

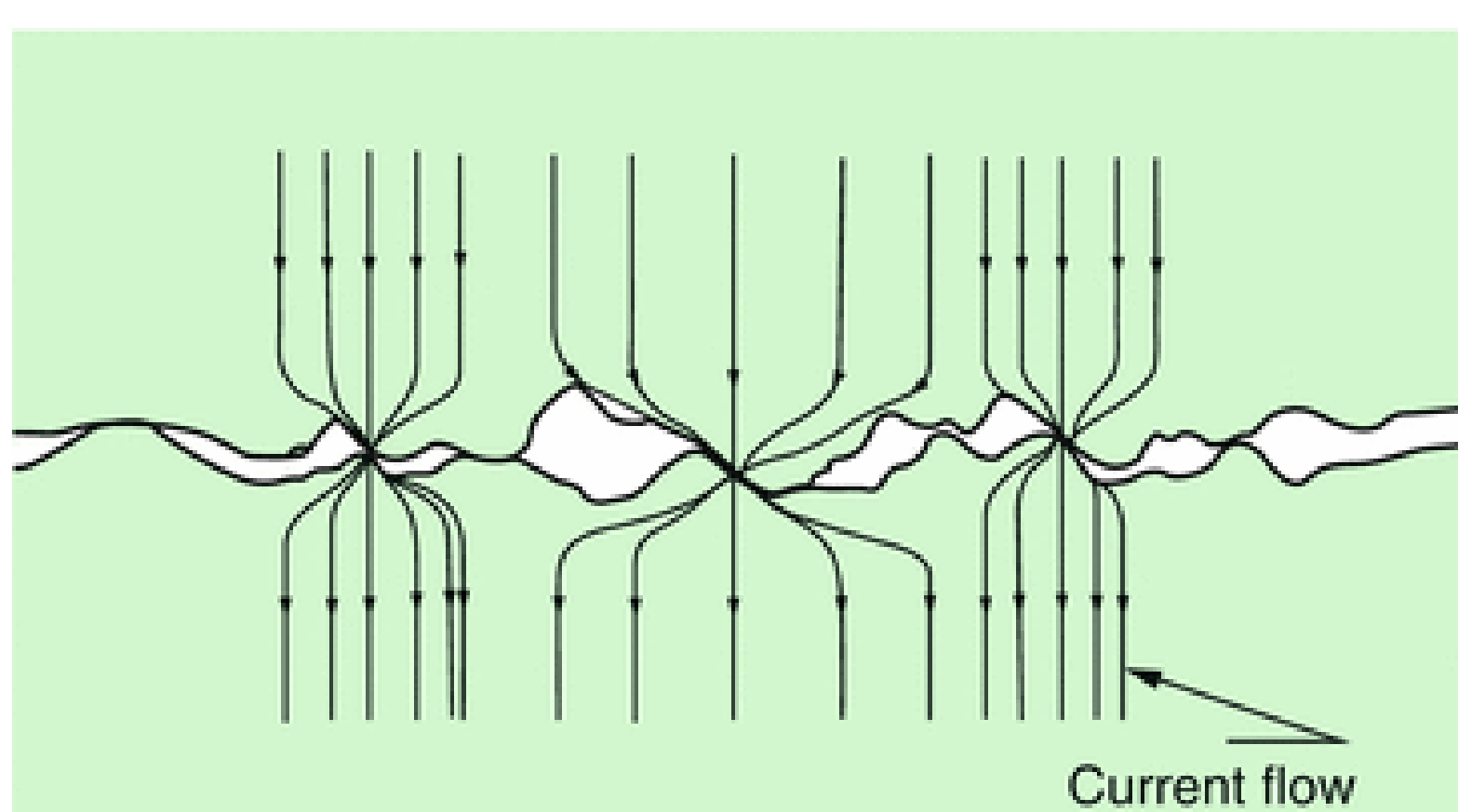
High power electrical contacts for Kicker magnets applications

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Motivation: Kicker magnets are fast pulsed systems which require high voltage and high current (up to 400 kA) in magnets, pulse generators and transmission lines. Contact erosion leading to fatal failure have occasionally been observed at CERN, in several kicker systems, and we propose to start systematic investigations into this.

