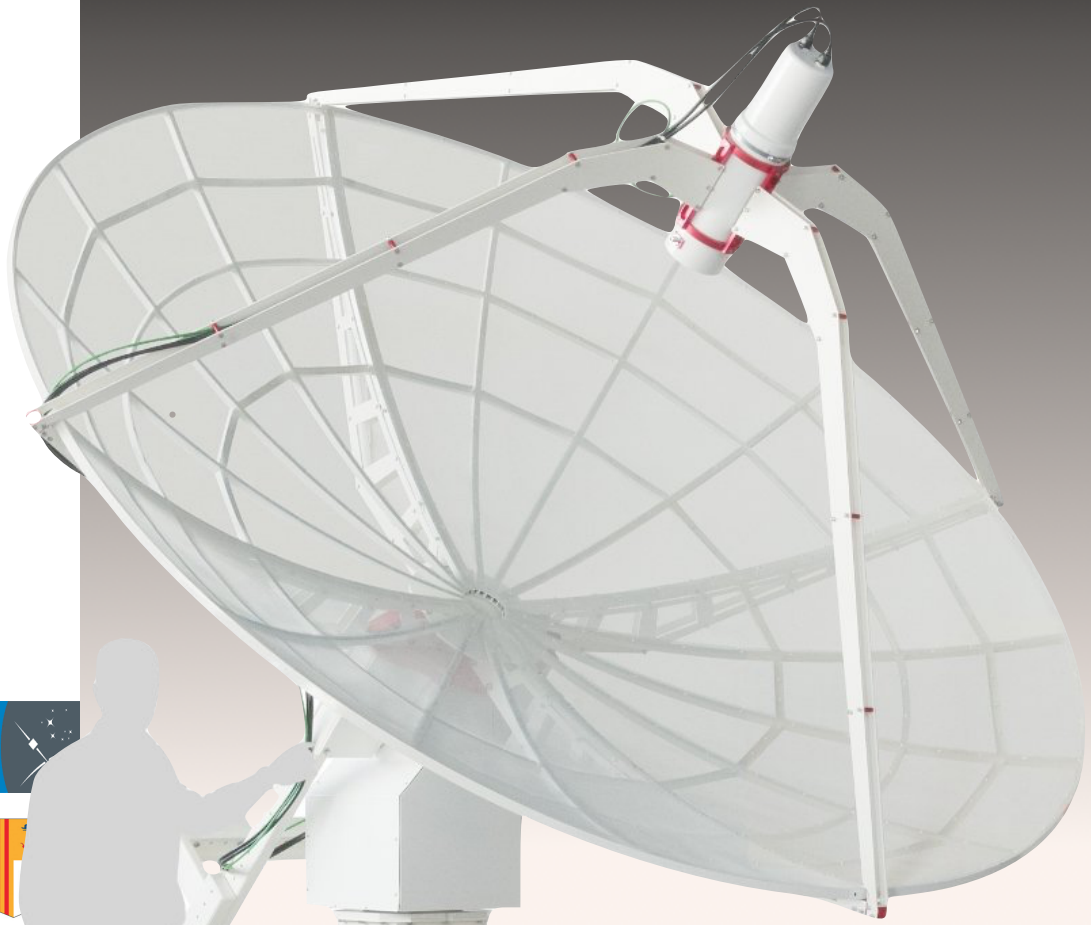
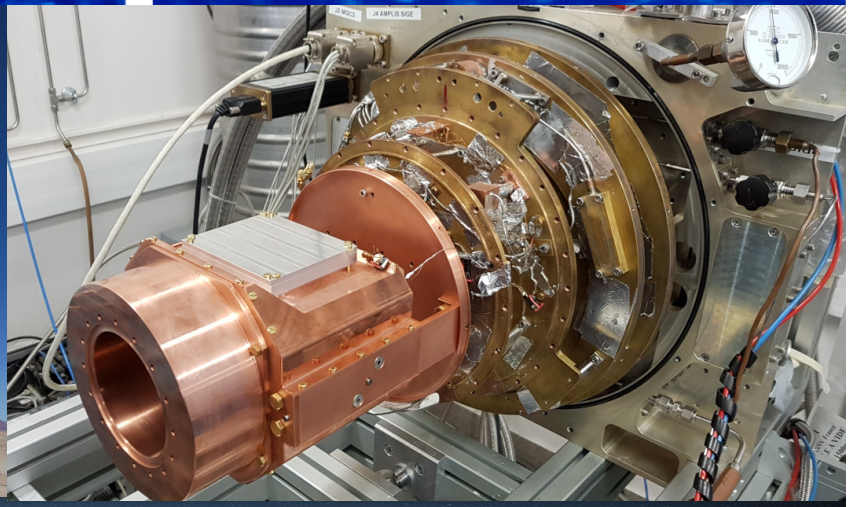
Radio @ OHP

Carlo Schimd, LAM - IPhU days, February 10-11, 2022



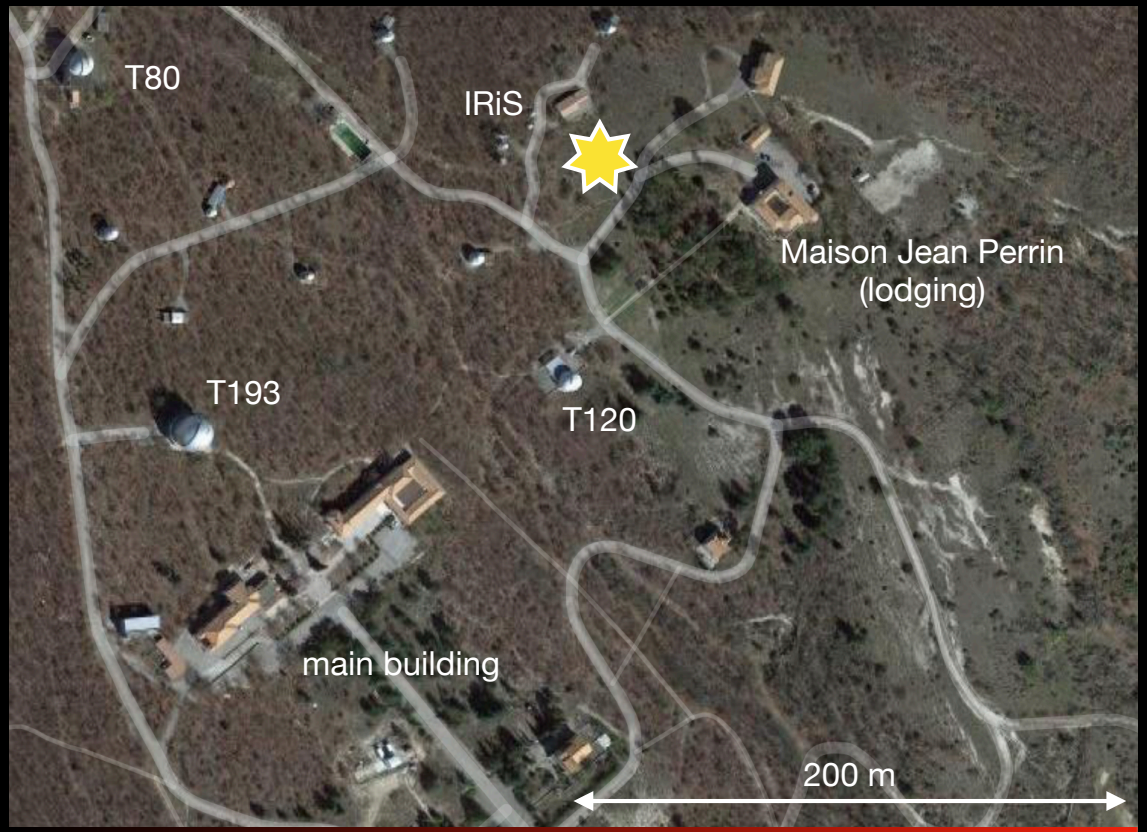
Observatoire de Haute-Provence

Concerto



Radio @ OHP

Carlo Schimd, LAM - IPhU days, February 10-11, 2022



BENEFIT:

no time loss: observations possible day&night if wind < 50 km/s

optical obs hampered by unstable weather conditions: 68% clear nights/yr

GOALS:

