ASTRON

Netherlands Institute for Radio Astronomy

The Five-hundred meter Aperture Spherical Telescope (FAST)

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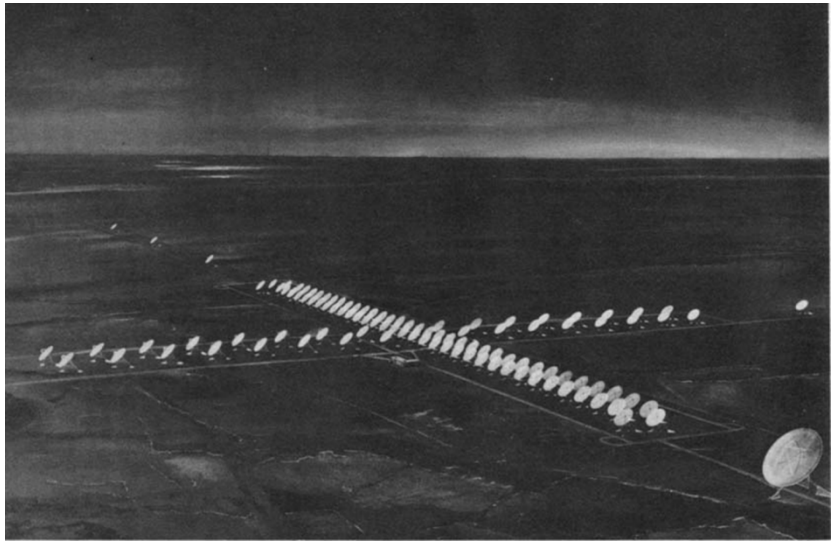
The need for radio telescopes of very large dimensions is so obvious that it does not require an introduction! – Jan Oort (1961)



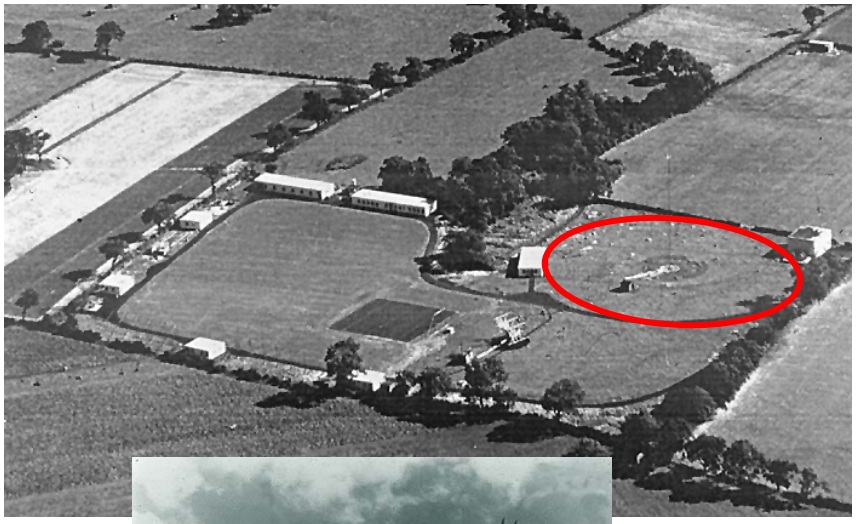
- The BCAP foresaw (1963) building an array of total collecting area ≈100,000 m^2

- FAST area of ca. 200,000 m^2 (70,000 m^2 instantaneous)
- The FAST area would be a significant fraction of SKA
- Foreseen as a super Arecibo (73,000 m^2)

But what preceded Arecibo (and FAST)?

