

Possible shower outburst in December 2023 associated with comet 46P/Wirtanen

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This document supplements the 2023 meteor shower activity forecast for low Earth orbit. We advise spacecraft operators that a possible shower outburst associated with comet 46P/Wirtanen is predicted for December 12, 2023, two days prior to the Geminid peak. If the outburst occurs, activity will be brief but could rival that of the Geminid meteor shower at small particle sizes.

1 Overview

Both the MSFC meteoroid stream model [1] and the Vaubaillon et al. model [2] have predicted a possible new meteor shower in December 2023 originating from comet 46P/Wirtanen [3, 4]. The orbit of this comet has evolved in recent decades such that its orbit now closely approaches that of the Earth. The levels of past cometary activity are not well known, but recent observations indicate that comet 46P is active [5, 6]. If past activity produced significant material intersecting the Earth, a new meteor shower would result.

Because this shower has not been observed before, it is not possible to estimate the activity level by calibrating models against past observations. We therefore caution that our predictions for the strength of this shower are highly uncertain. Furthermore, even if this comet does produce meteor activity in 2023, it will be difficult to confirm due to the brief window of activity, southern radiant, small particle size, and slow encounter speed (which corresponds to dim meteors).

2 Details

Figure 1 presents the zenithal hourly rate (ZHR) of major meteor showers in December 2023, including the possible outburst associated with 46P. Figure 2 presents the flux profiles for the four limiting kinetic energies used in this forecast. An estimate of the sporadic meteoroid flux for each energy threshold is also shown for comparison (horizontal lines). In order to facilitate risk assessments we also provide flux enhancement factors in Figure 3. This is the enhancement of the flux averaged over a seven-hour period.

Readers may notice that the peak labeled “WIR” is much more pronounced in Figures 2 and 3 than in Figure 1. This shower is expected to produce meteors with comparatively low speeds (15 km/s). Low-speed showers are generally more significant in terms of flux than they are in terms of visual meteors, due to the strong dependence of a meteor’s brightness on speed.

3 Contact information

The Meteoroid Environment Office will update this forecast as necessary. Those with questions or special needs in the near future are encouraged to contact:

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References

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- [7] Moorhead, Kingery, and Ehlert. NASA’s Meteoroid Engineering Model 3 and its ability to replicate spacecraft impact rates. *Journal of Spacecraft and Rockets*, 57:160–176, 2020.