★ Undergraduate lectures @ (Bachelor and) Master in Physics: e.g.
M1: Astrophysics (project based)
M2: Astronomical observations at OHP, *next Instrument Scientist option*

★ …opening to R&D in μelectronics & telecom @ Ecole Centrale Marseille (L/M), Polytech Marseille (Cycle ingénieur), IUT (LP EPOCS)

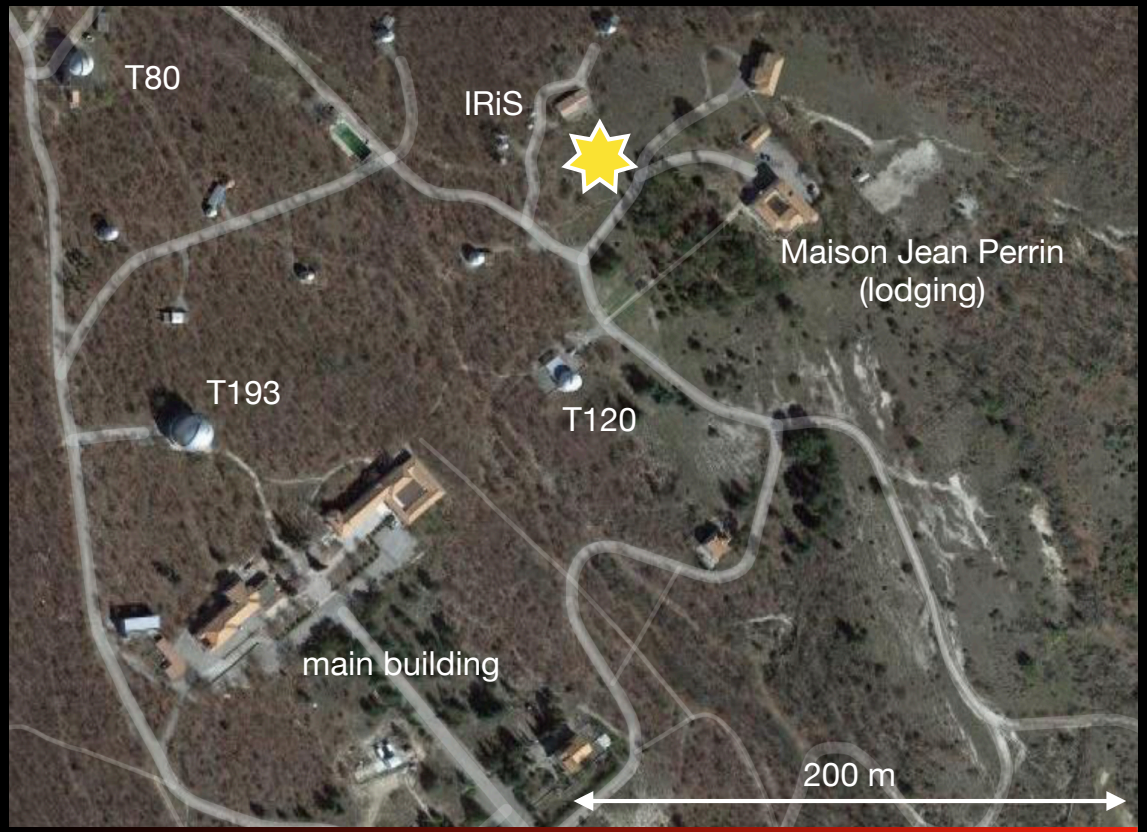
★ High-school lectures on (radio)astronomy research (Rectorat)

★ Outreach

- **Antenna diameter:** 3 m
- **Antenna type:** Prime focus, parabolic
- **Working frequency:** 1420 MHz
- **Bandwidth:** 50 MHz
- **Feed:** H-FEED, optimized for 1420 MHz
- **LNA:** 2 high gain and stability 1420 MHz LNA units
- **Polarization:** circular, left and right hand
- **Receiver:** H142-One for 1420 MHz radio astronomy
- **Spectrometer:** 1024 channels (61 kHz each)
- **Radiometer:** 50 MHz instantaneous bandwidth
- **A/D converter:** 14 bits
- **Mount:** WP-100 computerized alt-azimuth
- **Pier:** C106-HEAVY High load capacity pier for concrete base
- **Remote control:** yes (internet + *webcam*)
- **Maximum slewing speed:** 90°/min (+anemometer)
- **Control software:** RadioUniversePRO (+ *Stellarium*)
- **Weatherproof:** Yes

Radio @ OHP

Carlo Schimd, LAM - IPhU days, January 11-12, 2021



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- ★ High-school lectures on (radio)astronomy research (Rectorat)
- ★ Outreach

SKA FRANCE
SQUARE KILOMETRE ARRAY

Nice – 14 Décembre 2020

Chiara Ferrari
Directrice de la Maison SKA-France
UCA, OCA, CNRS
E-mail: chiara.ferrari@oca.eu
Téléphone: +33 (0)4 92 00 3028

Object: **lettre de support pour le projet Radio@OHP**

Madame, Monsieur,

Sur la base de ces éléments, j'exprime tout mon soutien au projet Radio@OHP.

