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Oxygen isotope ratio studies in the Galactic Center regions

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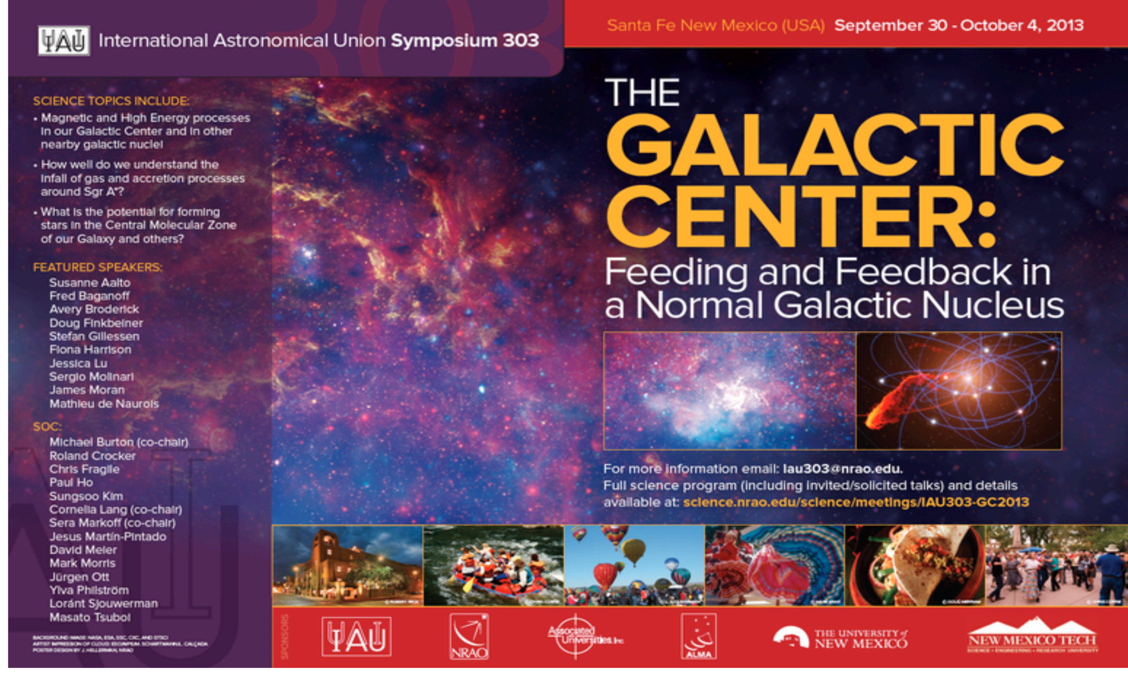


• Introduction

Gas kinematics of the Galactic center region (GC) show that gas in the halo flow inside toward the disk and gas in the outskirts of the disk fall further toward the GC *(e.g., Fukui et al. 2006; Binney et al. 1991; Rodriguez-Fernandez &Combes 2008).*

Isotope ratios are considered to be good tool to discriminate between gas flowing towards the disk and gas already residing in the disk of central galactic plane *(Riquelme et al. 2010).*

Systematic study on the ratio of ^{18}O to ^{17}O of the Galaxy, by $C^{18}O$ and $C^{17}O$ (similar chemical and excitation properties and both tend to be optically thin): 1) Detailed mapping of GC different molecular clouds: in disk, halo, X1-X2 orbits → check different properties of gas in the halo and disk and understand GC kinematics.
2) Combining with observations in different galactocentric distance clouds, to check the existence of $^{18}O/^{17}O$ gradient at large scale.

