The TPOL GEANT Monte Carlo
Version 1–0–initial

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Overview

The TPOL MC is based on James' code. It consists of the following FORTRAN functions:

- **`main.f`**: main program
- **`ugffgo.f`**: read user steering cards
- **`ugmed.f`**: definition of TPOL media
- **`ugeom.f`**: set up TPOL beamline and detector geometry
- **`gukine.f`**: generate initial beam particle and Compton photon
- **`gustep.f`**: sum up detector energy deposition
- **`guout.f`**: calculate detector response and write ntuple
- **`uglast.f`**: close ntuple

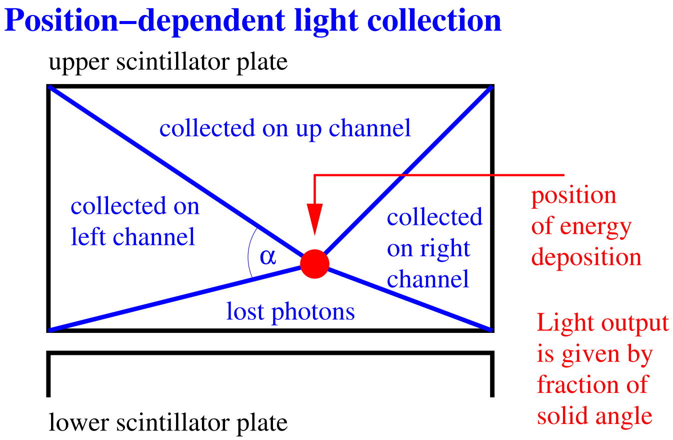
The latest CVS tag is `V1-0-initial`

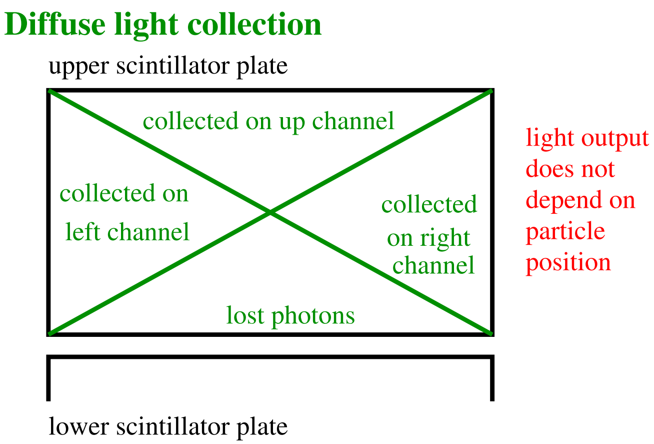
Example steering cards are provided as `tpolmc.cards`

The Calorimeter light-collection model

One of the most critical things is the calorimeter simulation.

The light collection is based on a simple geometrical model:





Direct light collection:

- Calculate α_U, α_D, α_L, α_R from the particle (x, y) position in the plate
- Distribute the energy $E_L = \alpha_L/360^\circ$, etc
- E_D (E_U) in the upper (lower) plate is lost.

Diffuse light collection:

- A significant amount of light does not reach the (U,D,L,R) sides of the plate, but gets reflected/absorbed at the front/back side. Eventually some fraction of this might reach the (U,D,L,R) side.
- This “diffuse” energy is distributed as $E_L = E_R = h/(h + w)$ and $E_U = E_D = w/(h + w)$ where h and w are the height and width of the plate

The Calorimeter light-collection

Total energy from direct light collection:

Upper plates: E_L^+, E_R^+, E_U^+, E_D^+ and lower plates: E_L^-, E_R^-, E_U^-, E_D^-.

Total energy from diffuse light collection:

Upper plates: E_{UD}^+, E_{LR}^+ and lower plates: E_{UD}^-, E_{LR}^-.

Number of Photons per channel:

$U = N \times (f_1 E_U^+ + (1 - f_1) E_{UD}^+ + f_2 (f_1 E_U^- + (1 - f_1) E_{UD}^-))$

$D = N \times (f_1 E_D^- + (1 - f_1) E_{UD}^- + f_2 (f_1 E_D^+ + (1 - f_1) E_{UD}^+))$

$L = N \times (f_1 (E_L^+ + E_L^-) + (1 - f_1)(E_{LR}^+ + E_{LR}^-))$

$R = N \times (f_1 (E_R^+ + E_R^-) + (1 - f_1)(E_{LR}^+ + E_{LR}^-))$

Parameter f_1 (steering card `DIFU`) controls the amount of light from diffuse sources within a single plate

Parameter f_2 (steering card `DILU`) controls the "dilution" of the up and down channel. This is the fraction of the "lost" photons collected in the opposite plate.

