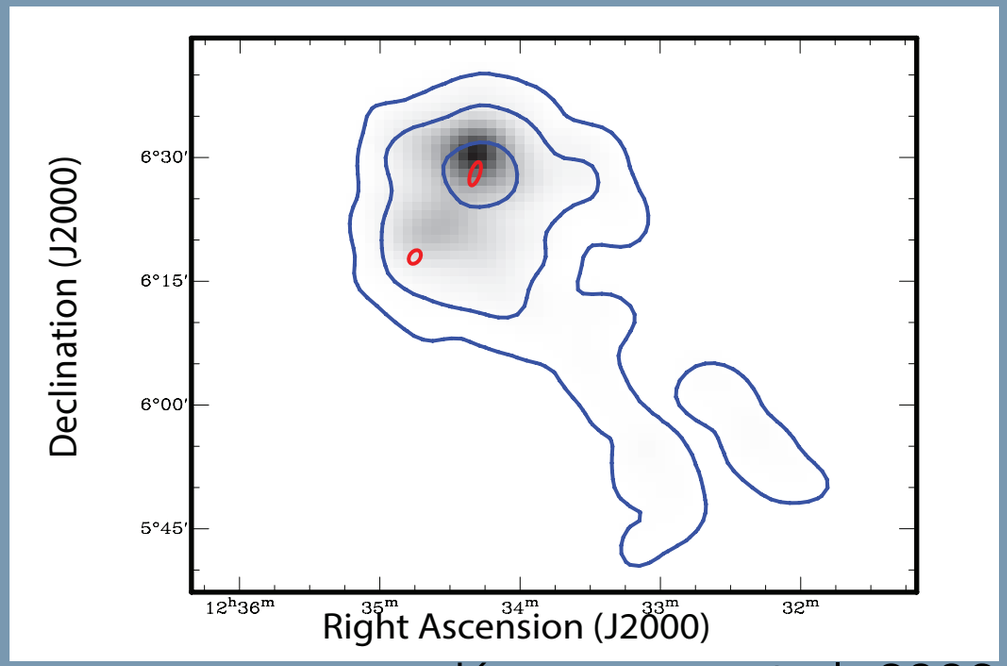

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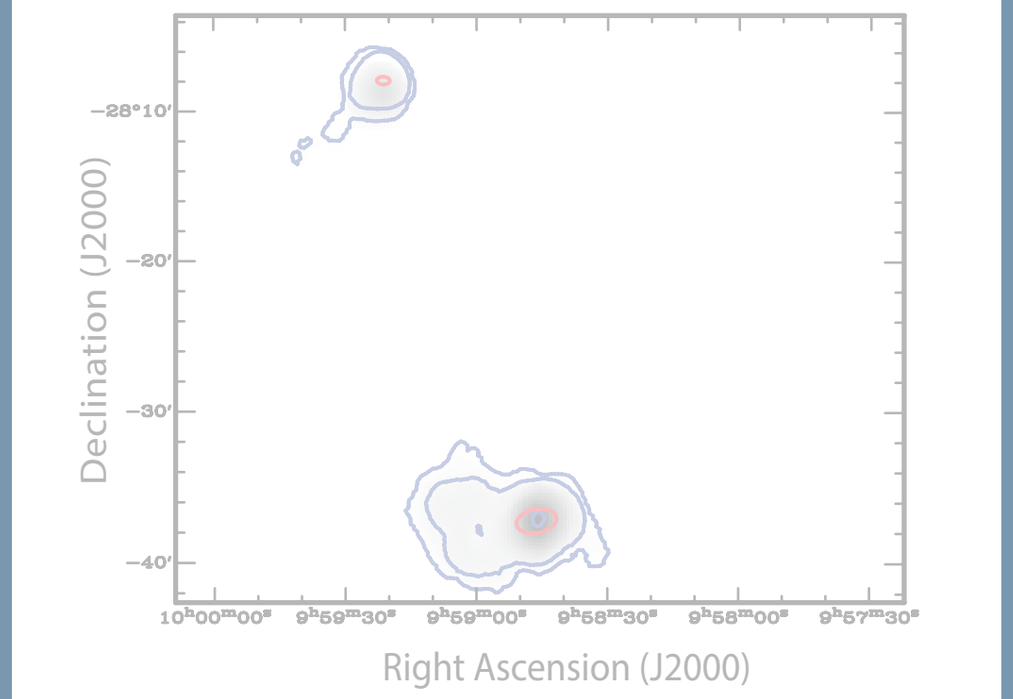

Kim et al, in prep

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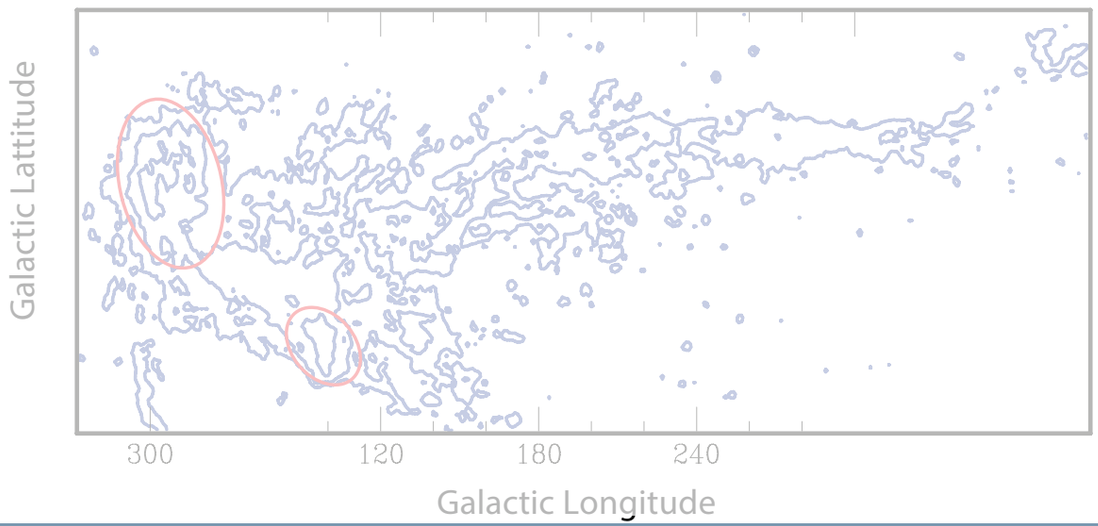

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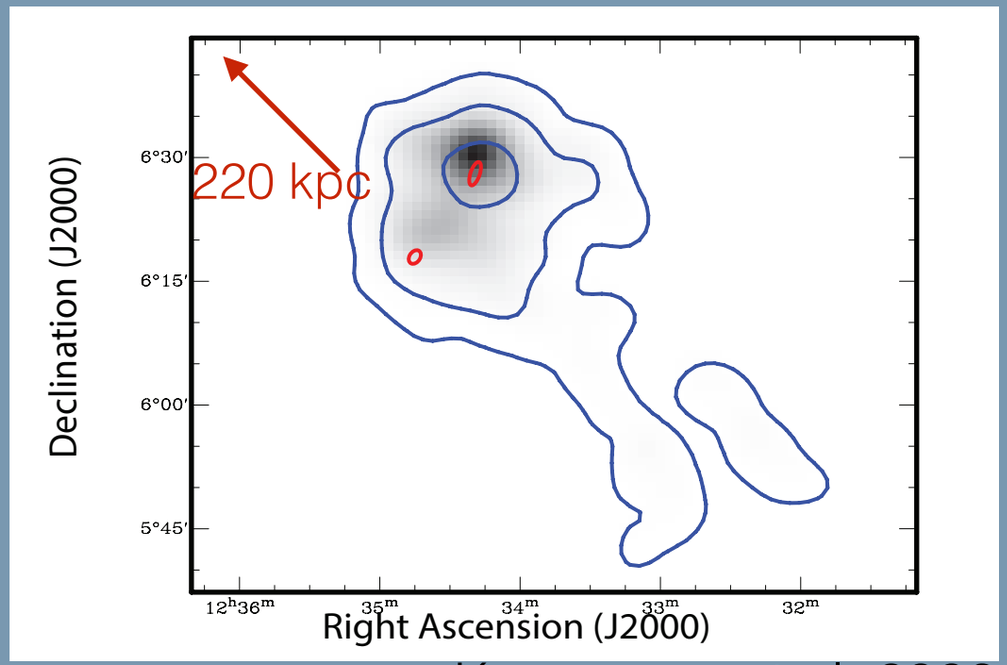

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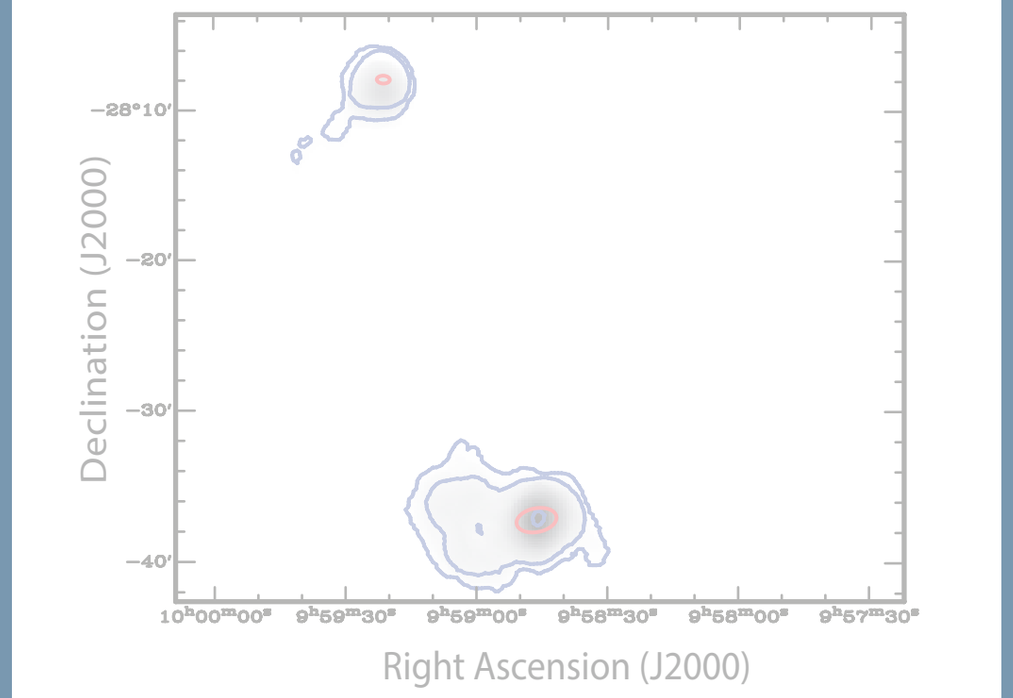
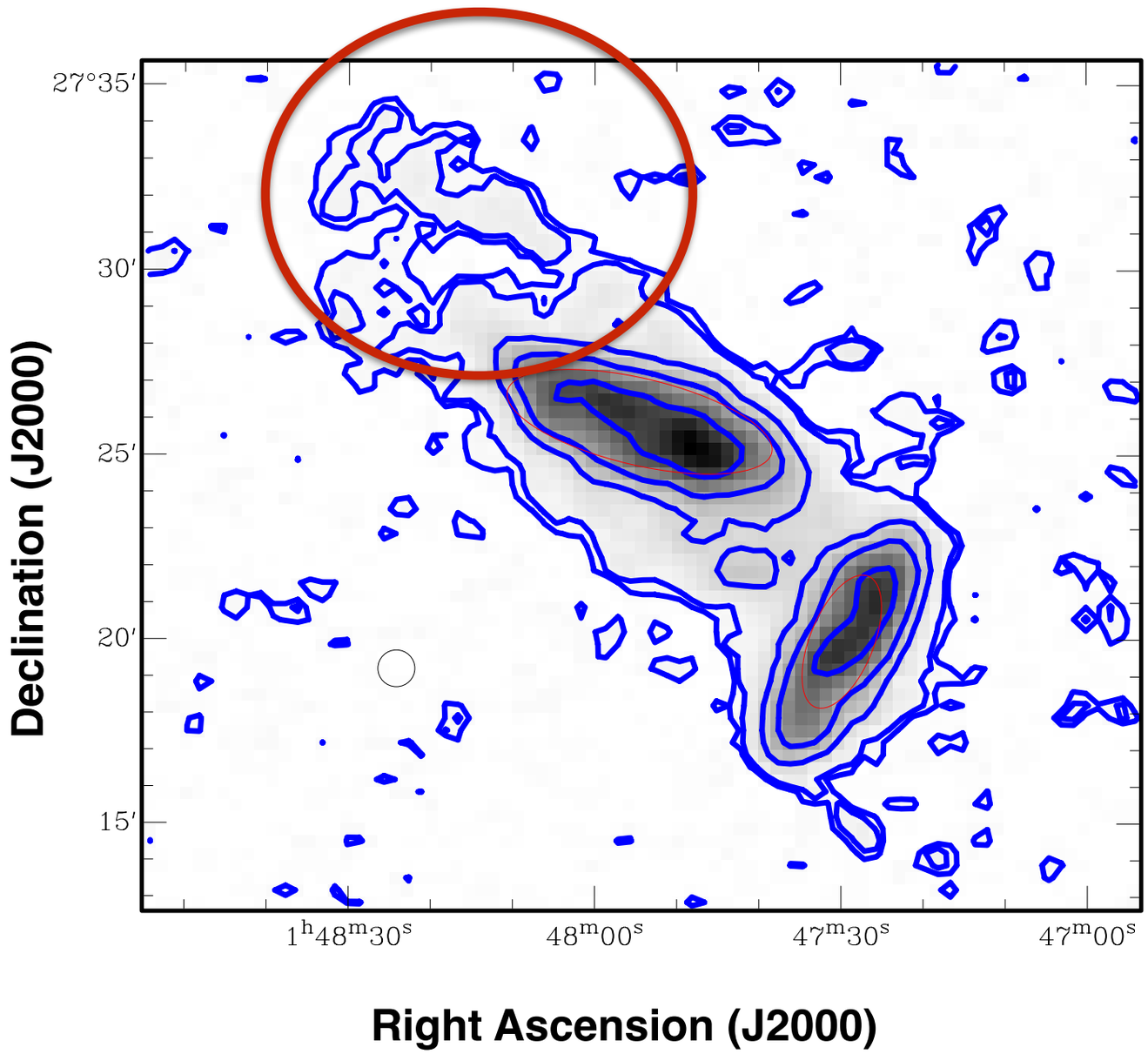


