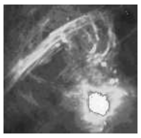
GCNEWS

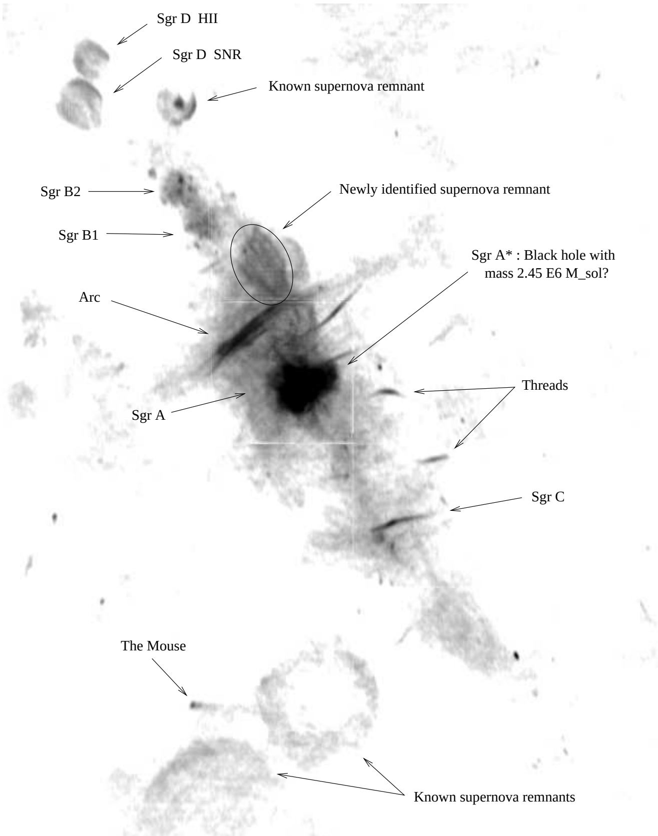
The Newsletter of Galactic Center Research



Vol.3 **November 1996**

email: gcnews@astro.umd.edu **http://www.astro.umd.edu/~gcnews/**

The Galactic Center at 90 cm - new images from the VLA



VLA 90 cm wide-field image: Kassim, Frail, & Briggs 1996, GCNEWs Vol. 3, p.1

Image of the Galactic Center taken from the VLA P band imaging project. The $156'$ HPBW of the 90 cm VLA primary beam allows it to map large fields of view quickly and efficiently (see abstract by Kassim & Frail). The high central dark mass in Sgr A in the center of this image was confirmed recently by Eckart & Genzel (abstract inside, see also Editorial). The nature of the non-thermal filaments visible here was discussed in a recent workshop at UCLA (see Conference Summary). Image courtesy of N. Kassim, D. Frail, and D. Briggs.

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Editorial: The Galactic Center makes (some) Headlines

Heino Falcke

Two articles about the Galactic Center appeared in Nature in the last two months and one in Science News. Those of our readers who have subscribed to the electronic "Newsflash" learned about the articles without delay. First, Serabyn & Morris (Nature, 382, 602) argue that there is some star formation going on in the center of the Galactic bulge. This reflects a growing trend which is quickly becoming the main stream - star formation in the GC is in. During the ESO/CTIO conference Marcia & George Rieke smilingly remarked that the phrase "star formation" used to be unheard of among GC folks and now it was on the conference poster. From my (currently) American perspective "stars and stripes" seem to dominate everything, even now the very center of the Galaxy. While years ago many phenomena in the GC were thought to be powered by a central AGN, today we trace most things we see in the central parsecs back to the activity of stars alone. In this issue of GCNEWS, for example, you will find a conference report about the recent workshop on the QPS complex, which was heavily advertised in the last issue and in Newsflashs. Again stars seem to be a crucial ingredient for the spectacular features and filaments we see in the GC. Some of these structures can be seen in the beautiful new 90 cm map of the Galactic Center by Kassim & Frail on our coverpage (see abstract p. 8).

The only object that can hardly be traced back to stellar activity in the GC is Sgr A* and for more than a decade now, we have strong evidence that there is a dark mass of $\sim 10^6 M_\odot$ in the center. For a long time the review paper by Genzel & Townes (1987, ARA&A) was often quoted in this respect since it showed an enclosed mass versus radius diagram that seemed to indicate a dark "point" mass of $\sim 2 \cdot 10^6 M_\odot$ in the GC. Since then this diagram has been continuously improved and continued to smaller radii — down to fractions of a parsec. Remarkably, regardless which method is used, the estimated mass never changed by much more than a factor of two, even though it was occasionally remarked that the data could in principle also be interpreted without any central object.

