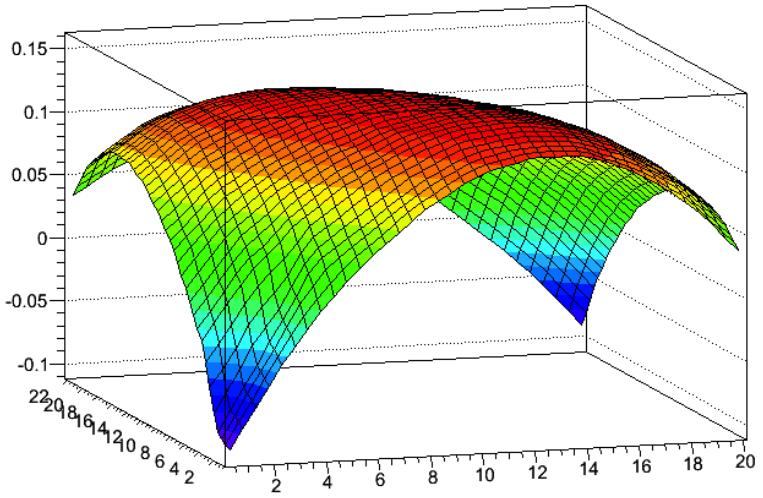
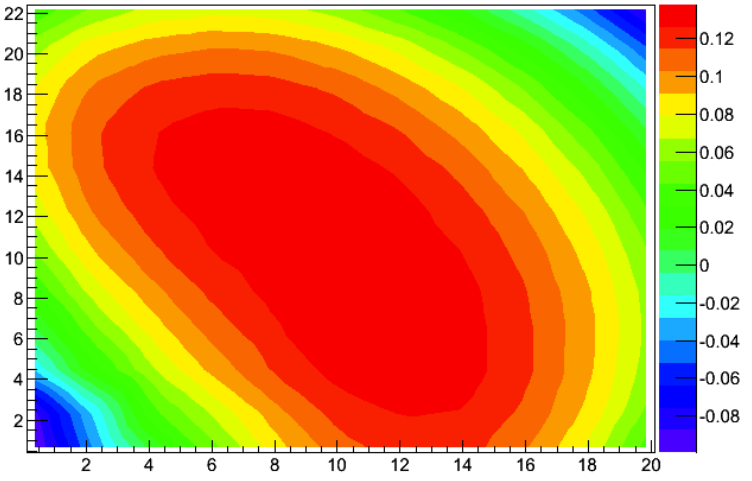
HFT Pixel Chip Survey Fit

