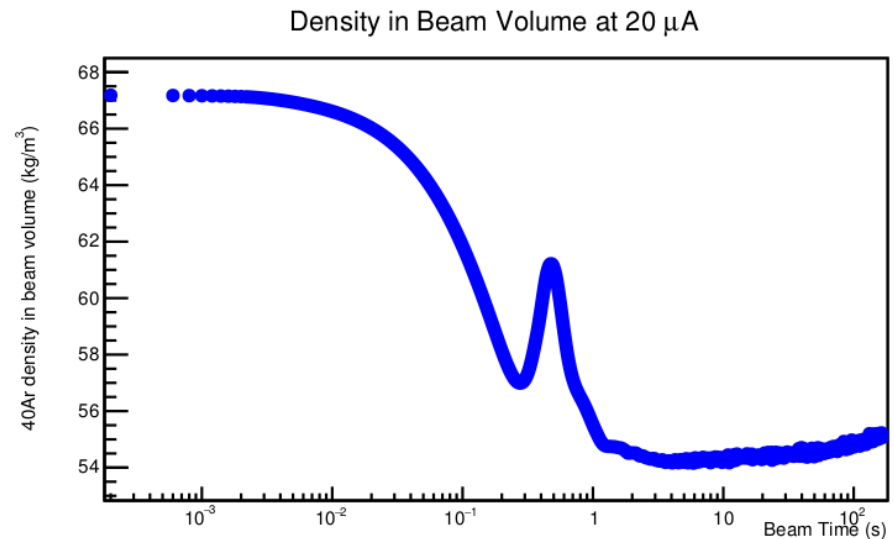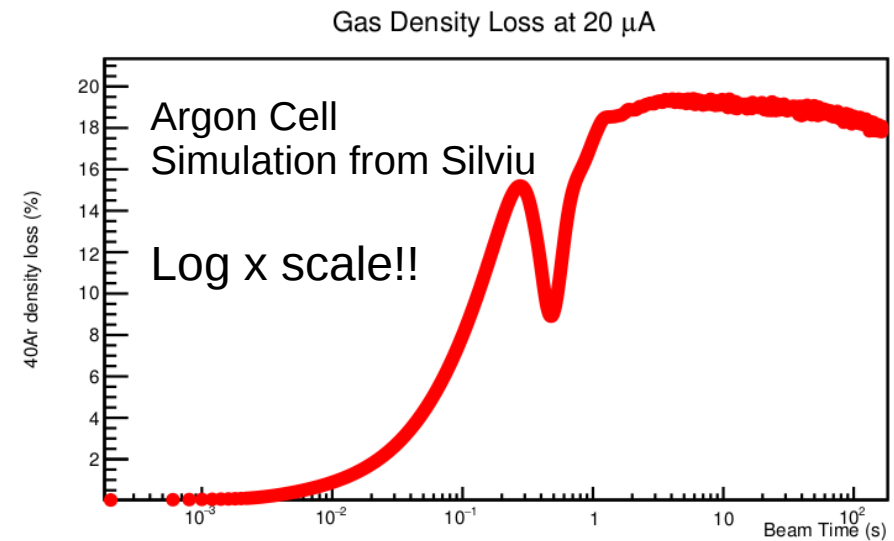# Test Gas Target Density for Time-dependence

- How long of beam it takes for the gas target to stabilize (short term),
- What is the overall trend of density change along beam on time (long term),
- And how to deal with the scaler information, and make beam trip cut

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Feb 2018

Gas Target Property

Gas Target	Thickness (mg/cm2)	Pressure (psi)
Argon	1455 (58.2kg/m3)	500
Tritium	77	203
Deuterium	142	514
Hydrogen	71	514
Helium-3	53	252

The boiling study told us the argon cell density loss is 20% at 20uA, while it is 10% for tritium cell. (see Nathaly and Sheren's work)

Argon cell takes seconds to stablize, Tritium cells are thinner and pressure are lower, will take longer

Gas Density Loss at 20 µA

Argon Cell Simulation from Silviu

Log x scale!!

