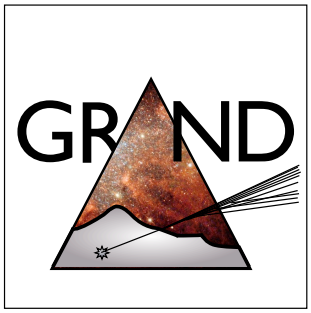
GRAND Science Case Topics



The most important questions

UHECR origin!

- **First detection of cosmogenic neutrinos**
- **First neutrino point sources = UHECR accelerators**
- **UHECR astronomy w. large statistics**
- **First UHE photon sources**

New physics?

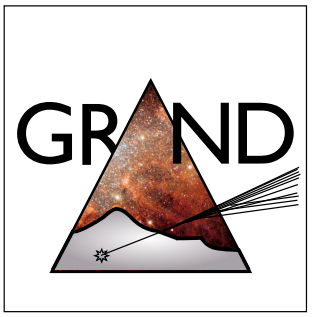
- Fundamental neutrino physics (nu-N cross section)
- Superheavy dark matter constraints

Radio Astronomy?

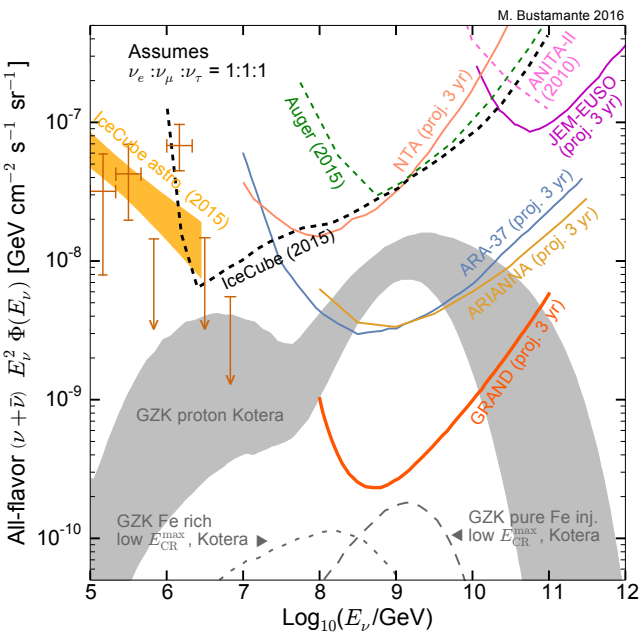
- FRBs/GRBs, GW counterparts, Pulsars, Reionization…

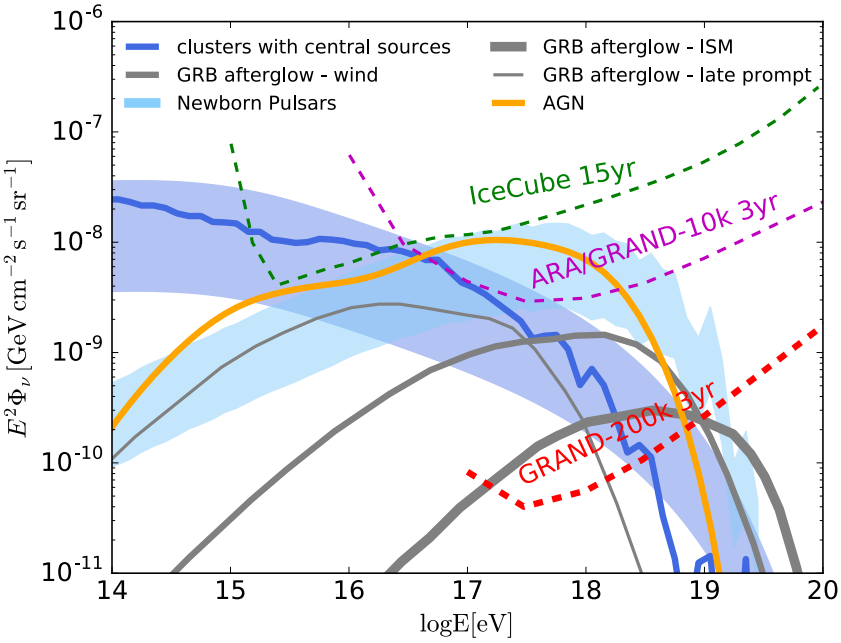
Multi-messenger monitor w. great sensitivities

UHE Neutrinos!