Kim et al, in prep

Asymmetric diffuse gas (tail)
Bridge connecting galaxies

Lower tidal index

NGC 672 & IC 1727



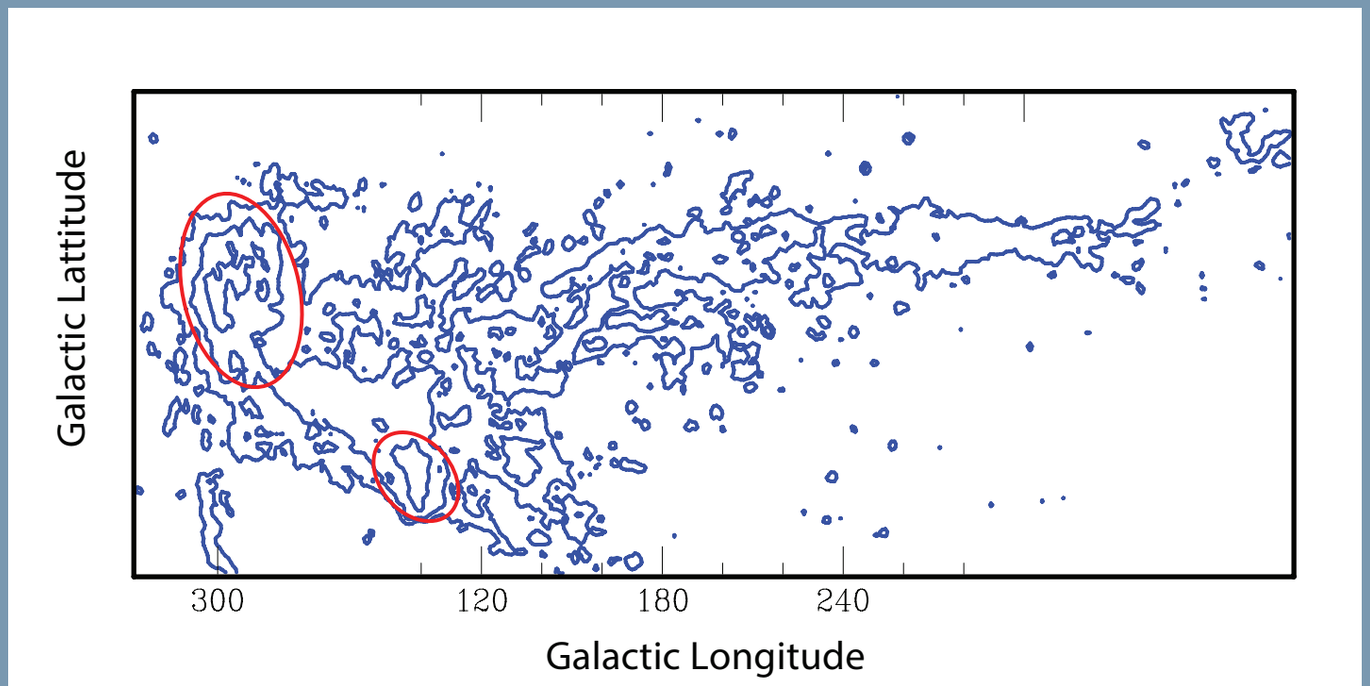
No massive galaxy within:
D_{proj} = 1.5 Mpc, v_{sep} = 1000 km/s

More symmetric diffuse envelope

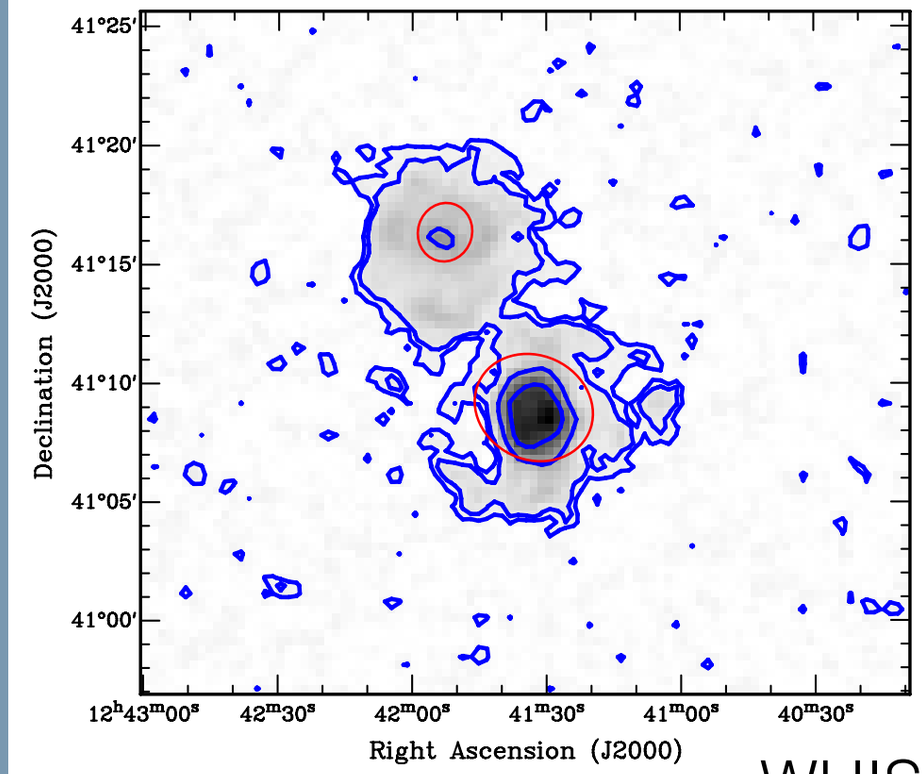
Material tidally removed/bridge

WHISP

Non-isolated vs isolated

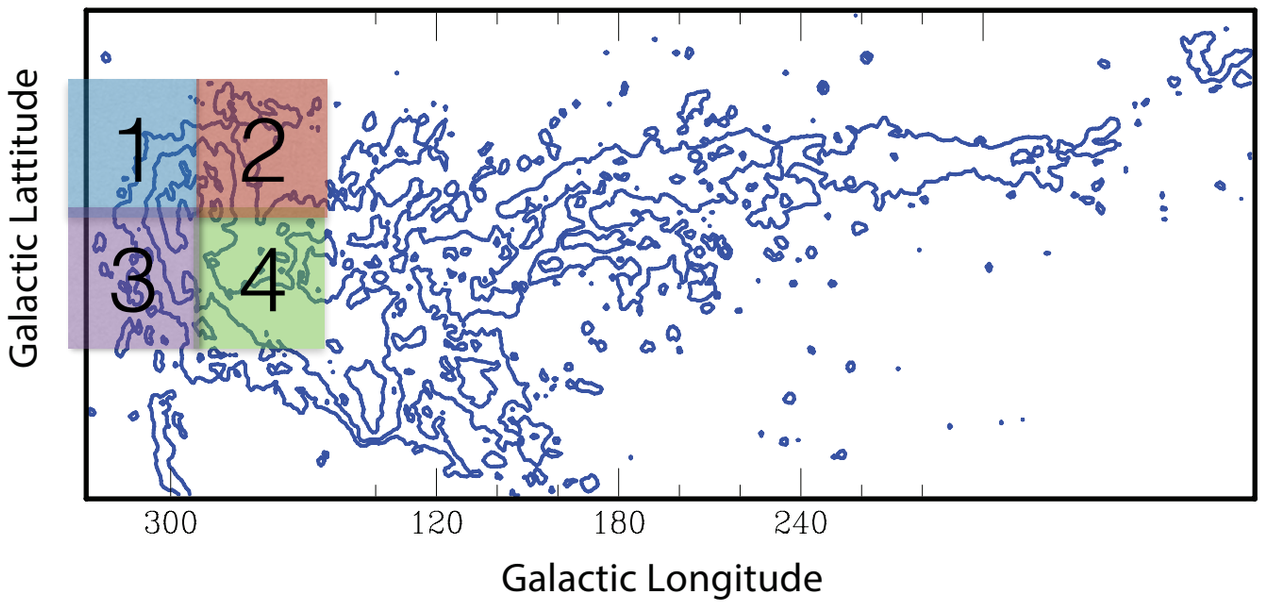


Putman + 2003



WHISP

Non-isolated: LMC



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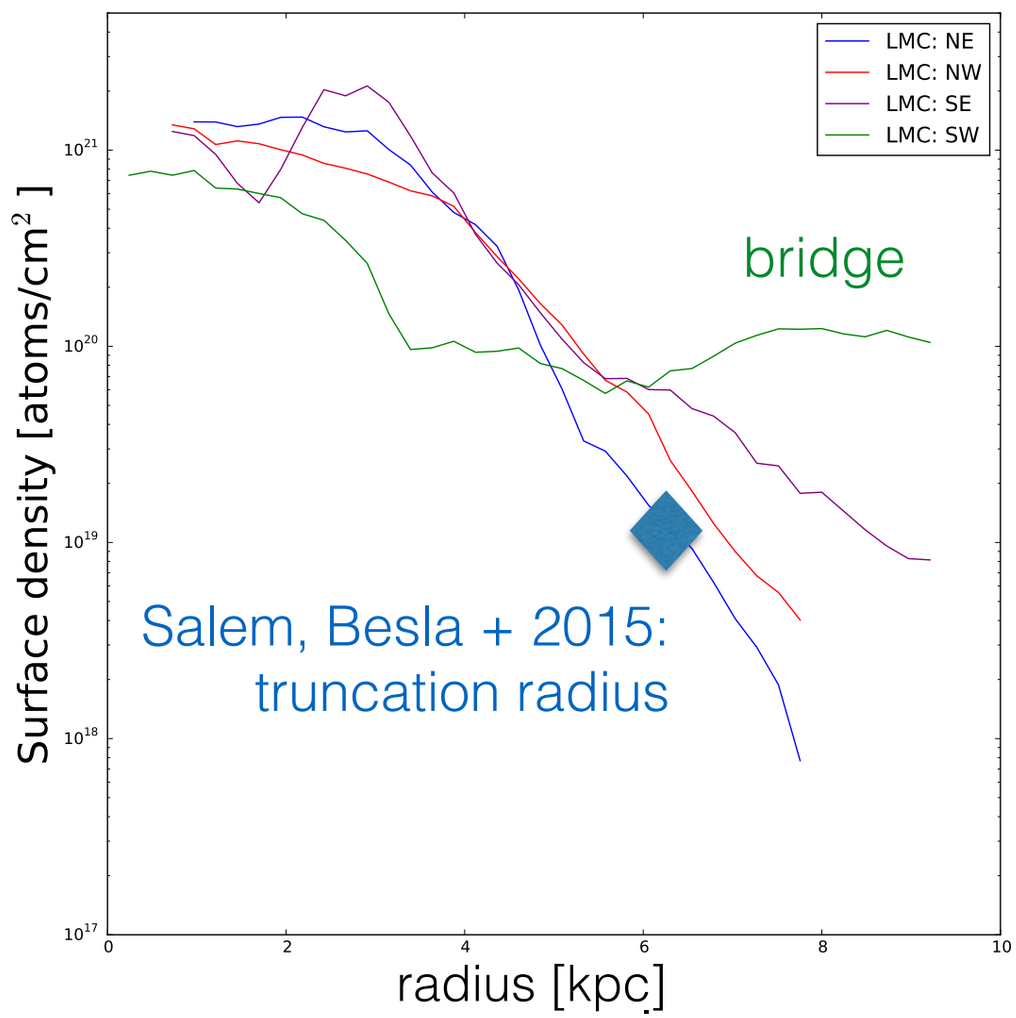

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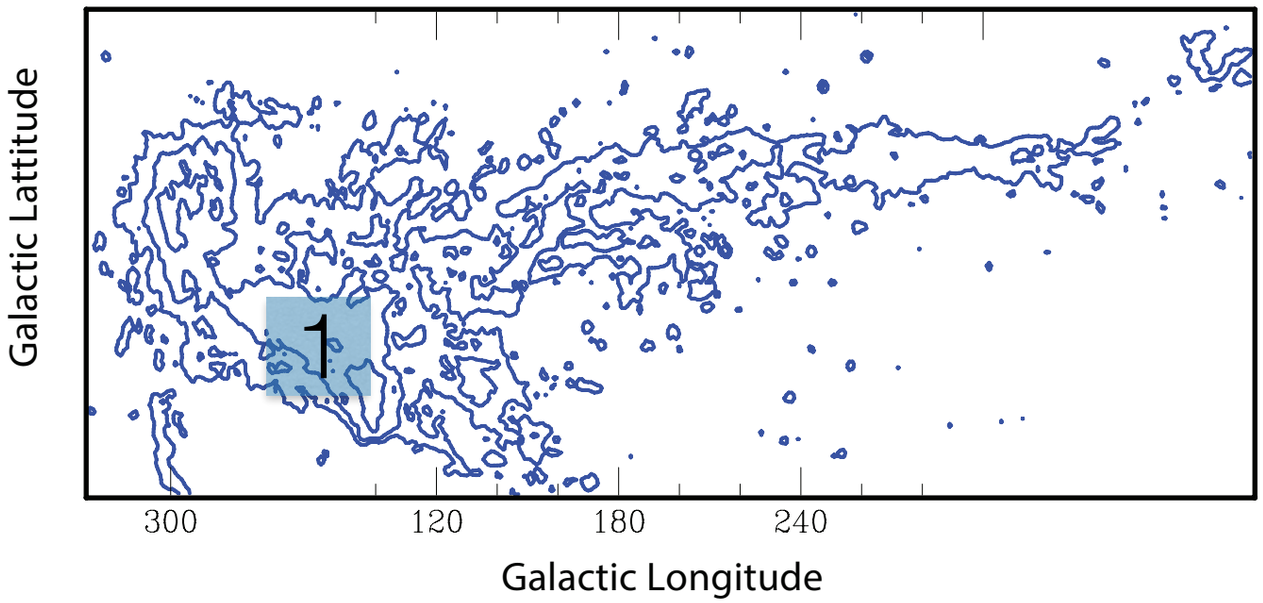

