Sara Buson

Curriculum Vitae

Institut für Theor. Physik und Astrophysik
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Current Position

08.2018 – present **Junior Professor**, *Institut für Theoretische Physik und Astrophysik, by the Chair for Astronomy at Universität Würzburg*, Würzburg, DE.
My research group focuses on studies of active galactic nuclei, blazar variability, multimessenger follow-up transients programs, γ-ray data analysis of potential neutrino sources.

Appointments

12.2018 – 12.2019 **Visiting Assistant Research Scientist**, *University of Maryland, Baltimore County*, MD, USA, Collaboration with NASA-GSFC in perspective of future high-energy multimessenger space missions (such as AMEGO), see e.g., White Paper for Astro2020: Santander, Buson et al (2019 BAAS, 51, 228) "A Unique Messenger to Probe Active Galactic Nuclei: High-Energy Neutrinos" - link.

05.2016 – 09.2018 **NASA Postdoctoral Fellowship**, *based at NASA Goddard Space Flight Center (GSFC)*, Greenbelt, MD, USA, study of flaring blazars, gamma-ray transients within gravitational waves and neutrinos searches.

06.2015 – 04.2016 **Post-Doctoral Research Associate**, *NASA/GSFC, Center for Space Science and Technology, University of Maryland, Baltimore County*, Greenbelt, MD, USA, study of γ-ray blazar spectra and variability, transients within gravitational waves and neutrinos searches; novae at γ-rays.

04.2013 – 04.2015 **Assegnista di Ricerca**, *(Post-Doc) Univ. of Padova, INFN and INAF Research Affiliate*, Flaring blazars, especially study of gravitationally lensed blazars at gamma-rays. Collaboration with several major multiwavelength teams (Veritas, MAGIC, Tuorla, OVRO among others).

Abilitazione Scientifica (Italian habilitation)

Abilitazione scientifica nazionale per il settore 02/A1 per Seconda Fascia (Physics, valid up to 05/10/2024).

Abilitazione scientifica nazionale per il settore 02/C1 per Seconda Fascia (Astronomy, valid up to 11/07/2024).

Education

04.2013 **Physics PhD degree**, *Title: The TeV AGN Portfolio: extending Fermi-LAT analysis into the CTA realm*, Supervisors: D. Bastieri, Univ. of Padova (IT) & Prof. G. Madejski, Univ. Stanford (USA), topics: Blazars at γ-rays in perspective of the upcoming CTA; gamma-ray transient searches, flaring blazars at multiwavelengths.

2013 **Visiting collaborator at Berkeley Space Sciences Laboratory**, project topic included investigation of AGN in context of extragalactic background light (one month, supervisor: Dr. M. Ajello).

2012 **Visiting scholar at Stanford University**, project topic included investigation of the peculiar blazar "neutrino candidate" PKS 1424-418 (one month, supervisor: Prof. G. Madejski).

2009 **Master degree in Physics**, *Title: Observation of VHE Blazars with the Fermi-LAT Telescope*, University of Padova, Supervisors: Prof. D. Bastieri & Dr S. Carrigan.

Fellowship and Awards

20.04.2021 **Officer of the *Order of Merit of the Italian Republic***, *bestowed by the President of the Italian Republic (S. Mattarella)*.
Ufficiale dell'*Ordine al merito della Repubblia Italiana*, onoreficenza conferita dal Presidente della Repubblica Italiana.

23.10.2018 **ISSNAF Award for Young Investigators (astrophysics)**, *competitive award (3k$) assigned at the italian embassy in Washington (DC, USA) to acknowledge the research of Italian young investigators, whose commitment to their discipline of study is innovative and high-impact (by Italian Scientists and Scholars in North America Foundation)*.

2015 **NASA Postdoctoral Fellowship (NPP) - competitive appointment (120k$)**, *awarded by NASA/Goddard Space Flight Center (MD, USA)*.

27.12.2018 **Attestato di Benemerenza**, *by Major of Pernumia (PD, IT)*, to acknowledge the outstanding contribution to the astrophysics field.
"*per i Meriti Accademici e Scientifici, che nel tributarle gli Onori della Comunità Internazionale danno lustro alla Nazione*".