Introduction

- Good understanding of the electrical contact systems is essential to avoid erosion and failures of systems.
 - Especially:
 - Nature of contact surfaces;
 - Cause and prediction of contact resistance (bulk, film and constriction resistance);
 - Effect of thin surface films;
 - Various thermal and arc phenomena
 - Surface corrosion.
- all these phenomena influence performance and lifetime of contact systems.



Timsit, R.S. (2013). Electrical Contacts: Scientific Fundamentals. In: Wang, Q.J., Chung, Y.W. (eds) Encyclopedia of Tribology. Springer, Boston, MA. https://doi.org/10.1007/978-0-387-92897-5_429



Where to start?

- Inventory of problem-free and malfunctioning electrical contact systems
- Define parameters and criteria of these systems:
 - Type of electrical contact (elastic or rigid)
 - Contact materials, surface roughness, topography, coating,
 - Contact pressures
 - Current density
 - di/dt
 - Duration of current flow ($\int i^2 dt$)

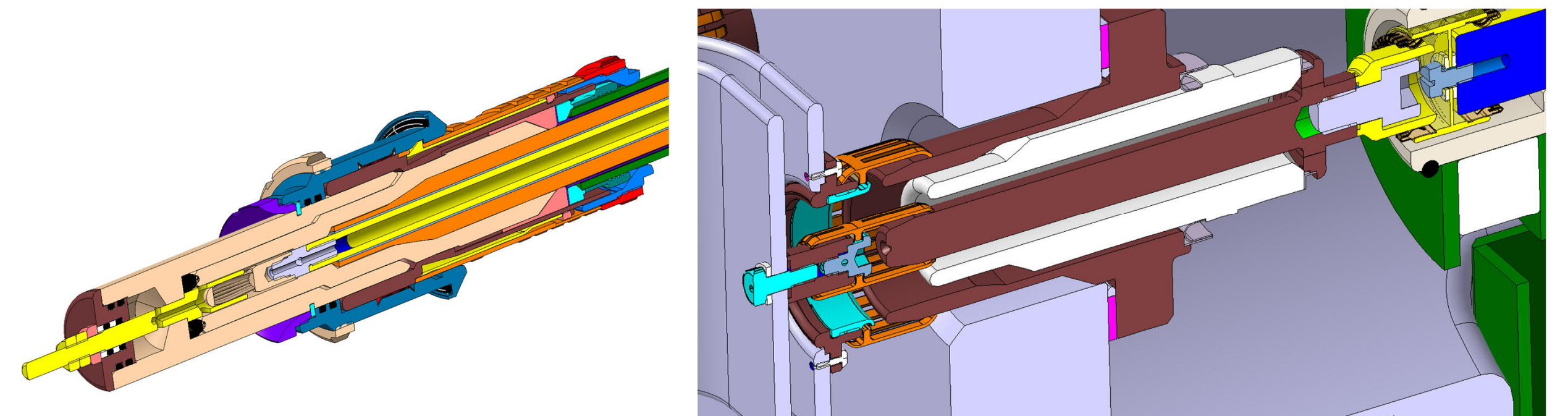
Test bench to be designed

- HV testing of different configurations
- Need to accelerate testing to see results?
 - Increase pulse frequency
 - Increase temperature
 - Increase current density

What to investigate?

