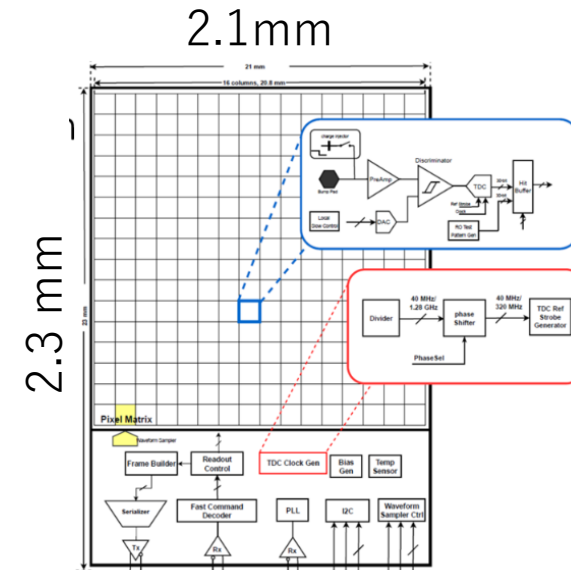
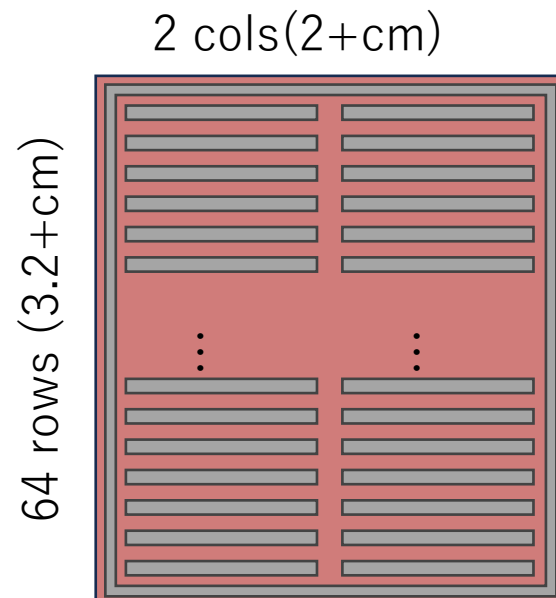
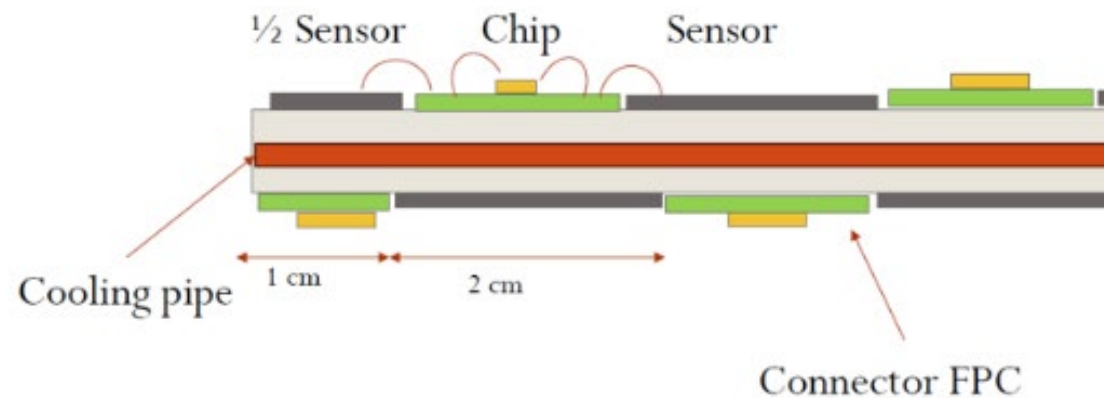