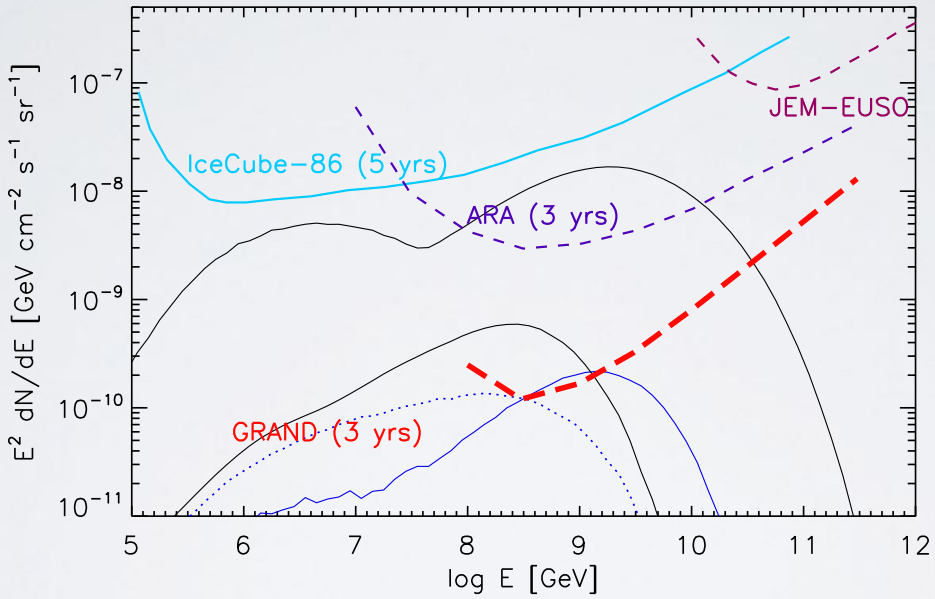
- Detection of the first UHE neutrinos
  - ✦ Cosmogenic neutrinos (UHECR composition)
  - ✦ Astrophysical sources (point source detection)





Expected flux of cosmogenic neutrinos - the allowed and "reasonable" ranges

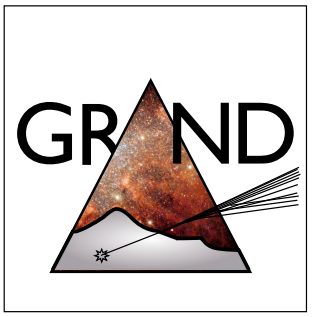
- Parameters compatible with Auger observed composition (low proton max. energy) imply large range of uncertainties…



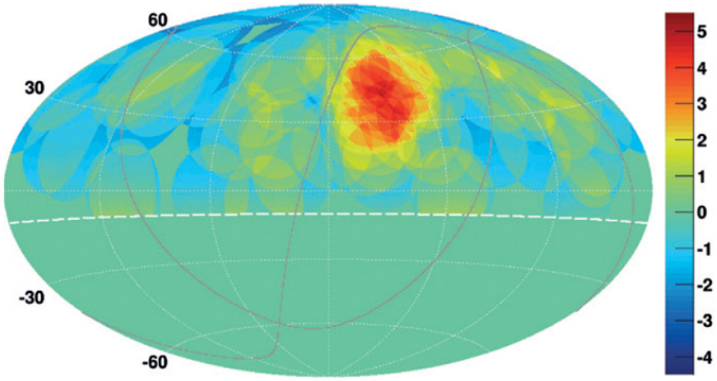
- A more precise calculation needed for Auger-compatible nu-flux
  Rafael Alves Batista will have results on Thursday

- How to turn this in the White Paper?