A few years ago the group at the MPE in Garching made headlines with their speckle images of the GC and the discovery of an alleged NIR counterpart to Sgr A* (ApJ, 407, 77). As it turned out later, those NIR sources were not Sgr A* itself but a cluster of stars very close to Sgr A*. Eckart & Genzel have now turned this into a big advantage: their paper (Nature 383, 415) (see p. 7 for abstract) crowns a four year effort to image the GC and to measure the proper motions of stars. Their most tantalizing result perhaps, is the possible detection of a high proper motion star ($v \geq 1600$ km/sec) within the central cluster previously thought to be Sgr A*. The proper motions of the other, more distant stars together with infrared spectroscopy (Haller et al. 1996, Genzel et al. 1996) now give us the first reliable estimate for the gravitational potential well inside the central parsec.

In the recent Science News (150, 212), a weekly publication of noteworthy general science advances, the article by Eckart & Genzel and the work by Stolovy et al., included in the last GCNEWS, were reported under the headline "Firm Evidence of Milky Way Black Hole". In the four years since the MPE group began their work, many other Galaxies have made headlines because of claimed black hole detections with much less substantive evidence and it appears now that, mainly thanks to the PR efforts of the Space Telescope Science Institute, those claims have saturated the popular market. This may explain, why the paper by Eckart & Genzel did not attract the popular media attention it merits. Their paper certainly sets a milestone in the long quest to determine the central mass.

While the fact that the authors specify the mass in the GC with three significant digits may still be amusing to some, it makes clear that the discussion has now reached a stage where we are no longer discussing orders of magnitude, but rather second and third significant digits. Moreover, their work has removed some of the ambiguity spectroscopy alone is unable to resolve. The GC is now the best supermassive black hole candidate – besides NGC 4258 – we know of, and the high proper motion of the stars can make this even better in the future. As reported in Vol. 1 of GCNEWS, HST/NICMOS will dedicate a lot of time to the same question, and the Keck telescope will undoubtablly add to this endeavour (see Klein et al. GCNEWS Vol. 2.).

Hence, the GC will remain a hot topic in the coming years and one can hope that in the wake of these discoveries other important parts of the GC research, despite less public attention, will prosper equally well. Thanks to the many colleagues who are contributing their abstracts, GCNEWS will be here to keep you up on the latest in this exciting field.

Conference Report: Highlights of the QPS Workshop

Angela Cotera

A mini-conference "QPS: A Rosetta Stone for Understanding Large-Scale MHD Activity near the Galactic Center" was held at UCLA on September 19 & 20th. There were twelve talks, and much discussion, on work being done at almost all wavelengths at which the Quintupulet/Pistol/Sickle (QPS) have been observed (with the exception of high energy observations), including the first ISO images of the Quintuplet (see the abstract by Nagata et al. in this volume of GCNEWS)

Don Figer (UCLA) presented results on the Quintuplet cluster which contains approximately 10 Wolf-Rayet (WR) stars, including four probable WCL (late-type WR stars which show carbon emission lines), 14 OB supergiants, at least one red supergiant and a possible LBV candidate. The ratio of WN/WC stars is $\gtrsim$0.5, which would suggest a higher than solar metallicity, although the ratio still represents small number statistics. The Qunituplet cluster extends well towards the Sickle, with at least one WN6 star located on top of the southwestern extension of the Sickle. Figer suggested that the hot stars in the Quintuplet cluster, which are moving at roughly the Galactic rotation speed, produced an expanding bubble which is now pushing into a slower-moving molecular cloud, the surface of which is being ionized to produce the Sickle. This was supported by work on the NIR spectra of the Sickle and Pistol as presented by Angela Cotera (JPL/Caltech), who showed that the extinction in the Brγ line is consistent with the stellar population and therefore concluded that the ionized gas is not embedded in the molecular cloud. In addition no stellar sources are coincident with any of the peaks in the Brγ emission. The ionization within the Sickle therefore appears from this evidence to be the fortunate happenstance of a wayward molecular cloud and a cluster of hot stars. Figer also pointed out the location of the cluster within a larger apparent bubble of ionized gas that can be seen in radio continuum maps, but most strikingly in recent MSX images (presented at the meeting by Janet Simpson).