Je vous prie d'agréer, Madame, Monsieur, mes salutations distinguées,

Chiara Ferrari

Chiara Ferrari

Aix*Marseille université

université PARIS-SACLAY

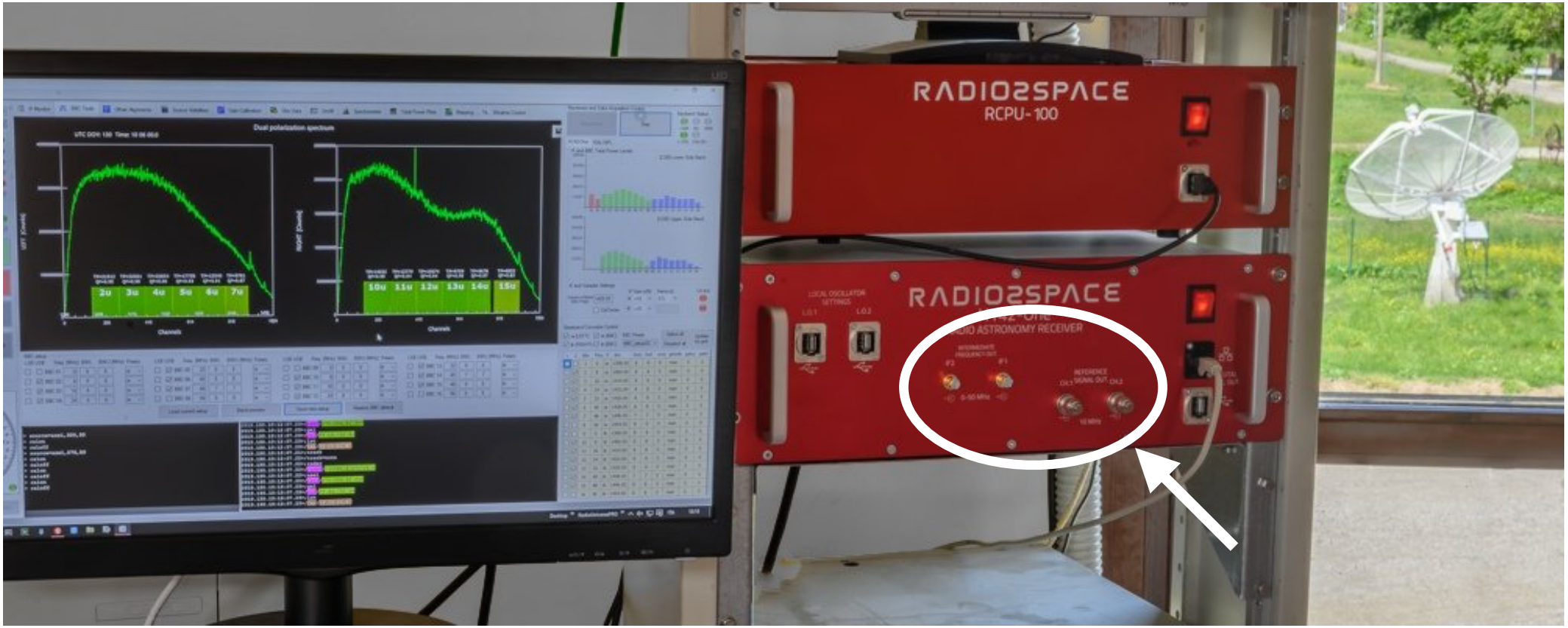
UNIVERSITÉ CÔTE D'AZUR

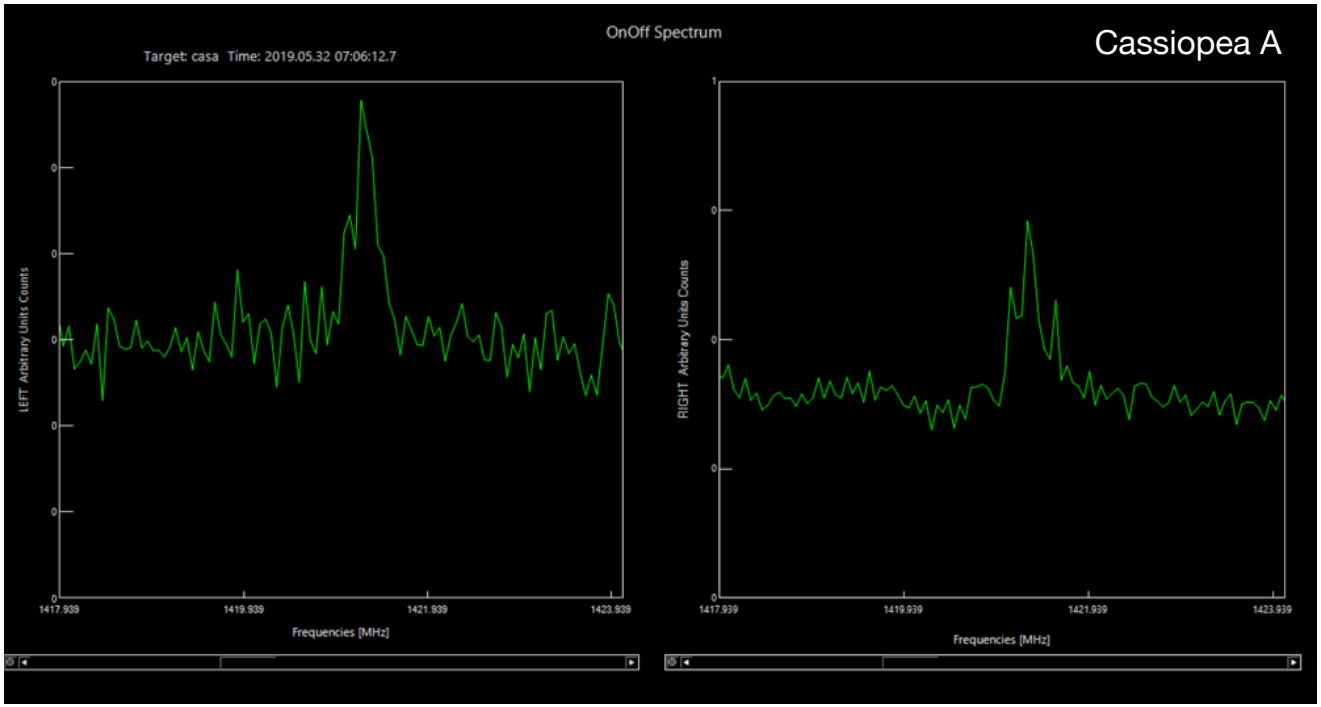
ACADÉMIE D'AIX-MARSEILLE
Liberté Égalité Fraternité

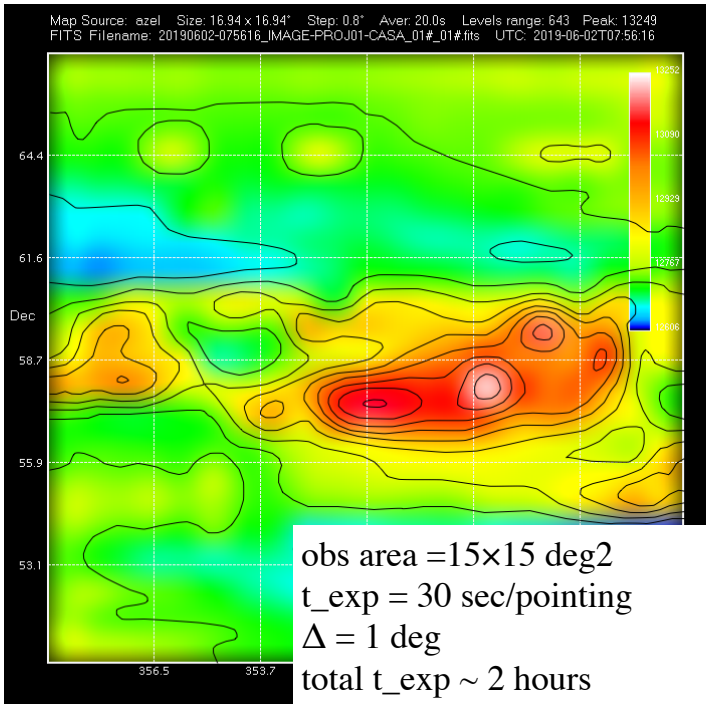
Centre d'Astronomie
SAINT-MICHEL L'OBSERVATOIRE
ALPES DE HAUTE PROVENCE

