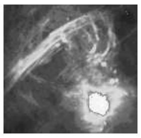
GCNEWS

The Newsletter of Galactic Center Research



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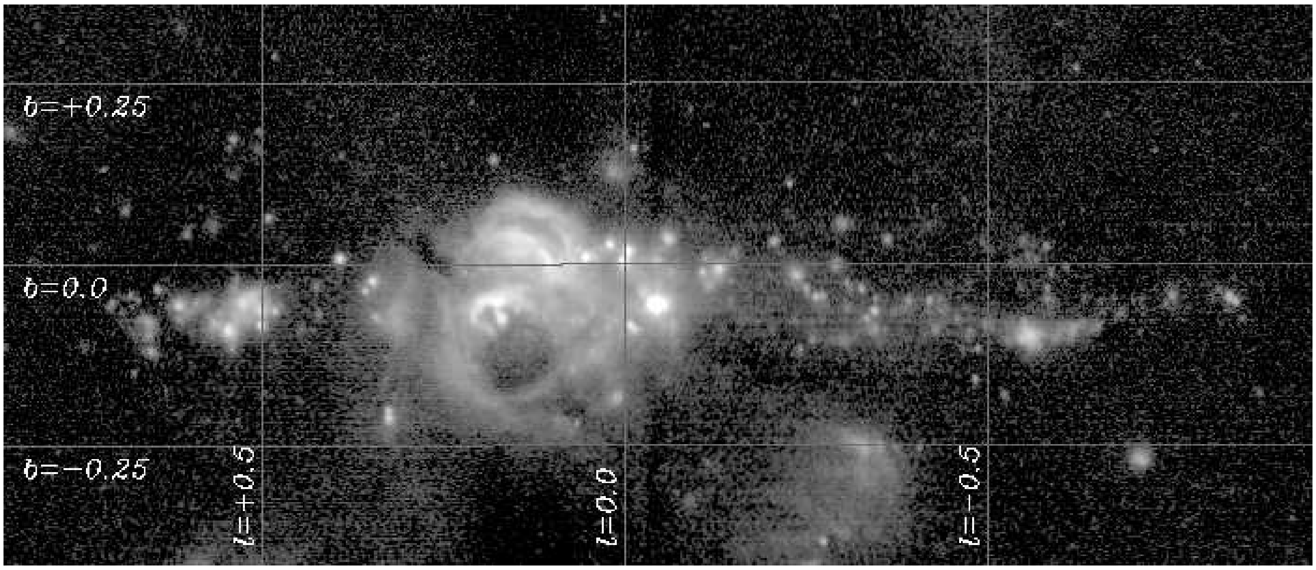

Figure 1: MSX Band E (16-26 μm) image of the Galactic Center

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Editorial: Surprises

Heino Falcke & Angela Cotera

MSX

For astronomers it is quite common to be surprised by what is "out there". Only rarely, however, are the surprises of human origin. When many of us first heard about the Midcourse Space Experiment (MSX), with its amazing mid-infrared observations of the Galactic Center, we were somewhat puzzled. Usually the development and deployment of new space telescopes and their mission objectives are widely known in the astronomical community, often decades before their launch and first light. So, we wondered was it just our ignorance of this specific mission or a general phenomenon that we were surprised by these new images? A quick, non-representative, survey of a few colleagues seemed to indicate that indeed there was a void of pre-launch information in the community. Even now, the results have not been widely discussed, as the mission results have been presented in very few articles, with many of the first results recently released in the form of BAAS abstracts. Since the primary objective of the mission is part of the SDI program (now the Ballistic Missile Defense Organization), and the project has been run by the navy, it is obvious that MSX is not your typical astronomical satellite, and understandable why the development was not widely publicized.

Neverthless, the mid-IR images available so far are quite beautiful and should be very useful in understanding the structure of the dust near the Galactic Center – especially in conjunction with other recent astronomical observations. Hence, we invited the MSX team to make one of their images, the one that best shows the complete ring of emission which contains the "Sickle", our cover image and provide our readers with an introduction to the preliminary results. Our hope is that this will stimulate wider interest in these results and lead to some new investigations, which we look forward to reporting in the future issues.

This issue

The interest in both dust and molecular gas, as two of the major areas of research in the GC, is well represented in the abstracts contained in this issue of GCNEWS. There are four abstracts on molecular line surveys by Dahmen et al. (see Fig. 2), Oka et al., and Staguhn *et al.*, and two on mid-infrared and far-infrared observations of dust and gas from the KAO by Chan et al. and Simpson *et al.* respectively. The other main topic covered in this issue is, of course, the very center itself–Sgr A* and its implications. Typical for GC research, we have a very diverse and very interesting mix.

GCNEWS – to serve and to ...

The surprises in creating and maintaining GCNEWS continue. In the last period we have found that since, in addition to the hardcopy newsletter and newsflashes we send out, all of our information is available on our webpage, we have become a clearing house for questions and problems the general public has concerning the GC. Be it a home schooler who wants to know more about a specific question which his textbooks could not answer, a freshman who is finishing an assignement and needs references for good reviews on the GC, or a journalist who urgently needs a color image for the next issue of a big German magazine, we have been available to help and, when needed, provide contact with the right persons or papers in a timely manner. Thanks to our (asymptotically?) growing subscriber list, the many references and papers already available online, and the contacts this list provides, in the course of our first year of operation, we have not only been able to meet our goal of providing a means of rapidly sharing the latest results, but we have also begun to serve the scientific interests of the public in general, a nice and welcome benefit of producing this newsletter, and another reason to continue this endeavour into our second year and beyond.

GCNEWS will be the subject of a poster (JD12-003P) at the JD 12 on electronic publishing at the upcoming IAU General Assembly in Japan. We encourage you to stop by, take a look, and share your ideas on ways we can improve the service to you, our subscribers.

Preliminary MSX Galactic Center Results

R.F. Shipman, M.P. Egan & S.D. Price *Phillips Laboratory, Geophysics Directorate, Hanscom AFB.*

The Midcourse Space Experiment (MSX) observatory is a Ballistic Missile Defense Organization project. SPIRIT III is the primary instrument for gathering long-wave infrared data during the MSX mission. It consists of an extremely high off-axis rejection telescope; a five-color, high-spatial resolution, 4.2 to 26 μm multispectral radiometer; and a six-channel, high-spectral resolution, 2.5 to 28 μmFourier transform spectrometer. The radiometer detectors are arranged in columns to cover 1 degree of the sky perpendicular to the scan direction.

Two separate Celestial experiments have observed the Galactic Center. From these, we have over 50 scans across the center from 4 to 26 μmand at 30 times the spatial resolution of IRAS. For a complete description of all the Celestial experiments see Price (1995) and Price et al. (1996).

