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Parkes Backends

Ettore Carretti
CASS
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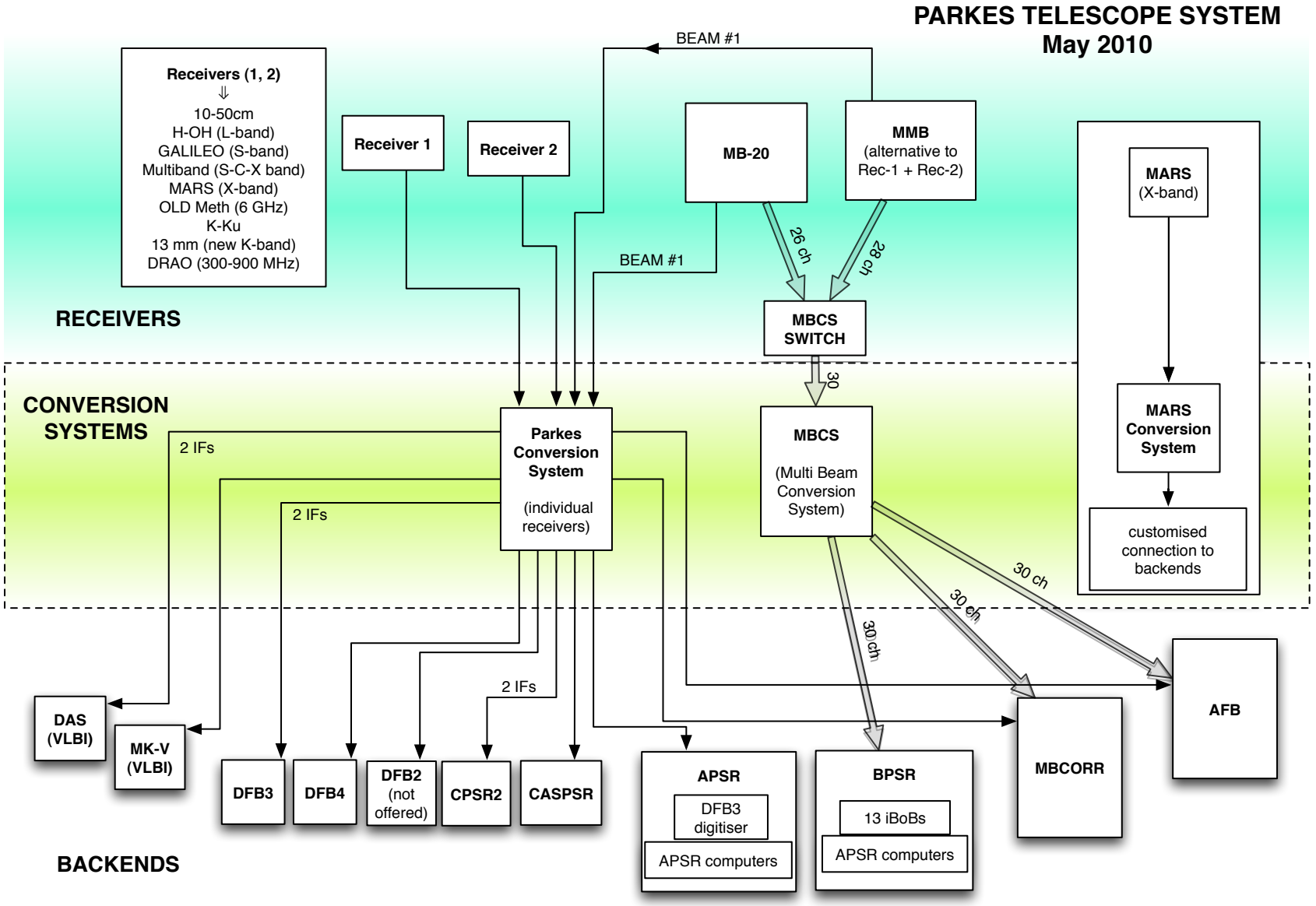
The Parkes System



Parkes Backends

- Pulsars
  - DFB3
  - DFB4
  - APSR
  - CPSR2 (on its way to be decommissioned)
  - CASPSR (development B/E by Swinburne, not offered)
  - BPSR (Multi Beam)
  - AFB (Multi Beam)
- Spectral Lines, Continuum, Polarization
  - DFB3 (Dual IF)
  - DFB4
  - MBCORR (Multibeam)
- VLBI
  - DAS
  - MK-V

Parkes Science Priorities

- Parkes will continue to excel in areas such as pulsar timing and searching where its close packed collecting area is vital and similarly large scale mapping studies that require the extreme surface brightness sensitivity of a single dish. ("ATNF Science Priorities: Science in 2010 – 2015")

	Gas Evolution in Nearby Universe	Pulsars	Star Formation	Galaxy Evolution at high z	Magnetic Fields	Understanding the Variable Sky
LBA		●	●			○
ASKAP	●	●		○	●	●
ATCA	○		●	●	○	●
Mopra			●			
Parkes	○	●	●		○	●

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Science Priorities (1/2)

- **PULSAR RESEARCH**
  - Pulsar timing
  - Pulsar searching – surveys
  - pulsar/variable obj searching – follow ups
- **POLARISED DIFFUSE EMISSION**
  - Galactic Magnetic Fields
  - ISM
  - Extragalactic Magnetic fields
  - CMB foregrounds
- **HI science**
  - intergalactic HI (IGM)
  - extended HI sources
  - deep “moderate” redshift HI (stacking)