Qiu Hao





Measured

TPS, pol2, pol3 methods to fit

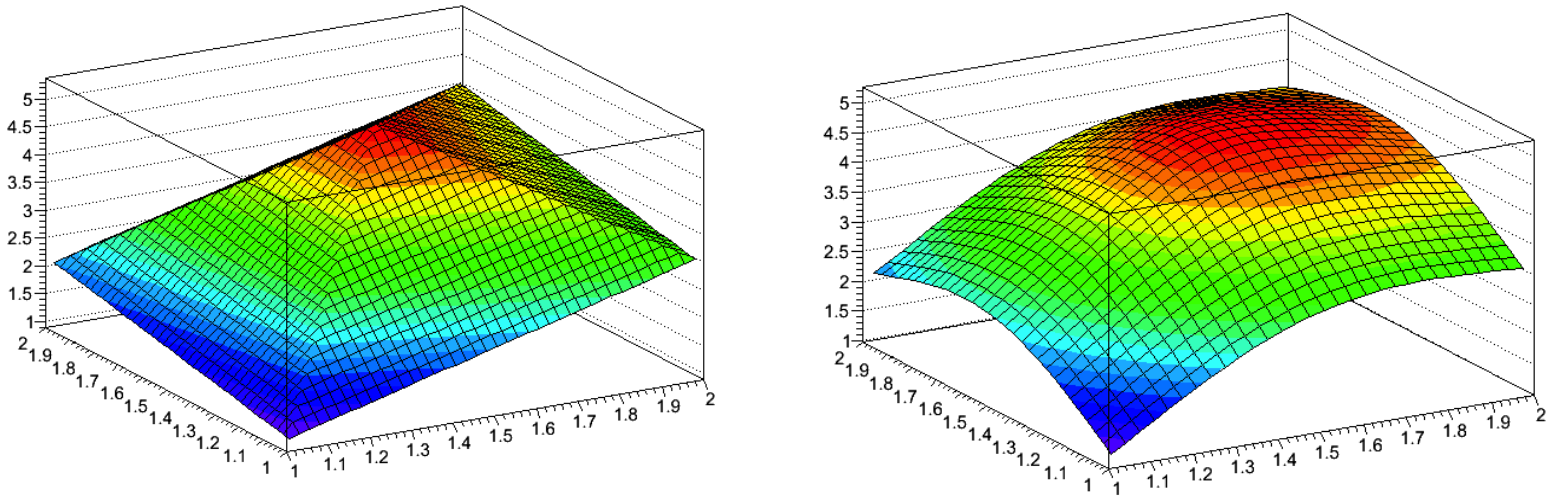
TPS Method

Found and realized in VC by Xiangming, rewriten in ROOT

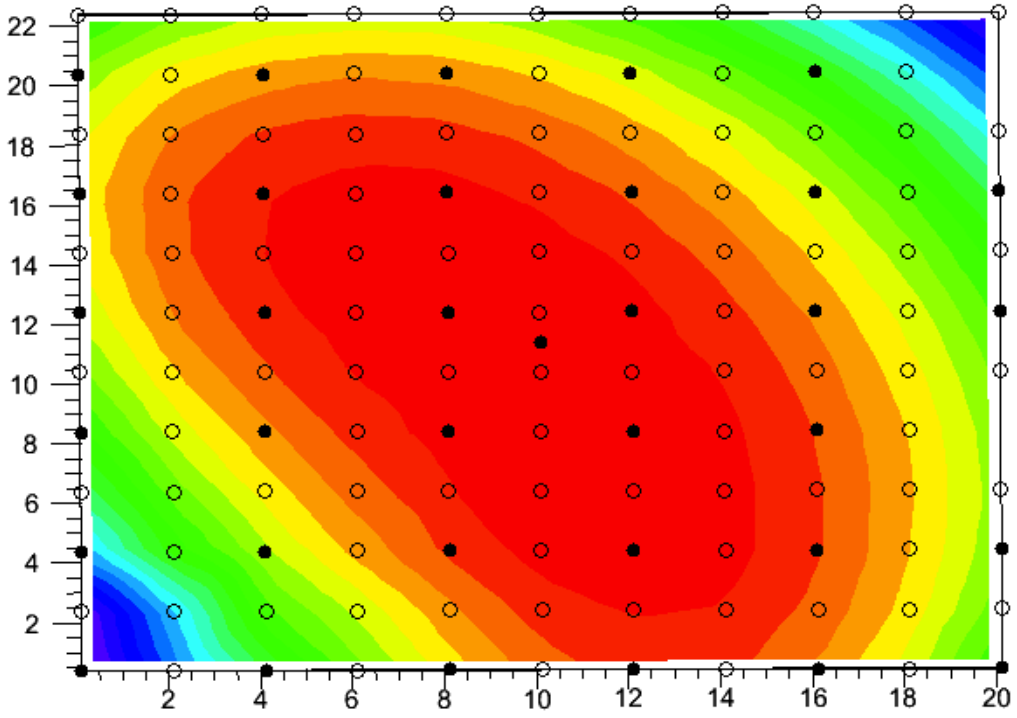
thin plate spline

minimize the “bending energy”, defined by

$$I(f) = \iint_{R^2} (f_{xx}^2 + 2f_{xy}^2 + f_{yy}^2) dx dy$$