The figure shows a 16-26 micron image of one scan across the Galactic Center. The pixels are $9''$and the image covers roughly $2{\times}0.75\,^{\circ}$. The high spatial resolution of SPIRIT III reveals many details of the Galactic Center that were not seen in earlier surveys. The image clearly shows the dust emission around Sgr A* (l=-0.06,b=-0.05) and the dust emission from the thermal radio filaments (l=+0.2,b=0). Also, for the first time a closed loop is clearly visible at l=0.2, b=-0.12. Finally, the molecular cloud core, M0.25+0.01 (Lis et al. 1994), is seen in extinction.

The high spatial resolution of SPIRIT III makes it ideal for studying the confused regions of our Galaxy. For more images and early results of MSX, please visit out Web site: http://www.mrcnh.com/msx/CB/index.htm

References

Lis D.C., Menten, K.M., Serabyn, E., Zylka, R., 1994, ApJ, 423, 39L
Price, S. D. 1995, Space Sci. Rev., 74, 81
Price, S. D. et al., 1996, IAU Symposium No. 179, Baltimore

Abstracts

Dust Compsition, Energetics, and Morphology of the Galactic Center

K.-W. Chan[1], H. Moseley[2], S. Casey[2] P. Harrington[3], E. Dwek[2], R. Loewenstein[4] F. Városi[2] and W. Glaccum[5]

(1) NASA/Ames Research Center, (2) NASA/Goddard Space Flight Center, (3) Department of Astronomy, University of Maryland, (4) Yerkes Observatory, (5) Applied Research Corp.

16 - 45 μm spectra of several regions within the central $80''$of the Galaxy have been obtained at $20''$resolution using the Goddard Cryogenic Grating Spectrometer on the Kuiper Airborne Observatory. A broad band of excess emission extending from 24 to 45 μm is present in the spectra at positions covering the 'tongue'and the inner edge of the circumnuclear disk. A similar dust emission feature has been observed in some carbon-rich evolved stars and in a nitrogen-rich evolved massive star. The observations reported here are the first ust emission feature in the interstellar medium. We find that the dust properties in the 'tongue'and the inner edge of the circumnuclear disk are different from the dust in the cavity which shows no evidence for the $\sim$30 μm feature in its spectrum. The relation between the tongue feature and the inner disk has been a subject of considerable debate, with suggestions that the tongue material is either falling in or has been expelled from the Galactic Center. Our observations suggest that if there is a physical connection between the two regions, then the tongue material is more likely falling in towards the Galactic Center. Two kinds of dust components and corresponding heating sources are argued to be responsible for the dust emission in the Galactic Center: (1) the hot dust component (140 - 300

K) heated by IRS sources which are distributed throughout the cavity; and (2) the warm dust component (60 - 90 K) heated by a He I emission line star cluster which give rise to a local interstellar radiation field that heats the dust in the central several parsecs. We find a lower limit of ~ 1 x 10^6 $L_\odot$ for the He I emission line star cluster. Finally, we find that the line of sight extinction across the cavity is not uniform. It is diminished and roughly constant in the northeastern side of the cavity, but increases to the southwestern side. Based on this result, together with the past study by Zylka et al. (1995) who found that there is a cold dust component along the line of sight to the central 30″of the Galaxy, we propose that there is a cool dust envelope with non-uniform distribution covering the cavity of the Galactic Center.

ApJ, in press

email: kwc@ssa1.arc.nasa.gov

γ-ray Emission From Advection-Dominated Accretion Flows Around Black Holes: Application to the Galactic Center

Rohan Mahadevan[1], Ramesh Narayan[1] and Julian Krolik[2]

(1) Harvard-Smithsonian Center for Astrophysics, (2) Department of Physics and Astronomy, Johns Hopkins University

We calculate the flux and spectrum of γ-rays emitted by a two-temperature advection-dominated accretion flow (ADAF) around a black hole. The γ-rays are from the decay of neutral pions produced through proton-proton collisions. We discuss both thermal and power-law distributions of proton energies and show that the γ-ray spectra in the two cases are very different. We apply the calculations to the γ-ray source, 2EG J1746-2852, detected by EGRET from the direction of the Galactic Center. We show that the flux and spectrum of this source are consistent with emission from an ADAF around the supermassive accreting black hole Sgr A*. The model uses accretion parameters within the range made likely by other considerations, and requires a power–law energy distribution of proton s. If this model is correct, it provides evidence for the presence of a two temperature plasma in Sgr A*, and predicts γ–ray fluxes from other accreting black holes which could be observed with more sensitive detectors.

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email: rohan@cfata5.harvard.edu

Molecular Gas in the Galactic Center Region I. Data from a Large Scale $C^{18}O(J=1\rightarrow 0)$ Survey

G. Dahmen[1,4], S. Hüttemeister[2,1,5], T.L. Wilson[1], R. Mauersberger[6,1], A. Linhart[1], L. Bronfman[3], A.R. Tieftrunk[1,7], K. Meyer[1], W. Wiedenhöver[1], T.M. Dame[2], E.S. Palmer[2], J. May[3], J. Aparici[3] & F. Mac-Auliffe[3,7]

(1) Max-Planck-Institut für Radioastronomie, Bonn, (2) Harvard-Smithsonian Center for Astrophysics, (3) Departamento de Astronomía, Universidad de Chile, (4) Physics Department, Queen Mary & Westfield College, University of London, (5) Radioastronomisches Institut, Universität Bonn, (6) Steward Observatory, University of Arizona, (7) Swedish-ESO Submillimetre Telescope, European Southern Observatory

A large scale survey of the Galactic center region in the $C^{18}O(J=1\rightarrow 0)$ transition is presented. This survey was obtained with the 1.2 m Southern Millimeter-Wave Telescope (SMWT) at the Cerro Tololo Interamerican Observatory (CTIO) near La Serena, Chile. It covers the region $-1°05 \lesssim l \lesssim +3°6$ and $-0°9 \lesssim b \lesssim +0°75$ with a grid spacing of 9′, i.e. the sampling is at full FWHP beamwidth. 357 positions were in total observed. After reviewing the instrumentation of the 1.2 m SMWT, the observing techniques, and the methods used in the data reduction, the data of the survey are presented and morphologically described. In addition, data of the $HNCO(5_{0,5}$–$4_{0,4})$ line are presented, which was also included in the large bandwidth of the spectrometer. $^{12}CO(1$–$0)$ measurements performed for comparison purposes are presented and compared with other ^{12}CO results. The maps of the $C^{18}O(1$–$0)$ survey demonstrate that there are great differences between the distribution of the optically thin $C^{18}O(1$–$0)$ emission and the usually optically thick $^{12}CO(1$–$0)$ emission.