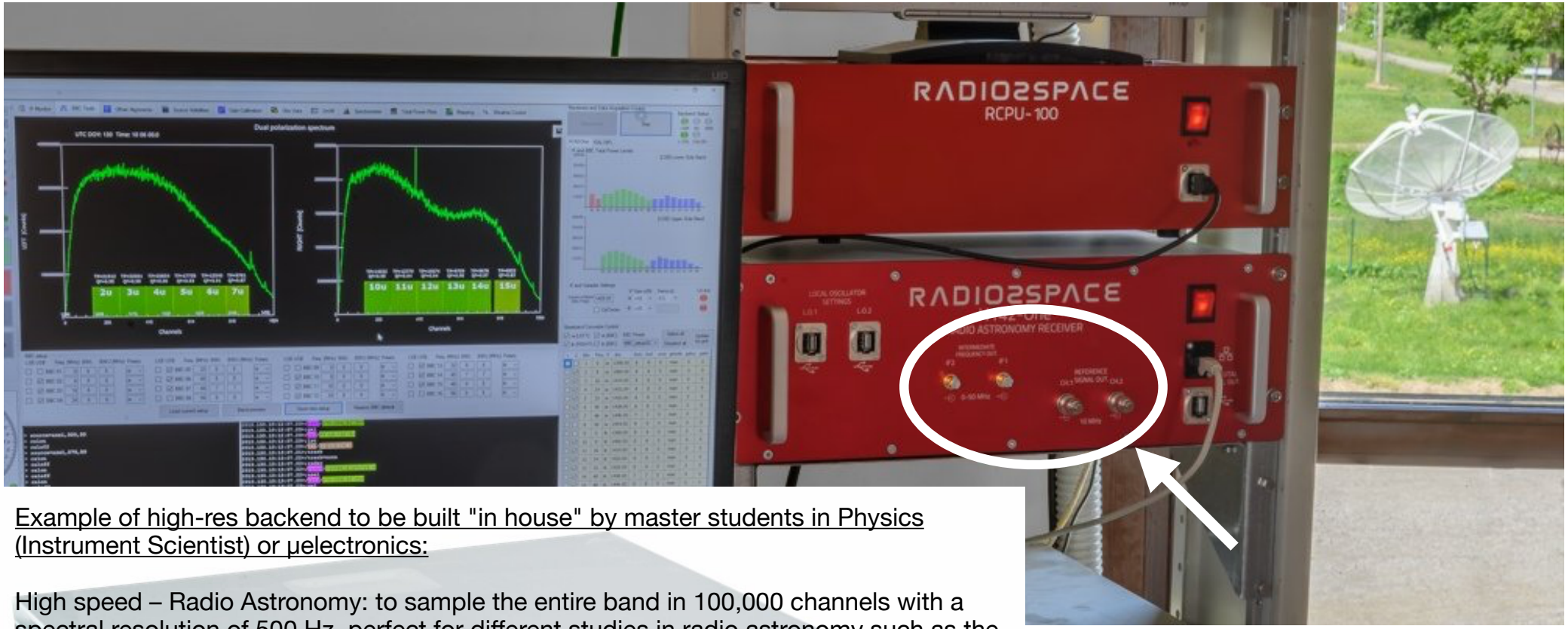
RÉGION SUD
PROVENCE ALPES CÔTE D'AZUR

who else?


RADIO2SPACE
RCPU-100
RADIO2SPACE

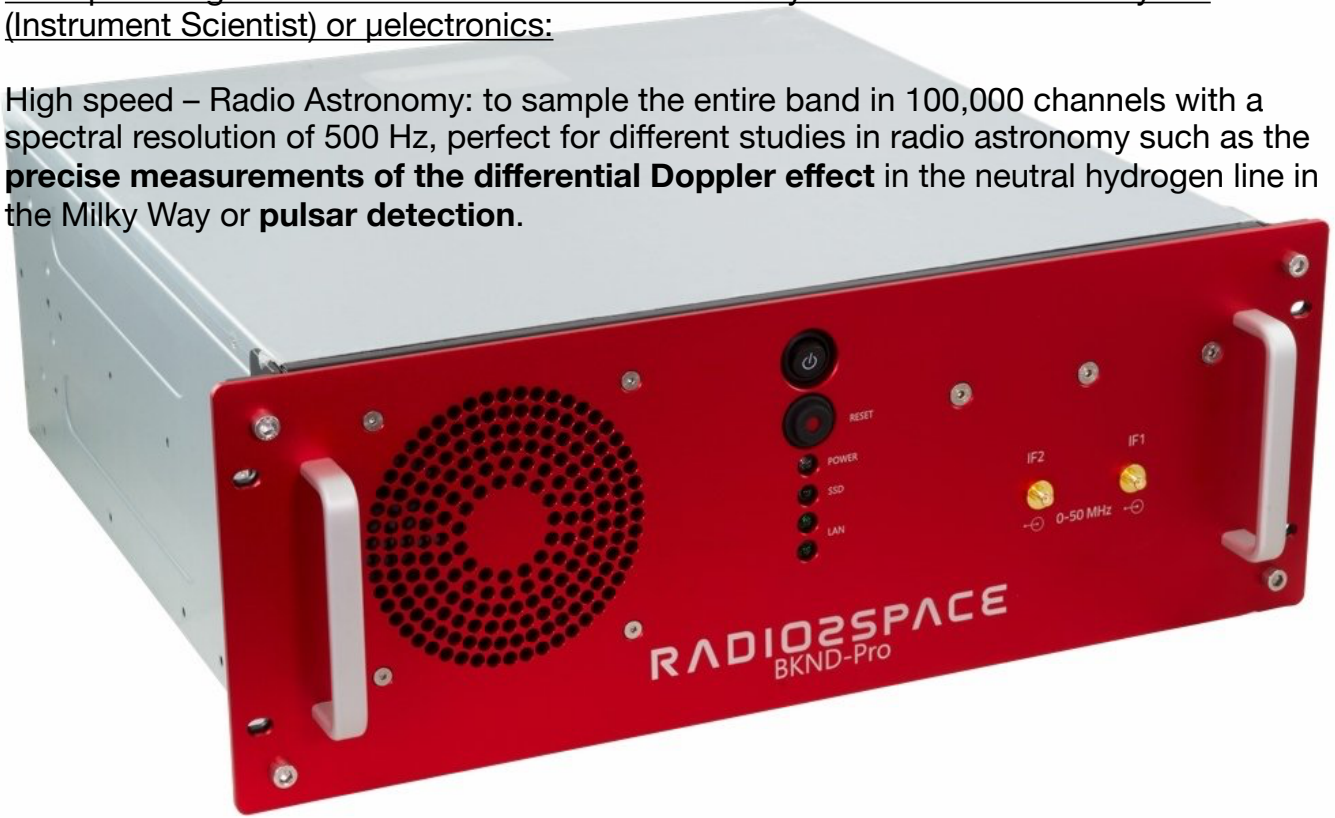

OnOff Spectrum
Target: casa Time: 2019.05.32 07:06:12.7
Cassiopea A
LEFT Arbitrary Units Counts
RIGHT Arbitrary Units Counts
1417.939
1419.939
1421.939
1423.939
Frequencies [MHz]

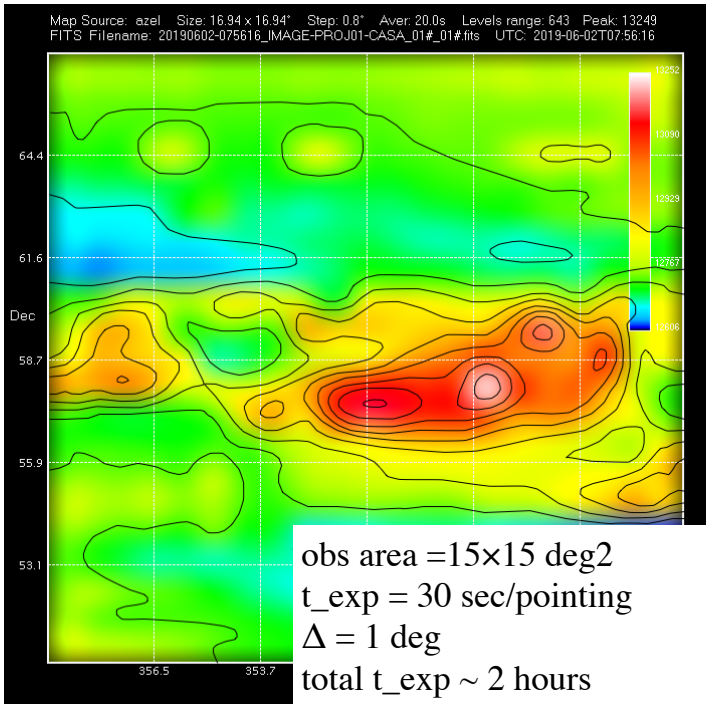

Map Source: azel Size: 16.94 x 16.94° Step: 0.8° Aver: 20.0s Levels range: 643 Peak: 13249
FITS Filename: 20190602-075616_IMAGE-PROJ01-CASA_01#_01#.fits UTC: 2019-06-02T07:56:16
64.4
61.6
Dec
58.7
55.9
53.1
356.5
353.7
obs area =15×15 deg2
t_exp = 30 sec/pointing
Δ = 1 deg
total t_exp ~ 2 hours



