



RadioNet support for Short Term Missions (staff exchange)



Application form

STM INFORMATION	
APPLICANT 'S NAME	Francisco Javier Beltrán Martínez
APPLICANT'S AFFILIATION	Observatorio de Yebes. Instituto Geográfico Nacional - UAH
HOST INSTITUTE	Max Planck Institut fuer Radioastronomie. Auf dem huegel 69, Germany. Helge rottmann.
DATE OF THE STM	April/May 2020
TOTAL COST OF STM	1500€
OTHER SOURCES OF FUNDING	IGN internal funds
Request	
Topic	<p>The goal of this Short Training Stay is that the Observatory of Yebes (via the Universidad de Alcalá de Henares, the current Radionet partner) acquires experience in the development of the so called universal digital backends.</p> <p>Traditionally radio astronomy has used specific backends for different types of observations, like for example for spectral observations, continuum observations, pulsar observations or VLBI (Very Long Baseline Interferometry). That means that the signal from the receiver, once converted to a lower frequency, is divided into different channels to feed such systems. This implies a multiplication of hardware with all the costs of operation and maintenance this causes and suffers some lack of flexibility if new processing is required.</p> <p>The current tendency at the most advanced institutes of Radioastronomy is to go for a universal backend that has flexibility and can be reprogrammed according to the needs of the observers. Furthermore, the trend is to avoid the downconversion and directly sample the signal after it has been amplified in a cryogenic receiver equipped with feeds and low noise amplifiers. This process is state of the art and involves a high processing capacity and the transfer of data from the frontends to the backends room. The signal can be processed by specialized firmware.</p> <p>The Observatory of Yebes manages two radiotelescopes at Yebes: a 40 m dish and a VGOS 13.2 m diameter dish. The latter forms part of RAEGE, a network composed of four 13.2 m radiotelescopes devoted to geodetic VLBI. RAEGE is a joint project between the Regional Government of Azores and the Spanish National Geographical Institute,</p> <p>The Yebes 13.2 m radiotelescope is the first element of the network in operation since 2016. A second one in Santa Maria, Azores Islands, is operative since 2018. In the future two more radiotelescopes will be built, one in the Canary Islands and another one in Flores, Azores.</p> <p>The 40m radiotelescope is devoted to spectral and continuum observations as a single dish telescope and to VLBI as an element of the EVN and the GMVA. It has no backend for pulsar observations. As for the 13.2m radiotelescopes they are equipped with VLBI backends.</p> <p>The Observatory of Yebes is very interested in developing a universal backend that can be used for different features such as VLBI, pulsar and molecular line observations at all its telescopes since that would provide a great flexibility. Furthermore, it would allow to adopt flexible solutions against RFI by masking certain frequencies or increasing the number of digitizing bits to get a larger dynamic range that avoids saturation of the signals. Currently the Observatory of Yebes has no experience on this field and would like to acquire</p>

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RadioNet has received funding from the EU's Horizon 2020 research and innovation programme under grant agreement No 730562

