TRANSIENTS WITH SKA PRECURSORS AND PATHFINDERS

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OUTLINE

• Exciting science with radio transients!

• SKA precursors: telescopes and capabilities of MeerKAT, ASKAP. NenuFAR at low frequencies.

• Some first results with MeerKAT

• Conclusions.
RADIO TRANSIENTS
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GRB

CI CAM
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• « Slow » Transients: explosive injection of energy into an ambient medium —> shocks —> particles acceleration up to HE + synchrotron emission:
  • XRBs (BH, NS, WD), ULX, Isolated BH, magnetar, SNe, TDEs, AGNs, GRBs, Novae, ….
RADIO TRANSIENTS

Limit ~1 sec

Pietka, Fender & Keane 2015
FAST TRANSIENTS: FRB

Lorimer et al. 2007

Ng et al. 2014

Spitler et al. 2016
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- Cosmological probes: measuring baryon content (from DM contributions)

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MOTIVATIONS FOR SLOW TRANSIENTS

• Accretion: the most powerful source of energy in the Universe!

• Whenever you have accretion, you always see ejection!! Nature of the existing fundamental coupling? Is it universal along the mass scale?

• Synchrotron flares from stellar mass compact objects: a unique laboratory with associated variabilities accessible with our lifetime.

• Astrophysics in extreme environments: density, temperature, gravity, velocity, ...

• Jets: Composition? Formation? Energetics? Kinetic feedback on their environment?

• Existence of intermediate mass black holes? Seeds of supermassive BHs? EOR?
TRANSIENTS & RADIO OBSERVATIONS

• A new generations of radio observatories to probe the variable radio Universe: LOFAR and NenuFAR, MeerKAT, ASKAP, … towards the SKA!

• Advantages of radio observations:
  • Probing the non thermal electrons (similarly to HE telescopes).
  • Large FOV, daily/night; huge sensitivity, precise localis., poss. high resolution imaging, fast reaction time (< 1 min) with response to external triggers.
  • Sometimes coupled with simultaneous multi wavelength observations.
  • Towards the Radio All Sky Monitor and automatic generation of alert by VO events.
  • Transient buffer board (low frequency telescope) —> transient precursors?
THE SKA PRECURSORS AND PATHFINDERS
SKA PRECURSORS: ASKAP

- Location: Australia
- Max Baseline: 6 km
- Frequency coverage: 0.7-1.8 GHz
- 36 antennas (12 m) with PAF (30 deg² FOV)
- Fully operational, all antennas equipped with PAF
FIRST ASKAP FRB IN MAY 2017!

« ASKAP has found its first FRB after less than four days of searching (8 antennas). The discovery came so quickly that the telescope looks set to become a world champion in this fiercely competitive area of astronomy. » ASKAP press release. CRAFT
SKA PRECURSORS: MEERKAT

- Location: South Africa
- 64 antennas (13.5 m) over an 8-km baseline
- Frequency coverage: 0.5-10 GHz (now L-band (0.9-1.67 GHz), UHF (0.58-1.0 GHz) ; 56 active antennas, S-band (1.75–3.5 GHz – by MPIfR) to come.
- Expanded MeerKAT+20 15-m dishes, baseline up to 18 km
- FOV: 1.69 deg² @ 1 GHz
- Inauguration in July 2018. Observations continue for MeerTime, ThunderKAT, MIGHTEE, and Open Time projects
MeerKAT bubble (Heywood et al. 2019)
THUNDERKAT
(PI: FENDER/WOUDT)

A MeerKAT Large Survey Project for synchrotron radio transients

• **Survey** and **monitor** populations of Galactic and extragalactic **synchrotron radio transients** (CVs, GRBs, XRBs, SN 1a).

• **Commensal** observations + **pointed** observations (3000 h = 100 min/day) typically for follow-up + simultaneous optical observations with **MeerLicht**.

• **Large international collaboration** (56 co-Is from 9 countries): AIM, IAP, IRAP, GEPI
• All the slides related to the preliminary results from the ThunderKAT collaboration can not be put online.

• See later:
  • Tremou et al. (for GX 339-4),
  • Coriat et al. (Cir X-1),
  • Espinasse et al. (for MAXI J1820+070),
  • Carotenuto et al. (for MAXI1348-630).
CONCLUSIONS

• Deployment of ASKAP and MeerKAT is done.

• MeerKAP still to be upgraded with 20 more antennae (D) and new receivers for higher frequencies

• NenuFAR is building up, Early Science. See PZ’s talk.

• First results from ASKAP and MeerKAT start to be available

• Strong synergies (not discussed here)

• Large programs to be discussed later: see
  