Let's look at the immediate predecessors, in the UK, NL, Australia and Russia…

The Jodrell 218' zenith antenna

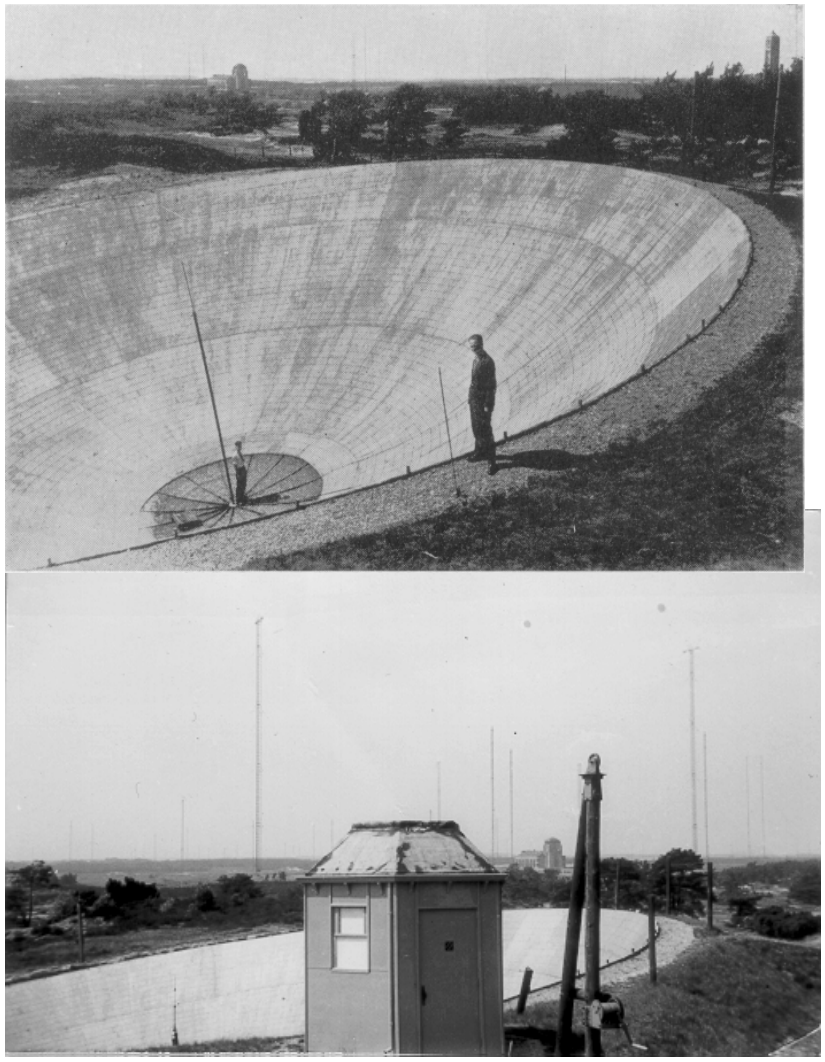


- Antenna for detection of cosmic rays with radar
- Wire dish (invisible): 26 km of 16 gauge wire
- Never did detect CRs, but observed radio sky
- It was realized that by displacing focus, beam could be pointed (±15°)
- So one could survey the sky over 38°< δ < 68°

About then, Hanbury Brown arrived

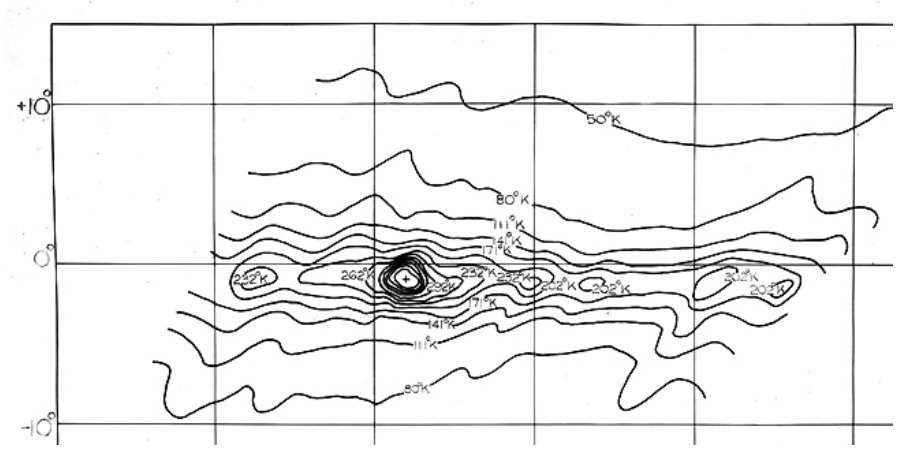
- Lovell suggested he use 218’ to observe sources
- Cyril Hazard appeared about the same time
- Observing at λ1.89 m, gave beam size ≈ 2°
- Highlights were survey (HB sources), detect M31 emission, detection of SN 1572 (Tycho) remnant
- 218’ still in use to 1960