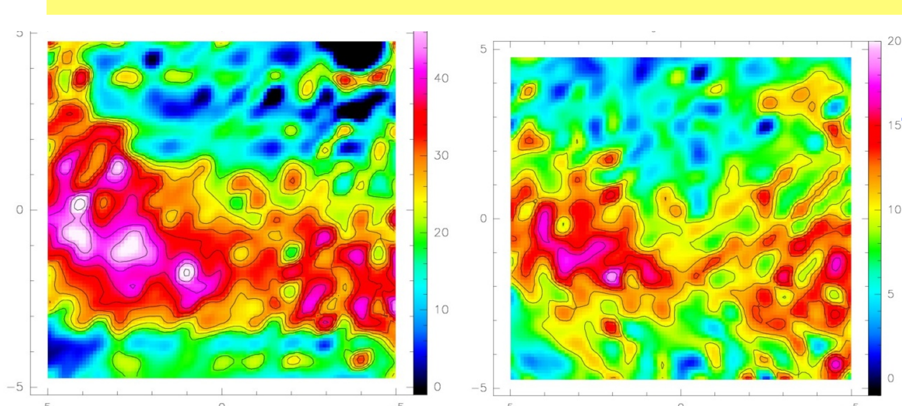
Preliminary results of molecular clouds in Galactic center region are presented: Sgr A, Sgr B2, Sgr C, Sgr D, 1.°3 complex in the disk of CMZ, and M+5.3-0.3 in halo.

• Observations

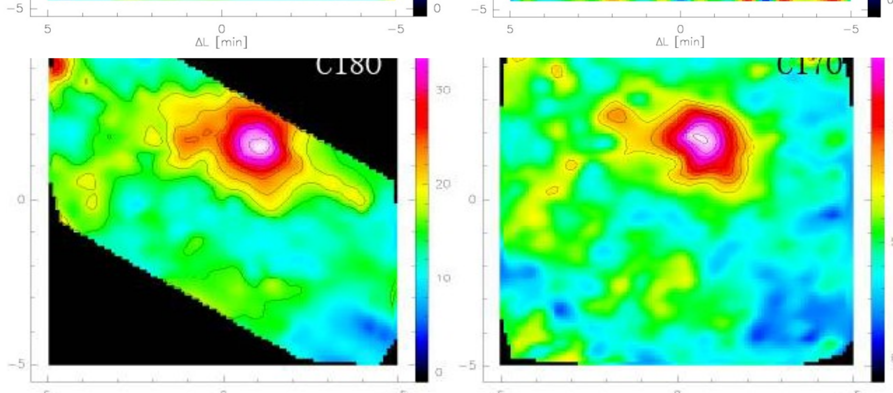
$C^{18}O$ and $C^{17}O$ (J=1-0) were mapped recently for GC molecular clouds, Sgr A, B2, C, D, 1.°3 complex and M+5.3-0.3 (2011.1, 2012.5), using the PMO 13.7 m telescope with installed 9-beam SIS superconducting re

