Curiculum Vitae

Tobias Karl Fritz
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Education and work

October 2013-present: Research Associate at the University of Virginia; I am working together with Professor Dr. Nitya Kallivayalil

July 2013- September 2013: Postdoc at Max-Planck Institute for Extraterrestrial Physics (MPE)

September 2009-July 2013: PhD thesis, grade: magna cum laude
Thesis advisors: Professor Dr. Reinhard Genzel, Dr. Stefan Gillessen, *"From the Sun to the Galactic Center: Dust, Stars and Black Hole(s)"*

March 2009-September 2009: Research Assistant at MPE

January 2008 – February 2009: Diploma thesis (similar to Master thesis) at MPE Garching, Germany; Thesis advisors: Professor Dr. Reinhard Genzel, Dr. Stefan Gillessen, *"Astrometry of IRS13E"*

October 2003 – March 2009: Physics studies for the degree of Diplom-Physik (similar to Msc+Bachalor in one degree in physics) at Ludwigs-Maximilians-University (LMU) Munich, Germany, grade: sehr gut (very good)

December 2002 – September 2003: Alternative Civilian Service at University Hospital, Freiburg, Germany

September 1993 - June 2002: Berthold-Gymnasium (grammar school), Freiburg, Germany

Observation proposals:

As PI:

VLT/NACO, 6 hours, Second epoch imaging for proper motions, "*What is the origin of young stars in the Galactic Center?"*

VLT/SINFONI, 35 hours, integral field spectroscopy, "*What is the origin of young stars in the Galactic Center?*"
VLT/NACO, 10 hours, Preimaging, "*What is the origin of young stars in the Galactic Center?*"

Herschel space observatory/PACS, 40.1 hours, imaging for time variability, "*Discovering Sgr A* in the far infrared with Herschel"*

Herschel space observatory/PACS, 6.7 hours, H recombination line integral field spectroscopy,

"*Extinction towards the Galactic Center*"

Gemini South, GS-2015A-LP-2, **Large Program 143.3 h** for proper motions, "*Probing the dark halo of the Milky Way with GeMS/GSAOI***"**

LBT/LBC (2016B), 4 hours, imaging for proper motions, "*The orbit of Crater II, the feeble giant*"

LBT/LBC (2016A), 5 hours, imaging for proper motions, "*The origin of Segue 1, one of the darkest galaxies*"

LBT/MODS (2015B), 6 hours, spectroscopy, "*Probing the Outer Halo of the Milky Way with M-giants*"

LBT/MODS (2015A), 8 hours, spectroscopy, "*Probing the Outer Halo of the Milky Way with M-giants*"

As Co-I:

***VLT/NACO**, 6 hours, "Stellar dynamics in the central arcsecond around the Massive Black Hole in the Galactic Center"*

***VLT/NACO+SINFONI**, 36 hours, "Watching a gas cloud fall into the super-massive black hole in the Galactic Center"*

***VLT/SINFONI**, 17.5 hours, "Watching a gas cloud disrupt in real-time while it is falling towards Sgr A*"*

***VLT/NACO**, 6 hours, "Stellar dynamics in the central arcsecond around the Massive Black Hole in the Galactic Center"*

***VLT/NACO+SINFONI**, 42 hours, "Stellar dynamics in the central arcsecond around the Massive Black Hole in the Galactic Center"*

VLT/NACO+APEX/LABOCA, 99 hours, "*What is the Origin of the Flares of Sgr A*?*"

HST-14734 (in Cycle 24): **164 orbits**, "*Milky Way Cosmology: Laying the Foundation for Full 6-D Dynamical Mapping of the Nearby Universe*"

HST-14236 (in Cycle 23): 14 orbits, "*The First Proper Motions of Ultra-faint Dwarf Galaxies: Probing Reionization and Planar Associations of Satellites*"

HST-13834 (in Cycle 22): 22 orbits, "*The Proper Motion field along the Magellanic Bridge: a New Probe of the LMC-SMC interaction*"

