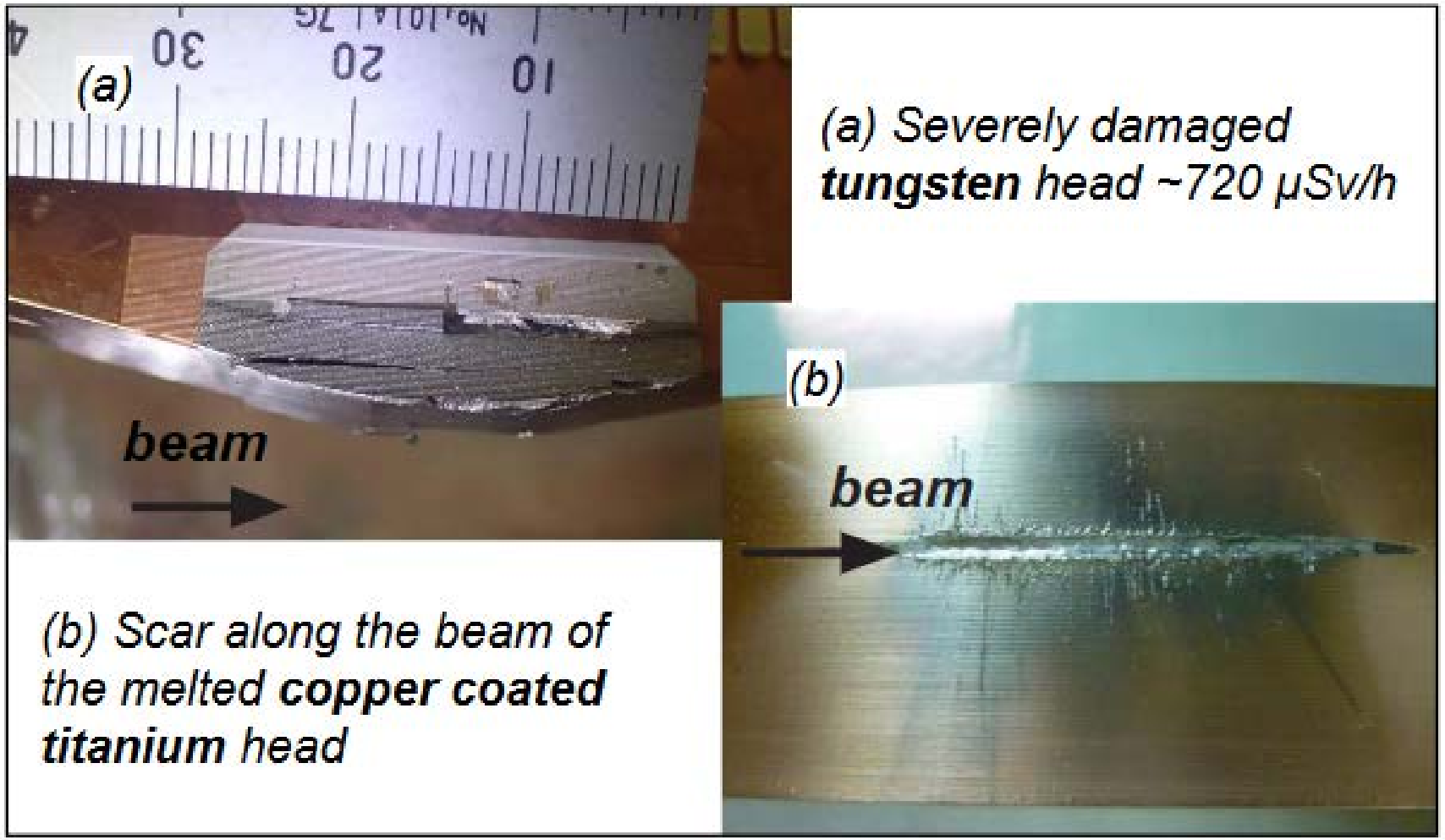
Thoughts on Si-XRM, other improvements



9-August-2022

We are now into Long Shutdown 1 (LS1)