Density in Beam Volume at 20 µA

2

Scaler readout

- Two scripts reading scaler counts from the same scaler:
  - Fast readout (evtree):
    - Read the scaler information every 100 events.
    - Results stored in evLeft/evRight, also Ttree
    - When the readout didn't update, the Ttree will copy the lastest information to its events
  - Slow readout (TStree):
    - Read the scaler info every ~10 secs
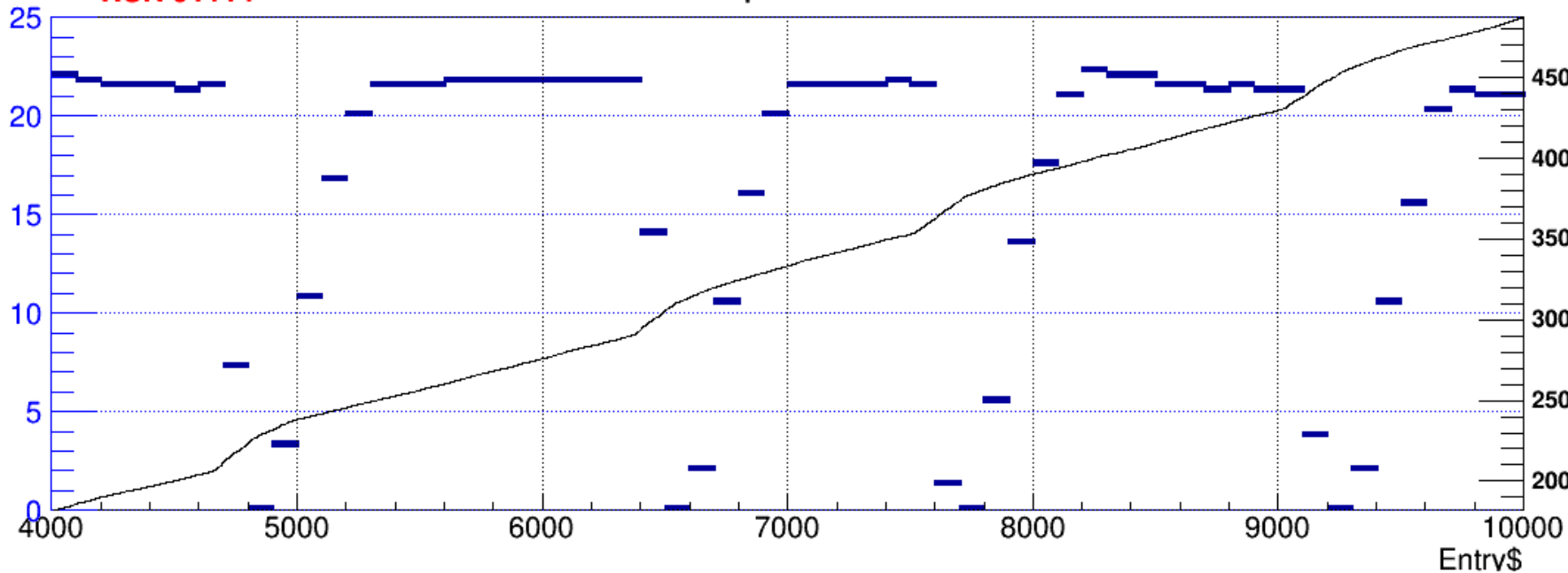   - Results in TSright/TSleft, also Ttree

