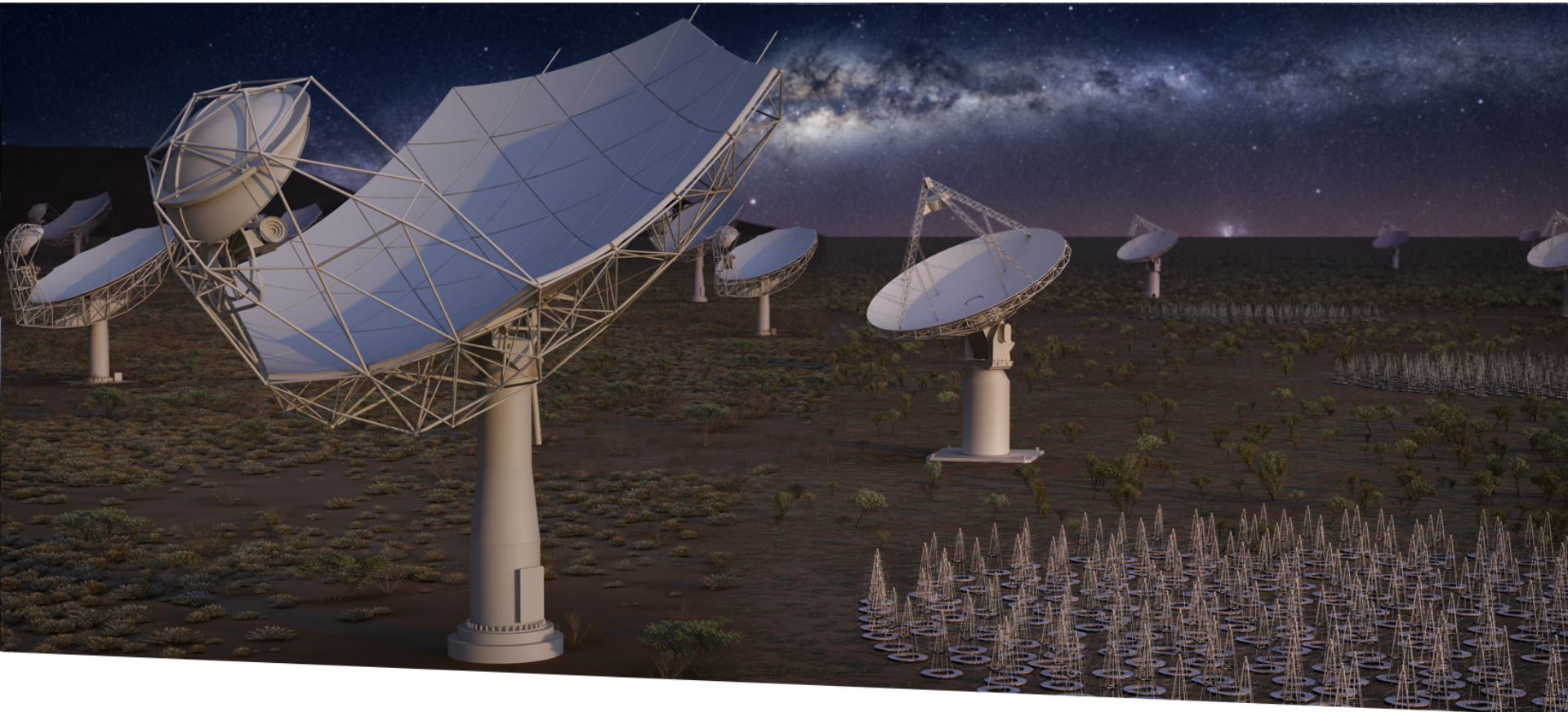


Pycraf for compatibility studies



SQUARE KILOMETRE ARRAY

Exploring the Universe with the world's largest radio telescope

IUCAF SM School

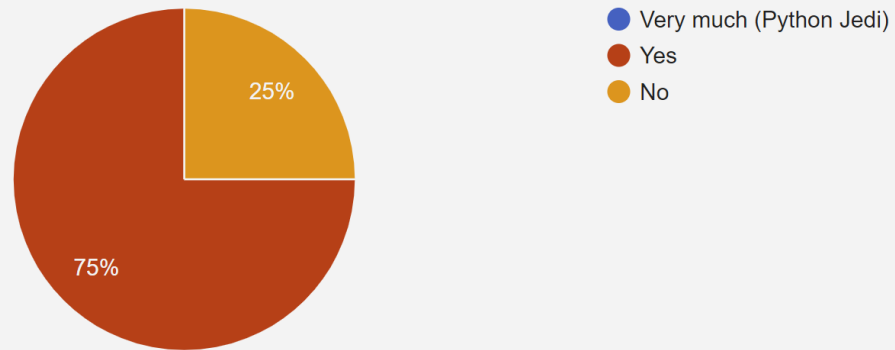
F. Di Vruno 05/03/2020

Survey



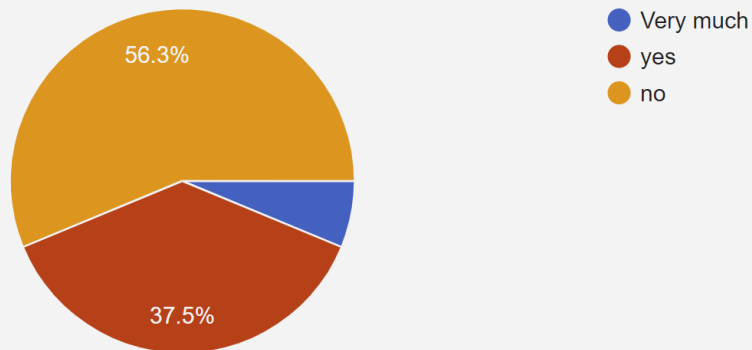
Are you familiar with Python language?

16 responses



Are you familiar with compatibility studies for Spectrum Management?

16 responses



What are we trying to do?

- Basics of sharing or compatibility studies
- Starting point with python and pycraf
- How to use the relevant documentation
- Have some fun 😊

This **IS HANDS ON**, if you where not able to install pycraf, please join a partner!

Basics of a sharing or compatibility study

- Frequencies involved
 - In band, adjacent band, nearby band.
- First order assessment
 - s-E, E-s, s-s, MLS, FS, BS, etc.
- Generic study:
 - Technical parameters: BW, modulation, EIRP, Gtx, Grx, protection thresholds, time characteristics, etc.
 - Minimum Coupling Loss, LoS, Atmospheric attenuation (Ag)
- Particular study:
 - Considering Terrain
- Propagation model: P.452-16 covers from 0.1 GHz to 50 GHz

Pycraf for compatibility studies

Pycraf basics

- Import and using modules
- Pycraf uses dictionaries extensively
- Astropy Units (Astropy.units)
- Pycraf conversions (pycraf.conversions)
- Protection levels (pycraf.protection)
- Attenuation, terrain maps and paths (pycraf.pathprof)
- Plotting (matplotlib.pyplot)
- Others:
 - Satellite, Antenna Patterns, Monte Carlo helpers

Virtualbox

- Create new VW
 - Linux
 - Ubuntu x64
- Assign disk unit (the one provided)
- Enable parallelization
 - Settings → System → Acceleration: KVM
- Cross your fingers.....
- Password: osboxes.org
(credit for providing the basic Kubuntu www.osboxes.org)

Ready? Always aim high...

Exercise 1: Small satellite constellation gateways 148.9-150.05 MHz