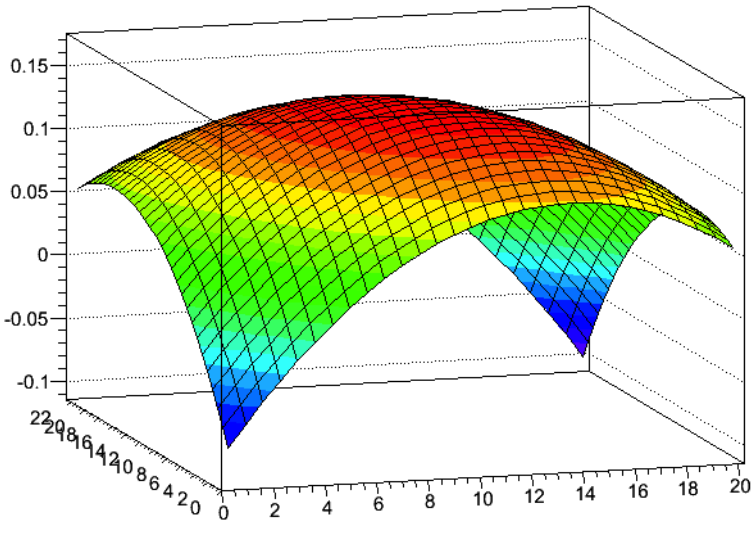
Points to fit and to test



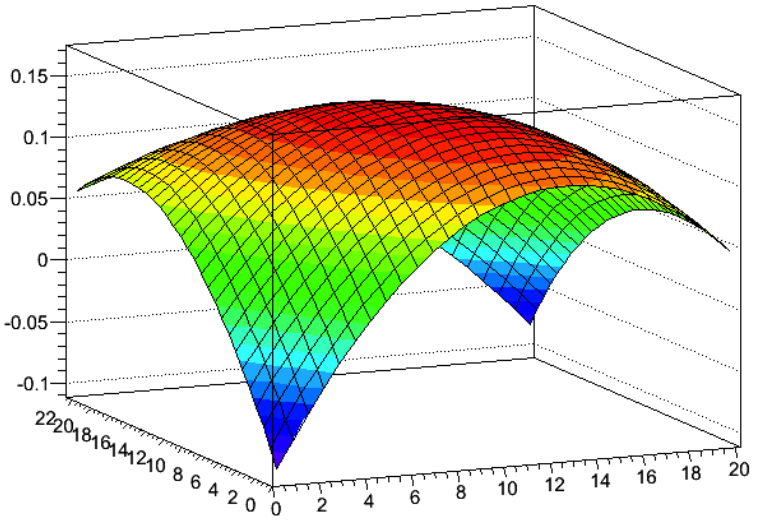
Black points – to fit
Circles – to test

Fit Result 3D

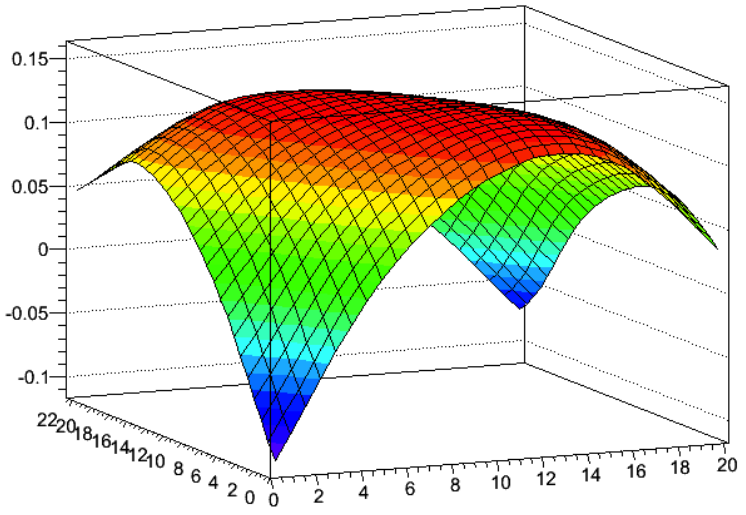
[0]+[1]*x+[2]*y+[3]*x*x+[4]*y*y+[5]*x*y



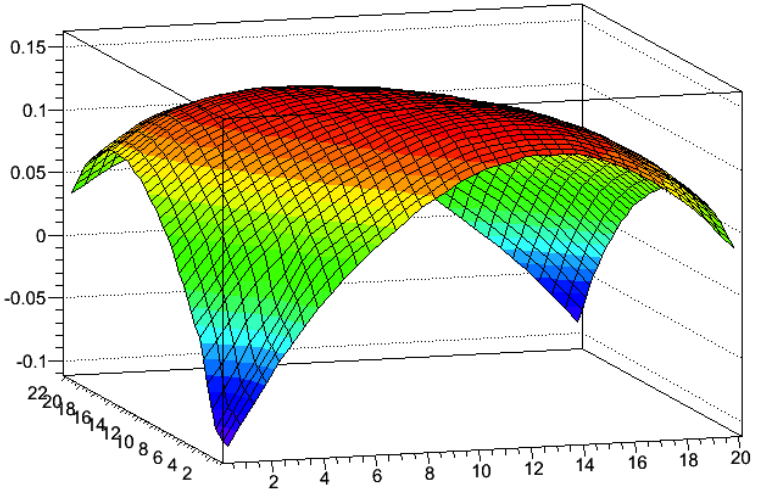
[0]+[1]*x+[2]*y+[3]*x*x+[4]*y*y+[5]*x*y+[6]*x*x*x+[7]*x*x*y+[8]*x*y*y+[9]*y*y*y