Scaler rate [ii] = scaler counts [ii] - scaler counts [ii-1]

```
*****************************************************************************************
*    Row    * evRightdnew * evRightdnew_r* V1495ClockCount * evRightLclock * RightBCM.isrenewed *
*****************************************************************************************
*        0 *           0 *            0 *         775510 *            0 *            1 *
*        1 *           0 *            0 *         777803 *            0 *            0 *
*        2 *           0 *            0 *         781590 *            0 *            0 *

                        ......

*       96 *           0 *            0 *        1162229 *            0 *            0 *
*       97 *           0 *            0 *        1167873 *            0 *            0 *
*       98 *           0 *            0 *        1168488 *            0 *            0 *
*       99 *      247812 *            0 *        1169166 *       394511 *            1 *
*      100 *      247812 *            0 *        1170873 *       394511 *            0 *
*      101 *      247812 *            0 *        1176499 *       394511 *            0 *

                        ......

*      196 *      247812 *            0 *        1532212 *       394511 *            0 *
*      197 *      247812 *            0 *        1532930 *       394511 *            0 *
*      198 *      247812 *            0 *        1535152 *       394511 *            0 *
*      199 *      480477 *    65026.481 *        1540206 *       765550 *            1 *
*      200 *      480477 *    65026.481 *        1548785 *       765550 *            0 *
*      201 *      480477 *    65026.481 *        1549266 *       765550 *            0 *

                        ......
                        ......
                        ......

*    88851 *   212660871 *            0 *      407787390 *    406384879 *            0 *
*    88852 *   212660871 *            0 *      407800641 *    406384879 *            0 *
*    88853 *   212660871 *            0 *      407822477 *    406384879 *            0 *
```
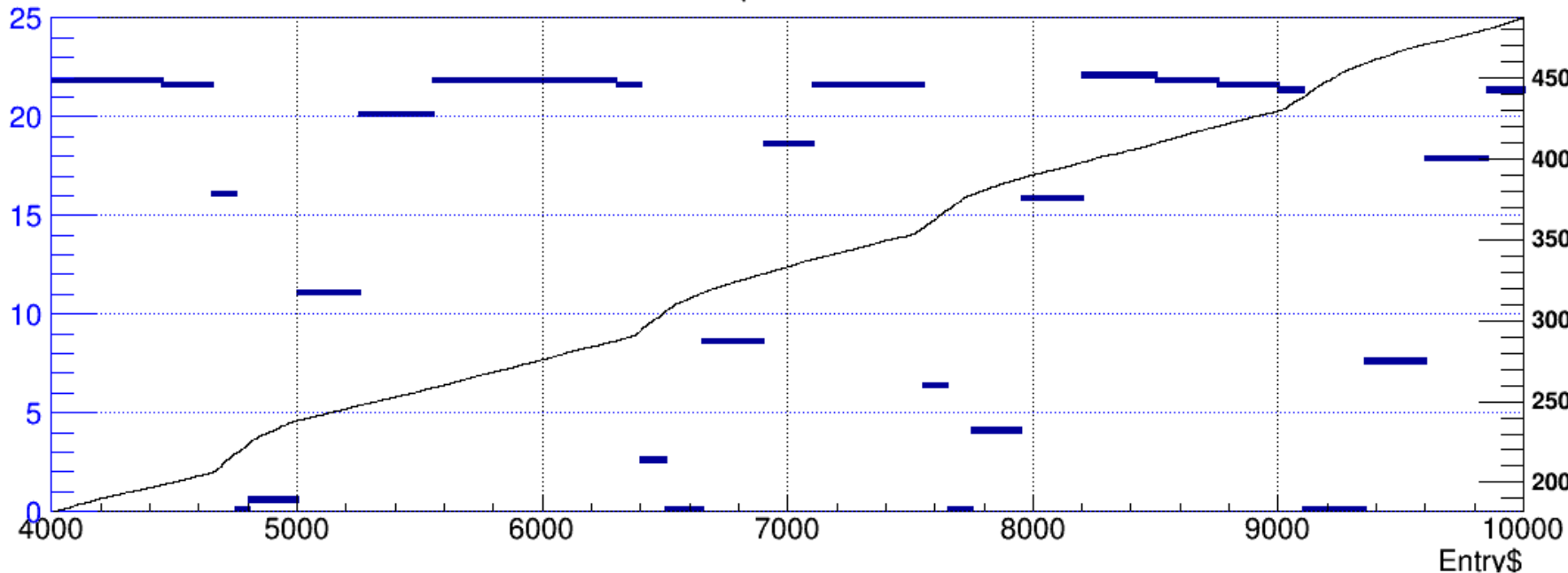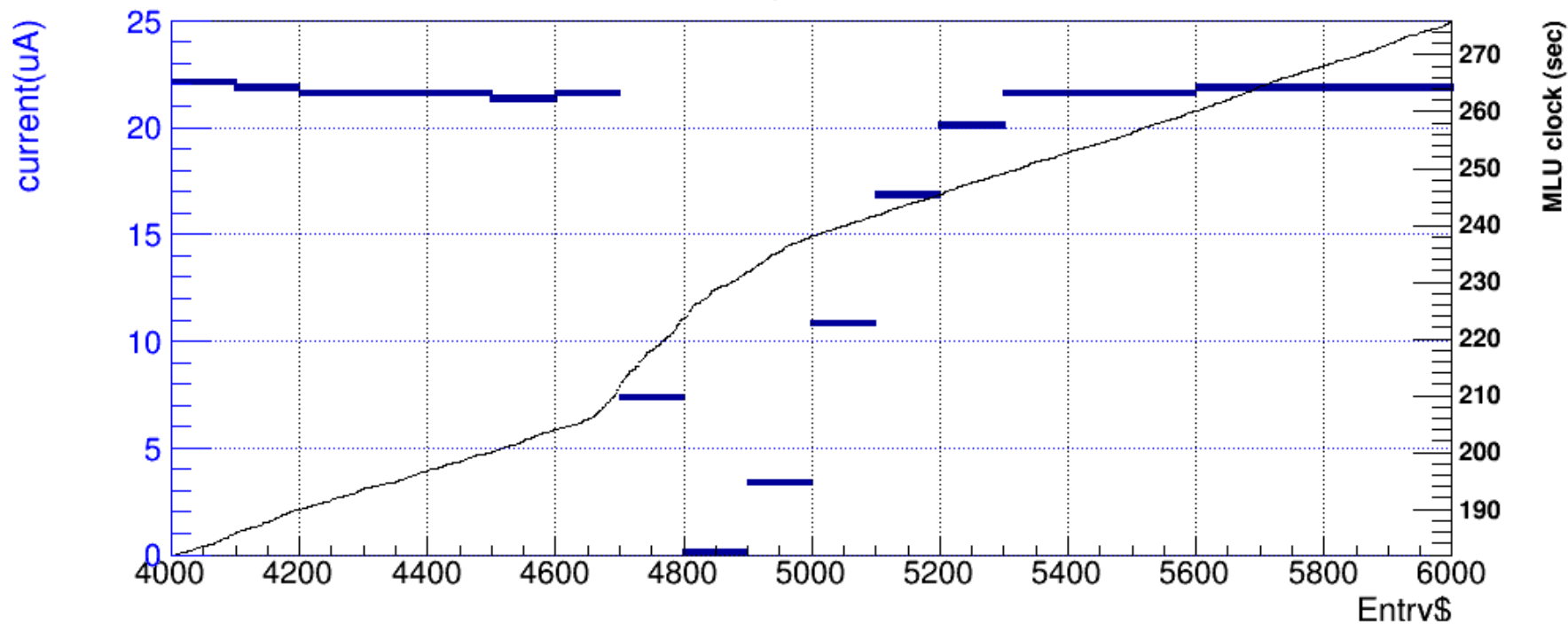
RUN 91114

