Parameter studies of the e^- cloud build up

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Many thanks to
all the e^- cloud team!!!!!!!

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2) Method

3) Results (state of the art)

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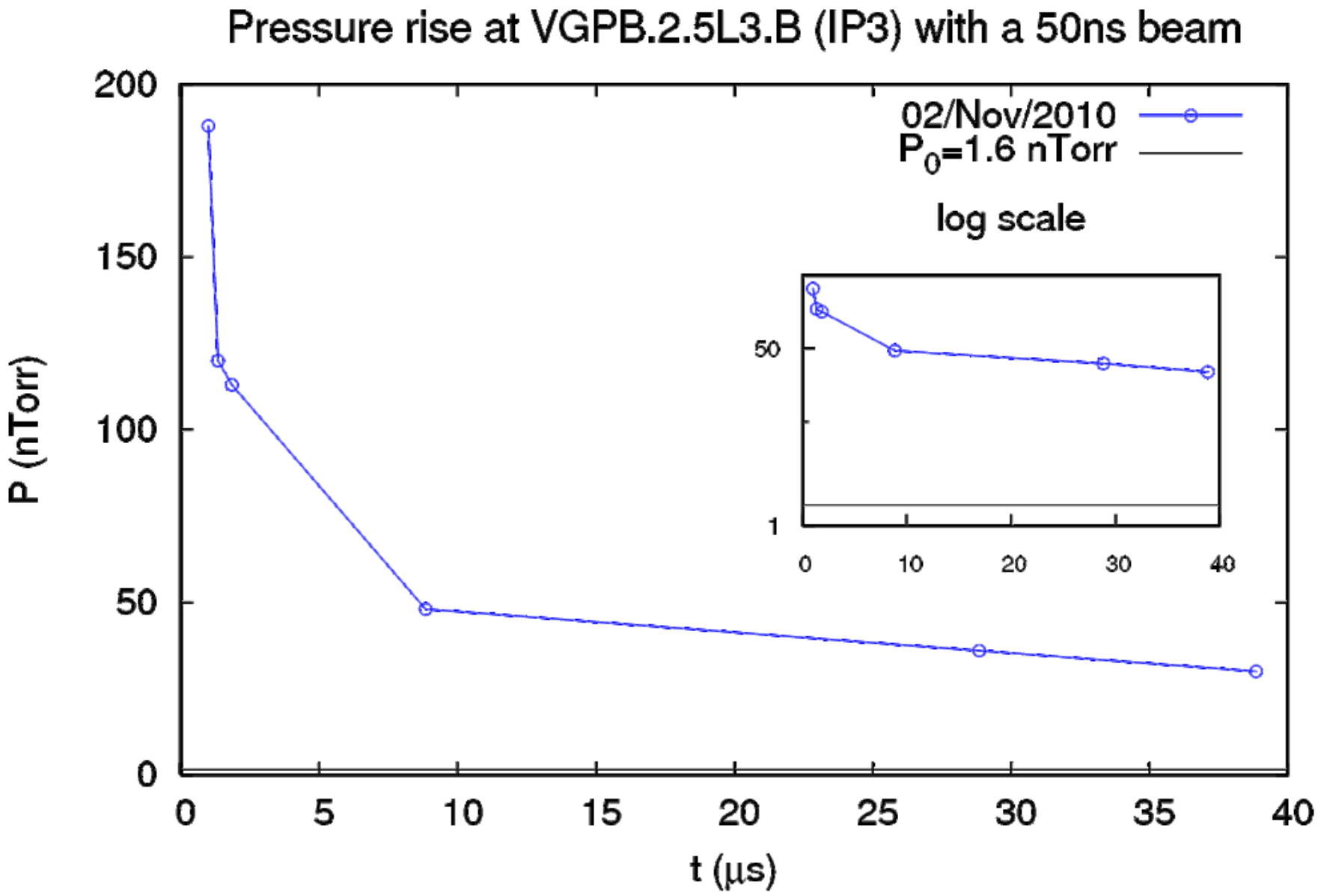
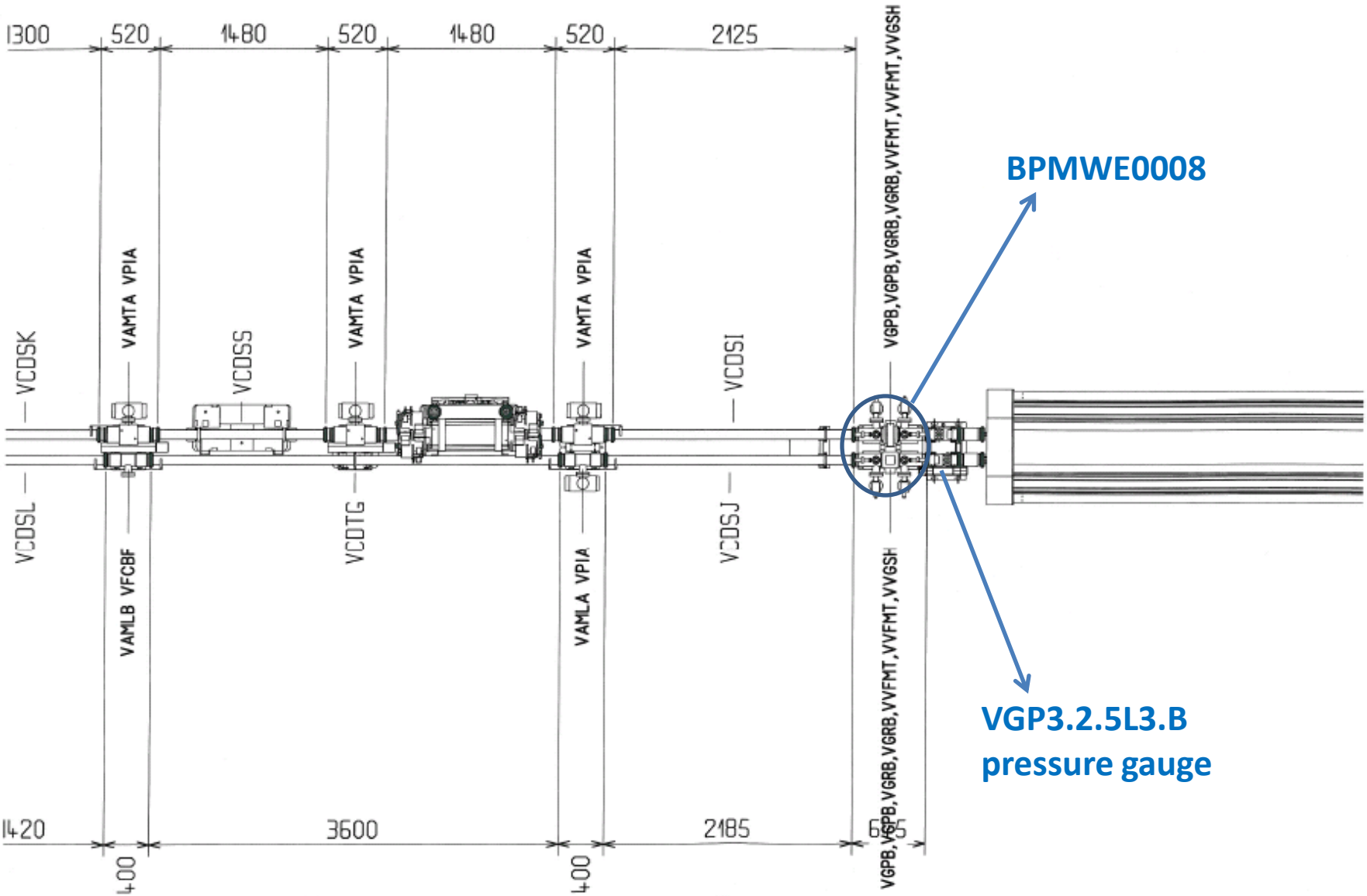
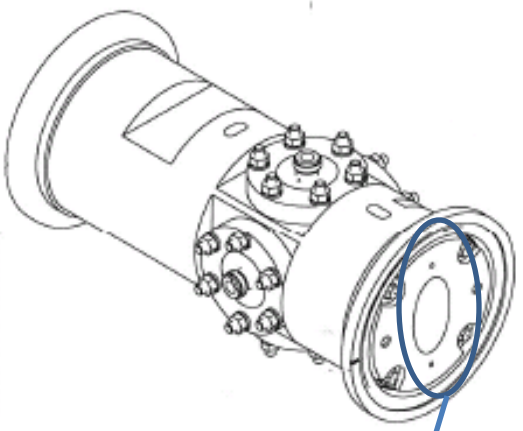

Pressure rise at VGPB.2.5L3.B (IP3) with a 50ns beam
02/Nov/2010
P0=1.6 nTorr
log scale
P (nTorr)
t (μs)
0
50
100
150
200
0
5
10
15
20
25
30
35
40
1
50
0
10
20
30
40