# Toward BTOF FPC design

Takashi Hachiya  
Nara Women's University

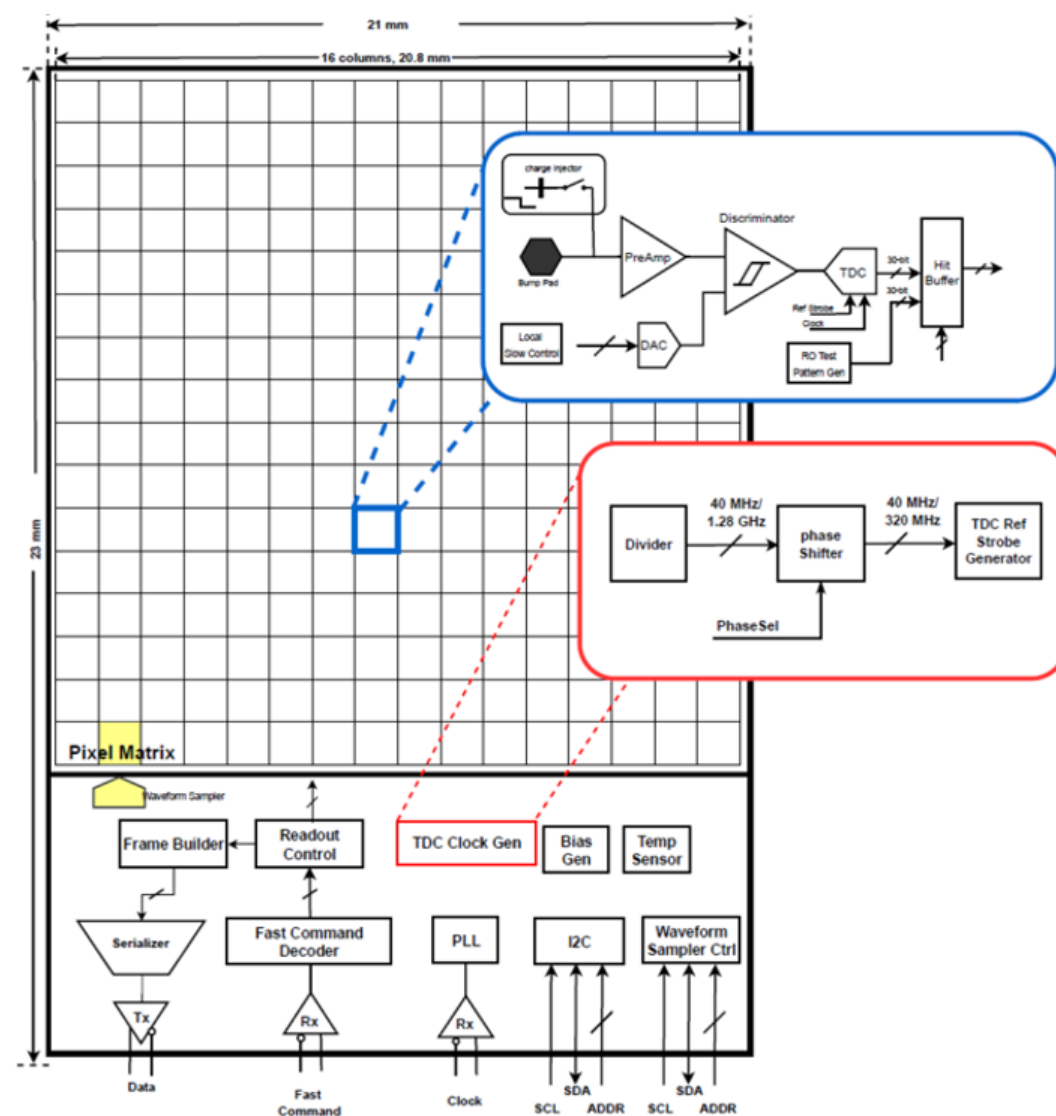
# Basic information

- BTOF Ladder structure
  - Sensor/ASIC on FPC are put at both front and back sides
    - 2 FPCs are necessary
- Sensor dimension
  - 64x2 strips as unit = 3.2 x 2 cm<sup>2</sup>
    - Strip size : 0.5mm x 1cm
- ASIC: ETROC2 as 1<sup>st</sup> candidate
  - This is for CMS-pad-LGAD)
  - Size : 21x23mm<sup>2</sup>
  - Analog inputs : 128 signals
    - Connected to 16x16 pixels on a sensor by bump bonding
- More ETROC2 info necessary for FPC design