1. **Complete original IRSX-based readout of SLAC Si sensor**

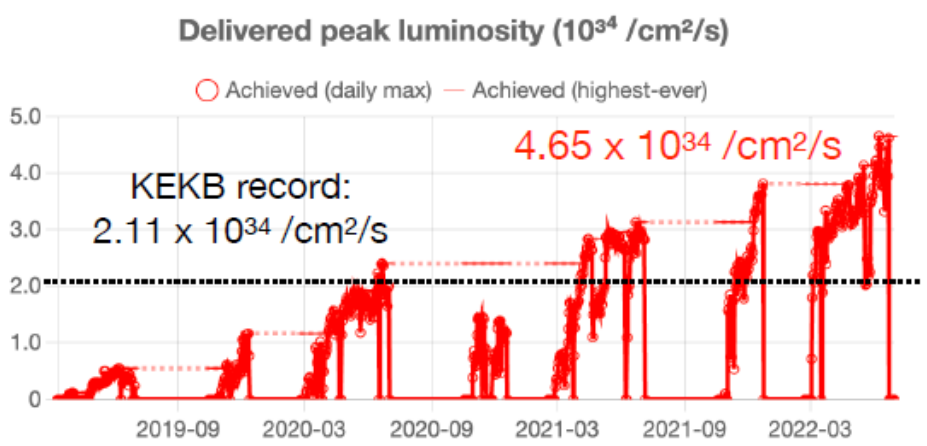
2. **Look for ways to improve performance/functionality**

3. **Initial idea floated has been to look at possibility of measuring head-tail motion**

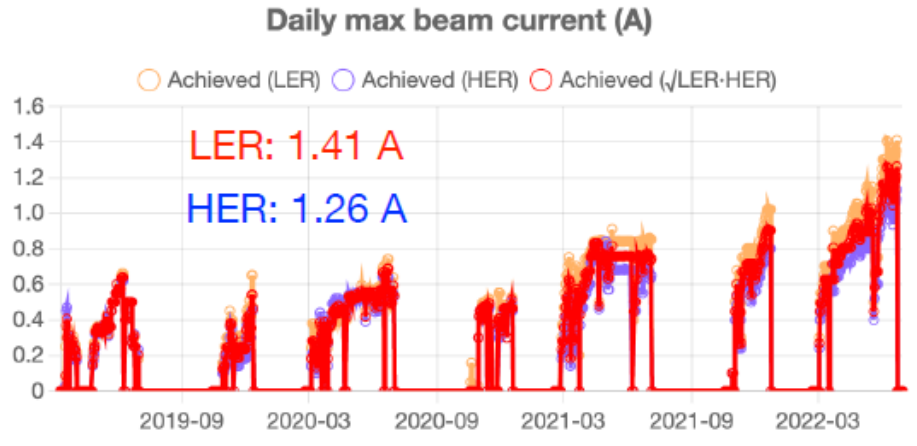
4. **What would this require?**

5. **Are there other diagnostics we could provide that might address serious SuperKEKB issues ? (e.g. leverage LCLS development)**