IP3 Geometry

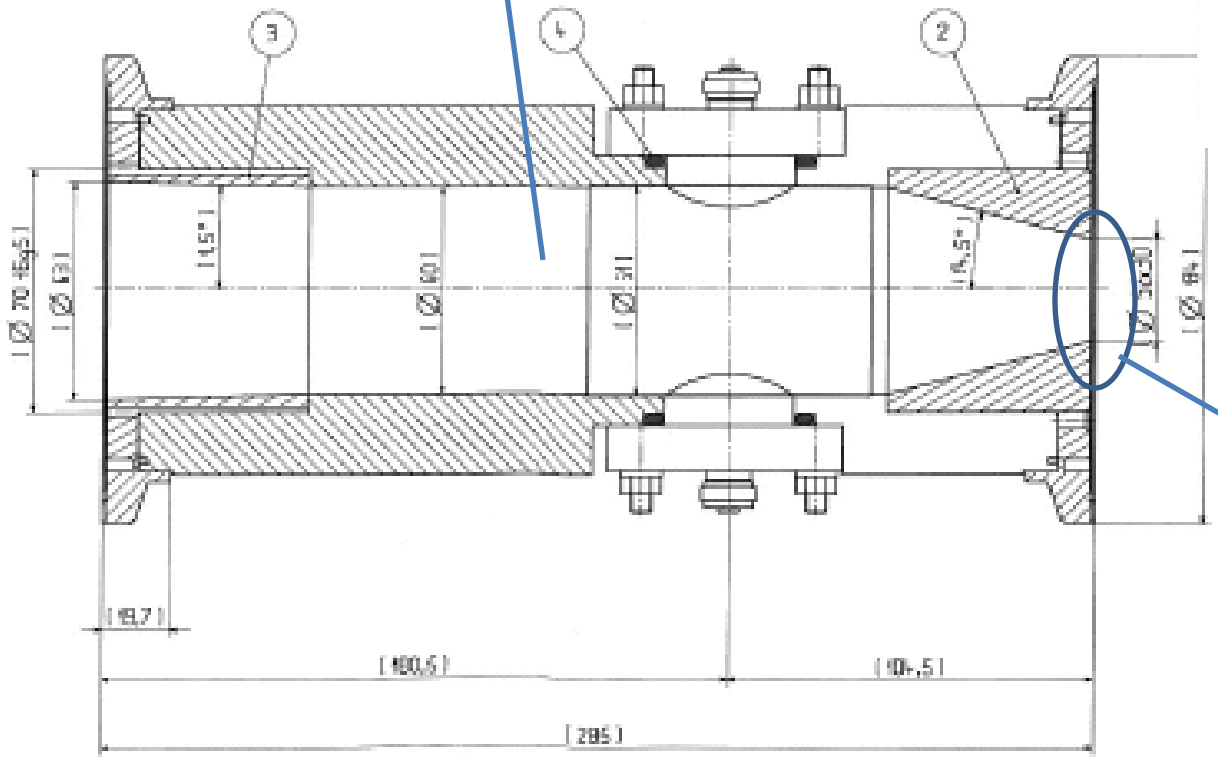


IP3 Geometry

BPMWE0008



Round section: Worst case

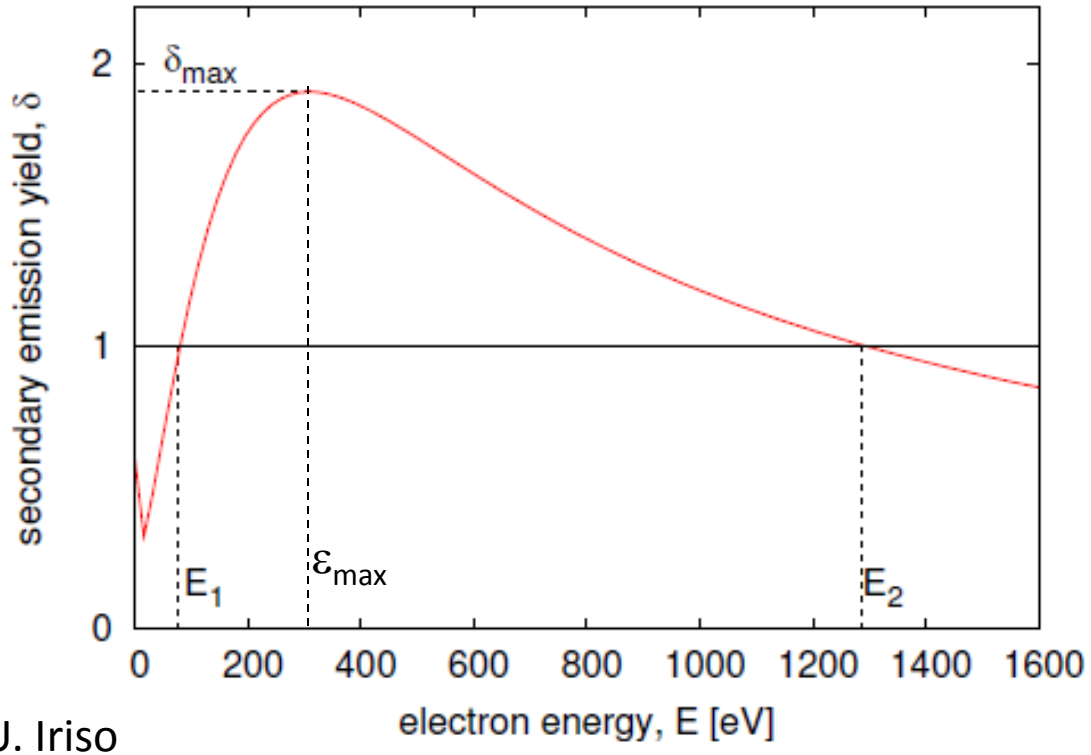


Elliptical section

The players of the game…

- δ_{max}: Maximum secondary electron yield
- ε_{max}: Electrons' energy at which the δ_{max} is reached
- **R**: Reflection coeficient
- **P**: Pressure rise due to e^- cloud

… so let's play!!!



Courtesy U. Iriso

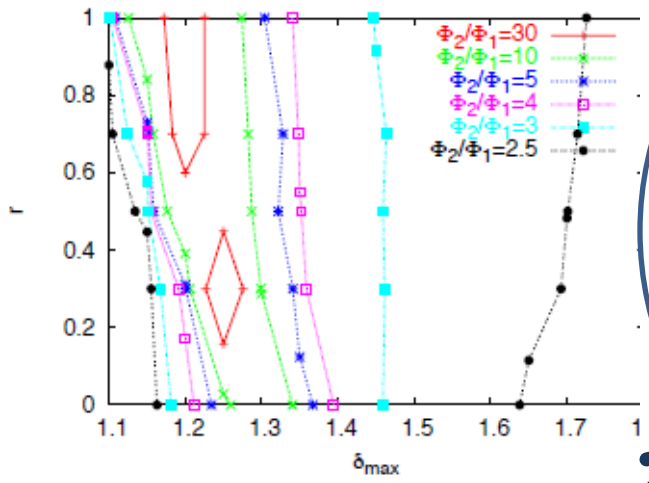
1) Observations. Description of the problem

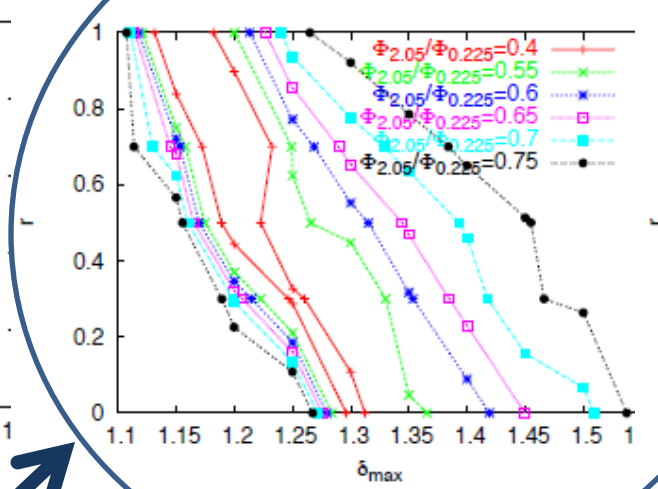
2) Method

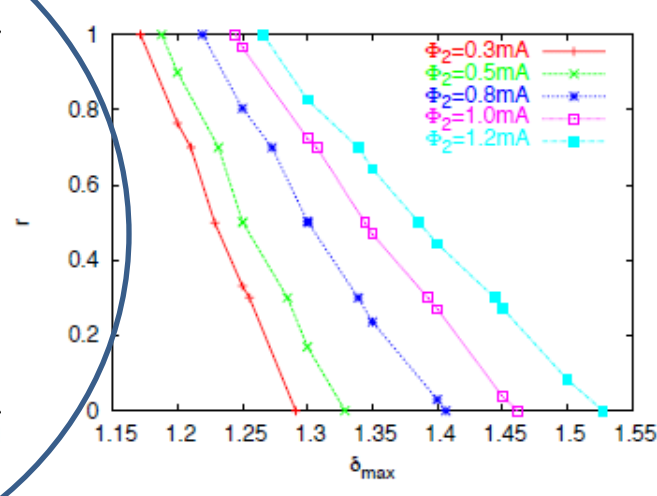
3) Results (state of the art)

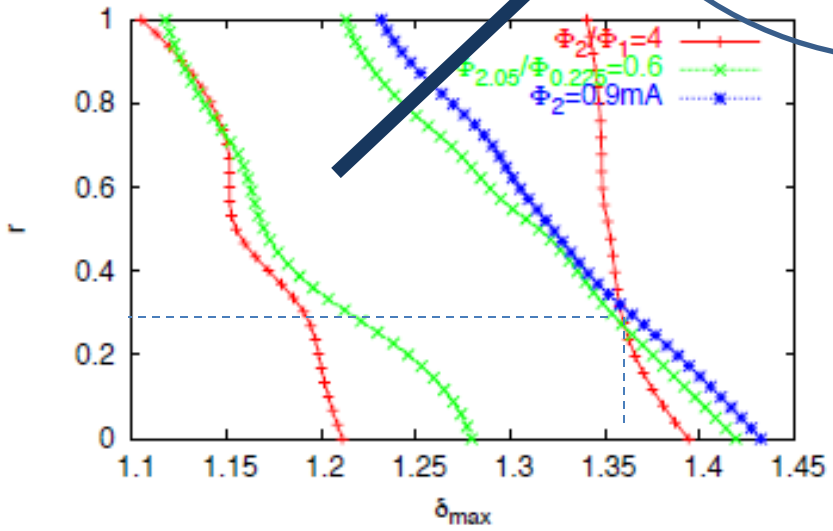
Method

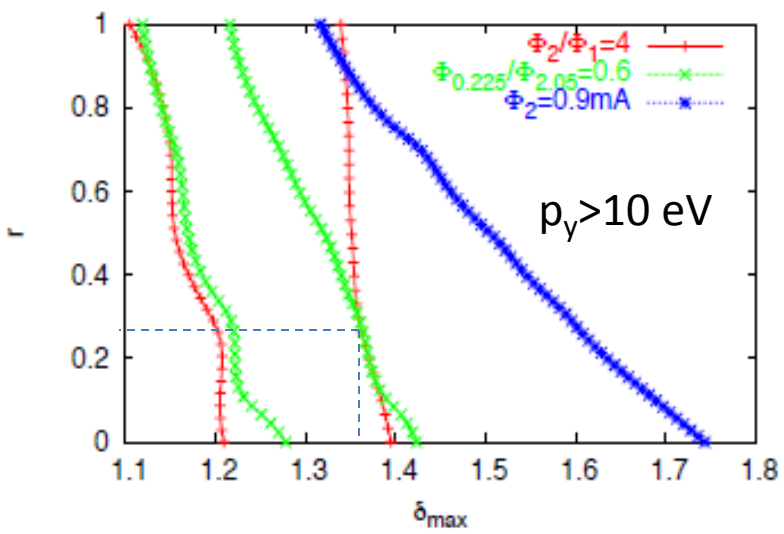
D. Schulte et al., "Electron cloud measurements in the SPS in 2004," *Proc. Particle Accelerator Conference (PAC 05), Knoxville, Tennessee, 16-20 May 2005, pp 1371, 2005*