beam trip from evtree

beam trip from TStree
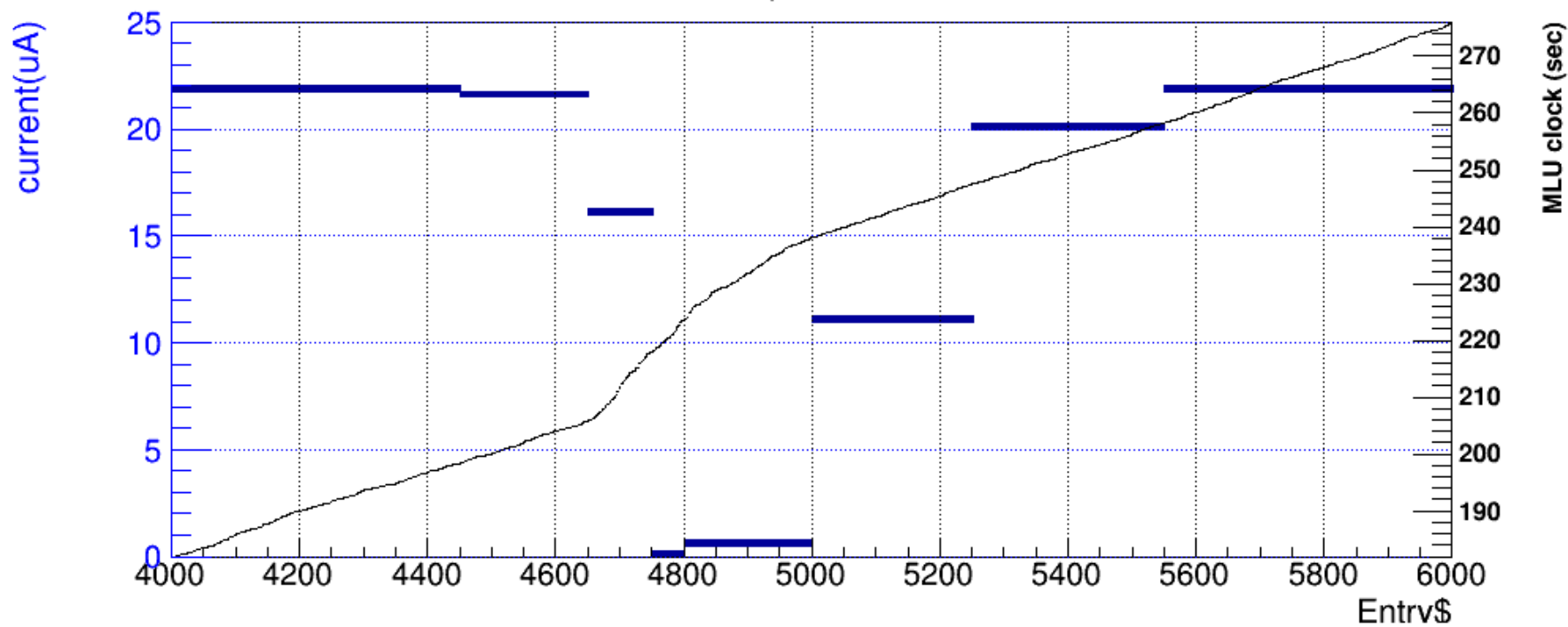
Run 91114: Beam on rate ~25 Hz, Cosmics ~ 10 Hz

```
*****************************************************
*     Row      * ev dnew_r * mlu clock * isrenewed *
*****************************************************
*      4634 * 21.661293 * 205.01886 *          0 *
              ......
*      4654 * 21.661293 * 205.98994 *          0 *     ──────►  Beam tripped
              ......
*      4665 * 21.661293 * 206.95198 *          0 *
              ......
*      4674 * 21.661293 * 207.97131 *          0 *
              ......
*      4698 * 21.661293 * 210.99236 *          0 *
*      4699 * 7.3564389 * 211.65746 *          1 *
*      4700 * 7.3564389 * 211.69176 *          0 *
*      4701 * 7.3564389 * 211.78585 *          0 *
              ......
*      4798 * 7.3564389 * 223.52168 *          0 *
*      4799 *         0 * 223.62164 *          1 *
```

Target Density v.s. Time

- Use evtree

- Record events per evtree update, normalized by the charge

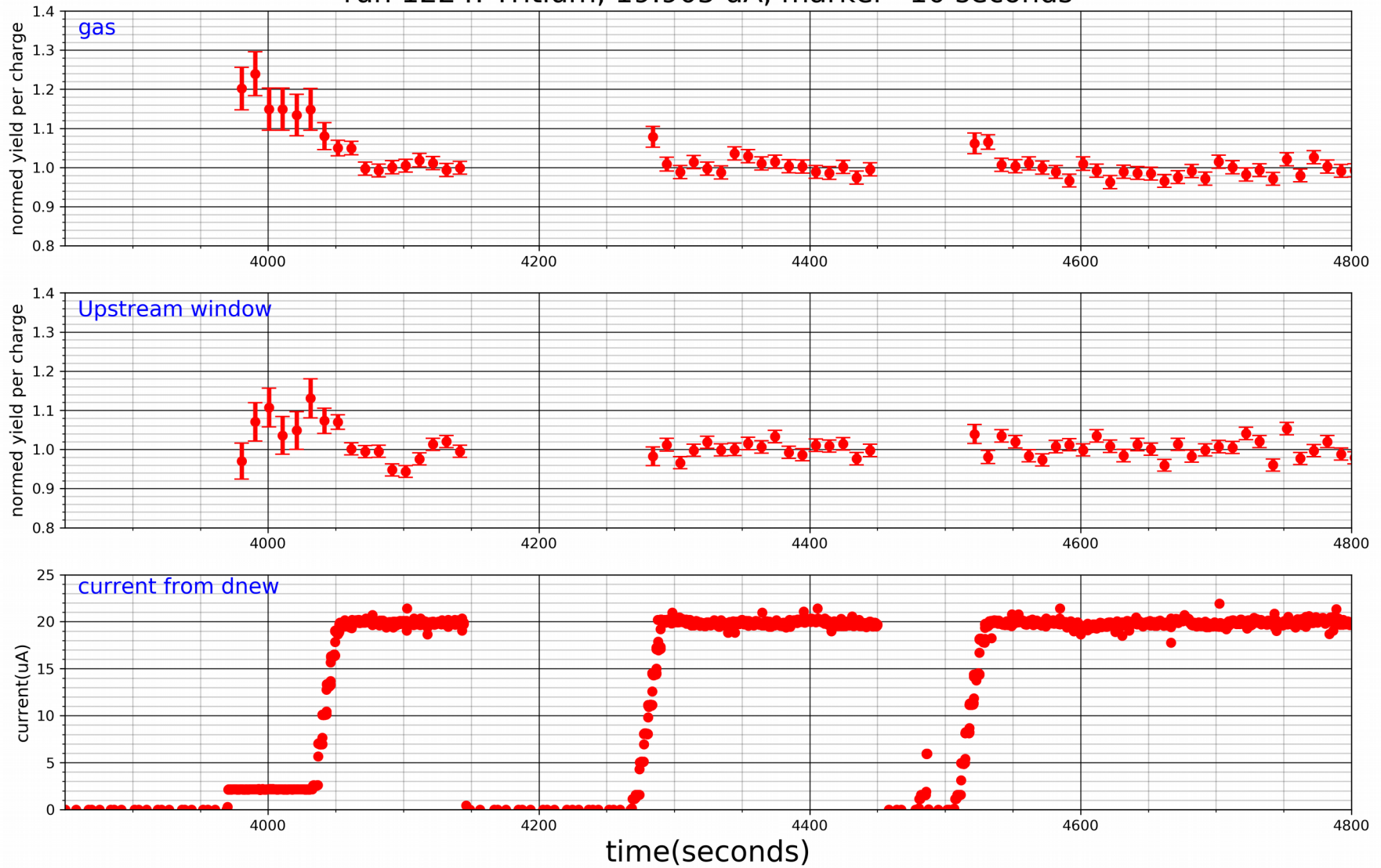- Plot its relative value (normed by its own mean) v.s. time per given time interval with stats errors