Keck/NIRSPEC (2017A): 2 half nights, "*High Resolution Infrared Spectroscopy of Giants in the Nuclear Bulge/Cluster*"

Keck/NIRSPEC (2016A): 2 half nights, "*High Resolution Infrared Spectroscopy of Giants in the Nuclear Bulge/Cluster*"

Keck/NIRPSEC (2015A): 3 half nights, "*High Resolution Infrared Spectroscopy of Giants in the Nuclear Bulge*"

LBT/MODS (2014B), 8 hours, "*Probing the Outer Halo of the Milky Way with M-giants*"

LBT/LBC (2014A), 12 hours, "*Astrometry of the Palomar 5 stream*"

Abilities

Languages

German: Native Speaker
English: Professional Proficiency

Observational experience

2015-2016: 10 nights of observations with **Gemini South**, using the 5 Laser AO camera system GeMS/GSAOI
2009-2013: 33 half nights of observations with the **VLT** in the IR (1.1 to 4 microns), observations of the Galactic Centre, mostly with adaptive optics, sometimes also with Laser guide star
Used instruments: the integral field spectrograph SINFONI, NACO in imaging mode

2007: 1 half night imaging with the 0.8 m telescope of the **Wendelstein** observatory

IT knowledge

Operating systems: Linux, Windows

Programming languages: IDL, dpuser (at MPE developed script languages, mainly for data reduction and analysis, also useful for many other purposes), some python

Word processing: Latex, Microsoft Office

Image visualization: ds9, QFitsView (At MPE developed Fits file viewer, optimized for integral field spectrograph data, includes dpuser)

Plotting: pgplot (part of dpuser)

Image/spectra analysis: dpuser, QFitsView, starfinder (a program for point spread function extraction and source extraction, optimized for adaptive optics images), GALFIT

Astronomical data reduction: SPREDUCE (data reduction software for SINFONI based on eclipse and python), dpuser, some IRAF, HIPE (Herschel-PACS data reduction)

Conferences and colloquia

Conference contributed talks

October 2015, AO4ELT4 (Lake Arrowhead, California, USA), "*Astrometry with MCAO at Gemini and ELTs*"

June 2015, Future & Science of Gemini Observatory (Toronto, Ontario, Canada), "*Probing the dark halo of the Milky Way with GeMS/GSAOI*"

September 2013, IAU symposium 303; The Galactic Center: Feeding and Feedback in a Normal Galactic Nucleus (Santa Fe, New Mexico, USA), "*The Nuclear Cluster of the Milky Way*"

March 2013, Gas Dynamics and Star Formation in the Extreme Environment of Galactic Nuclei (Ringberg, Germany), "*The Nuclear Cluster of the Milky Way*"

December 2012, Gluehwine Aarseth N-body meeting (Bonn, Germany), "*The smallest and the biggest star cluster*"

September 2011, The Central Kiloparsec in Galactic Nuclei, Astronomy at High Angular Resolution 2011 (Bad Honnef, Germany), "*The extinction towards the galactic center and a new determination of the distance to the Galactic Center*"

June 2010, Central Massive Objects: The Stellar Nuclei – Black Hole Connection, (ESO, Garching, Germany), "*GC-IRS13E – A puzzling association of three early-type stars*"

February 2010, Probing Strong Gravity near Black Holes (Prague, Czech Republic), "*The prospects of probing relativity in the Galactic Center with Adaptive Optics Observations*"

Conference, poster

August 2014, 11th Potsdam Thinkshop: Satellite galaxies and dwarfs in the local group (Potsdam, Germany) "*The absolute proper motion of Palomar 5*"

Colloquia and talks

3 November 2016, Columbia University (New York, USA) "*Constraining halo and satellite properties with proper motions*"

28 October 2016, Space Telescope Science Insitute (Baltimore, USA) "*Constraining halo and satellite properties with proper motions*"