Managerial Responsibilities

Coordination Experience

08.2019 – pres **Reviewing Editor for Journal Experimental Results**, *Physics and Astronomy*, Cambridge Univ. Press (ISSN: 2516-712X), (see this link).

03.2019 – pres **Coordinator: *Fermi*-LAT AGN scientific group**, ($>$ 170 members). Upon being appointed, since this duty could have conflicted with my major commitment on the time-domain task (below), with the $Fermi$ collaboration we decided to let my contribution be at the supporting level for the time-domain one.

03.2016– 03.2019 **Convener: *Fermi*-LAT Flare Advocate group**, ($\sim$ 30 members), Immediate aims: real-time time-domain study, multi-messenger follow up (neutrinos) observations.
Detailed achievements: Coordination of multi-wavelength observations with major current facilities in the context of follow-up publications. Space-based telescopes: *Fermi*-LAT, Swift-XRT/UVOT. Ground-based telescopes: MAGIC, VERITAS, HESS and FACT, HAWC. Neutrino observatories: IceCube, Antares. More than 60 Astronomer's Telegram and Global Circular Network (GCN) issued as leader and co-leader, among which γ-ray follow-up observations of IceCube neutrino alerts.

Organisation Responsibilities

2016/2018 **Board member of the NASA Post-Doc Association**, at NASA-GSFC.

2016/2018 **Organiser of the "*Fermi* Journal Club"**, at NASA-GSFC.

Conference Organisation - selected, major international (attendees $50 - 300$)

2020 **Convener of the 37th International Cosmic Ray Conference (ICRC)**, SOC & LOC member, topic "Space-based Gamma-ray Astronomy", dates: upcoming July 2021, Berlin (DE).

2018 **Convener of the TeV Particle Astrophysics (TeVPA) conference**, SOC member for the topic "Gamma-ray Astronomy", dates: 27/31-08-2018.

2018 **Organiser of the TeVPA pre-workshop on neutrinos and gamma-rays from AGN**, SOC member, DESY/Zeuthen, Berlin, DE, dates: 26-08-2018.

2018 **Organiser of the 8th *Fermi* Symposium**, LOC member, Baltimore, MD, USA, dates: 14/19-10-2018.

2017 **Organiser of the 4th *Fermi*-VERITAS-HAWC Workshop**, SOC member, UMD Unversity, 10/11-03-2017.

2016 **Organiser of the 3rd *Fermi*-VERITAS-HAWC Workshop**, SOC member, Utah Unversity, dates: 20/21-04-2016.

2015 **Organiser of the 6th *Fermi* Symposium**, LOC member, Washington, DC, USA, dates: 9/13-11-2015.

2015 **Organiser of the Workshop Cosmic Rays - Beyond The Standard Model**, LOC member, San Vito di Cadore, Italy, 16/22-03-2014.

2012 **Organiser of the *Fermi*-LAT collaboration meeting**, LOC member, Padova, Italy, dates: 5/9-03-2012.

Professional Experience

Active Member of the following teams:

2008–Present **Member of the *Fermi*-LAT Collaboration**.

2018–2020 **Member of the Zwicky Transient Facility (ZTF) team**, a time-domain survey in the optical energy range.

2014–2018 **Member of The Major Atmospheric Gamma ray Imaging Cherenkov Telescope (MAGIC) Collaboration**.

2016–Present **Member of the All-sky Medium Energy Gamma-ray Observatory (AMEGO) Team**, next-generation wide-aperture discovery mission for high-energy astrophysics led by NASA/GSFC (PI: McEnery).

2017–2019 **Member of the ASTROGAM team**, breakthrough Observatory space mission, similar to AMEGO, that was proposed to the European Space Agency (PI: De Angelis).

and of the following scientific societies:

2015–2019 **Member of the American Astronomical Society (AAS)**.

2014–present **Member of the International Astronomical Union (IAU)**.

Commission of Trust (including reviewing activities)

2019 **Member of PhD committee**, 1) PhD-candidate: E. Marchesini, Univ. Torino IT & Univ. La Plata (AR); 2) PhD-candidate: B. Donaggio, Univ. of Padova (IT).

2016–Pres **Review panel member for NASA Astrophysics programs (9 panels)**, including: NuSTAR, Fermi, Chandra, ADAP ("Guest Investigators",), space-science fellowship programs, NSPIRE. (USA).

