HI Absorption in the Magellanic Clouds

Lister Staveley-Smith (ICRAR/UWA)

C3086 team:

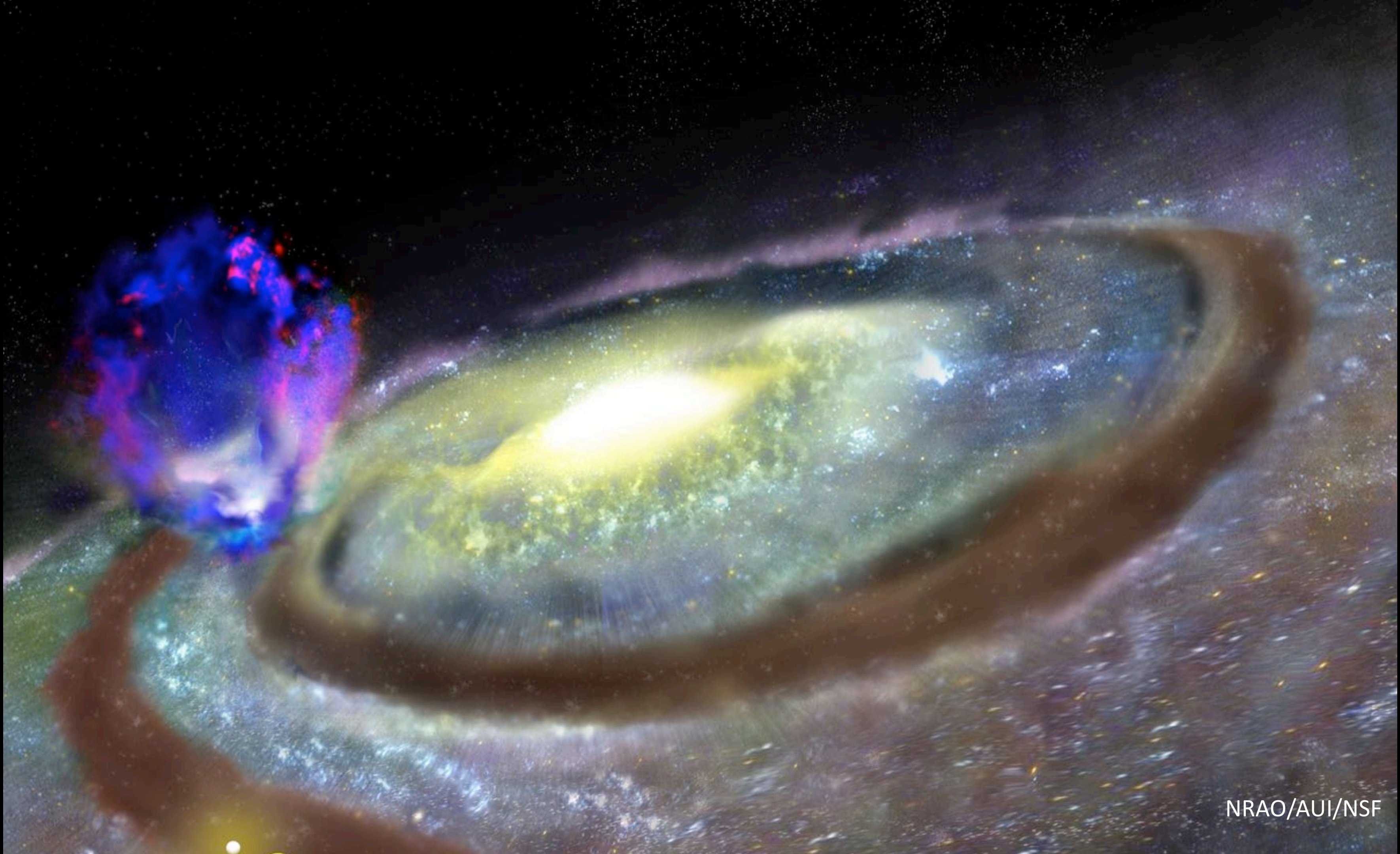
McClure-Griffiths, Dickey, Jameson, Liu, Denes and others

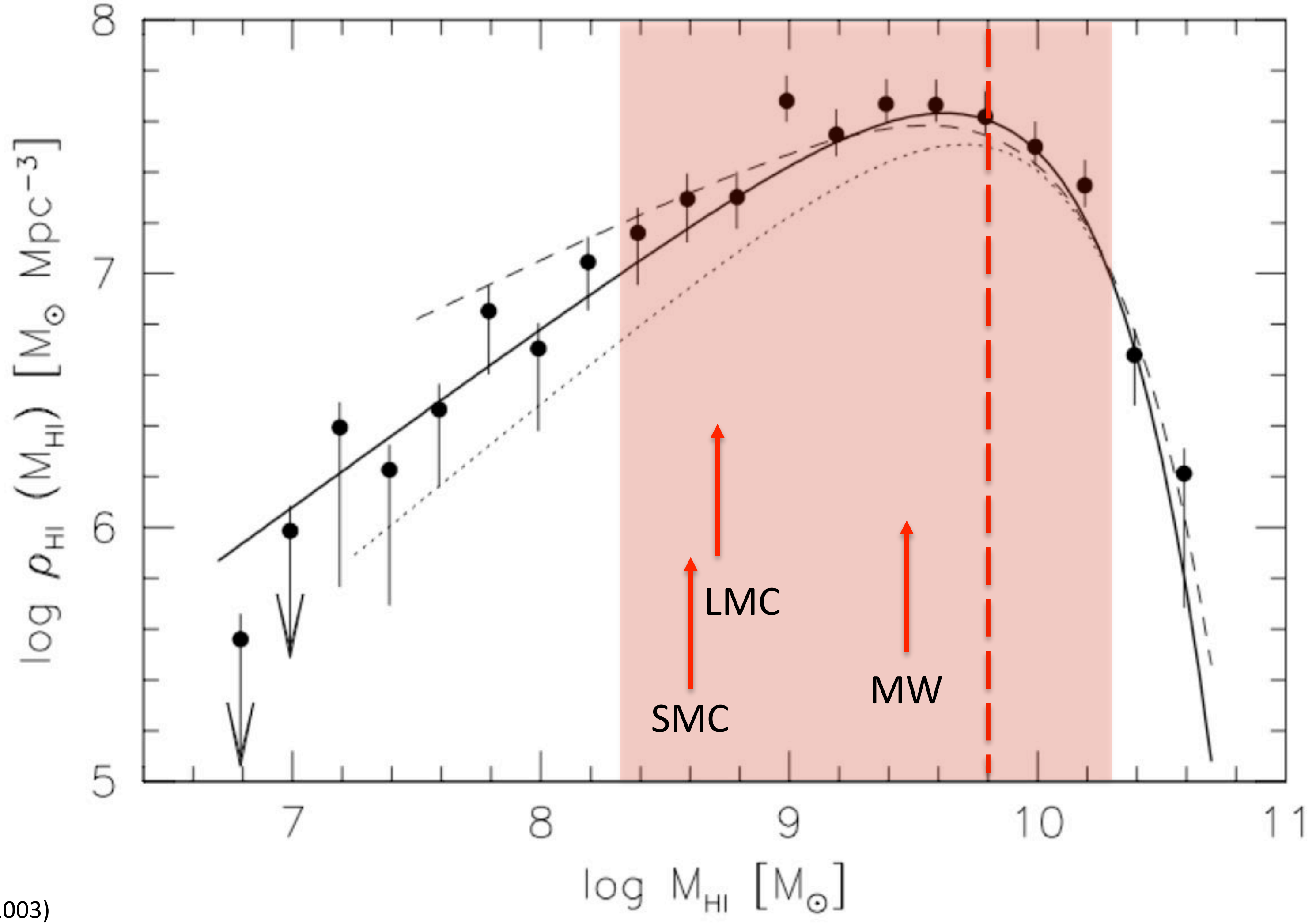
International Centre for Radio Astronomy Research