A&AS in press

email: G.Dahmen@qmw.ac.uk

Molecular Gas in the Galactic Center Region II. The Large Scale Structure and Physics based on a $C^{18}O(J = 1 \rightarrow 0)$ Survey

G. Dahmen[1,3], *S. Hüttemeister*[1,2,4], *& T.L. Wilson*[1]

(1) Max-Planck-Institut für Radioastronomie, Bonn, (2) Harvard-Smithsonian Center for Astrophysics, (3) Physics Department, Queen Mary & Westfield College, University of London, (4) Radioastronomisches Institut, Universität Bonn

The large scale structure and physics of molecular gas in the Galactic center region is discussed based on the detailed analysis of a 9′ resolution survey of the Galactic center region in the $J = 1 \rightarrow 0$ line of $C^{18}O$. Emphasis is placed on the comparison with ^{12}CO(1–0) data. The line shapes of $C^{18}O$(1–0) and ^{12}CO(1–0) differ significantly. The ratio of the intensities of the two isotopomers in the Galactic center region is generally higher than the value of $\sim$ 15 expected from the "Standard Conversion Factor" (SCF) of ^{12}CO integrated line intensity to H_2 column density. In the 9′-beam, this ratio is in the range from 30 to 200, mostly $\sim$ 60 to 80. From LVG calculations, we estimate that the large scale ^{12}CO(1–0) emission in the Galactic center region is of moderate ($\tau \gtrsim 1$) or low optical depth ($\tau < 1$). Higher optical depths ($\tau \geq 10$) are restricted to very limited regions such as Sgr B2. In addition, we estimate H_2 densities and kinetic temperatures for different ranges of intensity ratios. A considerable amount of molecular mass is in a widespread molecular gas component with low densities and high kinetic temperatures. From our $C^{18}O$ measurements and from results based on dust measurements, the total molecular mass is found to be $(3^{+2}_{-1}) \cdot 10^7$ $M_\odot$. We show that the SCF is *not* valid toward the Galactic bulge. It overestimates the H_2 column density by an order of magnitude because the assumptions required for this factor of optically thick ^{12}CO emission and virialization of the molecular clouds are not fulfilled for a significant fraction of the molecular gas. Therefore, one can also not apply a modified conversion factor to the Galactic center region since the ^{12}CO luminosity is not directly related to the H_2 mass. A comparison with results from bulge regions of external galaxies indicates that the ^{12}CO emission is generally not a suitable tracer of H_2 masses in the central regions of galaxies.

submitted to A&A

email:G.Dahmen@qmw.ac.uk
www-star.qmw.ac.uk/~dahmen/C18O_Paper_II.html

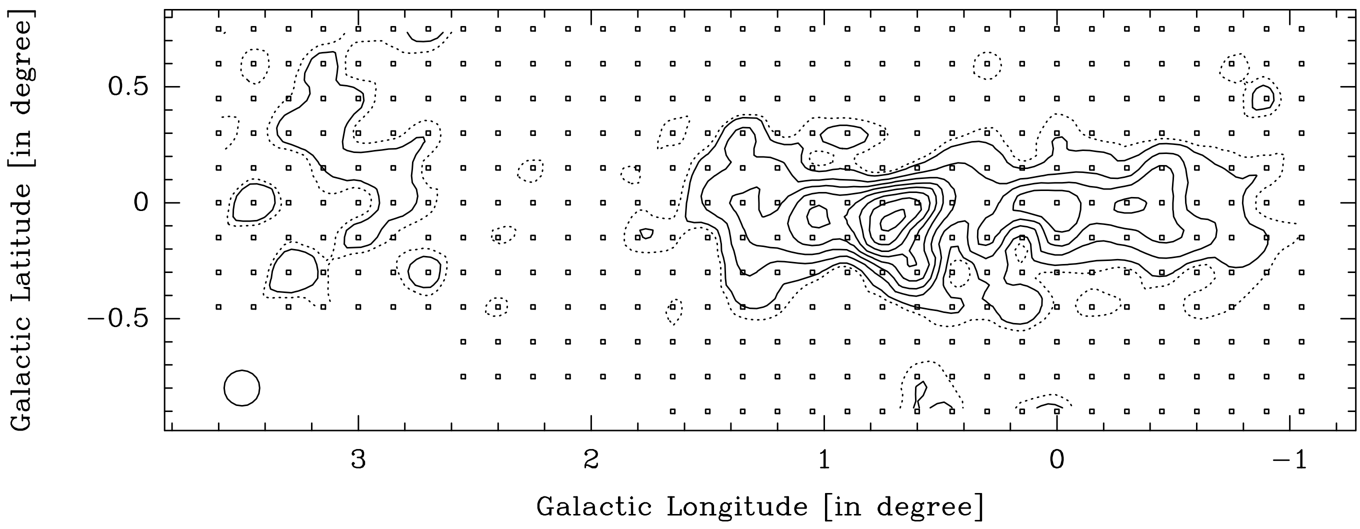

Figure 2: Integrated Intensity of $C^{18}O(1 \rightarrow 0)$ in T_{MB}, velocity range from −225.0 to +225.0 km/s, contour levels are from 3.9 to 28.05 in steps of 3.45 K m/s. (from Dahmen et al.)

CO (J=2-1) Line Observations of the Galactic Center Molecular Cloud Complex. II. Dynamical Structure and Physical Conditions

Tomoharu Oka [1,2], *Tetsuo Hasegawa* [3], *Masahiko Hayashi*[4,2], *Toshihiro Handa* [3], *& Seiichi Sakamoto*[5]

(1) Cosmic Radiation Laboratory, The Institute of Physical and Chemical Research (RIKEN), Japan (2) Department of Astronomy, Faculty of Science, University of Tokyo, (3) Institute of Astronomy, Faculty of Science, University of Tokyo, (4) National Astronomical Observatory, Tokyo, (5) Nobeyama Radio Observatory, Japan