Density v.s. time

- Sanity cuts:
  - L.tr.n==1
  - abs(L.tr.vz)<0.07
  - abs(L.gold.dp)<0.05
  - abs(L.gold.th)<0.06
  - abs(L.gold.ph)<0.04
  - Trigger = (S0&&S2)
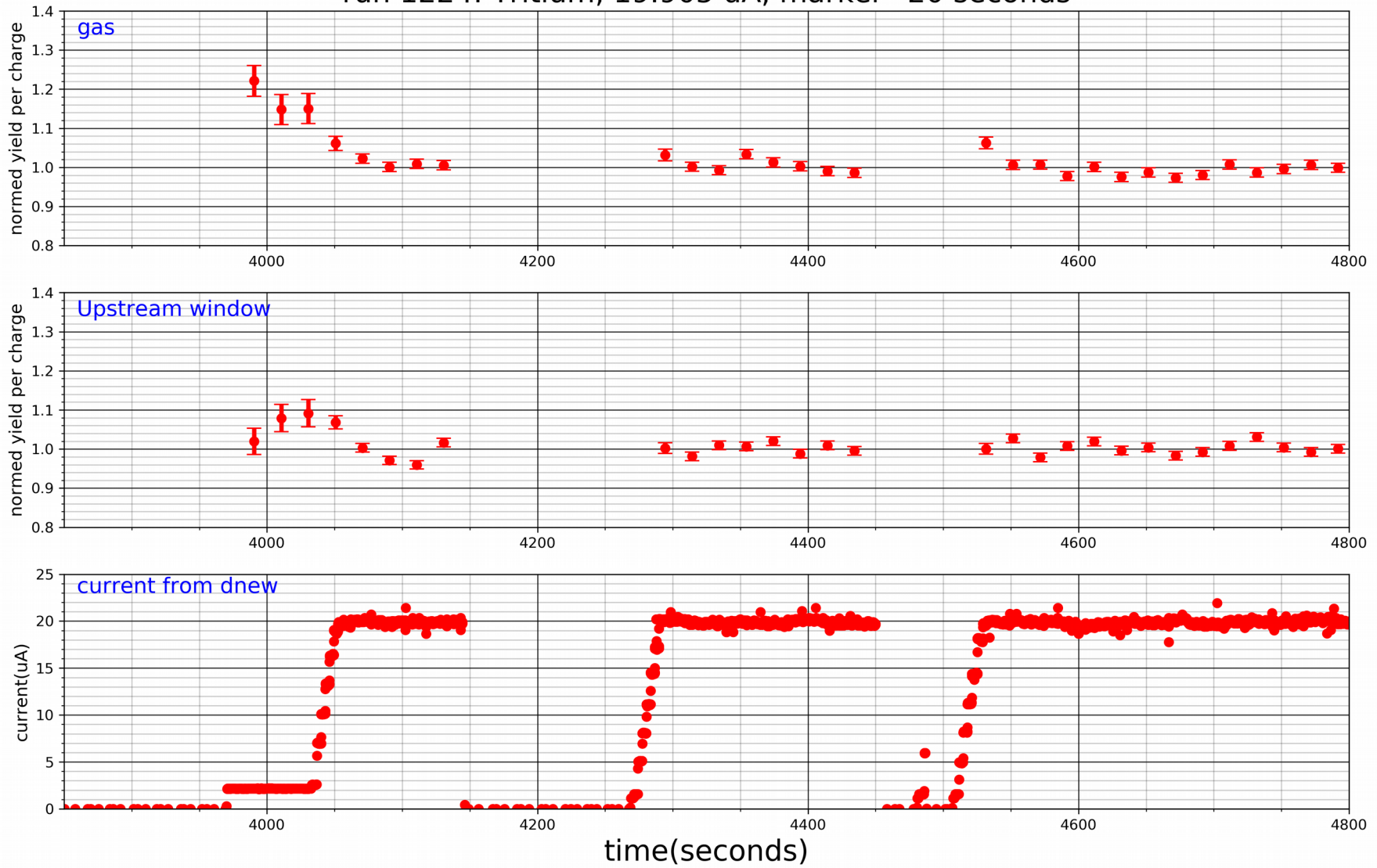   - * **included both pion and electron for better stats**