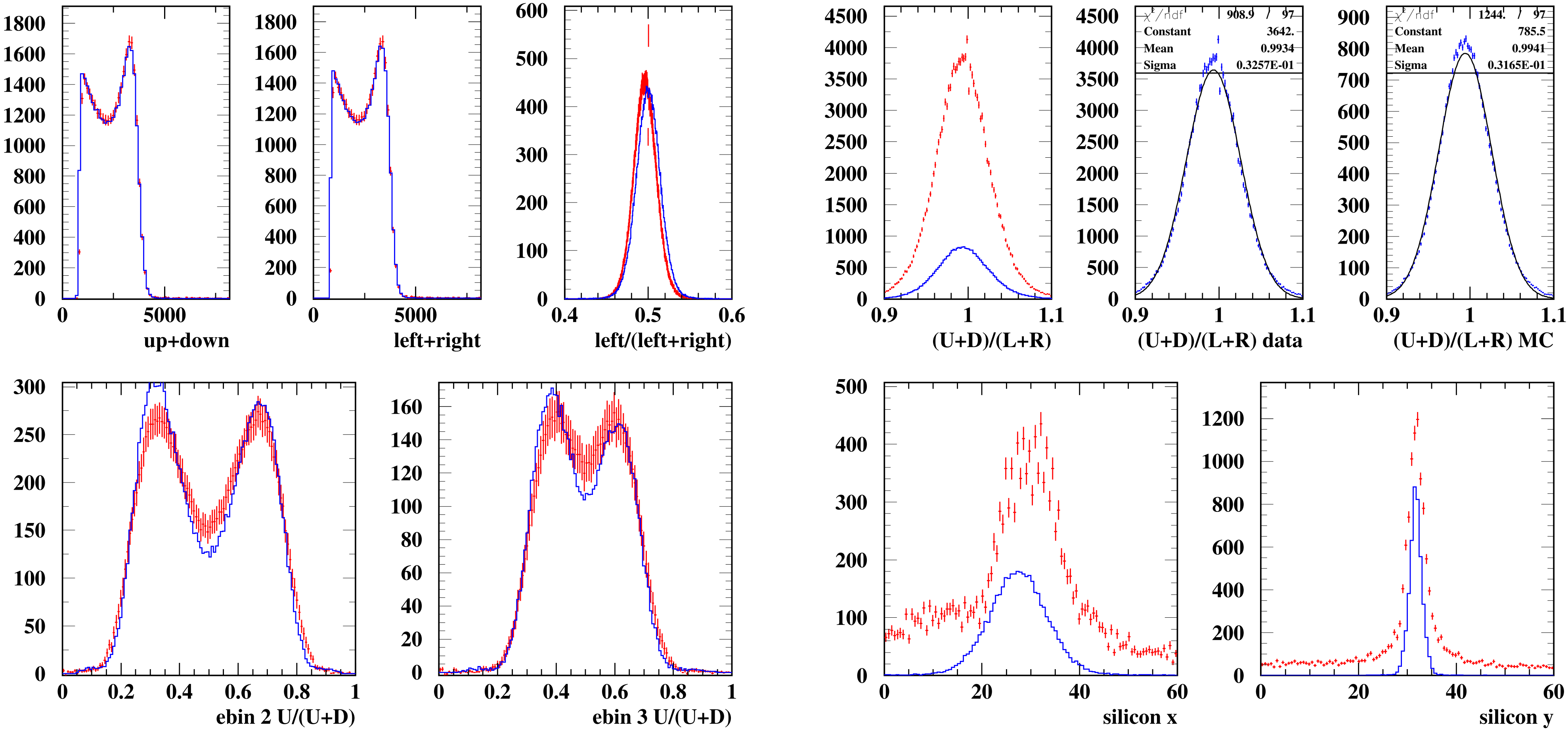
N is the total number of photons produced per GeV (steering card `PHOT`).