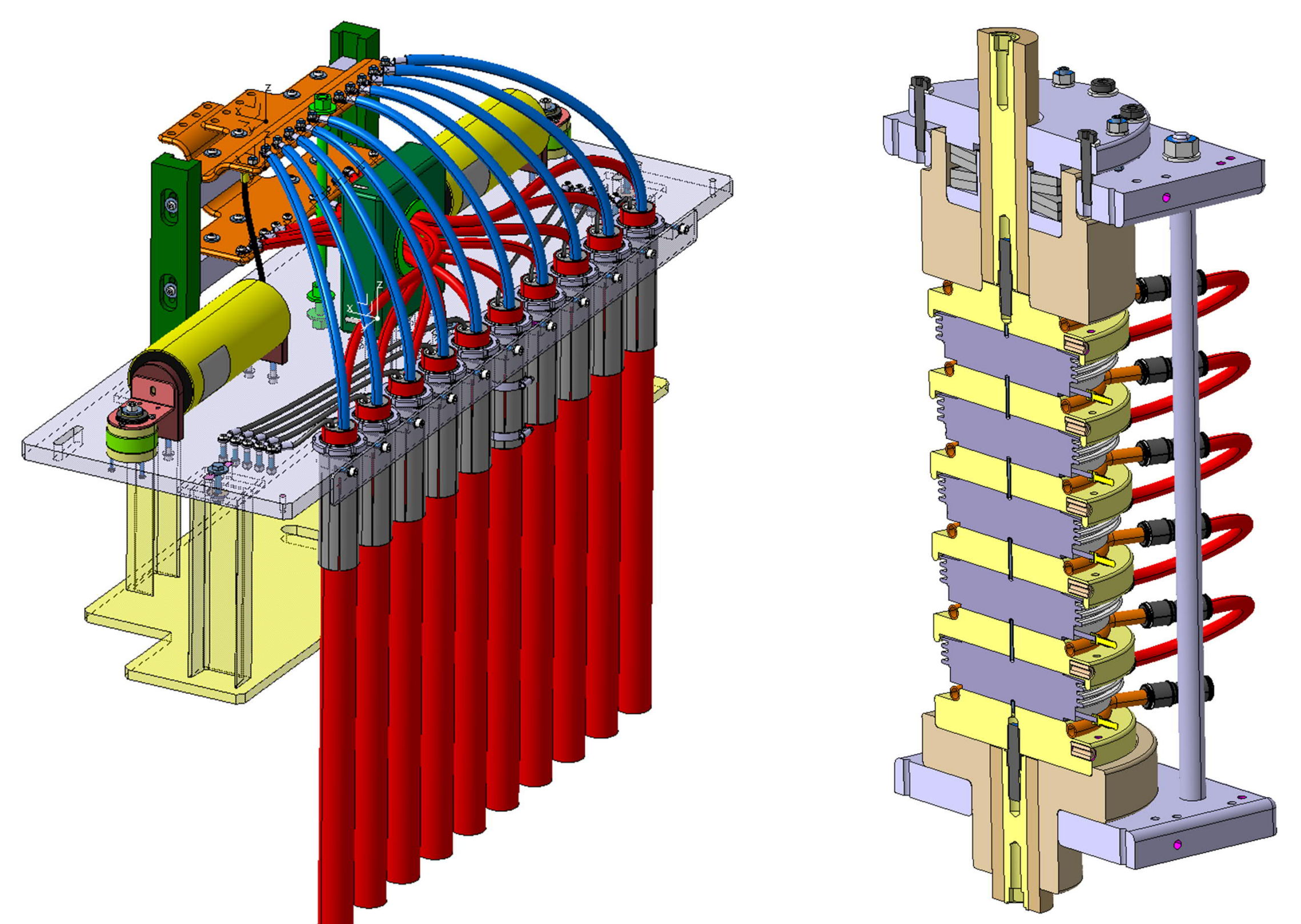
Two main categories of electrical contacts in Fast Pulsed systems:

1. Elastic contacts (Cable connectors, Feedthroughs):
Multicontacts assemblies, Clamp, banana plugs



- Different type of multicontacts – flat body in contact with multicontacts, surface pressure effect relative to the required current pulse
- Effect of eccentricity or misalignment by means of over and under sizing contact areas of round elastic contacts - example of large diameter multicontact

- 2. Rigid screwed contacts (busbars, stacks)



- Most conductive materials - determine limits of surface topography, surface pressure, rigidity of two bodies relative to the required current pulse
- Coating of conductive materials - determine limits of surface topography, surface pressure, rigidity of two bodies

- ⇒ Launch a campaign to identify optimal conditions and limits of material, coating, contact pressure for specific current density in correlation with lifetime as well
- ⇒ Investigate surface roughness and optimal surface topography for flat contacts
- ⇒ Optimization of electrical contact designs (contacts sleeve)