# Synthesis of new plastic scintillators for J-PET

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# THE AIM

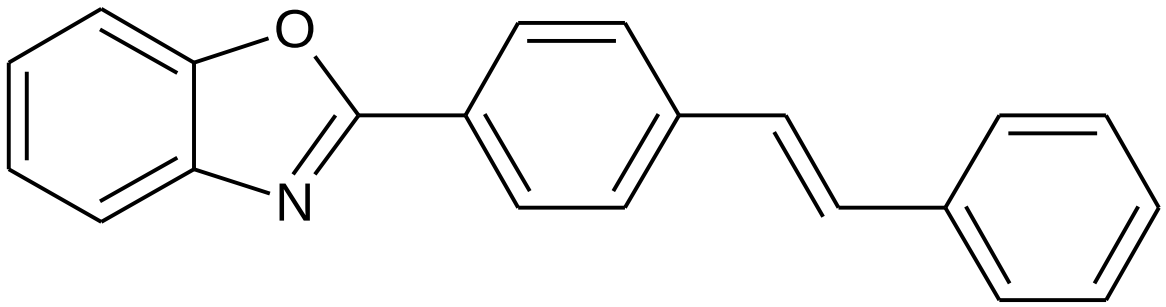
Production of scintillator which would have better timing properties than presently available.

# FIRST TRIAL

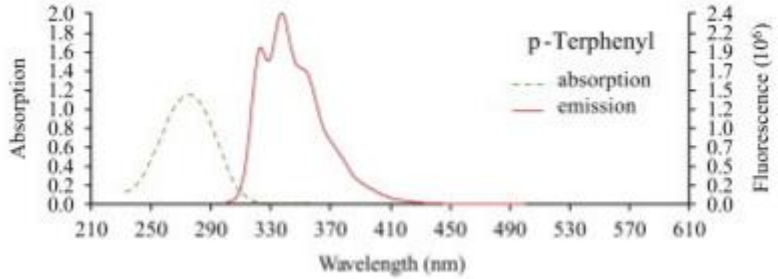
Synthesis of novel scintillator with wavelength shifter which has not been used so far as a scintillator dopant.

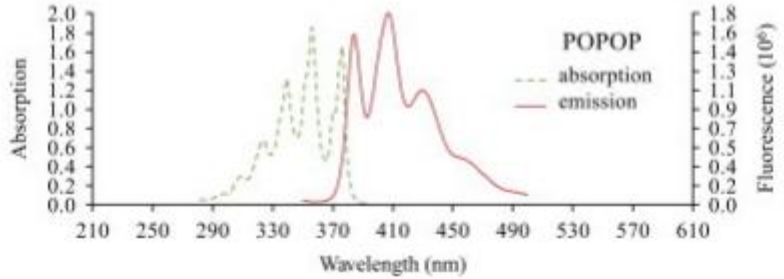
# 2-(4-styrylphenyl)benzoxazole

# NEW WAVELENGTH SHIFTER




Patent application No: P 409387 (2014)

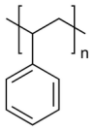


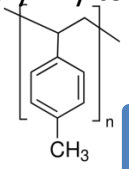

# ENERGY TRANSFER IN PLASTIC SCINTILLATOR

Incident radiation

- **POLYMER (98 - 99%)**
- polystyrene



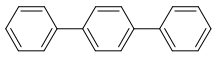
- polyvinyltoluene



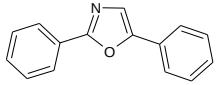
NON-RADIATIVE ENERGY TRANSFER

FLUORESCENCE (UV)

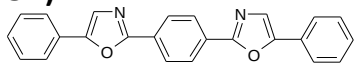
- **PRIMARY FLUOR (1-2%)**
- p-terphenyl **(PTP)**



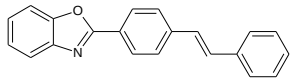
- 2,5-diphenyloxazole **(PPO)**



- **SECONDARY FLUOR – WAVELENGTH SHIFTER (0,01-0,03%)**
- 1,4-di(5-phenyl-oxazolo-2-yl)benzen **(POPOP)**