Munetaka Ueno (University of Tokoyo) presented ISO images of the Quintuplet at 7 μm which clearly show the Quintuplet and another faint peak of emission to the northeast of the Quintuplet. In the same presentation, high spatial resolution NIR images of the quintuplet were shown. Although at lower resolution the Quintuplet stars appear to be extended, they appear point like in the new images. It was suggested by Figer that the Quintuplet stars are dusty WCL stars, although the probability of five stars in a single cluster being in such a shortlived evolutionary state was the subject of some disscusion.

To discuss the ramifications on the ISM by the presence of WR stars, Tony Marston (Drake Univerisity) showed that there are often large shells around WR stars, in fact ~40% of all WR stars exhibit such shells. The tendency is to get an evacuated cavity from the stellar winds and only afterward the ejecta from the stars. Such a cavity is seen around the Quintuplet cluster in both the radio and in the MSX images. The Quintuplet cluster is offset from the center of the shell, but such an offset is common in other WR systems where the bubble is subject to a drag force produced by its interaction with the local ISM. How such a shell could possibly retain such a nearly perfect spherical shape under the considerably disturbed conditions in the Galactic Center is, however, problematic. Marston also pointed out that the Pistol appears to be morphologically similar to NGC 6888, an HII region made of circumstellar ejecta from a WR star; this supports the suggestion by Figer that the Pistol is ejecta from the LBV candidate.

The FIR observations of the QPS region presented by Janet Simpson (Ames Research Center), also indicate that the Sickle is caused by stellar ionization with some variations indicating that the ionization source is likely to be the Quintuplet stars. The Pistol however, does not look like a typical galactic H II region, which would be consistent with the pistol being formed from the outflow of a previous mass loss episode of a Luminous Blue Variable (LBV) star. Cornelia Lang (UCLA), presented VLA radio data on the velocity of the ionized gas as seen in across the Sickle and Pistol. In the Sickle, there is a definite velocity gradient and several of the spectra show a double peaked profile, indicating a more complex structure at smaller scales. In agreement with previous results, the Sickle has an average velocity of 34 km/s and the Pistol 110 km/s. The results for the Pistol are also in agreement with the Quintuplet stars which Figer has found, using super-resolution techniquesm to have an LSR velocity of 125 km/s.

Doug Roberts (Univ. Illinois), observed the H92α line toward the pistol and sickle with the VLA in its lowest resolution configuration (D-array). In general, the results are identical to the higher resolution observations presented by Lang et al.. However, more prominent in the low resolution data is a line at the forbidden negative velocity of -40 km/s which peaks at the location of a nonthermal filament. He also noted a high positive velocity (+150 km/s) line from a position near the "wake" north of the same nonthermal filament. This gas is likely from the sickle yet the velocity is higher than that of the pistol.

Tom Pauls (NRL) reported on new VLA observations of the non-thermal filaments at 22 GHz. A mosaic image roughly centered on the Sickle has been produced from four VLA pointings. The filaments are clearly seen in this image, and a comparison with 5 GHz observations indicates that the spectral index of the non-thermal filaments is roughly flat up to 22 GHz. Observations with the Nobeyama Array at 43 GHz did not detect the filaments, which implies that the spectral index must turn over somewhere between 22 and 43 GHz.

BIMA results from a mosaic of six fields around the Sickle were presented by Ray Plante (Univ. Illinois). The higher resolution CS 2-1 observations showed that the molecular filament stretches out from the main molecular cloud along the nonthermal filmaments, increasing the evidence for an interaction between two features and strengthening the case for the spatial coexistence of the ionized and molecular gas.