Method

$$P(z) = P_0 + \eta_e \frac{kT}{e} \left\langle \frac{dI}{dl} \right\rangle_\tau \left[\frac{2Lz - z^2}{2c} + \frac{L}{S} \right]$$

ϕ_{1turn}

P_0=Static pressure
η_e=electron induced molecular desorption coefficient
k=Boltzman's constant
T=Temperature
$2L$=Distance between two gauges
$2S$=Pumping speed
c=Specific molecular conductance

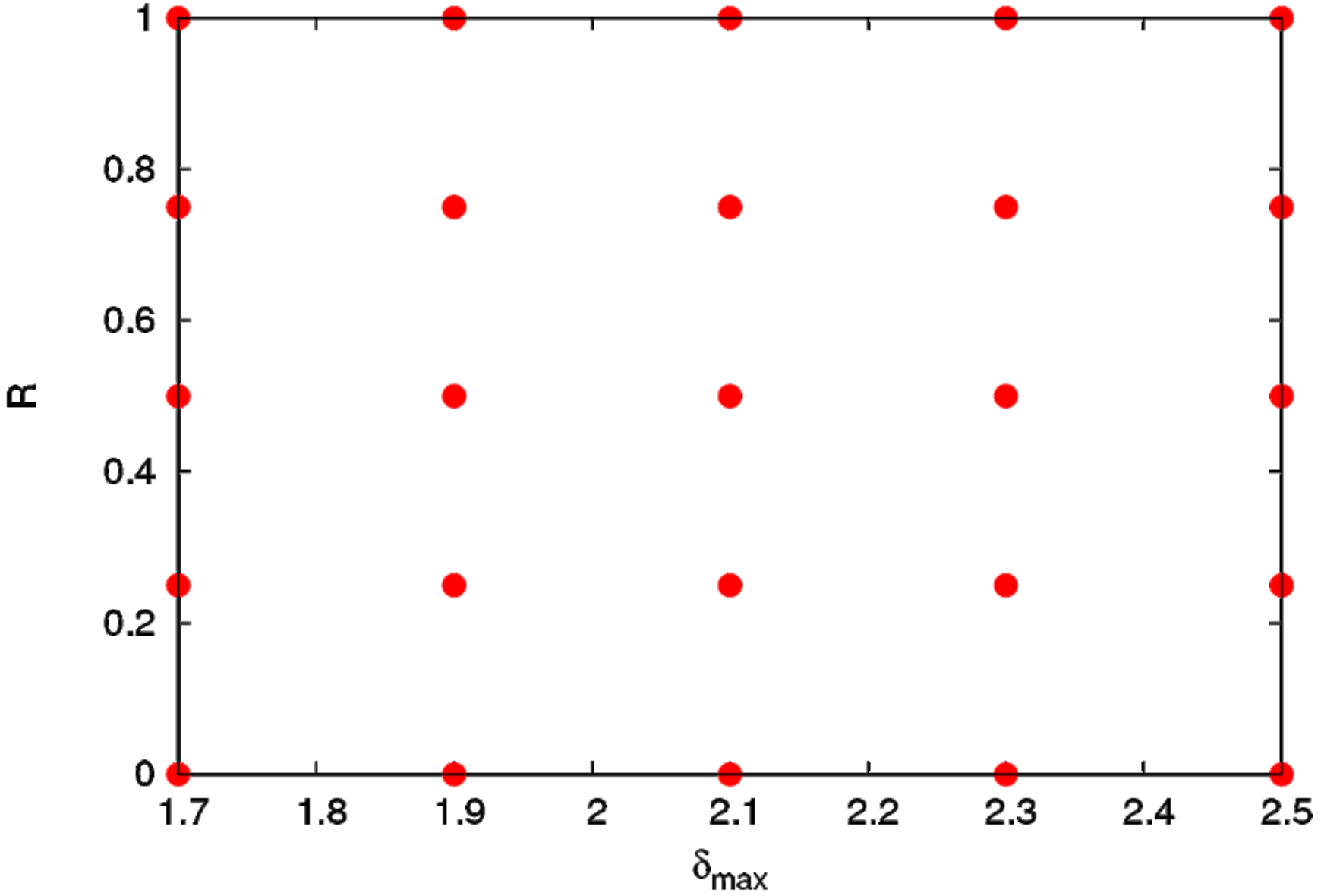
- In LHC: We measure pressure (P)
- In ECLOUD: We get the flux (ϕ)

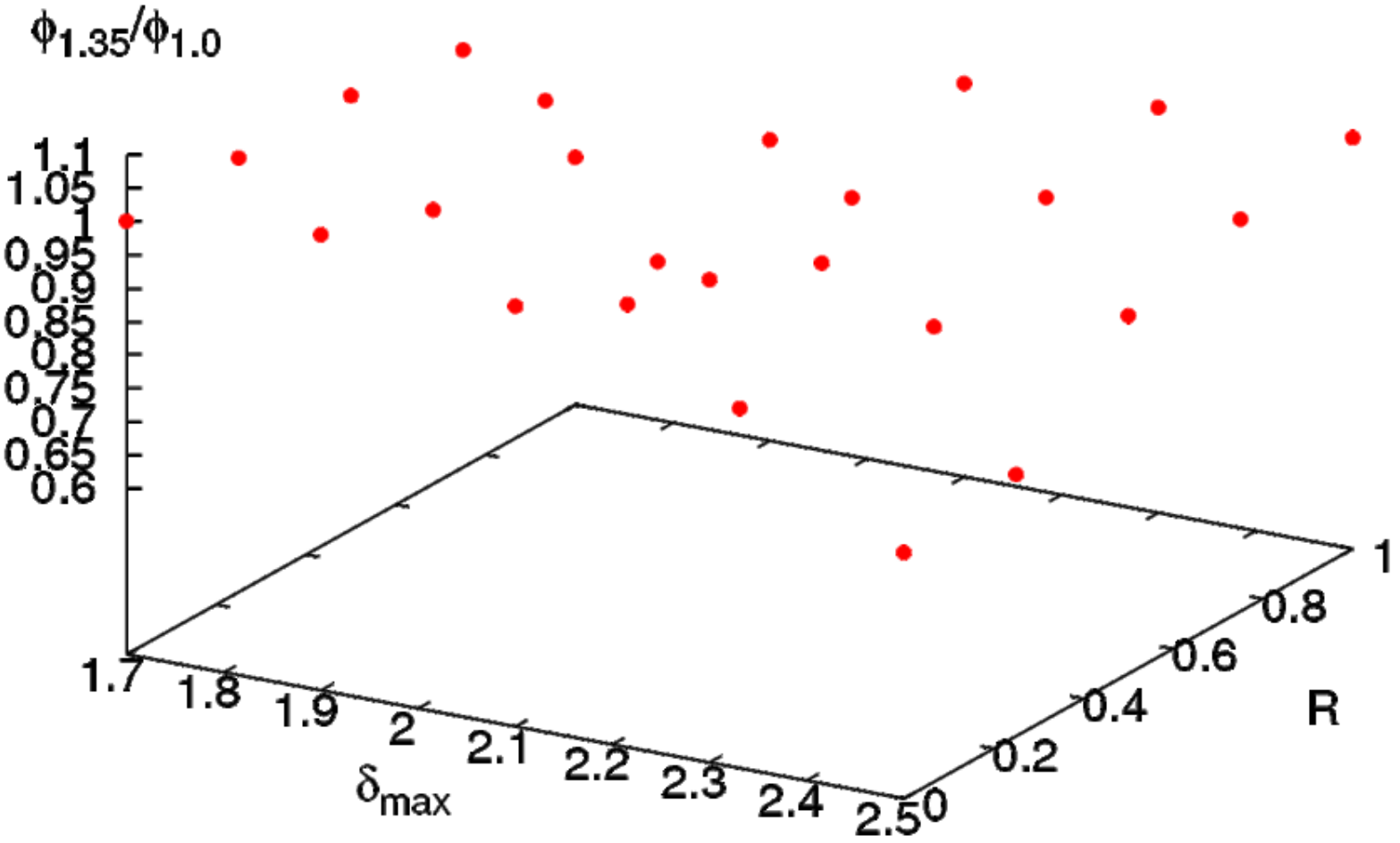
$$\Delta P_i \propto \phi_i \Rightarrow \frac{\Delta P_a}{\Delta P_b} = \frac{\phi_a}{\phi_b}$$