Curtin University

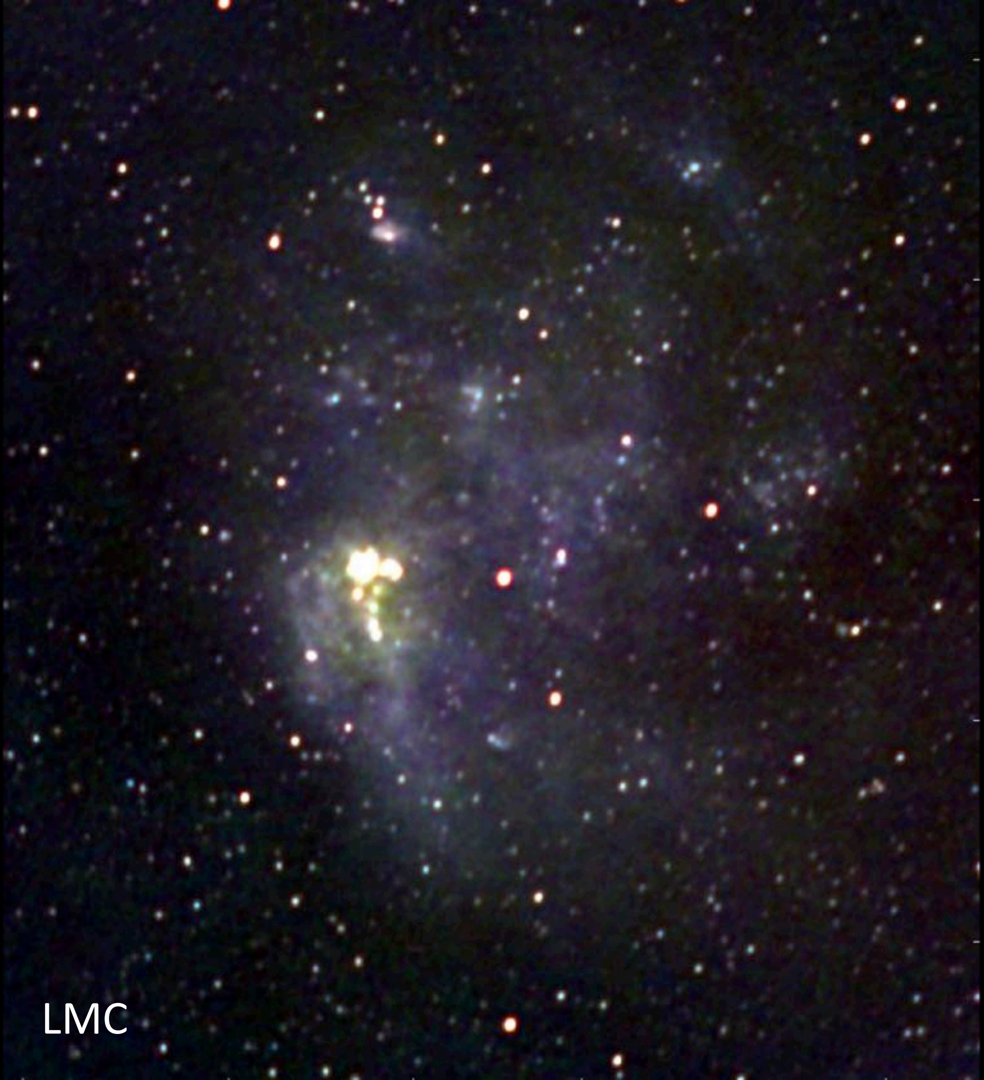
The University of Western Australia

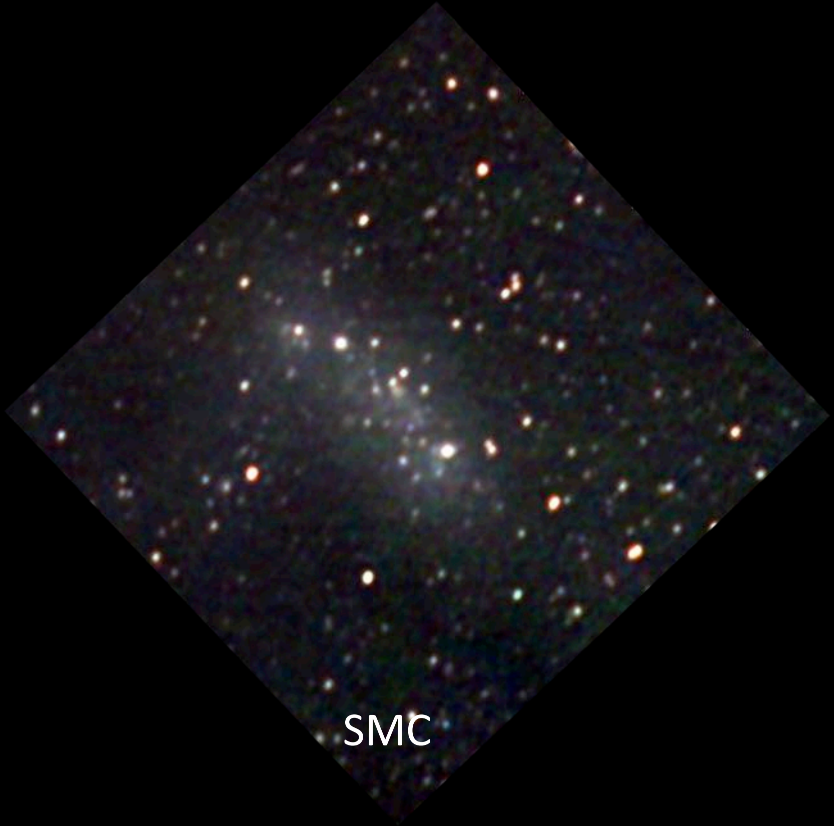
Government of Western Australia Department of the Premier and Cabinet Office of Science