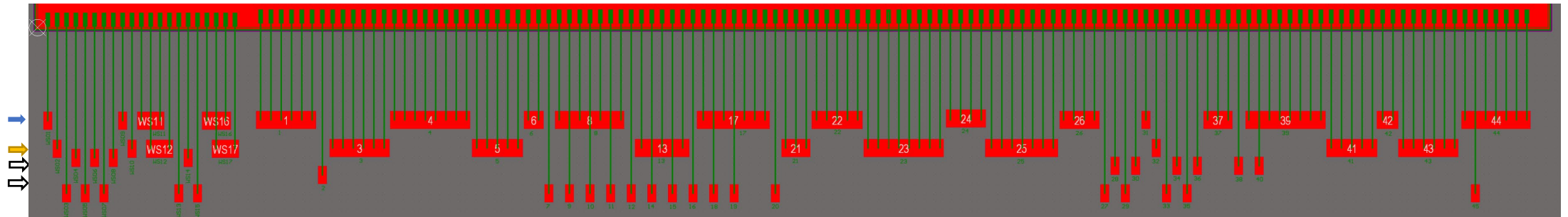
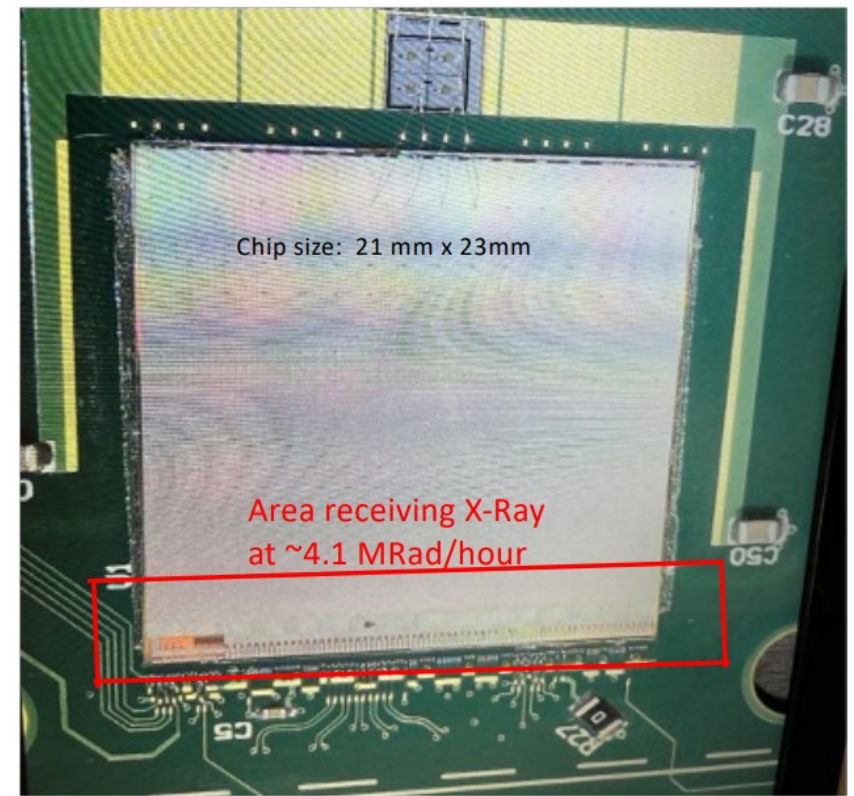
# More ETROC2 info