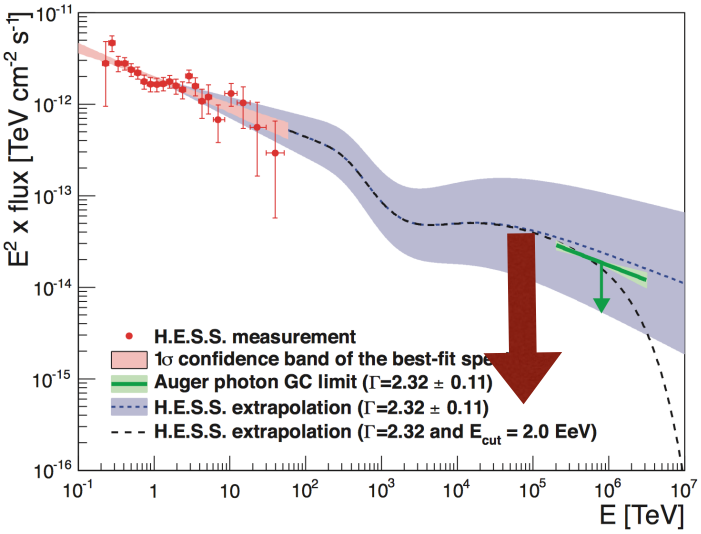
UHECRs & UHE Gamma Rays



- **UHECR astronomy**
  (hot spots? large-scale anisotropy?)
- **UHE photon astronomy**
  (~0.1 deg angular resolution + more statistics = ~100-300x better sensitivity)
  - Galactic EeVatrons?



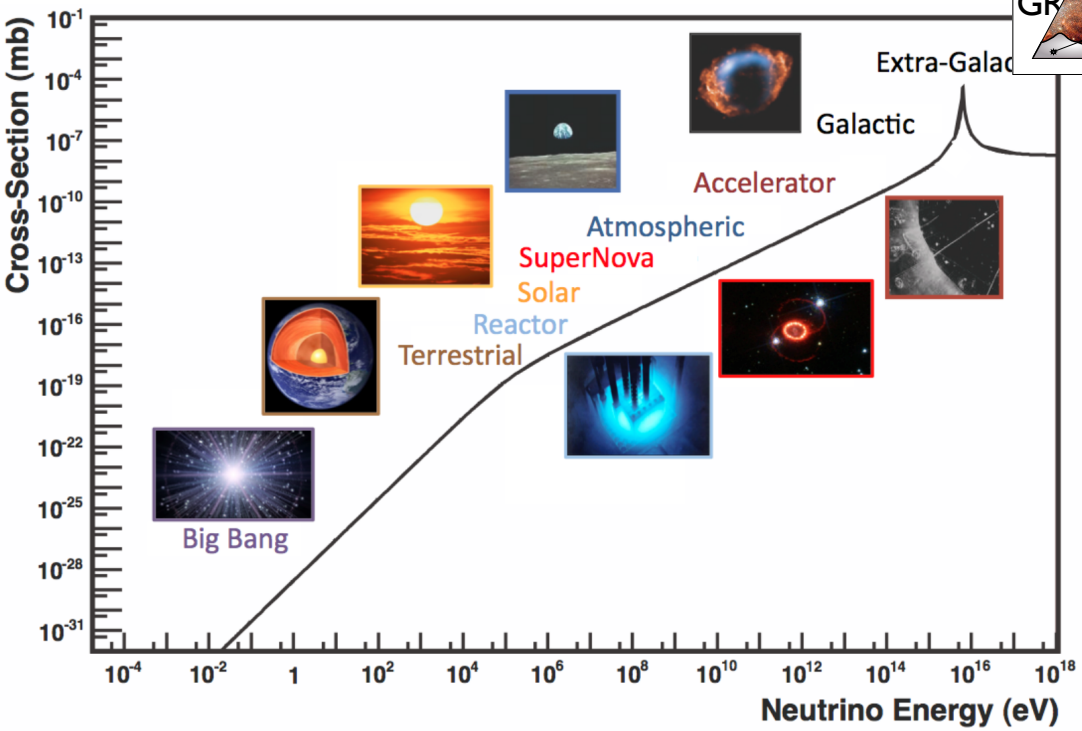
More UHECR structures can be resolved by GRAND