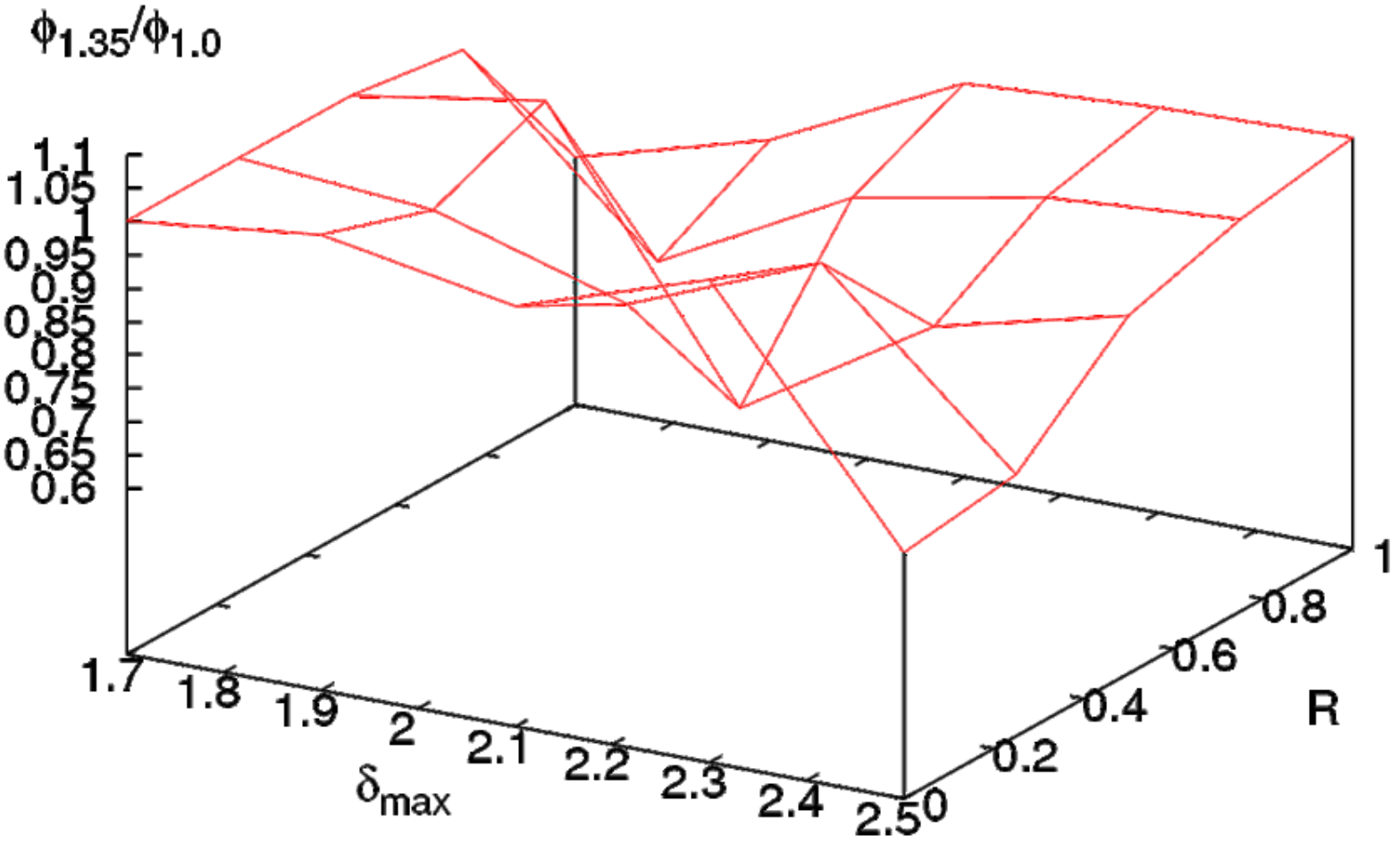
Spacing [μs]	P at VGPB.2.5L3.B [nTorr]	$\Delta P_i/\Delta P_{1\mu s}$
38.85	30	0.153
28.85	36	0.185
8.85	48	0.250
1.85	113	0.597
1.35	120	0.637
1	188	1.00

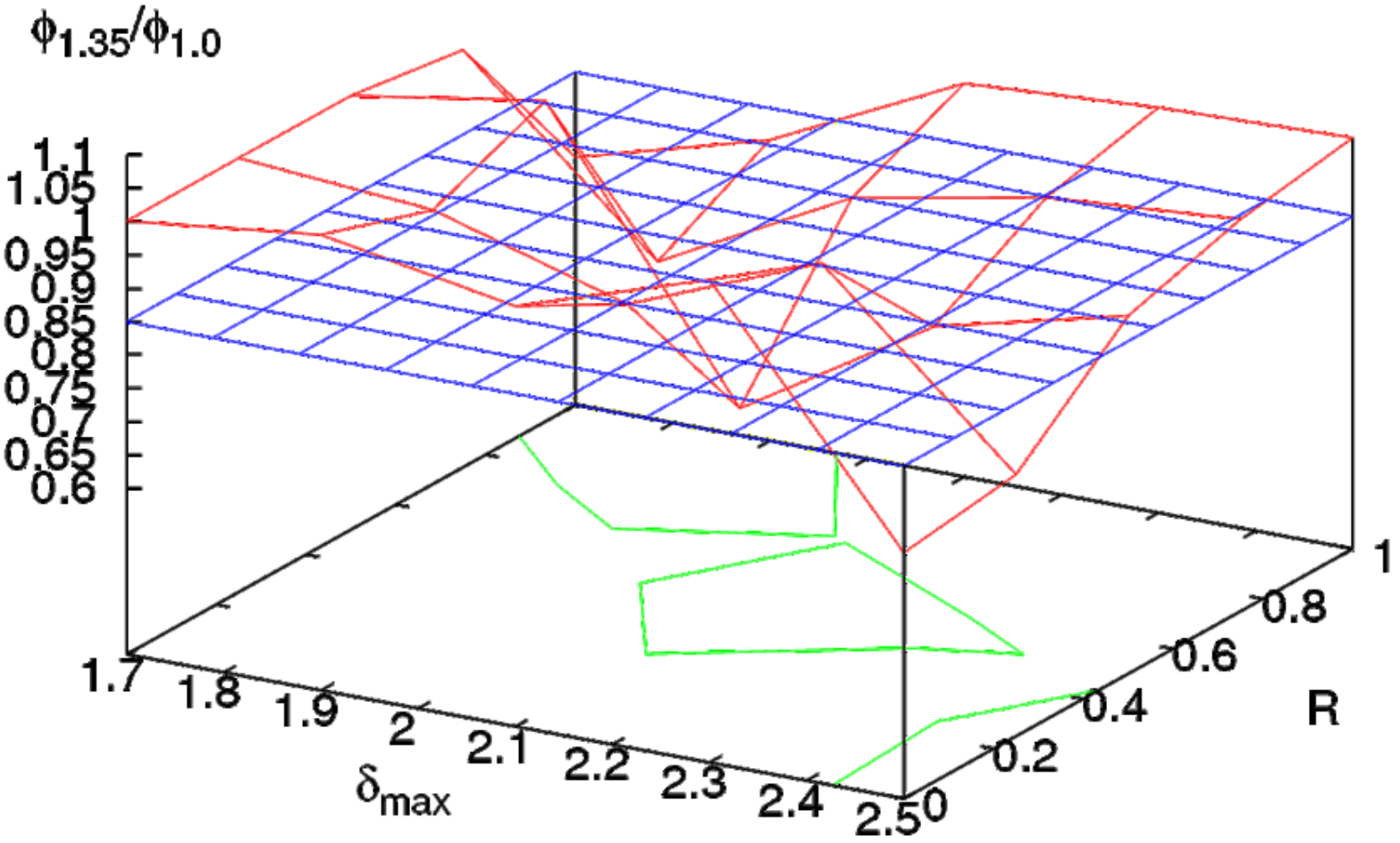
P_0=1.6 nTorr

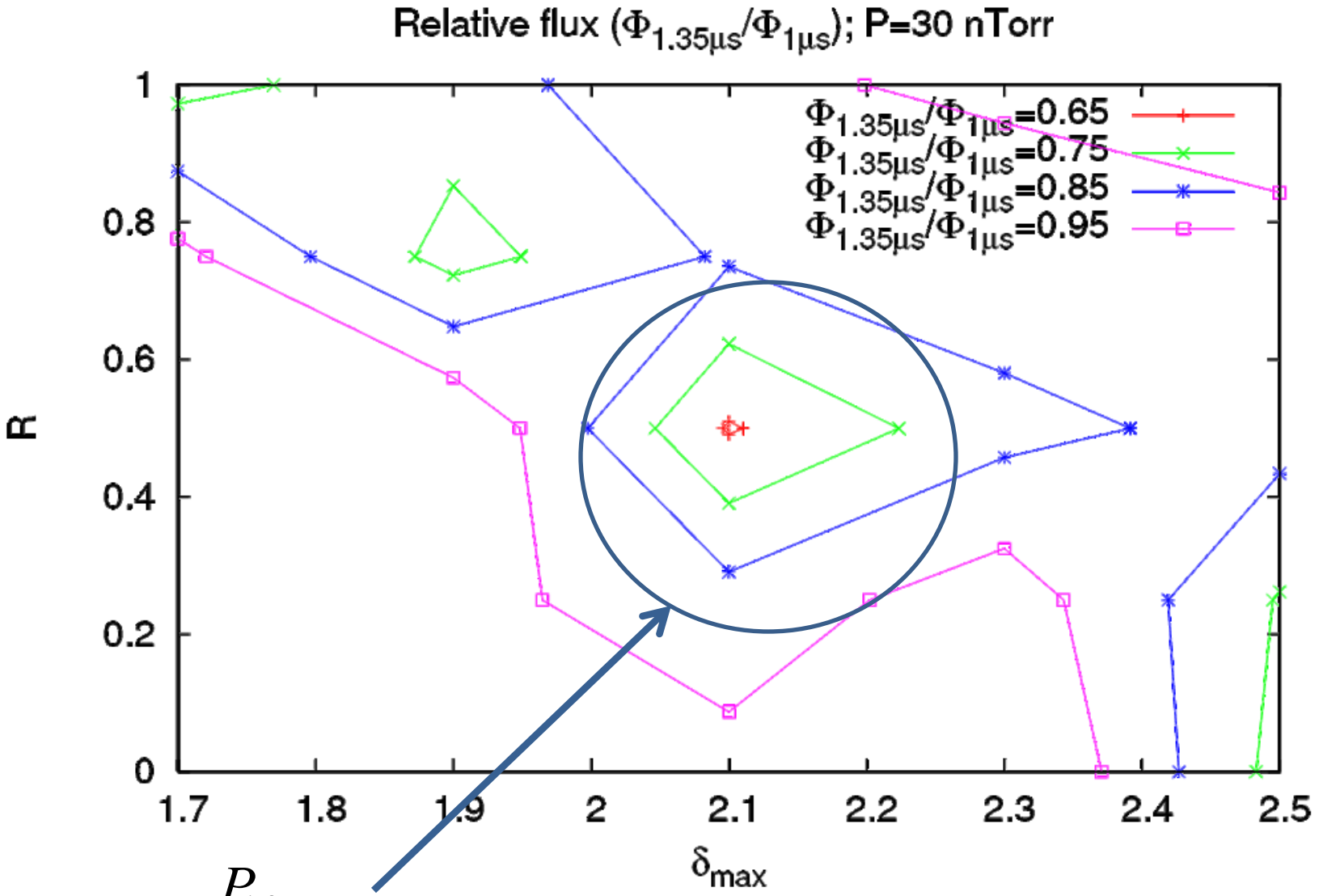
Method




$\phi_{1.35}/\phi_{1.0}$
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
δ_{max}
0
0.2
0.4
0.6
0.8
1
R