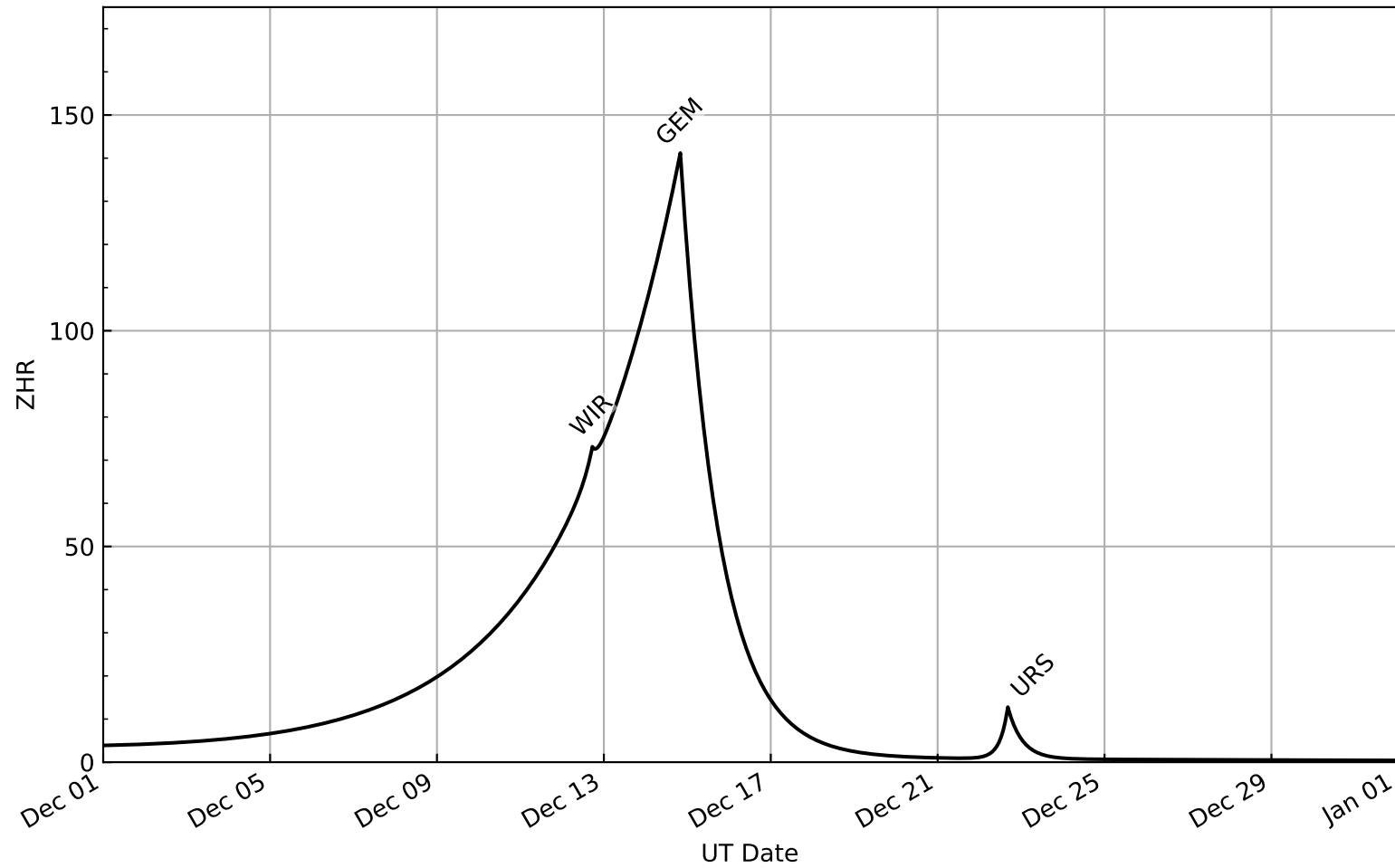


Figure 1: Meteor shower visual rates (zenithal hourly rate, or ZHR) in December 2023.

