Spectral properties of a sample of 20-GHz selected radio sources
Outline

- Description of KNoWS survey
- KNoWS follow-ups
- OCRA follow-ups
- KNoWS 20-GHz counts
- Color-color plots
- Comparison with other samples
- Conclusion and future work
**KNoWS**

**K-band Northern Wide Survey:**

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- Alessandra Zanichelli, Isabella Prandoni,
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- Franco Mantovani, Marcella Massardi,
- Rashmi Verma (Estrela PhD)

- INAF-IRA Medicina 32-m dish
- New 7-feed 18-26.5 GHz receiver *(SRT)*
Why KNoWS?

No wide-area surveys exist at these high frequencies for the northern hemisphere

**Goal:**
- to survey the northern sky at 20 GHz
- to detect sources **down to 50 mJy**

- **study of extragalactic compact sources as foregrounds for CMB observations**

- **study of the astrophysical properties of extragalactic sources**

Complementary to the **AT20G** survey (Murphy et al. 2010, Massardi et al. 2011) carried out in the southern sky with ATNF-ATCA
18-26.5 GHz  7-feed receiver

$T_{\text{sys}} = 70 \text{ K} \ (22 \text{ GHz, El}=45^\circ, \tau_a = 0.1)$

Gain = 0.11 K/Jy  (22 GHz, El=45°)

HPBW = 92”  (22 GHz)

Sky distance between beam couples = 212”

14 output channels (7 LCP + 7 RCP) with 2 GHz-wide IF bands
**KNoWS strategy: azimuth scans**

Fast scans at constant elevation, moving back and forth within the desired azimuth range, exploiting the sky apparent rotation to map the wanted area.

**Pros**

- All acquisition at same elevation, i.e. same airmass

**Cons**

- If there's RFI, it affects all scans
- Strictly LST-based strategy

Strategy by E.Carretti developed at Parkes (for S-PASS survey)
Sequence 1
Sequence 2 (+1 LST interleave)
Sequence 3 (+14 LST interleaves)
Sequence 4 (+15 LST interleaves)
Details: pilot survey setup

Azimuth range: 1° - 25° (Dec > 73.2°)  
Fixed elevation: 44.52°  
Scanning speed: 15 °/m (10.7 °/min on sky)  
Sampling interval: 40 ms  
Beamsize (FWHM): 108''  
Samples/beam, single subscan: 4.2  
Integration/beam, full map: 0.672 s

Final average rms: ~20 mJy
**Status: pilot survey**

Pilot survey for Dec > 73.2° (~ 900 sq deg) was performed in total intensity in winter 2009-2010 (heavily affected by bad weather)

*Map: all diffuse contributions are subtracted, looking for point-like sources.*

Data reduction confirmed the expected system performances.

Use of different source extraction tools → identification of ~ **150 candidate sources down to 100 mJy**
**KnoWS follow-up**

- Confirmation and multi-frequency continuum follow-up (5, 8.3, 20 GHz) of 151 pilot survey candidates, in April 2011

(30 GHz OCRA observations for a sample of sources)

**73 sources** were confirmed

**Righini et al., 2012.** (+Ricci et al., in prep.)
OCRA follow-up

- OCRA: One Cm Receiver Array
- 30 Ghz dual feed
- 32m Telescope
- 52 sources observed
  - 16 out of 52 in common with ERCSC (Planck)
KNoWS Source counts

Effective Area as function of sensitivity

Filled circles: KnoWS
Diamonds: AT20G
Solid line: model de Zotti+ 05
Examples of Radio spectra

Upturn

Steep

Inverted

Peaked
**KnoWS Radio Spectra: Colour-Colour Plots**

- Median spectral index:
  - $\alpha(1.4-5) = 0.02$
  - $\alpha(8-20) = -0.07$
  - 66 objects

- Crosses: QSOs (34)
- Asterisks: Gals (15)
- Diamonds: other ID's (17)
Colour-colour plots (II)

Median spectral index
- $\alpha(5-8) = -0.07$
- $\alpha(8-20) = -0.25$
- 66 objects

ATESP (Prandoni+10)
- 26 objects
- $\alpha(5-8) = -0.18 \pm 0.11$
- $\alpha(8-20) = -0.79 \pm 0.16$

AT20G FSR (Massardi+11)
- 3332 objects
- $\alpha(5-8) = -0.16$
- $\alpha(8-20) = -0.25$
## Source populations: % Stats table (I)

Comparison with Prandoni et al. 2010

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<tr>
<th>Type</th>
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<th>KNoWS α(1.4-5)</th>
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<tr>
<td>Upturn</td>
<td>9 ± 5</td>
<td>5 ± 3</td>
<td>11 ± 4</td>
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<td>Inverted</td>
<td>13 ± 7</td>
<td>20 ± 5</td>
<td>14 ± 5</td>
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<tr>
<td>Steep</td>
<td>61 ± 14</td>
<td>52 ± 9</td>
<td>39 ± 8</td>
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<tr>
<td>Peaked</td>
<td>17 ± 8</td>
<td>24 ± 6</td>
<td>36 ± 7</td>
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### Source Populations: % Stats Table (II)

Comparison with AT20G FSR (Massardi et al. 2011)

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F: $-0.5 < \alpha(5-8) < 0.5 \& -0.5 < \alpha(8-20) < 0.5$

I: $\alpha(5-8) > 0 \& \alpha(8-20) > 0$ – F

P: $\alpha(5-8) > 0 \& \alpha(8-20) < 0$ – F

U: $\alpha(5-8) < 0 \& \alpha(8-20) > 0$ – F

S: $\alpha(5-8) < 0 \& \alpha(8-20) < 0$ – F
Conclusions and future work

- KnoWS pilot survey successfully commissioned the K-band multi-feed receiver
- Sample of 66 radio sources down to 100 mJy extracted and analysed
  - source counts in agreement with previous measurements and model
  - follow-up flux density measurements used to compute spectral indices
  - spectral index analysis indicates that source populations are distributed as in AT20G full sample in the flux range 100-500 mJy

- Completion of KnoWS survey with K-band multi-feed at the Sardinian Radio Telescope (being commissioned right now)
- 20-GHz deep survey to study radio spectral properties of radio sources in the 1-mJy regime matching the work of Franzen et al. (10C) and Sadler et al. (southern Hemisphere)