

J. Łukasik, P.Lasko, P. Pawłowski et al. IFJ PAN, Kraków J. Brzychczyk et al. Jagiellonian University, Kraków



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ASY-EOS II @ FAIR (2019?)

Determination of the density dependence of the EOS at supra-saturation densities

Symmetric and asymmetric systems ¹⁰⁸Sn, ¹³²Sn, ¹⁹⁷Au @ 0.4, 1, 1.2 AGeV

Observables: ratios: n/p, t/³He, π^{-}/π^{+} (?) flow: n, p, t, ³He

Main detectors: NeuLAND, FOPI PlasticWall / ALADIN TOF-Wall, Trigger/Reaction Plane detector around the target Multiplicity Trigger and Reaction Plane detector around the target

Requirements:

- 1) should cover polar angles > 30° ,
- 2) high segmentation in azimuthal angle,
- 3) high geometrical efficiency,
- 4) low multihit probability,
- 5) possibility to set multiplicity threshold as a trigger condition,
- 6) remote control of discriminator thresholds (one common threshold per 32 scintillators (5 per ring ?)),
- 7) fast timing,
- 8) low sensitivity to δ -electrons (no final idea how)

No plan to provide amplitudes (no ADCs,

only discriminators \rightarrow CFD or LED?)

Trigger/Reaction Plane detector around the target:

- 5 rings of 5x5 mm² fast scintillating fibers (e.g. BCF-10) read out by SiPMs
- coverage of polar angles from 30° to 165° ,
- segmentation assuring more or less uniform count rates for the Au+Au at 1 AGeV,
- geometrical efficiency ~93%
- ~11% of charged particles involved in multihits,
- ~6% single segment multihit probability,
- sufficiently large for radioactive beams
- sufficiently small and lightweight not to disturb neutrons
- min radius 8 cm,
- max radius 14 cm
- length 53 cm
- 160 (5x32) segments in forward rings
- 96 (3x32) segments in backward ring
- 736 channels (similar to the FOPI Plastic Wall).



present idea





size comparable to that of a 24" monitor



ring segments



how to improve efficiency:

- trapezoidal cross sections \rightarrow taper by ~100 µm (?)
- do not use cladding (?)

how to wrap or paint to minimize cross talks:

- aluminized mylar (?)
- white/black tape/paint (?)



SiPM+Plastic

MicroFJ-300xx-TSV SiPM				20µm 35µ	um 35µm			
Parameter		ΔV	min	typical	cal m		(units
Breakdown Voltage (Vbr)			24.25	24.50		24.7	5	V
Overvoltage (ΔV)			1			6		V
Spectral Range			200	420 (peak))	900)	nm
Photon detection efficiency @		Vbr +2.5 V		31 38				%
Photon detection efficiency @		Vbr +6.0 V		42 51	42 51			%
Dark Count Rate @		Vbr +2.5 V		45				kHz/mm ²
Dark Count Rate @		Vbr +5.0 V		80	1		,	kHz/mm ²
Gain @		Vbr +2.5 V		9.1×10 ⁵ 2.8×	2.8×10 ⁶			
Gain @		Vbr +5.0 V		1.7×10 ⁶ 5.3 ×	3×10 ⁶			
Dark Current @		Vbr +2.5 V		0.2	0.2 (μA
Dark Current @		Vbr +5.0 V		1.1	1.1 1			μA
Rise time				100	100			ps
Microcell recharge time constant				12 37				ns
Microcell fill factor				62 75				%
No. of microcells				14850 5676				
Cover refractive Index				1.53 @ 436nm				
	Plastic Scintillator	Emission	Peak	Decay Time	Refr.	Ind.		Density
	BCF-10 fiber	blue	432 nm	2.7 ns	1.6	60	1.	050 g/cm ³
	BC-490 casting resin	blue	425 nm	2.3 ns	1.5	58	1.	032 g/cm ³

mechanics

1) external clamp for each ring holding SciFi segments + stand

or

2) 3D printed ring structure holding SciFi segments

or

3) use BC-490 Plastic Scintillator Casting Resin and 3D printed molds instead of SciFi







Cosmic pulse shape from Paweł's tests of MicroFJ-30035-TSV SiPM + his preamp



~ 4 ns rise time, ~8 ns FWHM

Some UrQMD + GEANT4 performance predictions

UrQMD + clustering: Au+Au 1000 AMeV, 0-10 fm, 200 fm/c



better correlation

hits/segment



SciFi segment number



Summary, Conclusions, Open problems

- challenging **KRAB** project accepted
- preliminary design of a compact multiplicity trigger/reaction plane detector for the ASY-EOS II
- additional simulations and tests needed to finalize the design:
 - light propagation and optimization of efficiencies
 - light sensors for readout
 - geometry and composition of scintillating segments and rings
 - cross-talks removal, light tightness
 - mechanics
 - design of front end electronics, PCB boards, cabling, power supplies, threshold control, trigger box, multiplicity threshold settings
 - target holder
 - delta electron suppression
 - any missing experimental limitations and demands to be taken into account
- any suggestions ?

J-Series High PDE and Timing Resolution, TSV Package DATASHEET



PERFORMANCE PLOTS