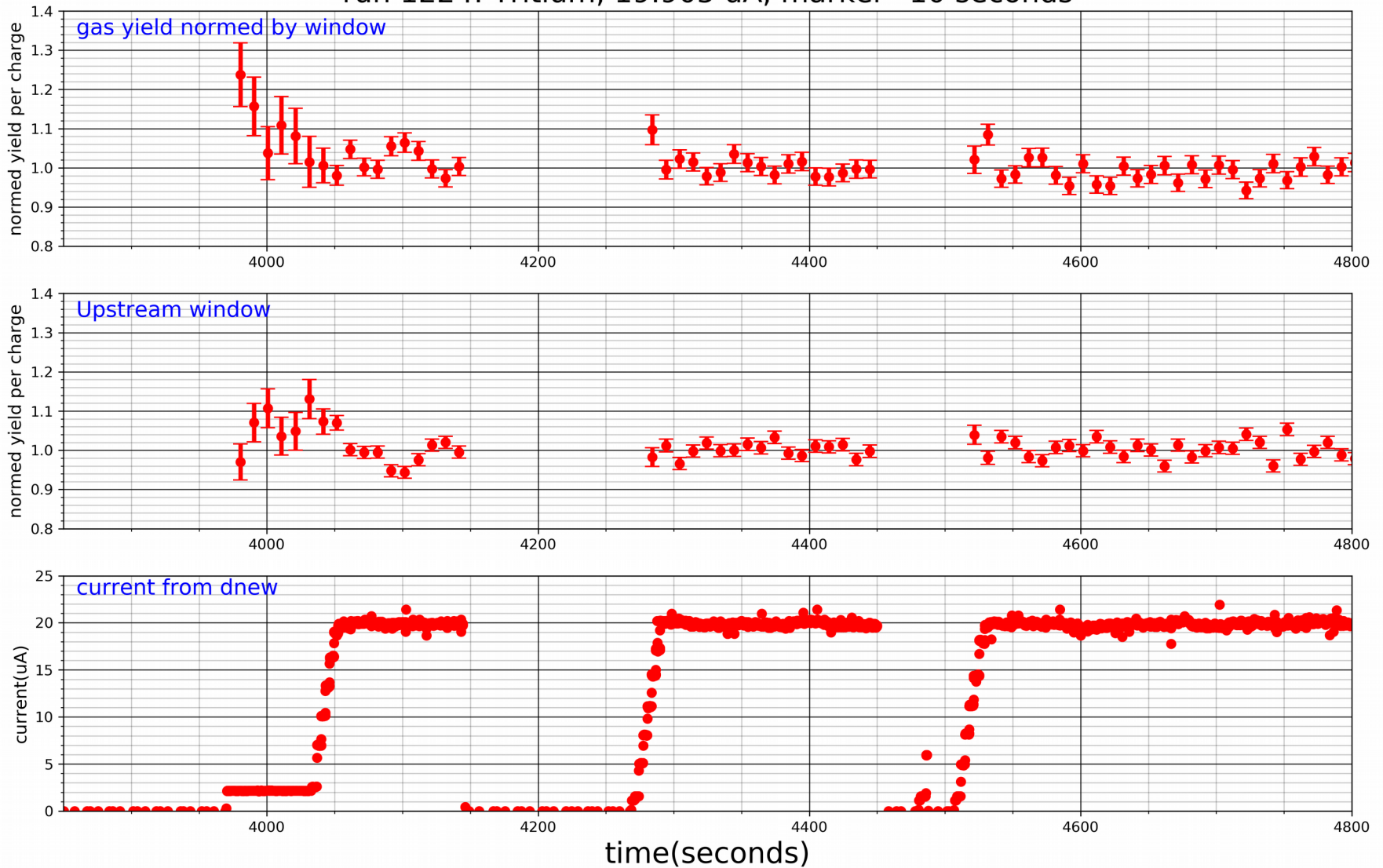run 1224: Tritium, 19.905 uA, marker=30 seconds
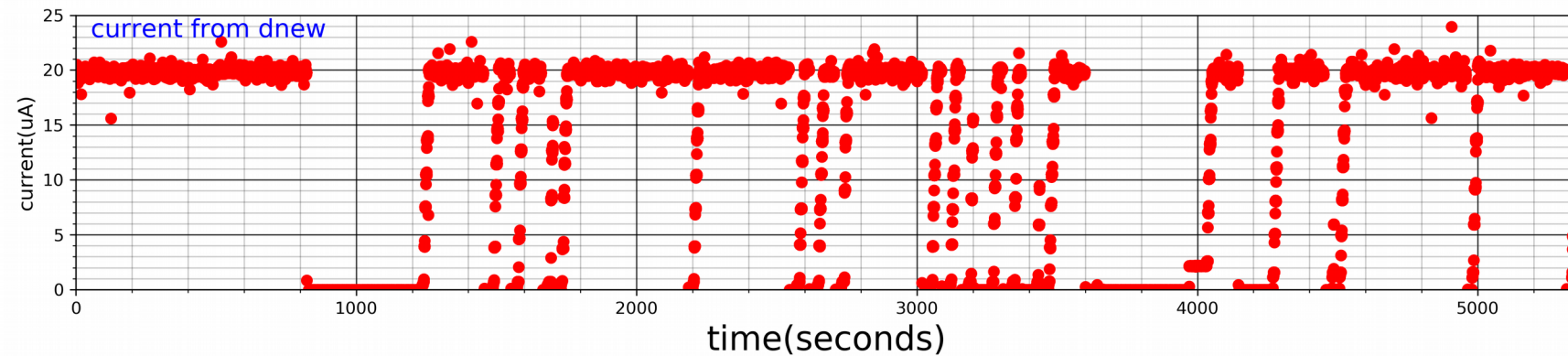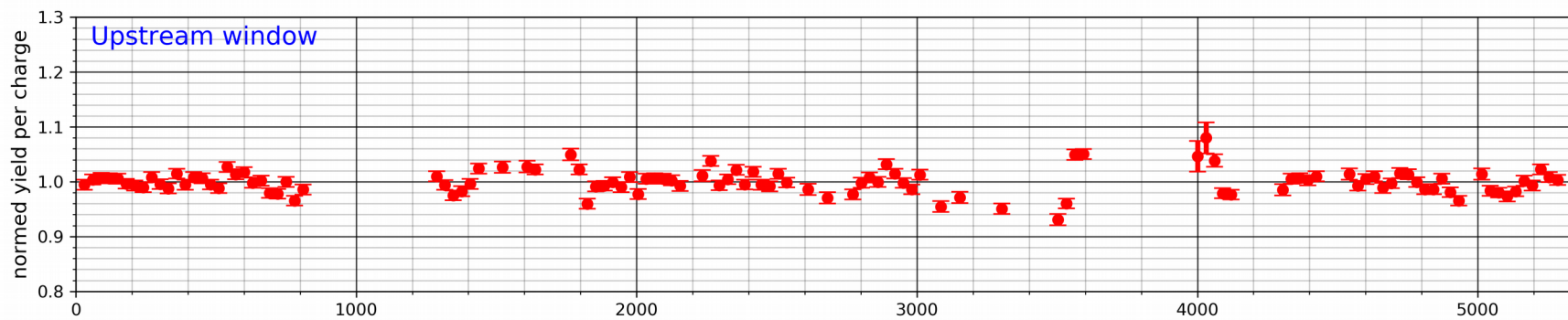