- Size : 21x23mm<sup>2</sup> since 2D for the pixels
  - I/O part is placed at bottom
- Npads : 124 for wire bonding
  - Digital lines: 18 lines
    - Tx: DataOut (LVDS) x 2
    - Rx: *CLK40 (LVDS)*
    - Rx: *FastCom (LVDS)*
    - Rx: **I2C (2 lines, SCK, SDA)**
    - Rx: I2C addr (5bits)
    - Rx: **RSTn (1line)**
    - Rx: CLK1280 (LVDS) : debug
  - Analog : 1 line (Vtemp)
  - Power/GND/others : 105 lines
  - No connection of waveform sampling part assumed
- Questions : which input lines can be connected in parallel ?
  - I2C and RSTn should be
  - CLK40 and FastCom ?



# ETROC2 test board by CMS

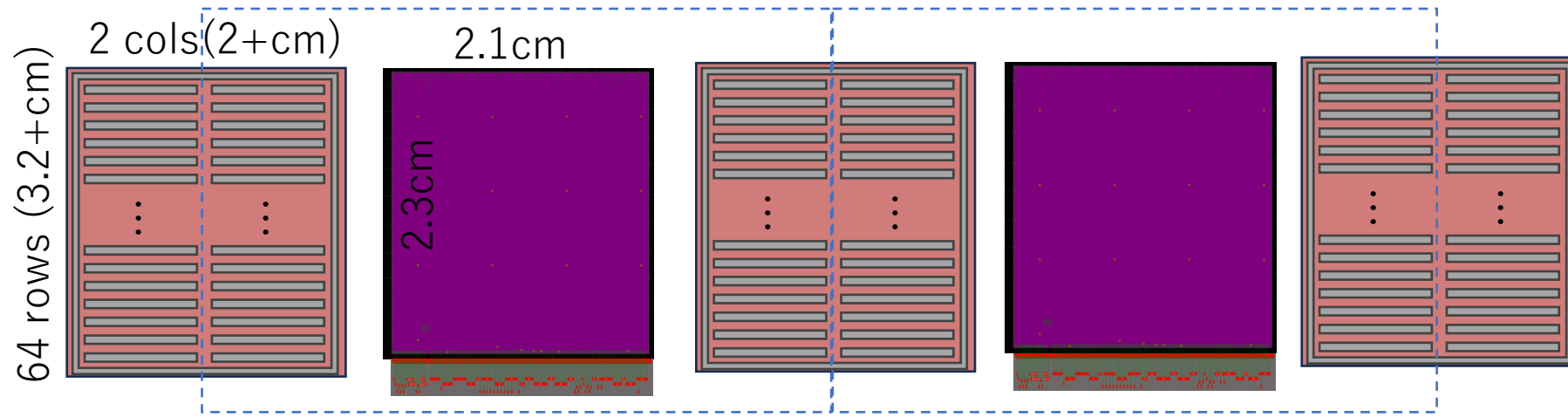
- The Photo and PCB design for the wire bonding are useful for us



- ➡ One row of 17 PCB pads are ground
- ➡ One row of 13 PCB pads are power supplies
- ⇕ Two rows of 31 PCB pads are signals, pin#40 is GND

Smallest PCB pad size : 5x10 mils  
Smallest PCB pad pitch : 10.236 mils (0.26 mm)  
Smallest bonding distance : 1.4 mm  
Longest bonding distance : 2.451 mm