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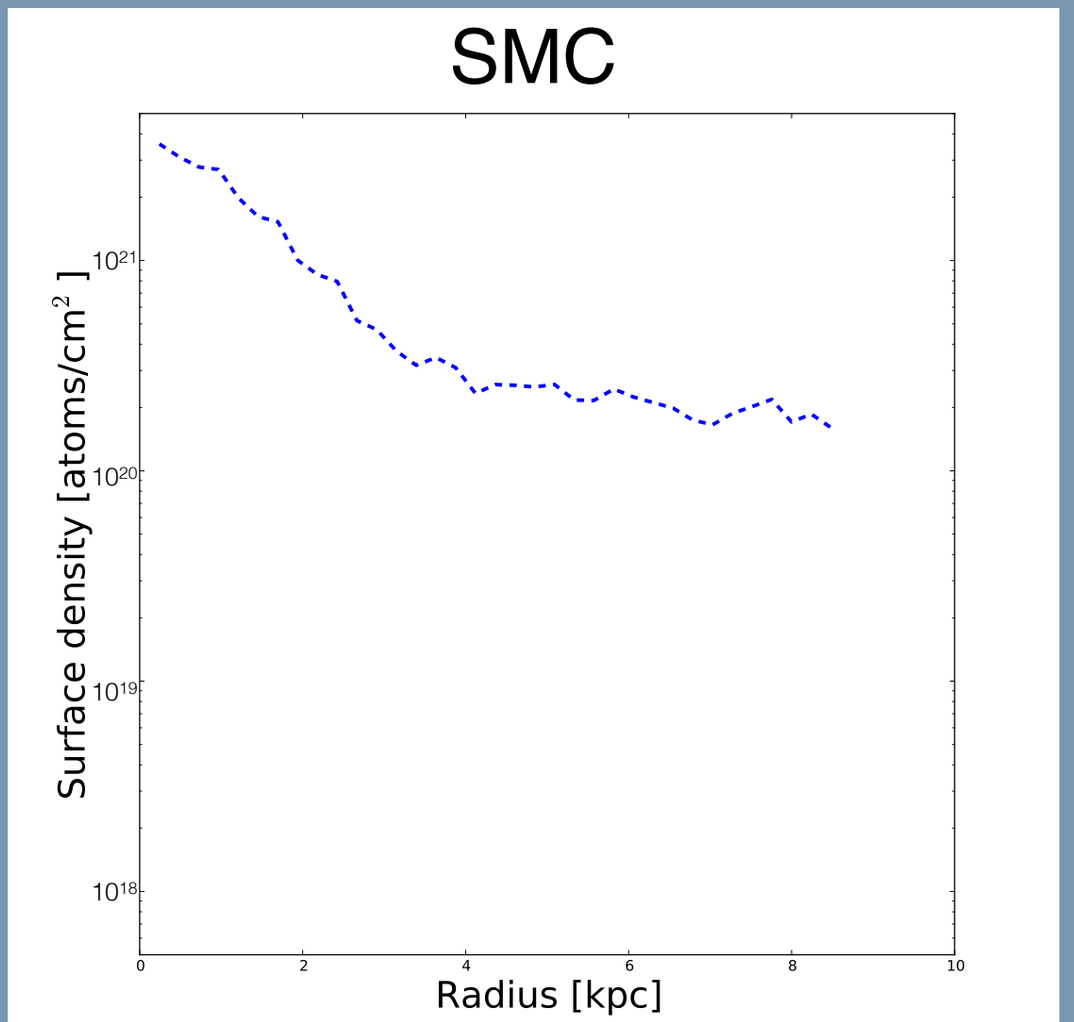
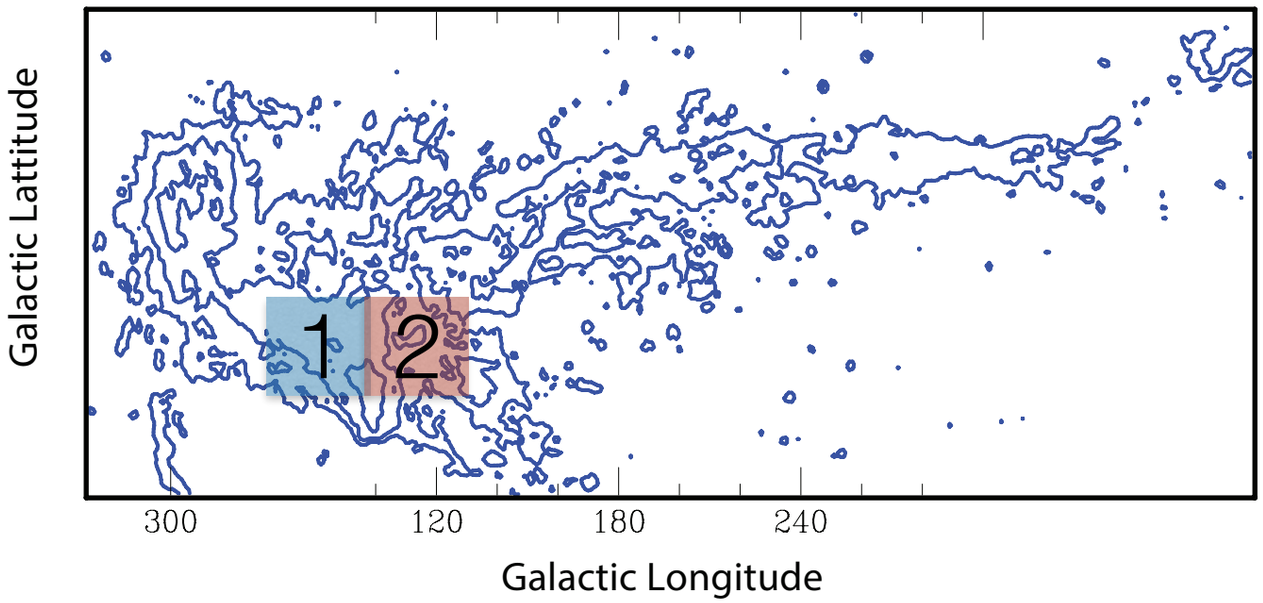


Non-isolated: SMC



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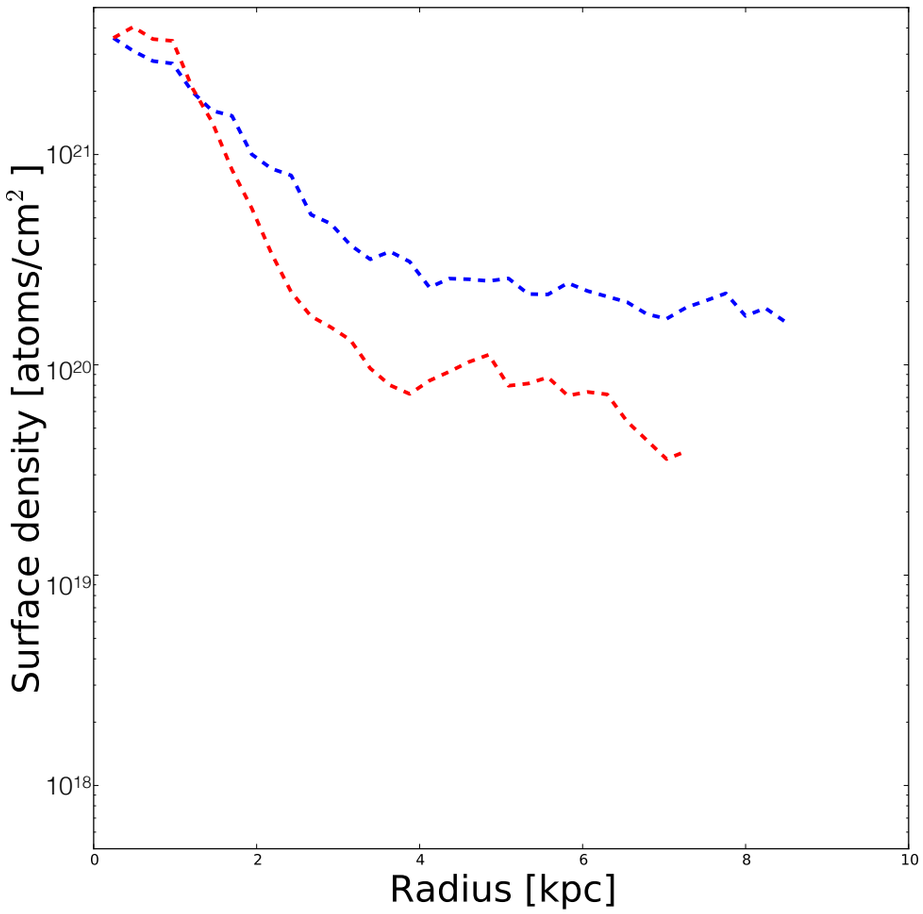
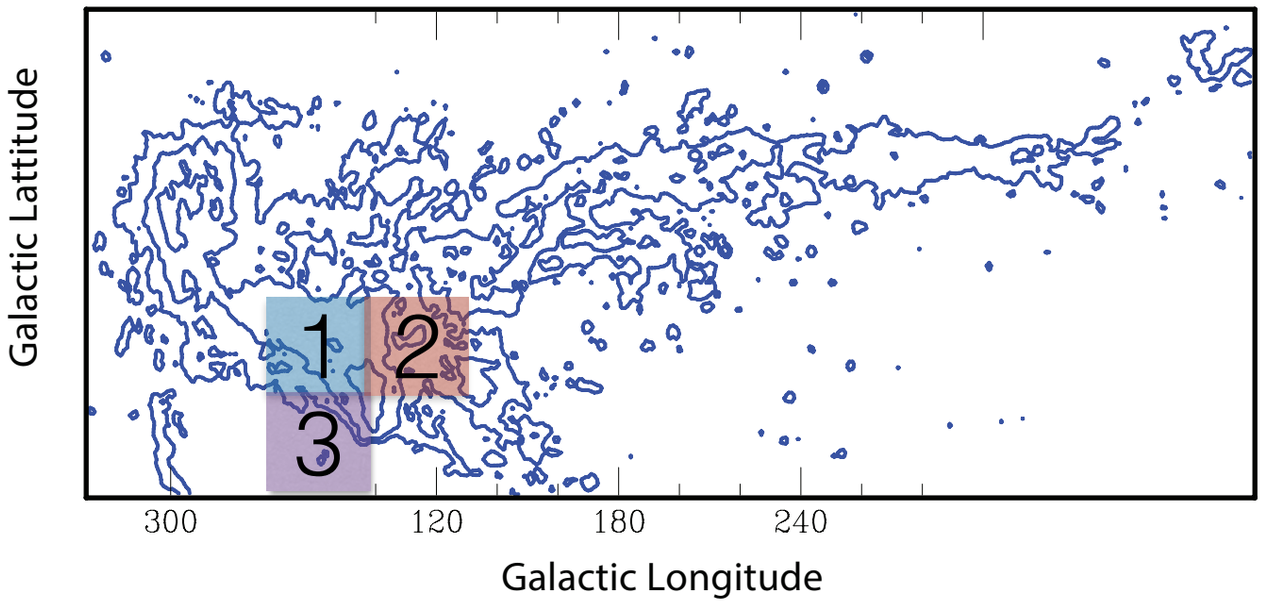
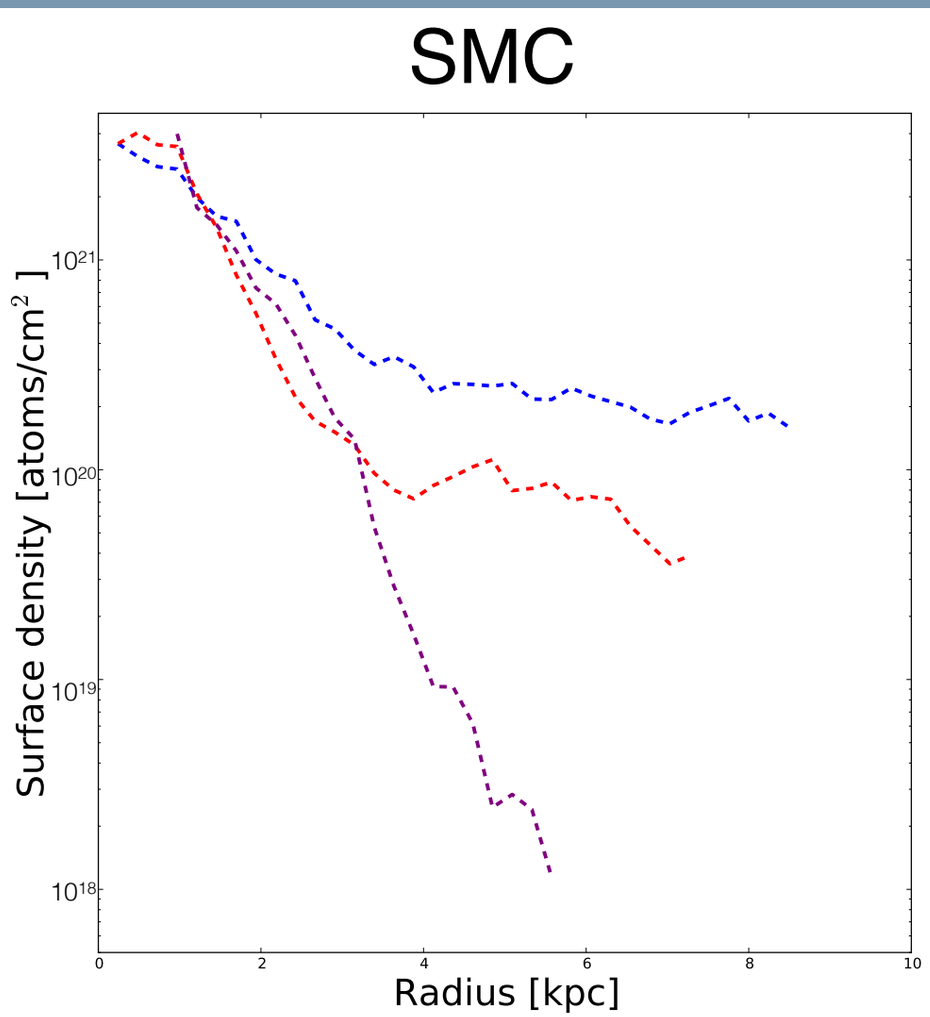