Science Priorities (2/2)

- **STAR FORMATION**
  - OH and CH_3OH masers
  - 22 GHz spectral lines (H_2O masers, NH_3)

- **FOLLOW UPs (i.e. the Unexpected)**
  - e.g.: first radio Magnetar discovery

B/E requirements: pulsar science

- **PULSAR RESEARCH**
  - high time precision and resolution (~100 us) of the digital backends
  - high freq res (1-2k channels)
  - broadband (up to 1 GHz) and polarization capabilities
  - RFI mitigation
  - base band recorders
  - multiple backends (e.g. dual receiver, dual B/E: double pulsar, RFI mit.)
  - searching mode capabilities
  - Multi-beam searching modes capabilities (350 MHz, high freq and time res.)
- **BACKENDS**
  - DFB3, DBF4 => folding mode (timing)
  - DFB3, DFB4, AFB => searching-mode
  - APSR, (CASPSR) => recorders
  - DFB3 => RFI mitigation
  - BPSR => surveys (lack in configuration flexibility)
  - AFB => surveys

B/E requirements: Polarized diffuse emission

- **POLARIZED DIFFUSE EMISSION**
  - polarization capabilities (cross-products)
  - spectropolarimetry (RM-synth): broadband (up to 1 GHz), moderate freq res (2k channels)
  - Dual backends => dual receiver surveys (e.g. S-PASS/STAPS)
  - Multibeam B/E? 300-350 MHz, pol capabilities
- **BACKENDS**
  - DFB3 (Dual IF; dual freq; 8k channels; 8 to 1024 MHz B/W)
  - Total Intensity counterpart: would require a high cal signal synch mod/ demod detection system to correct for gain drifts.
  - MBCORR not suitable (64 MHz is too narrow a B/W)
  - MB surveys?
    - extended B/W: 64 => 350 MHz
    - cross-products (MBCORR does not compute them)
    - MMB => OK (circular pol receivers)
    - 20cm MB => Hard… It would also require other mods: ¼ wave plates for MB receivers (to provide circular pols)

B/E requirements: HI science

- **HI SCIENCE**
  - deep IGM HI obs + extended sources => MB backend
  - moderate HI => extended B/W of MB backend (up to 350 MHz)
  - ~ a few kHz resolution

- **BACKENDS**
  - DFB3 / MBCORR => central beam or H-OH obs (DFB3 more robust)
  - MBCORR-13 beams is not sufficient for part of this science
  - Needs for an updated system with:
    - larger bandwidth (ideally up to 350 MHz, the limit of the current RF/IF system)
    - filters and/or more channels because of freq res. (e.g.: S/W correlation for a virtually unlimited number of channels).
    - more bits (better dynamic range)

B/E requirements: Star Formation

- **STAR FORMATION**
  - OH and Methanol lines
  - H_2O Maser and NH_3 lines (22 GHz)
  - broadband for 22 GHz observations
  - high freq res; full Stokes; high dynamic range
  - the document recommends a 22 GHz array for surveys/mapping
  - full Stokes
- **BACKENDs**
  - DFB3 => single beam observations (up to 2-GHz B/W dual pol, 8k ch)
  - if developed, the 22 GHz array could use:
    - the current MB IF path (up to 350 MHz B/W)
    - MB B/E with extended B/W (up to 350 MHz)
    - would allow multiple NH_3 line observations => (1,1), (2,2), (3,3)
  - MBCORR => 64 MHz B/W => one line at a time
  - larger B/W Multi Beam B/E (2/8 GHz) would imply more profound H/W mods

B/E requirements: Follow Ups

- **FOLLOW UPs (i.e. the Unexpected)**
  - e.g.: first radio Magnetar discovery
  - B/E flexibility

- **BACKENDs**
  - DFB3 and DFB4 => pulsar and spectral modes have sufficient flexibility to allow a broad spectrum of observation types.

B/E requirements: VLBI

- **VLBI**
  - current capabilities: up to 128 MHz B/W (1 Gbps)
  - larger B/W desired?

- **BACKENDs**
  - DAS + MK-V => OK for current needs.
  - Larger B/W => new sampler system is required
  - DFB3 samplers:
    - dual IF
    - up to 1 GHz + 1 GHz B/W
    - high dynamic range (8 bits)

A possible configuration

- **A possible configuration satisfying the identified Science Priorities**
  - DFB3 (8 to 1024 MHz; 8 bits; dual IF; dual pol; full Stokes. 8192 ch)
  - DFB4 (single IF)
  - APSR (1 GHz, dual pol, base band recorder)
  - BPSR (13 beams, 400 MHz, 1024 ch, 8 bits)
  - MB spectrometer with extended B/W (up to 350 MHz, 8-16k ch(?), 8 bits)
  - Guest B/Es

Parkes Observatory
CSIRO Astronomy and Space Science
Ettore Carretti
Systems Scientist

Email: Ettore.Carretti@csiro.au
Web: www.atnf.csiro.au

www.csiro.au

Thank you

Contact Us
Phone: 1300 363 400 or +61 3 9545 2176
Email: enquiries@csiro.au Web: www.csiro.au

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