# ATS Flat MDs

## rMPP MD1 preparation meeting

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on behalf of

*the OP, OMC, Coll., LBDS, Lumi, Beam-beam, Instability & ADT teams*

- **MD 2148:** Flat Optics 60/15 cm continuation

# Contents

- Overall MD plan and schedule
- MD Hyper-cycle
- Detailed Activities
- TCDQ derogation request (tighten, not open ..)

# MD plan and schedule

**Re-using the flat optics hyper-cycle built up in 2017 (with slight modifications, see later):**

**→ 60/15-15/60 cm @ IP1-5 with H-V crossing (130 μrad)**

**→2 shifts**

1. Tuesday 12/06/2018 (10+2 h) – 7H00/17H00
   **with probes, essentially for optics commissioning.**

2. Sunday  12/06/2018 (8+2 h) – 12H00/20H00
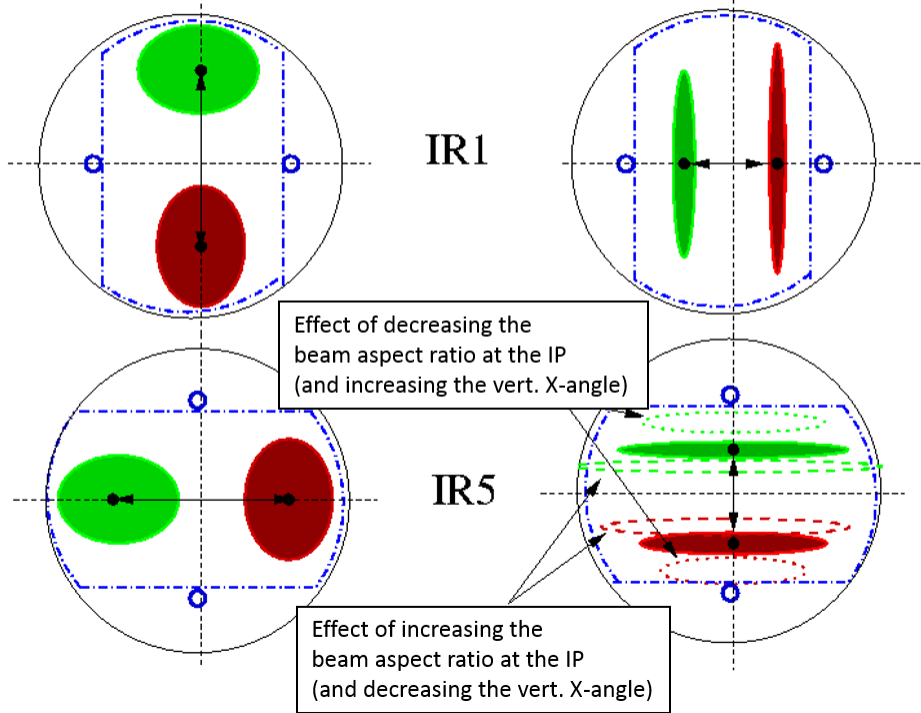   **with setup beams, for collisions, IT aperture and LMs.**

# Hyper-cycle description

- **RAMP_PELP-SQUEEZE-6.5TeV-ATS-1m-2018_V3_V1_TELE-ATSFlat** <u>**with nominal collimator settings**</u>

→ Clone of the nominal ramp: $\beta^*$=1 m, X= ± 160 mrad (V/H), sep= ± 0.55 mm (H/V) reached EoR at IP1/5

- **TELE-ATS_knobs-2017_V1_ATSFlat** <u>**with nominal collimator settings**</u>

→ exchange of standard knob values onto TELE-knob, and tune shift (.275/.295→ .28/.31).

- **BUMPS-INVERSION-2018_V1** <u>**with new TCT functions**</u>

→ **X-bump reduction (160 →150 µrad), followed by a clockwise 90° rotation (V/H→ H/V)**

- **SQUEEZE-6.5TeV-ATS-1m-65cm-2017_V1** <u>**with new TCT functions**</u>

→ Pre-squeeze down to $\beta^*$=65 m combined with X and sep reduction (150 → 130 µrad, and 0.55 mm → 0.30 mm)

- **SQUEEZE-6.5TeV-ATS-65cm-60_15cm-2017_V1** <u>**with new TCT functions**</u>

→ **Tele-squeeze at cst crossing bumps down to $\beta^*$=60/15 cm-15/60 cm at IP1-5**.

