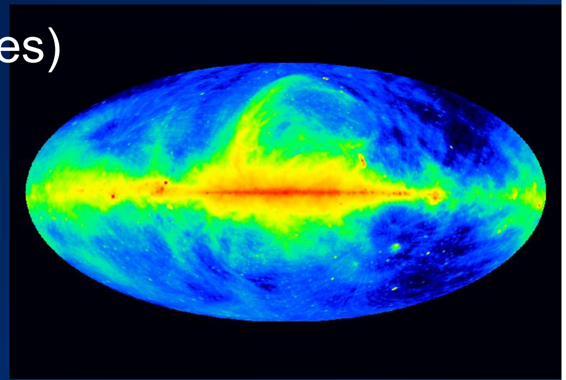
Single Dish Opportunities

Alex Kraus,
October 1, 2010

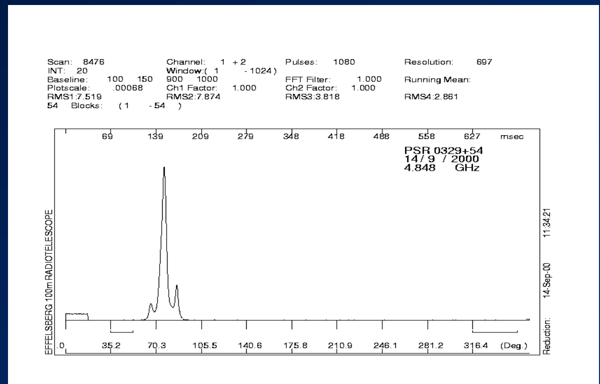
European Single Dish School in the Era of Arrays

Why using single-dish telescopes??

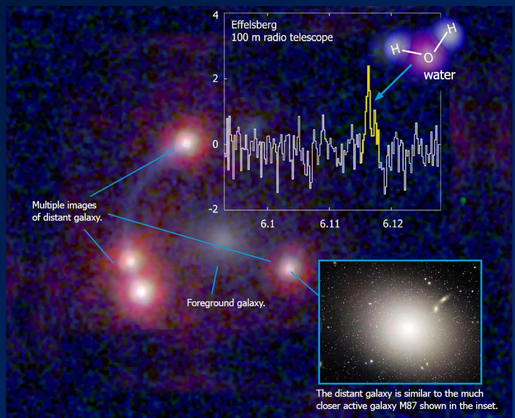


1. to observe large scale structures (ie. small spatial frequencies)
   → eg. zero-spacings to combine with interferometry data
   → large surveys (408 MHz Bonn-Jodrell Bank-Parkes or EBHIS)

2. to observe Pulsars (ie. point-like objects)



3. to search for molecular lines



Further advantages of single-dish telescopes:

+ no necessity of coordination
+ no correlation required
+ software easier to use

→ Interferometers are important, Single-Dishs, too!

Single-dish telescopes
(an arbitrary selection)

Arecibo:

305-m telescope → high sensitivity,
fixed in a valley,
Declination range: -1° ... + 38°
Frequency range: 300 MHz ... 10 GHz

Green Bank Telescope:

Largest fully steerable RT (D = 102m)
Frequency range: 300 MHz ... 100 GHz
Well suited for spectroscopic
and pulsar observations

Single-dish telescopes

Jodrell Bank Centre for Astrophysics, University of Manchester

© INAF - Osservatorio Astronomico di Cagliari

Jodrell Bank:

D = 76.2 m,
Frequency range: 300 MHz ... 5 GHz

Sardinia Radio Telescope:

Picture of May 2010,
First light expected for fall 2011
D = 64m
Frequency range: 300 MHz ... 100 GHz