2019 **Reviewer for LEaDing Fellows Program**, (NL).

2014/Pres **Peer Reviewer**, *for astrophysics Journals*, (ApJ, MNRAS) and *Fermi* Collaboration publications.

Competitive Scientific Proposals // Self-Rise Funds ($>$ 2M€)

— As Principal Investigator (**PI**) of the telescope-time request / project: including the management of the grant, coordination of the scientific activities and researchers involved.

2020 **ERC Starting Grant**, *MessMapp: Mapping Highly-Energetic Messengers throughout the Universe*, PI, ∼1.5M€.

2020 **Fermi GI-13**, *Enabling Prompt identifications of electromagnetic counterparts to high-energy neutrinos with Fermi-LAT*, Scientific PI, ∼70k$.

2019 **JMU Start-up Funding**, *Variability of blazars*, PI, 20k€ (Univ. Würzburg).

2019 **Bavarian Funding (BayIntAnt)**, *High-Energy transients*, PI, 2k€ (Univ. Würzburg).

2019 **Swift GI-18**, *Follow up of neutrino source candidates*, Scientific PI, 60k$.

2020 **Follow up of a gravitationally lensed, flaring γ-ray blazar**, *Chandra Director's Discretionary Time* (2 DDT), Swift-XRT/UVOT (ToOs, 3-month monitoring campaign), ATCA (DDT, radio, 2-month monitoring), VLBA (monitoring).

2019 **INTEGRAL AO-17**, *Digging into the high-energy Transient and Variable Mine*, 300 ksec.

2018 **XMM-Newton GO**, *Best-Bet Cosmic Neutrino Candidates*, 83 ksec.

2018 **Fermi GI-11**, *Bridging the gap in the census of γ-ray variable sources*, 60k$.

2017 ***Fermi* GI-10**, *Intrinsic absorption in FSRQs: probing γ-ray emission sites in blazar jets*, 60k$.

2016 **NASA NPP Fellowship**, *Pinpointing Fingerprints in the Flat Spectrum Radio Quasars γ-ray spectra*, 120 k$.

2014 ***Fermi*-LAT ToO**, *γ-ray follow-up observations of flaring gravitationally lensed blazar*.

— As co-I of the project: including the coordination of the scientific activities and researchers involved.

2020 **Fermi GI-13**, *The first $> 5\sigma$ detection of periodicities in blazars*, ∼70k$.

2013 **Swift GI-10**, *Investigating the anomalous behavior of extreme blazars*, Scientific PI, 45 k$.

2012/2013 **Swift GI-10; GI-09**, Fermi-*LAT initiated ToO's for bright flaring γ-ray blazars*, co-I, 23k$; 23k$.

Invited Plenary Talks at International Conferences (total: 17)

1) 43rd COSPAR Scientific Assembly, session: E1.17: The Space View of Radio Galaxies, Sydney (AU); dates: 28-01/04-02-2021

2) 43rd COSPAR Scientific Assembly, session: E1.6: X- and Gamma-ray Counterparts of New Transients in the Multimessenger Era, Sydney (AU); dates: 28-01/04-02-2021

3) Town Hall KM3NeT Meeting: Invited talk on *Fermi-LAT: an ideal partner for neutrino observatories*, dates: 17/19-12-2019

4) PAHEN Meeting: Invited talk on *High-energy neutrinos from AGNs? (the case of TXS 0506+056/IC170922A)*, dates: 25-27-09-2019

5) 12th INTEGRAL Conference, 1st AHEAD Gamma-ray Workshop, Geneve (SW): Invited talk on *Linking Electromagnetic Observations to Neutrino Astrophysics*, dates: 11/15-02-2019

6) TeV Particle Astrophysics (TeVPA) conference, Berlin (DE): Invited talk on *Hunting neutrino sources with the Fermi-Large Area Telescope*, dates: 27/31-08-2018

7) High Energy Astrophysics in Southern Africa conference (HEASA), Free State (South Africa): Invited talk on *Cosmic Synergies between Gamma rays and Neutrinos*, dates: 1/3-08-2018

8) 15th Marcell Grossman Conference, Rome (IT): Invited talk on *Neutrinos and gamma-rays from blazars*, dates: 1/7-07-2018

9) Vulcano Workshop, Vulcano (IT): Invited talk on *Flaring gamma-ray AGNs*, dates: 20/26-05-2018