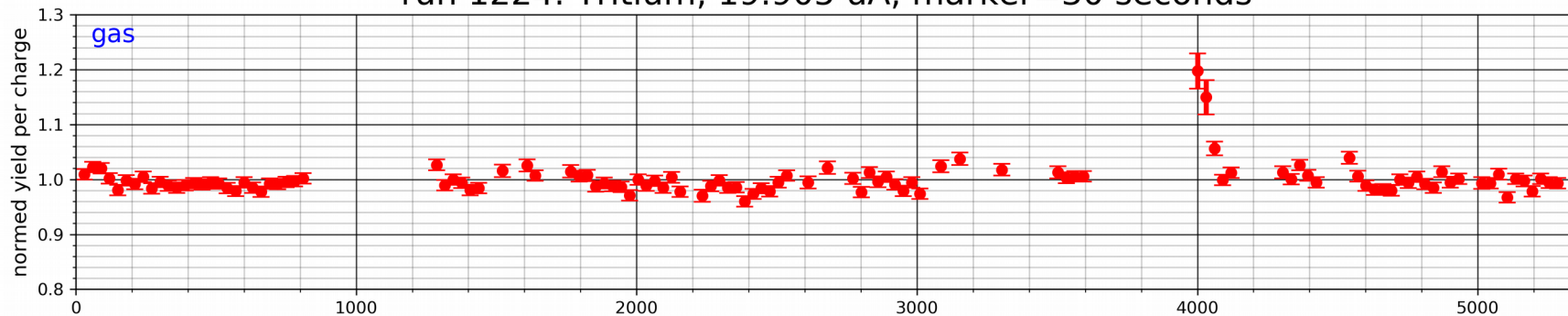
run 1224: Tritium, 19.905 uA, marker=10 seconds
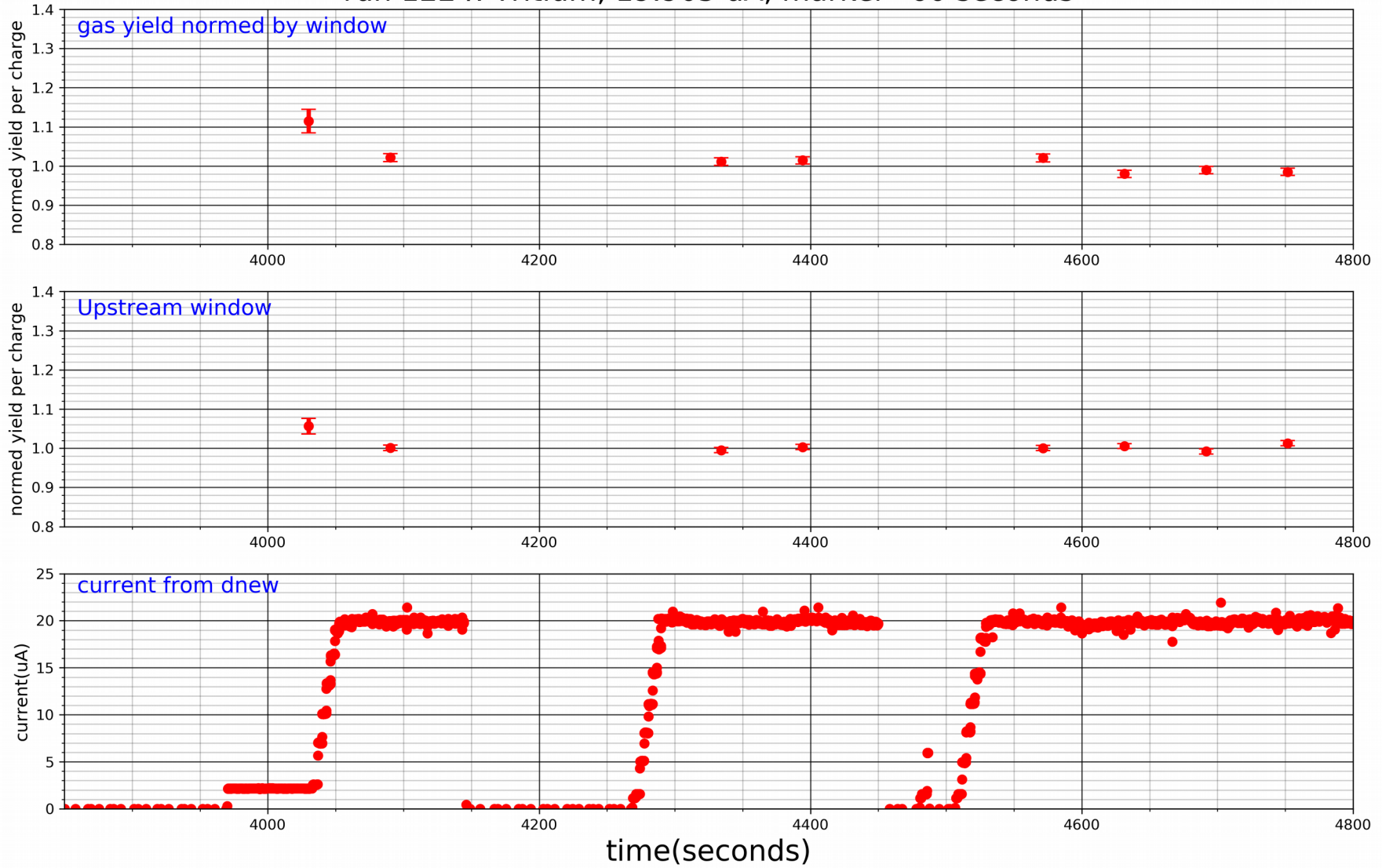
run 1224: Tritium, 19.905 uA, marker=20 seconds