NRAO/AUI/NSF



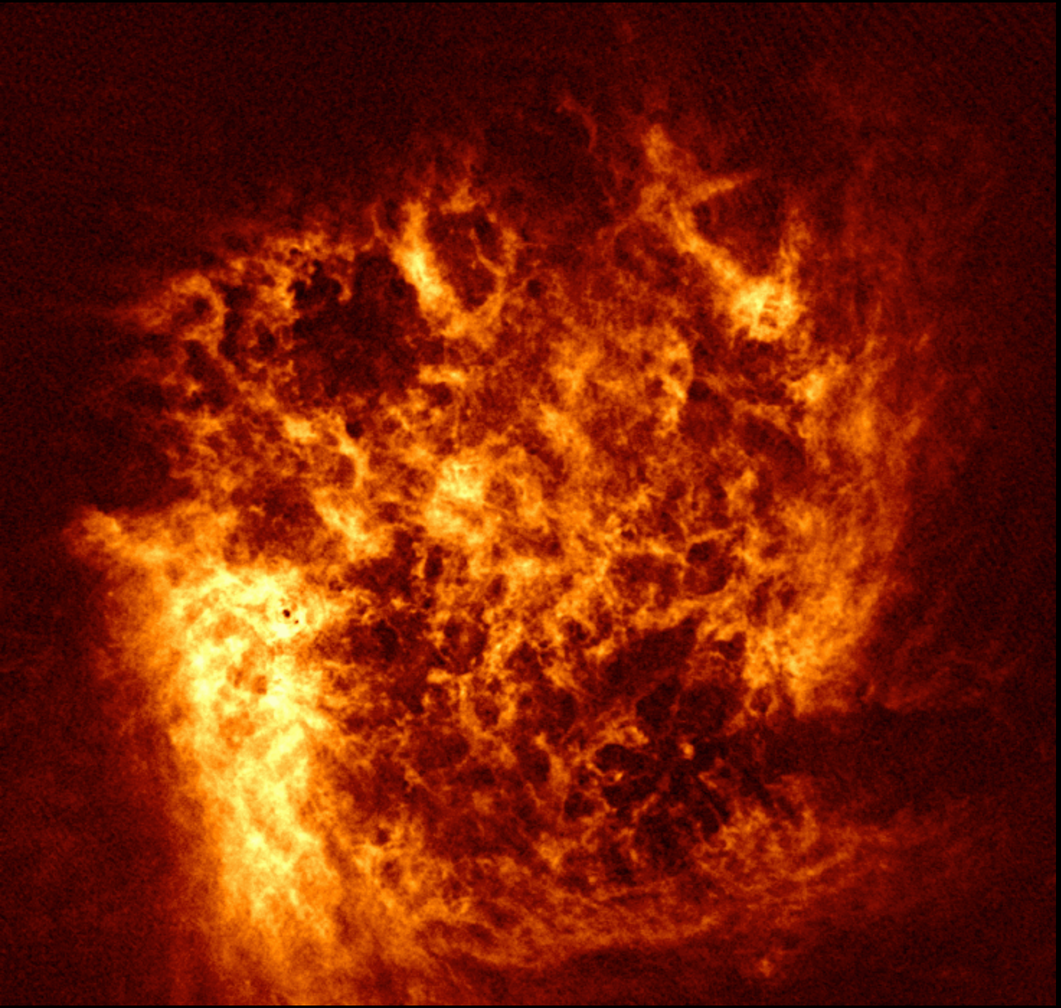
Zwaan et al. (2003)





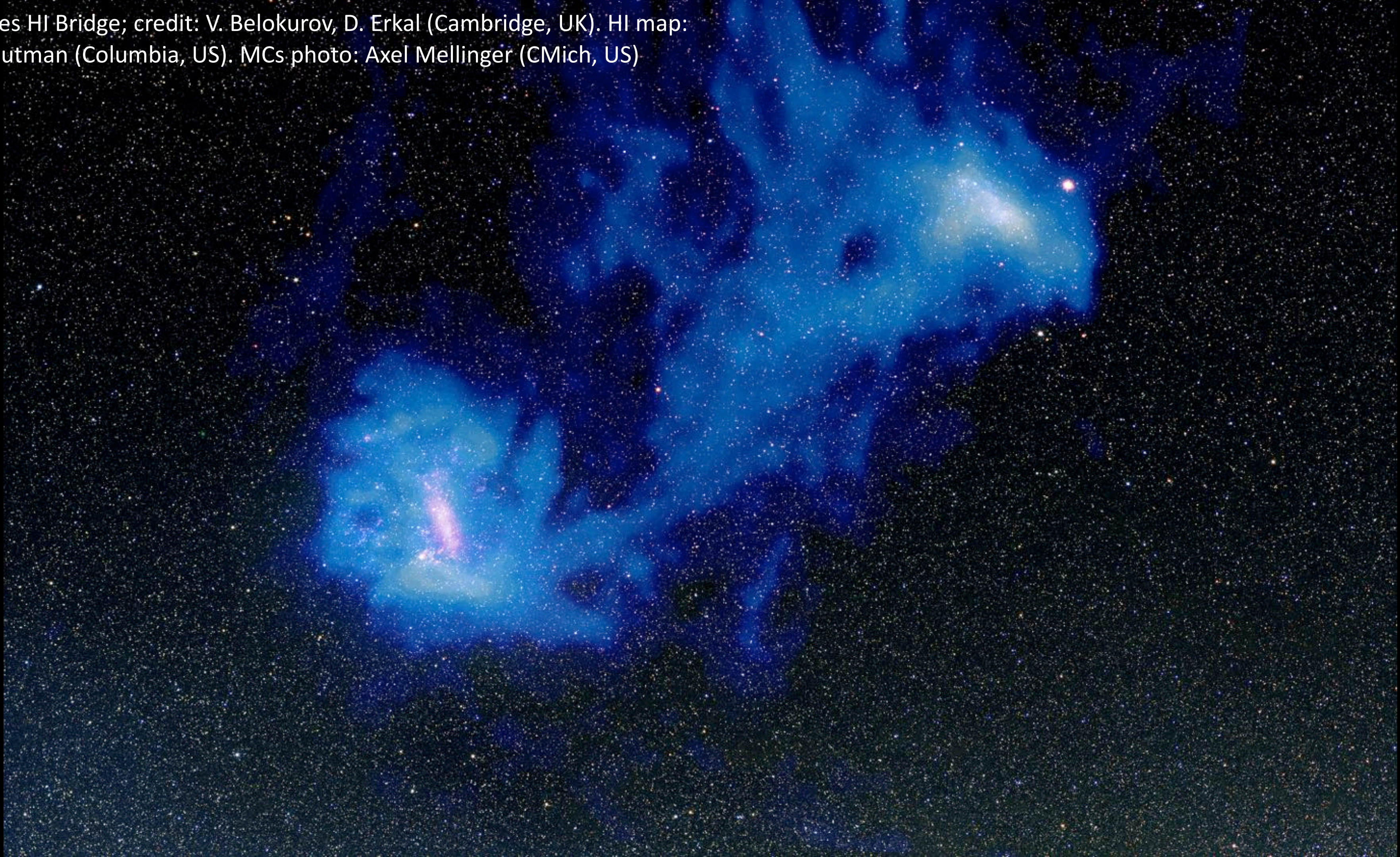
MWA three-colour (123, 181, 227 MHz) continuum images (For, Staveley-Smith et al.2017)