10) AGILE Symposium, Rome (IT): Invited talk on *Short-Timescale Variability of Gamma-ray Blazars Detected by Fermi*, dates: 11/13-12-2017

11) ShanghaiTech Summer School, Asiago (IT): Invited talk on *The Dawn of the Multi-Messenger Astronomy: Exploring the Extreme Universe with Cosmic Messengers*, dates: 17-08 / 06-09-2017

12) Workshop on Perspectives on the Extragalactic Frontier, ICTP Trieste (IT): Invited talk on *Fermi, an Ideal Partner for Gravitational Waves Observatories*, dates: 2/6-05-2016

13) The Future of Research on Cosmic Gamma Rays, La Palma, Canary Islands (ES): Invited review on *Fermi Highlights and Perspectives*, dates: 26/29-08-2015

14) Mondello Workshop, Palermo (IT): Invited review on *The Extragalactic Background Light: the emission from all stars and black holes*, dates: 26/31-05-2014

15) 10th SciNeGHE Workshop, Lisbon (PT): Invited talk on *Gamma Ghosts and Gravitational Lensing*, dates: 4/6-06-2014

16) Vulcano Workshop, Vulcano (IT): Invited talk on *Flaring gamma-ray AGNs*, dates: 18/24-05-2014

17) Les Rencontres de Physique de la Vallee d'Aoste, La Thuile (IT): Invited review on *An extreme point of view: the Fermi gamma-ray sky*, dates: 23-02 / 01-03-2014

18) The Roma International Conference on Astroparticle Physics, Rome (IT): Invited talk on Fermi-*LAT recent results on AGNs*, dates: 21/24-05-2013

19) GAMMA 400 Workshop, Trieste (IT): Invited talk *Fermi-LAT extragalactic gamma-ray highlights*, dates: 2/4-05-2013

Contributed Presentations/ solicited Seminars (total: 20) Selected:

2017 16th High Energy Astrophysics Division (HEAD) meeting, Sun Valley, Idaho: contributed talk *The Cosmic Monster Quest: Hunting MeV Blazars with AMEGO*, dates: 20/24-08-2017

2017 American Physical Society (APS) April meeting, Washington, DC: contributed talk *Depicting the MeV realm with the Compton Pair-Production Telescope (ComPair)*, dates: 28/31-01-2017

2016 227th American Astronomical Society (AAS) meeting, Kissimmee, FL: contributed talk *Galactic Novae using* Fermi-*LAT Pass 8*, dates: 4/8-01-2016

2015 34th ICRC, The Hague, The Netherlands: contributed talk *Gamma-ray Flares from the gravitationally lensed blazar B0218+357*, dates: 29-07 / 6-08-2015

2019 Colloquium at UCM Madrid (SP): *The dawn of neutrino astronomy: high-energy neutrinos from AGN?*, date: 12-12-2018

2018 Colloquium at SISSA Trieste (IT): *New roadmaps throughout the Universe*, date: 6-9-2018 (about neutrino/AGN gamma-ray connection)

2018 Colloquium at Würzburg Univeristy (DE): *New roadmaps throughout the Universe*, date: 3-12-2018 (about neutrino/ AGN gamma-ray connection)

2018 Colloquium at NASA/GSFC (USA): *A Suggestive Link between Neutrino and Gamma-ray Astronomy*, date: 12-07-2018. This talk followed the NSF press conference announcement of the discovery of the first neutrino cosmic source)

2016 Colloquium at Univ. of Padova (IT): *Fermi challenges Einstein: an ideal partner for Gravitational Waves Observatories*, date: 10-05-2016

2013 Colloquium at Berkeley Space Sciences Laboratory, Berkeley (USA): *Fermi Science Highlights*, date: 15-11-2013

2012 Colloquium at KIPAC, Stanford (USA): *Peculiar behaviour of the blazar PKS1424-418*, date: 19-10-2012

About ten poster contribution to conferences (not listed)

Mentoring and Teaching Experience

Students mentoring / tutoring activities

2018/2019 Group meeting: mentoring and tutoring the students that I supervise during the year. Topics include AGN studies and machine learning for astrophysics, 1hr per week at Univ. of Würzburg.