- **QCHANGE-6.5TeV-ATSFlat-2018_V1** <u>**with new TCT functions**</u>

→ Tune shift (.28/.31→.31/.32)

- **PHYSICS-6.5TeV-ATSFlat-2018_V1** <u>**with new TCT functions**</u>

→ Collapse of the separation bumps (w/o IP shift for Alice and CMS)

# Crossing bump rotation @ 1 m (EoR)



Round beam configuration
(V–crossing in ATLAS, H–crossing in CMS)

Flat beam configuration
(H–crossing in ATLAS, V–crossing in CMS)

IR1

IR5

Effect of decreasing the beam aspect ratio at the IP (and increasing the vert. X-angle)

Effect of increasing the beam aspect ratio at the IP (and decreasing the vert. X-angle)

The rotation is needed to boost the $\beta^*$ reach in the former X-plane. **But then the IT aperture @ 1 m is reduced from 18.2 $\sigma$ down to 12.4 $\sigma$ in the new X-plane, and increases up to ~23 $\sigma$ in the other plane**
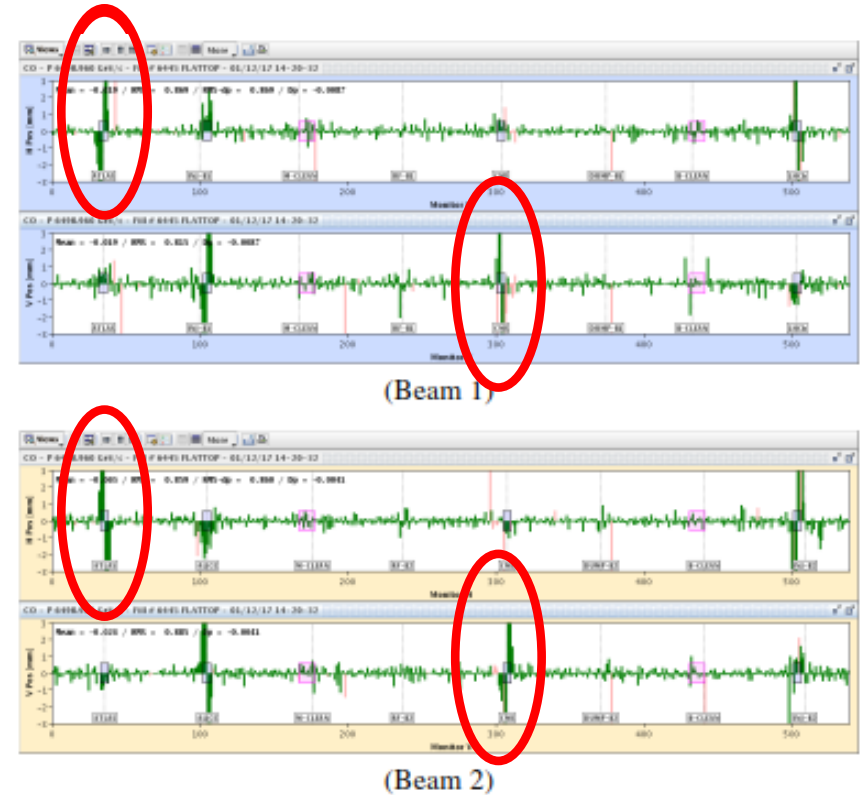
(Beam 1)

(Beam 2)

Figure 27: Closed orbit snapshot taken after the crossing plane rotation beam process. The crossing plane becomes horizontal in ATLAS and vertical in CMS (and conversely for the parallel separation planes).