- 2-(4-styrylphenyl)benzoxazole



FLUORESCENCE (VISIBLE RANGE)

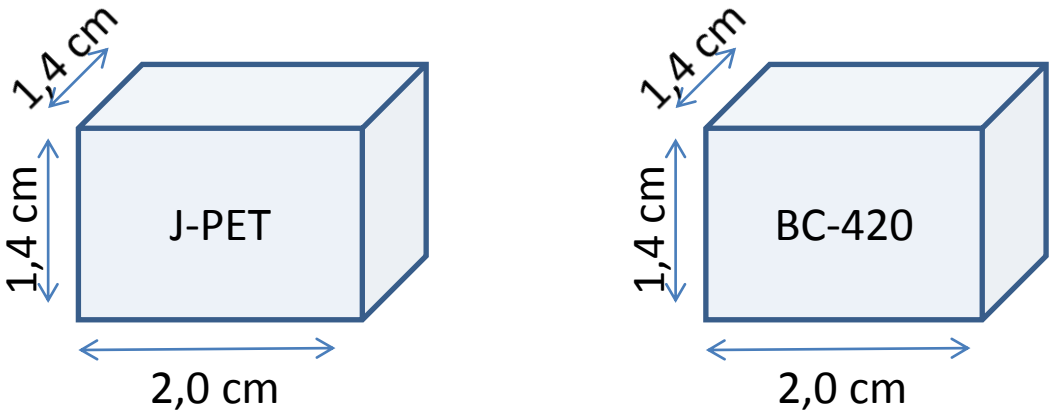
*Physics and Engineering of Radiation Detection S. Ahmed 2007*

| Scintillator | Price [US $/cm$^3$] |
|---|---|
| Plastic | 0,1-1 |
| Plastic, boron-loaded | 11-12 |
| Plastic, lead-loaded | 3 |
| Liquid, boron-loaded | 5 |
| Liquid, gadolinium-loaded | 0,15 |
| NaI:Tl | 6 |
| LiI:Eu | ~100 |
| YAG:Ce | 90 |
| LSO:Ce | 60 |
| $LaBr_3$:Ce | ~500 |

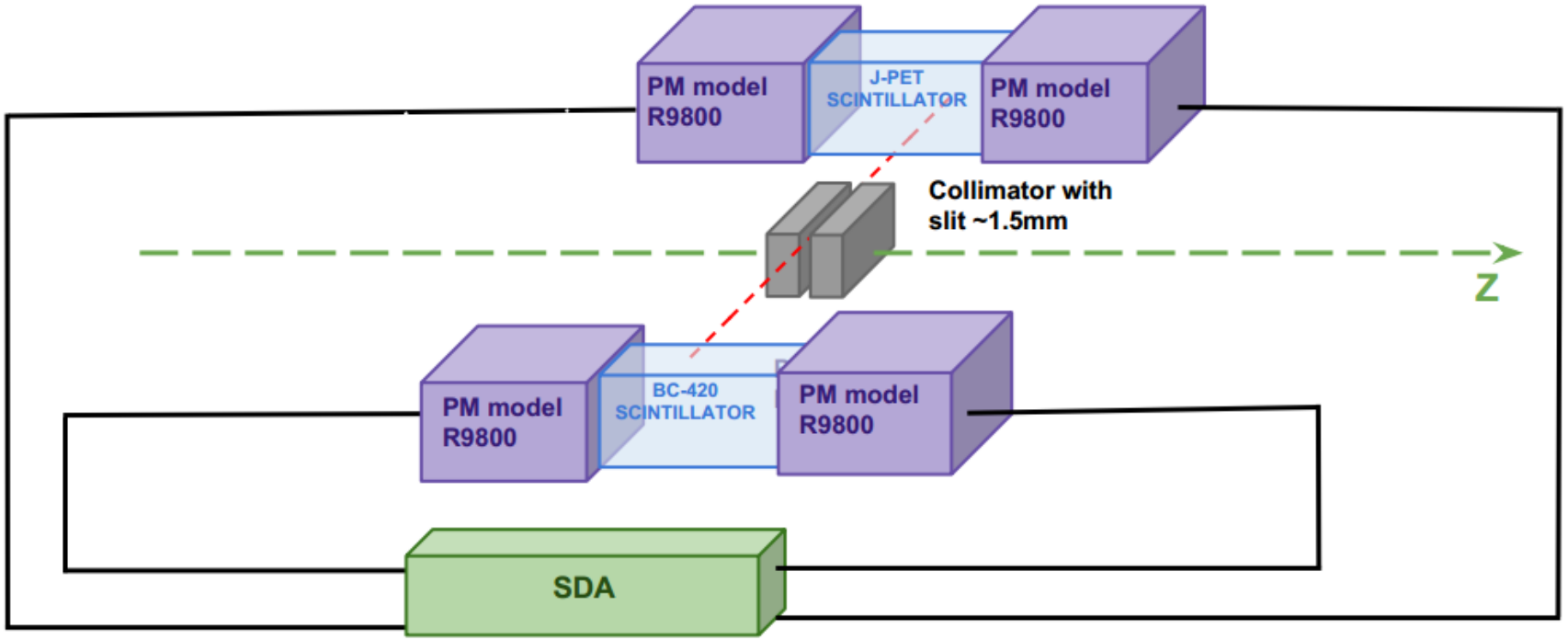
Handbook of Particle Detection and Imaging C. Grupen, I Buvat, 2012