29 September 2016, Leibniz Institut fuer Astrophysik (Potsdam, Germany) "*Constraining halo and satellite properties with proper motions*"

23 September 2016, Institute of Astronomy (Cambridge, United Kingdom) "*Constraining halo and satellite properties with proper motions*"

15 September 2016, MPIA (Heidelberg, Germany) "*Constraining halo and satellite properties with proper motions*"

18 December 2015, MPE (Garching, Germany), "*Proper motions outside of the Galactic Center*"

10 September 2015 Laboratoire d'Astrophysique de Marseille (Marseille, France) "*Astrometry with GeMS/GSAOI*"

13 January 2015, AURA (La Serena, Chile) "*Masses and Proper Motions from the Galactic Center to Carina*"

14 August 2014, MPIA (Heidelberg, Germany) "*The proper motion of Palomar 5*"

11 August 2014, MPE (Garching, Germany) *"Proper motions in the halo of the Milky Way*"

13 August 2012, ESO-Santiago (Santiago, Chile) „*The extinction curve towards the Galactic Center*"

13 July 2011, Universidad Catolica (Santiago, Chile) "*The extinction curve towards the Galactic Center*"

Attended conferences

January 2014, AAS 223 (Washington, D.C, USA)

April 2008, The Universe under the Microscope, Astrophysics at high angular resolution (Bad Honnef, Germany)

Publications

Refereed first author publications:

Fritz, T. K., Kallivayalil, N.
2015, ApJ, 453, 939
The proper motion of Palomar 5

Fritz, T. K., Chatzopoulos, S., Gerhard, O., Gillessen, S., Genzel, R., Pfuhl, O., Tacchella, S., Eisenhauer, F., Ott, T.
2016, ApJ, 821, 44
The nuclear cluster of the Milky Way: total mass and luminosity

Fritz, T. K., Gillessen, S., Dodds-Eden, K., Lutz, D., Genzel, R., Raab, W., Ott, T., Pfuhl, O., Eisenhauer, F., Yusef-Zadeh, F.
2011, ApJ, 737, 73
Line derived infrared extinction toward the Galactic center

Fritz, T. K., Gillessen, S., Dodds-Eden, K., Martins, F., Bartko, H., Genzel, R., Paumard, T., Ott, T., Pfuhl, O., Trippe, S., Eisenhauer, F., Gratadour, D.
2010, ApJ, 721, 395
GC-IRS13E- A puzzling association of three early-type stars

Fritz, T., Gillessen, S., Trippe, S., Ott, T., Bartko, H., Pfuhl, O., Dodds-Eden, K., Davies, R., Eisenhauer, F., Genzel, R.
2010, MNRAS, 401, 1177
What is limiting near infrared astrometry in the Galactic centre?

First author submitted:

Fritz, T. K., Linden, S., Zivick, P., Kallivayalil, N., Beaton, R., Bovy, J., Sales, L., Sohn, T., Angell, D., Boylan-Kolchin, M., Carrasco, E. R., Damke, G., Davies, R., Majewski, S., Neichel, B., van der Marel, R.
The proper motion of Pyxis: the first use of adaptive optics in tandem with HST on a faint halo object
arXiv:1611.08598

PhD Thesis

Fritz, Tobias
2013, Ludwig-Maximilians-University, Munich
From the sun to the Galactic Center: dust, stars and black hole(s)

First author conference proceedings:

Fritz, T. K., Kallivayalil, N. Carrasco, E. R., Neichel, B., Davies, R., Beaton, R., Angell, D., Linden, S., Zivick, P., Majewski, S., Damke, G., Boylan-Kolchin, M., van der Marel, R., Sohn, T.
2015, arXiv:1601.00965, Proceedings of Adaptive Optics for Extremely Large Telescopes 4,
Astrometry with MCAO at Gemini and at ELTs