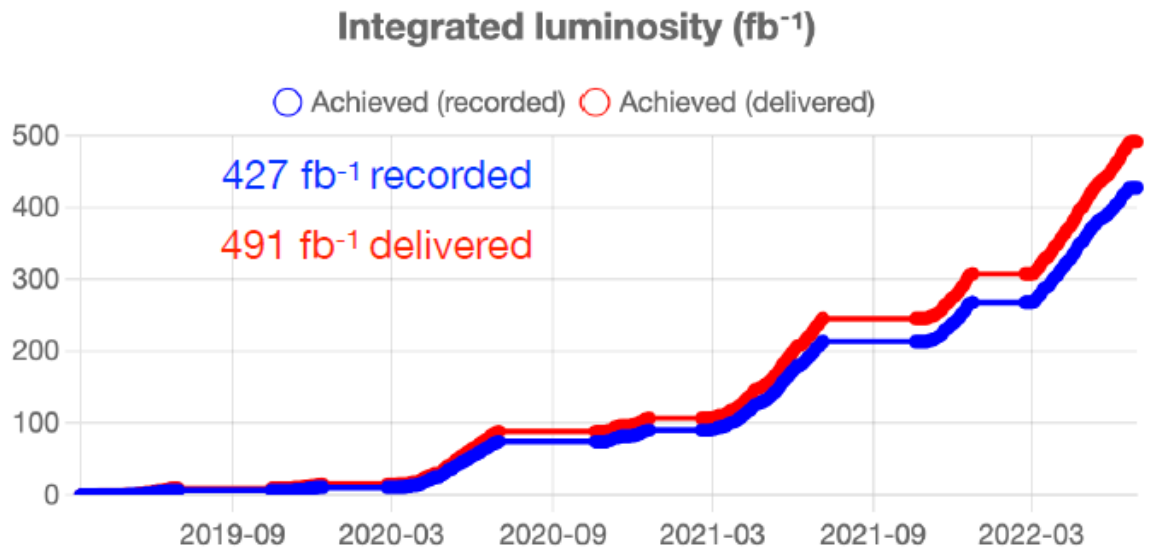
Phase 3 Operation Summary



Delivered peak luminosity during physics runs

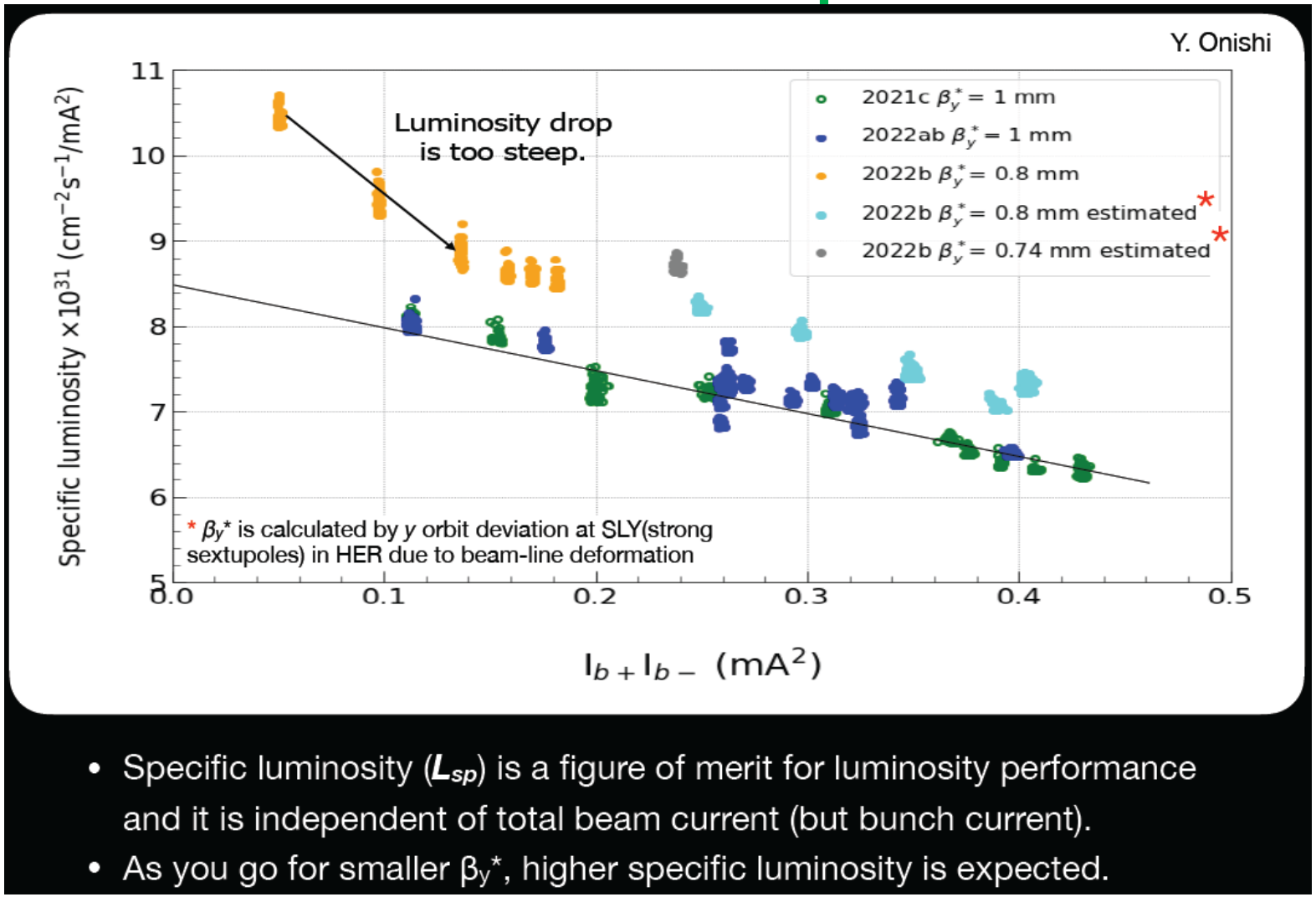


[beam current] = $\sqrt{I_{\mathrm{LER}}\, I_{\mathrm{HER}}}$, I_{LER}, or I_{HER} when the HV permission is given.