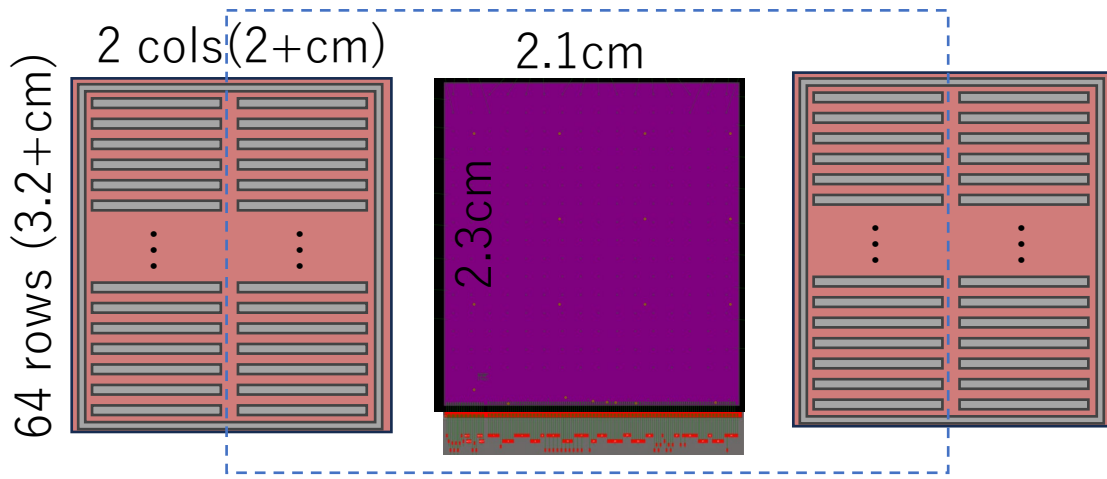
# Sensor and ASIC Layout as example



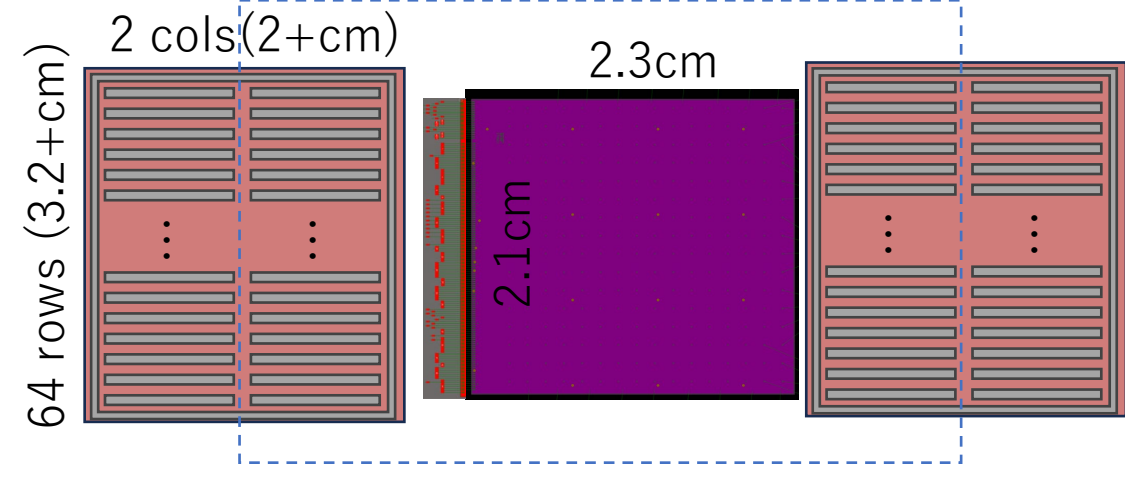
- Sensor & ASIC(ETROC2) are almost same size
  - Need to redesign ETROC2 (at least floor plan of the component for 1D)
    - What layout is good for us?
- Half ch of a sensor and half ch of a ASIC are connected
  - All sensors and ASIC are tied together (daisy chain)
  - Not so easy to build a ladder
    - Possible module structure by combining some Sensor and ASIC
    - Half size ASIC for 64 ch instead of 128 ?