LMC in HI (Kim et al. 2003) - ATCA/PKS

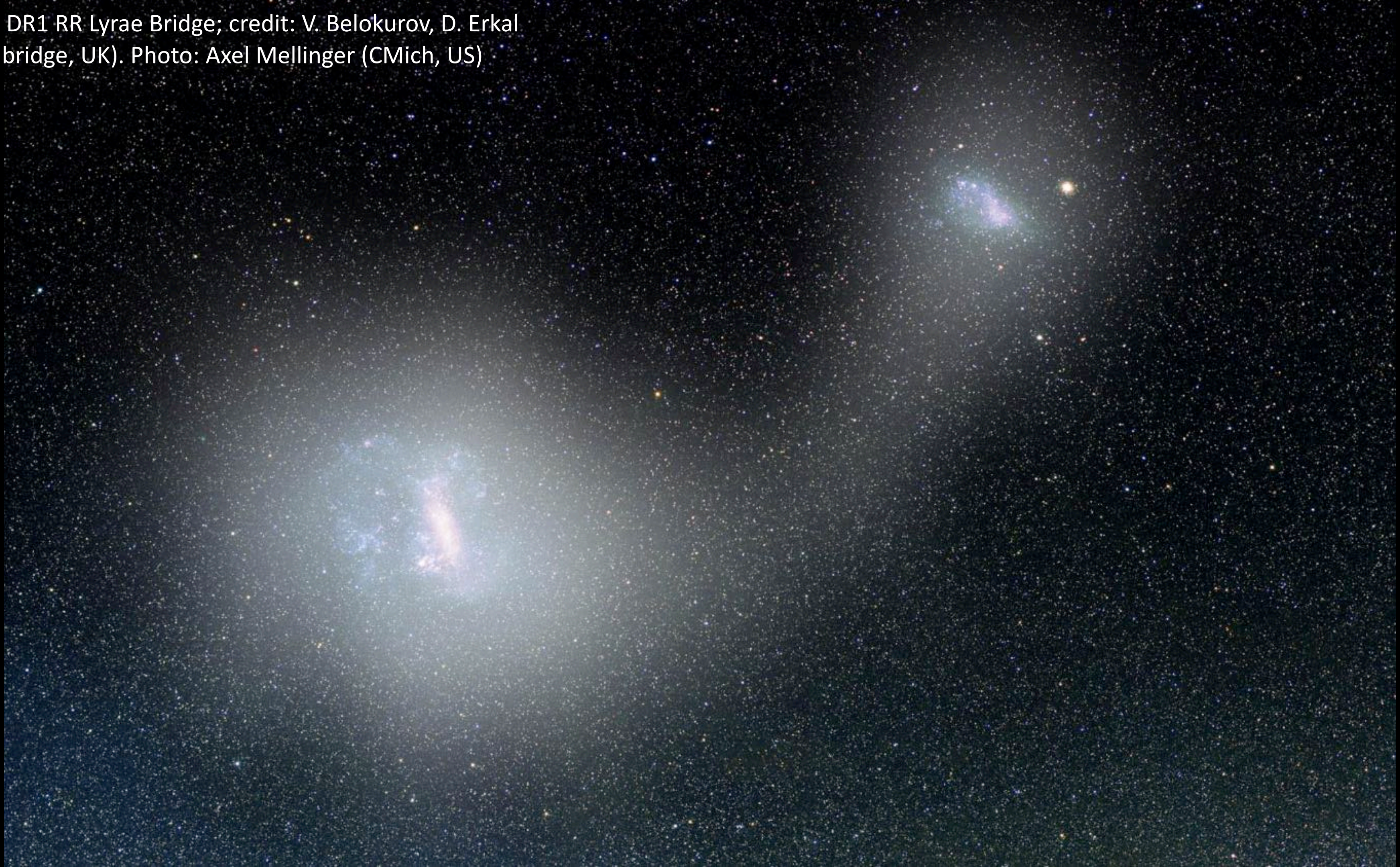


SMC in HI (McClure-Griffiths et al. 2018) - ASKAP

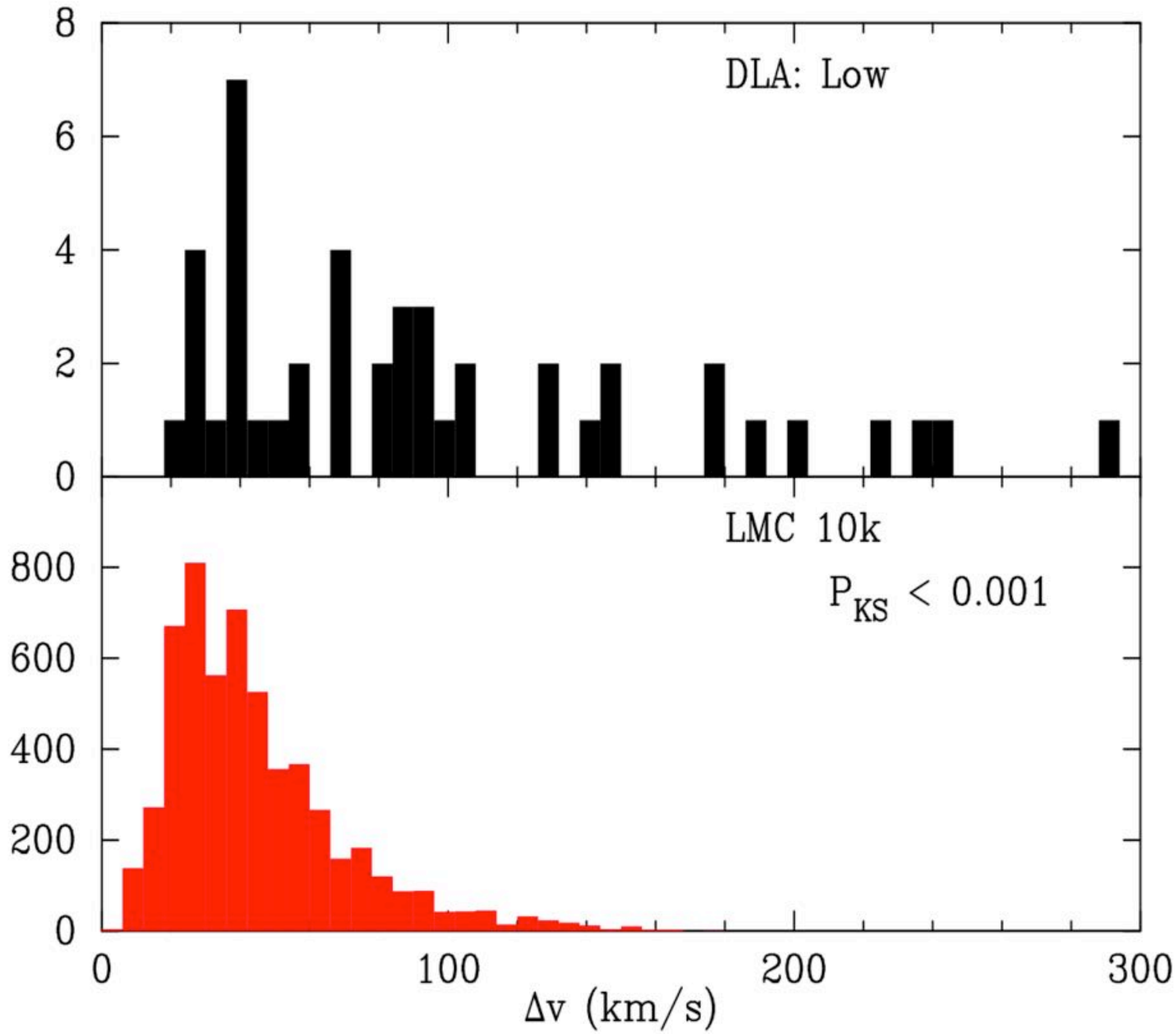
Parkes HI Bridge; credit: V. Belokurov, D. Erkal (Cambridge, UK). HI map: M. Putman (Columbia, US). MCs photo: Axel Mellinger (CMich, US)