Tuning the parameters

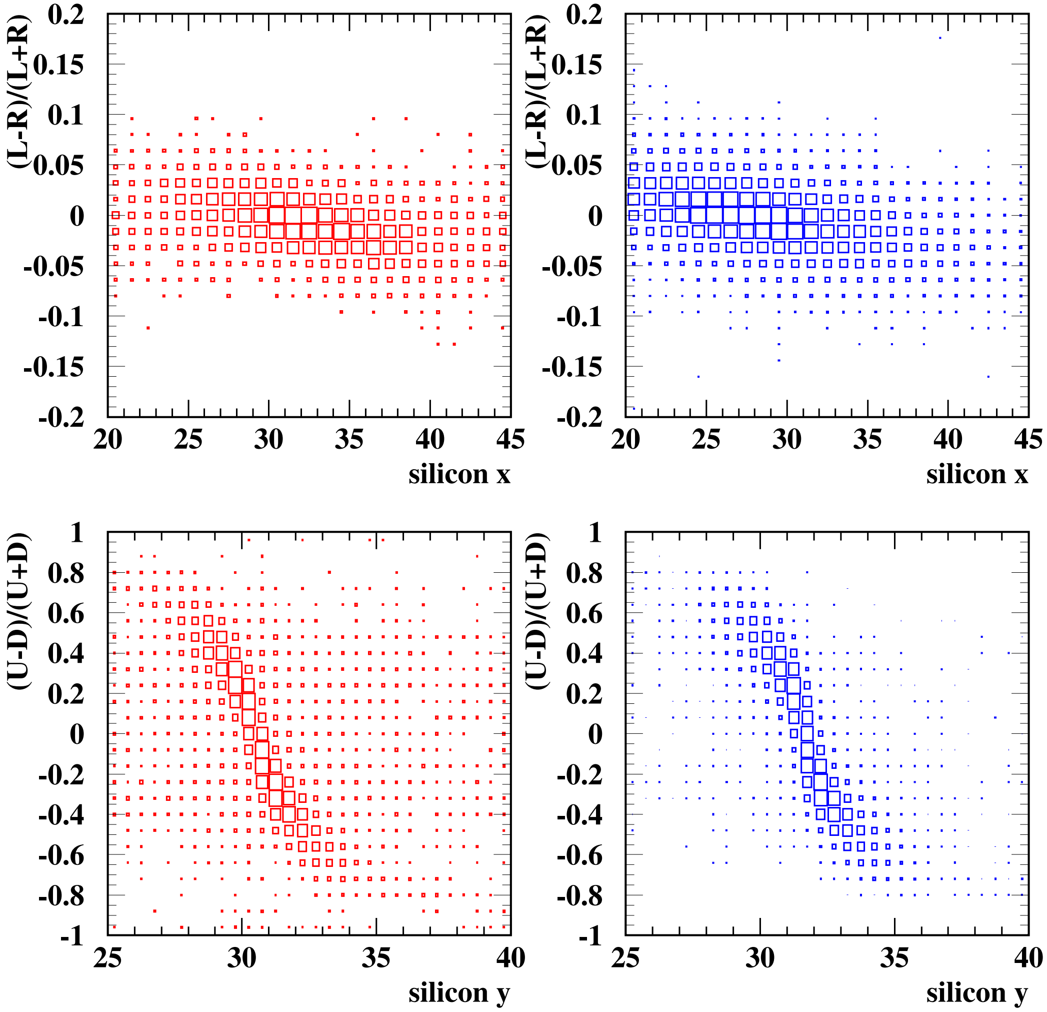
- The parameter `DIFU`. If it is zero (one), $\frac{L-R}{L+R}$ has maximum (no) sensitivity to the horizontal position
- The parameter `DILU`. It it is zero, $\frac{U-D}{U+D}$ has largest sensitivity to the vertical position
- The parameter `PHOT`. If it is small, the $\frac{U+D}{L+R}$ distribution is large
- Best parameters found after quick checks:

Parameter	Value
`DIFU`	0.6
`DILU`	0.06
`PHOT`	15000

Control plots compared to TPOL data



Correlation of $\eta - y$ and $\frac{L-R}{L+R} - x$



Conclusions

- Simple model of Calorimeter light collection can explain many features of the data:
  - $\frac{U+D}{L+R}$ distribution (parameter `PHOT`)
  - Correlation of $\frac{L-R}{L+R}$ to silicon x and to $\frac{U+D}{L+R}$ (parameter `DIFU`)
  - $\eta - y$ correlation and analyzing power ($> 5\%$ too high) require more tuning.

    E.g. parameter DILU$= 5\%$. Is this realistic? Requires 5% of the U light to be seen in the D plate and vice versa.

    Possible other sources: distance calorimeter-IP wrong by 2 meter?
- Silicon detector and fiber detector have no detailed simulation yet