ZTps

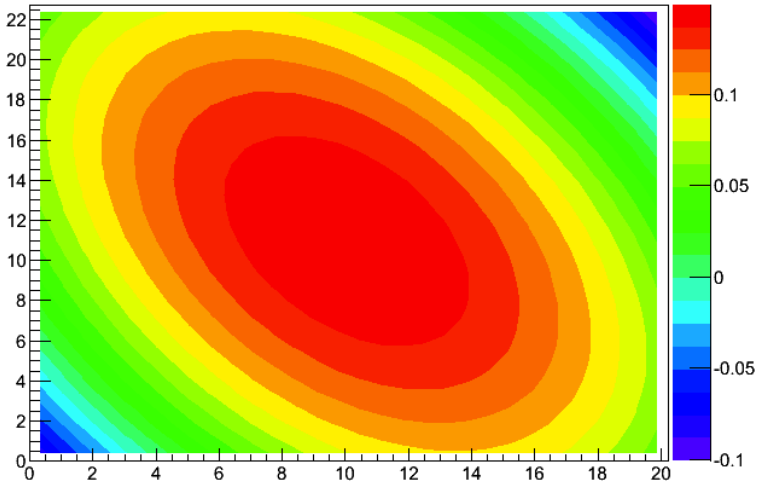


measured

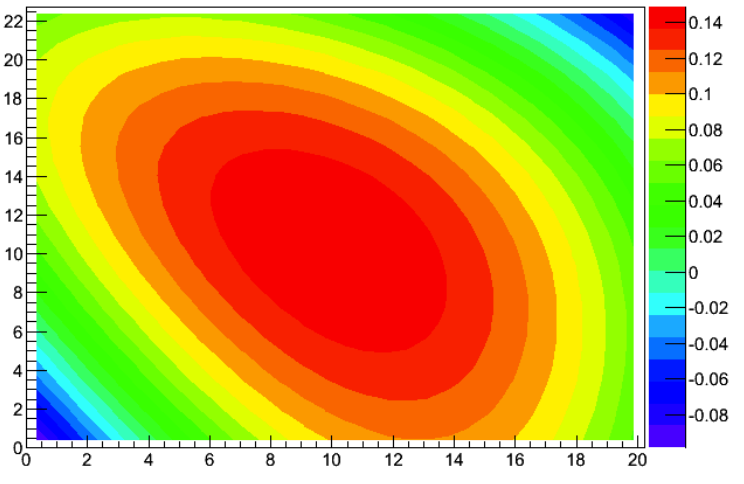


Fit Result 2D

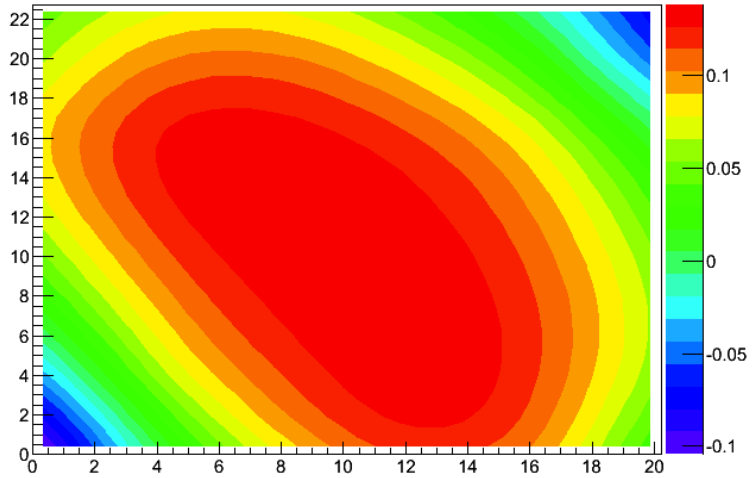
[0]+[1]*x+[2]*y+[3]*x*x+[4]*y*y+[5]*x*y



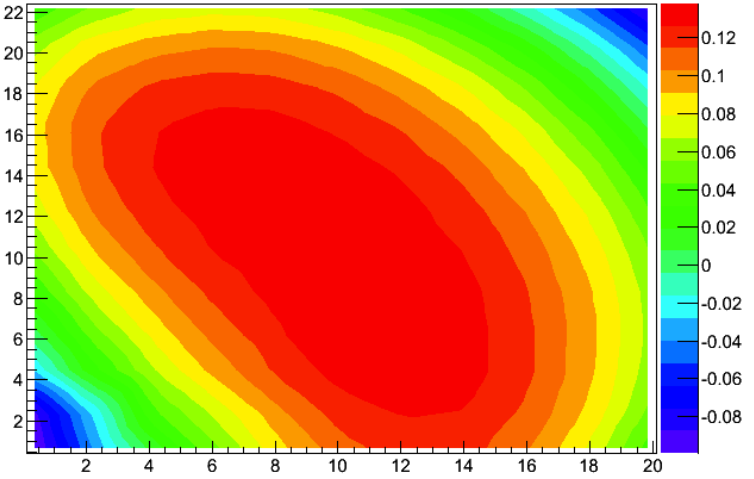
[0]+[1]*x+[2]*y+[3]*x*x+[4]*y*y+[5]*x*y+[6]*x*x*x+[7]*x*x*y+[8]*x*y*y+[9]*y*y*y