run 1224: Tritium, 19.905 uA, marker=10 seconds

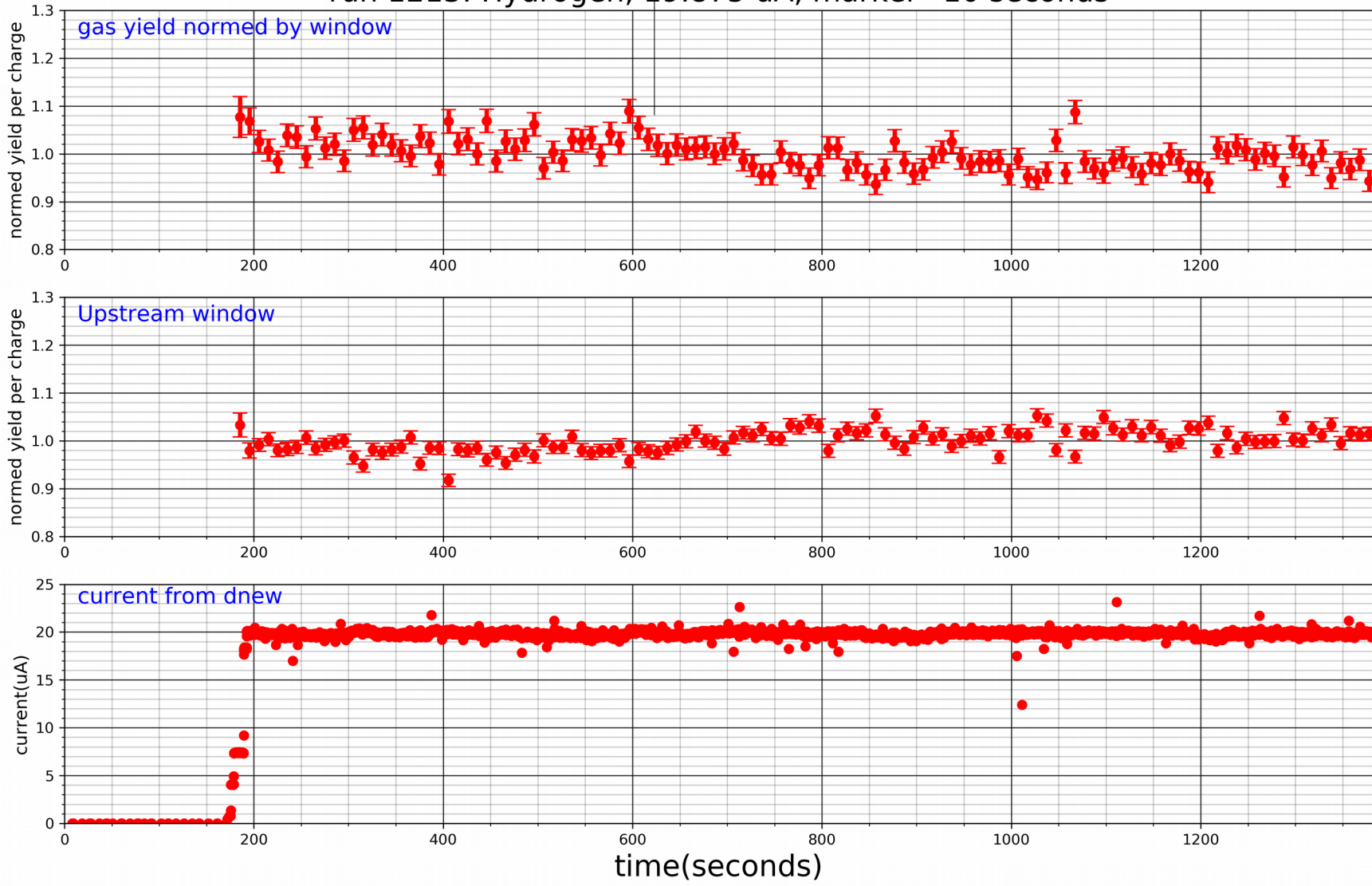Normed gas yield by window in hope to cancel deadtime (5% at 20uA) and other effect

run 1224: Tritium, 19.905 uA, marker=60 seconds

14

Beam position changed

run 1213: Hydrogen, 19.875 uA, marker=10 seconds

Conclusion

- 1. target stabilized in 20 seconds after a beam trip
- 2. no significant long term density change

- To check:
  - Why beam position correlated with upstream thickness
  - Any events scattered from upstream window then side wall?