GAIA DR1 RR Lyrae Bridge; credit: V. Belokurov, D. Erkal (Cambridge, UK). Photo: Axel Mellinger (CMich, US)



High-z DLA and LMC velocity functions differ



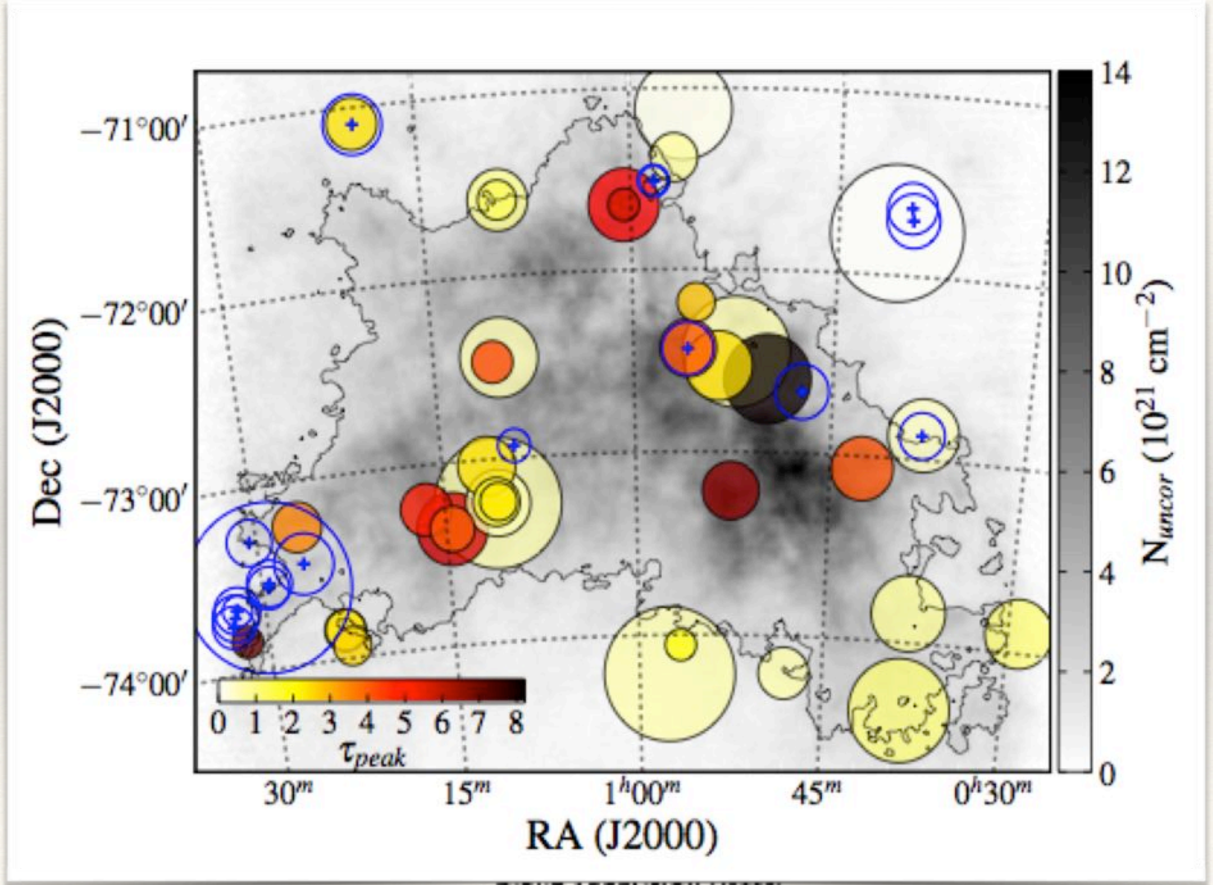
Prochaska, ERW & LSS (2002)

Significant improvement on existing measurements (SMC)

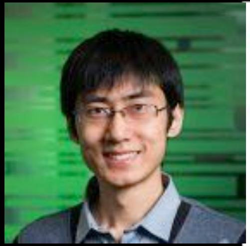
Dickey+ 2000		This Work
$\sigma_\tau \sim 0.05 - 0.2$	x5	$\sigma_\tau \sim 0.01 - 1$
$\Delta v_{ch} = 0.8$ km s^{-1}	x4	$\Delta v_{ch} = 0.2$ km s^{-1}
$N_{source} = 28$	x2	$N_{source} = 55$
$N_{abs} = 13$	x3	$N_{abs} = 37$

Our new view of HI absorption in the SMC

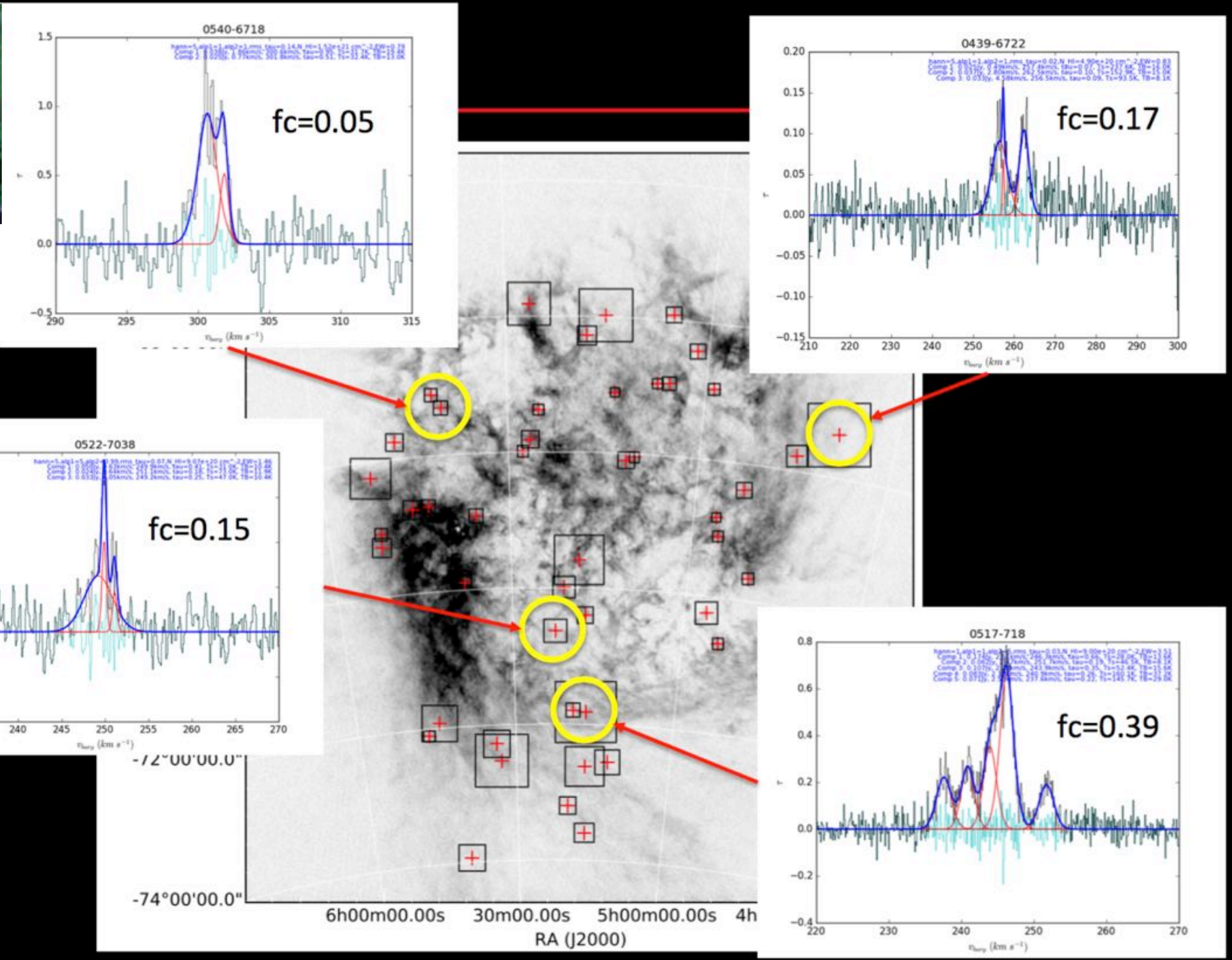
Katie Jameson (ANU)