A large scale $^{12}C^{16}O$ (J=2-1) survey of the inner a few hundred parsecs of the Galaxy has been conducted using the University of Tokyo-Nobeyama Radio Observatory 60 cm survey telescope. We have taken about 700 $^{12}C^{16}O$ (J=2-1) spectra in the region $-2.5° \lesssim l \lesssim 2.5°$ and $|b| \lesssim 1°$ with 0.125 deg grid spacing, covering the entire region of the huge molecular cloud complex in the Galactic center. We refer to the CO (J=1-0) data taken with the Columbia 1.2 m telescope and calculate the J=2-1 to J=1-0 intensity ratio. Velocity channel maps and longitude-velocity maps of CO (J=2-1) line are presented with corresponding maps of (J=2-1)/(J=1-0) intensity ratio. Large scale CO maps enable us to identify several giant molecular cloud complexes and many characteristic features of molecular gas. We identify 15 molecular cloud complexes larger than ~30 pc in our CO (J=2-1) data. Their virial masses are at least an order of magnitude larger than the masses estimated from the CO luminosity. This discrepancy can be removed if we notice that they may not be gravitationally bound but be in pressure equilibrium with the hot gas and/or magnetic field in this region. Using the expressions of virial mass and CO mass for a cloud in pressure equilibrium case, we get the X-factor for the Galactic center molecular clouds as $X = 0.1\times10^{20}$ cm^{-2} (K km s^{-1})$^{-1}$, which is an order of magnitude lower than that in the Galactic disk ($X0 = 3.0\times10^{20}$ cm^{-2} (K km s^{-1})$^{-1}$). We estimate the total molecular mass in the Galactic center as $M(H_2) = 1\times10^7\ M_\odot$ as a lower limit; the actual total gas mass within the central 400 pc of the Galaxy must be $M(H_2) = (1\text{-}6)\times10^7\ M_\odot$. We diagnose the physical conditions of the molecular gas in the Galactic center using the intensity ratio between the J=2-1 and J=1-0 lines. Although the CO (J=2-1)/(J=1-0) line intensity ratio is high (~0.74) in the midplane, molecular gas at $|b| > 0.25°$ exhibits low (J=2-1)/(J=1-0) ratios (~0.6). The overall (J=2-1)/(J=1-0) luminosity ratio is $R(2\text{-}1)/(1\text{-}0) = 0.64 \pm 0.01$ if we include all the emission within $|b| \lesssim 1°$, $-2.5° \lesssim l \lesssim 2.5°$, and $|VLSR| \lesssim 150$ km s^{-1}. This indicates that low density gas $\gtrsim 50$ pc away from the plane dominates the total CO luminosity of the central 400 parsecs of the Galaxy. The fractional distribution of the molecular gas with R(2-1)/(1-0) for each cloud complex clearly demonstrates the close relationship between the gas with very high ratio (R(2-1)/(1-0) $\gtrsim 1.0$) and associated UV sources.

ApJ in press
email: oka@postman.riken.go.jp

Non-Acceleration of Sgr A*: Implications for Galactic Structure

Andrew Gould & Solange Ramirez

Ohio State University

We show that observations by Backer and collaborators over the past two decades constrain the time derivative of the proper motion of Sgr A* to be less than 0.14 mas yr^{-2}. Using this result and a preliminary measurement by Eckart and Genzel of sigma ~500 km s^{-1} for the velocity dispersion of the star cluster within 0.2″ of Sgr A*, we derive the following implications. First, if the nuclear star cluster is dominated by a massive black hole, then either Sgr A* is that black hole or it orbits the black hole with a radius less than 3 AU. Second, even if the star cluster does not contain a massive black hole, Sgr A* is constrained to move slower than 20 km s^{-1} (1σ) relative to the center of mass of the cluster. The Galactocentric distance is therefore $R_0 = 7.5 \pm 0.7$ kpc, independent of the nature of Sgr A*. These error bars could be substantially reduced by future observations. If they are, it will also be possible to probe the motion of the nuclear star cluster relative to the center of mass of the Galaxy at the ~4 km s^{-1} level.

submitted to ApJ
email:gould@astronomy.ohio-state.edu
xxx.lanl.gov/abs/astro-ph/9705174

Advection-Dominated Accretion Model of Sgr A*: Evidence for a Black Hole at the Galactic Center

Ramesh Narayan, Rohan Mahadevan, Jonathan E. Grindlay, Robert G. Popham, & Charles Gammie

Harvard-Smithsonian Center for Astrophysics

Sgr A* at the Galactic Center is a puzzling source. It has a mass M = $(2.5 \pm 0.4) \times 10^6$ M$_\odot$ which makes it an excellent black hole candidate. Observations of stellar winds and other gas flows in its vicinity suggest a mass accretion rate $\dot{M} \gtrsim$ few $\times 10^{-6}$ M$_\odot$ yr^{-1}. However, such an accretion rate would imply a luminosity $> 10^{40}$ erg s^{-1} if the radiative efficiency is the usual 10%, whereas observations indicate a bolometric luminosity $< 10^{37}$ erg s^{-1}. The spectrum of Sgr A* is unusual, with emission extending over many decades of wavelength. We present a model of Sgr A* which is based on a two-temperature optically-thin advection-dominated accretion flow. The model is consistent with the estimated M and $\dot{M}$, and it fits the observed fluxes in the radio and X-ray bands as well as measured upper limits in the submillimeter and infrared bands. The model explains the very low luminosity of Sgr A* by invoking advection. Most of the viscously dissipated energy is carried into the central star by the accreting gas, and therefore the radiative efficiency is extremely low, $\sim 5 \times 10^{-6}$. A critical element of the model is the presence of an event horizon at the center. The success of the model may thus be viewed as confirmation that Sgr A* is a black hole.

submitted to ApJ
email:rohan@kailash.harvard.edu
xxx.lanl.gov/abs/astro-ph/9706112

Colliding Windsin the Stellar Core at the Galactic Center: Some Implications

Leonid M. Ozernoy[1,2], Reinhard Genzel[3], & Vladimir V. Usov[4]

(1) Computational Sciences Institute and Department of Physics & Astronomy, George Mason U., (2) Laboratory for Astronomy and Solar Physics, Goddard Space Flight Center, (3) Max-Planck-Institut für Extraterrestrische Physik, Garching, (4) Department of Physics, Weizmann Institute, Israel

We point out that a high number density of stars in the core of a dense star cluster such as the central stellar cluster at the Galactic center, where many stars possess strong stellar winds, should result in collisions of those winds. The wind collisions in the dense stellar core at the Galactic center would result in production of strong X-ray flares with the rate of $\sim 10^{-4}$ $(N_w/10^3)^2$ yr^{-1} and duration of ~ 1 week, where N_w is the number of the wind producing stars in the core. Presence of a massive black hole would enhance the stellar density around it and would make collisions of the winds in the core substantially more frequent. Collisions of the stellar winds in the cluster have also a number of interesting observable implications, including generation of γ-rays by particles accelerated by the shocks from the colliding winds. These processes are also expected to be relevant to compact regions of intense star formation elsewhere.

MNRAS in press
email:ozernoy@hubble.gmu.edu
xxx.lanl.gov/abs/astro-ph/9706196

Sgr A* and Company - Multiwavelength observations of Sgr A* and VLA search of "Sgr A*'s "in LINERs

H. Falcke[1,2], W.M. Goss[3], L.C. Ho[4], H. Matsuo[5], P. Teuben[1], A.S. Wilson[1], J.-H. Zhao[4], & R. Zylka[2,6]

(1) Dept. Astronomy, University of Maryland, (2) Max-Planck-Institut für Radioastronomie, Bonn, (3) NRAO, Socorro, (4) Harvard/CfA , (5) NRO/Japan, (6) ITA Heidelberg

We report first results from a multiwavelength campaign to measure the simultaneous spectrum of Sgr A* from cm to mm wavelengths. The observations confirm that the previously detected submm-excess is not due to variability; the presence of an ultracompact component with a size of a few Schwarzschild radii is inferred. In a VLA survey of LINER galaxies, we found Sgr A*-like nuclei in one quarter of the galaxies searched, suggesting a link between those low-power AGN and the Galactic Center.

