Optimization of data-taking operation

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Luminosity

Proportionality factor between cross section σ and number of interactions per second dN /dt

Unit: $cm^{-2}s^{-1}$

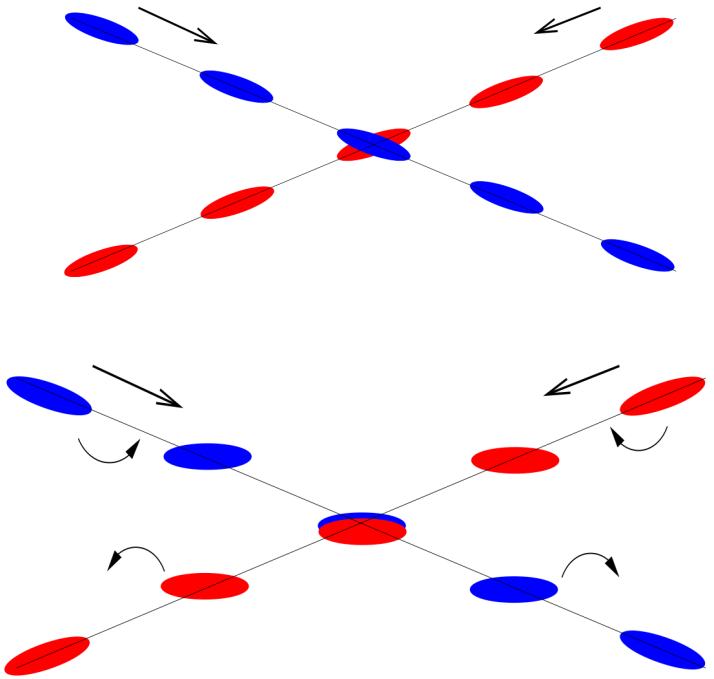
$$\mathscr{L}(t) = \mathscr{L}_0 e^{-(t/\tau_1 + t/\tau_2)}, \quad \mathscr{L}_0 = f\frac{n_1^0 n_2^0 n_b}{4\pi\sigma_x\sigma_y}, \quad n_1 = n_1^0 e^{-t/\tau_1}, \quad n_2 = n_2^0 e^{-t/\tau_2}$$

$$N_{exp} = \sigma_{exp} \times \int \mathscr{L}(t)dt.$$

- n_i: number of particles in bunches
- n_b: number of bunches
- f: head-on collision frequency
- τ_i: life of beams
- Our goal is maximize $\int \mathscr{L}(t)dt$

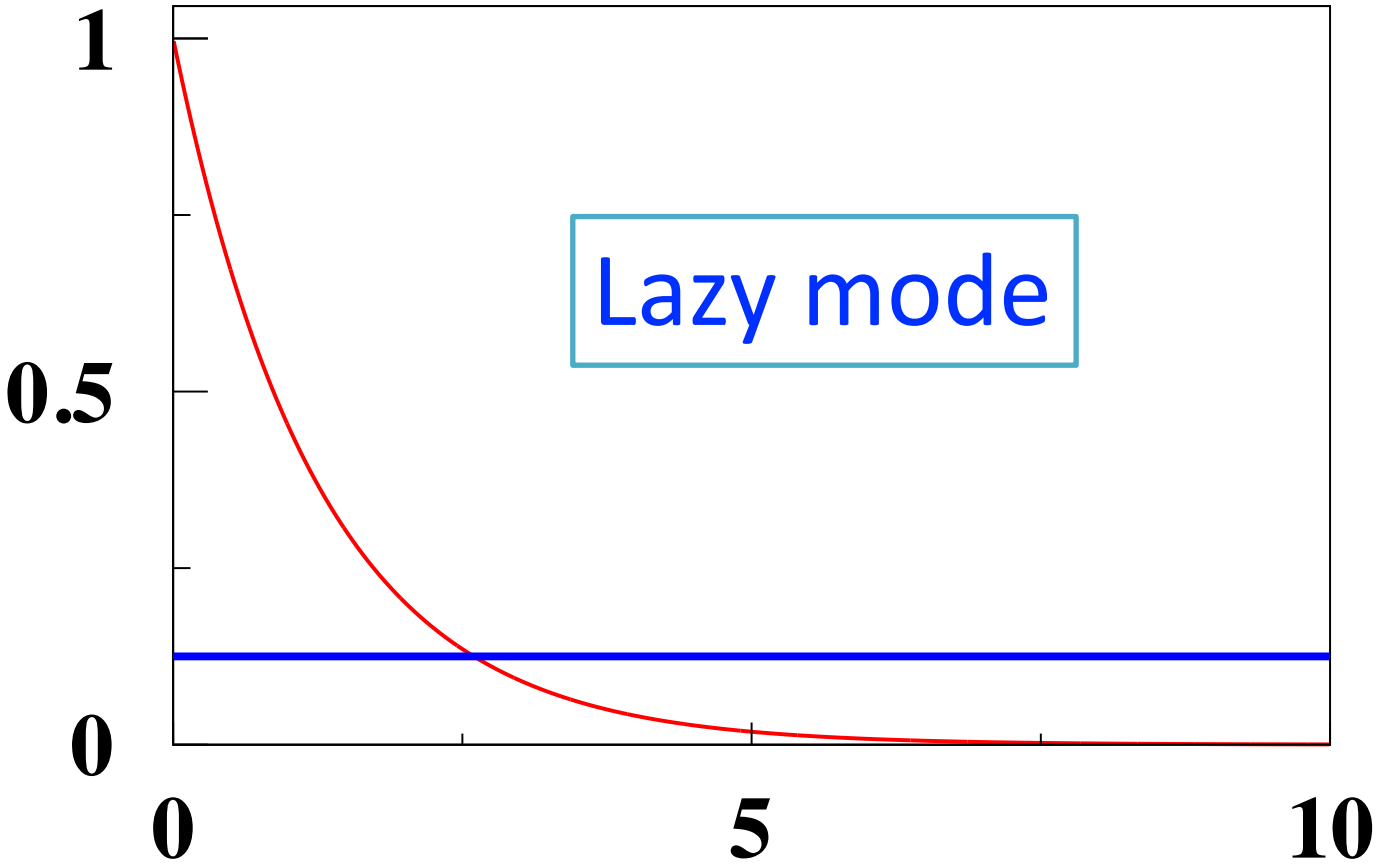
Lots of work done by accelerator experts