Non-isolated: SMC



Putman + 2003



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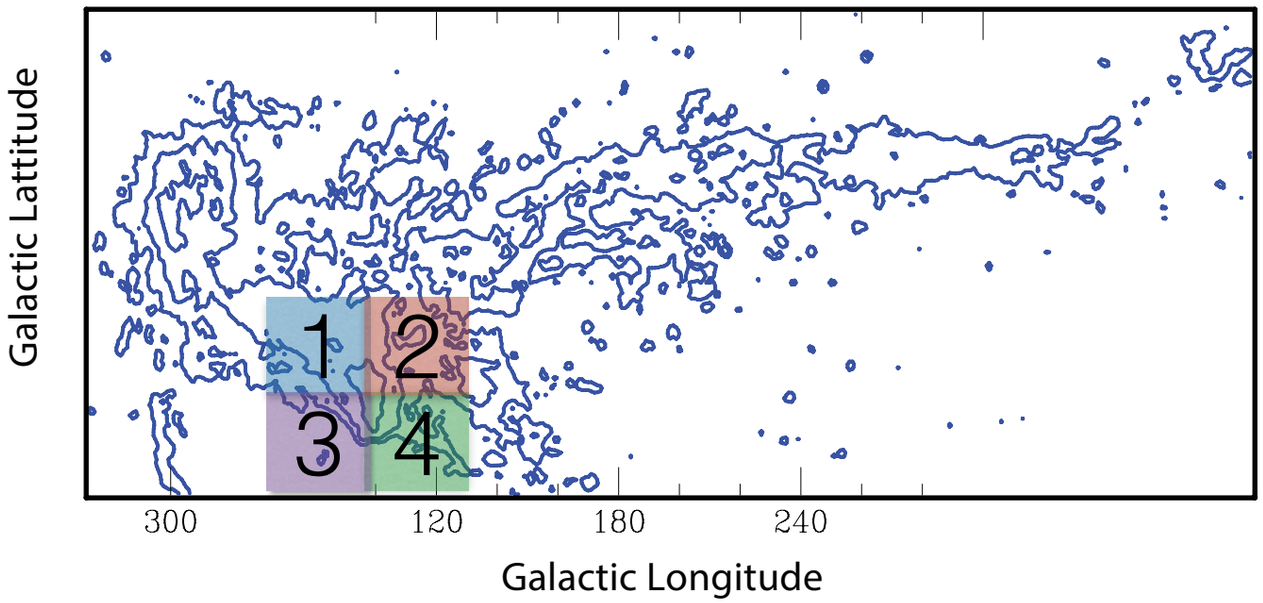
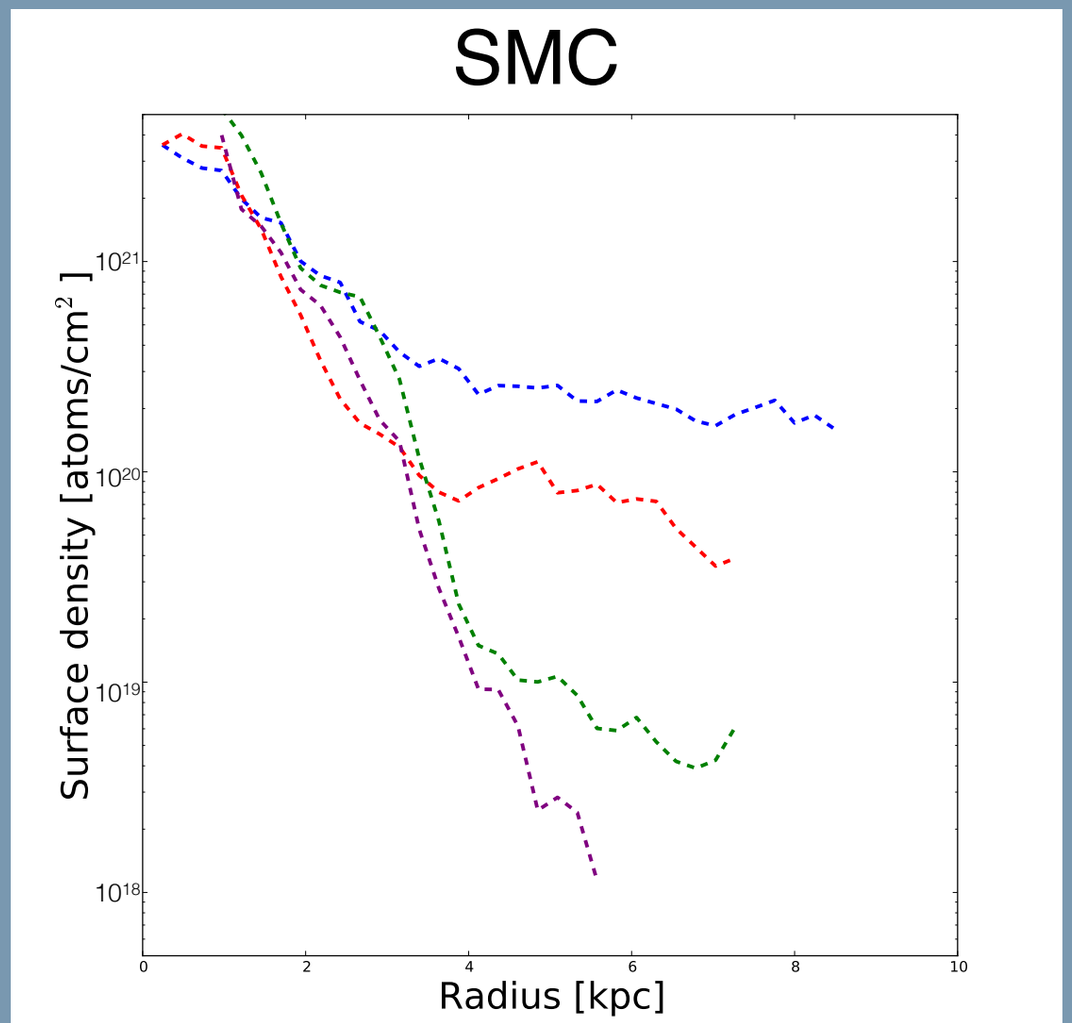


Putman + 2003



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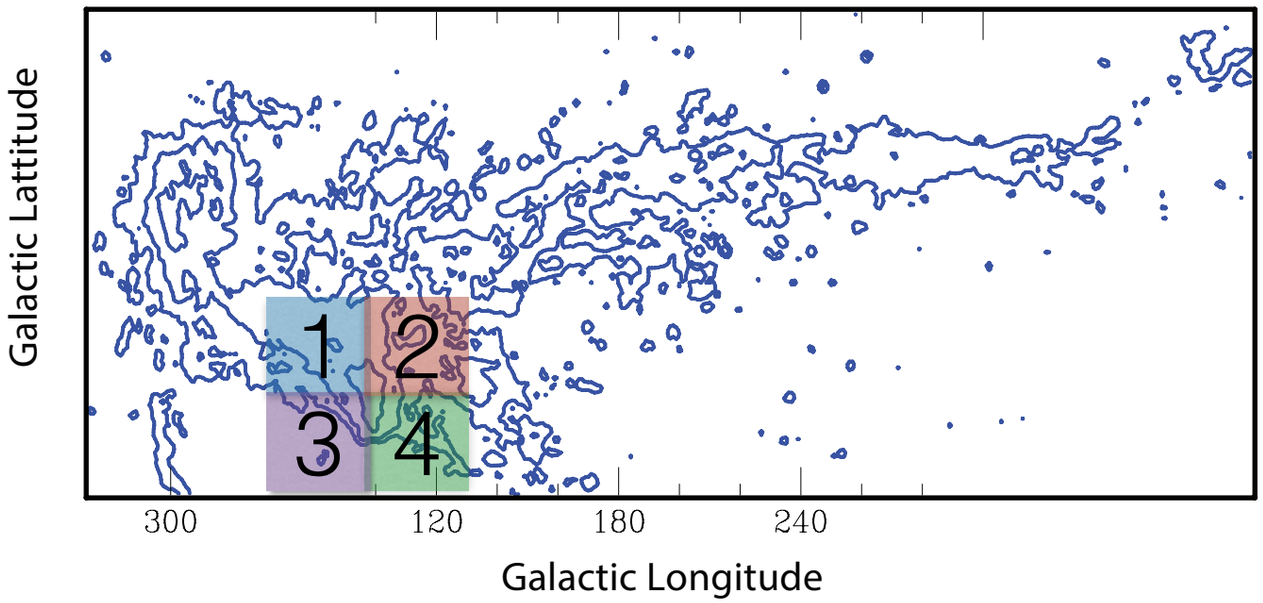
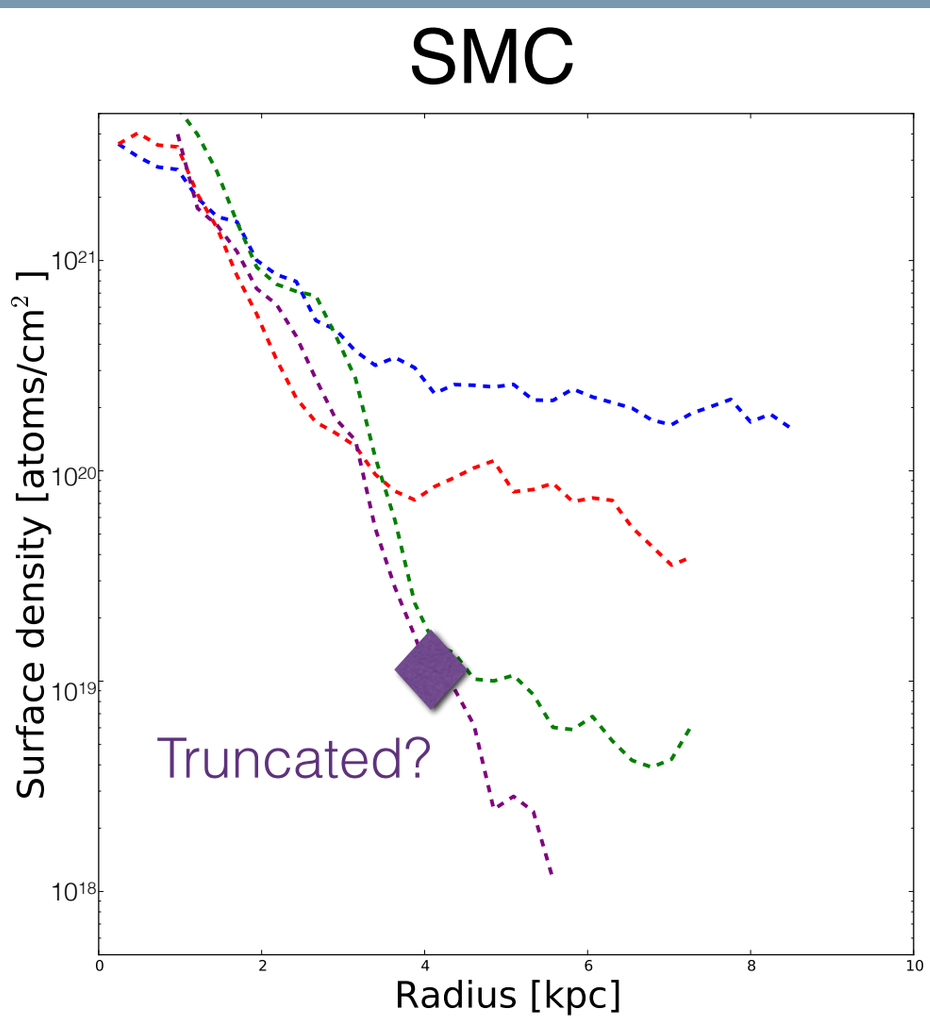
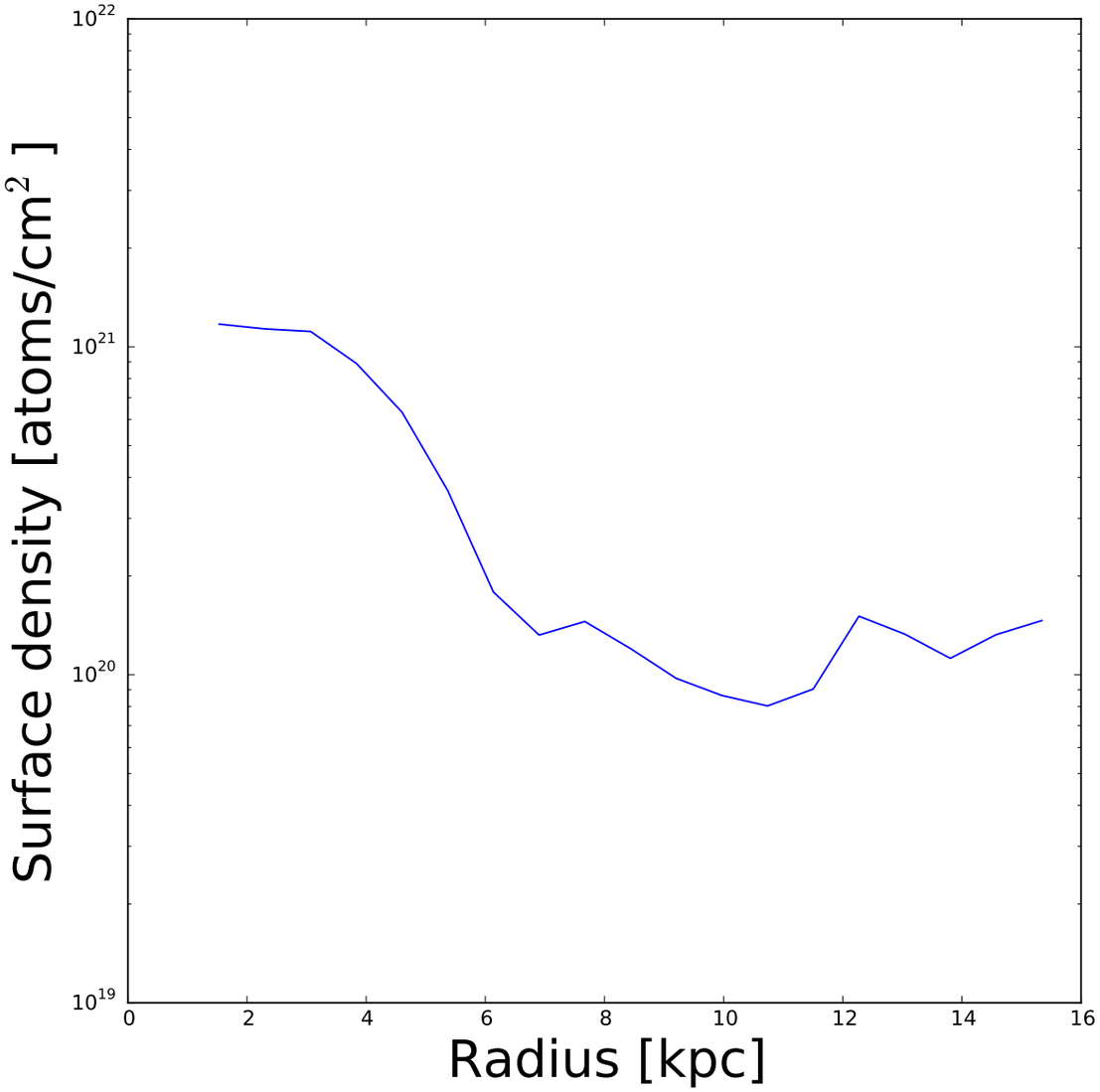
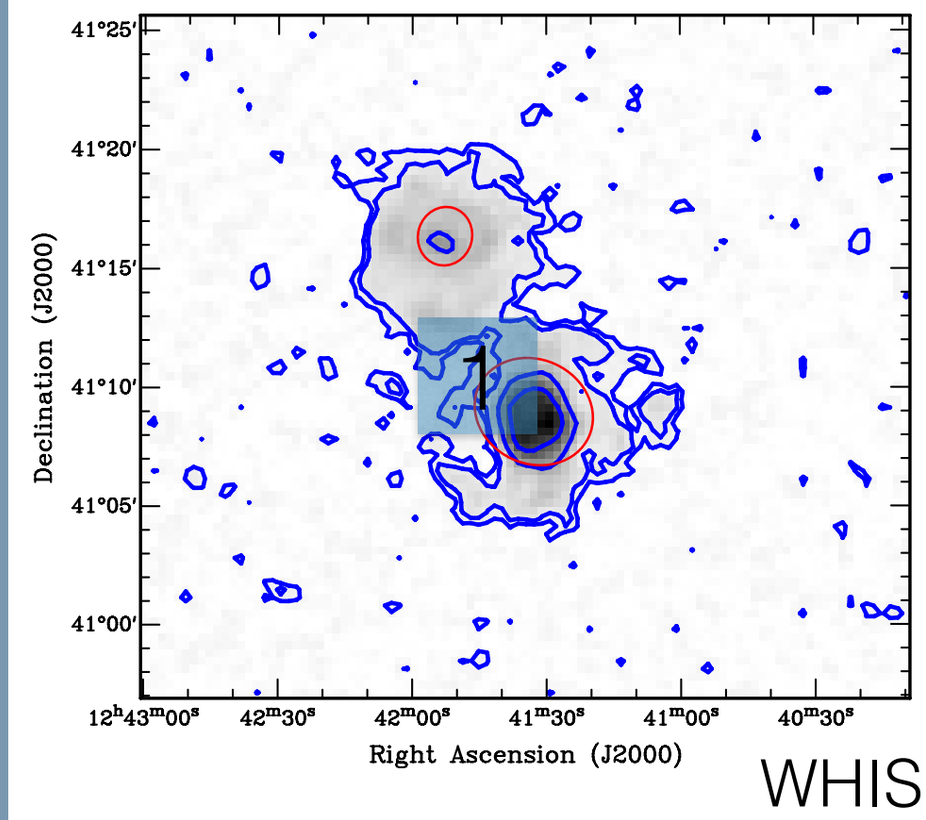


