

# HIGGS: The Herschel Inner Galaxy Gas Survey

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## ABSTRACT

The Herschel Inner Galaxy Gas Survey (HIGGS) is a Herschel Open Time Key Project to investigate the inflow of matter in the bulge of the Milky Way using the HIFI and PACS instruments to observe [C II], [N II], [O I], [O III], and high- $J$  CO emission lines to determine the relationship between central black holes and their host galactic bulges and thus the causes and mechanisms of starbursts. As [Binney *et al.* 1991] have suggested, the gas in closed orbits in the bar of the Milky Way provides a means to study in detail the accretion processes leading to starbursts and active galactic nuclei. Shocks effectively transfer some fraction of the clouds' orbital kinetic energy into heat which escapes through dust continuum and line emission. By measuring this emission and characterizing the star formation that occurs under these unusual conditions, we can estimate the amount of orbital energy that has been dissipated and constrain estimates of the mass inflow from the decaying orbits.

## HIGGS TEAM

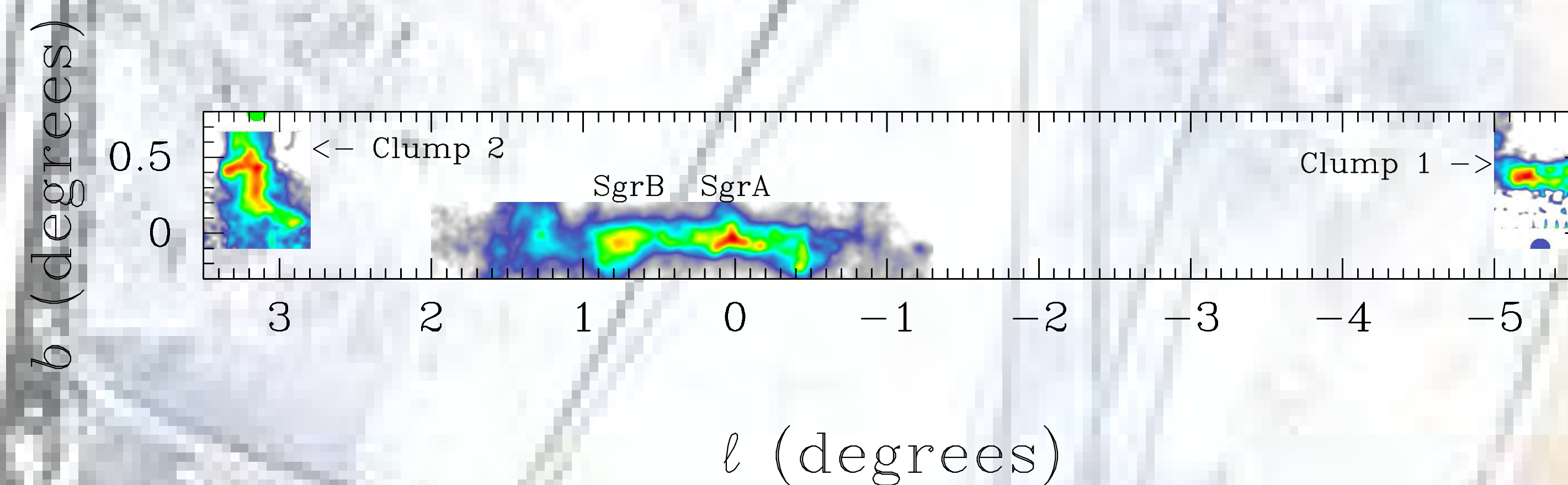
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## REFERENCES