- $\sigma_{x,y}$
- $n_{i,j}$
- n_b
- τ
- Cross angle
- …
- And some could be done be us



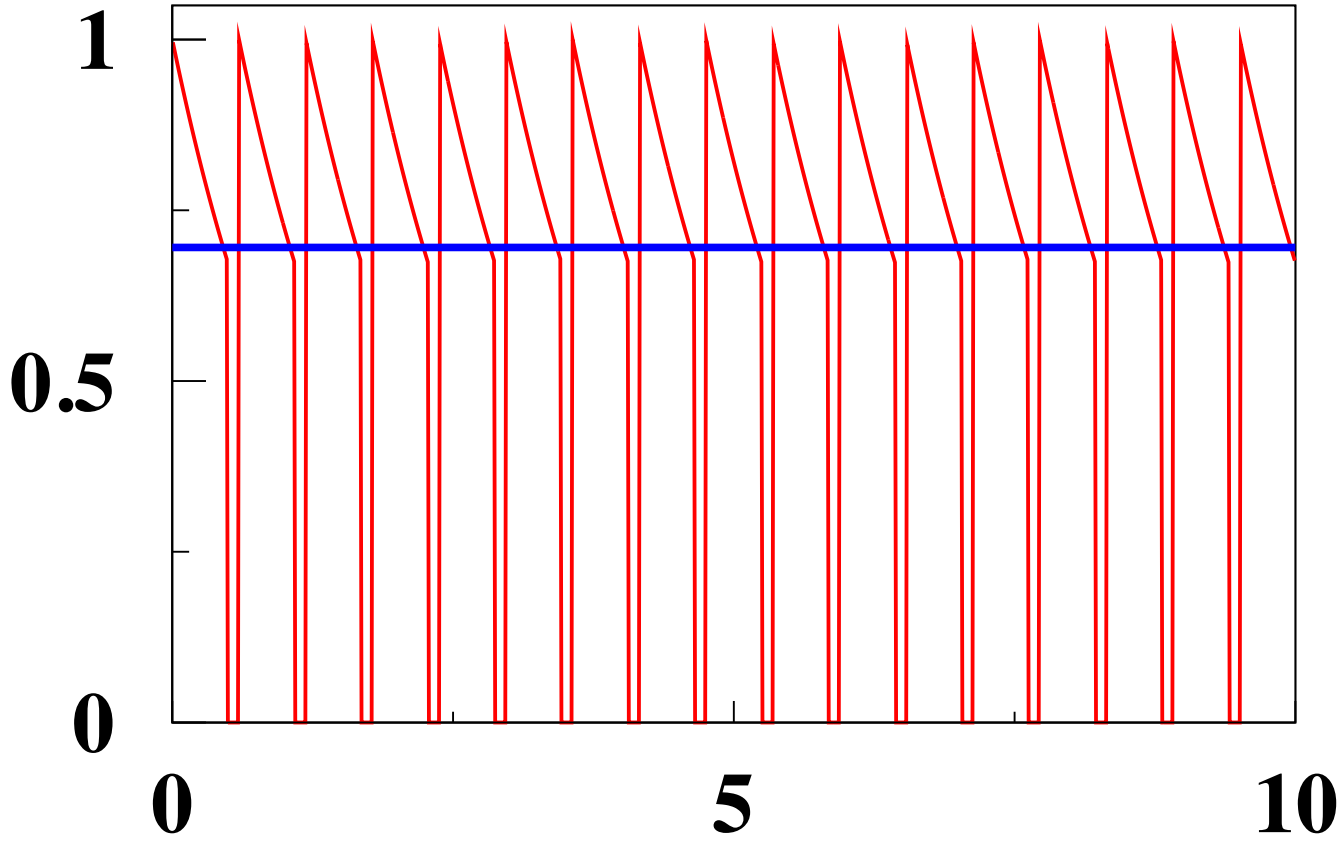
In decay mode

- Given τ_i and injection time τ_r
- Maximize the area under luminosity curve



Example

- τ=2.5, refill time =0.1, intL= 6.96
- Exponential decay model(not always)



```
double DecayLumi(double *x,double *par)
{
   Double_t tau     = par[0];
   Double_t T_work  = par[1];
   Double_t T_refl  = par[2];
   Double_t v =0;
   Double_t t = fmod(x[0],T_refl + T_work);
   if ( t < T_work ) v = exp(-2*t/tau);
   return v;
}

void fcn(Int_t &npar, Double_t *gin, Double_t &f, Double_t *par, Int_t iflag)
{

   Double_t T_work  = par[0];
   Double_t tau     = par[1];
   Double_t T_refl  = par[2];
   Double_t T_scrn  = par[3];
   //
   TF1 *f1 = new TF1("DecayLumi",DecayLumi, 0, period, 3);
   f1->SetParameters(tau, T_work, T_refl);
   Double_t L =  f1->Integral(0, period);
   //
   //TF1 *f2 = new TF1("TopupLumi",TopupLumi, 0, period, 4);

   f=-L;
   delete f1;
}
```

/workfs/bes/lig/workarea/BeamOpt

In topup mode