Neutron star observations and theories workshop 2023, Kyoto Univ., 6-8 Sep 2023

# コンパクト天体の可視高速撮像システム IMONY の本格稼働へ

## IMONY : Optical fast imager for compact objects

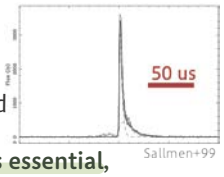
Imager of MPPC-based Optical photoN counter from Yamagata

**Takeshi Nakamori（Yamagata Univ.）** with many collaborators : R. Sato, A. Sato, Y. Ouchi, K. Hashiyama, M. Shoji, M. Hasebe, E. Ono, K. Kawabata, T. Nakaoka, T. Terasawa, H. Misawa, F. Tsuchiya, Y. Yonekura and more

## Our 1st target : Giant radio pulse

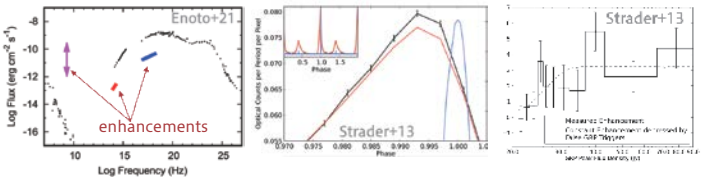
GRP : Intense radio pulse observed for seveal pulsars, like Crab

★ ns--us duration, multi pulses contained
★ ~3% optical enhancement w/ GRPs
★ ~3% X-ray enhancement w/ GRPs
★ Emission scenario has been long argued



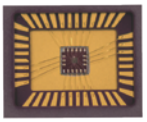

Need more stats!

High Δt instrument is essential, collabarations w/ Japanese radio facilities



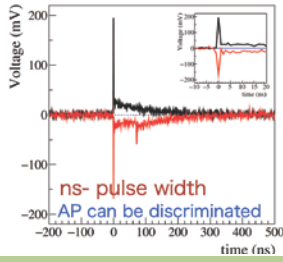

## IMONY Geiger APD array ver.1

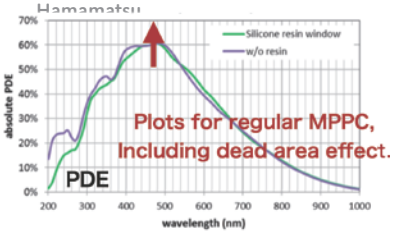
Customized MPPC, cell-by-cell readout



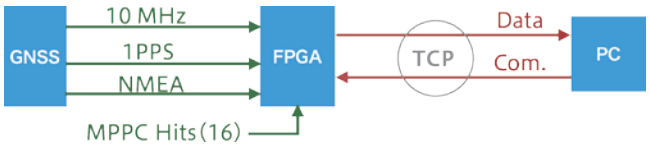

★ Single photon sensitivity
★ 0.1x0.1 mm²/pixel
★ 4x4 pixel imaging capability
★ Lower dark count
O(10) counts/s@0℃

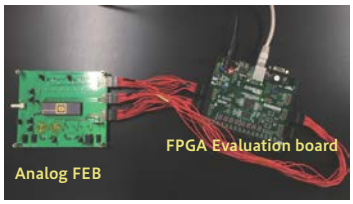
No cooling operation




## Data Acquisition

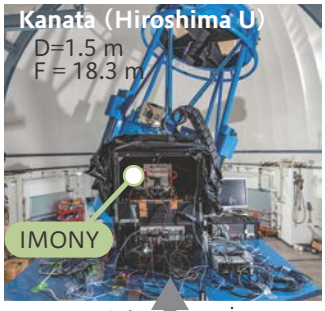



Time stamp res. : 100 ns
Readout deadlime : None
Data Transfer rate: 100 Mb/s

high cadence movie

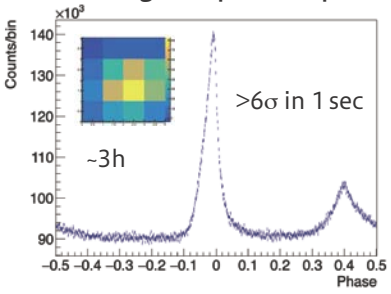
## Crab observation




GRP info $P, \dot{P}, t_{\mathrm{JPL}}$

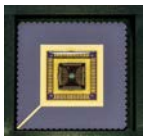
**Radio telescopes**
Iitate (Tohoku), Hitachi (Ibaraki), ...

Integrated pulse shape

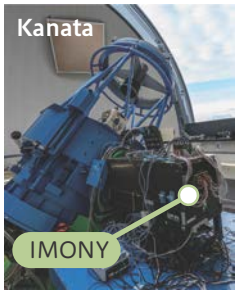



Success!
but need wider FoV

## IMONY Geiger APD array ver.2

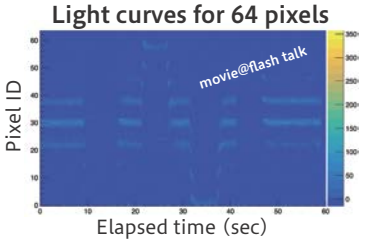


★ 0.15x0.15 (or 0.10x0.10, etc) mm²/pixel
★ 8x8 pixels, Wider FoV
Full coverage for Kanata PSF
Tolerant for tracking accuracy etc
Suit for well-known point sources

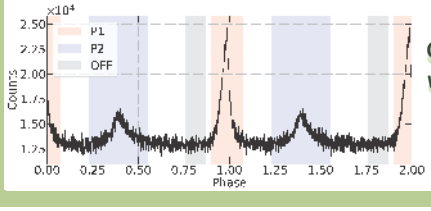



★ Operated by 4 sets of the readout
★ Star captured during telescope slew

Light curves for 64 pixels




### Crab observation

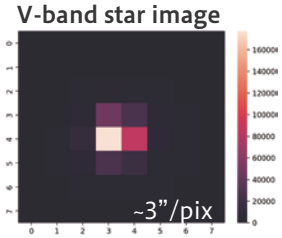


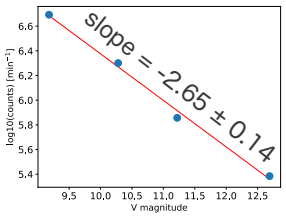

Clearly detected
with accurate time stamping

See Hashiyama's talk

### Photometric linearity

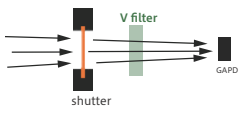
V-band star image

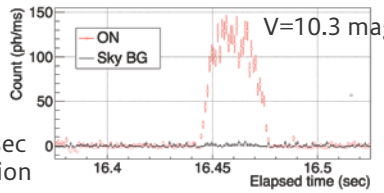



Consistent with expectation!

### Excercise for transient detection




Shutter opened for 1/30 sec
Sensitivity under estimation

fast photometry!

### Future plans

No space to present ! Let's discuss !