Fritz, T. K., Chatzopoulos, S., Gerhard, O., Gillessen, S., Genzel, R., Pfuhl, O., Tacchella, S., Eisenhauer, F., Ott, T.
2014, IAU Symposium, 202, 248
The nuclear cluster of the Milky Way: total mass and luminosity

Not yet printed coauthor publications:

Bovy, J., Bahmanyar, A.**, Fritz, T. K.,** Kallivayalil, N.
2016, arXiv:1609.01298, accepted for publication in ApJ
The shape of the inner Milky Way halo from observations of the Pal 5 and GD-1 stellar streams

Refereed coauthor publications:

Gillessen, S., Genzel, R., **Fritz, T. K**., Quatert, E., Alig, C., Burkert, A., Cuadra, J., Eisenhauer, F., Pfuhl, O., Dodds-Eden, K., Gammie, C. F., Ott, T.
2012, **Nature**, 481, 7379,
A gas cloud on its way towards the supermassive black hole at the Galactic Centre

Ryde, N., **Fritz, T. K.**, Rich, R. M., Thorsbro, B., Schultheis, M., Origila, L., Chatzopoulos, S.
2016, ApJ, 831, 40
Detailed Abundance Analysis of a Metal-poor Giant in the Galactic Center

Chatzopoulos, S., **Fritz, T. K.**, Gerhard, O., Gillessen, S., Wegg, C., Genzel, R., Pfuhl, O.
2015, MNRAS, 447, 948
The old nuclear star cluster in the Milky Way: dynamics, mass, statistical parallax, and black hole mass

Dodds-Eden, K., Gillessen, S., **Fritz, T. K.**, Eisenhauer, F., Trippe, S., Genzel, R., Ott, T., Bartko, H., Pfuhl, O., Bower, G., Goldwurm, A., Porquet, D. Trap, G., Yusef-Zadeh, F.
2011, ApJ, 728, 37
The two states of Sgr A in the near-infrared: bright episodic flares on top of low-level continuous variability*

Gillessen, S., Eisenhauer, F., **Fritz, T. K**., Bartko, H., Dodds-Eden, K., Pfuhl, O., Ott, T., Genzel, R.
2009, ApJL, 707, 114
The orbit of the star S2 around Sgr A from Very Large Telescope and Keck data*

Chatzopoulos, S., Gerhard, O., **Fritz, T.**, Wegg, C., Gillessen, S.
2015, MNRAS, 453, 939
Dust within the old nuclear star cluster in the Milky Way

Schultheis, M., Cunha, K., Zasowski, G., Garcia Perez, A. E., Sellgren, K., Smith, V., Garcia-Hernandez, D. A., Zamora, O., **Fritz, T. K.**, Anders, F., Allende Prieto, C., Bizyaev, D., Kinemuchi, K., Pan, K., Malanushenko, E. Malanushenko, V., Shetrone, M. D.
2015, A&A, 45, 5
Evidence for a metal-poor population in the inner Galactic bulge

Pfuhl, O., Gillessen, S., Eisenhauer, F., Genzel, R., Plewa, P. M., Ott, T., Ballone, A., Schartmann, M., Burkert, A., **Fritz, T. K.**, Sari, R., Steinberg, E., Madigan, A.-M.
2014, ApJ, 798, 111
The Galactic Center Cloud G2 and its Gas Streamer

Pfuhl, O., Alexander, T., Gillessen, S., Martins, F., Genzel, R., Eisenhauer, F., **Fritz, T. K.**, Ott, T.
2014, ApJ, 782, 101
*Massive Binaries in the Vicinity of Sgr A**

Gillessen, S., Genzel, R., **Fritz, T. K.**, Eisenhauer, F., Pfuhl, O., Ott, T., Schartmann, M., Ballone, A., Burkert, A.
2013, ApJ, 774, 44
Pericenter Passage of the Gas Cloud G2 in the Galactic Center

Gillessen, S., Genzel, R., **Fritz, T. K**., Eisenhauer, F., Pfuhl, O., Ott, T., Cuadra, J., Schartmann, M., Burkert, A.
2013, ApJ, 763, 78
New observations of the gas cloud G2 in the Galactic center