[Delivered $\int\mathcal{L}$(plan)] = Σ [Daily delivered $\int\mathcal{L}$(plan)]

Beam-beam effects & Specific Luminosity

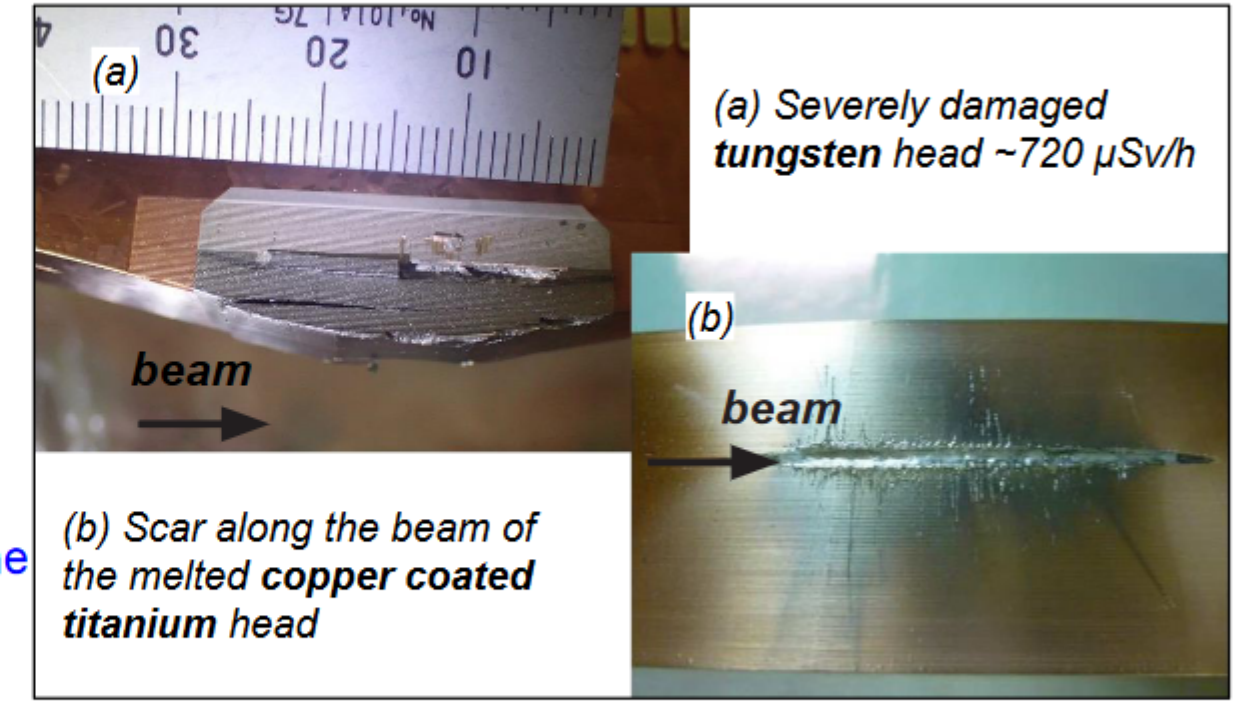


- Specific luminosity (L_{sp}) is a figure of merit for luminosity performance and it is independent of total beam current (but bunch current).
- As you go for smaller β_y^*, higher specific luminosity is expected.