	<p>knowledge and experience on it. This experience probably requires the implementation of solutions using GPUs and FPGAs. Both are used to handle the processing of large amounts of data in short periods of time, which is a considerable improvement over backends manufactured so far.</p> <p>Experience in Yebes will be beneficial for the different networks in which it participates internationally, as well as for its single dish observations where it would increase its capabilities by being able to use its antennas in pulsar mode.</p> <p>Max Planck Institut fur Radioastronomie in Bonn has been working on Universal Backends during the last 5 years and has an extraordinary valuable experience on this technique. It is been used for MeerKat and SKA and for the two receivers to be installed at the new 40m NARIT radiotelescope at Chiang Mai in Thailand. The MPIfR is an optimum place to learn implementation of digital backends and we believe that a short mission at its labs in Bonn would be a first step to acquire experience.</p>
Proposed work	<p>Learn how to setup a complete functional universal digital backend. Introduction to the different components of the backend, the tasks of each part and its implementation via software/firmware. Sampling, digitalizing and signal transport are the keys issues to be learned.</p> <p>Implementation of the firmware needed for the data integration and the configuration of the different operating modes. Some interesting topics are the change between modes, the commands and the parameters needed and if they must fit a standard, know the different output data formats available and how is it transmitted to the other system parts, and others.</p> <p>Get knowledge of the tools available to develop this type of code including the debugging. Tests during observations and understanding how it works for the different modes.</p> <p>Identification of observational problems such as RFI, oscillators' instability and other well-known issues, through the interpretation of the output data.</p>
Cross-disciplinary	<p>The stay of F^{co} Javier Beltrán from the Observatory of Yebes in MPIfR will be a first step to acquire expertise in the development of digital backends in Yebes. His knowledge will be transferred to young people and students to arrive in the future at Yebes and to colleagues currently working at the Observatory.</p>
Impact	<p>The relation between radio astronomy and industry has been solidly demonstrated through the years. Radio astronomy demanding needs are a driver for the industry development that can be applied to society in a posterior stage. On the other hand solutions developed and applied to radio astronomy may be transferred to industry and society in general. There are well known cases of such transfers like the synthesis aperture which is used for digital treatment of images obtained from medical scans (TAC).</p> <p>The digital backend development is an example of both cases. The hardware solution is an example of the first case, where its usage in radioastronomy and VLBI observations can be applied in other industry areas, such as RADAR or space communications. The second one is a frequent case in software development where the scientific community plays a special role in algorithm production that are latter adopted by others in many areas such as AI, economy, or biotechnology.</p>
Curriculum Vitae	<p>Education</p> <ul style="list-style-type: none"> • 2016 – Universidad de Alcalá, Master's Degree in Telecommunications Engineering • 2014 – Universidad de Alcalá, Bachelor's degree in Telecommunications Systems Engineering <p>Experience Skills</p> <ul style="list-style-type: none"> • Development of control and data acquisition systems for radiotelescopes • Programming of graphical tools for monitoring and laboratory measurements

	<ul style="list-style-type: none"> • LAN network design • Radioastronomy basics • Programming languages: C++, Java, Python. <p>Publications</p> <ul style="list-style-type: none"> • June 2019, "Broad-band high-resolution rotational spectroscopy for laboratory astrophysics". In Astronomy & Astrophysics, Volume 626, A34. • March 2019, "Instrumentation Developments for VGOS at IGN-Yebes Observatory". Conference paper of the 24th EVGA Meeting. • 2018, "The Status of RAEGE". Conference paper of the IVS 2018 General Meeting Proceedigs. <p>Languages</p> <ul style="list-style-type: none"> • Spanish – Native • English - Fluent
<p>Privacy Policy: With signing this template and applying for RadioNet funding, I accept the <u>Privacy Policy of RadioNet</u>, which is based on the EU General Data Protection Regulation (GDPR).</p>	
<p>Place & Date: _____ Signature of the applicant: _____</p>	
<p>29-01-2020</p>  <p>.....</p> <p>Date and Signature of the applicant</p>	<p>I confirm that the proposed STM is in compliance with the agenda of my organisation</p> <p>29-1-2020</p>  <p>.....</p> <p>Date and Signature of the director of the home institute</p>



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29th Jan 2020

To Whom It May Concern

Herewith we invite


Francisco Javier Beltrán Martínez

from the Observatorio de Yebes for a technical short term mission to the Max Planck Institute for Radioastronomy (MPIfR), Bonn, Germany.

Francisco Martínez will work with the lead for the Backend development at the MPIfR Electronics Division on generic backend systems. The duration of his mission is set to two weeks and will be organized in the April/May 2020.

We understand that Francisco Martínez has his own funding for travel and living and is requesting support funding from RadioNet.

Sincerely,


MAX-PLANCK-INSTITUT
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Training:

- **2014-2016: Master's Degree Telecommunications Engineering.**
University of Alcalá (Spain).
- **2010-2014: Bachelor's Degree Telecommunications Systems Engineering.**
University of Alcalá (Spain).