1951: Kootwijk 'kuil' (pit) antenna



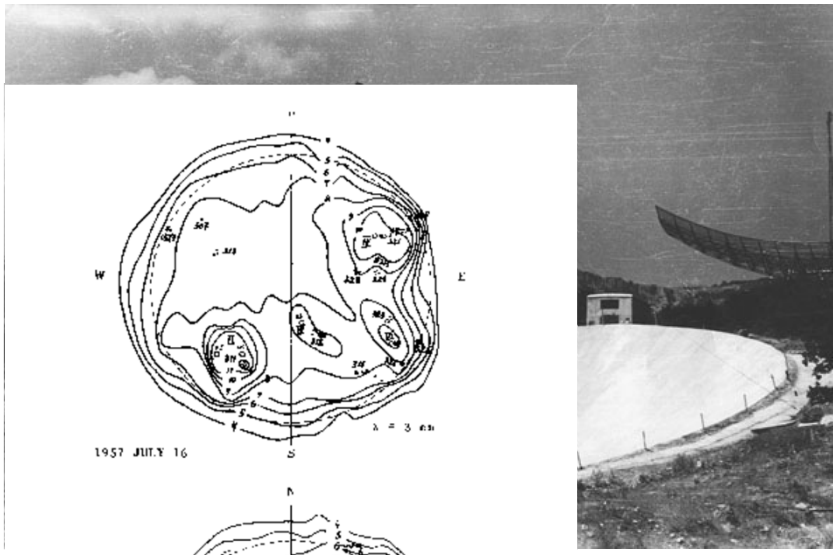
- 30 m diameter, built in natural sand pit
- Main goal was to monitor transparency of the ionosphere
- Tilted 10° south (Cyg A passed through beam daily)
- Used for some test observations

1951: Dover Heights "hole-in-ground"



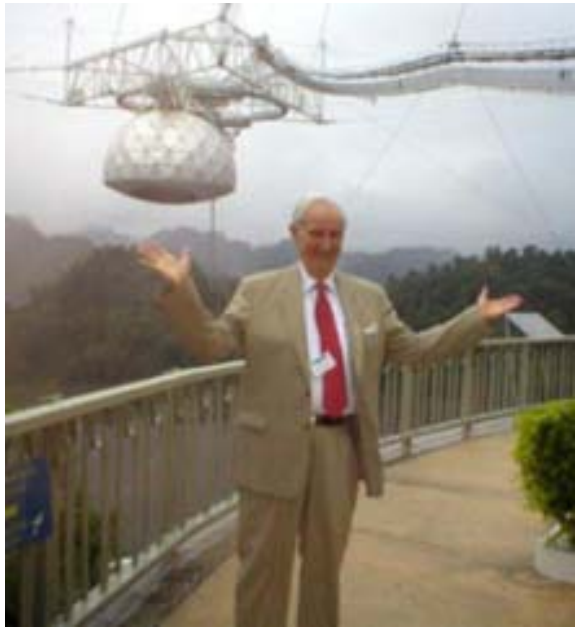
- Sydney, Australia
- 22 m diameter
- Motivation: galactic center passes near zenith
- Manually excavated (Bolton, Slee, Stanley; during lunch) in secret (kept from Pawsey)
- Mapped GC region