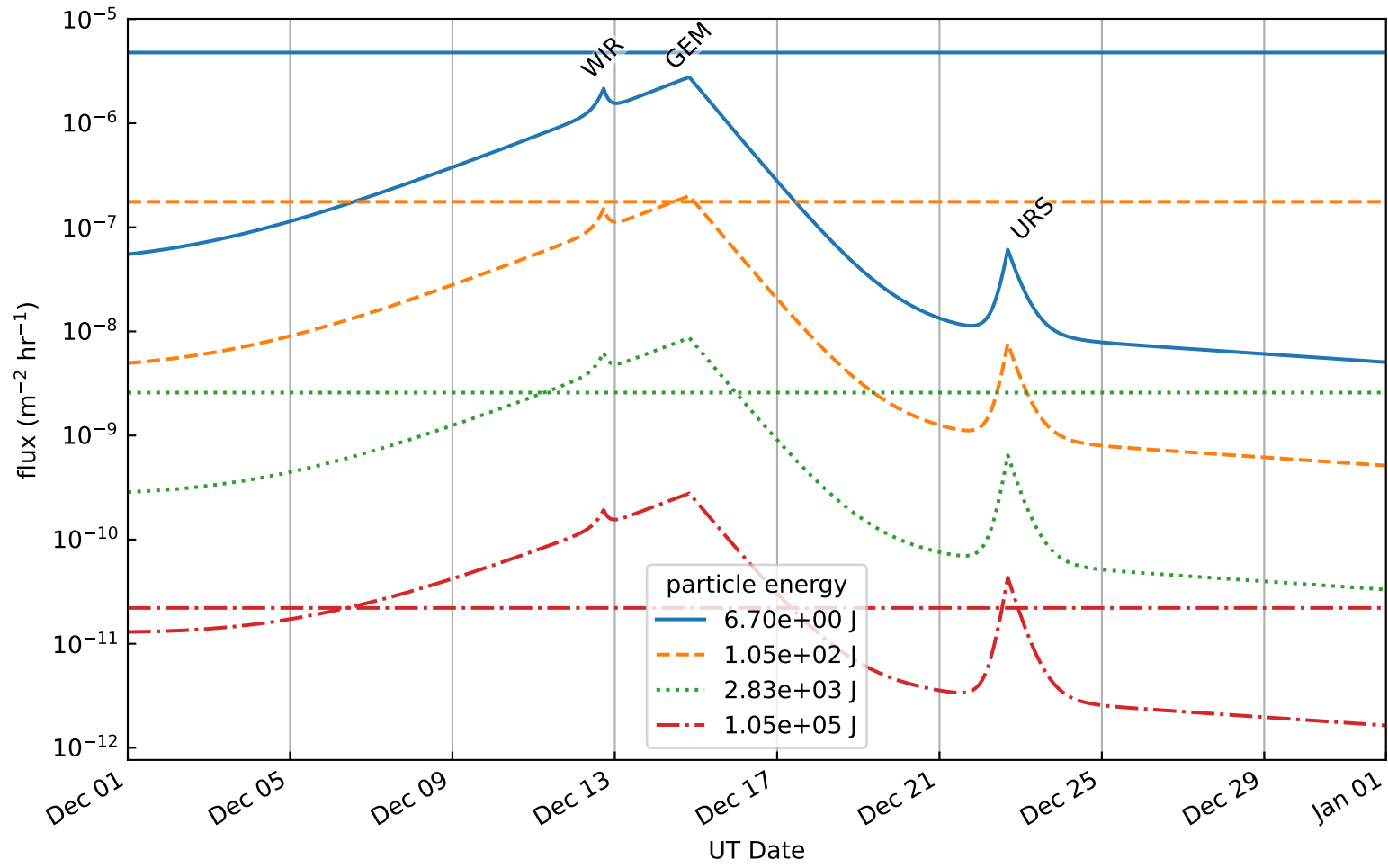


Figure 2: Meteor shower flux (variable lines) and sporadic meteoroid flux (horizontal lines) in December 2023. Fluxes have been weighted to a constant limiting kinetic energy. Fluxes are quoted for four particle kinetic energies; these kinetic energies correspond to particles with diameters of 0.04 cm, 0.1 cm, 0.3 cm, and 1 cm, assuming a density of 1 g cm^{-3} and a speed of 20 km s^{-1} .