Putman + 2003



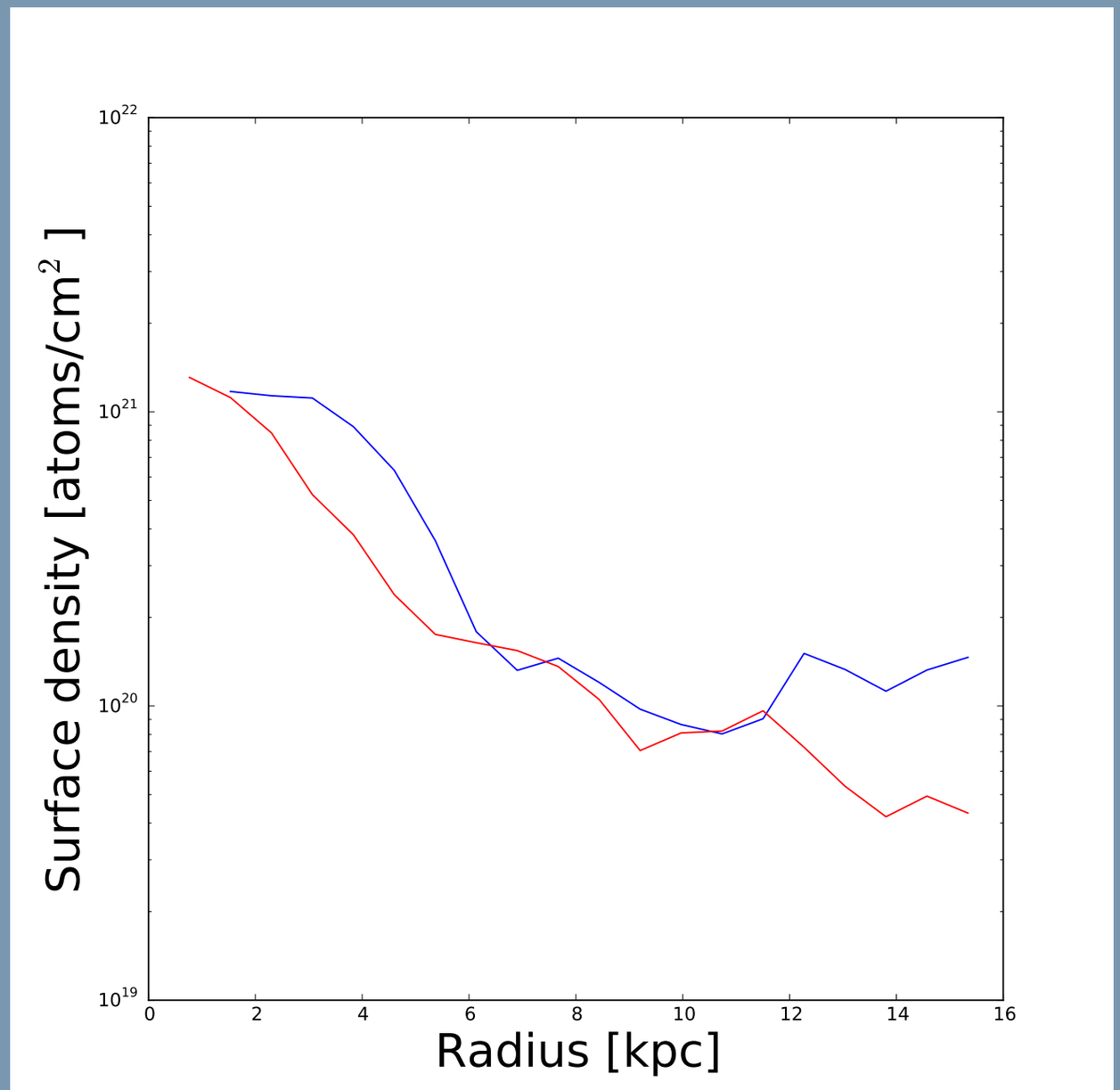
Isolated: NGC 4618

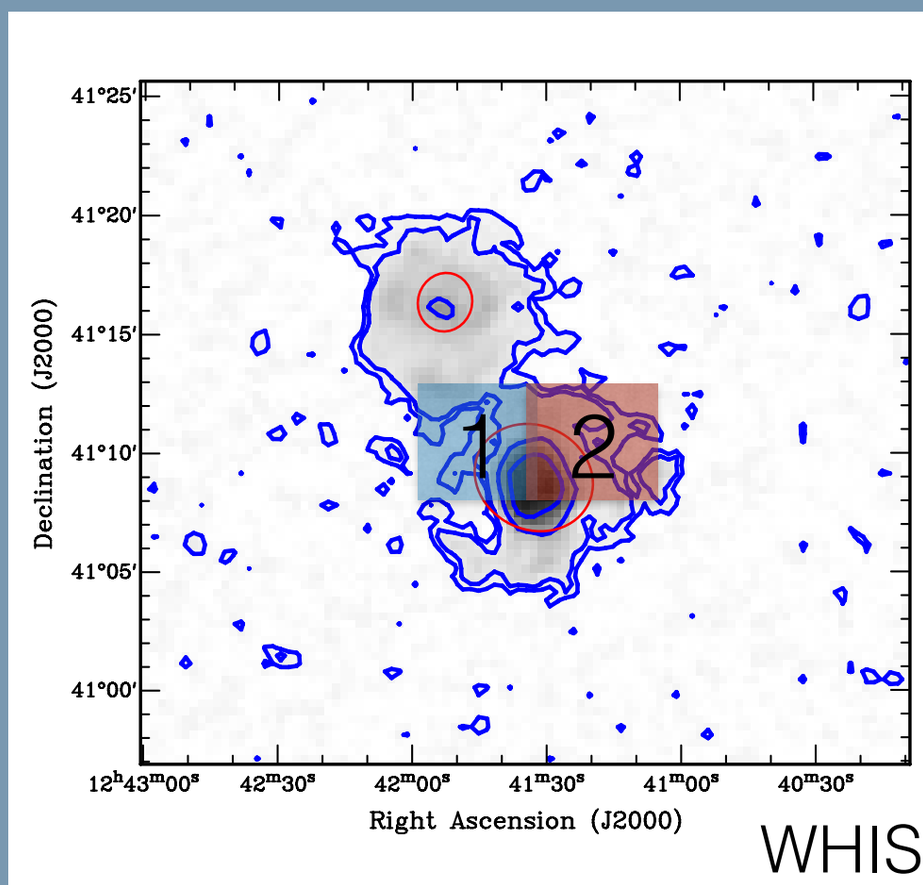




WHISP

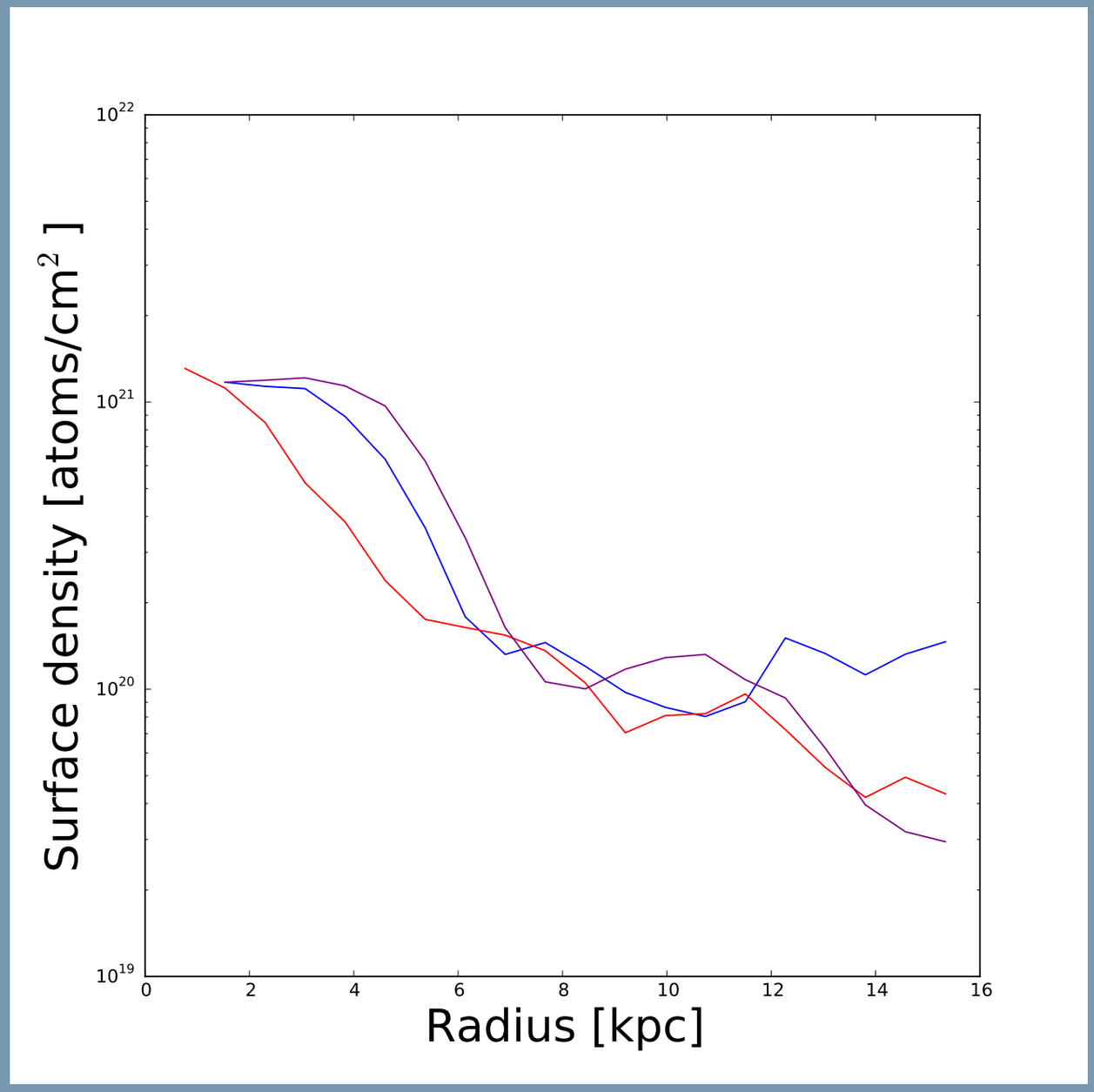
Isolated: NGC 4618

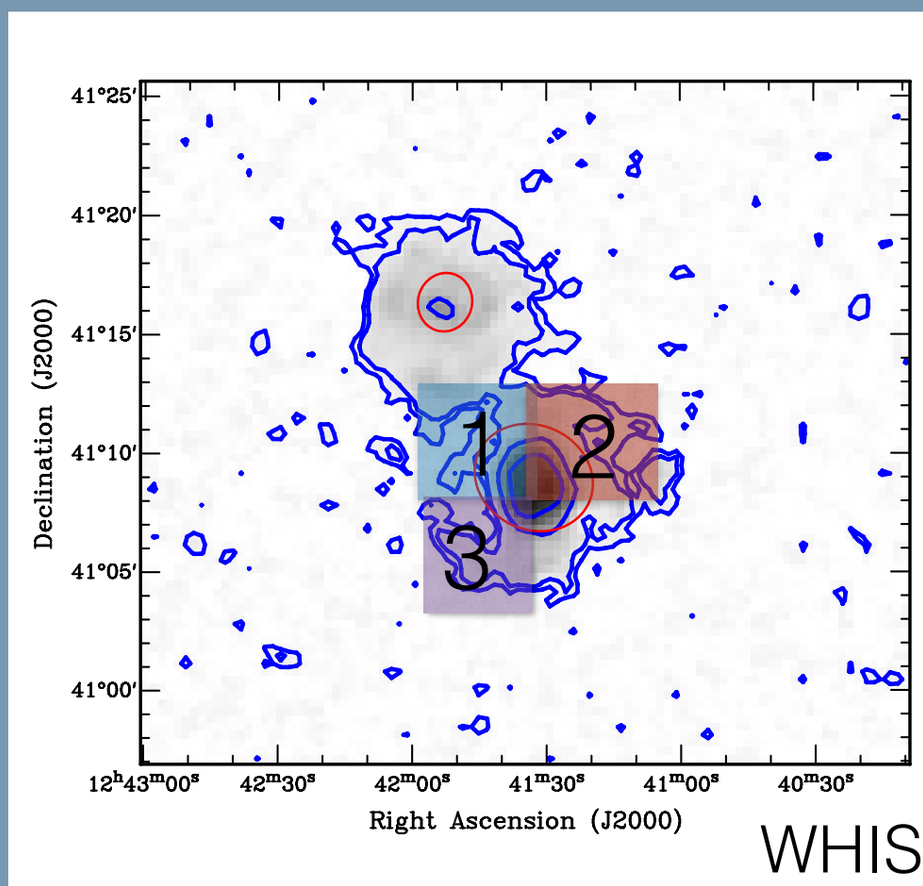




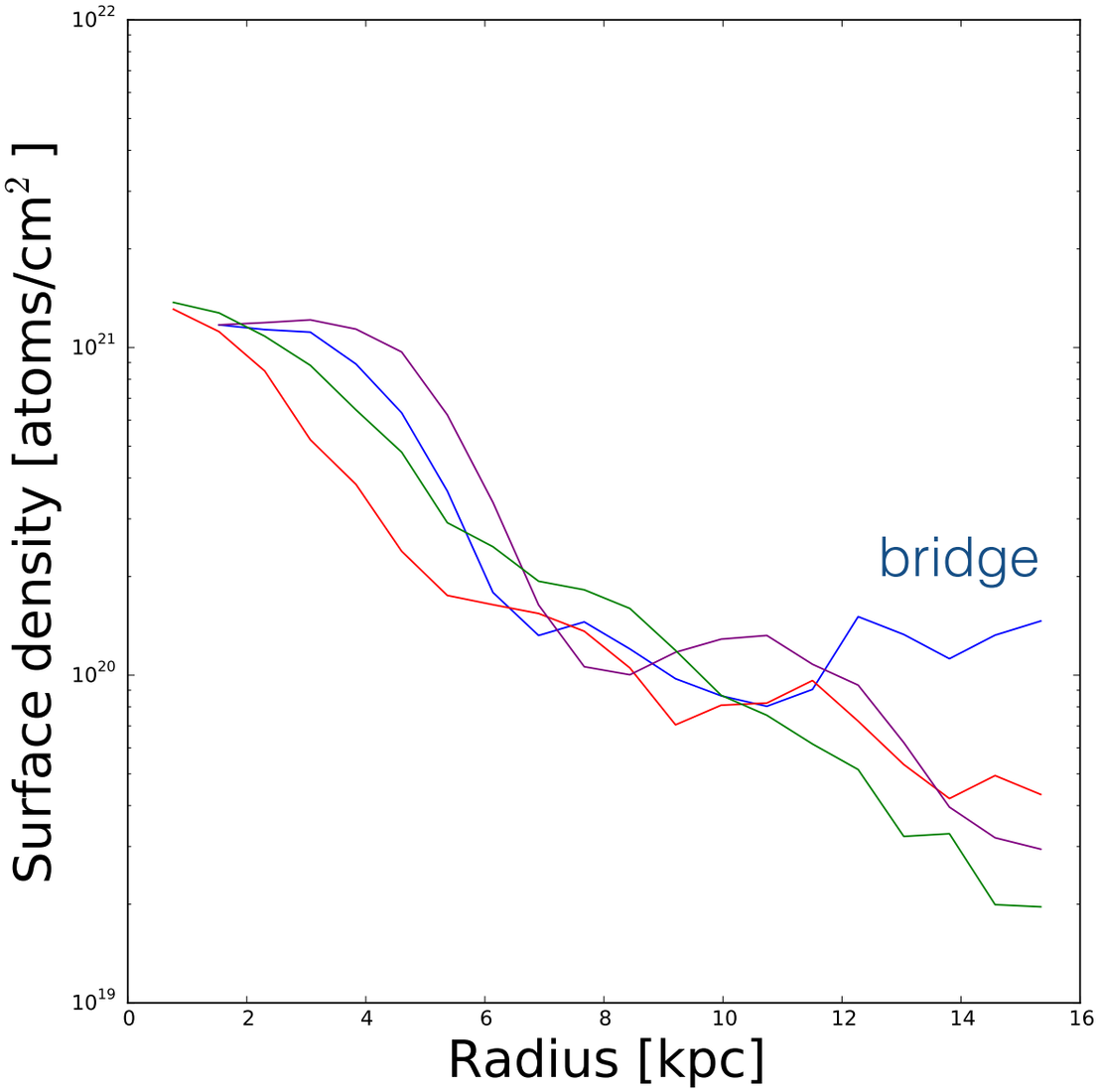
WHISP

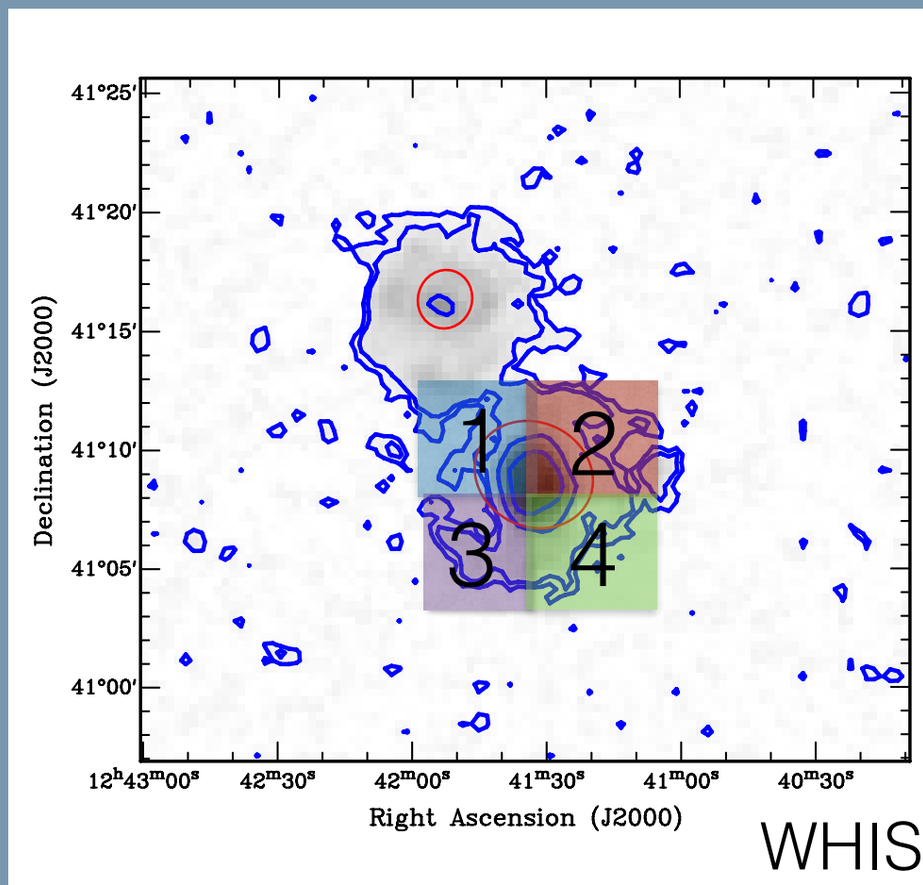
Isolated: NGC 4618