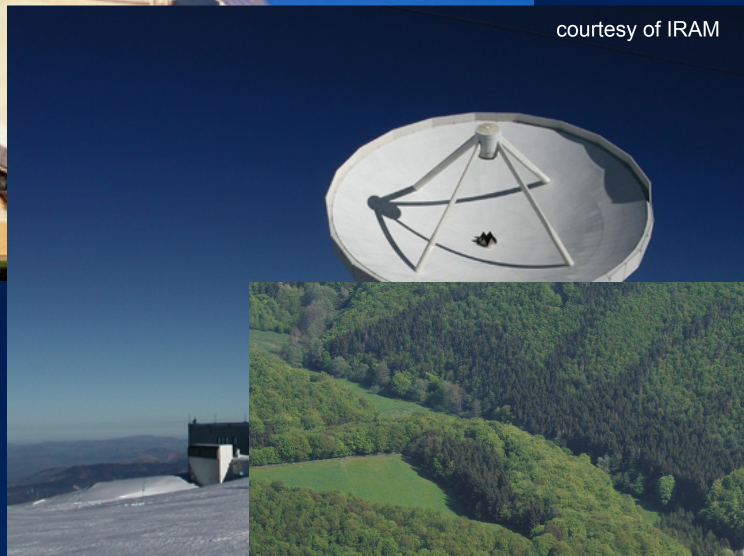
... and many more

Parkes:

D = 64 m

Pico Veleta:

D = 30 m,
Frequency range:
90 GHz ... 350 GHz

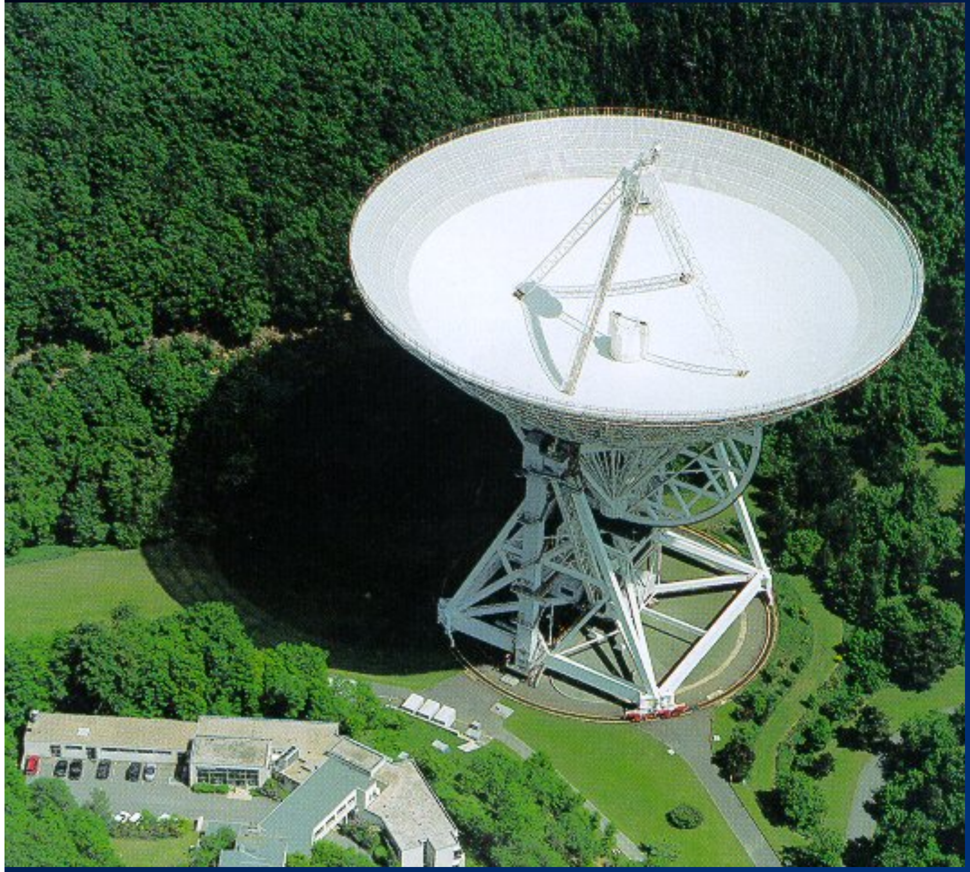


and certainly:
the 100-m telescope
at Effelsberg:

D = 100 m,
Frequency range:
400 MHz ... 90 GHz

The 100-m telescope

Technical data:

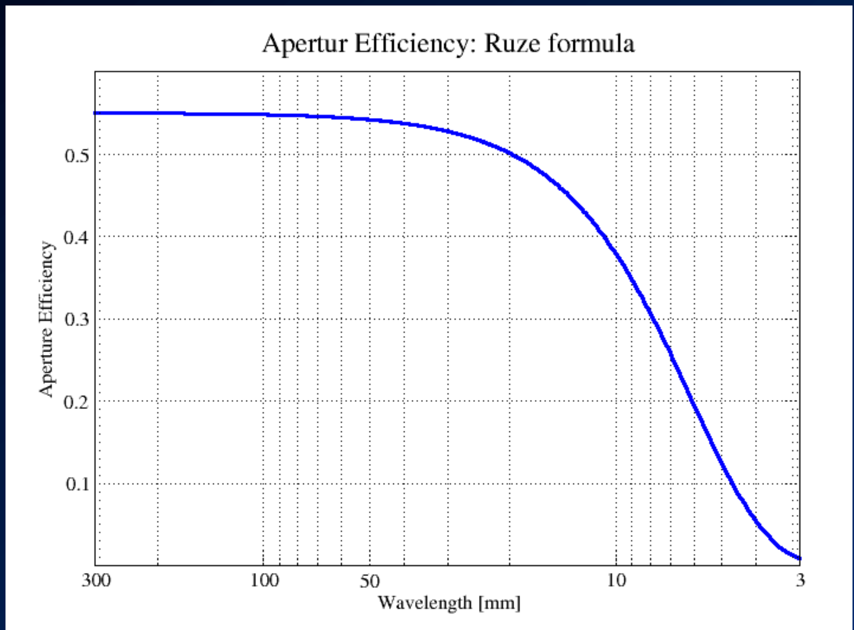


Diameter main dish: (Paraboloid)	100 m
Diameter subreflector: (Ellipsoid)	6,5 m
Weight:	3200 to
Diameter track:	64 m
Accuracy of track:	ca. 0,3 mm
Surface accuracy of main dish:	ca. 0,5 mm
of subreflector:	ca. 0,06 mm

Why does one need a 100-m telescope?

Resolution ~ wavelength / diameter

Sensitivity ~ diameter^2 · aperture efficiency



Ruze formula:

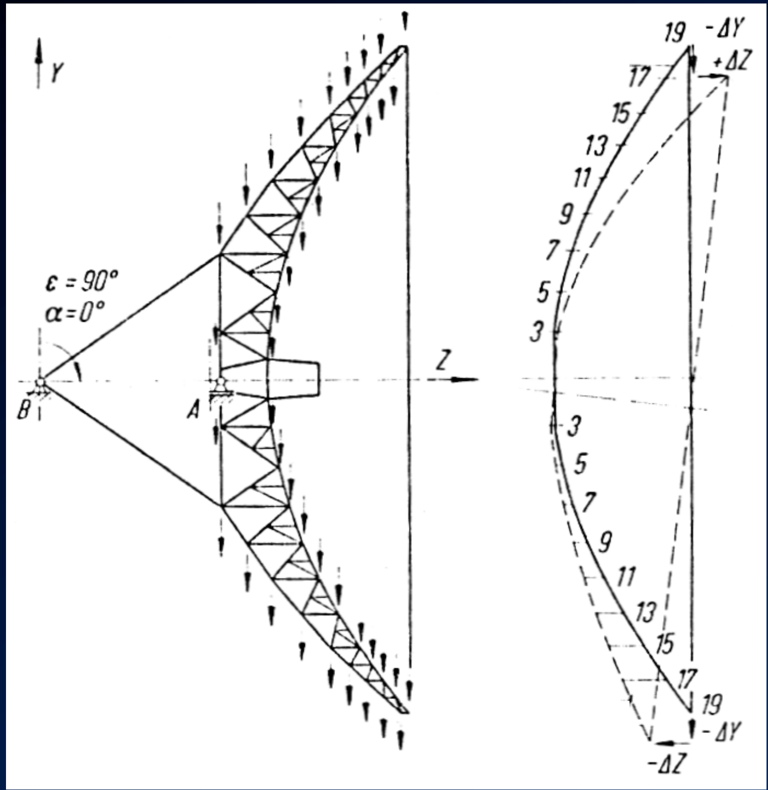
$\eta_A \sim \exp[(-4\pi\sigma/\lambda)^2]$