The generation of the non-thermal filaments was suggested by Gene Serabyn (Caltech) to be the result of the interaction of a molecular cloud ionized by stars, which then reconnects to the magnetic field and streams outward from the Sickle region. Serabyn showed that the Pistol is depolarized and therefore suggests that the Pistol, and thus the Quintuplet cluster, is behind the molecular gas, rather than in front as suggested by others. Mark Morris (UCLA) presented radio polarization studies of synchrotron emission from the nonthermal filaments (NTF's), which confirm that the magnetic field is oriented parallel to the filaments: perpendicular to the galactic plane. Far-IR measurements made on the KAO with the Univ. of Chicago array polarimeter, STOKES, show that the thermal emission from dust in or near the ionized interface with the molecular cloud underlying the sickle is strongly polarized (up to 10–12%), with the electric field vectors being very uniform, and oriented perpendicular to the Galactic plane. The highest polarization in the region was shown by Roger Hildebrand (Univ. of Chicago) to be coincident with both the Arched Filaments and the Sickle. The polarization in these regions is a factor of 3 higher than in Orion. The implied magnetic field in the molecular cloud is thus parallel to the galactic plane–perpendicular to the field in the NTF's just outside the clouds. The interaction of the two perpendicular field systems at the ionized cloud interface will give rise to field line recombination, which can accelerate electrons to relativistic energies and account for the synchrotron "illumination" of the NTF's.

As to be expected, no hard conclusions were reached, but some questions, such as the ionization source of the Sickle, seem to have been answered. Also, as expected, many intriguing questions were raised. How can the geometries of the cluster of ionizing stars, the multiple velocity gases and the non-thermal filaments possibly be reconciled? What is the extent of the interaction of the thermal Sickle and the straight non-thermal filaments? What does this imply for the other regions of thermally ionized gas and non-thermal threads? We look forward to learning the answers to these and other such questions at future conferences and workshops!

Abstracts

Gravitational Microlensing and the Structure of the Inner Milky Way

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We analyze the first-year MACHO collaboration observations of microlensing towards the Galactic center using a new direct likelihood technique that is sensitive to the distribution of the events on the sky. We consider the full set of 41 events, and calculate the direct likelihood against a simply-parameterized Galactic model consisting of either a gaussian or exponential bar and a double exponential disk. Optical depth maps are calculated taking into account the contribution of both disk lenses and sources. We show that based on the presently available data, a slope in the optical depth has been clearly detected (3σ) in Galactic latitude and that there are indications of a small slope in Galactic longitude. We discuss limits that can be set on the mass, angle and axis ratio of the Galactic bulge. We show that based on microlensing considerations alone, $M_{Bulge} > 1.5 \times 10^{10} M_{\odot}$ at the 90% confidence level and that the bulge inclination angle is less than 30° also at the 90% confidence level. The mostly likely bar mass is $M_{Bulge} = 3.5 \times 10^{10} M_{\odot}$. Such a high mass would imply a low MACHO fraction for the halo. We consider disk parameters and show that there are two degeneracies between the effects of a disk and those of a bar on the optical depths. Finally, we discuss how to break these degeneracies and consider various strategies for future microlensing observations.

submitted to ApJ

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ftp://astro.uchicago.edu/pub/astro/gyuk/micromap

http://xxx.lanl.gov/abs/astro-ph/9607134

Finding Radio Pulsars in and Beyond the Galactic Center

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Radio-wave scattering is enhanced dramatically for Galactic center sources in a region with radius $\gtrsim$ 15 arc min. Using scattering from Sgr A* and other sources, we show that pulse broadening for pulsars in the Galactic center is *at least* $6.3\,\nu^{-4}$ seconds ($\nu =$ radio frequency in GHz) and is most likely 50–200 times larger because the relevant scattering screen appears to be within the Galactic center region itself. Pulsars beyond—but viewed through—the Galactic center suffer even greater pulse broadening and are angularly broadened by up to ~ 2 *arc min.* Periodicity searches at radio frequencies are likely to find only long period pulsars and, then, only if optimized by using frequencies $\gtrsim 7$ GHz and by testing for small numbers of harmonics in the power spectrum. The optimal frequency is $\nu \sim 7.3\,GHz(\Delta_{0.1}P\sqrt{\alpha})^{-1/4}$ where $\Delta_{0.1}$ is the distance of the scattering region from Sgr A* in units of 0.1 kpc, P is the period (seconds), and α is the spectral index. A search for compact sources using aperture synthesis may be far more successful than searches for periodicities because the angular broadening is not so large as to desensitize the survey. We estimate that the number of *detectable* pulsars in the Galactic center may range from ≤ 1 to 100, with the larger values resulting from recent, vigorous starbursts. Such pulsars provide unique opportunities for probing the ionized gas, gravitational potential, and stellar population near Sgr A*.

to appear in ApJ

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http://astrosun.tn.cornell.edu/SPIGOT/papers/pulsar/gc_psr.web/

http://xxx.lanl.gov/abs/astro-ph/9608028

VLA H92α and H115β Recombination Line Observations of the Galactic Center H II Regions: The Sickle (G0.18-0.04) and Pistol (G0.15-0.05)