From 1954, observing station at Katsiveli, Crimea



- Radio telescope built set in ground
- Tilted like Kootwijk dish
- 31 m diameter (called RT-31)
- Concrete base, thin zinc coating
- Accurate surface (for 10 GHz observing): Sun
- Iniative of: V. Vitkevich

Arecibo, Puerto Rico, 1965



- Bill Gordon (1918-2010), father of Arecibo
- Interested in ionospheric research
- Original plan was to build a parabolic reflector for back-scatter experiments
- Spherical dish idea came later
- NB: contemporaneous with BCAP plans, similar area

Radio telescope projects in China

- BAO Miyun synthesis array (1960s)
- SHAO Sheshan 25-m dish (1987)
- Xinjiang Nanshan 25-m dish (1993)
- Miyun 50-m dish (2005)
- Yunnan Observatory 40-m dish (2006)
- 21 CMA 50-200 MHz array (2007)
- SHAO Tianma 65-m dish (2012)
- CSRH 0.4-15 GHz solar array (2012)
- FAST 500-m fixed dish (2016)

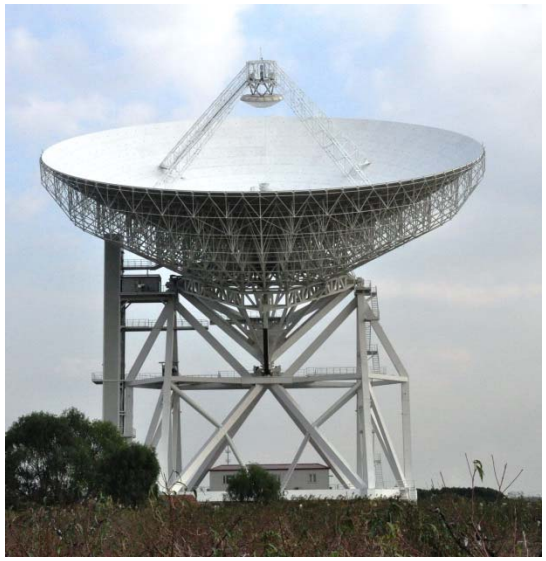
The Miyun Synthesis Radio Telescope

- MSRT: landmark for PRC
- Construction began in 1965, with help from W.N. Christiansen
- Originally “Christmas-tree” linear array
- 1164 m EW baseline
- 28 x 9 m dishes
- Frequency = 232 MHz

Chris & radio team, 1987

Part of MSRT array

Recent new radio telescopes in China



- SHAO 65 m dish
- 21 CMA array
- Yunnan 40 m dish
- CSRH solar radio heliograph: 40 x 4.5 m + 60 x 2 m

Development of FAST…

- In 1992, Titus Spoelstra suggested that China consider a successor to Miyun
- A year later, I reiterated the idea to Wang Shouguan
- In 1994, Peng Bo and I measured interference levels in Guizhou, China
- Possible array in Xinjiang still being considered then

Go-ahead for a large radio telescope

- By 1994, Nan Rendong and Peng Bo were jointly leading what came to be called the FAST project
- Southwest China has the world's most extensive karst terrain (≈ 40% of the global total)

- An Arecibo-like fixed reflector became preferred
- Survey began for 500 m wide circular depressions

One demand: it must be the largest!

- Guizhou Province was extensively mapped
- Plans for the project were put to the Academy and ministry
- Impressive size was a selling point
- 1998: Qiu Yuhai proposed actively shaping surface to give parabolic shape over 300 m
- Initially, money was approved for pre-study and a 30 m test version was built at Miyun
- This was used for some test measurements

FAST construction site, Dec. 2012

FAST in September 2016

Some views of FAST

- Aerial view shows supporting ring & towers
- Detail shows cable junction of surface-supporting net
- (FAST is all about cable technology…)

The FAST inauguration, after years of work

- Wim served on several advisory panels for FAST
- Wim and friends at FAST opening, Sept. 2016
- FAST characteristics:

  500/300 m diameter

  Optimal at L band

  Zenith angle to 40°

  Covers $-14° < \delta < 66°$

Wim's incisive sense of humor…

Thank you!