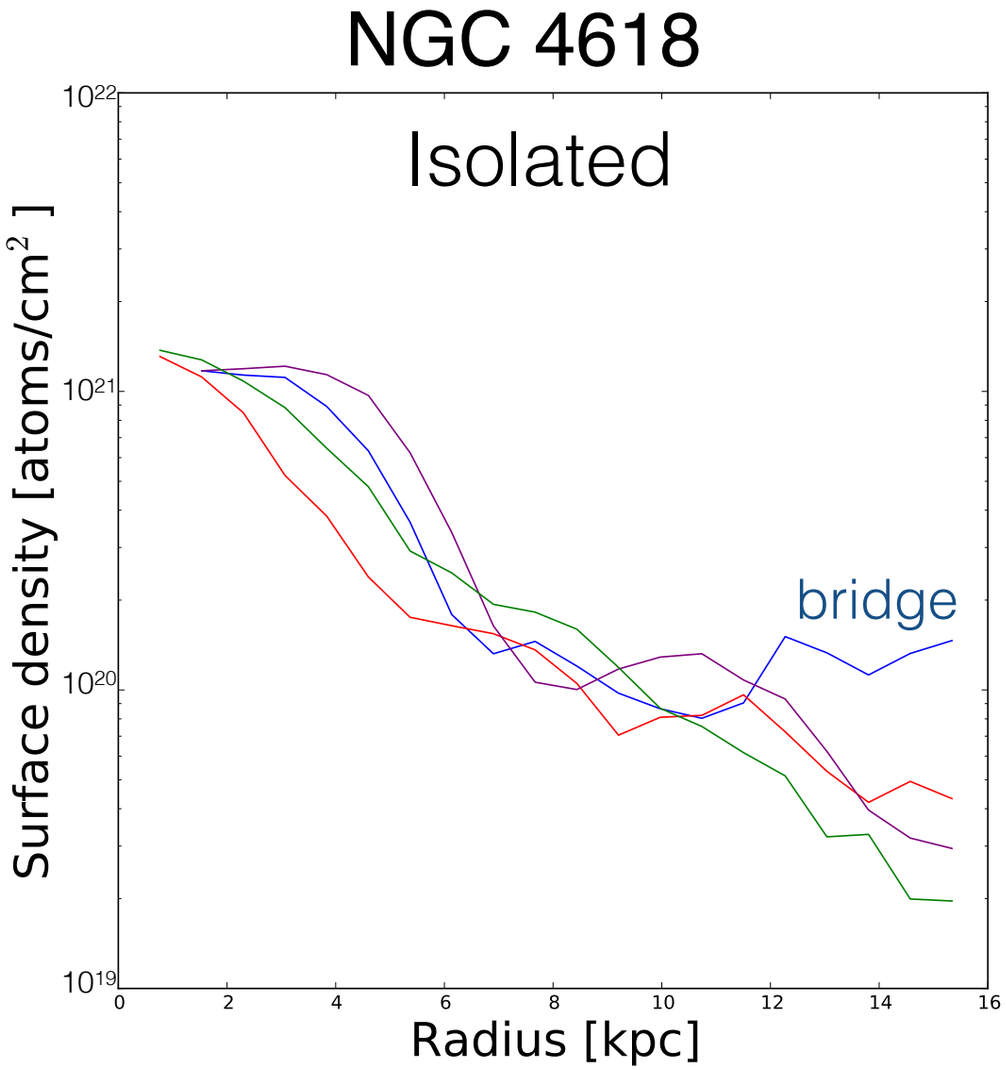
Isolated: NGC 4618

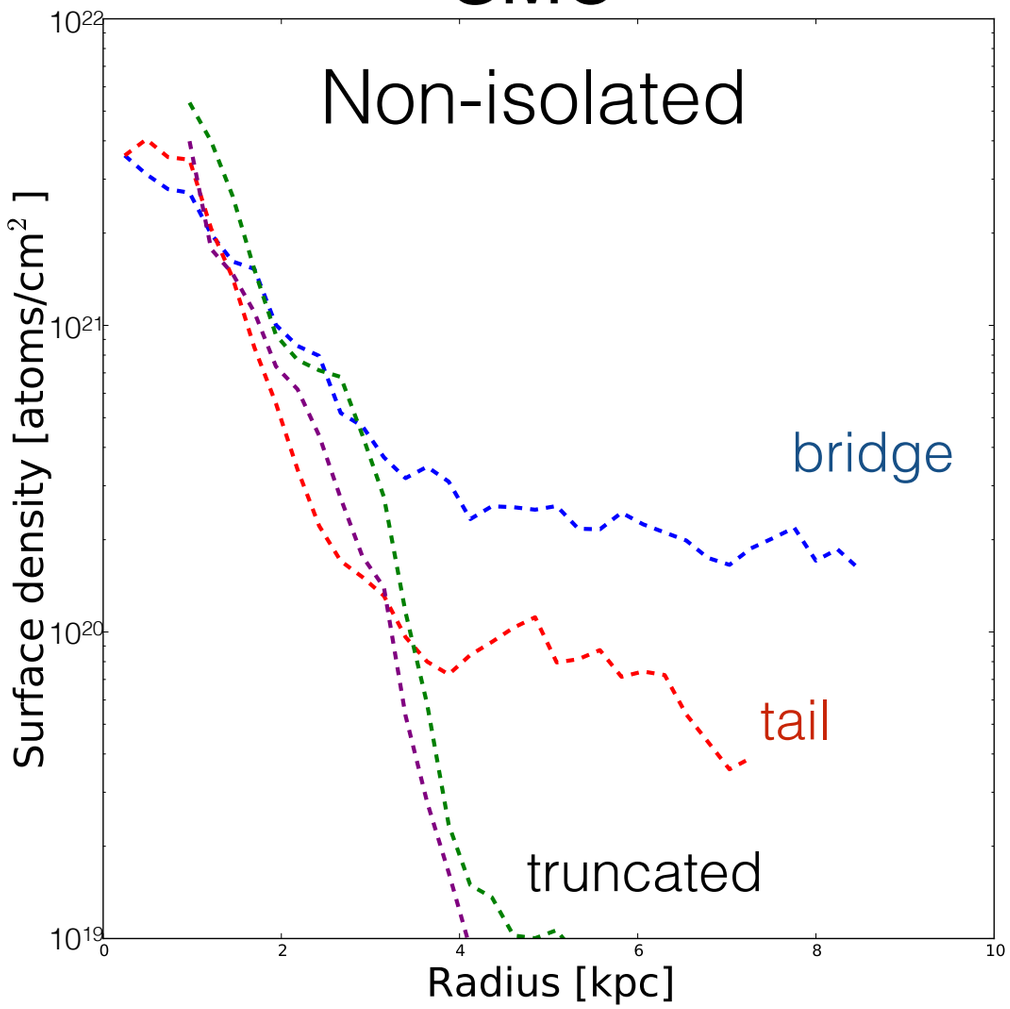




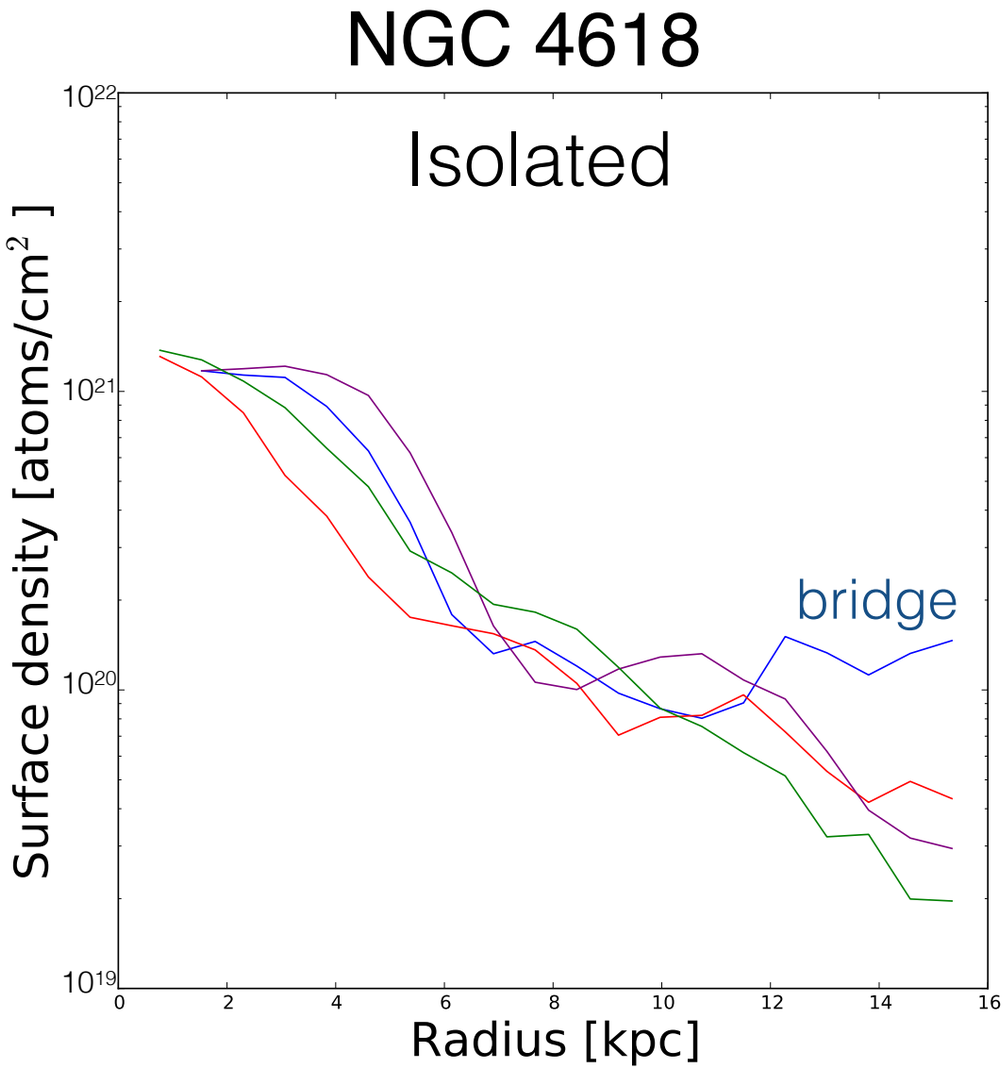
WHISP

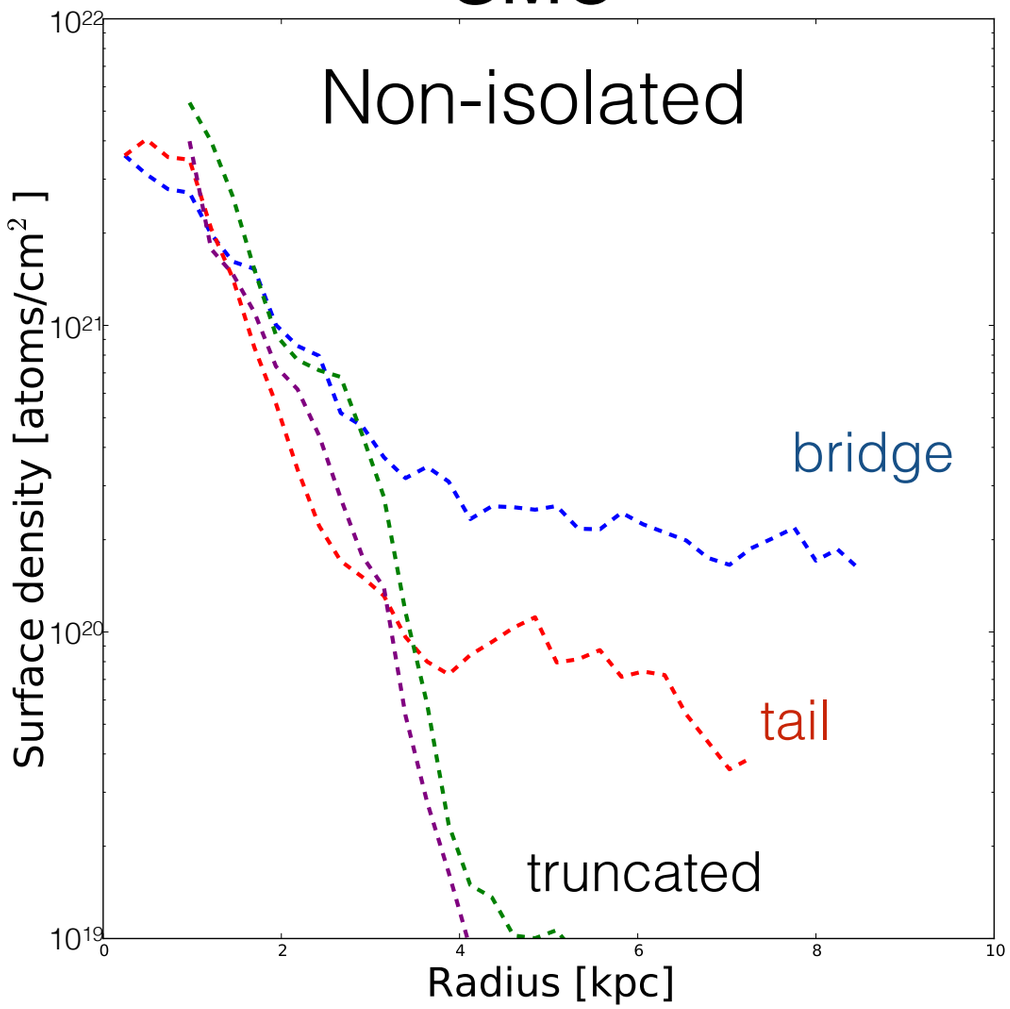
Non-isolated vs isolated





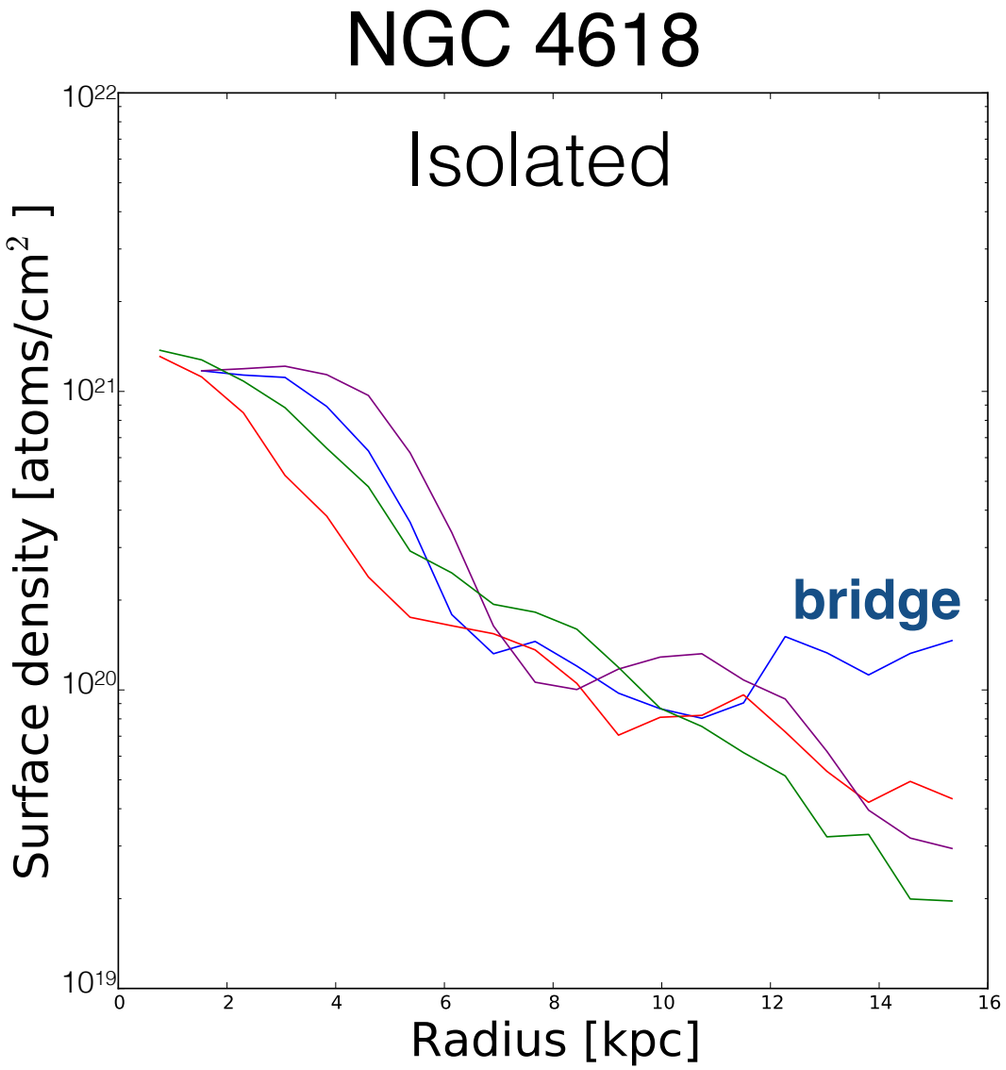
Non-isolated vs isolated

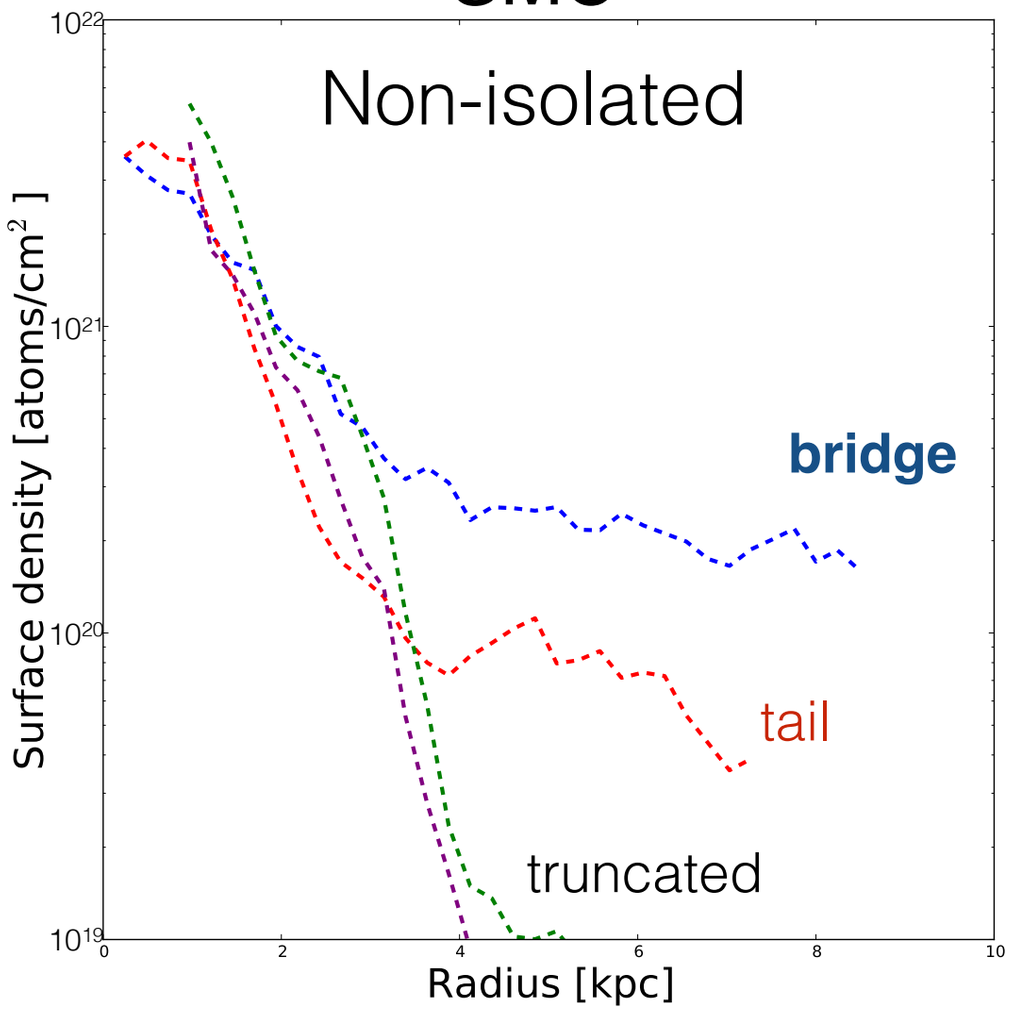