**...Already played in 2017 (as expected, ..within some improvement needed in the ref orbit management)**

# Activity plan for the **first shift** (2 fills with probes)

| Activity (and comments) | Time estimate [h] |
|---|---|
| **First fill: Optics commissioning @ 60/15—15/60 cm (with flat machine), 1 n.c. probe/beam (b1/2 e.g. in bucket 1/2001)** | |
| - Setting up at injection → 0.25 h <br> - Nominal combined ramp & squeeze with nominal collimator settings → 0.25 h <br> - Coarse collimator settings, octupole OFF → 0.25 h <br> - Tele-knob exchange, crossing bump rotation and pre-squeeze to 65 cm → 0.5 h <br> - Crossing OFF and setting up → 0.25 h | 1.5 |
| - Telescopic squeeze by step down to 60/15—15/60 <br> - Fast optics checks at the 5 intermediate steps (Q', coupling, YASP dispersion) → 0.5 h <br> - Optics measurement and correction at 60/15—15/60, including W's, K-modulation, coupling correction and non-linear measurement → 5.0 h | 5.5 |
| **Dump and Ramp down** | 1.0 |
| **Second fill (if time permits): IT aperture @ 65 cm and 60/15—15/60 optics reach (with crossing on), 2 probes/beam** | |
| - Setting up at injection → 0.25 h <br> - Nominal combined ramp & squeeze with nominal collimator settings → 0.25 h <br> - Coarse collimator setting, octupole OFF → 0.25 h <br> - Tele-knob exchange, crossing bump rotation, and pre-squeeze to 65 cm → 0.5 h <br> - IT aperture measurement @ 65 cm (10.6 $\sigma$ expected in H/V for IR1/5, ~ 18 $\sigma$ in V/H) → 1.5 h <br> - Telescopic squeeze down to 60/15—15/60 with crossing bumps ON → 0.25 h <br> - Beam dump | 3.0 |
| **Total** | 11.0 |

# Activity plan for the **second shift** (2 fills)

| Activity (and comments) | Time estimate [h] |
|---|---|
| **Setup fill: TCT alignment, collision, aperture measurement at 60/15—15/60, 2 colliding nominal + 6-8 non-colliding probes** | |
| - Injection, ramp with nominal collimator settings, <u>coarse TCT settings,</u> Tele-knob exchange, X-rotation → 1.0 h <br> - <u>**TCT alignment @ 1 m**</u> → 0.25 h <br> - **Pre-squeeze down to 65 cm, and setting up** → 0.25 h <br> - <u>**TCT alignment @ 65 cm**</u> → 0.25 h <br> - **Telescopic squeeze down to 60/15—15/60** → 0.25 h <br> - <u>**TCT alignment @ 60/15 cm**</u> → 0.25 h <br> - <u>**Find and optimize collisions at IP1/2/5/8**</u> → 0.75 h <br> - <u>**TCT alignment in collision and first loss maps**</u> → 0.25 h <br> - <u>**Intensity scraping down to 1-2 pilots /beam, and IT aperture measurement**</u> (8.9 σ expected limited in V/H in IR1/5, ~10 σ in the other plane) → 2.0 h | **5.5** |
| **Dump and Ramp down** <u>**and generation of new TCT functions**</u> | **1.0** |
| **Validation fill: Loss maps and asynchronous dump tests ,2 colliding nominal + 8-10 non-colliding probes** | |
| - Injection, ramp with nominal collimator settings, Tele-knob exchange, X-rotation with <u>**new TCT functions**</u> → 1.0 h <br> - <u>**Loss maps @ 1 m**</u> → 0.25 h <br> - **Pre-squeeze down to 65 cm** <u>**with new TCT functions**</u> → 0.25 h <br> - <u>**Loss maps @ 65 cm**</u> → 0.25 h <br> - **Telescopic squeeze down to 60/15—15/60** <u>**with new TCT functions**</u> → 0.25 h <br> - <u>**Loss maps @ 60/15 (beams separated)**</u> → 0.25 h <br> - **Find and optimize collisions at IP1/2/5/8** → 0.25 h <br> - <u>**Loss maps @ 60/15 (beams colliding)**</u> → 0.25 h <br> - <u>**Scraping (<5E10), de-bunching, & asynchronous dump with TCT@ 8.0 σ**</u> → 0.5h | **3.5** |
| **Total** | **10.0** |

# TCDQ "derogation" request (not yet in the procedure)

**TCDQ normalized settings for various optics, assuming no change in the TCTQ settings**

| Optics | $\beta_x$ [m] @ TCDQ for b1/b2 | Norm. settings [$\sigma$] for b1/b2 |
|---|:---:|:---:|
| EoR (@ 1m) & MD @ 1m-65 cm | 526/529 | 7.9/7.4 |
| **Nominal @ 25 cm (ref.)** | **614/538** | **7.3/7.3** |
| MD @ 60/15 cm | 652/474 | 7.1/7.8 |