• Analysis & Discussion

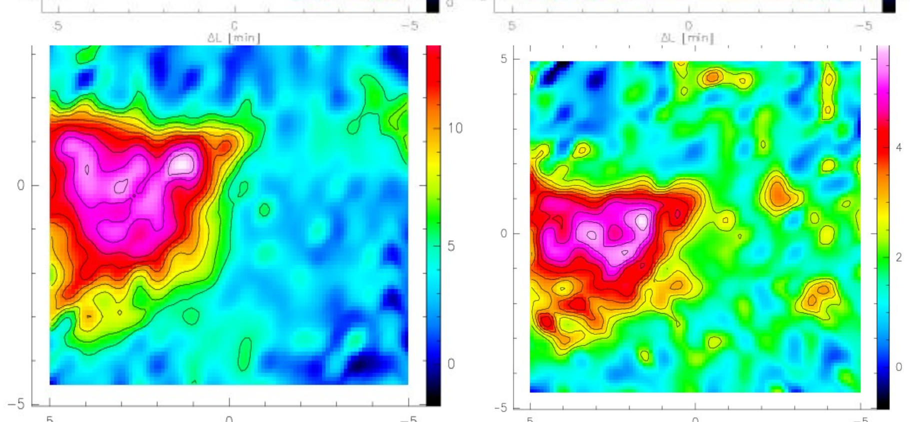
Contour maps: （10'*10'）



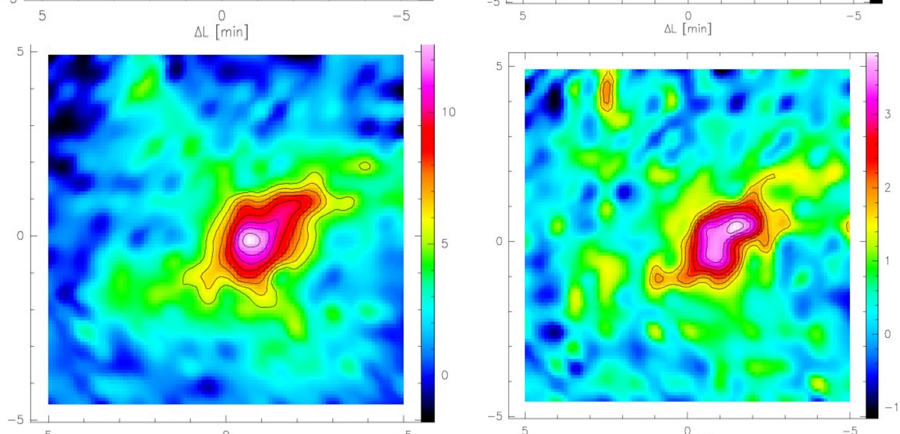
Sgr A
$C^{18}O$(left): -63~98km/s
Velocity range, from ">3σ"
$C^{17}O$(right): -66~88km/s



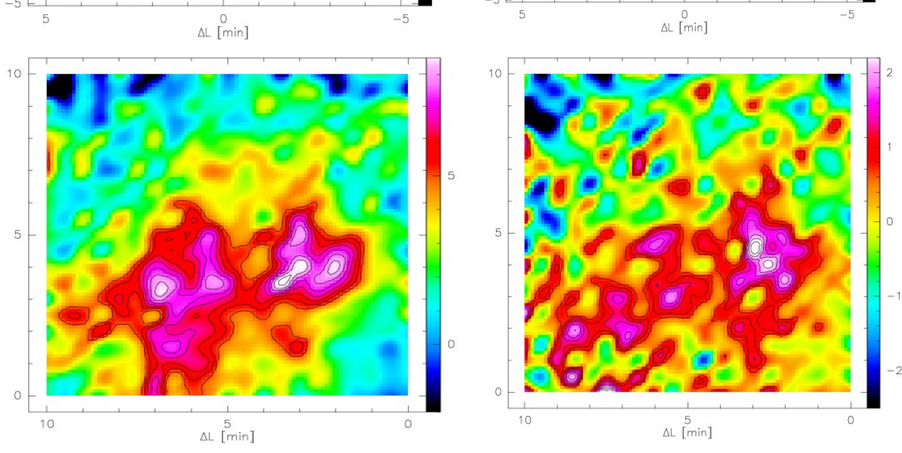
Sgr B2
$C^{18}O$(left): 8~102 km/s
$C^{17}O$(right): 0 ~106 km/s



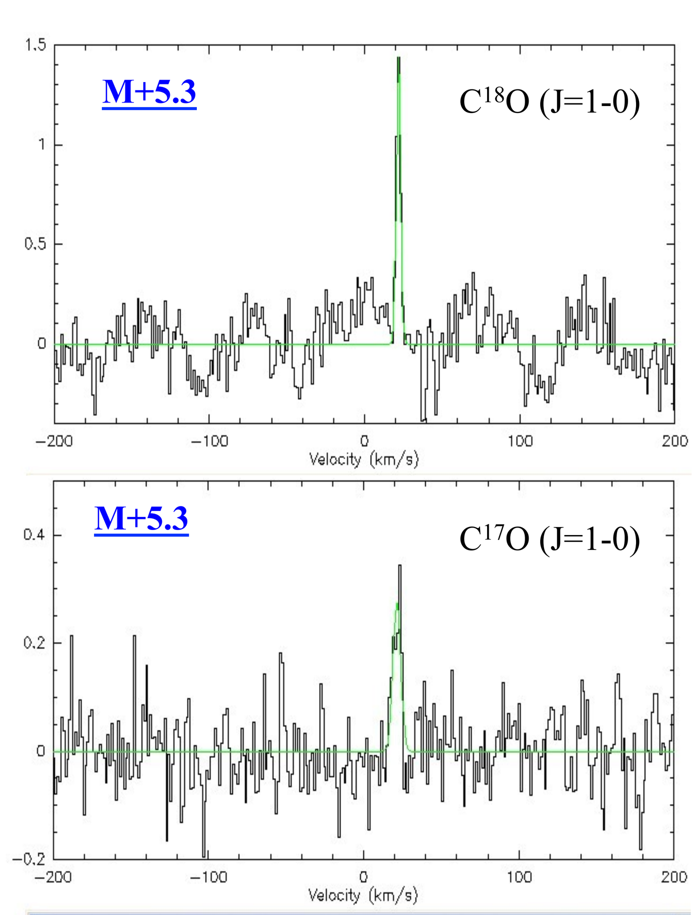
Sgr C
$C^{18}O$(left):-74~17 km/s
$C^{17}O$(right):-80 ~20km/s