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The Very Large Array has been used in the CnB and DnC configurations to observe the remarkable Galactic Center sources, the Sickle and Pistol, morphology and may be physically associated with the linear sources. The H92α (8.31 GHz) and H115β (8.43 GHz) radio recombination lines arising from these sources have been observed with angular resolutions of 6″ and 9″, respectively. In addition there is a probable detection of the helium line in the Pistol ($Y^+ \sim 14\pm6\%$), while in the Sickle, no helium lines were detected with an upper limit of $Y^+ \sim 5\%$ (3σ). A complex velocity field has been observed in both sources. The LSR velocity in the Sickle varies from 0 to 75 km s^{-1}, with an average velocity of ~35 km s^{-1}; the average velocity of the Pistol is ~115 km s^{-1} . The recombination line properties of the Sickle and Pistol (FWHM line widths, line to continuum ratios, β to α ratio) are consistent with photoionization from hot stars. The β to α line ratio of $\sim 0.35\pm0.07$ over most of the Sickle and Pistol does not differ significantly from the LTE value of 0.28. The average LTE electron temperature, T_e^*, for the Sickle (~5500 K) is similar to typical Galactic Center HII regions, and T_e^* for the Pistol is somewhat lower (~3600 K). An additional HII component in the line profiles of three regions of the Sickle in which the non-thermal filaments are present suggests that an interaction between the ionized gas and the non-thermal filaments is occuring. The probable detection of He92α in the Pistol and the non-detection in the Sickle may be due to a difference in the radiation field of the ionizing sources.

to appear in ApJ, 1 Jan 1997
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Sustained Star Formation in the Central Stellar Cluster of the Milky Way

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The central stellar bulge of our Galaxy is commonly held to consist predominantly of a coeval population of very old ($\sim 10^{10}$ yr) stars. On the other hand, evidence for both very young and intermediate-age stars in the bulge is accumulating. Here we argue that star formation has been occurring in the molecular gas near the center of the bulge throughout the lifetime of the Galaxy, and that the resulting stellar population is evident as the prominent infrared "r^{-2} central star cluster" (a cluster whose space density decreases as the square of the distance from the center). Although our hypothesis is at odds with the standard view that this central cluster is the innermost part of the more extended and ancient bulge, sustained star formation is consistent with both the available observational data, and simple models of mass inflow and collisionally induced star formation in this region. Even if the central star-formation rate is relatively modest, it appears that the stellar population of the Galactic bulge has been augmented substantially since its birth.

Nature, 382, 602
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Really Cool Stars at the Galactic Center

R. D. Blum[1,3,4], *K. Sellgren*[2,5] and D. L. DePoy[2]

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New and existing $K-$band spectra for 19 Galactic center late–type stars have been analyzed along with representative spectra of disk and bulge M giants and supergiants. Absorption strengths for strong atomic and molecular features have been measured. The Galactic center stars generally exhibit stronger absorption features centered near Na I (2.206 μm) and Ca I (2.264 μm) than representative disk M stars at the same CO absorption strength. Based on the absolute $K-$band magnitudes and CO and H_2O absorption strengths for the Galactic center stars and known M supergiants and asymptotic giant branch (AGB) stars, we conclude that only IRS 7 must be a supergiant. Two other bright stars in our Galactic center sample are likely supergiants as well. The remaining bright, cool stars in the Galactic center that we have observed are most consistent with being intermediate mass/age AGB stars. We identify four of the Galactic center stars as long period variables based on their $K-$band spectral properties and associated photometric variability. Estimates of initial masses and ages for the GC stars suggest multiple epochs of star formation have occurred in the Galactic center over the last 7–100 Myr.

to appear AJ, November 1996
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No eclipses in A1742-289 archival

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It has been suggested that a recently detected galactic center binary X-ray source represents the quiescent state of A1742-289, a transient source which appeared in 1975. We find no evidence for eclipses in the Ariel V RMC data for the transient, suggesting that the binary source is a previously undetected distinct system.