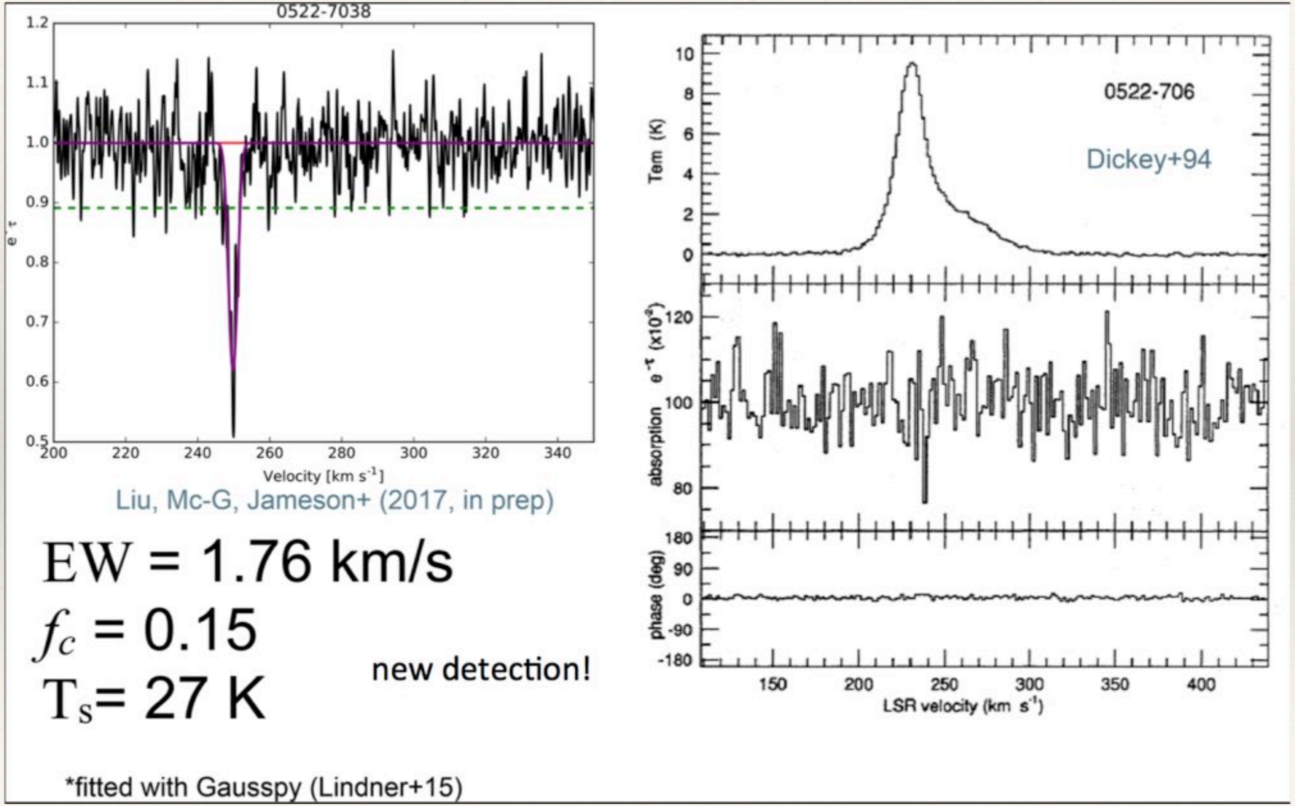
RIGHT ASCENSION (J2000)



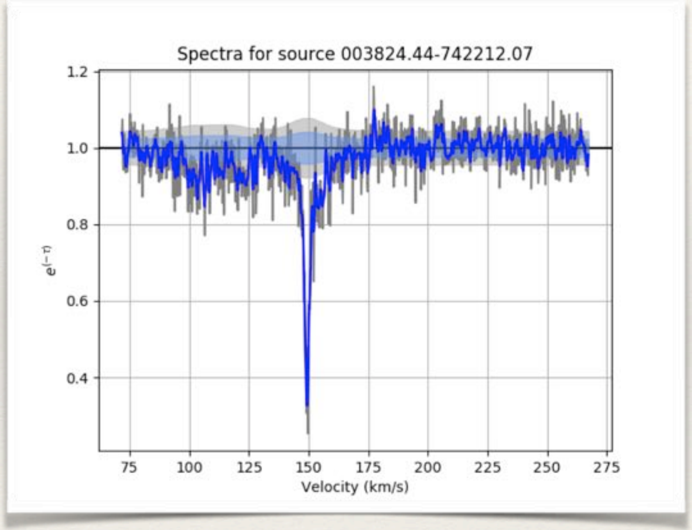
Boyang Liu
(ICRAR/NAOC)



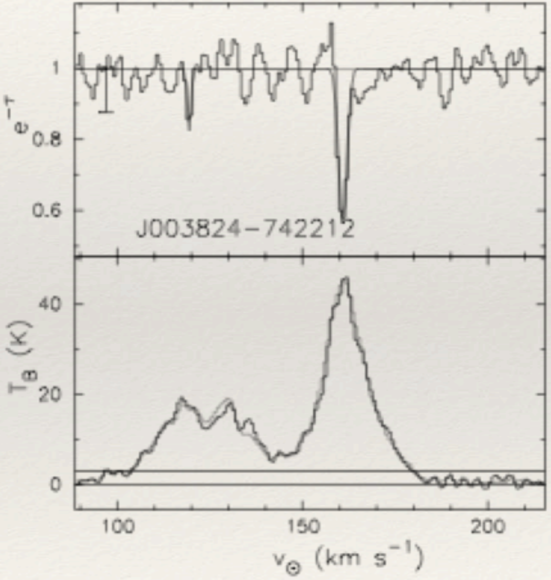
LMC example: emergence of narrow+deep absorption feature