Ballone, A., Schartmann, M., Burkert, A., Gillessen, S., Genzel, R., **Fritz, T. K.**, Eisenhauer, F., Pfuhl, O., Ott, T.
2013, ApJ, 776, 13
Hydrodynamical Simulations of a Compact Source Scenario for the Galactic Center Cloud G2

Pfuhl, O., **Fritz, T. K.,** Zilka, M., Maness, H., Eisenhauer, F., Genzel, R., Gillessen, S.; Ott, T., Dodds-Eden, K., Sternberg, A.
2012, ApJ, 741, 108,
The star formation history of the Milky Way's nuclear star cluster

Burkert, A., Schartmann, M., Alig, C., Gillessen, S., Genzel, R., **Fritz, T. K**., Eisenhauer, F.
2012, ApJ, 750, 58
Physics of the Galactic center could G2, on its way toward the supermassive black hole

Schartmann, M., Burkert, A., Alig, C., Gillessen, S., Genzel, R., Eisenhauer, F., **Fritz, T. K.**
2012, ApJ, 755, 155
Simulations of the origin and fate of the Galactic center cloud G2

Bartko, H., Martins, F., Trippe, S., **Fritz, T. K**., Genzel, R., Ott, T. Eisenhauer, F., Gillessen, S., Paumard, T., Alexander, T., Dodd-Eden, K., Gerhard, O., Levin, Y., Mascetti, L., Nayakshin, S., Perets, H. B., Perrin, G., Pfuhl, O. Reid, M. J., Rouan D., Zilkam M., Sternberg, A.,
2010, ApJ, 708, 834
An extremely top-heavy initial mass function in the Galactic center stellar disks

Trippe, S., Davies, R., Eisenhauer, F., Förster Schreiber, N. M., **Fritz, T. K**.; Genzel, R.
2010, MNRAS, 402, 1126
High-precision astrometry with MICADO at the European extremely large telescope

Dodds-Eden, K., Porquet, D., Trap, G., Quataert, E., Haubois, X., Gillessen, S., Grosso, N., Pantin, E., Falcke, H., Rouan, D., Genzel, R., Hasinger, G., Goldwurm, A., Yusef-Zadeh, F., Clenet, Y., Trippe, S., Lagage, P.-O., Bartko, H., Eisenhauer, F., Ott, T., Paumard, T., Perrin, G., Yuan, F., **Fritz, T. K**., Mascetti, L.
2009, ApJ, 698, 676,
Evidence for X-Ray synchrotron emission from simultaneous mid-infrared to X-Ray observations of a strong Sgr A flare*

Bartko, H., Martins, F., **Fritz, T. K**., Genzel, R., Levin, Y., Perets, H. B., Paumard, T., Nayakshin, S., Gerhard, O., Alexander, T., Dodds-Eden, K., Eisenhauer, F., Gillessen, S., Mascetti, L., Ott, T., Perrin, G., Pfuhl, O., Reid, M. J., Rouan, D., Sternberg, A., Trippe, S.
2009, ApJ, 697, 1714,
Evidence for warped disks of young stars in the Galactic center

Trippe, S., Gillessen, S., Gerhard, O. E., Bartko, H., **Fritz, T. K**., Maness, H. L., Eisenhauer, F., Martins, F., Ott, T., Dodds-Eden, K., Genzel, R.
2008, A&A, 492, 419,
Kinematics of the old stellar population at the Galactic centre

Coauthor conference proceedings:

Bochanski, J. J., Willman, B., Caldwell, N., Sanderson, R. E., West, A. A., Strader, J., Brown, W. R., **Fritz, T**., Kallivayalil, N.
2015, AAS meeting #225, 342, 19
Hunting the Most Distant Stars in the Milky Way