PASJ, in press
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http://www.sr.bham.ac.uk/ jak/papers/papers.html

ISOCAM CVF observations of the Quintuplet and Object#17 clusters near the Galactic Center

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Two fields near the Galactic Center, containing the Quintuplet and Object #17 star-clusters, have been imaged with the ISOCAM circular variable filters (CVFs) in the wavelength range of 2.47 – 3.08μm and 3.99 – 9.09μm. Emission of [Ar II] 6.99μm is detected in the "pistol-shaped" H II region (G0.15-0.05) to the south of the Quintuplet cluster. Absorption probably due to O-H stretching vibration (2.8μm) is evident in the Quintuplet spectra. In addition, Quintuplet members and the central part of Object #17 have CO_2(4.3μm) and CO (4.7μm) absorption. Abundant CO_2 might be present in these lines of sight.

accepted in A&A (First results from ISO)
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Stellar Proper Motions in the Central 0.1 Parsec of the Galaxy

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We report the first results of a program to measure proper motions of stars in the innermost core of the Galaxy. From high resolution near-infrared imaging over the last 4 years we have determined proper motions for 39 stars between 0.03 and 0.3 pc from the compact radio source SgrA*. For 19 of these the derived motions are more significant than 4s in at least one coordinate. Proper motion and radial velocity dispersions are in very good agreement indicating that the stellar velocity field on average is close to isotropic. Taking radial and proper motion data together the dynamic evidence is now strong that there is a $2.45(\pm0.4)\times10^6 M_\odot$ central dark mass located within <0.015 pc of SgrA*. Its mass density is at least $6.5\times10^9 M_\odot/pc^3$ excluding that the central mass concentration is in form of a compact white dwarf or neutron star cluster. In addition, we have detected significant changes in the structure of the innermost complex of stars in the immediate vicinity of SgrA*, implying in at least one case stellar motions of ~1500 km/s within ~0.01 pc of the compact radio source. Including this preliminary evidence, the inferred density of the central dark mass would then have to be in excess of $10^{12} M_\odot/pc^3$, implying that the central mass concentration is likely a single massive black hole.

Nature 383, 415
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A New Supernova Remnant Over The Galactic Centre

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Improved images and a newly determined spectrum from 80 MHz to 15 GHz have clarified the nature of the radio source G 0.33+0.04 at the Galactic Centre. Its non-thermal spectral index and its shell-like morphology favor an interpretation that this is a supernova remnant. Furthermore, the absorption characteristics of the continuum spectrum at the lowest frequencies and its elongation along the plane suggest that, like Sgr A East, it is in physical proximity to the Galactic Centre (see http://rsd-www.nrl.navy.mil/7214/weiler/dragonfarm.html for an image)

MNRAS accepted
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http://rsd-www.nrl.navy.mil/7214/weiler/dragonfarm.html

A SiO emission from the Galactic Center Molecular Clouds

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We have mapped the J=1 $\rightarrow$ 0 line of SiO in a $1^\circ \times 12'$ (l$\times$b) region around the Galactic center (GC) with an angular resolution of $2'$ ($\sim$ 4 pc). In contrast to the spatial distribution of other high dipole moment molecules like CS, whose emission is nearly uniform, the SiO emission is very fragmented and it is only associated with some molecular clouds. In particular, it is remarkable that the SiO emission closely follows the non-thermal radio arc in the GC. The SiO clouds are more extended than the beam with typical sizes between 4 and 20 pc. High angular resolution ($26'$) mapping in the J=2 $\rightarrow$ 1 line of SiO toward the molecular clouds in Sgr B2 and Sgr A shows that the SiO emission is relatively smooth with structures of typically 2 pc. From the line intensities of the J=2 $\rightarrow$ 1, J=3 $\rightarrow$ 2 and J=5 $\rightarrow$ 4 transitions of SiO we derive H_2 densities for these clouds of a few $10^4 cm^{-3}$. The SiO fractional abundances are $\sim 10^{-9}$ for the SiO clouds and $\lesssim 10^{-10}$ for the other molecular clouds in the GC. The characteristics (size and H_2 densities) of the SiO emission in the GC are completely different from those observed in the Galactic disk, where the SiO emission arises from much smaller regions with larger H_2 densities. We briefly discuss the implications of the SiO emission in the molecular clouds of the GC. We conclude that the particular chemistry in these clouds is probably related to large scale fast shocks occurring in the Galactic center region.

