PULSARS AND FRBs

Ongoing activities towards the SKA

Marta Burgay - INAF Osservatorio Astronomico di Cagliari
Pulsars and transients are two of the Main Science Drivers for the SKA.
The scientific impact of Pulsars

Emission physics
Extreme magnetic fields
Binary & stellar evolution
Gravity
Supernova explosions
Super-dense matter

Stappers 2015
THE SCIENTIFIC IMPACT OF FRBs

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Lorimer et al 2007
## Pulsars and FRBs with the SKA Precursors

**Rank-ordered list of approved MeerKAT Large Survey Projects**

1. MeerTime (binary)
2. MHONGOOSE
3. MeerTime (MSPs)
4. LADUMA
5. Fornax
6. TRAPUM (Fermi sources)
7. MeerTime (1000 PTA)
8. ThunderKAT (CVs)
9. MIGHTEE (L band)
10. ThunderKAT (GRBs)
11. MeerTime (GCs)
12. MALS (UHF and L band)
13. TRAPUM (nearby galaxies)
14. TRAPUM (GCs)
15. TRAPUM (SNR, PWN, TeV)
Pulsars and FRBs with the SKA Precursors

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PULSARS AND FRBs WITH THE SKA PRECURSORS

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MeerTime

MeerKAT KSP on Pulsar Timing - P.I. Mathew Bailes

- Regular timing of ~1000 PSRs to
  - study relativistic gravity (GR, masses, EoS…)
  - search for GWs from SMBH binaries
  - study pulsar phenomenology (intermittency, moding, glitches, NS interiors, NS magnetospheres…)
  - study pulsars in GCs (ICM, ICB, binary evolution…)
MeerTime commissioning

courtesy of M. Bailes
MeerTime commissioning

Red = PKS_MB (340 MHz)
White = MeerKAT16 (850 MHz)

courtesy of M. Bailes
Daniel Reardon on behalf of the MeerTime collaboration.

Red = PKS_MB (340 MHz)
White = MeerKAT16 (850 MHz)

8x Parkes in S/N
64x Parkes in timing efficiency
Search targets:
- High-energy point sources (Fermi)
- SNRs, PWN
- Globular Clusters
- Nearby Galaxies

Search for pulsars and fast transients thanks to:
- exceptional sensitivity
- large FoV
- angular resolution through beam-forming

Search for transients:
- commensally, using extra resources (MeerTRAP).
- wide area searches using 64 dishes combined incoherently
- use up to 400 tied-array beams for localisation
INAF INvolvement

- A. Possenti
  - SKA Pulsar KSP group member
  - MeerTime INAF representative
  - MeerTime GC timing project leader
  - TRAPUM

- M. Burgay,
  - SKA Pulsar KSP group member
  - TRAPUM follow-up project leader
  - MeerTime member

- A. Ridolfi (postDoc)
  - TRAPUM member
  - MeerTime member

- F. Abbate (PhD @MiBicocca)
  - TRAPUM member
  - MeerTime member

+ 27 collaborators distributed over 7 INAF structures, to fully exploit the MeerKAT investigations across the e.m. spectrum

- 2 PRIN SKA-CTA projects funded
  - P.I. Giroletti (IRA) - transients, including FRBs
  - P.I. Possenti (OAC) - pulsars with MeerKAT
PSRs and FRBs in INAF towards the SKA

- Parkes surveys
  - Found more than 1/2 of all known pulsars
  - Discovered Fast Radio Bursts
  - Ongoing SUrvey for Pulsars and Extragalactic Radio Bursts (SUPERB) finds FRBs in real time
PSRs and FRBs in INAF Towards the SKA

• Pulsar Timing Arrays
PSRs AND FRBs IN INAF TOWARDS THE SKA

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PSRs and FRBs in INAF Towards the SKA

- Pulsar Timing Arrays
PSRs and FRBs in INAF Towards the SKA

- Sardinia Radio Telescope

Approved PSR/FRB projects this semester

- EPTA/LEAP (GW & Rel Binaries)
- Eclipsing MSPs (binary evolution)
- Fermi point sources
- Monitoring FRB 121102
**SUMMARY & CONCLUSIONS**

- PSRs and fast transients studies will greatly advance thanks to the SKA
- SKA precursors have PSRs and FRBs among their top priorities and the first results obtained with these instruments look, indeed, extremely promising
- INAF is deeply involved in PSR and FRB projects within the SKA framework
- INAF people involved in these projects have a proven expertise and many international collaborations in all major PSR and FRB science topics that the SKA will keep on investigating

*We are ready for the SKA challenges!*
THANK YOU!