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email:hfalcke@mpifr-bonn.mpg.de
www.astro.umd.edu/~hfalcke/publications.html#iauc164
xxx.lanl.gov/abs/astro-ph/9706196

Observational constraints on annihilation sites in 1E 1740.7–2942 and Nova Muscae

Igor V. Moskalenko[1] *and Elisabeth Jourdain*[2]

(1) Max-Planck-Institut für extraterrestrische Physik, Garching, (2) Centre d'Etude Spatiale des Rayonnements, France

The region of the Galactic center contains several sources which demonstrate their activity at various wavelengths and particularly above several hundred keV. Escape of positrons from such a source or several sources into the interstellar medium, where they slow down and annihilate, can account for the 511 keV narrow line observed from this direction. 1E 1740.7–2942 object has been proposed as the most likely candidate to be responsible for this variable source of positrons. Besides, Nova Muscae shows a spectrum which is consistent with Comptonization by a thermal plasma $kT_e \lesssim 100$ keV in its hard X-ray part, while a relatively narrow annihilation line observed by SIGMA on Jan. 20–21, 1991 implies that positrons annihilate in a much colder medium. We estimate the electron number density and the size of the emitting regions suggesting that annihilation features observed by SIGMA from Nova Muscae and 1E 1740.7–2942 are due to the positron slowing down and annihilation in thermal plasma. We show that in the case of Nova Muscae the observed radiation is coming from a pair plasma stream ($n_{e^+} \approx n_{e^-}$) rather than from a gas cloud. We argue that two models are probably relevant to the 1E source: annihilation in (hydrogen) plasma $n_{e^+} \lesssim n_{e^-}$ at rest, and annihilation in the pair plasma stream, which involves matter from the source environment.

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email:imos@mpe-garching.mpg.de
xxx.lanl.gov/abs/astro-ph/9706283

A new sample of OH/IR stars in the Galactic center

Loránt Sjouwerman[1,2], *Huib Jan van Langevelde*[3], *Anders Winnberg*[1] *& Harm J. Habing*[2]

(1) Onsala Rymdobservatorium, Sweden, (2) Sterrewacht Leiden, The Netherlands, (3) Joint Institute for VLBI in Europe

Two independent, largely overlapping 1612 MHz data sets were searched for OH/IR stars in the Galactic center. One set, taken with the Very Large Array in the period 1988 to 1991, consists of 17 epochs monitoring data of Van Langevelde et al. (1993). The other set was observed in 1994, using the Australia Telescope Compact Array. This article describes the data reduction procedures as well as a different way of searching image cubes for narrow line sources, and lists a total of 155 double peak OH maser detections within 18′ or 40 projected parsecs of Sagittarius A*, the compact radio continuum source in the Galactic nucleus. Presented are 65 formerly unseen double peaked 1612 MHz emitters, of which 52 are OH/IR stars. Also given are 3 single peak sources, which we believe to be masers of OH/IR stars. Apart from being less bright in their 1612 MHz OH maser line, the previously unknown OH/IR stars do not seem to be different from the previously known population of OH/IR stars in the Galactic center. We find that the OH/IR star OH maser luminosity distribution peaks at $L_{OH} \approx 10^{43.4}$ photons per second. Further physical and kinematical analysis of the new sample will be presented in additional papers. (Figures 4 and 5 are only published electronically at CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5), or via the WWW at http://cdsweb.u-strasbg.fr/Abstract.html. Tables 2 and 3 are also available in electronic form at CDS.)

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email:sjouwerm@sigyn.oso.chalmers.se
ftp://sigyn.oso.chalmers.se/pub/Lorant/ohsurvey_all.ps.gz

Infrared Observations of G0.18−0.04

Janet P. Simpson[1,2], *Sean W. J. Colgan*[1,2], *Angela S. Cotera*[3], *Edwin F. Erickson*[1], *Michael R. Haas*[1], *Mark Morris*[4], *& Robert H. Rubin*[1,5]

(1)NASA/Ames Research Center, (2) SETI Institute, (3)Jet Propulsion Laboratory, (4) UCLA, Dept. of Physics and Astronomy, (5) Orion Enterprises

The Galactic Center H II region, G0.18−0.04, also known as the "Sickle", is located where the nonthermal "Arc"crosses the Galactic plane. The Sickle appears to be the ionized edge of a dense molecular cloud. The source of ionization has been ascribed to both the interaction of the cloud with the magnetic field of the Arc and to the hot stars in the adjacent cluster, AFGL 2004, also known as the "Quintuplet Cluster". This paper addresses the relative locations of the stars, the ionized and molecular gas, and the sources of gas excitation and dust heating.

The far-infrared forbidden lines of [S III] 18.7 and 33.5 μm, [Si II] 34.8 μm, [Ne III] 36.0 μm, [O III] 51.8 and 88.4 μm, [N III] 57.3 μm, [O I] 63.2 and 146 μm, [C II] 158 μm, and [N II] 205 μm and the adjacent continua were observed with NASA's Kuiper Airborne Observatory at 11 positions around G0.18−0.04, including G0.15−0.05, also known as the "Pistol". The beam size was $40'' - 60''$. The electron density, the ionic abundances, and the ionization structure of the H II region were estimated from the doubly ionized line fluxes. The density and radiation field found in the photodissociation region (PDR) between the H II region and the molecular cloud were estimated from the [C II] and [O I] line fluxes and the far-infrared continuum. The ionization structure and the PDR properties were compared to shell models of H II regions with varying distances from their exciting stars. The agreement of observations and models indicates that the hot stars of AFGL 2004 are the likely source of ionization of the Sickle. Additional hot stars are necessary to ionize the more outlying positions. However, the low ionization and high PDR radiation field of the Pistol imply that it cannot be as close to AFGL 2004 as is indicated by its proximity on the sky. Instead, the Pistol is probably ionized by the luminous blue variable candidate, Pistol Source A.

The extinction to the region was estimated from the IRAS low resolution spectrum of AFGL 2004 and from the distribution of the J, H, and K′ magnitudes of previously observed stars in the field. The extinction is fairly uniform, with no apparent enhancement due to the molecular clouds. The strength of Brackett γ, the 19 μm lines and continuum, and the IRAS 25 μm continuum are all consistent with the absence of a dense, foreground molecular cloud. We conclude that the H II region is on the near side of the dense cloud.