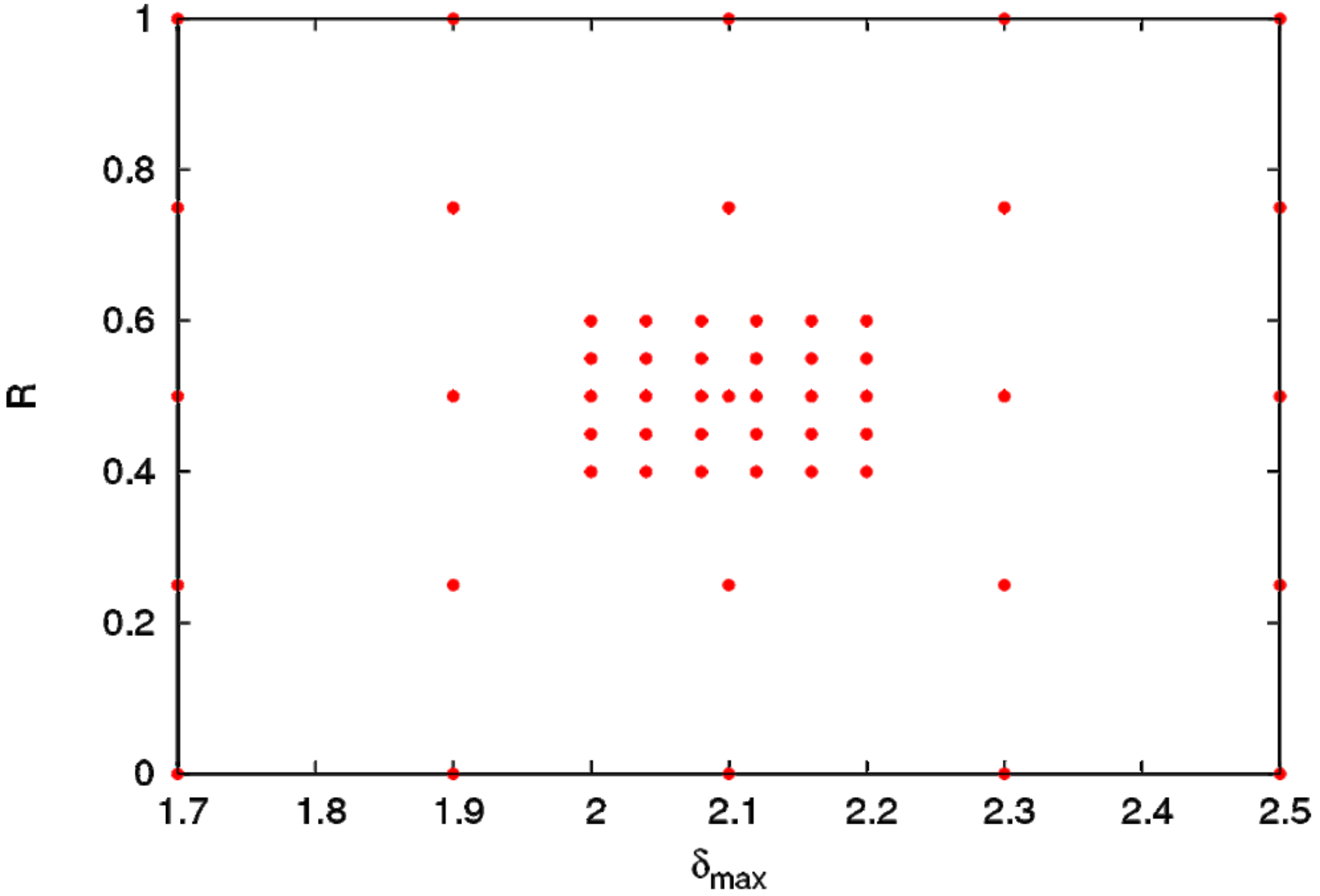

$\phi_{1.35}/\phi_{1.0}$
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
δ_{max}
0
0.2
0.4
0.6
0.8
1
R

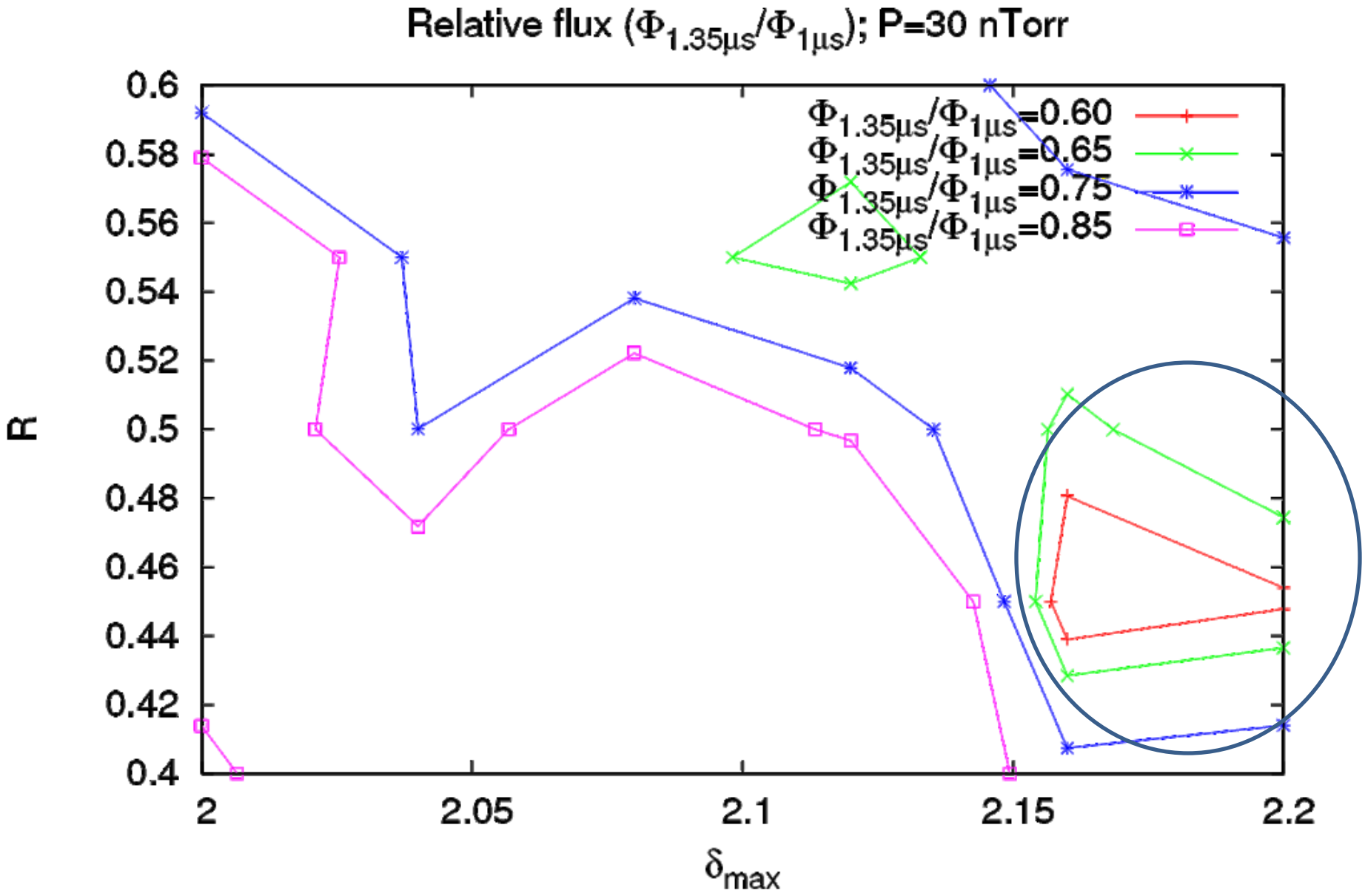

$\phi_{1.35}/\phi_{1.0}$
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
δ_{max}
0
0.2
0.4
0.6
0.8
1
R