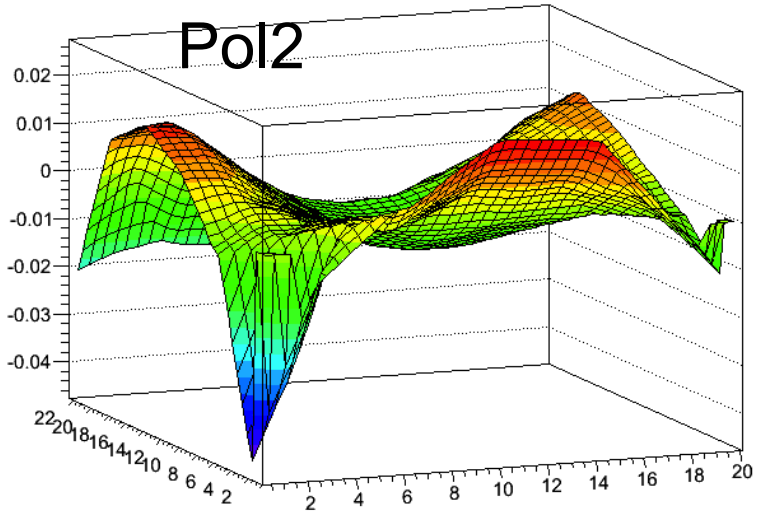
ZTps

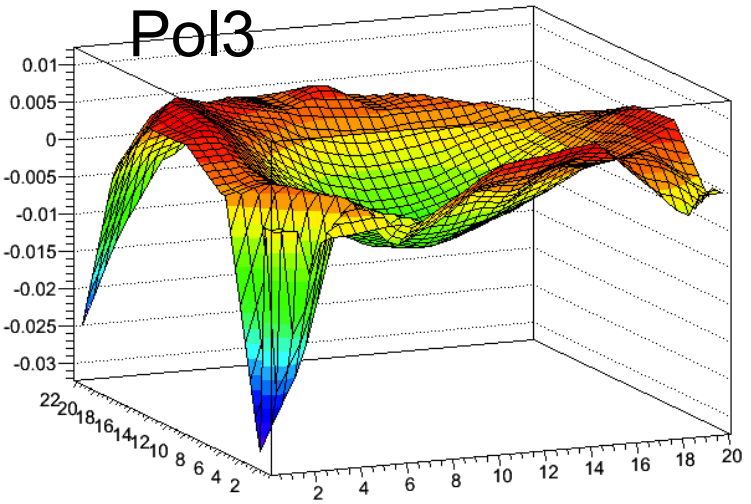


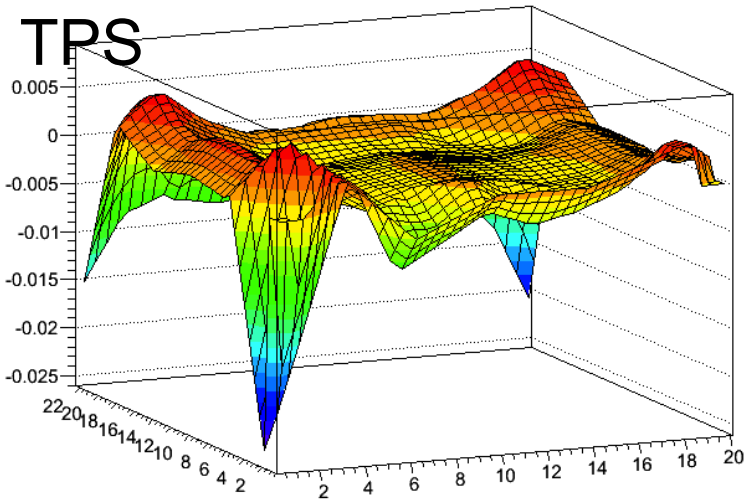
measured



Difference between Measured and Fit

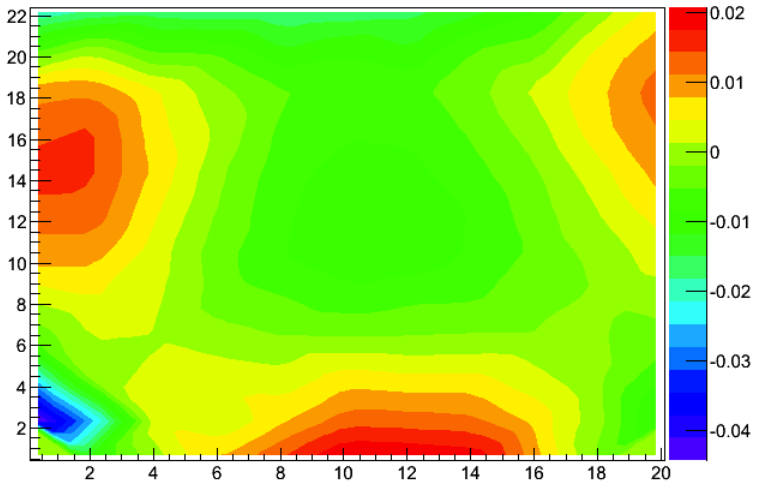