Example of high-res backend to be built "in house" by master students in Physics (Instrument Scientist) or μelectronics:

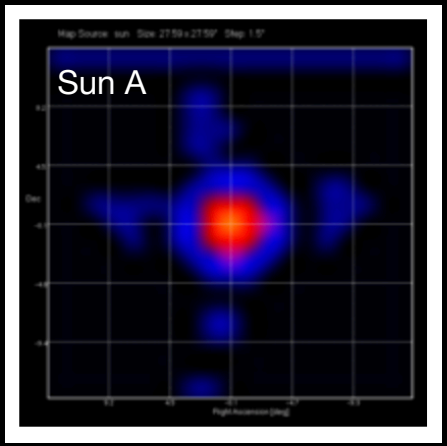
High speed – Radio Astronomy: to sample the entire band in 100,000 channels with a spectral resolution of 500 Hz, perfect for different studies in radio astronomy such as the **precise measurements of the differential Doppler effect** in the neutral hydrogen line in the Milky Way or **pulsar detection**.

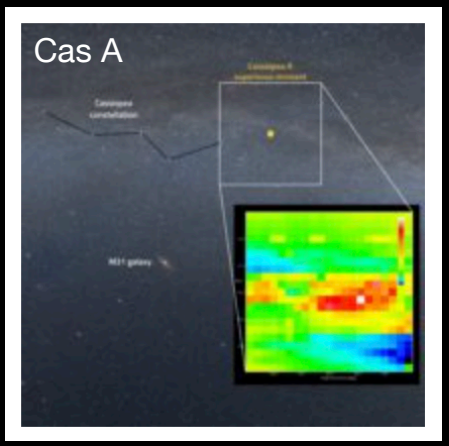


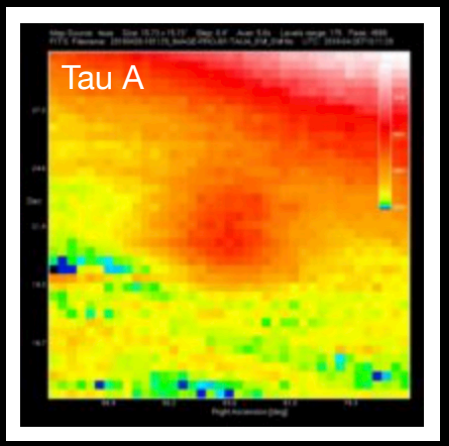


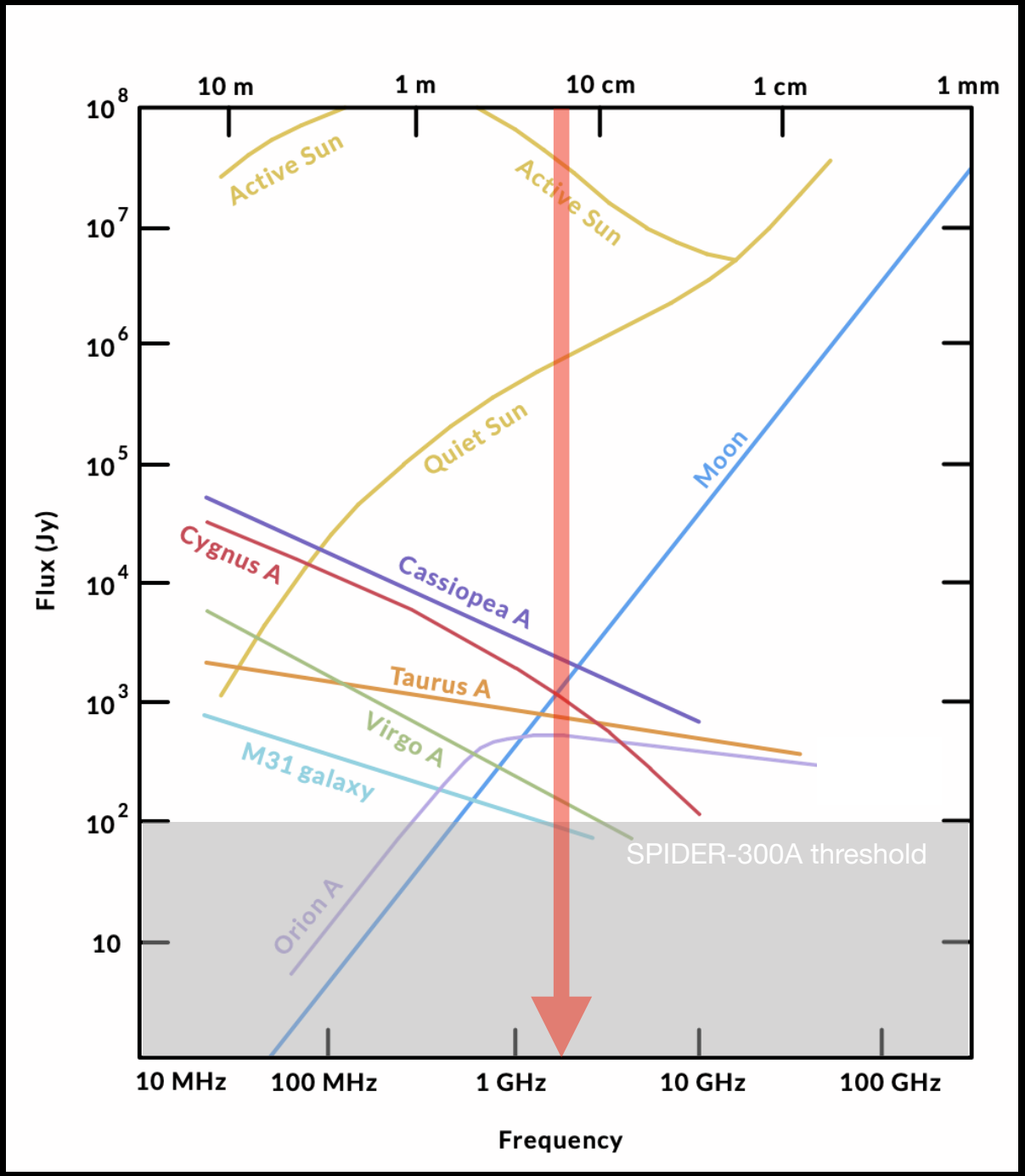
obs area =15×15 deg2
t_exp = 30 sec/pointing
Δ = 1 deg
total t_exp ~ 2 hours

Most brilliant 21-cm sources in Northern hemisphere, observable with SPIDER-300A










Spider 300A @ Visitor Center, IRA-INAF (Medicina, Bologna)
Demo live: February, 5th 2021
https://www.radio2space.com
R2S
PRIMALUCELAB

