Prospects for southern sky exploration with IMONY, the photon counting imager

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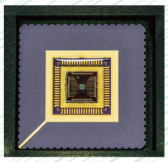
IMONY

Imager of MPPC-based Optical photoN counter from Yamagata

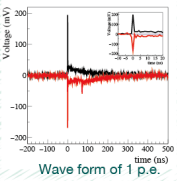
Photon counter + imager

- 8×8 Geiger APD array (= SPAD array)
- 0.2 mm×0.2 mm pixel, narrow FoV (entire FoV ~15")
- 100 ns time stamp resolution (will be upgrade to 5 ns)
- Monochromatic (3-color option is under development)
- FPGA based DAQ, operated via ethernet by SiTCP[1]
- No cooling system

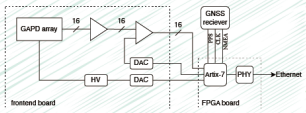
Suit for point souces with known position



GAPD array



Wave form of 1 p.e.



Structure of DAQ (1 unit)

IMONY on Seimei

See talk by A. Sato, K. Hashiyama

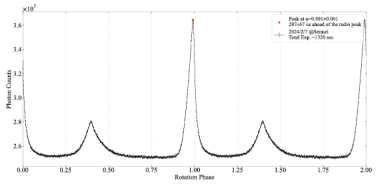
IMONY installed

Successful installation

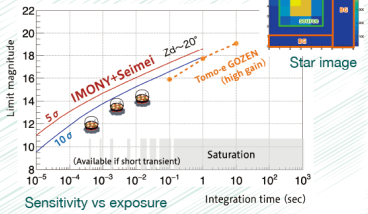
- Temporarily installed on the instrment rotator plane
- Focal axis alignment using a defocussed bright star
- Best position implimented in the telescope opretaion system

Comissioning

- Timing accuracy and imaging by Crab pulsar
- Simultaneous obervation with radio telescopes
- Photometry evaluation by stars

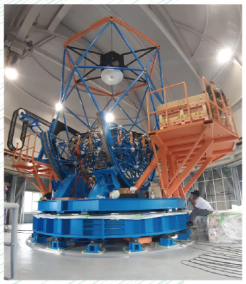


Phasogram of Crab pulsar



Star image

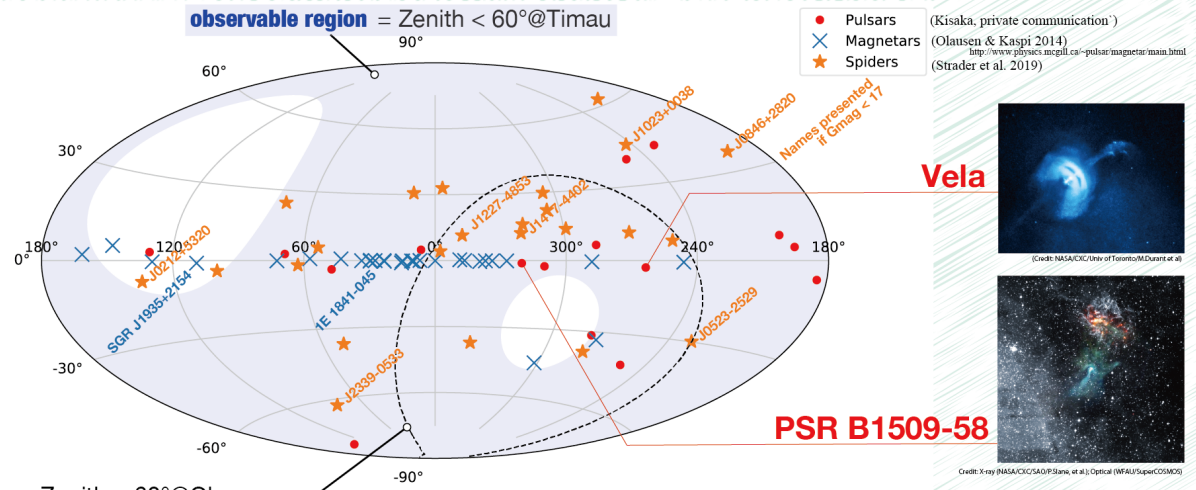
Imagine if IMONY were installed in Timau observatory



Telescope

123.9471E, 9.5974S
1300 m a.s.l.

Location



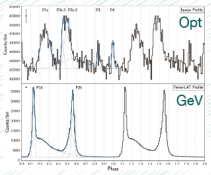
Okayama + IMONY-South or IMONY-North+Timau may also be interesting

Optical pulsars

- Limitted number of pulsars detected so far
  - Some are detected only as point sources without pulse detection
  - Uncertain fraction of pulsed emission due to the viewing angle
- Extending variety of pulsed-optical PSRs to understand pulsar magnetsphere structure and emission models.
- **PSR B1509-58**, the 2nd highest Edot optical pulsar
  - P=150 ms, young, high-B (1.5×10^{13} G) close to magnetars
- **Vela**, the 4th highest Edot optical pulsar
  - P=89 ms, mid-aged but brightest in GeV sky
  - Known to show GRP-like activity -- joint radio obs. is important

PSRs with optical counterparts

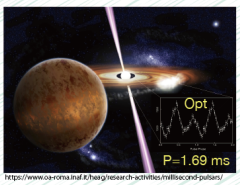
Pulsar	log(τ) (yr)	log($\dot{E}$) (erg s^{-1})	Log luminosity (erg s^{-1}) Optical	X-ray	γ-ray	d (kpc)
Crab	3.10	38.65	33.15	36.32	35.79	2
PSR B1509−58	3.19	37.25	30.97	35.04	34.83	4.2
PSR J0205+6449	3.73	37.43	30.06	33.42	34.91	3.2
Vela	4.05	36.84	28.13	32.44	34.93	0.287
PSR B0656+14	5.05	34.58	27.53	32.22	32.49	0.288
Geminga	5.53	34.51	27.20	30.97	34.39	0.250
PSR B1055−52	5.73	34.48	28.20	32.18	34.23	0.72



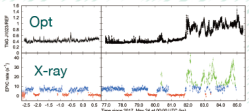
Pulse shape of Vela pulsar

Spiders (redback & black widows)

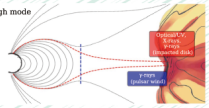
- Binary of a milisecond pulsar and a companion star
- Probing pulsar wind interaction with the companion
- MWL obs. is useful to monitor the mode change



PSR J1023+0038

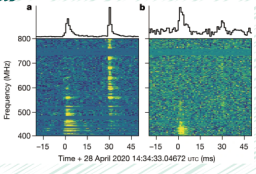


Mode change in light curve



Modeling of PW-interaction

Magnetar radio bursts/Rep. FRBs



SGR J1935+2154

- Challenge on the origin of FRBs
- MWL obs. with high-time resoution is crucial
  - No optical counterparts so far
- Galactic magnetars would play an important role, since distances are close
- Waintng for more samples and trials.

Others

- Blackhole binaries with O(100 Hz) quasi-periodic activities
- Occutation by asteroids -- NEOs, Main belts, TNOs, KBOs,...

references

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