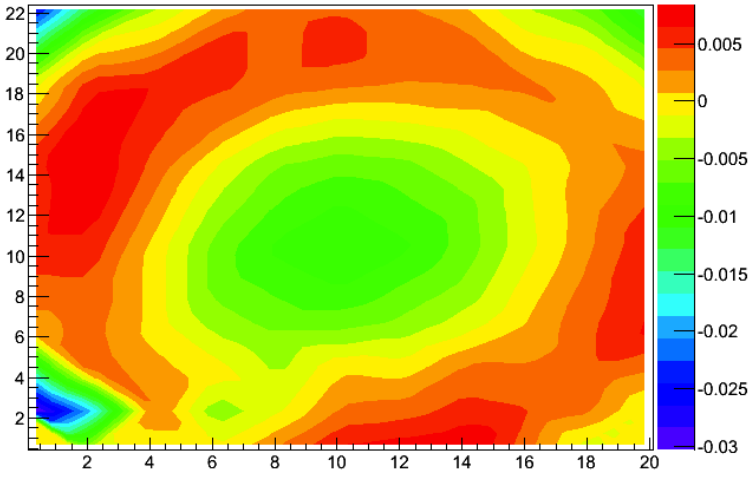


Difference between Measured and Fit

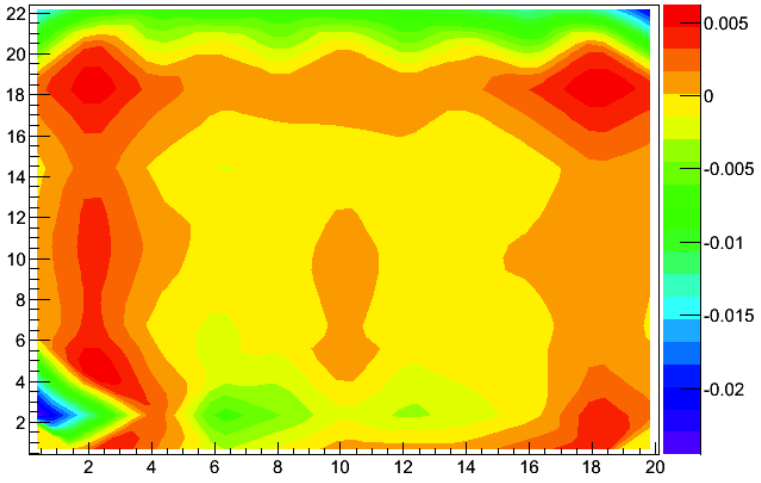
Pol2



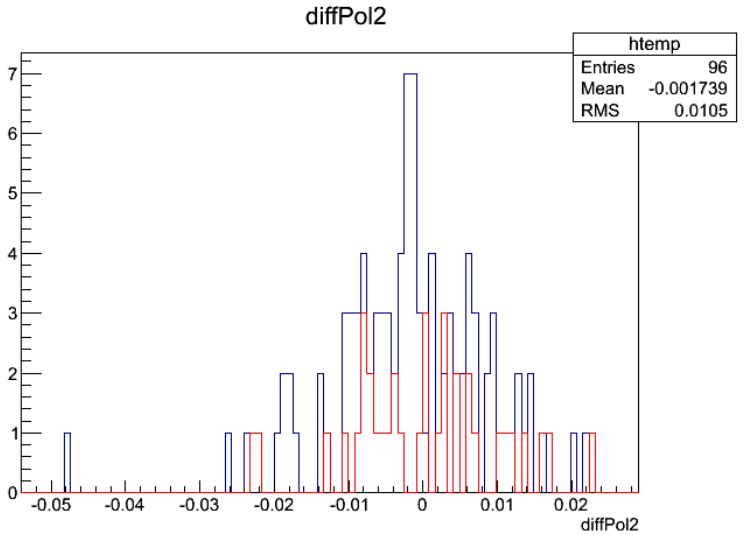
Pol3

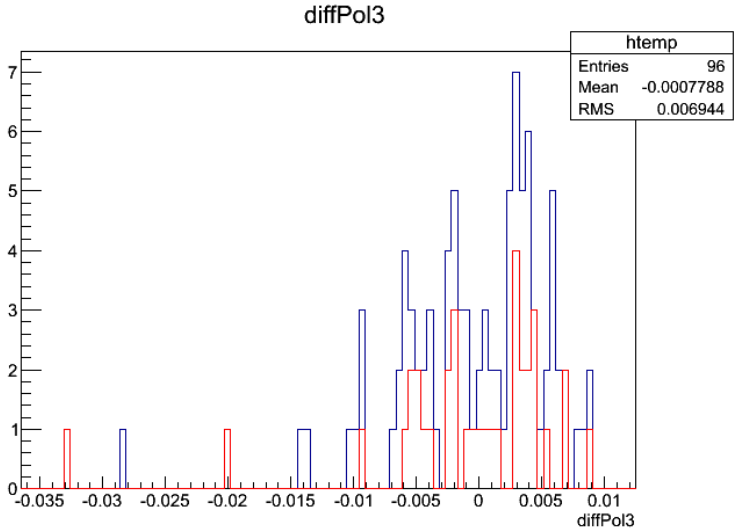


TPS