Larger variations in complex environment

Non-isolated vs isolated

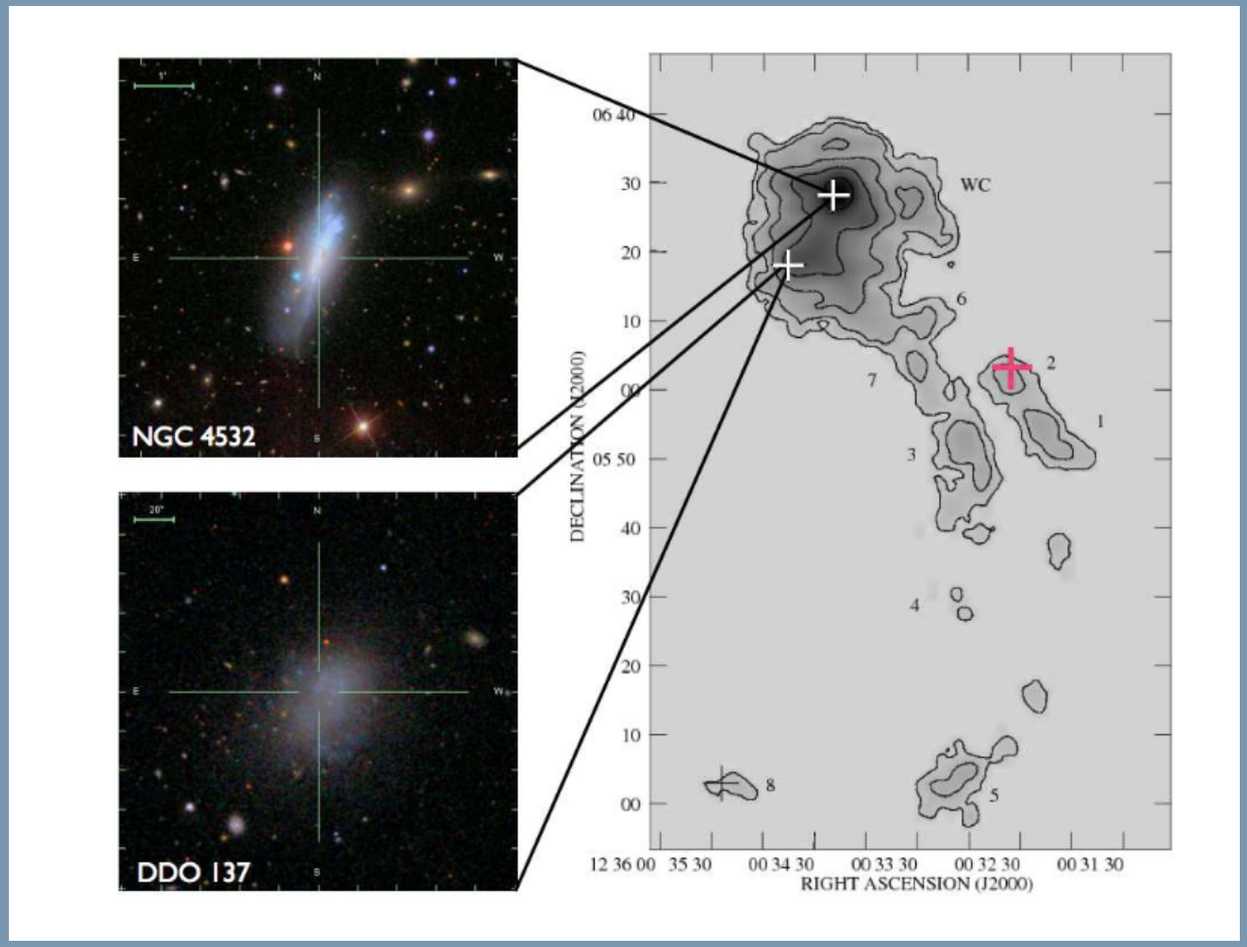




Larger variations in complex environment

Dense bridges

What happens to stripped material?

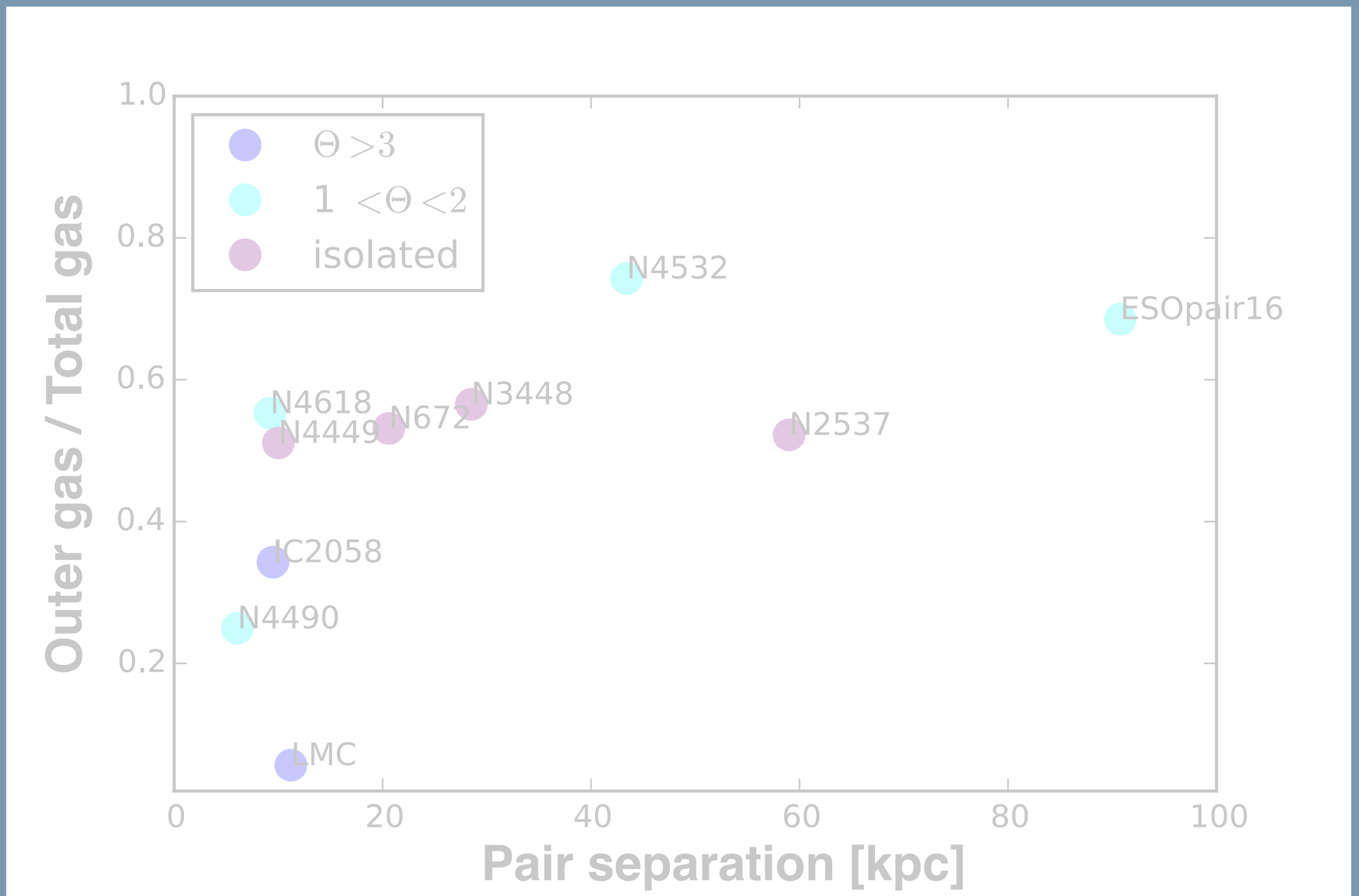


Putman, Besla, Yoon and Werk, HST-COS proposal, 2013

HST-COS observations indicate that there is no ionized gas in tail (~220 kpc from host)