Other courses:

- **2013:** CST Microwave Studio seminar, University of Alcalá (8 hours).
- **2013:** Online course "An Introduction to Interactive Programming in Python", Rice University (90 hours).

Languages:

- Spanish (native)
- English (B2 level)

Professional experience

- **2014-Present: Observatorio de Yebes, working on the development of control systems for radiotelescopes.** At the beginning as a collaborator grant of the University of Alcalá (2014-2016), later as a grant of the Instituto Geográfico Nacional (2016-2019) and currently as a civil servant of the Instituto Geográfico Nacional (2019-Present).

Experience skills

- Development of control and data acquisition systems for radiotelescopes and spectroscopy laboratories.
- Programming of graphical tools for monitoring and laboratory measurements.
- LAN network design.
- Radioastronomy basics.
- Good knowledge of Windows and Debian (Linux) operative systems.
- Programming languages: C++, Java, Python.

Publications

- López-Pérez JA, Tercero F, Serna JM, Vaquero B, Patino M, García-Carreño P, González-García J, García-Pérez Ó, Beltrán FJ, Albo C, Gallego JD, López-Fernández I, Díez-González C, Malo I, Barbas L, de Vicente P, López-Fernández JA. 2019. *A Tri-band Low-*

noise Cryogenic Receiver for Geodetic VLBI Observations with VGOS Radio

Telescopes. Preprints 2019, 2019120408 (DOI: 10.20944/preprints201912.0408.v1).

- López-Pérez JA, Tercero F., Serna JM, Vaquero B, Patino M, García-Carreño P, Gallego JD, Malo I, López-Fernández I, Díez-González C, González-García J, García-Castellano A, Albo C, López-Ramasco J, Barbas L, Bautista M, García-Pérez Ó, Beltrán FJ, Baldominos A, Amils R, de Vicente P, López-Fernández JA. 2019. ***Instrumentation Developments for VGOS at IGN-Yebes Observatory***. 24th EVGA meeting, March 17-19, 2019, Gran Canaria, SPAIN.
- Cernicharo J, Gallego JD, López-Pérez JA, Tercero F, Tanarro I, Beltrán FJ, de Vicente P, Lauwaet K, Alemán B, Moreno E, Herrero VJ, Doménech JL, Ramírez SI, Bermúdez C, Peláez RJ, Patino M, López-Fernández I, García-Álvaro S, García-Carreño P, Cabezas C, Malo I, Amils R, Sobrado J, Díez-González C, Hernández JM, Tercero B, Santoro G, Martínez L, Castellanos M, Vaquero B, Pardo JR, Barbas L, López-Fernández JA, Aja B, Leuther A, Martín-Gago JA. 2019. ***Broad-band high-resolution rotational spectroscopy for laboratory astrophysics***. A&A 626 A34 (DOI: 10.1051/0004-6361/201935197)
- de Vicente P, González-García J, López-Pérez JA, Bolaño R, S. García Espada S, P. García-Carreño P, Beltrán FJ, Patino M, García-Pérez Ó, Serna JM, Vaquero B, Malo I, López-Fernández JA. 2018. ***The Status of RAEGE***. International VLBI Service for Geodesy and Astrometry 2018 General Meeting Proceedings: "Global Geodesy and the Role of VGOS - Fundamental to Sustainable Development", Eds. Kyla L. Armstrong, Karen D. Baver, Dirk Behrend, NASA/CP-2019-219039, p. 3-6.
- López-Ruiz S, Tercero F, López-Fernández JA, Seog-Tae H, López-Espí PL, Sánchez-Montero R, Beltrán FJ. 2016. ***Multi frequency feed system for high magnification cassegrain radiotelescopes at millimeter wavelengths***. 46th European Microwave Conference (EuMC), London, 2016, pp. 1275-1278 (DOI: 10.1109/EuMC.2016.7824583).

Other information

- Availability to travel.
- License of car.