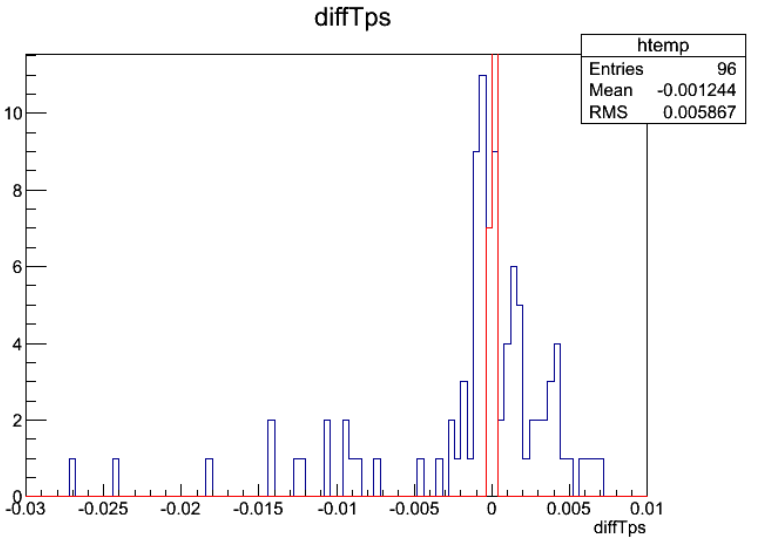


Difference between Measured and Fit

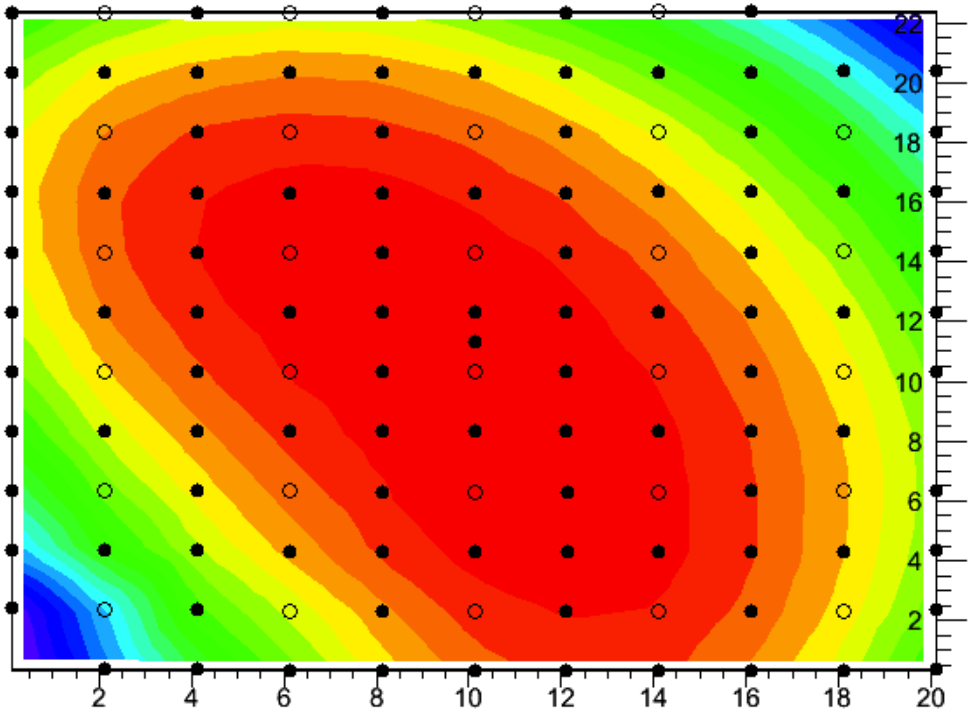




Red: from pointsto fit
Blue: from points to test



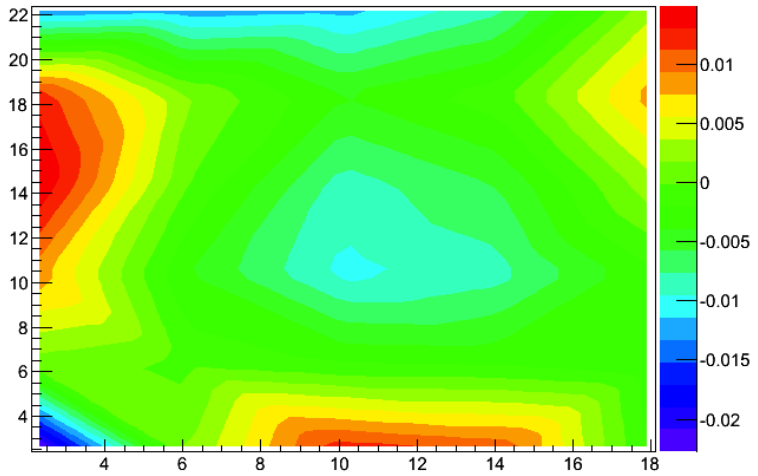
How about more points to fit?