$\sigma_{100m} \sim 0.5$mm (surface rms)

Receiver	Resolution	Γ [K/Jy]	G [dB]
21cm-PF	9 arcmin	1.57	61
6cm-SF	2.5 arcmin	1.55	71
1.3cm-PF	40 arcsec	0.90	82
9mm-SF	25 arcsec	0.70	84

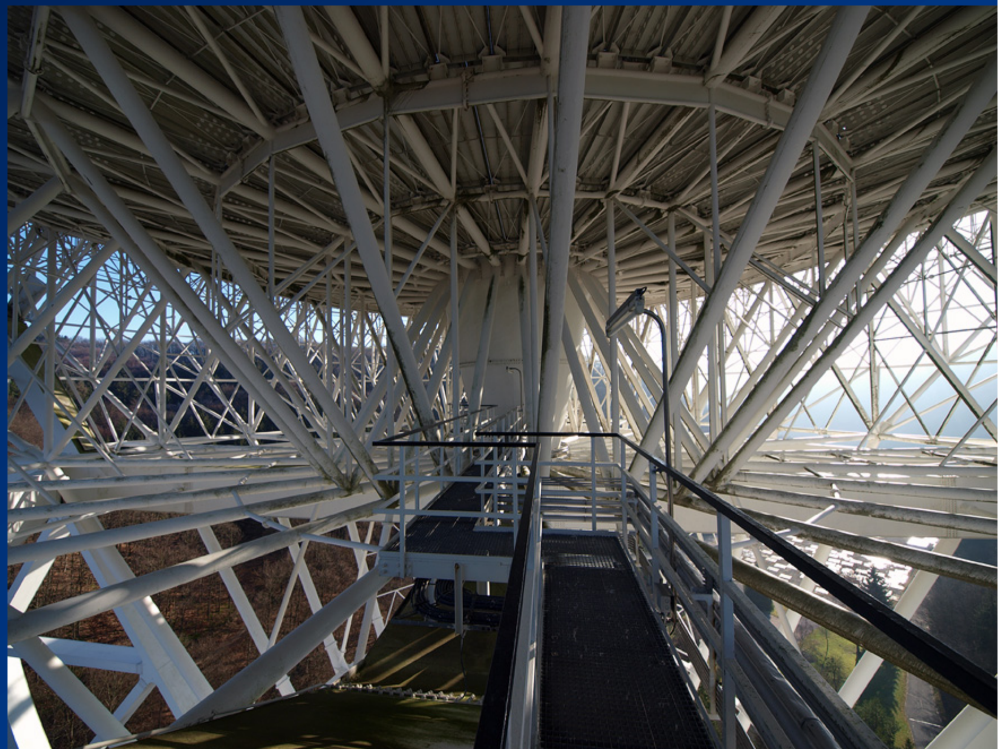
(Resolution of the human eye ~1 arcmin)