Master Courses

2019/2020 Lecturer of the course "Hochenergie Astrophysik" (High-Energy Astrophysics) at the University of Würzburg, Master level, focus: active galactic nuclei, astrophysical jets. Winter semester course, 4 hours per week, ECTS: 6

2018/2019 Lecturer of the course "Oberseminar Theoretische Physik" at the University of Würzburg, Master level, focus: high-energy astrophysics, gravitational waves, neutrino astronomy. Summer semester course, 2 hours per week, ECTS: 4

2018/2019 Lecturer of the course "Hochenergie Astrophysik" (High-Energy Astrophysics) at the University of Würzburg, Master level, focus: active galactic nuclei, astrophysical jets. Winter semester course, 4 hours per week, ECTS: 6

2019/2020 co-Lecturer of the course "Hauptseminar Theoretische Physik" at the University of Würzburg, Bachelor level, focus: quantum mechanics. Summer semester course, 2 hours per week, ECTS: 4

2019/2020 co-Lecturer of the "Astropraktikum" Course at the University of Würzburg, Master level, focus: astrophysical data analysis of space-based instruments. Summer semester course, 4 hours per week, ECTS: 6

Advanced Courses

2019 Lecturer at *Bad Honnef Physics School on Plasma-Astroparticle Physics*, Bad Honnef, Germany; 4 hours. The school is aimed for PhD students and PostDocs. Topic: Active Galactic Nuclei, dates: 21/25-01-2019.

Tutor of astrophysical data analysis

2013 Lecturer at the Workshop *High-energy gamma-ray astrophysics: from solar activity to black holes*, Sesto, Italy. Topic: data analysis; 2 hours.

2012 Tutor for the Master Course in Astronomy and Astrophysics *AstroMundus* (part of the *Erasmus Mundus* program funded by the European Community), Asiago, Italy. Topic: data analysis; 4 hours.

SUPERVISOR of graduate and undergraduate work

Upon joining as a Professor the Chair of Astronomy at the University of Würzburg in mid-2018, I have the opportunity to supervise students:

MASTER students (1)

2019-2020

- Sarah Wagner, Univ. Würzburg. Master Thesis Title: Statistical properties of the high-energy gamma-ray flux variation of blazars. Primary supervisor.

BACHELOR students (1)

2019

- Aurora Micheli, Univ. of Torino (IT), Bachelor Thesis Title: Analysis of the gamma-ray lightcurve of a bright blazars detected by the *Fermi*-Large Area Telescope. Primary supervisor during a three-month internship at Univ. Würzburg through the ERASMUS program.

SUPERVISOR of interns at JMU Würzburg

2020

- Alice Bonino, Univ. of Torino, (IT); Post-Master Erasmus internship; carried out remotely due to covid-19 emergency. Focus: electromagnetic signatures of binary black hole systems.

SUPERVISOR of summer interns at NASA/GSFC

During the 3.5 years (2015-2018) spent as an NPP Fellow at the NASA-GSFC there were limited opportunities to mentor students being that a research laboratory. Besides, my position did not allow to teach courses. However, I always took the chance to interact with students when possible. For instance, taking advantage of the NASA/GSFC summer internship program, I supervised:

2017

- ShiQuoi Isaac, University of the Virgin Islands
  Project: "Analyzing Gravitationally Lensed Blazars with *Fermi*-LAT"

Co-SUPERVISOR of graduate and undergraduate work

During my PhD and Post-Doc at the University of Padova (2009-2015) I have co-supervised the following students with Prof. Bastieri. Thesis topics include blazar studies, among which gamma-ray and multi-wavelength spectral and temporal variability properties, gravitationally lensed objects; space and time clustering of high-energy photons, improvements of gamma-ray analysis techniques.