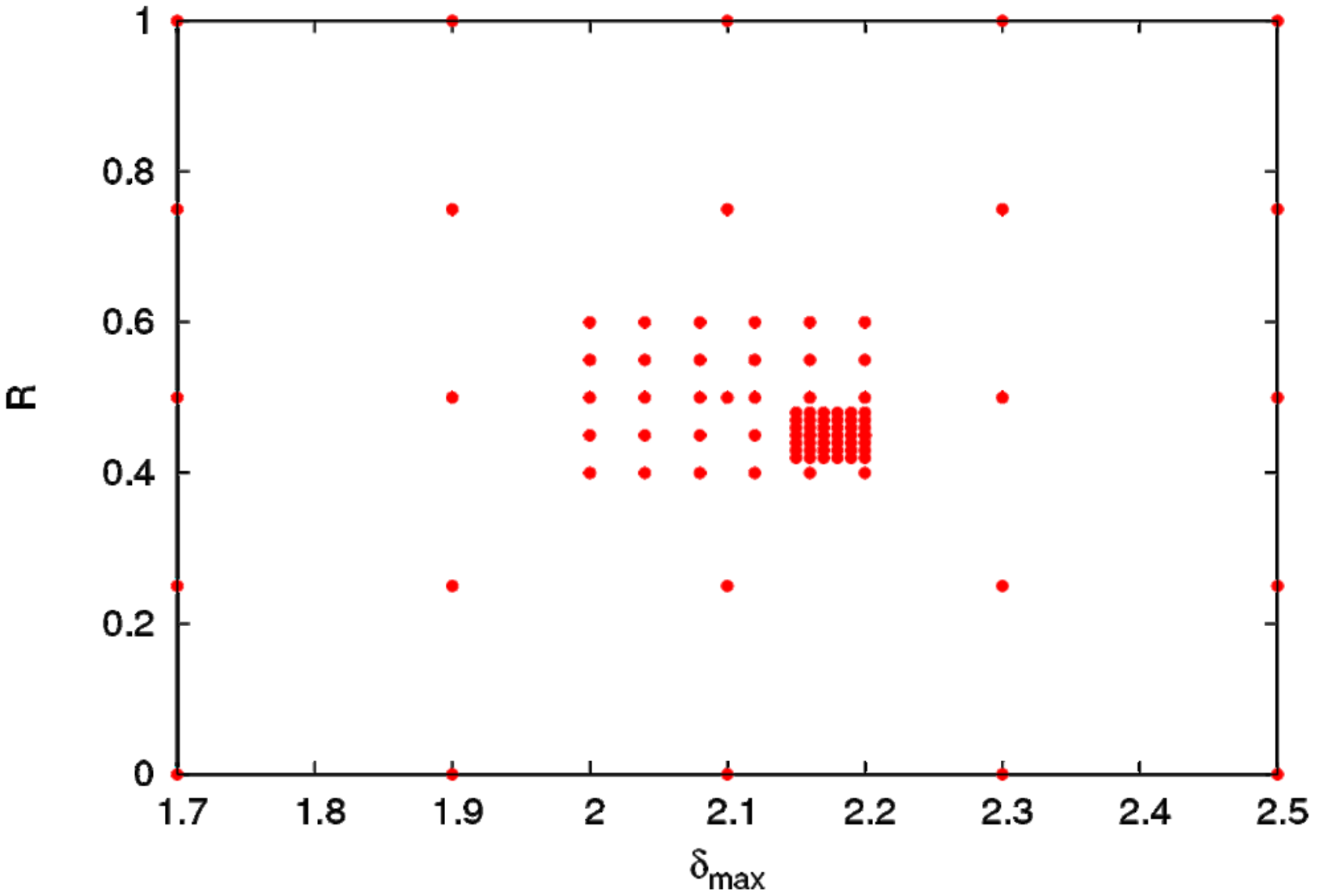
$$\frac{P_{1.35\mu s}}{P_{1\mu s}} = 0.637$$

Method




Relative flux ($\Phi_{1.35\mu s}/\Phi_{1\mu s}$); P=30 nTorr
$\Phi_{1.35\mu s}/\Phi_{1\mu s}$=0.60
$\Phi_{1.35\mu s}/\Phi_{1\mu s}$=0.65
$\Phi_{1.35\mu s}/\Phi_{1\mu s}$=0.75
$\Phi_{1.35\mu s}/\Phi_{1\mu s}$=0.85
R
0.6
0.58
0.56
0.54
0.52
0.5
0.48
0.46
0.44
0.42
0.4
2
2.05
2.1
2.15
2.2
δ_{max}

Method



1) Observations. Description of the problem

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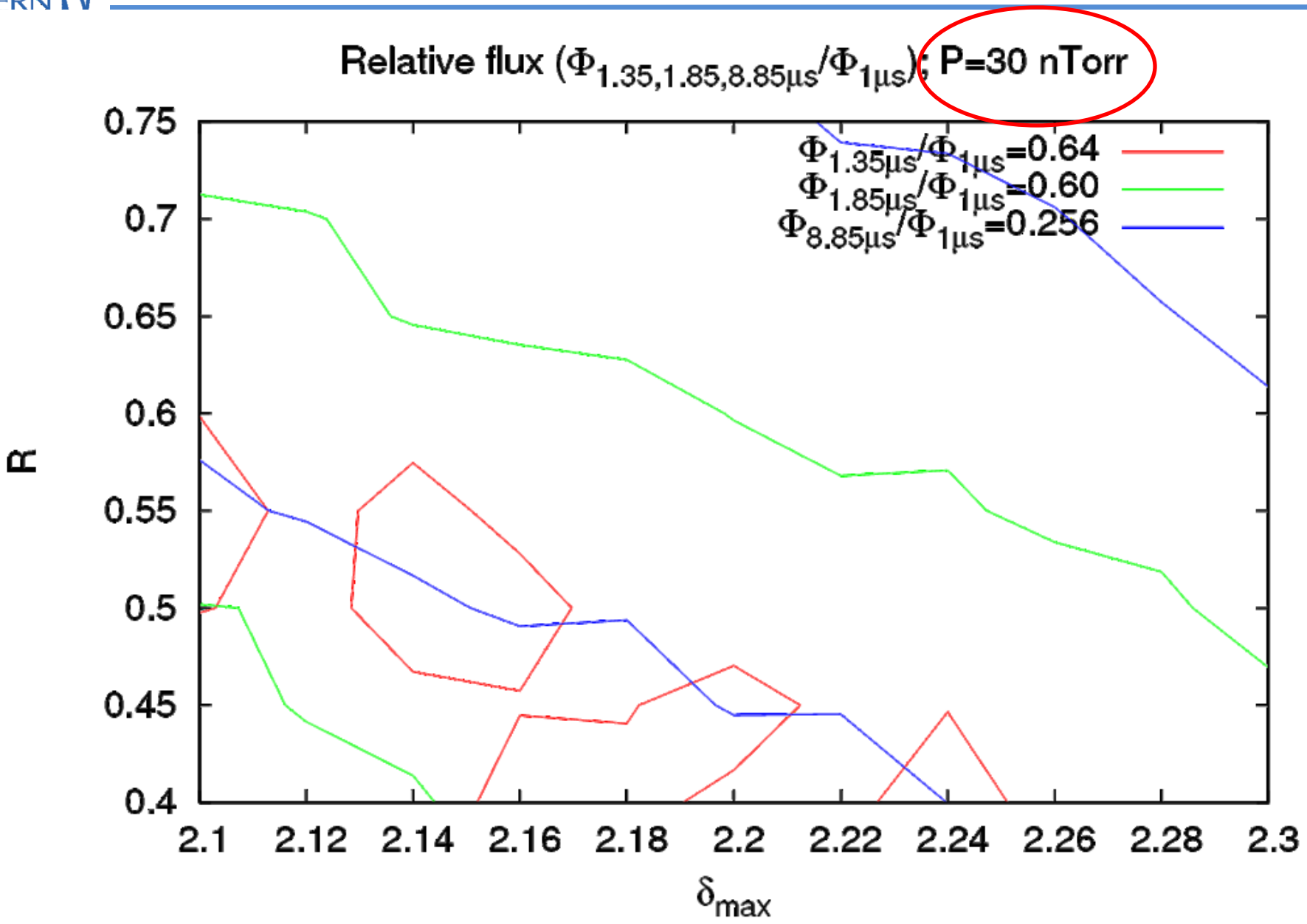
Nice in the theory but in practice…

- Working with 4 parameters is not easy

- Small variations in one parameter can change your results significantly

- That can lead to completely different conclusions/strategies

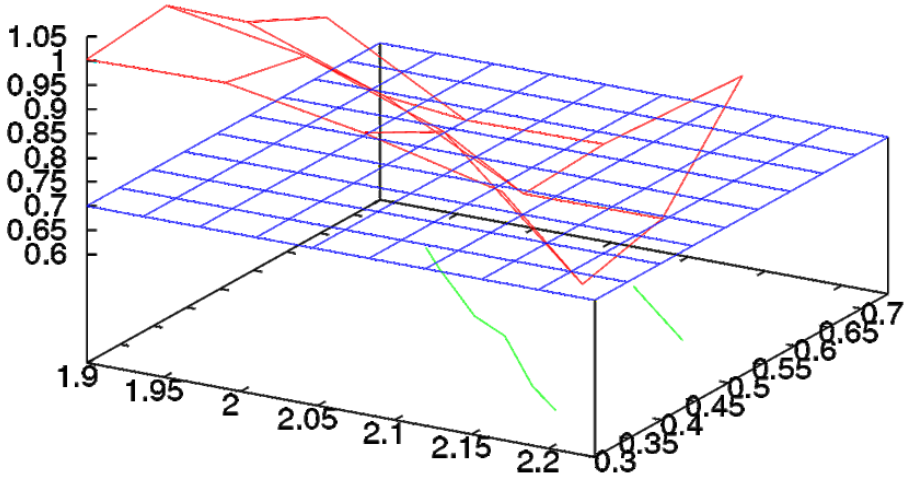

Relative flux ($\Phi_{1.35,1.85,8.85\mu s}/\Phi_{1\mu s}$); P=30 nTorr
$\Phi_{1.35\mu s}/\Phi_{1\mu s}$=0.64
$\Phi_{1.85\mu s}/\Phi_{1\mu s}$=0.60
$\Phi_{8.85\mu s}/\Phi_{1\mu s}$=0.256
R
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
2.1
2.12
2.14
2.16
2.18
2.2
2.22
2.24
2.26
2.28
2.3
δ_{max}

• The pressure rise is due to the multiturn effect → each simulation should have the measured pressure as *seed pressure* (input in ECLOUD)