Schartmann, M., Burkert, A., Ballone, A., Alig, C., Gillessen, S., Genzel, R., Eisenhauer, F., **Fritz, T.**
2014, IAU Symposium, 303, 342
Hydrodynamical simulations of G2 interpreted as a diffuse gas cloud

Ballone, A., Schartmann, M., Burkert, A., Gillessen, S., Genzel, R., **Fritz, T. K.**, Eisenhauer, F., Pfuhl,

O., Ott, T.
2014, IAU Symposium, 303, 307
Hydrodynamical simulations of a compact source scenario for G2

Gillessen, S. Genzel, R., **Fritz, T. K.**, Eisenhauer, F., Pfuhl, O., Ott, T., Burkert, A., Schartmann, M., Ballone, A.
2014, IAU Symposium, 303, 254
Observations of the gas cloud G2 in the Galactic center

Gillessen, S., Eisenhauer, F., **Fritz, T. K.**, Pfuhl, O., Ott, T., Genzel, R.
2013, IAU Symposium, 289, 29
The distance to the Galactic Center

Schartmann, M., Burkert, A., Alig, C., Gillessen, S., Genzel, R., Eisenhauer, F., **Fritz, T.** Ballone, A.
2012, Proceedings of Nuclei of Seyfert galaxies and QSOs - Central engine & conditions of star formation (Seyfert 2012), 5, 5
Simulations of the origin and fate of the Galactic Center cloud G2

Dodds-Eden, K., Porquet, D., Trap, G., Quataert, E., Gillessen, S., Grosso, N., Genzel, R., Goldwurm, A., Yusef-Zadeh, F., Trippe, S., Bartko, H., Eisenhauer, F., Ott, T., **Fritz, T.**, Pfuhl, O.
2011, ASPC, 439, 309
Flares from Sgr A and their emission mechanism*

Trippe, S., Gillessen, S., Gerhard, O. E., Bartko, H., **Fritz, T. K.**, Eisenhauer, F., Ott, T., Dodds-Eden, K., Genzel, R., Maness, H. L., Martins, F.
2011, ASPC, 439, 232
Kinematics of the old stellar population at the Galactic centre

Gillessen, S., Eisenhauer, F., Bartko, H., Dodds-Eden, K., **Fritz, T. K**., Pfuhl, O., Ott, T., Genzel, R.
2011, ASPC, 439, 157
The power of monitoring stellar orbits

Bartko, H., Martins, F., Trippe, S., **Fritz, T. K**., Genzel, R., Ott, T., Eisenhauer, F., Gillessen, S., Paumard, T., Alexander, T., Dodds-Eden, K., Gerhard, O., Levin, Y., Mascetti, L., Nayakshin, S., Perets, H. B., Perrin, G., Pfuhl, O., Reid, M. J., Rouan, D., Zilka, M., Sternberg, A.
2011, ASPC, 439, 100
Massive young stars in the Galactic center

Bartko, H., Eisenhauer, F., **Fritz, T.**, Genzel, R., Gillessen, S., Martins, F., Ott, T., Paumard, T., Pfuhl, O., Trippe, S.
2008, JPhCS, 131, 2010
Young stars in the galactic center: one or two disks?

Other Coauthor publications:

Kallivayalil, N., Wetzel, A. R., Simon, J. D., Boylan-Kolchin, M., Deason, A. J., **Fritz, T. K.**, Geha, M., Sohn, S. T., Weisz, D. R.
2015, ArXiv 1503.01785, White Paper submitted for Hubble's 2020 Vision
A Hubble Astrometry Initiative: Laying the Foundation for the Next-Generation Proper-Motion Survey

of the Local Group

Walsh, J., Gillessen, S. , Genzel, R., **Fritz, T. K.**, Eisenhauer, F., Pfuhl, O., Ott, T., Schartmann, M., Ballone, A., Burkert, A., Hau, G., Girard, J., O'Neal, J., Bonnet, H.
2013, The Messenger, 153, 25
Following the G2 Gas Cloud towards the Galactic Centre