ApJL accepted
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Compact Radio Cores in the Galactic Center and Elsewhere

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Compact radio cores are not only common in radio galaxies and quasars but also in many nearby galaxies with low-active, supermassive black holes. One famous example is the Galactic Center source Sgr A*. Recent studies of proper motions and radial velocities of stars in the inner parsec of the Galaxy convincingly demonstrate the presence of a compact dark mass of $2.5 \cdot 10^6 M_\odot$ in the nucleus of the Milky Way. Millimeter VLBI and submm observations of Sgr A* thus probe a region of only a few Schwarzschild radii in diameter. In this paper I will review our current theoretical and observational knowledge of this source and compare it to some famous LINER galaxies like NGC 4258, NGC 3079, and NGC 6500. In all cases these radio cores can be well explained by a standard AGN jet model, and, with the exception of Sgr A*, large scale outflows are observed that have powers comparable to those inferred from the radio cores. Recent VLBI observations of radio-weak quasars and HST observations of Seyfert galaxies indicate that these AGN also produce powerful jets which, however, have relatively less luminous radio cores than radio-loud quasars and the LINERs discussed here. Therefore, jets and compact radio cores appear to be natural constituents of an AGN, but the reason why apparently some jets are radio-loud and others not remains a mystery.

review, to appear in: IAU Coll. 163, "Accretion Phenomena and Related Outflows", Wickramasinghe D., Ferrario L., Bicknell G. (eds.), PASP Conf. Proc.

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http://xxx.lanl.gov/abs/astro-ph/9608107

Call for papers

1st Circular

IAU Symposium No. 184

THE CENTRAL REGIONS OF THE GALAXY AND GALAXIES

1997 Aug 18-22, Kyoto Japan

Dear Colleagues

An IAU Symposium as above will be held in conjunction to the 23rd IAU General Assembly. Please find below the preliminary program.

We would be happy if you could join us and present your recent scientific results. If you are interested, please use the inquiry attached to express your (preliminary) willing to attend the meeting. In case you need a more formal invitation, please indicate so.

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Purpose of Symposium

To understand the general characteristics of dynamics, mass and ISM distributions, evolution, activities including outflow/inflow, shocks, and starformation, in the central regions of the Galaxy and galaxies. Highlights also on black holes and related activity.

Preliminary Program

- 1997 Mon Aug 18, afternoon: Session 1:

STELLAR CLUSTERS AND STAR FORMATION

Galactic Center star clusters
Nuclear star clusters in galaxies
Evolution and dynamics of dense star clusters

- Tue Aug 19, morning: Session 2:

Galactic bulges: structure and evolution
Star Formation
Starburst

- Tue Aug 19, afternoon: Session 3:

NUCLEAR INTERSTELLAR MEDIUM

Neutral ISM in the Galactic Center
Molecular gas in nuclei of galaxies
Evolution of nuclear gas

- Wed Aug 20, morning: Session 4:

Rotation & kinematics of the nuclear gas disks
Gas dynamics in the central pc to kpc
Bars and shocks
Angular momentum and accretion

- Thu Aug 21, morning: Session 5:

Magnetic phenomena
High-energy phenomena
Outflow and circulation

- Thu Aug 21, afternoon: Session 6:

BLACK HOLES AND CENTRAL ACTIVITY

Black holes in galaxies
Case for black hole in the Milky Way center

- Fri Aug 22, morning: Session 7:

Circum nuclear mass distribution and kinematics
Formation of black holes
Black hole powering of central activity

Supporting Commission 40, Division X (Radio astronomy), Co-Supporting Commissions 28 (galaxies) & 33 (structure & dynamics of galactic systems)
SOC: J. Binney (UK), F. Combes (France), R. Genzel (Germany; co-chair), J. Kormendy (Canada), R.P. Kraft (IAU), M. Morris (USA; co-chair), N. Scoville (USA), Y. Sofue (Japan; chair), M. Tsuboi (Japan)

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Phone:+81-422-34-3734; Fax +81-422-34-3749,
Dates: 1997 August 18-22
(in conjunction with the 23rd IAU General Assembly)
Place: Kyoto International Conference Hall, Japan
Registration and Local Organization:
See IAU Information Bulletin and
http://www.tenmon.or.jp/iau97

Other Announcements

- The (tentative) next GCNEWS Newsletter abstract deadline is Monday, Dec 30.
- If you would like to know whether a paper listed in GCNEWS has appeared, use the NASA ADS Abstract server (`http://adswww.harvard.edu/abs_doc/abstract_service.html`) which is extremely useful. We have also added a new cummulative list of abstracts submitted to this and previous issues of GCNEWS to our homepage which you can search for a specific paper.

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