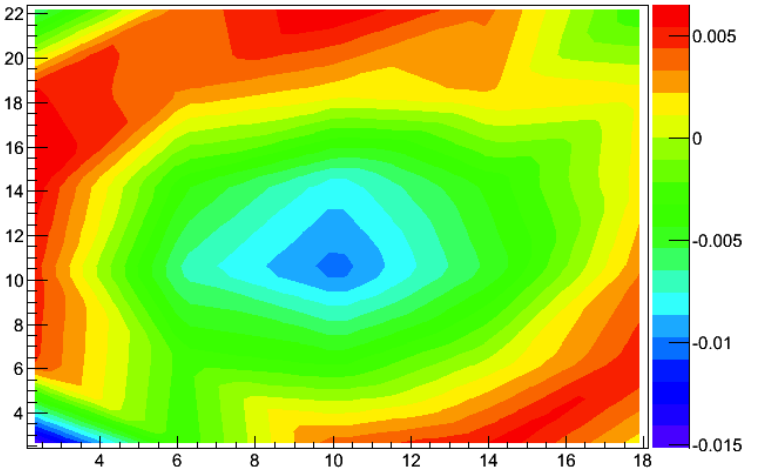
Black points – to fit
Circles – to test

Difference between Measured and Fit

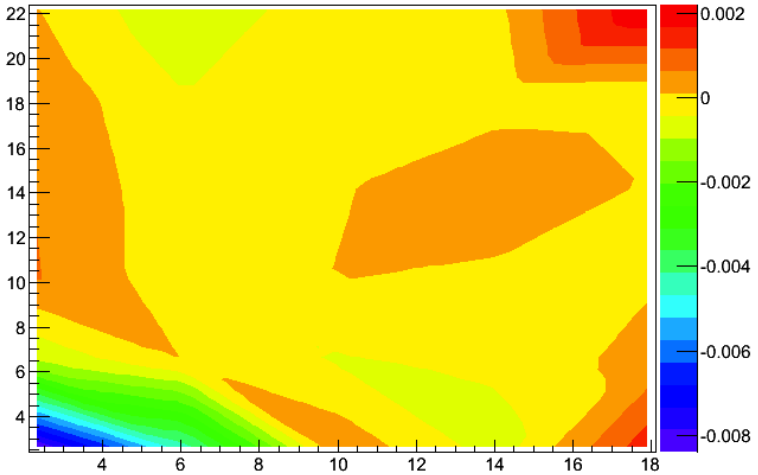
Pol2



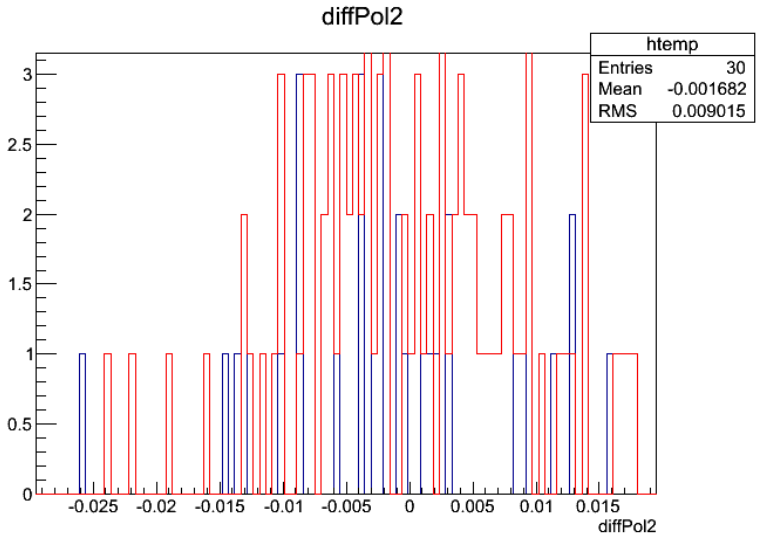
Pol3

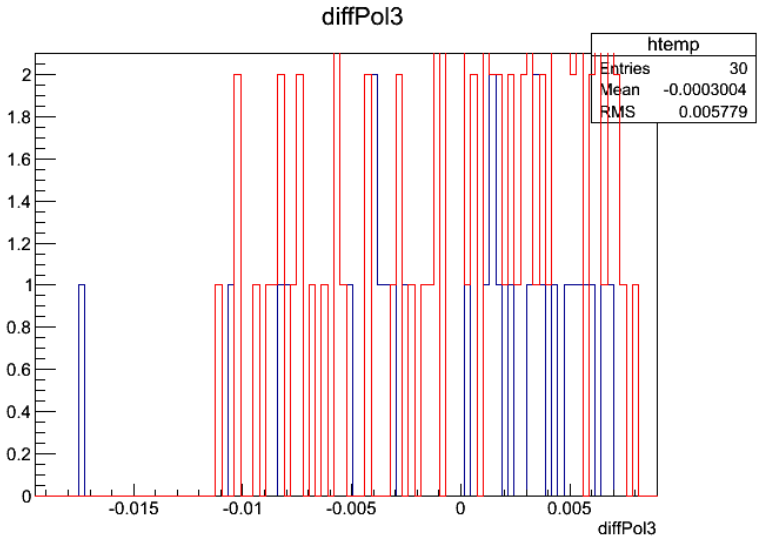


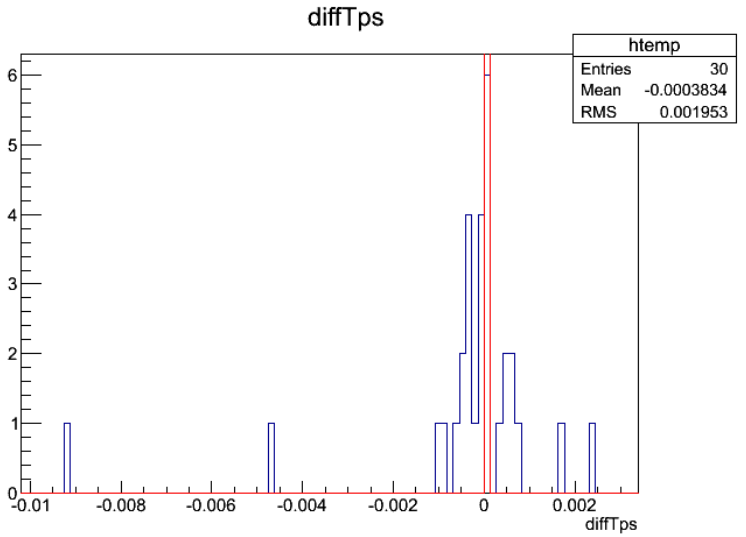
TPS



Difference between Measured and Fit







Utilization of TPS

With n measurements of (x, y, z)

Fitting results need to calculate z(x, y):

a0, a1, a2, array x[n], y[n], w[n]

Size in DB and memory if n = 132:

(3+132*3)*10*4*10 ~ 160 k --------not a big deal

CPU time if n = 132:

0.088 s for 10 k hits (n hits for central 200 GeV AuAu without pile up) ----------acceptable

Conclusion

• TPS does better than global pol2 and pol3 fit for a chip, and meets requirements on DB size and CPU time. The only backward is that it's not very straightforward.

• Piecewise interpolation/pol2 might do better than global pol2/pol3 fit, but require measurements on controlled (x, y) grids, which is only nearly true.

• TPS will yield ~< 1 μm difference for 132 measured points to fit

~< 5 μm difference for 36 measured points to fit

• The λ parameter in TPS, related to measurement errors, needs further study. Now λ = 0 is used, meaning measurement error = 0.

• Δx(x, y), Δy(x, y) from z(x, y) needs to be studied.