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email:simpson@cygnus.arc.nasa.gov

Observations of [C I] and CO Absorption in Cold, Low Density Cloud Material Towards the Galactic Center Broad Line Emission

J. Staguhn[1], *J. Stutzki*[1], *R. A. Chamberlin*[2,3], *S. P. Balm*[4,5], *A. A. Stark*[4], *A. P. Lane*[4], *R. Schieder*[1], *& G. Winnewisser*[1]

(1) Universität zu Köln, I. Physikalisches Institut, (2) Astronomy Department, Boston University, (3) California Institute of Technology, Sumbmillimeter Observatory, (4) Havard–Smithsonian Center for Astrophysics, (5) Department of Physics and Astronomy, UCLA

We report the detection of a deep $^3P_1 \rightarrow {}^3P_0$ [C I] absorption feature at $v_{lsr} = 12$ km s^{-1} with a linewidth of 6 km s^{-1} towards extended line emission at a distance of $11'$ from Sgr C. The 492 GHz observations were made with the Antarctic Submillimeter Telescope and Remote Observatory (AST/RO). The absorption feature allows the derivation of lower limits for the CI column density in the cold foreground material. The feature is unlikely to be caused by self-absorption within the [CI] emitting cloud because it is observed over a region at least $4'$ across and is also seen in emission $22'$ north of the Galactic plane in ^{12}CO J=2–1. In order to determine the temperature and the abundance ratio of CI to CO in the foreground gas, we compare the observations with ^{12}CO and ^{13}CO J=1–0 observations obtained with the Bell Labs 7 m antenna and with ^{12}CO and ^{13}CO J=2–1 observations made with the KOSMA 3 m telescope. All these observations have about the same beam size. On the assumption that the background emission is not spatially associated with the absorbing cloud(s), a consistent model for the observed line intensities yields an excitation temperature of 3.5 K for ^{13}CO and 5 K for [CI], implying low volume densities $n(H_2) \lesssim 10^3$ cm^{-3}. The measured abundance ratio of CI to ^{13}CO is ~ 34. This value is consistent with photochemical model calculations which predict an abundance ratio of CI to ^{12}CO of $\sim$1 and a ^{12}CO to ^{13}CO ratio of $\sim$30 (reduced in comparison to the intrinsic ^{12}C to ^{13}C isotopic ratio of 60 by fractionation). The observed ^{13}CO column density corresponds to an A_V of 4.6^m, i.e., the hydrogen column density N(H) is $\sim 9 \times 10^{21}$ cm^{-2}. This, together with the observed [CI] linewidth, indicates that the absorption is likely due to several translucent clouds. We compare our results with line fluxes derived from the large-scale, low resolution COBE FIRAS spectral line survey of [CI] ^{3}P$_1$ $\rightarrow$ ^{3}P$_0$ and [CI] ^{3}P$_1$ $\rightarrow$ ^{3}P$_1$ emission in the galactic plane. Taking into account beam filling, the *lower limit* for the column density of cold ($T_{ex} \leq 10$ K) CI which is traced by our absorption observations is at least a factor of two higher than the column density of the warmer CI ($T_{ex} \geq 20$ K) detected in emission by COBE. Our results suggest that a substantial fraction of atomic carbon in the interstellar medium may be difficult to detect in [CI] emission, due to its low excitation.

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email:staguhn@Newton.ph1.Uni-Koeln.DE
http://www.ph1.uni-koeln.de/ staguhn

The Origin of the High-Energy Activity at the Galactic Center

Farhad Yusef-Zadeh[1], *William Purcell*[1], *& Eric Gotthelf*[2]

(1) Dept. Physics and Astronomy, Northwestern University,
(2) NASA/GSFC

Recent X-ray and gamma-ray observations of the Galactic center region by the ASCA and CGRO/EGRET instruments show evidence of 2–10 keV and > 1 GeV continuum emission as well as 6.7 and 6.4 keV line emission from the inner 0.2° of the Galactic center. This region is also known to host a bright nonthermal radio continuum source Sgr A East and a dense molecular cloud M–0.02–0.07 known as the 50 km s^{-1} cloud. The oval-shaped nonthermal Sgr A East is physically interacting with M–0.02–0.07 at the Galactic center. A comparison between the distribution of ionized, synchrotron and neutral gas suggests a self-consistent interpretation of the high-energy activity at the Galactic center. Our preliminary analysis of the data suggest a shock model of cosmic ray acceleration at the site of the interaction to explain the enhanced GeV γ-ray emission. We also address a number of issues related to the spatial correlation of the diffuse radio and X-ray emitting gas as well as to the origin of the fluorescent 6.4 and 6.7 keV emission at the Galactic center.

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email:zadeh@ossenu.astro.nwu.edu
www.astro.nwu.edu/astro/faculty/farhad/papers.html

Announcements

- **Deadline:** July 15 is the deadline of registration by WWW/E-mail/FAX/Mail for the IAU meeting in Kyoto, Japan. The Final Program will be available by the end of the next week.
- The call for proposals for HST Cycle 7-NICMOS (only), has been issued. The deadline is September 5, 1997.
- **Deadline:** The tentative deadline to insure your abstract is included in GCNEWS Volume 6 is October 3, 1997.
- Note that one of the editors, Heino Falcke, has moved to Germany. His new address can be found on the back of this issue. The Internet addresses of GCNEWS have not changed.

Preliminary Time Table of Oral Sessions

IAU Symposium No. 184
THE CENTRAL REGIONS OF THE GALAXY AND GALAXIES
1997 Aug 18-22, Kyoto Japan

R: Review (25 min),
I: Invited/highlight talk (15 min),
C: Contributed talk (10 min)

Monday, August 18, afternoon: Session 1:

14:00 Introductory Talk: *Mark Morris (UCLA)*

(1) STELLAR CLUSTERS AND STAR FORMATION

(1.1) Galatic Bulges

14:15 **R:** Chemical Evolution of Galactic Bulges: *M. Rich, (Columbia U, USA)*
14:40 **C:** The Stellar Population of M31 bulge: field and star clusters: *P. Jablonka (Paris-Meudon, Fr)*
14:50 **C:** First Stellar Iron Abundance Measurements in the Galactic Center: *K. Sellgren (OSU), J. S. Carr (NRL), S. Balachandran (UMd)*
15:00 **C:** Miras as Probes of the Galactic Bulge: *Shaun M.G. Hughes (Cambridge, U.K.)*
15:10 **C:** SiO Maser sources in the Galactci Bulge: *Shuji Deguchi, JAPAN*
15:20 **C:** Are the galactic bulge and bar the same? *Y.K. Ng, ITALY*
15:30 **C:** Secular Dynamical Evolution of Spiral Galaxies and the Formation of Galactic Bulges: *Xiaolei Zhang, CfA USA*

. . . . COFFEE BREAK 15:40 - 16:10 . . . .