PARTICIPANTS @ 2021 proposal

Name	Nature of the contribution to the project	#PM 2022	#PM 2023	#PM 2024
Carlo Schimd	Management (acquisition, installation, tests). Teaching M1/M2 “FunPhys”. Outreach.	3	3	3
Christophe Adami	Teaching M1/M2 “FunPhys”. Member of the Time Allocation Committee (TAC).	0.25	0.25	0.25
Alexandre Beelen	Management assistant. Member of the Time Allocation Committee (TAC).	0.25	0.25	0.25
Stephane Basa	Management assistant (acquisition, installation).	0.5	-	-
Benoît Epinat	Member of the Time Allocation Committee (TAC).	0.25	0.25	0.25
Guilaine Lagache	Teaching M1/M2 “FunPhys”.	0.25	0.25	0.25
Alessia Longobardi	Management assistant (tests). Member of the Time Allocation Committee (TAC).	0.5	1	1
Delphine Russeil	Teaching M1/M2 “FunPhys”. Member of the Time Allocation Committee (TAC).	0.25	0.25	0.25
Patrice Theule	Management assistant (installation, tests). Teaching M1/M2 “FunPhys”.	0.5	0.5	0.5
William Gillard	Development of projects for the ‘Instrument Scientist’ option of Master “FunPhys”.	0.25	0.5	0.5
August Le Van Suu	OHP local contact. Relation with *Centre d'Astronomie de Saint-Michel.*	0.5	-	-
Jean Strajnic	Link with *Direction régionale académique de l'enseignement supérieur – Région PACA*	0.5	0.5	0.5

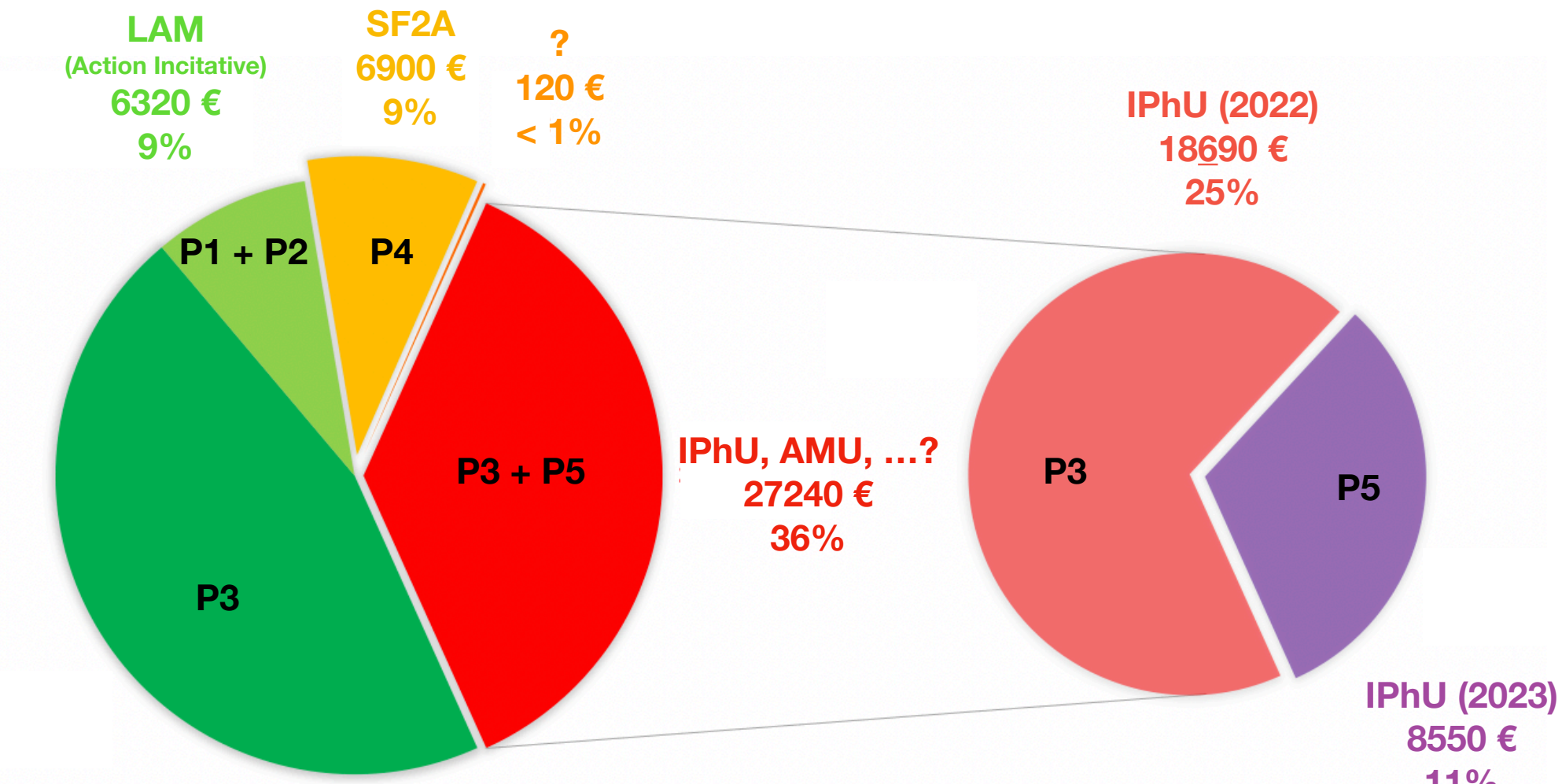
new participants are welcome!

R2S installations

https://www.radio2space.com

R2S
PRIMALUCELAB

BUDGET 2022 (update): 74580 € (+10% w.r.t. 12/2020)



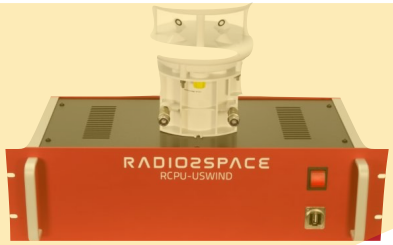
Date d'effet : 28/10/2021	**Date de début d'éligibilité** : 28/10/2021
Date fin : 27/10/2023	**Date de fin d'éligibilité** : 27/10/2023
Durée : 24 mois	

BUDGET 2022 (updated): 74580 € …priorities?

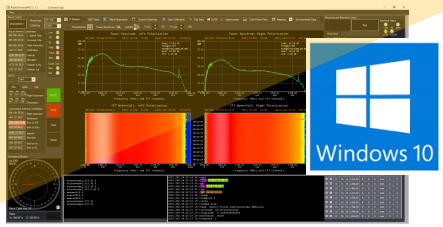
ITEM	CATEGORY		PRIORITY	SUB-TOTAL/PRIORITY	remarks
Mission CEO PrimaLuceLAB: 3-days mission with lodging at OHP	(TE)	300 €	1 ✔	2 700 €	
Honoraire CEO PrimaLuceLAB (3 jours) for installation project (TTC)	(OB)	2 400 €	1		
Masonry at OHP: basement for SPIDER 300A telescope (concrete, pad reinforced with rebar)	(E)	3 400 €	2 ✔	3 400 €	*no VAT. New offer: 4 320 €
SPIDER 300A advanced radio telescope	(E)	39 950 €	3		
Kit for installation of electric cables and optical fibres	(E)	750 €	3		
NSGen noise generator for absolute calibration of the SPIDER radio telescope	(E)	3 950 €	3		
UltraSonic Wind Sensor for SPIDER radio telescopes (to automatically park the radio telescope in safety position when the wind exceed the safety limit 50 km/s)	(E)	3 700 €	3		R2S quote: no VAT
Delivery of radiotelescope and accessories to OHP	(E)	2 240 €	3	53 030 €	
Safety barrier at OHP (including gate; masonry work not included)	(E)	*740 €*	3		*w/ VAT. New offer (w/ masonry): 2 856 € online estimation
UPS (onduleur)	(E)	1 400 €	3		
Training for the use of the radiotelescope by PrimaLuceLab (3 hours)	(OB)	300 €	3		
All-sky camera for SPIDER radio telescopes to remotely see the radio telescope	(E)	1 950 €	4	6 900 €	
Networking Module for RadioUniversePRO software for Radioastronomy Virtual Classroom	(E)	4 950 €	4		
Kit radio over fiber for radiotelescope SPIDER and optical fibres (at least 30 meters)	(E)	8 550 €	5	8 550 €	