# NEW SCINTILLATOR

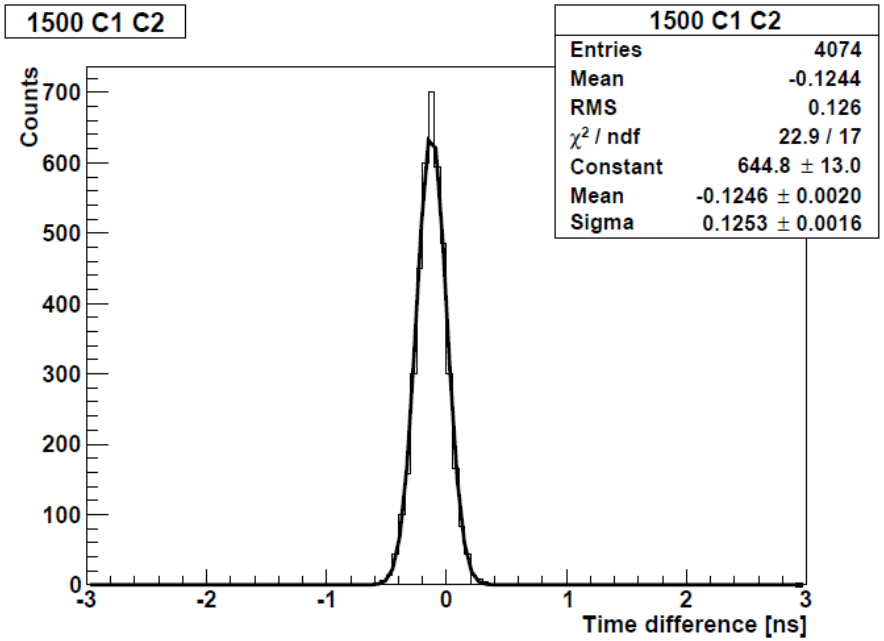
| **Base** | **First additive** | **Wavelength shifter** |
|---|---|---|
| Polystyrene/ polyvinyltoluene | PTP/PPO | 2-(4-styrylphenyl)benzoxazole |
| ~98% | 2% | 0,03% |