(1.2) Galatic Center Star Clusters

16:10 **I:** ISOCAM CVF observations of the Quintuplet and Object#17 clusters near the Galactic Center: *Tetsuya Nagata (Nagoya), K. Kawara, T. Onaka, Y. Kitamura, & H. Okuda*
16:25 **I:** The Stellar Content in the Quintuplet Cluster: *Donald F. Figer, USA*
16:40 **C:** Observations of the Galactic Center Region with ISO.*Sabine Philipp and Robert Zylka (Bonn)*
16:50 **C:** Collisional stellar dynamics around a central galactic black hole*Marc Freitag and Willy Benz (Geneve)*
17:00 **C:** Stellar Mg Abundances at the Galactic Center : *Solange Ramirez, Kristen Sellgren, John Carr,Suchitra Balachandran, Robert Blum, Donald Terndrup (Ohio, USA)*
17:10 **C:** Resolved 3.6mu survey of the Inner Galaxy: *M.Unavane, G.Gilmore (Cambridge UK)*

Tuesday August 19, morning: Session 2:

(1.3) Star formation and Starbursts

9:00 **I:** Star Formation at the Galactic Center and its Long-term Effect on the Stellar Population: *E. Serabyn, (CalTech, USA)*
9:15 **I:** Starbursts, Inhibited Star Formation, and Evolutionary Trends for Molecular Gas Distributions in Circumnuclear Regions: *Jeff Kenney (Yale University)*
9:30 **I:** ISO spectroscopy of the Galactic Center and Starburst Nuclei: *Dieter Lutz (MPE, FRG)*
9:45 **I:** Circumnuclear regions of active and non-active barred galaxies: *J.H. Knapen (Uni Hertfordshire, UK)*

10:00 **C:** ISO SWS spectroscopy of Active Galactic Nuclei: *Eiichi Egami (MPE, Germany)*

10:10 **C:** The Nuclear Region of NGC 1068 the stellar cluster and hot dust emission.: *Niranjan Thatte (MPE, Germany)*

10:20 **C:** Evidence for spiraling massive star formation in the nucleus ofan active galaxy: NGC4303: *L. Colina, STScI*

. . . . COFFEE BREAK : 10:30 - 11:00 . . . .

11:00 **C:** High-resolution ISOCAM view of nuclear and circumnuclear starburstsin barred galaxies: *H. Wozniak (Marseil), D. Friedli, L. Martinet, and D. Pfenniger*

11:10 **C:** A turning point in AGN Variability Studies: *Marie-Helene Ulrich*

11:20 **C:** Diffraction-limited IR Speckle Masking Observations of the Central Regions of Seyfert Galaxies: *M. Wittkowski (Bonn), Y. Balega, T.Beckert, W.J. chl, K.-H. Hofmann, G. Weigelt*

11:30 **C:** Are the stellar populations in starbursts, LINERs and Seyfert milar?: *Monique Joly, (Meudon, France)*

11:40 **C:** 30 Doradus - the Starburst Nucleus of the Large Magellanic s ?: *M.D. Filipovic (Sydney, Au), M. Costa, R.F. Haynes, J. Dickel, D. Milne, W. Pietsch, G.L. White, J.S. Lazendic and P.A. Jones*

11:50 **C:** Intranight variability of NGC 1275 nucleus in optics implying s central activity: *I.I.Pronik, N.I.Merkulova, L.P.Metik (Crimea)*

Tuesday, August 19, afternoon: Session 3:

(2) NUCLEAR INTERSTELLAR MEDIUM

(2.1) Neutral ISM in the Galactic Center

14:00 **R:** Radio Continuum and Molecular Gas in the GC: *Yoshiaki Sofue, Japan*

14:25 **I:** The Galactic Center filled with Molecular Shells: *Masato Tsuboi (Ibaraki Uni)*

14:40 **C:** A Large-Scale CO Imaging of the Galactic Center with the Nobeyama45-m Telescope - Shell Statistics and Star Formation History: *Tetsuo Hasegawa (U.Tokyo), Tomoharu Oka, Fumio Sato, Masato Tsuboi, Atsushi Miyazaki, and Hideto Yamasaki*

14:50 **C:** The Sagittarius C region mapped in CS (2-1), (3-2) and 13CO(2-1) with the IRAM 30m telescope : *C. Kramer (Koeln), J. Staguhn, H. Ungerechts, A. Sievers*

15:00 **C:** Large Scale Observations of the Far-Infrared [CII] Line Emission from the Galactic Center : *T. Nakagawa (ISAS), H. Okuda, H. Shibai, Y. Y. Yui, Y. Doi, K. Mochizuki, T. Nishimura, and F. J. Low*

15:10 **C:** Sub-mm [CI] and CO observations of two Galactic center molecular cloud interacting with the G359.54+0.18 Nonthermal Filaments: *Johannes Staguhn et al. (Koeln)*

15:20 **C:** Structure of the Molecular Cloud and Star-Formation Activity in the Sagittarius B2 Region: *J. B. Whiteoak (Australia Telescope), T. Hasegawa, F. Sato, and R. Miyawaki*

. . . . COFFEE BREAK : 15:30 - 16:00 . . . .

(2.2) Molecular Gas in Nuclei of Galaxies

16:00 **R:** Molecular gas in the nuclei of luminous IR galaxies : *Nick Scoville, USA*

16:25 **I:** The BIMA Survey of Seyfert Nuclei: *Leo Blitz (Berkeley, USA)*

16:40 **I:** Dense Molecular Gas in the Circumnuclear Regions of AGN: *Linda Tacconi (MPE, FRG), Downes, Eckart, Gallimore, Genzel, Schinnerer, Sternberg, Tacconi-Garman*

16:55 **I:** Molecular Gas and Nuclear Outflow: *J. A. Irwin (Queen's Uni, Canada)*

17:10 **I:** The centers of ultraluminous IR galaxies at sub-arcsecond Resolutionin CO and the millimeter continuum: *D. Downes (IRAM, France)*

17:20 **I:** CO(1-0) Imaging Survey of the Central Regions of Nearby Spiral Galaxies: *Kazushi Sakamoto (Nobayama), Sachiko Okumura, Sumio Ishizuki, and Nick Scoville*

17:30 **C:** New high-resolution observations of molecular gas towards the nuclei of spiral galaxies : *Santiago Garcia-Burillo., (OAN,SPAIN)*

17:40 **C:** The detection of a gas rich bar in the interacting galaxy UGC 2855 : *S. Huettemeister(Bonn), S. Aalto and W. Wall*

Wednesday, August 20, morning: Session 4:

(2.3) Gas dynamics in the Galactic center

9:00 **R:** Nonaxisymmetric Gas Dynamics in the Galactic Center : *Combes, Francoise, France*

9:25 **I:** Efficiency in Nuclear Fueling : *M. Noguchi (Tohoku Univ)*

9:40 **I:** Physical Conditions of the Gas in the Center of the Nearby Spiral Galaxy IC 342 : *Jean L. Turner (UCLA, USA)*

9:55 **I:** Formation and Evolution of Nuclear Gaseous Bars : *Daniel Friedli (Quebec, Canada)*

10:10 **C:** Old and New Evolution Channels in Stellar Bar : *D. Pfenniger (Geneva)*

10:20 **C:** Hydrodynamical simulation as a probe for galactic structure : *Keiichi Wada (Hokkaido U, Japan)*

10:30 **C:** Structure and dynamics of the inner Galaxy (COBE results) : *Ortwin Gerhard (Basel, Switzerland)*

10:40 **C:** Dynamics of asymetries in the Galactic Center region : *F. Masset and M. Tagger (CEA Saclay, France)*

. . . . COFFEE BREAK : 10:50 - 11:20 . . . .