Homology



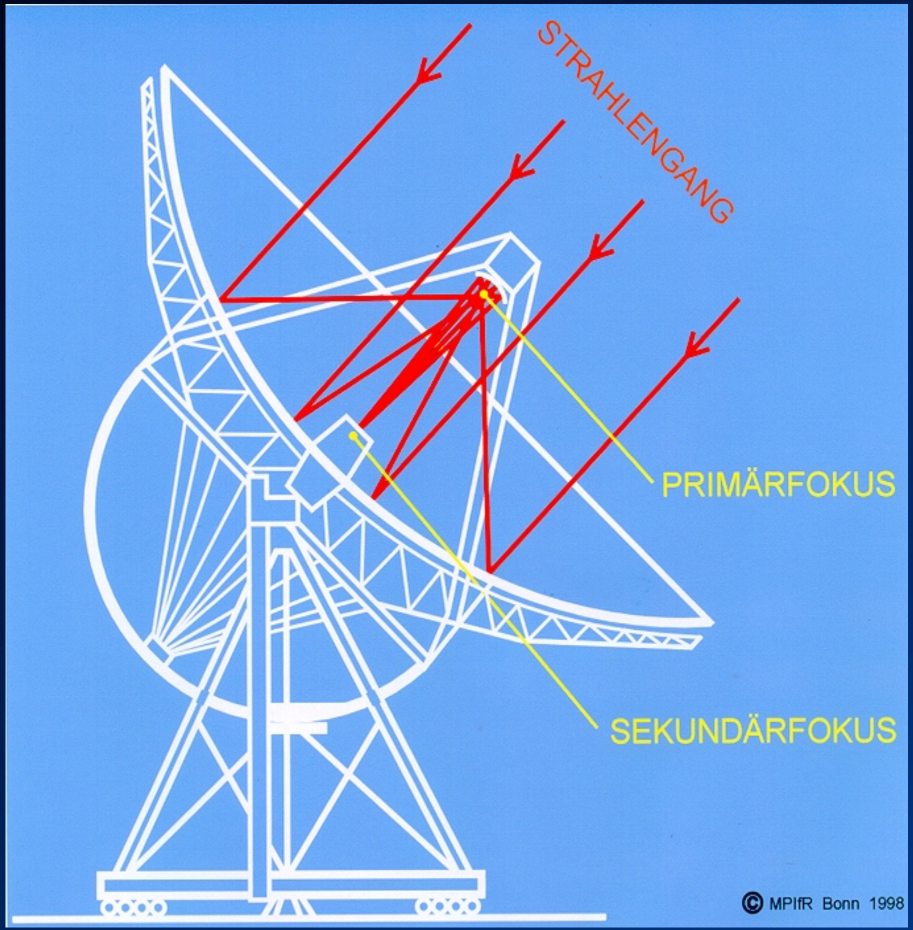
Main dish deforms when tilted (due to gravity)
→ loss of defined parabolic form

Special construction leads to a defined parabolic form for all elevations!