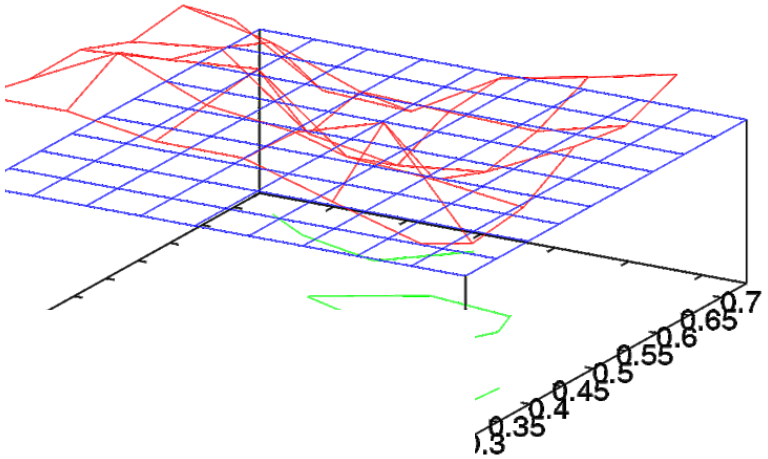
• Need to “open” the zoom

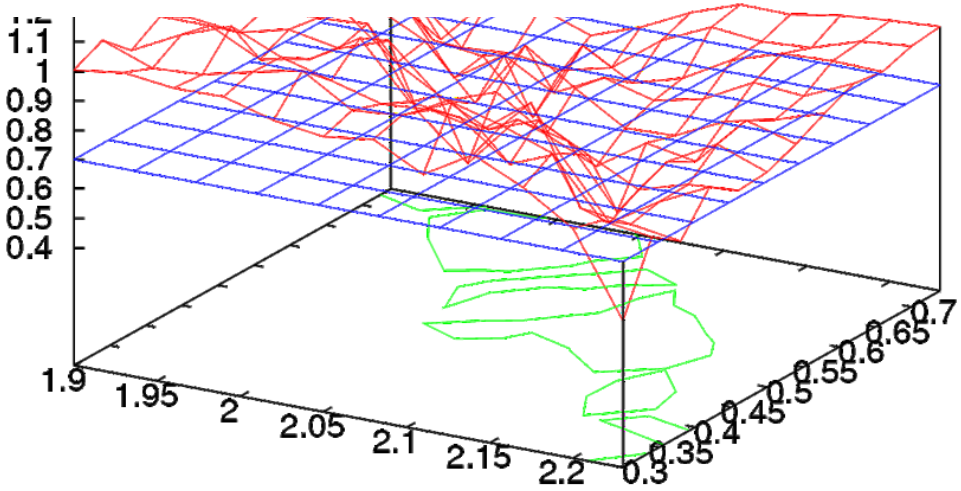
• Big dependence on the number of grid points → Finer grids required

4x4 grid

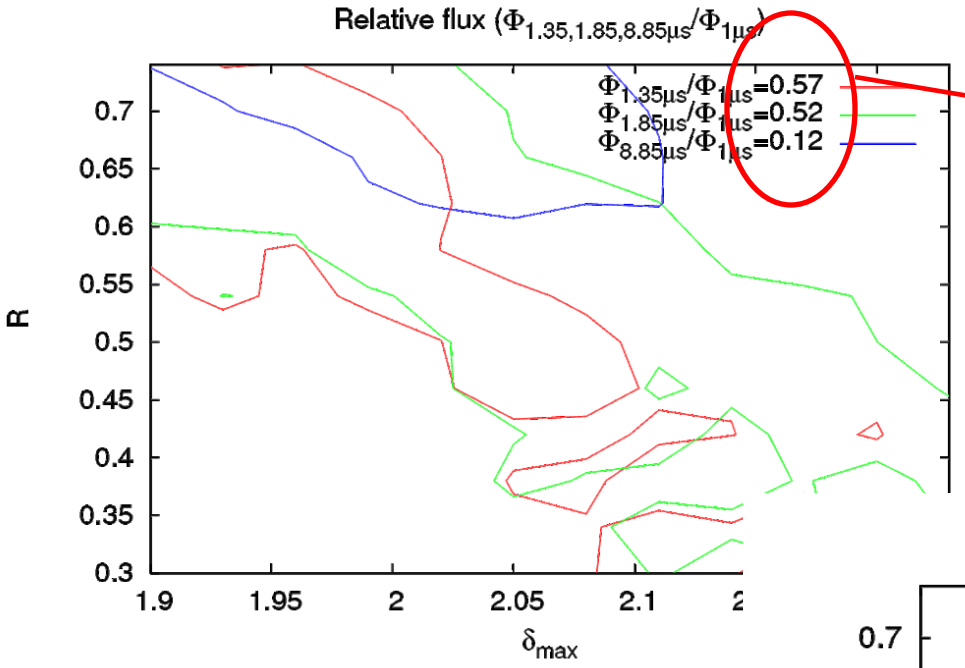


6x6 grid



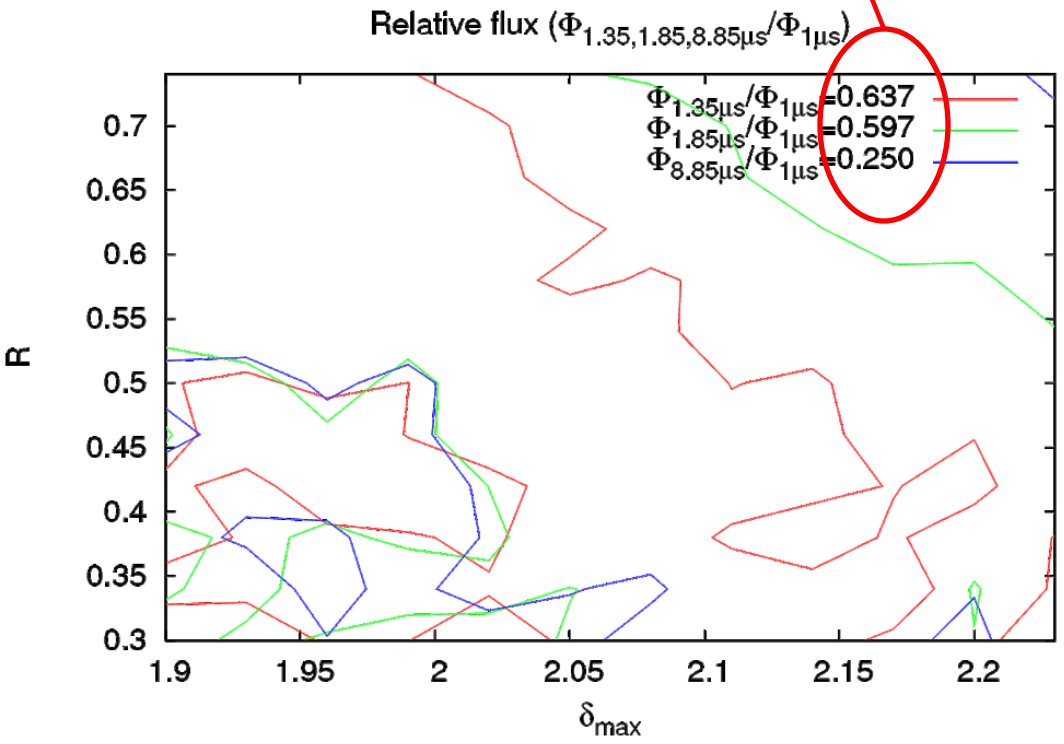


12x12 grid



$$\frac{\Delta P_i}{\Delta P_{1\mu s}} = \frac{P_i - P_{38.85\mu s}}{P_{1\mu s} - P_{38.85\mu s}}$$

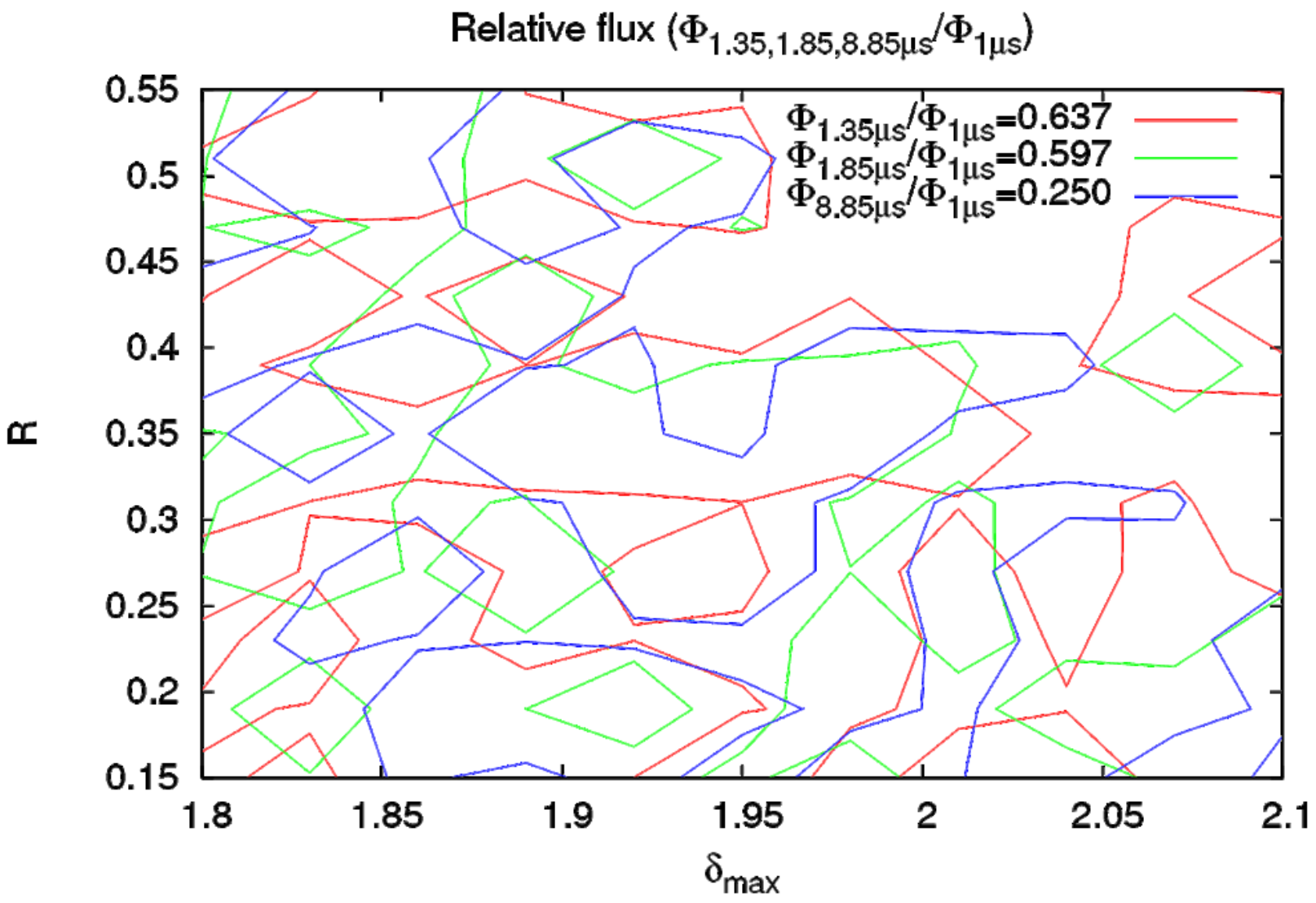
$$\frac{\Delta P_i}{\Delta P_{1\mu s}} = \frac{P_i - P_0}{P_{1\mu s} - P_0}$$



