

DIVISION H / WORKING GROUP GALACTIC CENTER

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TRIENNIAL REPORT 2015-2018

1. History and Rationale

The Galactic Center WG was created in the mid-2000s as a response to the coordination of various activities related to planning for Galactic Center international, multi-wavelength observing campaigns as well as establishing an international group of researchers for exchange of ideas related to the astrophysics of the Galactic Center. In 2012, we re-established and formalized ourselves as a WG under the Division H (Interstellar Matter and the Local Universe) with the following mission: The Working Group on the Galactic Center will serve to facilitate scientific discussion, coordinate multi-wavelength observing campaigns, and to foster collaborations in theoretical research on the central few hundred parsecs of our Galaxy. The working group represents an effort over the last two decades to keep Galactic Center astronomers in close contact and to ensure that the trend of international Galactic Center symposia held every three years remains a priority in our active community. The IAU has a long history of supporting regular IAU symposia on topics related to the Galactic Center, starting in 1986 when UCLA (USA) hosted the first Galactic Center IAU symposium, through to 1996 (Chile), 1998 (USA), 2002 (Hawaii, USA), 2006 (Germany), 2009 (China), 2013 (USA), and 2016 (Australia).

2. Developments within the past triennium

The GC working group has been active during the past triennium. Activities can be split into three parts: (1) IAU Symposium 322 in Palm Cove, Australia, (2) Multi-wavelength Observing Campaigns and Science Highlights and (3) Planning for the next IAU Symposium (Proposed 2019).

3. IAU Symposium 322: *The Multi-Messenger Astrophysics of the Galactic Centre*

Held in Palm Cove, Australia in July 2016, the meeting had more than 150 international participants, including a record number of students and junior colleagues.

Meeting highlights (taken directly from Preface of IAU 322 Proceedings, eds., Crocker, Longmore and Bicknell): From small to large scales around SgrA*, gamma-ray data continue to provide surprises and mysteries; indeed, a strong spectral signal consistent with annihilation of 10 GeV-scale WIMP dark matter particles peaking towards the Galactic Centre continues to draw attention. Yet because this is a crowded and unique environment within the Galaxy, we cannot dismiss the prospect that some hitherto underappreciated process or type of conventional source is ultimately responsible for this and other anomalous signals. One significant priority of the meeting was to facilitate direct discussion between the community of researchers working on Dark Matter interpretations of the Fermi spectral anomaly (amongst other promising signals) and those who work on understanding the conventional astrophysics of the region and much fruitful interaction occurred. One exciting achievement was to bring together different communities to start a conversation working towards the goal of a self-consistent understanding of the mass flows and energy cycles through the central regions of the Milky Way and other galaxies, from the kpc-scale mass flows from the disk through the star formation and feedback cycles, to the feeding of and feedback from the central SMBH.

4. Multi-wavelength Observing Campaigns and Science Highlights

During the last few years, there have been substantial advances in instrumentation, many of which are facilitating unprecedented views of the core of the Milky Way galaxy (and the cores of nearby galaxies). These new and upgraded instruments have been used in coordinated, international observing campaigns around significant events for SgrA* and include ALMA, the VLA (Very Large Array), the Event Horizon Telescope (EHT), the Australia Telescope Compact Array (ATCA) radio telescope, Mopra radio telescope, Hitomi (despite its short and tragic lifetime), the Submillimeter Array (SMA), and the Cherenkov Telescope Array, HESS, Chandra, Swift, FERMI-LAT, NuStar, and VERITAS. During April 2018, there is a pericenter passage of S2 around SgrA* that will to be observed by many GC astronomers using these facilities. In addition, during April 2017 and April 2018 are two major coordinated runs of the EHT with multiwavelength observing occurring at many of the facilities listed. In addition, to explore the multiple timescale variations of SgrA*, there have been several coordinated Chandra/Spitzer campaigns, which have collected 24-hour long, fully simultaneous IR and X-ray lightcurves of Sgr A*.

A few key science results include the following:

- Observations of general relativity effects near the Galactic Center supermassive black hole are becoming possible using orbits of pulsars such as the Galactic Center magnetar in the vicinity of SgrA* (G.C. Bower et al. 2015, ApJ, 798, 120).
- The gamma-ray Fermi Bubble in the galactic center has been traced by a surrounding wall of neutral hydrogen in recent 21 cm observations (Lockman & McClure Griffiths 2016, ApJ, 826, 215).
- Dynamical models of gas flows, star formation and feedback suggest the Central Molecular Ring oscillates between bursting and quiescent states (M.R. Krumholz, et al. 2016, MNRAS, 466, 1213).

5. Future Galactic Center Symposium Proposal

During 2017, conversation in the Galactic Center WG centered around planning an IAU symposium proposal submitted by Asian astronomers, Geoffrey Bower (Taiwan), Tomoharu Oka (Japan) and Takeshi Go Tsuru (Japan). The proposed symposium is entitled, "New Horizons in Galactic Center Astronomy and Beyond" to be held in Yokohama, Japan during 21 October - 25 October 2019. The rationale is as follows (from the proposal text): The Galactic Center hosts a variety of astrophysical phenomena, including the currently inactive supermassive black hole and rich signatures of past central activities. Given the advent of several state of the art national observing facilities as well as upgraded current facilities, it must be fruitful to hold an international symposium of Galactic center astronomy. The current key issues in Galactic center studies may be: (1) triggering mechanism of central activity, (2) formation process of the central supermassive black hole, (3) existence proof of the supermassive black hole at Sgr A*, (4) star formation properties in the CMZ, and (5) properties of stellar remnants and their binaries, which would be gravitational wave progenitors. These issues are common in studies of extragalactic nuclei. The goal of this symposium is to bring together researchers having wide area of expertise, to share their latest results in research, to encourage active discussion and collaboration, and thereby to explore the new horizon of Galactic center astronomy and beyond. We have assembled a geographically and scientifically diverse SOC and a reliable LOC from a number of Japanese institutions.

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chair of Working Group