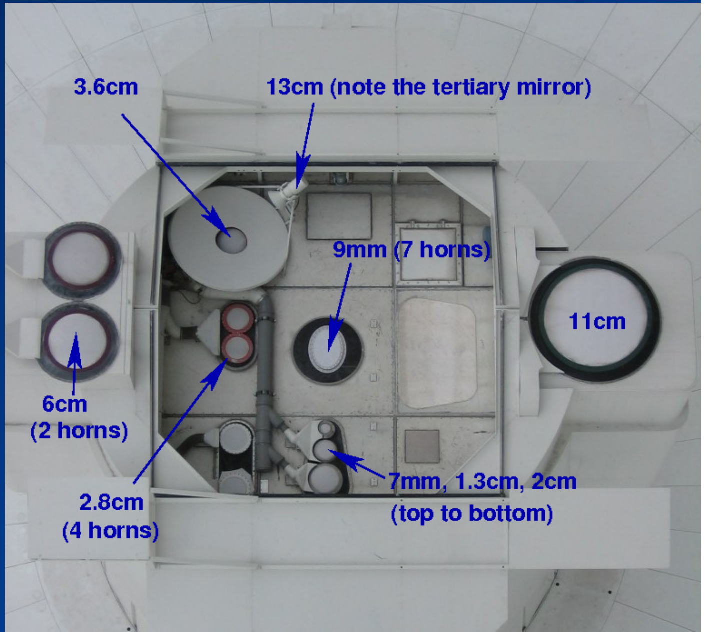


Optics of the 100-m Telescope

„Gregory-Design":
Main dish: paraboloid
Subreflector: ellipsoid

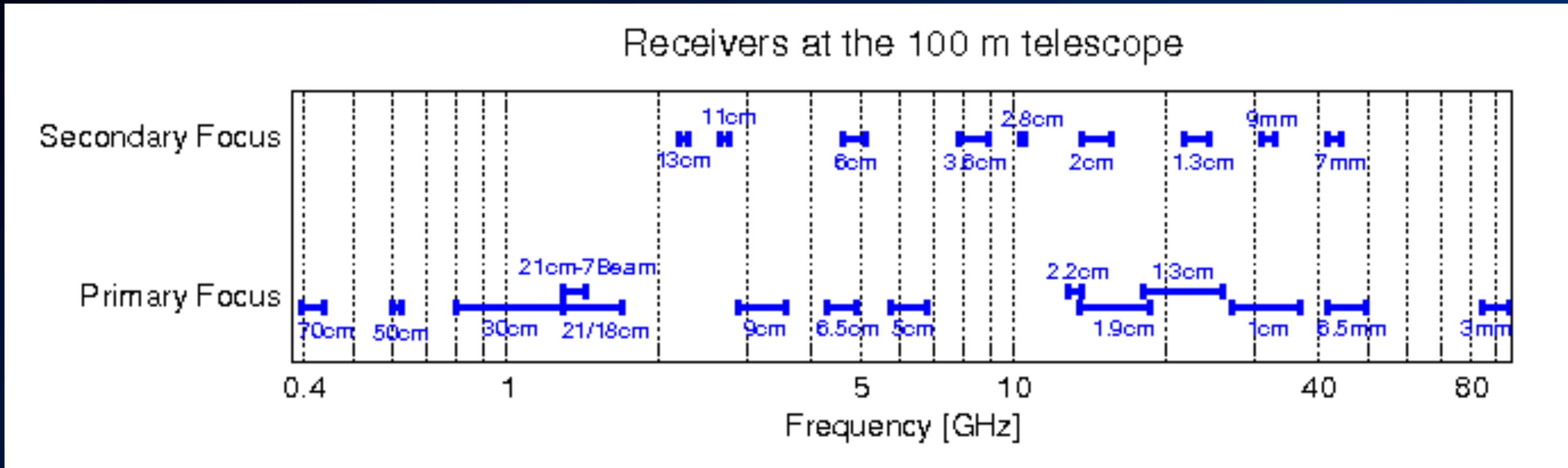


21cm-7 Beam-Receiver in the prime focus



Receivers of the 100-m telescope

λ = 70cm … 3.5 mm (~8 octaves)



most receivers are cooled
T_{rec} < 10 K
T_{sys} ≈ 20…100 K

several receivers are
equipped with polarimeters

Backends

Pictures by N. Tacken

Backends are available for

- *Continuum observations:*
  4x80 channels
  various polarimeters
- *Spectroscopy:*
  14x16384 channels FFT-Sp.
- *Pulsar observations:*
  a Digital Filter Bank
  a Search Backend