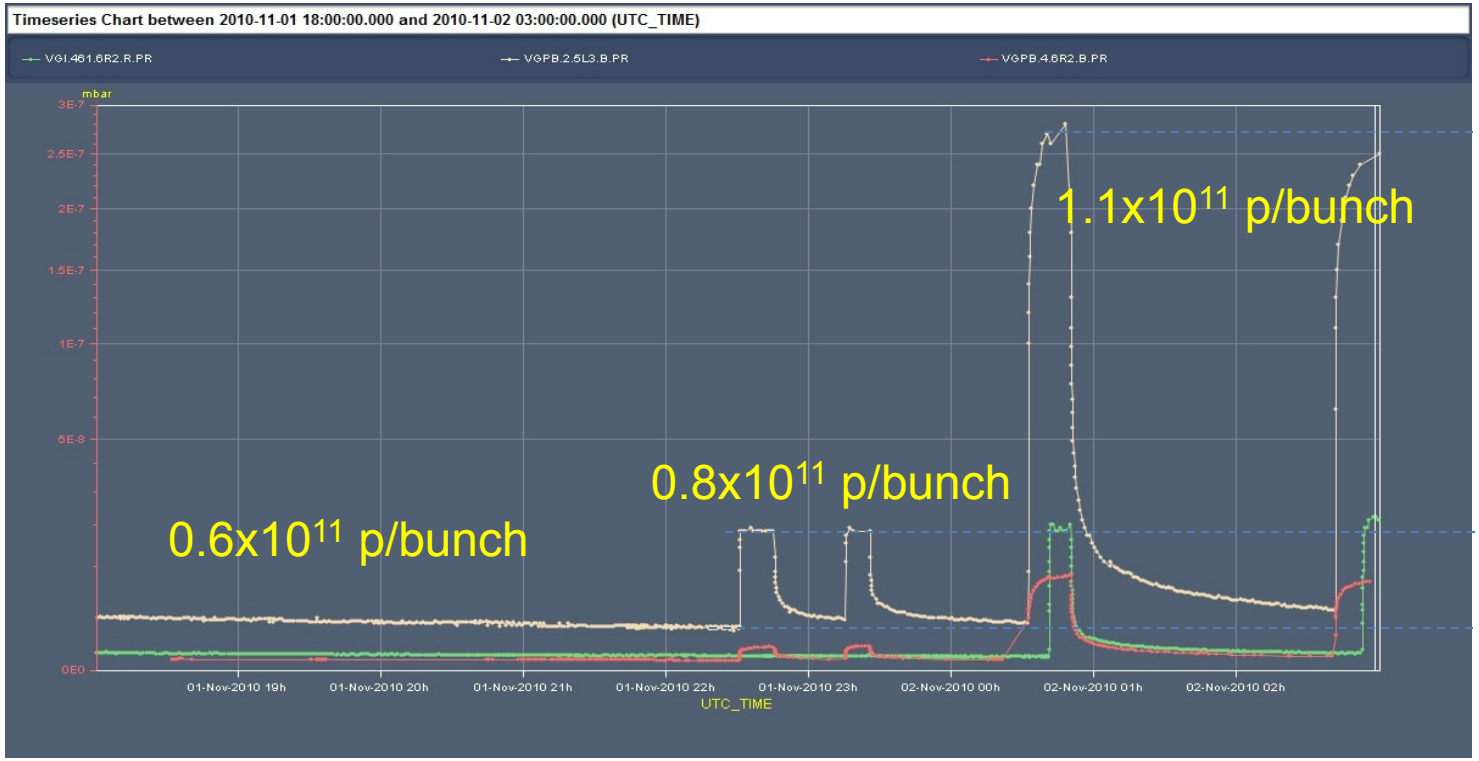
ECLOUD input seed pressure → P_i

ECLOUD input seed pressure → $P_i - P_0$

$$\Delta P_i \qquad P_i - P_0$$



Results



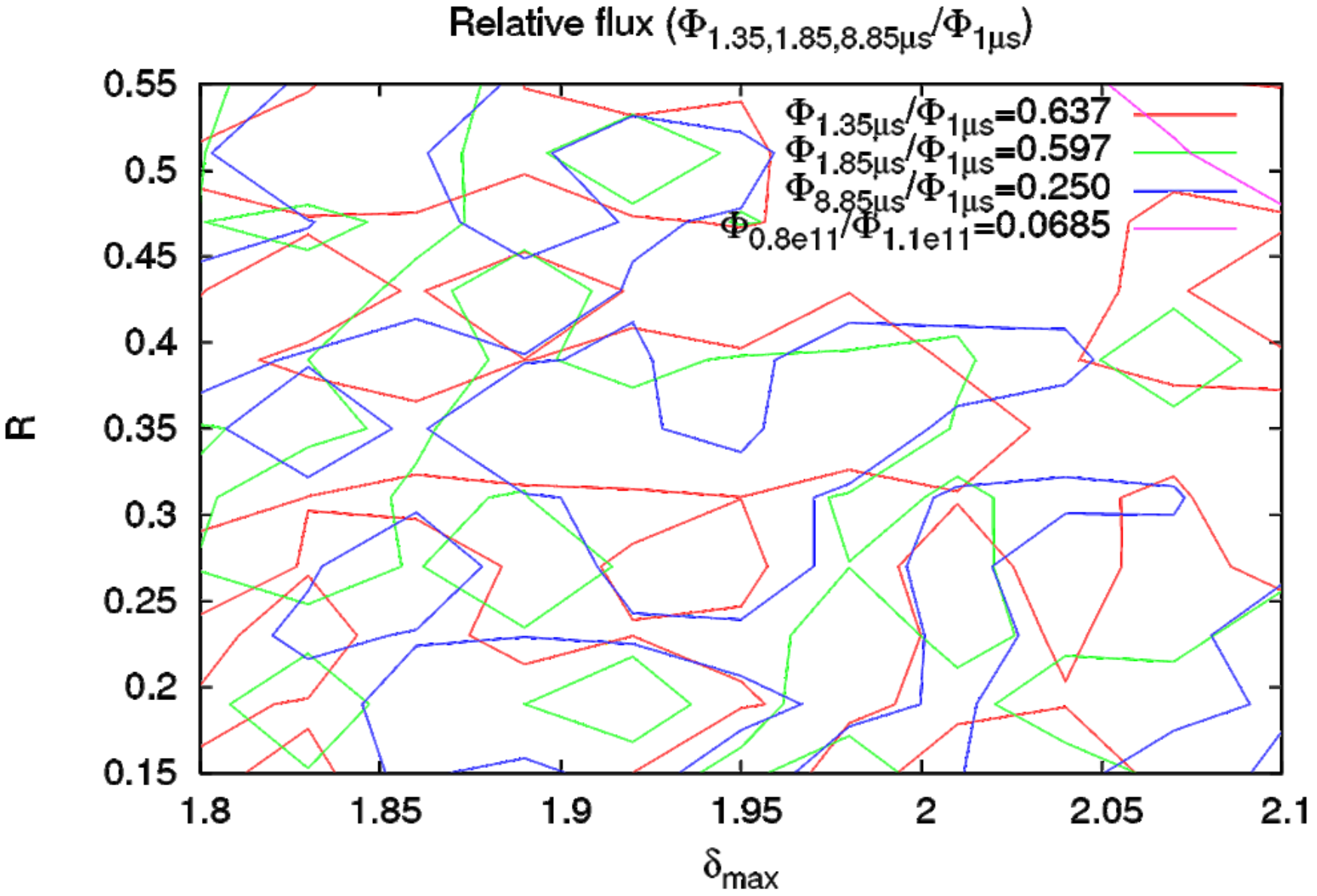
197nTorr

13.5nTorr

1.6nTorr

Courtesy G.Arduoni

$$\frac{P_{0.8e11}}{P_{1.1e11}} = 6.9 \cdot 10^{-2}$$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$\Phi_{1.85\mu s}/\Phi_{1\mu s}$=0.597
$\Phi_{8.85\mu s}/\Phi_{1\mu s}$=0.250
$\Phi_{0.8e11}/\Phi_{1.1e11}$=0.0685
R
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
1.8
1.85
1.9
1.95
2
2.05
2.1
δ_{max}

Conclusions

- Parameter studies are taking place to characterize the IR3
- 4 parameters have been chosen to describe the surface properties
- Significant impact on searched parameters with a small variation in the input
- The number of grid points become important too
- No good agreement yet. Possible reasons:

  - The assumption of the geometry is not optimum
  - Pressure at $z \neq 0$ (from gauge) varies more than expected (ratios might change!)
  - **Need to explore the ε_{max} parameter (set to 230 eV for all present simulations)**

- Need to explore other IPs

Thank you for your attention