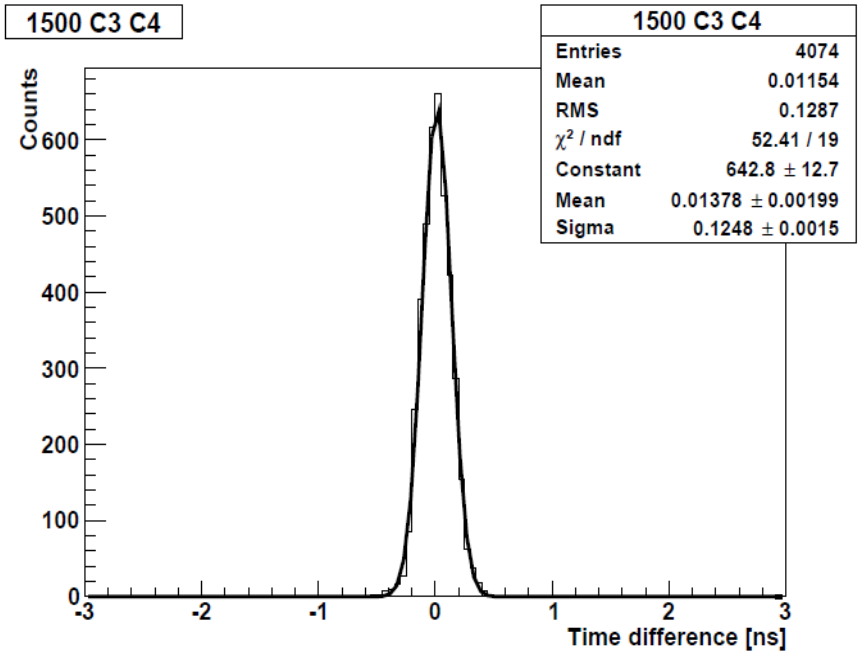

1,4 cm
1,4 cm
J-PET
2,0 cm
1,4 cm
1,4 cm
BC-420
2,0 cm

# EXPERIMENTAL SETUP



# TIME RESOLUTION




J-PET SCINTILLATOR

125,3 ± 1,6 ps

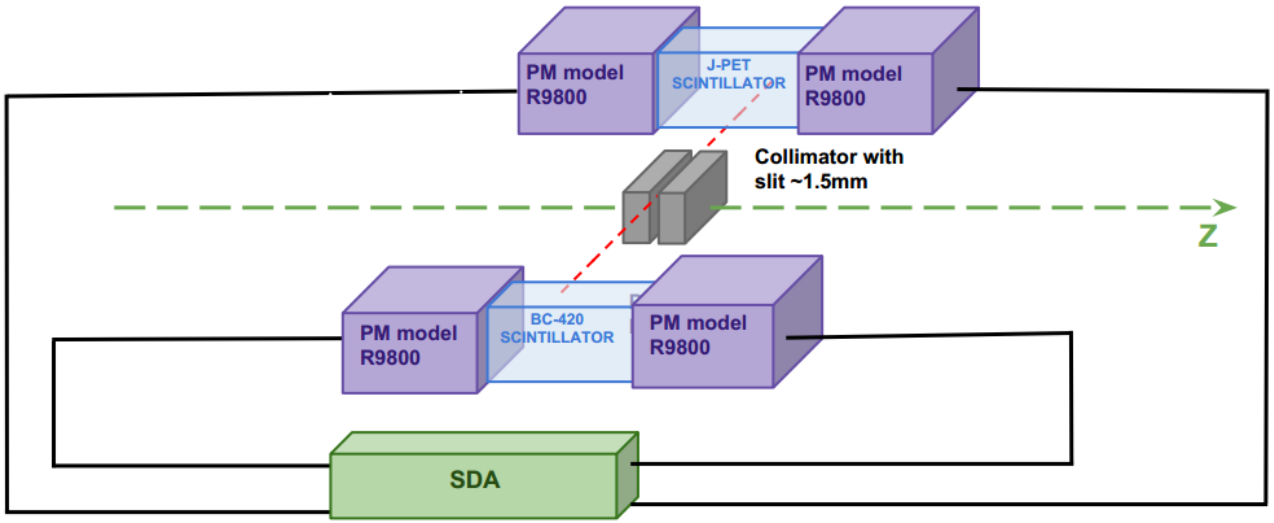
BC-420 SCINTILLATOR