SMC example: emergence of narrow+deep and shallow+wide absorption features



Dickey+ 2000



Jameson+ *in prep*

Definitions

Line-of-sight average spin temperature:

$$\langle T_s \rangle \equiv \frac{N_{\text{unc}}}{\text{EW}} = \frac{\int T_B(v)dv}{\int (1 - e^{-\tau(v)})dv} = \int \frac{n(s)}{[n(s)/T_s(s)]} ds$$

Cold gas fraction:

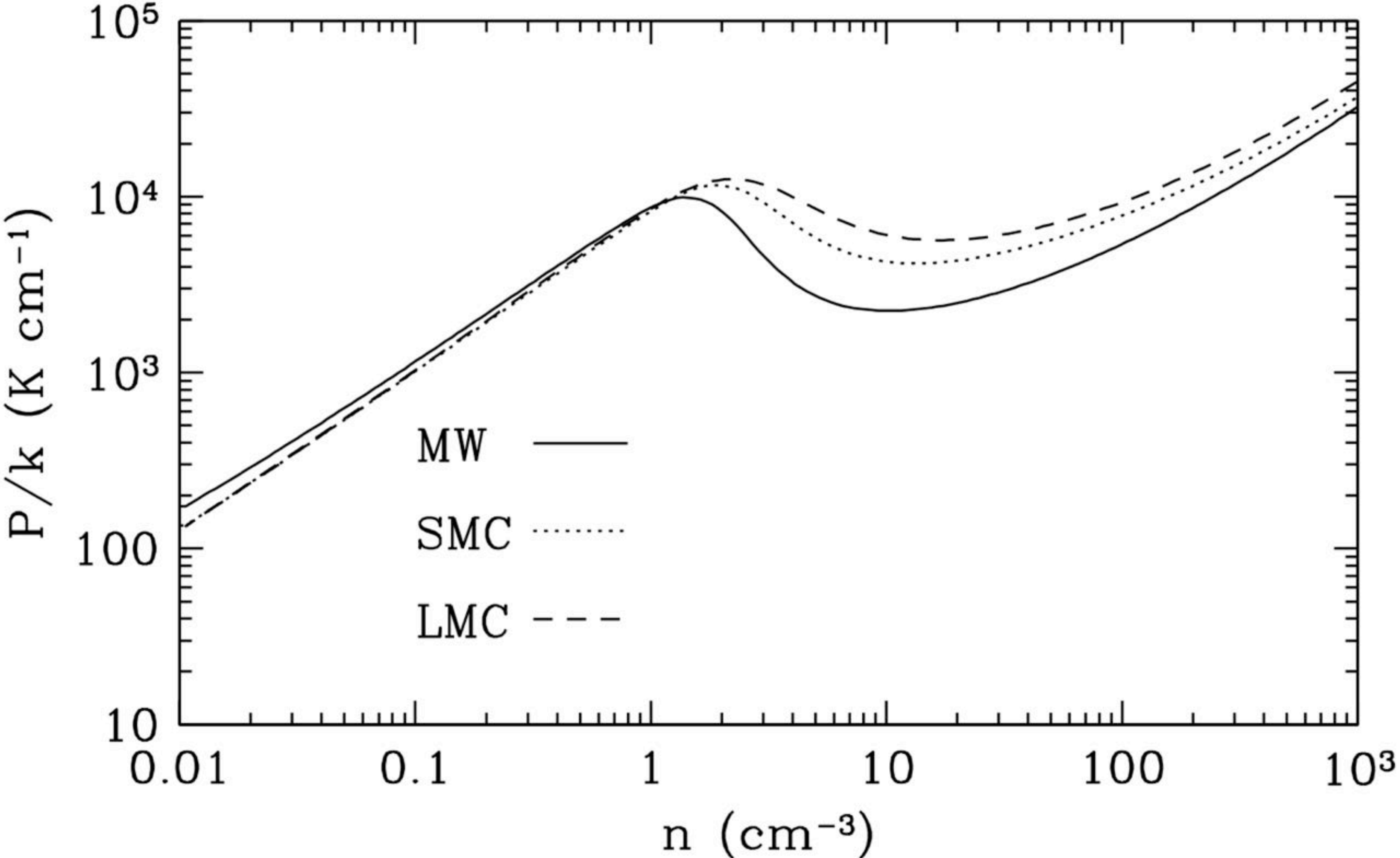
$$f_c \equiv \frac{N_c}{N_w + N_c} \simeq \frac{T_c}{\langle T_s \rangle}$$

Dickey et al. (2000)

Dickey et al. (2000)

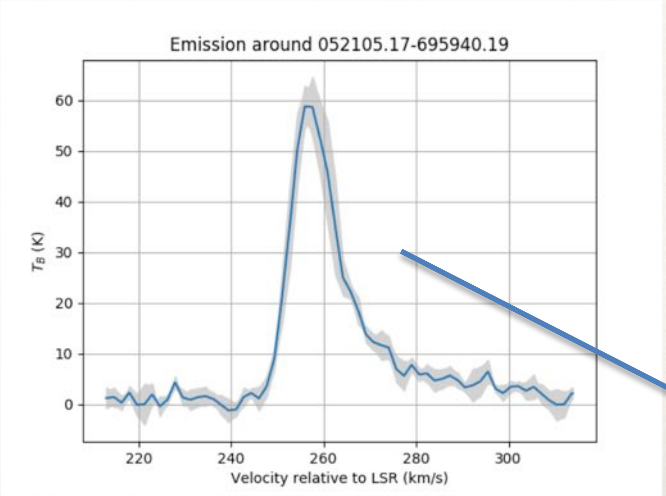
Cool-Phase H I Fractions for Galaxies

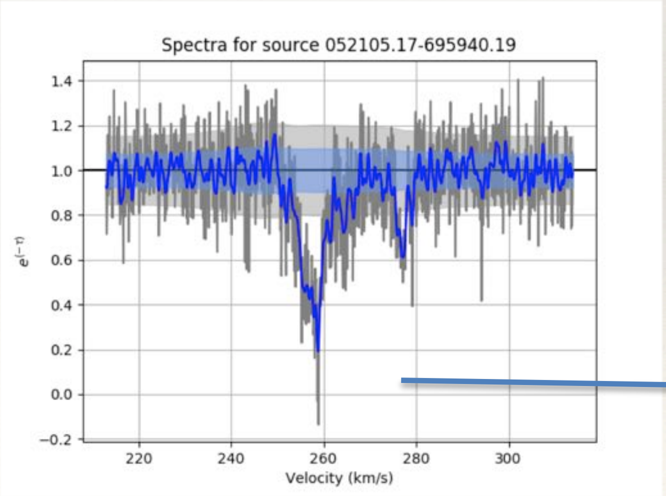
Galaxy	Sample Size	$\langle T_s \rangle$ (K)	f_c ($T_c = 55$ K)
SMC	28	440	0.13
LMC	49	170	0.33
M31	16	150	0.37
M33	7	370	0.15
Milky Way......	19	250	0.22