Swarm Technologies, Inc. (Swarm) is a U.S. corporation that has United States Federal Communications Commission (FCC) authorization to launch and operate an innovative constellation of 150 small two-way communications satellites in the non-voice, non-geostationary (NVNG) Mobile-Satellite Service (MSS) very-high frequency (VHF) bands in Low Earth Orbit (LEO). Swarm has filed via the USA before the ITU and a coordination request has been published under the name USASAT-NGSO-7 in Special Section CR/C 4998 in BR IFIC 2901 on 6 August 2019. ([from SE40\(20\)005_WI](#))

This system will be using 137-138 MHz band for downlink and 148-150.05 MHz for uplink.

In Region 1 there is a protected RAS band in 150.05-153 MHz.

You are a Spectrum Manager within the Netherlands and you come to know that there has been a request to install a satellite ground station near LoFAR. You must make a case to get the necessary separation distance so that the protection criteria is met.

Exercise 2: Kepler's Anniversary

Johannes Kepler was born on December 27, 1571. To celebrate his 450th anniversary, the government of the state of North-Rhine-Westphalia decides to switch off all artificial light sources on December 27, 2021, so that people can finally enjoy the stars in the sky in the middle of Europe.

Unfortunately, hundreds of amateur astronomers make themselves ready to use their sophisticated and highly automated optical telescopes during this night. It is well known, that especially the Pro-OBS-2000 telescope motorized mount has insufficient shielding and produces radio frequency interference at multiples of an oscillator running at 48.5 MHz. One of the harmonics happens to lie at 1406.5 MHz, close to the important 21-cm HI line at 1420 MHz and well within the protected RAS band.

Therefore, the German administration has asked you, to provide the necessary calculations to determine a protection zone around the 100-m radio telescope at Effelsberg, such that no harm is put to radio observations on that night.