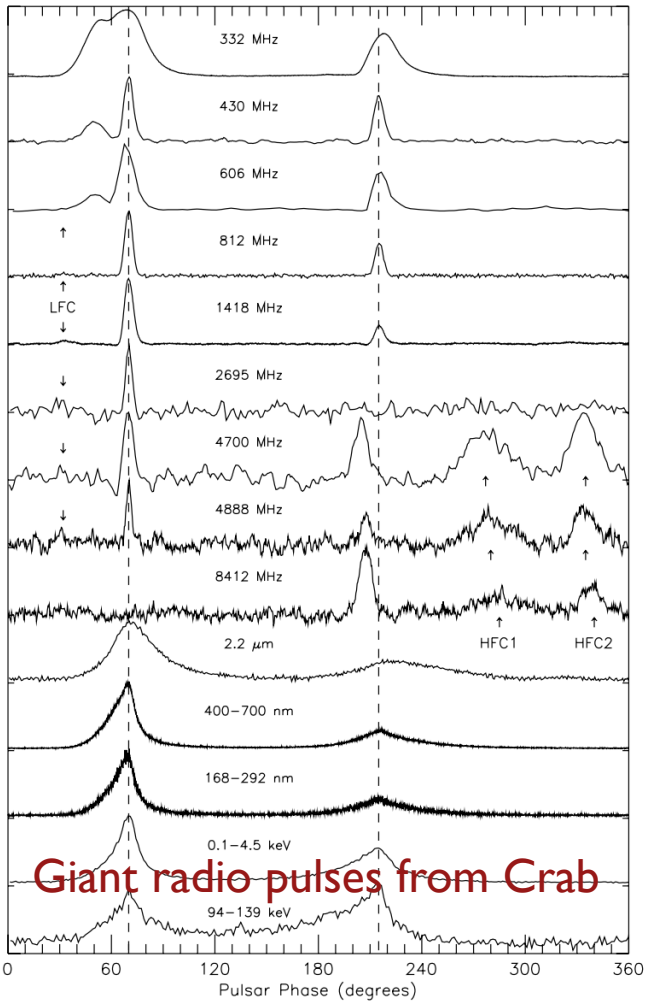
~300x more sensitive

New physics

- Neutrino-nucleon cross section
- More exotic physics (many…)