(2.4) The Central Parsecs of the MW

11:20 **I:** NIR and Mm/Submm Mosaicing of the Central ~100 pc: *Robert Zylka, Germany*

11:35 **I:** 12.5-Micron Imaging of Sgr A West with the Keck Telescope: *Eric Becklin (UCLA), Mark Morris, Donald Figer, Rick Puetter & Barbara Jones*

11:50 **C:** The Possible Wind and mid-IR Emission associated with Sgr A*,and the Correct Positiion of the Bow-Shock/Tail at S7: *Dan Gezari (NASA, USA)*

12:00 **C:** Advection-Dominated Model of Sgr A* and Other Galactic Nuclei: *Ramesh Narayan (CfA, USA)*

12:10 **C:** Resolved 3.6mu survey of the Inner Galaxy: *M.Unavane, G.Gilmore (Cambridge UK)*

Thursday, August 21, morning: Session 5:

9:00 **I:** Inside the central cavity: *Peter G. Mezger, Germany*

9:15 **I:** The Galactic Center - A Laboratory for AGN: *Wolfgang J. Duschl, Germany*

9:30 **C:** Sagittarius A East, the G-0.02-0.07 HII Complex, and the Cloud That Links Them: *Keven Uchida (Ohio State University), Mark Morris, David Fong, Gene Serabyn, T.C. Meseroll*

9:40 **C:** Gaseous Accretion Flows in the Inner Parsec of the Galaxy: *Robert F. Coker and Fulvio Melia, (Tucson USA)*

9:50 **C:** The Fourier analysis of the observed velocity field of gas in the inner 1.5pc: *A.M Fridman (Moscow, Russia)*

. . . . COFFEE BREAK : 10:00 - 10:30 . . . .

(2.5) Magnetic and High-Energy Phenomena

10:30 **R:** Magnetic Phenomena in Galactic Centers: *Mark Morris, USA*

10:55 **I:** Magnetic Phenomena around Black Hole: *R. Blandford (Caltech, USA)*

11:10 **I:** Polarized emission from the Galactic Center: *W. Reich (Bonn)*

11:25 **I:** Overview of OH (1720 MHz) Observations of the Galactic Center Region: *Farhad Yusef-Zadeh, USA*

11:40 **C:** Far-infrared/submillimeter Polarimetry of Galactic Center Clouds: *Giles Novak (Northwestern)*

11:50 **C:** Properties of synchrotron emission and magnetic fields in the neutral region of M31: *Philipp Hoernes (Bonn), Rainer Beck, Elly M. Berkhuijsen*

Thursday, August 21, afternoon: Session 6:

(3) BLACK HOLES AND CENTRAL ACTIVITY

(3.1) Black Holes in Galaxies

14:00 **R:** Massive Black holes in galaxies: Results from HST: *H. Ford, (Johns Hpkins, USA)*

14:25 **I:** Studies of AGN and Black holes with water vapor masers: *N. Nakai, (NRO JAPAN)*

14:40 **C:** HST measurements of Cores of Galaxies in the Coma Cluster: *R. L. Davies, R. F. Minchin, R. S.*

De Jong & J. R. Lucey (Durham UK)

14:50 **C:** HST observation of two extraordinary S0s; A massive BH in NGC 4342 and a nuclear bar in NGC 4570. : *Frank van den Bosch (Leiden)*

15:00 **C:** HST/FOS observations of the nuclei of M32, NGC 7052 and IC 1459 the case for massive black holes: *Roeland van der Marel (Princeton USA)*

15:10 **C:** The "Double Nucleus"of M 31 in J, H, and K : *P. Hinz, M. Llyod-Hart, K. Hege, D. McCarthy, and F. Melia (Tucson)*

15:20 **C:** Dynamical models for the center of NGC 3115: *E. Emsellem (ESO, Germany), H. Dejonghe*

15:30 **C:** Warps, Jets, and Proper Motions in the Central Parsec of NGC 4258: *J.R. Herrnstein (NRAO, Socorro)*

. . . . COFFEE BREAK : 15:30 - 16:00 . . . .

(3.2) Case for a Black Hole in the Galactic Center

16:10 **I:** Stellar proper motions based on diffraction-limited imaging at 2 μm with the Keck Telescope of the inner 5″of the Galaxy: *Andrea Ghez, M. Morris, and E.E.Becklin, (UCLA)*

16:25 **C:** Stellar Proper Motions in the Central 0.1 Parsec of the Galaxy: *A.Eckart and R.Genzel (Garching)*

16:35 **C:** The Radiative and Hydrodynamical Characteristics of Sgr A* and its Nearby Environment: *F. Melia (University of Arizona)*

16:45 **C:** Progress toward a Trigonometric Parallax of SgrA*: *Reid, M. J. (CfA, USA), Readhead, A. C. S., Treuhaft, R. & Vermeulen, R.*

16:55 **C:** Multi-wavelength VLBA Mapping of Sgr A*: *Zhiqiang Shen, K. Y. Lo, JuiHui Zhao, Paul Ho (Nankang, Taiwan)*

Friday, August 22, morning: Session 7:

9:00 **R:** The Nuclear Stellar Cluster and the Central Dark Mass in the Milky Way: *Reinhard Genzel, Germany*

9:25 **I:** Stellar Dynamical Constraints On Alternatives To A Black Hole: *Eyal Maoz, (Berkeley USA)*

(3.3) Black-hole powering of AGN and jets

9:40 **R:** Black Holes and the Centers of Galaxies: *Douglas Richstone, (Michigan, USA)*

10:05 **I:** The nature of compact radio nuclei in galaxies: *Heino Falcke, (UMd, USA)*

. . . . COFFEE BREAK : 10:20 - 10:50 . . . .

10:50 **C:** Binary Black Hole Engines in Active Galacitc Nuclei: *Yoshiaki Taniguchi (Tohoku U), and Osamu Kaburaki*

11:00 **C:** Periodic Mass Outflow from the Nucleus of M101: *J. W. Moody, P. W. A. Roming (Brigham Young U, USA)*

11:10 **C:** Demographics of Nuclear Activity in Nearby Galaxies: *Luis C. Ho, (CfA USA)*

11:20 **C:** Is it possible to distinguish between different accretion processes from the UV/X-ray spectrum of AGN? : *Suzy Collin-Souffrin, Anne-Marie Dumont (Meudon, France)*

11:30 - 12:00 CONFERENCE SUMMARY:*Francoise Combes (France)*

GCNEWS is brought to you by

Angela Cotera
Jet Propulsion Laboratory 100-22
4800 Oak Grove Dr.
Pasadena, CA 91109-8099
(cotera@ipac.caltech.edu)
(626) 397-7059

Heino Falcke
Max-Planck-Institut für Radioastronomie
Auf den Hügel 69
D-53121 Bonn, Germany
(hfalcke@mpifr-bonn.mpg.de)
+49 (228) 525-217

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