# ASIC Layout as example

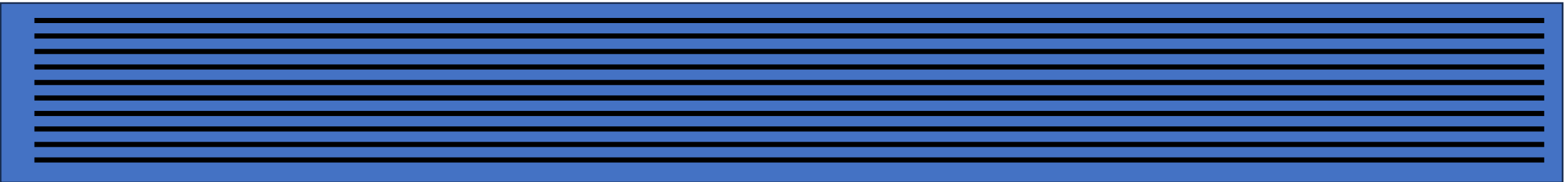
ASIC vertical placement



ASIC horizontal placement

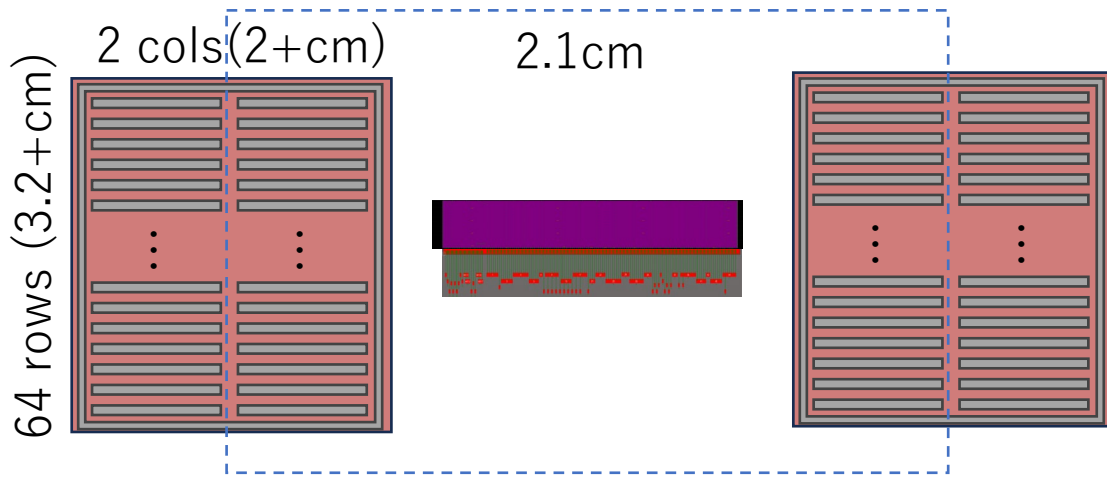


- Signal lines are placed horizontally in FPC
  - Which placement are appropriate for us?