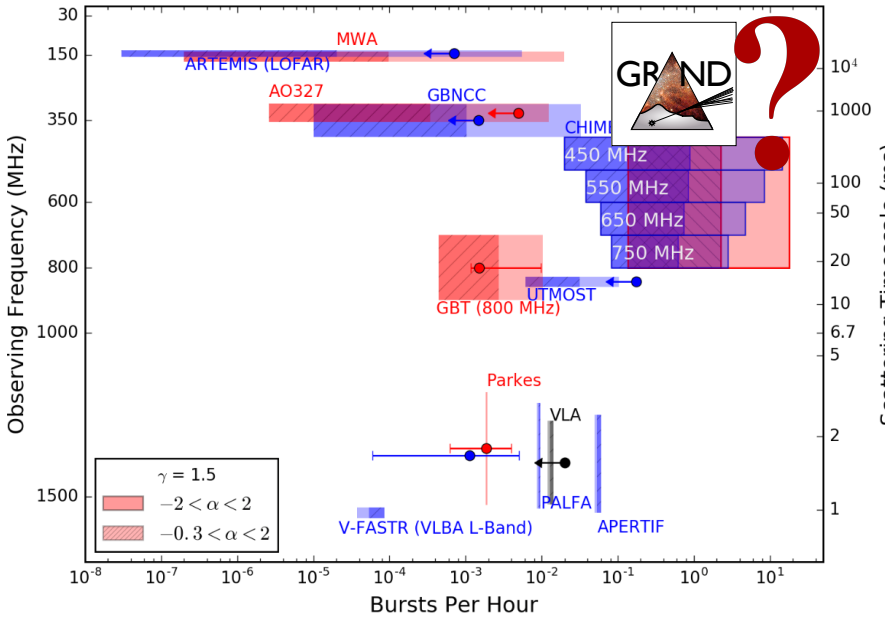


Radio Astronomy

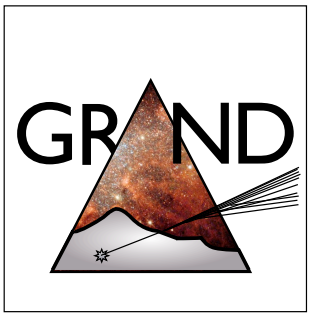


Giant radio pulses from Crab

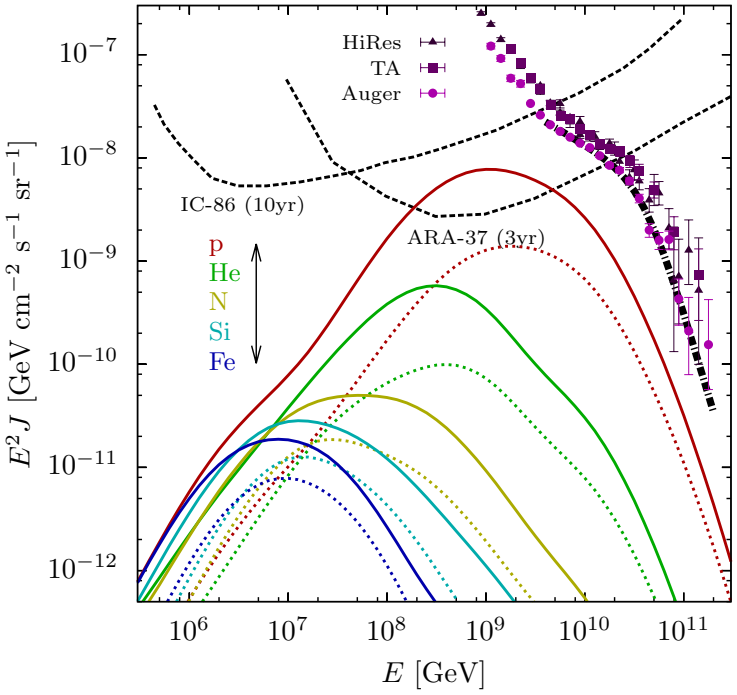
Fast radio bursts

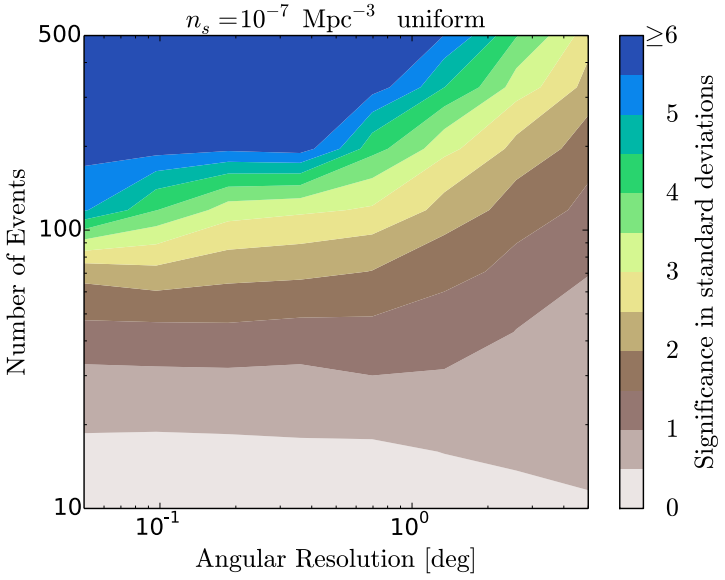


UHE Neutrinos!

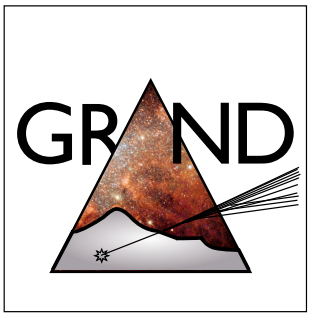


- Detection of the first UHE neutrinos
  - ✦ Cosmogenic neutrinos (UHECR composition)
  - ✦ Astrophysical sources (point source detection)