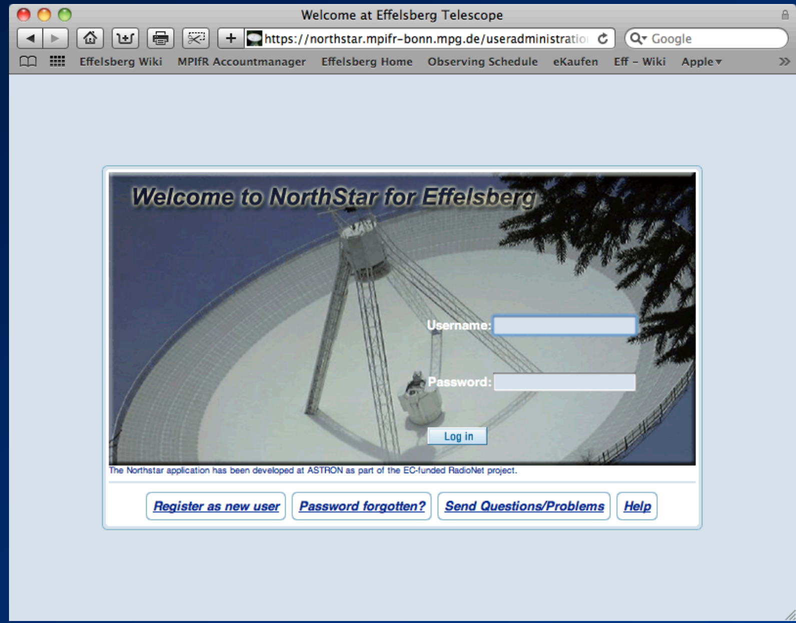
The high sensitivity (large diameter, small surface rms) together with the variety of receivers and backends

make the 100-m telescope a flexible, all-purpose instrument for radio-astronomical observations!

How to get time at the 100-m telescope

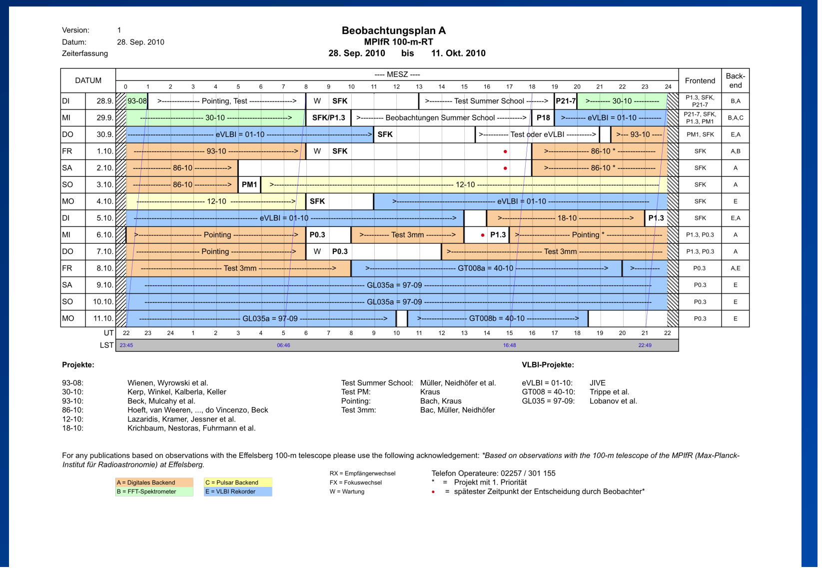
* 3 proposal deadlines / year:
  in the first week of February, June, October

* Use the web-based proposal tool „North Star“:
  https://proposal.mpifr-bonn.mpg.de



* Effelsberg Program Committee:
  3 internal referees,
  5 external scientists
  plus the scheduler/station manager (me)

* If accepted, your project will appear on
  the telescope schedule.



Single Dish School, Bonn 2010

Support

* Support in preparing, executing and analyzing your observations can be granted by the Effelsberg (and Bonn) staff.

* Financial (ie. travel cost) support can be granted for proposers from institutes within the EU under the RadioNet Transnational Access Programme (TNA)

(see: www.radionet-eu.org/transnational-access)

“RadioNet is an EC integrating activity that brings together all the major radio observatories in Europe.”

Criteria of Eligibility: The PI and the majority of co-Is must come from the EU or associated states (except Germany).

After successful proposing we would be happy to welcome you at Effelsberg!