124,8 ± 1,5 ps

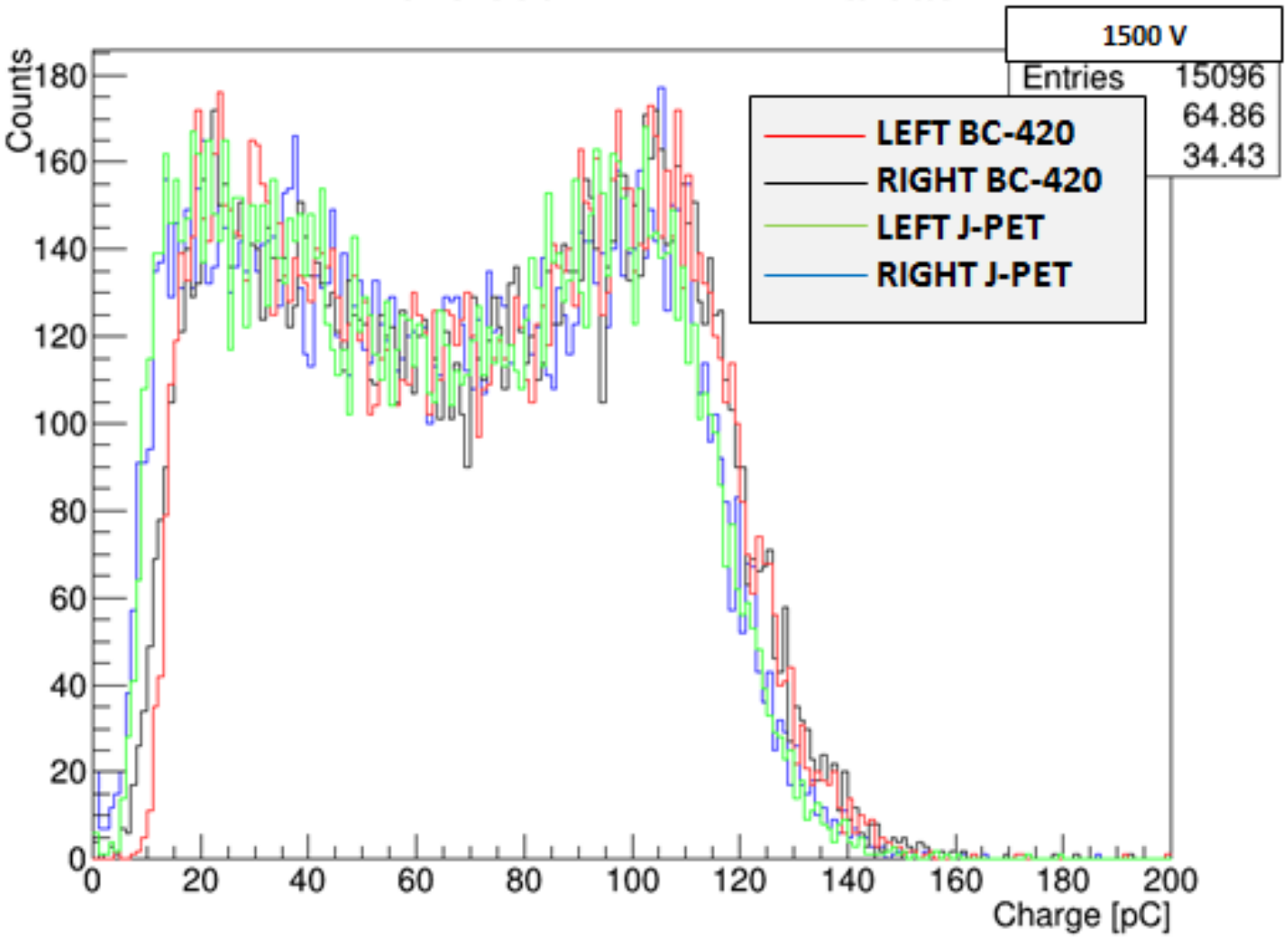
# RESOLUTION FOR HIT TIME DETERMINATION

$$\sigma(t_L - t_R) \cong 125\, ps$$

$$\sigma\left(\frac{t_L + t_R}{2}\right) \approx 63\, ps$$



# CHARGE SPECTRA



THANK YOU