1. **What is the component due to orbit excitation?**
2. **Head-tail?**

Uncontrolled beam losses

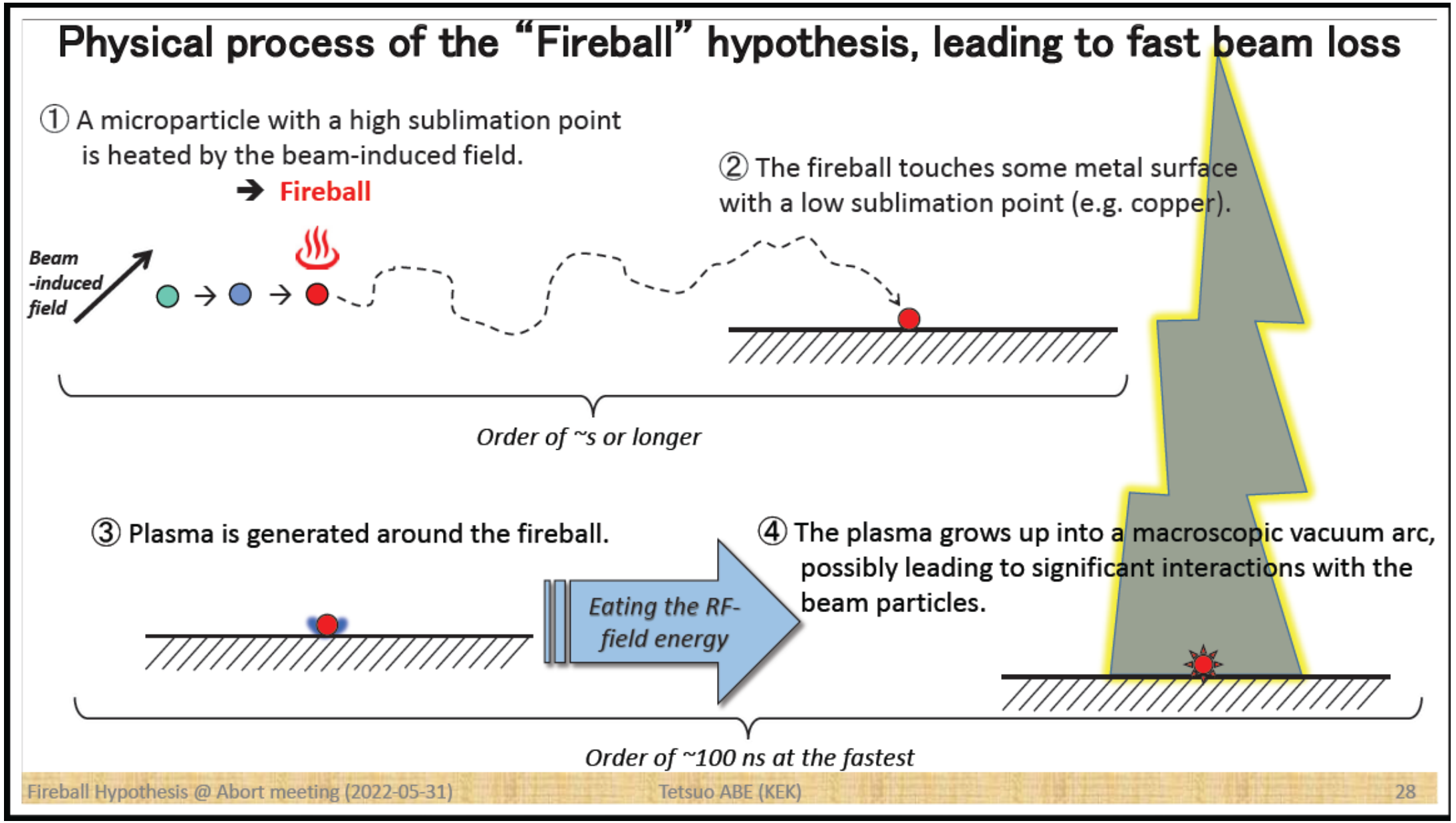
- During stable machine operation unexplained beam instabilities and beam losses may occasionally occur in one of the rings causing **fast beam losses** at a specific location around the ring due to
  - Injection kicker errors
  - Beam-dust interaction
  - Vacuum element defects
- **Consequences**
  - Detector and/or collimators damage
  - Superconducting magnet quenches
  - Belle II background increase
- Usually only a few such catastrophic beam loss events happen per year
  - In 2022, we had many of these events in the LER trying to go beyond 0.7 mA/bunch
- **Cures**
  - Upgraded abort system → fast abort signal
  - Low-*Z* materials for collimator heads (MoGr, Ta+Gr)
  - Understand the source of the unstable beam (vacuum system inspection, beam dynamics study)



*(a) Severely damaged **tungsten** head ~720 μSv/h*

*(b) Scar along the beam of the melted **copper coated titanium** head*

Fireball hypothesis



Discussion Items

- **Existing Si-XRM completion, calibration @ KEK, installation and commissioning schedule?**
- **What to propose this year? (due ~Christmas)**
- **RFSoC development at SLAC ?**
- **New sensors?**
- **New ideas?**

Backup Slides