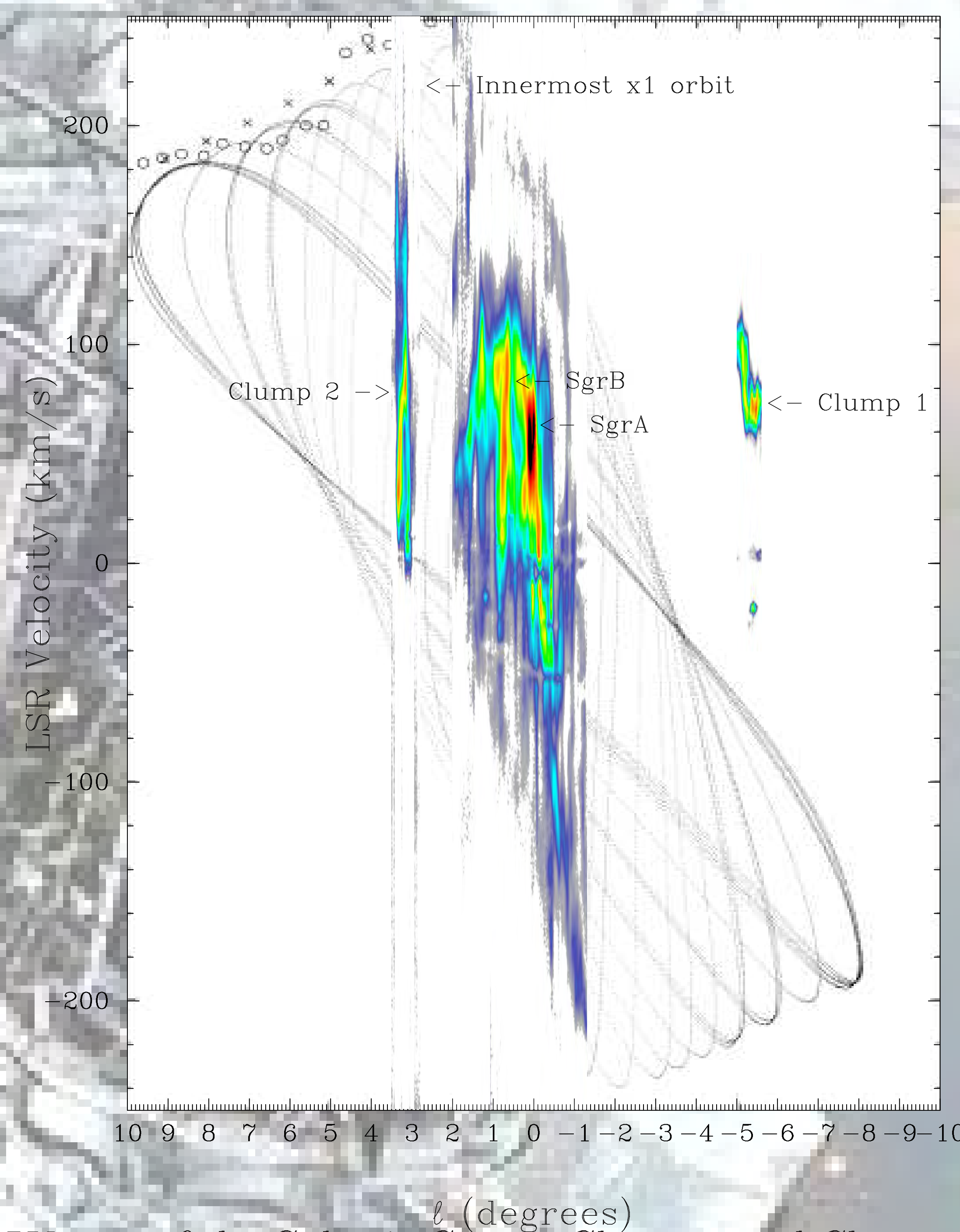
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## THE AST/RO SURVEY

To determine where to take Herschel data, the Antarctic Sub-mm Telescope Remote Observatory (AST/RO) surveys of the inner galaxy in CO  $J = 7 \rightarrow 6$ , CO  $J = 4 \rightarrow 3$ , CO  $J = 2 \rightarrow 1$ , [C I]  $^3P_1 \rightarrow ^3P_0$ , and  $^{13}\text{CO } J = 2 \rightarrow 1$  [Martin *et al.* 2004; Martin *et al.* 2008] were used. With the high- $J$  coverage provided by these surveys, particularly hot and dense regions can be identified and targeted for study using the lines made accessible by Herschel.



**Figure 1:** LB map of the Galactic Center, Clump 1, and Clump 2 regions in the CO  $J = 4 \rightarrow 3$  461 GHz transition



**Figure 2:** LV map of the Galactic Center, Clump 1, and Clump 2 regions in the CO 4-3 461 GHz transition overlaid on the LV model of [Bissantz, Englmaier, and Gerhard 2003]. Note that Clump 2 on the left lies directly along of the innermost  $x_1$  orbit, while many of the diagonal features of the inner Galactic center lie along the  $x_2$  orbits. The x's and o's in the upper left corner come from the [Bissantz, Englmaier, and Gerhard 2003] figure and indicate the extent of H I emission.

## ACKNOWLEDGMENTS

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## HIGGS GOALS

HIGGS observations of the inner galaxy gas (IGG) are central to two of the outstanding problems in galactic and extragalactic astronomy:

- the relationship between supermassive central black holes and their host galactic bulges, and
- the causes and mechanisms of starbursts.

The processes governing the evolution of central black holes and circumnuclear starbursts are closely related to the gas flows in the inner parts of galaxies. HIGGS will explore the dynamics and energetics of the IGG as a spatially-resolved laboratory specifically for evaluating the following physical processes:

- use HIFI to map the highly dense neutral and ionized component of this gas and determine its energetics,
- use HIFI's fine velocity resolution to track the dynamics of this region, and
- use PACS to trace highly energetic atomic and ionized gas and characterize the dust emission to complete the picture of the energetics.

By separating and evaluating the distinctly different roles of the central nuclear engine, the Galactic Bar, and dynamical stellar and interstellar feedback mechanisms, HIGGS will provide a high-resolution template for the physical processes in galaxy nuclei throughout the local universe, in particular those engaged in starburst activity.

## DATA REDUCTION

In order to analyze the data once it has come off the spacecraft, our group has been working on refined versions of the OTF regridding tool. We look forward to releasing this tool to the community soon.