MASTER students (5)

2016

- Denise Constantin,
  Thesis: "Spatial and Time Clustering of High-Energy Photons collected by the *Fermi*-LAT"

2015

- Giacomo Principe,
  Thesis: "Space and Time Clustering of High-Energy Photons detected by the *Fermi*-LAT"

2014

- Andrea Pigato
  Thesis: "The imprint of new Physics in AGN cutoffs – low redshift sources"

2012

- Valentina Tronconi
  Thesis: "Discovery of high energy emission from 1ES 0033+595: a BL Lac blazar shining through the Galactic plane"
- Carlo Romoli
  Thesis: "Multiwavelength Observation of the BL Lacertae Object OJ 287 During an Intense Flaring Episode detected by the $Fermi$-LAT"

BACHELOR students (8)

2014

- Martina Nicoletti
  Thesis: "L'autocorrelazione nella curva di luce della blazar B0218+357"

- Simone Fiorentini
  Thesis: "Identifying spectral features in $Fermi$-LAT blazars"
- Valeria Milotti
  Thesis: "Searching for clusters of high-energy photons in the $Fermi$-LAT sky"
- Giulio Lucchetta
  Thesis: "Characterization of 3c454.3 SED with the $Fermi$-LAT"
- Francesco Berlato
  Thesis: "Multiwavelength characterization of the blazar NRAO190"
- Luca Foffano
  Thesis: "High resolution gamma-ray spectroscopy with $Fermi$-LAT"

2013

- Giacomo Principe
  Thesis: "Analysis of 1ES 1959+650 in a multiwavelength context with $Fermi$-LAT"

2011

- Leonardo Pigatto
  Thesis: "Episodi di estrema variabilitá nella blazar 4C 38.41"

Outreach Activities - Attività di servizio e di terza missione

My Philosophy: *"What's the point of learning fascinating science if we don't share it?!"*

2020 JMU Würzburg press release on gamma-ray periodicity in active galactic nuclei (english weblink - german weblink).

2020 Solicited speaker at the event "Nello Spazio - Museo M9 Mestre - Venezia" with public outreach talk "Oltre la luce - Nuovi messaggeri per esplorare l'Universo", Mestre - Venezia (IT), date: 08-02-2019 (∼200 attendees)

2019 Solicited speaker at the event "La Notte sotto la Rocca" with public outreach talk "Oltre la luce - Nuovi messaggeri per esplorare l'Universo", Monselice (PD, IT), date: 20-09-2019 (∼80 attendees)

2019 Solicited speaker at the "Night of Science", organised by the Fachschaft Physik, with public outreach talk about astrophysics, Würzburg (DE), date: 29-06-2019 (∼200 attendees)

2019 Solicited speaker at TEDx-Padova, Public outreach talk about multi-messenger astrophysics, Padova (IT), date: 25-05-2019 (∼1000 attendees, talk available at this link[1]).

2018 Public outreach talk about multi-messenger astrophysics. Title: *Messaggeri Celesti: L'Alba dell'Astrofisica Multi-Messaggera*, Pernumia (PD, IT), date: 28-12-2018 (∼150 attendees).

Masterclass:

2019 "Fermi masterclass", teaching γ-ray analysis to high-school students; outreach talk to high-school students about high-energy astrophysics, Perugia (IT), date: 5/6-04-2019

2016-2018 MENTOR for the Maryland Institute College of Arts (MICA) students. In this collaboration between NASA-GSFC and MICA, students are introduced to science topics related to the *Fermi*-LAT satellite and develop animations based on those topics. During the 2016 collaboration, I introduced the gravitational lensing effect to the MICA students. The result of the collaboration is the "Space Pirates" play that gained the "audience award" at the 2016 MICA Animation Festival. In 2018, I chose the topic multi-messenger astronomy, with focus on neutrino and gamma-ray connections. More information about this program at this link. Animations are available at this link.

2018 Talk to students of the College of Arts (MICA) about gamma rays and neutrinos connections, Baltimore (MD, USA).

2017 Talk to students of the College of Arts (MICA) about blazars and studies with the *Fermi*-LAT, Baltimore (MD, USA).

2016 Promotion of science and learning with the NASA "Global Learning and Observations to benefit the Environment Program". Specifically, participation as a reviewer at the "Northeast & Mid-Atlantic U.S. Science Fair", Greenbelt (MD, USA).

Software and Hardware Experience

- General: HTML, LaTeX, OpenOffice, Linux, Microsoft Windows, Mac OS
- Astrophysical data-analysis software: PYTHON, HEASARC TOOLS, FTOOLS, ROOT, GEANT and MEGAlib (simulations for hard-X-rays/MeV telescopes); XSPEC; *Fermi*-LAT ScienceTools

Languages

- Italian: Mothertongue
- English: Fluent
- German: Basic - learning
- Spanish: Basic

Research activity / Publications

These are provided as a separate document upon request.