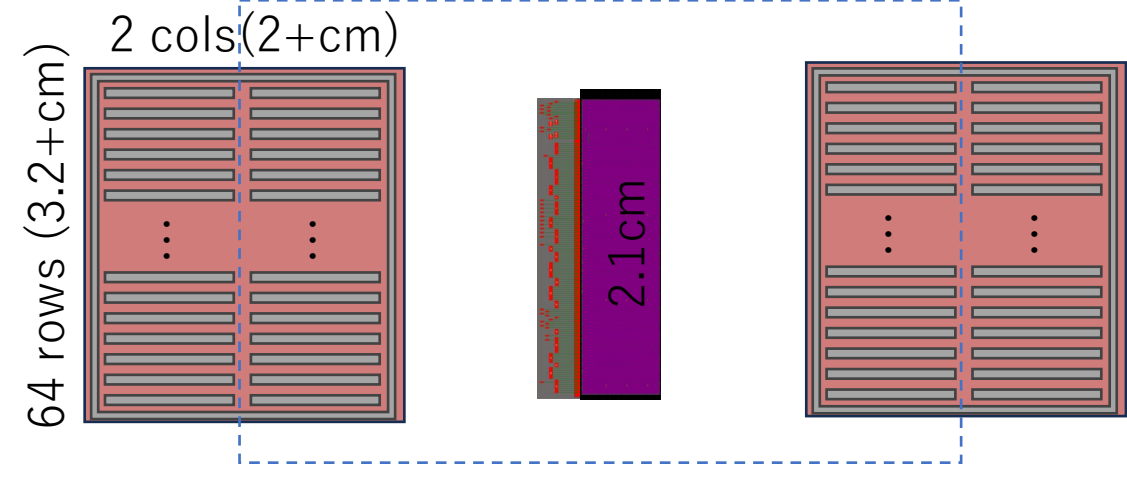


# ASIC Layout as example 2

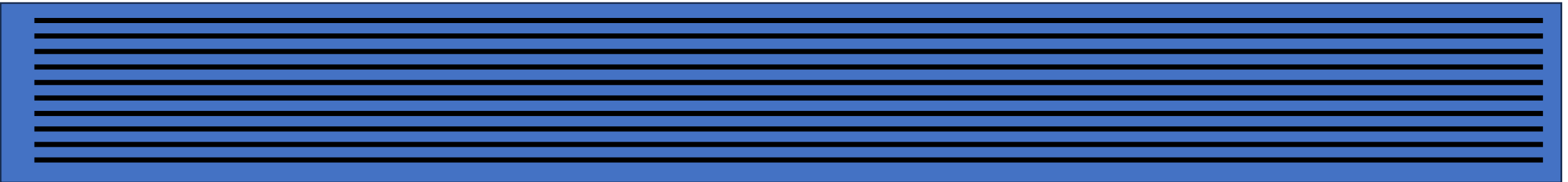
ASIC vertical placement



ASIC horizontal placement

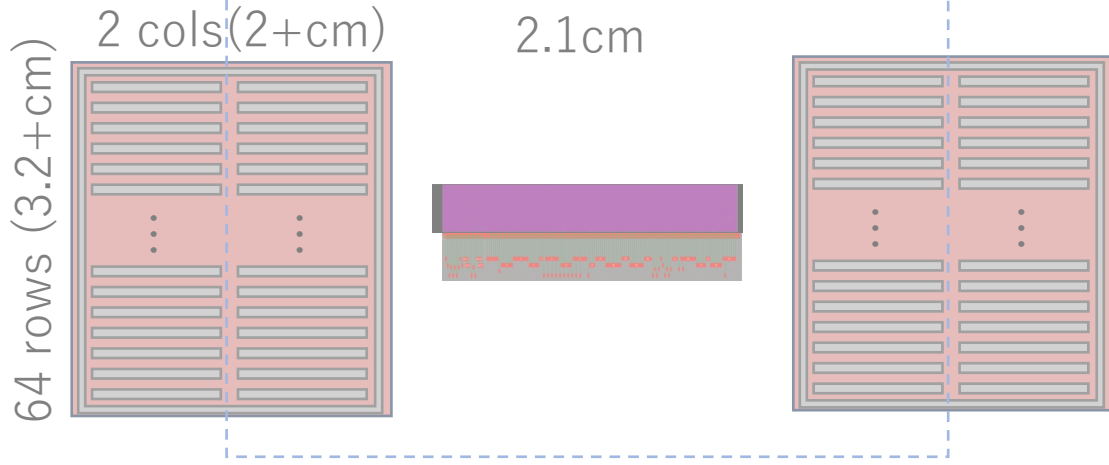


- Signal lines are placed horizontally in FPC
  - Which placement are appropriate for us?
- ASIC size might get shorter