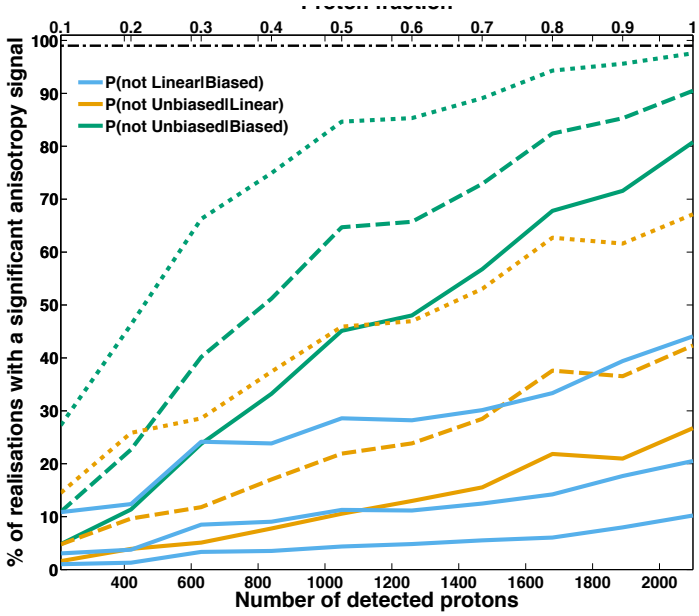


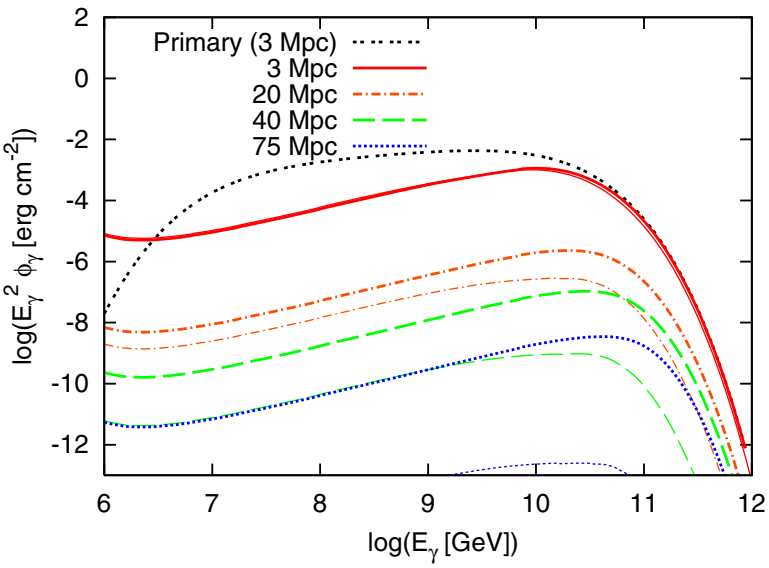


UHECRs & UHE Gamma Rays



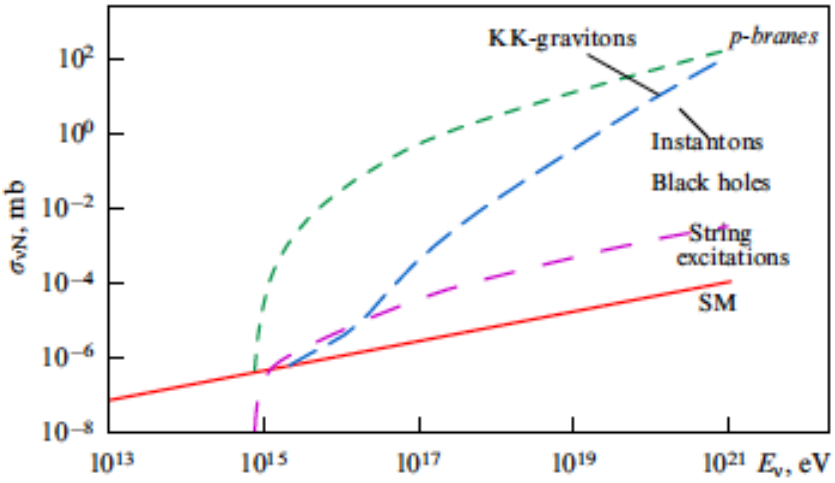
- **UHECR Astronomy**
  (hot spots? large-scale anisotropy?)
- **UHE photon astronomy**
  (~0.1 deg angular resolution + more statistics = ~100-300x better sensitivity)
  - Galactic EeVatrons?