READY TO START OPERATIONS

19 k€ missing



wind sensor



RadioUniversePRO

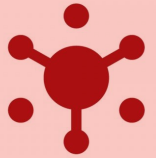
optical fibres kit

1420 MHz receiver, radiometer and spectrometer

noise generator

all-sky webcam

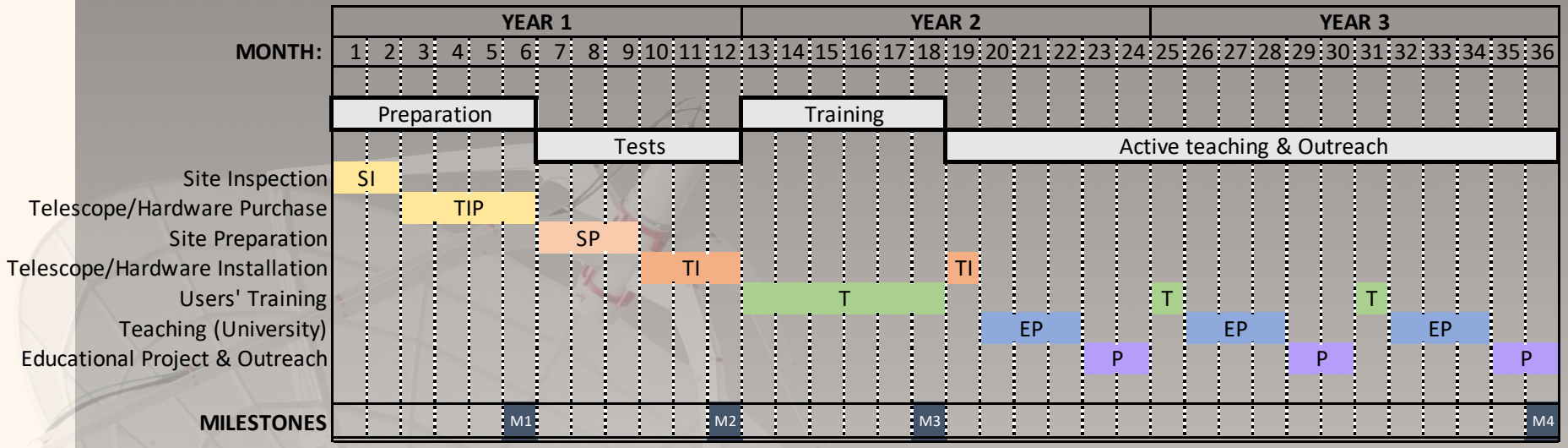
Networking module



for RadioUniversePRO

ethernet

Ongoing and future urgent actions & open questions



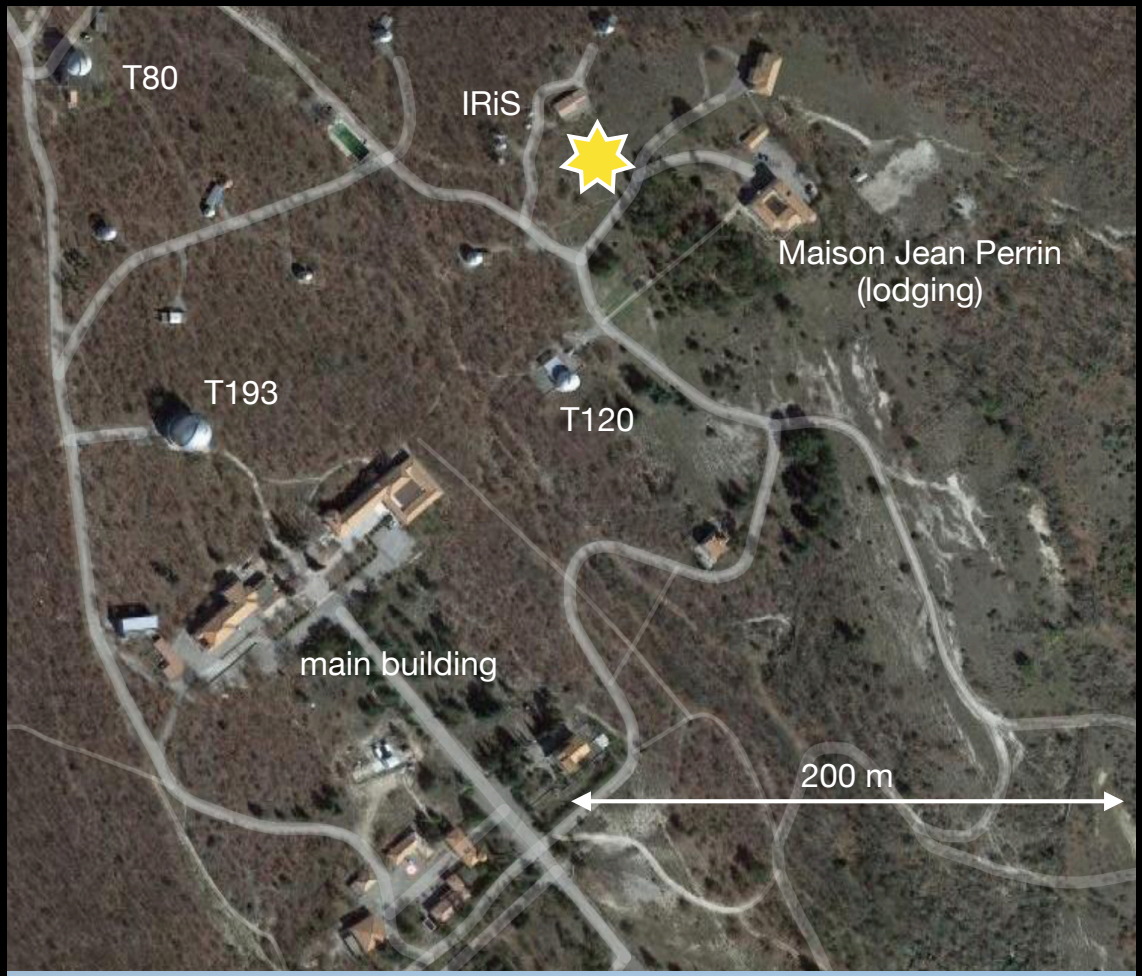
- **find additional funding sources:**
  1) waiting for answer by *Actions Spécifique LOFAR-SKA:*
  one call/year, "usually in autumn" but last call in Jan 2021
  2) Maison SKA France?
  3) AMU/TIGER?
  4) Rotary??!!
- **budget for Priority 1-2 (visit OHP + projet + masonry): OK**
  budget for Priority 3 (instrument): -19 k€
  …wait until P3 fully acquired?
  …or start operations (P1+P2) now?
  (DL Région PACA: 27/10/2023)
- **Project Assistant to manage contracts and payments: IPhU/CNRS/…?**
- **Operating costs: OHP ?**
- **website: hosted by IPhU webpage/wiki?**

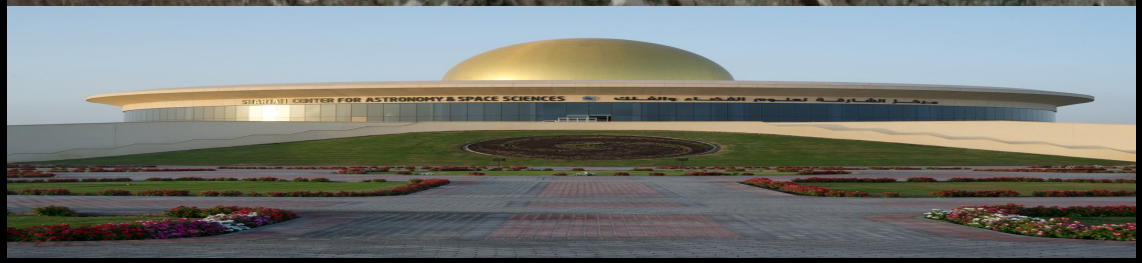
Possible UNIQUE improvements:

5m dish antenna

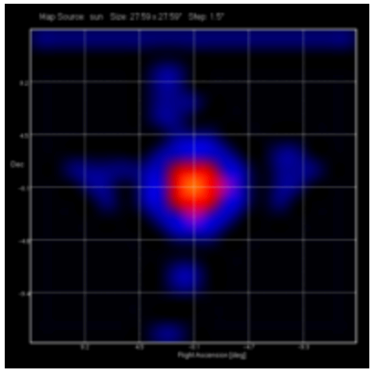
+ 20 k€

interferometry !