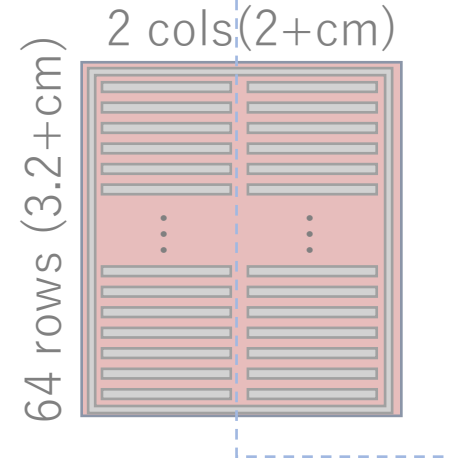


# ASIC Layout as example 3

ASIC vertical placement



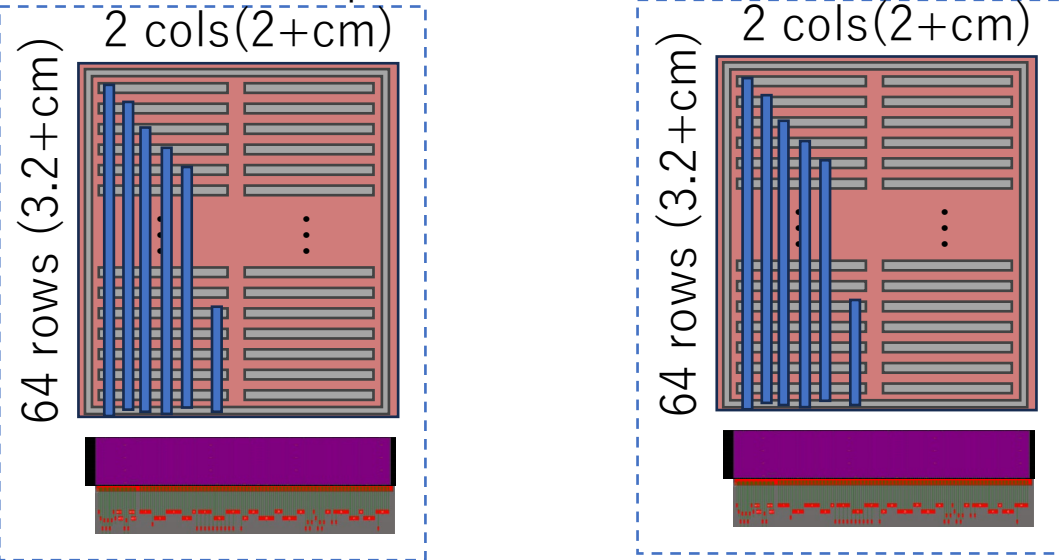
ASIC horizontal placement



N shaped electrodes by double metal on INTT sensor



ASIC bottom placement



- Bottom placement
  - Double metal technology
    - Standard for nominal Si (INTT used)
  - Easy to make an unit module



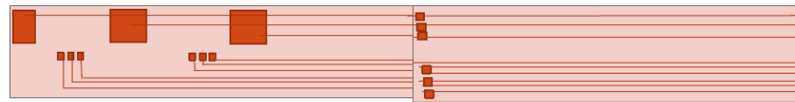
# Summary

- ETROC2 has many connections (124) including signals, power, and GND
- Questions for design
  - Which lines are in parallel ?
  - What size (dimension) of ASIC (ETROC2) for us?
  - How does ASIC is placed?
  - Furthermore
    - How signal lines are placed in FPC ?
  - Complicated routing of the signal lines are not good for the long FPC.
  - Connecting some short FPC to make long FPC is possible option (as shown by Simone last week)

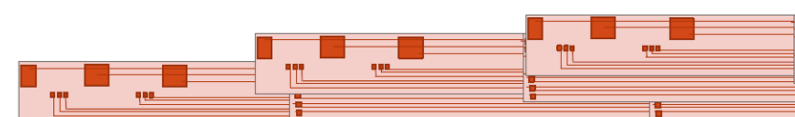
## Simone's slide last week

**FPC idea**


- FPCs are spTAB bonded to be extended so it's flush



- Flex are stacked and glued on the stave one on top of the other



- Side view



11 Dr. Simone M. Mazza - University of California Santa Cruz  
2024/11/7