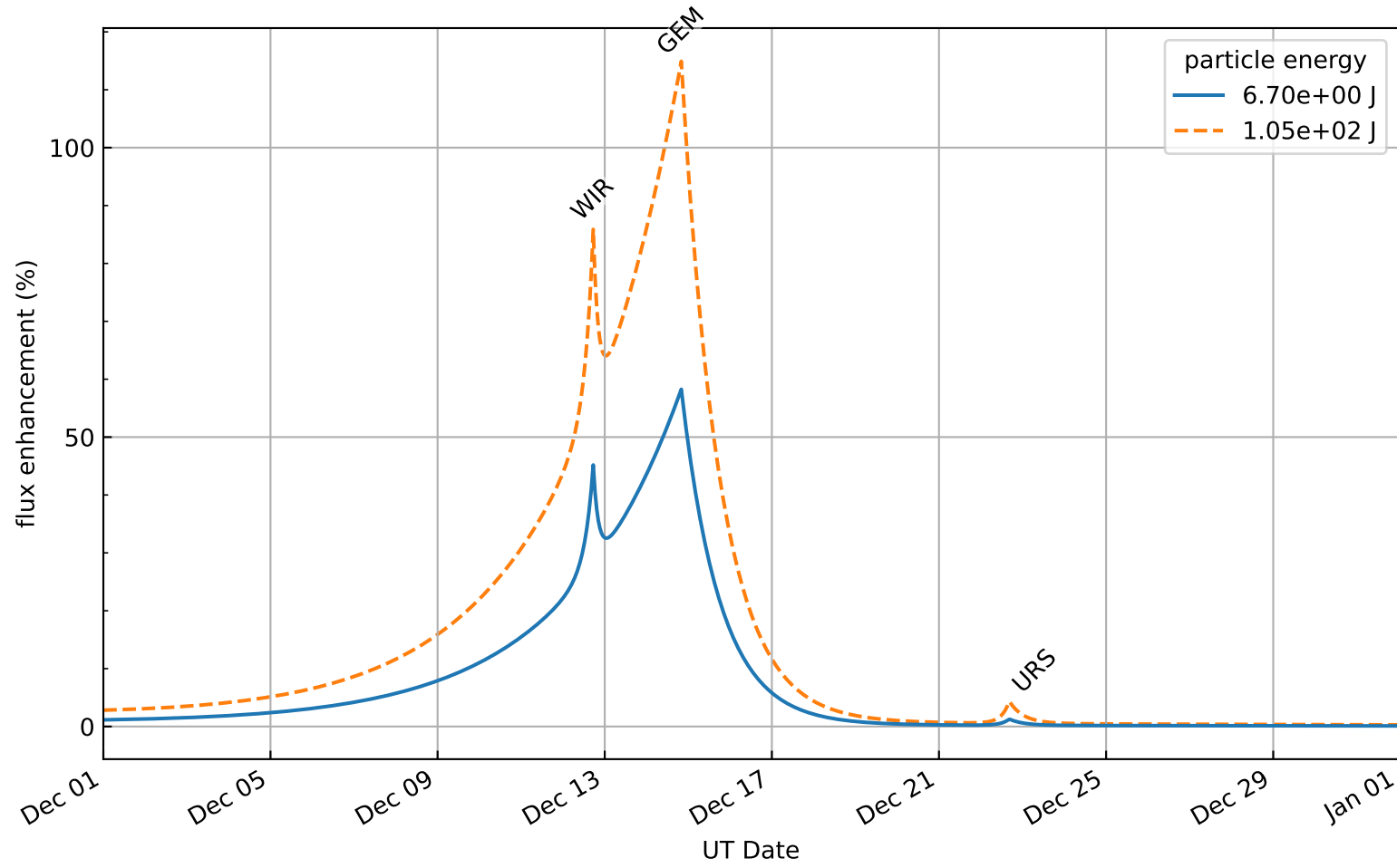


Figure 3: Meteor shower flux enhancement relative to the sporadic meteoroid flux in December 2023. These factors can be used in conjunction with a meteoroid model such as the Meteoroid Engineering Model (MEM) [7], to compute the flux at a particular time of year on a plate facing the unobscured shower radiant.

shower name	ID	max time (UT)	max ZHR
Quadrantids	QUA	2023-01-04 00:25	120
eta Aquariids	ETA	2023-05-04 12:31	129
Daytime zeta Perseids	ZPE	2023-06-03 12:08	20
Daytime Arietids	ARI	2023-06-11 04:46	50
Southern mu Sagittariids	SSG	2023-06-20 09:19	2
beta Taurids	BTA	2023-06-28 23:36	2
Southern delta Aquariids	SDA	2023-07-28 13:49	30
alpha Capricornids	CAP	2023-07-29 03:38	4
Perseids	PER	2023-08-13 08:50	80
kappa Cygnids	KCG	2023-08-18 12:27	5
Daytime Sextantids	DSX	2023-10-03 05:45	5
October Draconids	DRA	2023-10-09 07:48	3
Orionids	ORI	2023-10-23 04:25	30
Southern Taurids	STA	2023-11-06 00:32	5
Northern Taurids	NTA	2023-11-12 23:47	5
“Wirtanenids”	WIR	2023-12-12 17:24	5
Geminids	GEM	2023-12-14 19:59	140
Ursids	URS	2023-12-22 16:23	12

Table 1: Meteor showers in 2023. Column 2 provides the 3-letter code for each shower, Column 3 lists the date and time of maximum activity, and Column 4 provides the shower’s ZHR at the time of maximum activity. The possible outburst associated with 46P/Wirtanen appears third from the bottom.