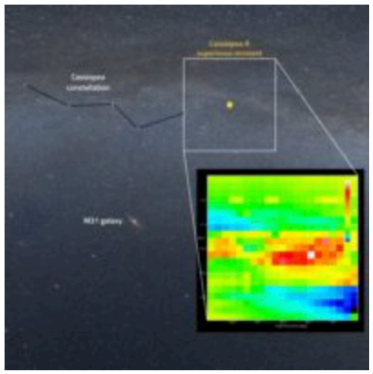


Examples for Virtual Classroom



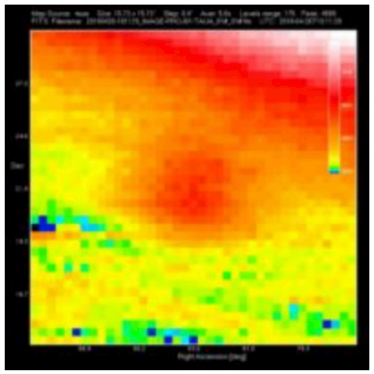
Experiments: solar radio emission with SPIDER radio telescope

Solar radio emission can be studied by using SPIDER radio telescopes. The Sun is in fact one of the most interesting radio source in the sky. In fact the Sun not only emits visible light but also other frequencies in the electromagnetic spectrum. For example, everyone can feel the Sun heat on our skin, expression of infrared radiation. In this article, with step-by-step guide, we see how the SPIDER radio telescopes detect radio waves coming from the Sun and we show…



Cassiopeia A recorded with SPIDER 300A radio telescope

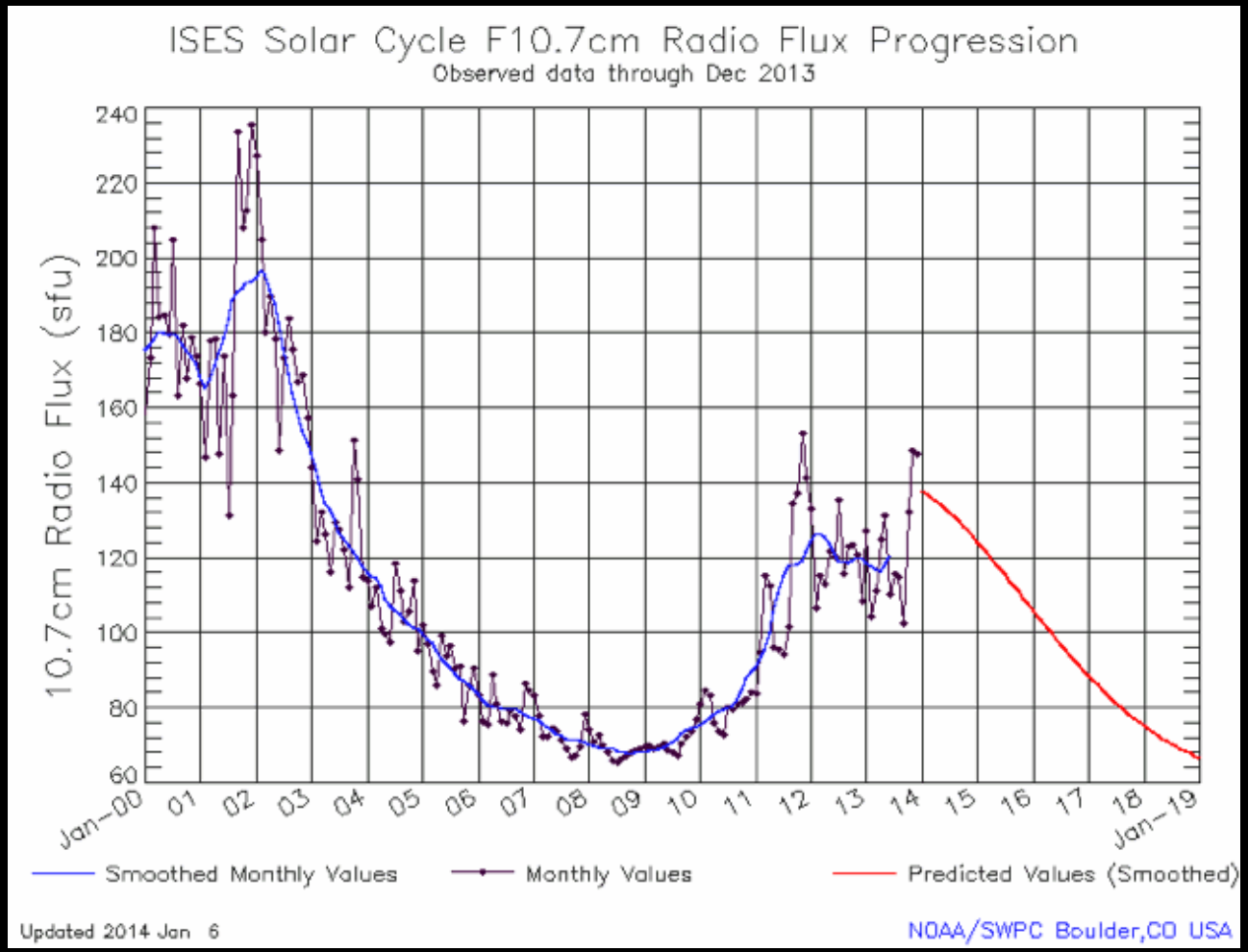
Cassiopeia A it's an important object for radio astronomy, a supernova remnant located in Cassiopeia constellation with a flux of 2400 Jansky flux at 1420 MHz. Thanks to the large parabolic antennas, high sensitivity of the H142-One receiver and the advanced features of the RadioUniversePRO software, the SPIDER radio telescopes are able to detect Cassiopeia A. In this article we describe how we detected Cassiopeia A by using the 3 meter diameter SPIDER 300A advanced radio telescope: starting with antenna alignment, we detected interferences…



Taurus A recorded with SPIDER 300A radio telescope

Taurus A is the radio source in Taurus constellation that corresponds to the Crab Nebula (M1), the supernova remnant exploded on July 4, 1054 and noted by Chinese and Arabian astronomers of the time. Since then, the gas cloud has expanded and today is over 6 light years large. In this article we see how the SPIDER 300A radio telescope "discovered" it by capturing the radio waves emitted by Taurus A and converting them into a radio map, a real…

Example of radioastronomy at school



Radio astronomy at school: solar flux at 10 cm

Even objects around us emit radio waves. For example, pointing the radio telescope towards a nearby building, you will notice an increase in the value of radio waves. Comparing this value with the one found by pointing the Sun or the Moon, it will be possible to determine their surface temperature! Thanks to the possibility of calibrating the signal, SPIDER control software lets you to monitor the emission of a radio source for a long time. For example, by focusing to the Sun, you can make one measurement per day for the period of time necessary to its revolution (about 25 days) and then will be able to correlate it with other phenomena such as the number of sunspots visible with an optical telescope.