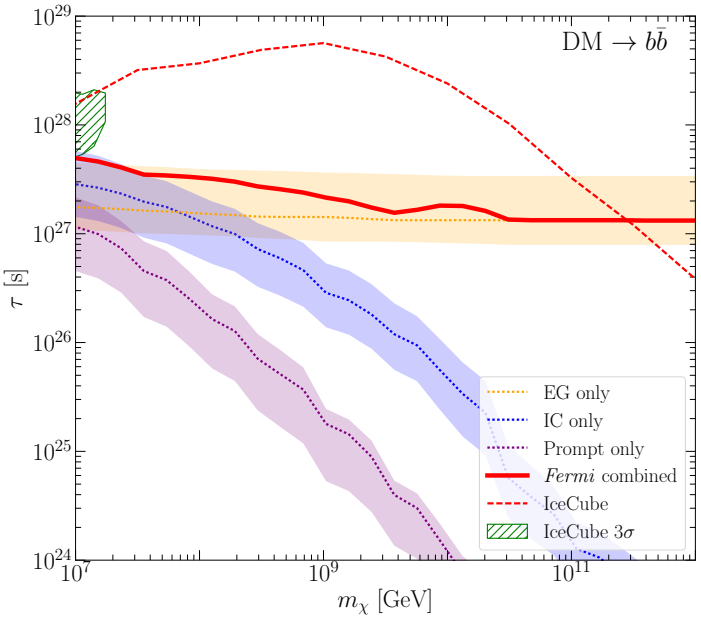




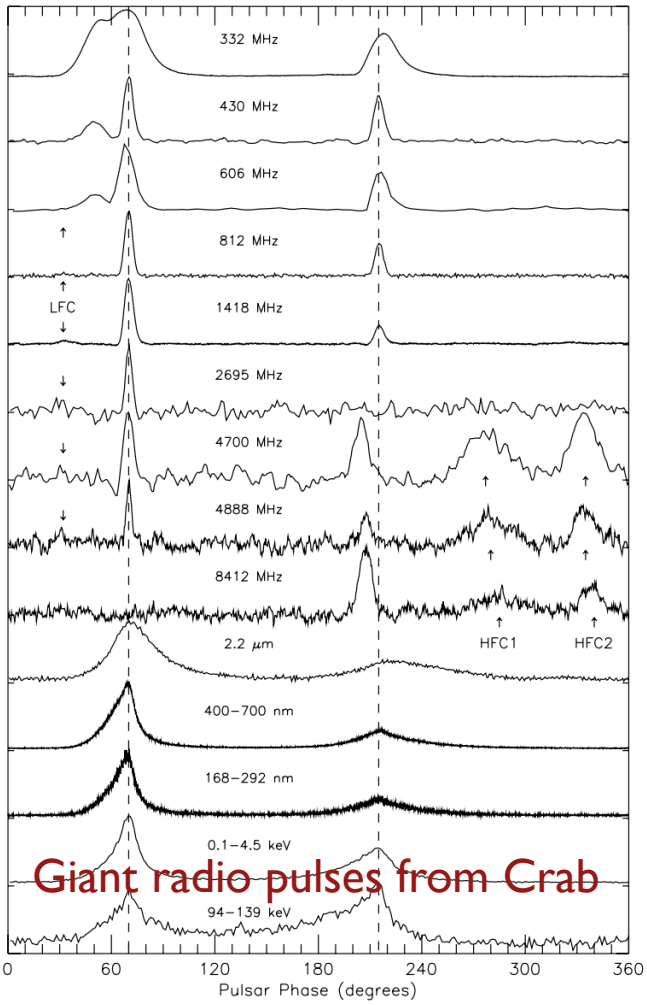
New physics

- Neutrino-nucleon cross section
- More exotic physics (many…)





Radio Astronomy



Giant radio pulses from Crab

Fast radio bursts