In view of the tight IT aperture (9 $\sigma$) with $\beta^*$ =15/60 cm at IP5, it is requested **to tighten the Beam 2 TCDQ/TCSP ramp function by 6.2% (219 $\mu$m) in the very end of the ramp** (corresponding to 6.9 $\sigma$ EoR and 7.3 $\sigma$ @ 15/60 cm)

→ **Would be available as of the first shift with probes** (for all fills, the ramp is planned to be done with nominal settings, so quasi-nominal in this case)
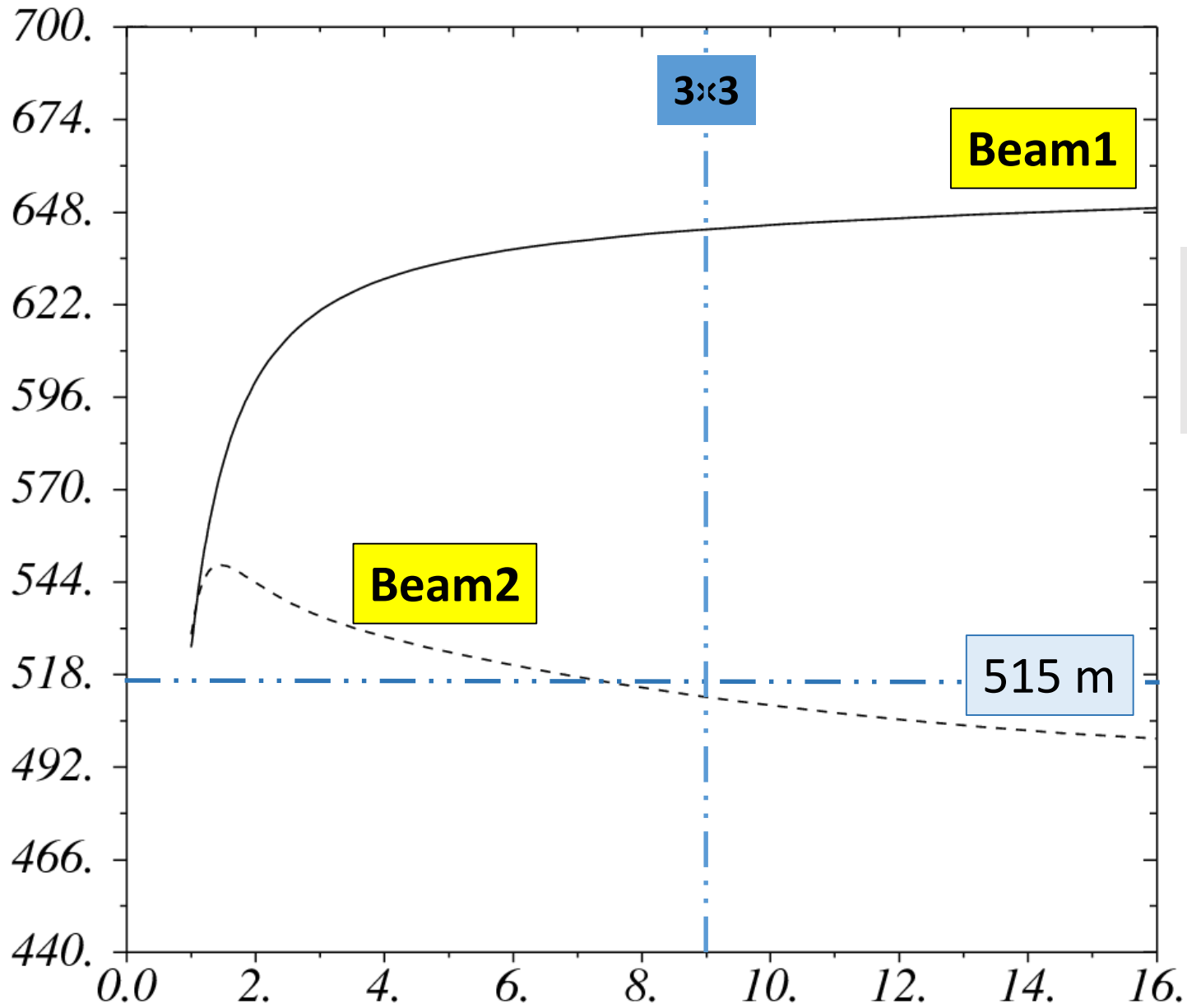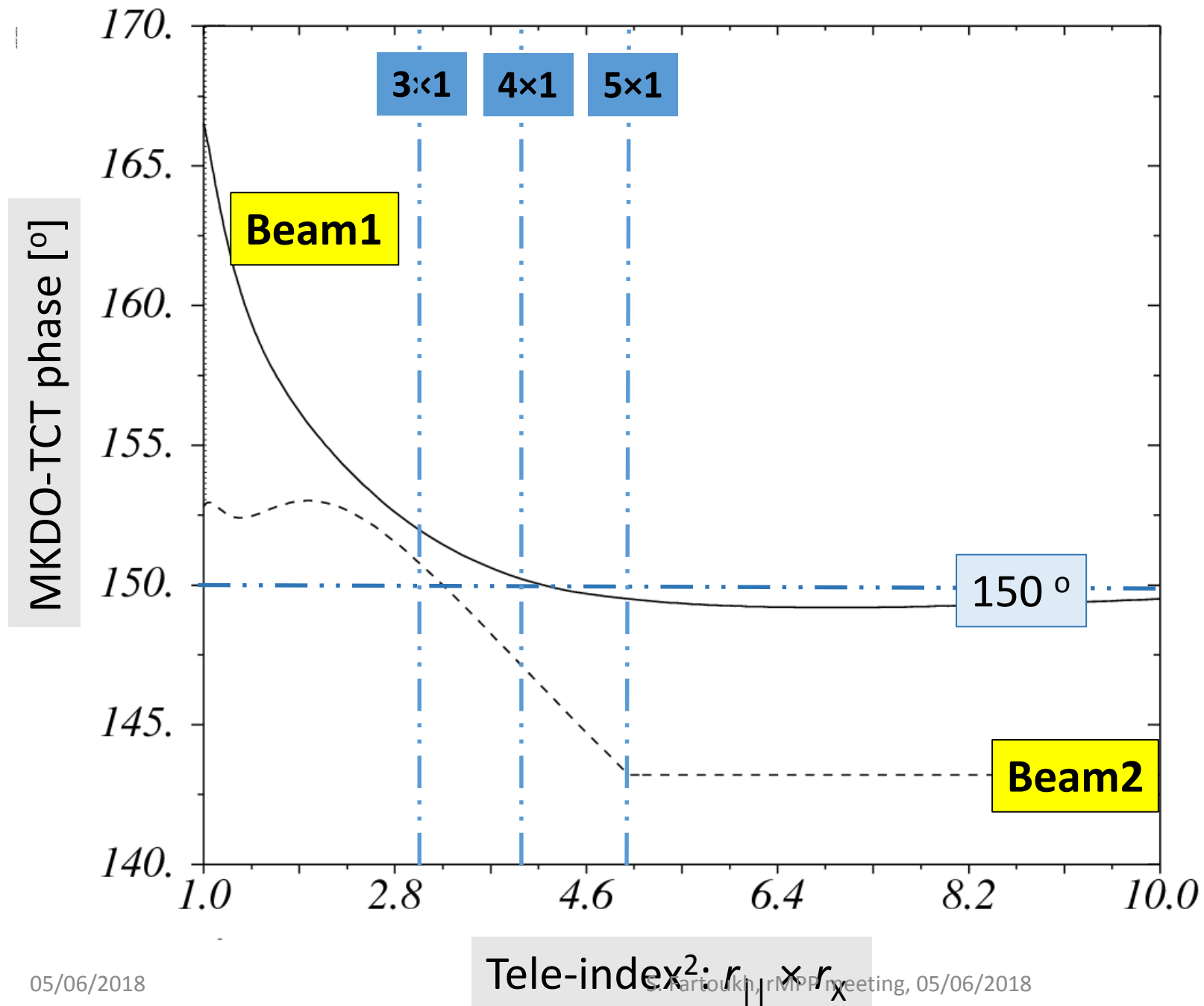
# Back-up slides