Global trends

Uniform cut at N(HI) = 7 x 10^{19} cm^{-2}



Global trends

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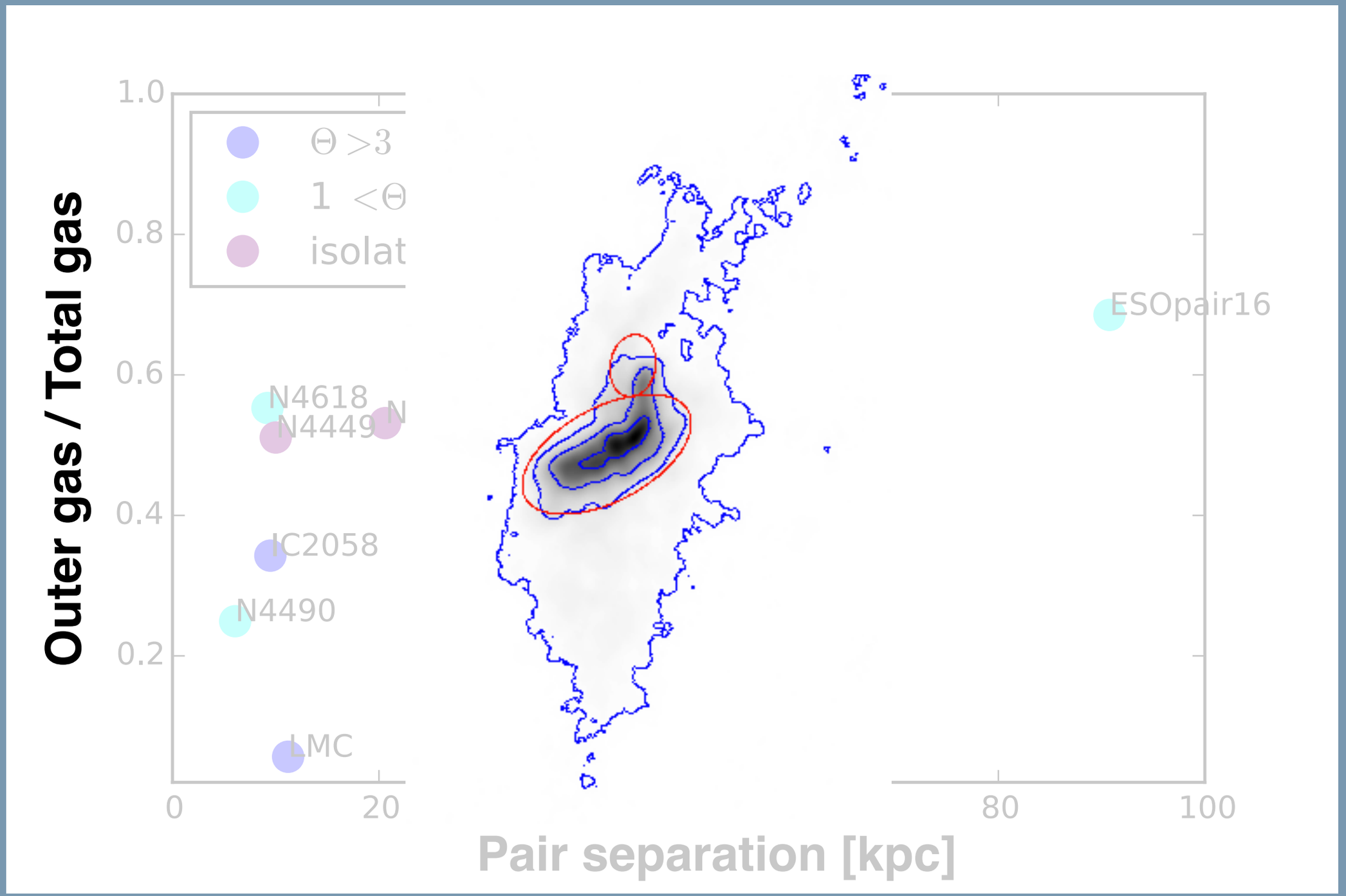

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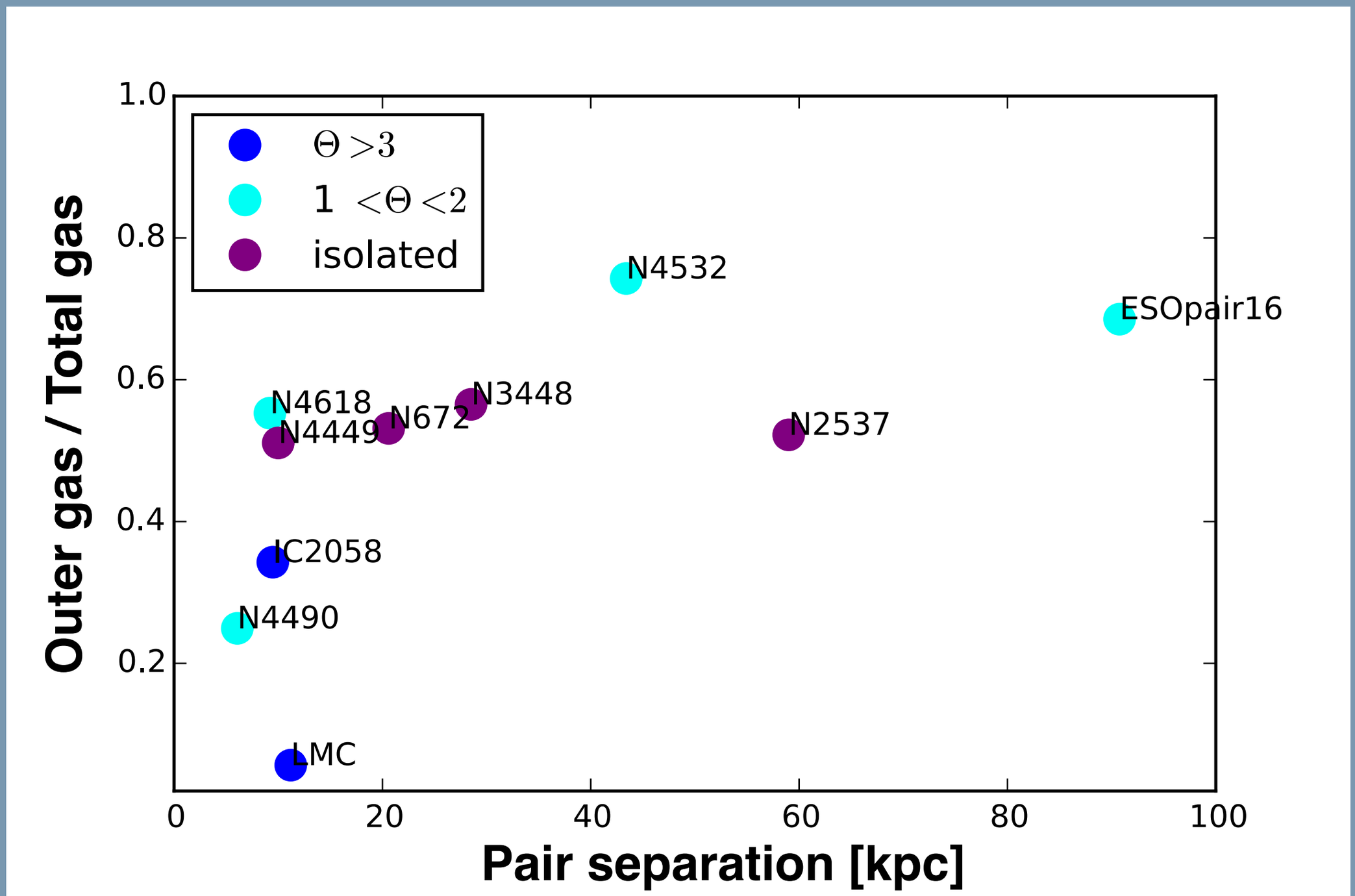

Global trends

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