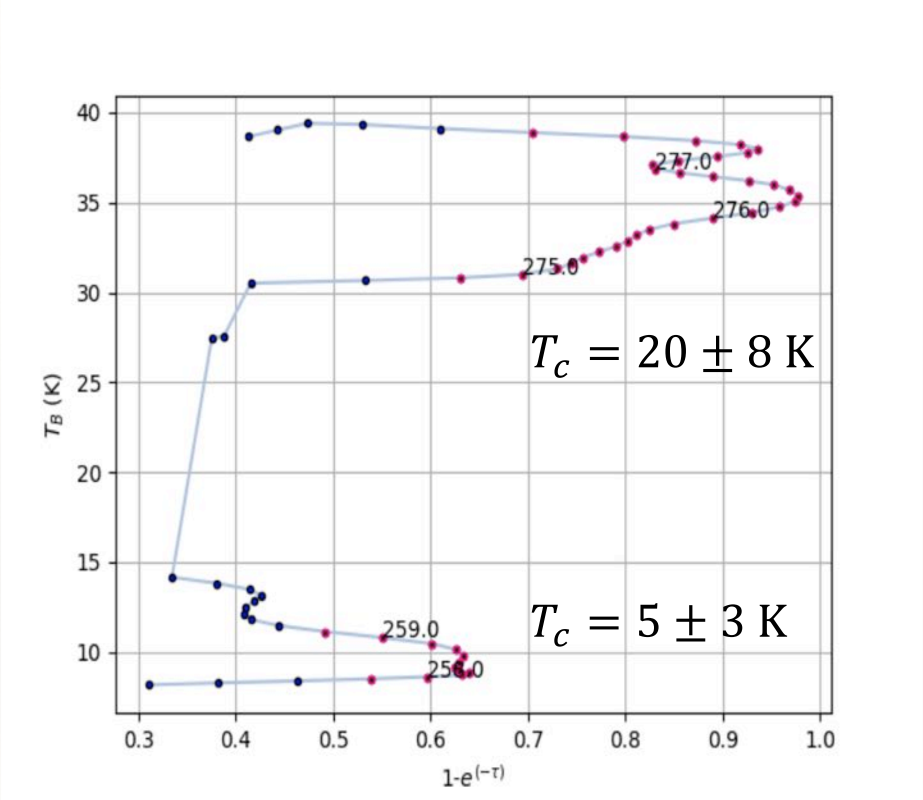
Wolfire, McKee, Ostriker & Bolatto (in prep)

Multiple phases: mixed absorption and self-absorption





Emission



Absorption

(see Dickey et al. 2000)

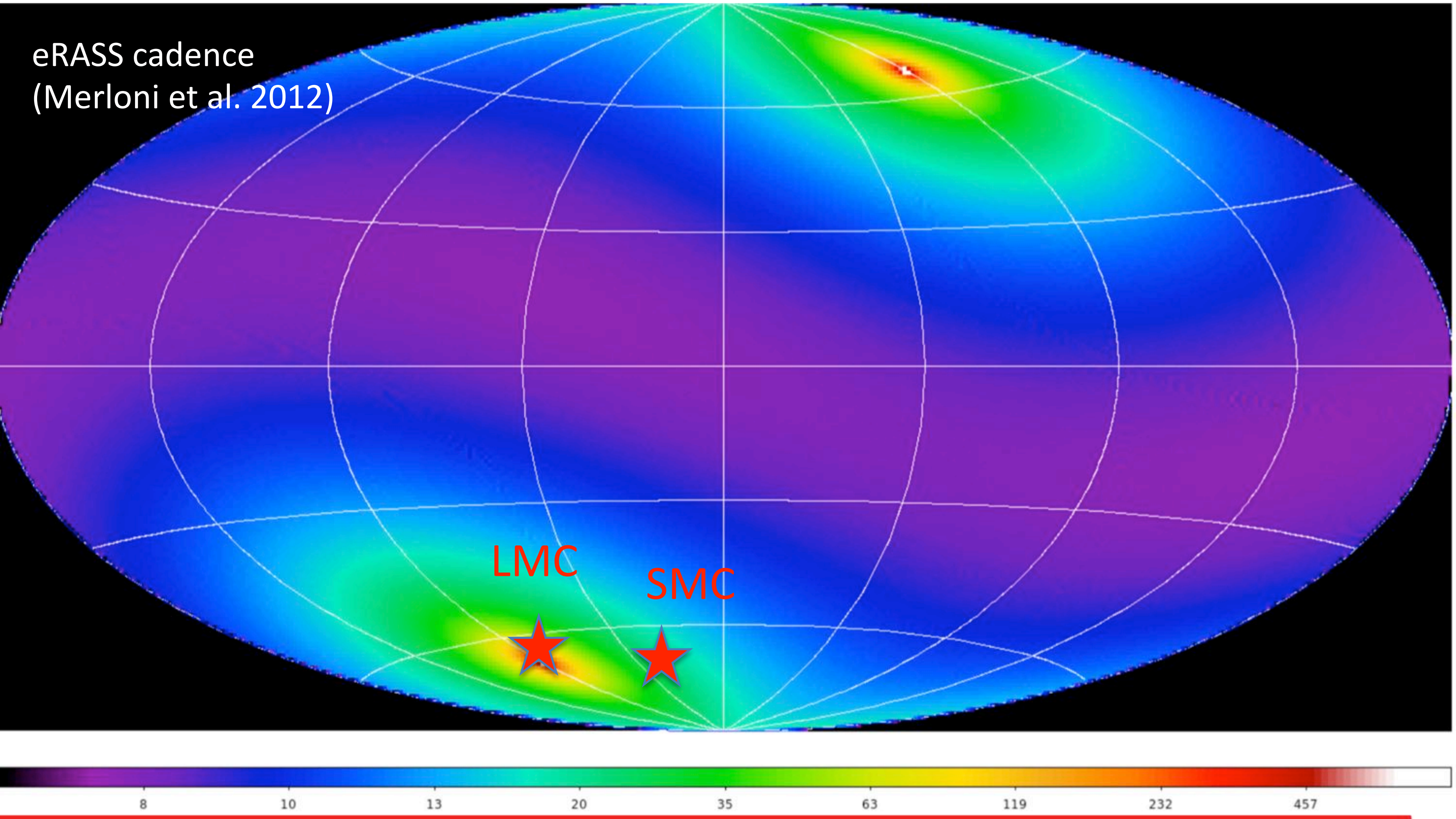
eRASS and MCs

Approved eROSITA-CAASTRO Science Project

Supernova remnants, superbubbles, and the global structure of the interstellar medium in the Magellanic Clouds:

- DE: **Sasaki**, Haberl, Kerp
- AU: Staveley-Smith, Filipovic, Koribalski
- Other: Kavanagh, Points

Investigate the relation of cold gas, hot gas and cosmic rays in MCs to investigate evolution of star-formation regions, superbubbles and SNRs and their impact on the evolution of the MCs.


eRASS cadence
(Merloni et al. 2012)
LMC
SMC
8
10
13
20
35
63
119
232
457

Summary

Large C3086 ATCA program progress report:

- Observations (1000 hrs) concluded
- SMC analysis underway (Katie Jameson)
- LMC analysis underway (Boyang Liu)
- Possibly more cool gas than previously detected
- ASKAP will provide emission spectra better matched to size of background sources:
  - 2-4 times spatial resolution and 2 times more temperature sensitivity
  - but need ZOOM modes
  - can't provide better absorption spectra (MeerKAT/SKA)
- Useful low-z reference point for high-z absorption studies