S. Fartoukh, rMPP meeting, 05/06/2018
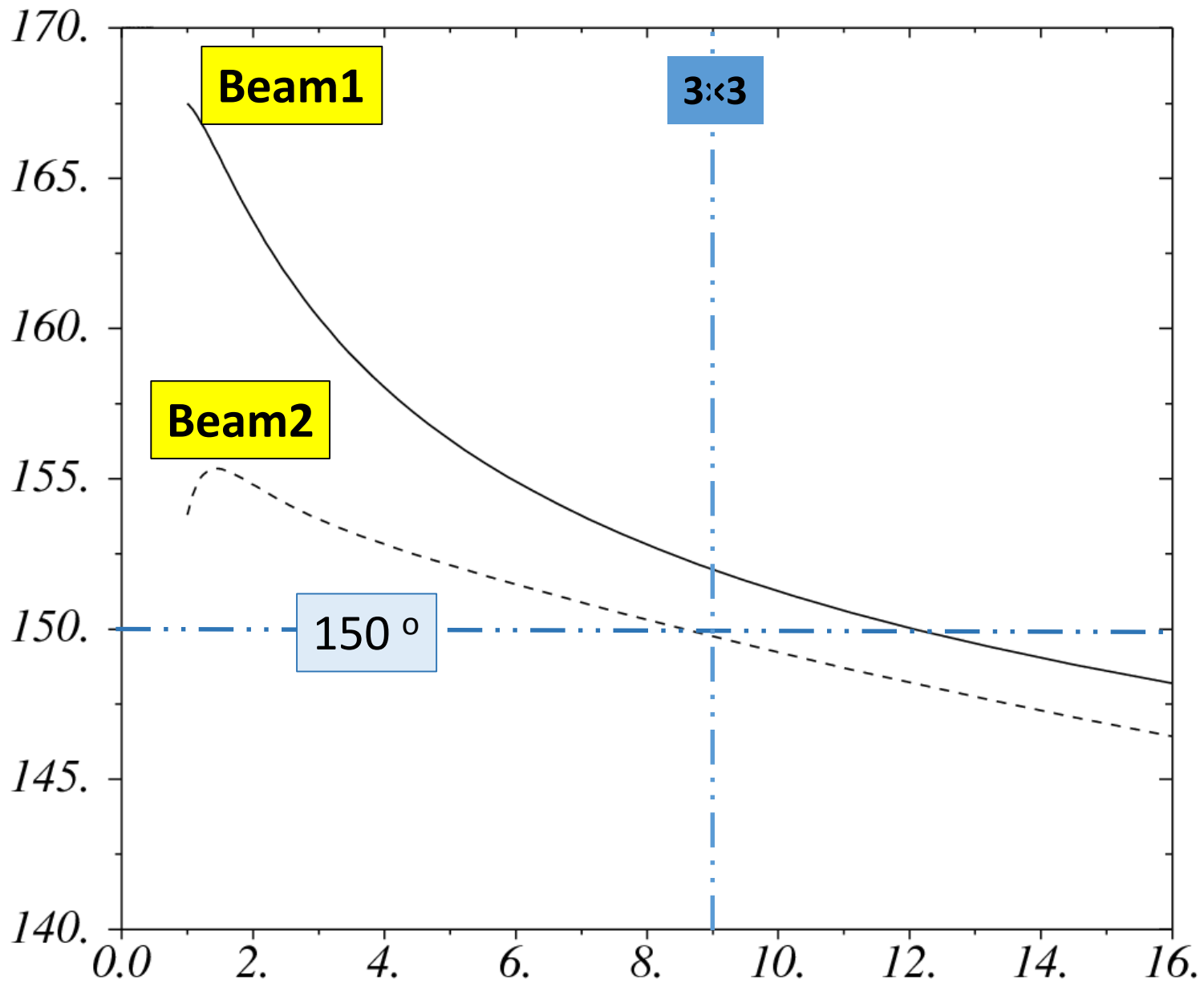
Round Tele-Squeeze MKD-TCT phase

S. Kartoukh, rMPP meeting, 05/06/2018

Round Tele-Squeeze: $\beta_x$ at TCDQ

Flat Tele-Squeeze MKD-TCT phase

Flat Tele-Squeeze: $\beta_x$ at TCDQ