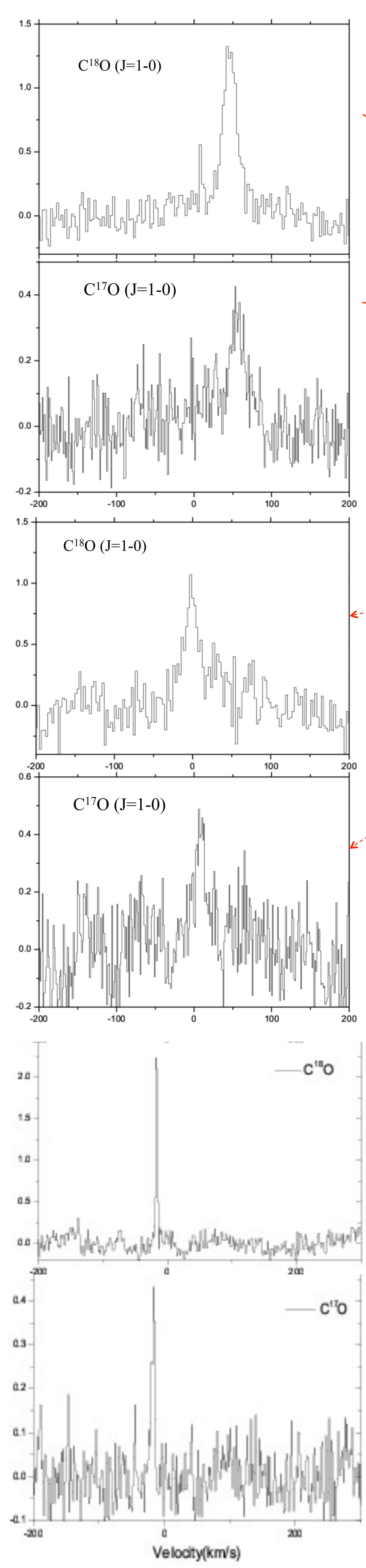


Sgr D
$C^{18}O$(left): -30~ 0km/s
$C^{17}O$(right):-25~ 0km/s



1.°3 Complex
$C^{18}O$(left): -30~ 0km/s
$C^{17}O$(right):-20~ 10km/s





$^{18}O/^{17}O$ isotopic ratios:

Integrated intensity ratio are derived for those positions:
1)The same velocity component for both lines;
2)Both have strong signal (SNR>5σ)

➢ **Integrated intensity ratio of $C^{18}O/C^{17}O$ (frequency corrected)**
→ **isotopic ratio $^{18}O/^{17}O$**
• Optical thin; Fractionation? Selective photo-dissociation?

Source	Vpeak	$^{18}O/^{17}O$	Source	Vpeak	$^{18}O/^{17}O$
Sgr A	~ 0 km/s	2.86±0.05	Sgr B2	~ 62km/s	3.26±0.10
	~ 50 km/s	3.72±0.19	Sgr D	~ -20km/s	***4.18±0.13***
Sgr C	~ -56 km/s	3.53±0.09	1.°3 Complex	~ -17km/s	***4.44±0.15***
			M+5.3	~ 23km/s	***3.21±0.13***

Summary:
• **Sgr A, B2, consistent with previous result** (e.g., *Wouterloot et al. 2008*)
• **First $^{18}O/^{17}O$ results for Sgr C, Sgr D, 1.°3 Complex, M+5.3**
• **May no significant difference in disk and halo**
→ **Need more data: in halo, X1 orbit;**

L-V diagram& density on x_1 and x_2 orbits in the inner Milky Way, from Stark et al. (2004)